SUSTAINABLE URBAN ENERGY PLANNING

A ROADMAP FOR RESEARCH AND FUNDING

CONSULTANT REPORT

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Preface

California's 2000–2001 electricity crisis laid bare the economic and political consequences of not thinking systematically about the state's basic infrastructure needs, as businesses and residents of the world's fifth largest economy found themselves wondering whether anything would happen when they turned on their lights.

While there are state-level efforts being made to plan for the state's long-term energy needs, progress at the local level is beginning, yet slow. In part this is because California's local governments still find themselves wrestling with the fiscal aftermath of the dot-com bust. But it is also because there is a long-standing perception that energy conservation and the pursuit of more sustainable energy sources are matters best left to federal, state, and regional policy-makers.

As this roadmap makes clear, nothing could be further from the truth. Local governments can engage in sustainable energy planning in three important ways. First, they can investigate ways to reduce energy consumption within their own facilities and operations. Second, local governments can promote efficient energy use and alternative resources in the private sector through the judicious use of incentives, regulations, and demonstration projects. Last, local governments can begin to shape local land use and development patterns in ways that reduce per capita energy use and exert a lighter touch on the natural environment.

If at first glance these actions seem marginal to the bigger energy picture, consider the long-term effects of a 1% per year reduction in per capita electricity use. According to the California Energy Commission, Californians used 276,000 gigawatt-hours of electricity in 2003, or about 8 megawatts per each of California's 35 million residents. Thirty years from now, by 2035, state forecasters project that California's population will likely reach 50 million. If California's per capita electricity use were to decline at an annual rate of just one percent per year, by 2035, Californians would consume just 286,000 gigawatt-hours of electricity—only slightly more than they consume today—despite the addition of another 15 million residents.

What must happen if California is to embrace a future of population growth *and* energy conservation? At a minimum, local decision-makers must better understand how their day-to-day decisions regarding private development projects affect long-term energy demand; and how different development patterns, building designs, and materials and construction technologies can promote energy conservation without compromising individual and community quality of life.

Such understanding requires research. Research into current "local best practices" regarding energy (and water) conservation. Research that looks past California's immediate borders to see how communities throughout the country and around the world are dealing with these very same issues. Research that uses the tools of "alternatives analysis" and "scenario-building" to identify the steps which, if undertaken today, are most likely to lead to effective outcomes. And lastly, research that focuses on the interplay between technological innovation and institutional evolution. If the events of the last few years have taught us anything, it is that our old way of looking at issues with their historical and agency-based "silos," is no longer adequate, and that promoting sustainable energy planning will require rethinking the traditional roles of private business, not-for-profit organizations, and state, regional, and local governments.

This California-based roadmap for research into sustainable energy planning is a good start down that path. The sooner we get going, the better.

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Executive Summary

California's local governments are in a position to play a critical role in advancing the state's policies for the reliability, affordability, and environmental sustainability of its electric energy supply. The regulatory and institutional landscape of federal and state energy policy makes local governments critical partners in promoting efficient resource use, market transformation, and location efficiency within the built environment. Because the PIER program is funded by a surcharge on electric utility ratepayer bills, this report is primarily concerned with electricity production and use. Although some of the recommended research agenda will also have implications on transportation energy use, transportation research is handled by other divisions and agencies mandated for such research. Local governments have strong reasons to promote what can be considered *sustainable urban energy planning* practices, and a number of local governments throughout California are already doing so. Among the main energy-related concerns driving local action are: the need for price stability; the public health and safety consequences of energy unreliability; the centrality of affordable and reliable energy to economic development; strong public support for environmental initiatives; quality of life considerations; and environmental justice demands by disproportionately impacted communities.

However, local governments also face formidable obstacles to greater participation that create risk and uncertainty. These obstacles include: a lack of awareness of (or knowledge gaps about) program and policy options and effectiveness; technical gaps that result from a lack of effective tools and a historical avoidance of energy issues within the urban planning profession; competing priorities that draw scarce attention and fiscal resources; regulatory obstacles caused by the shifting policy terrain and fractured decision-making; and institutional mismatches between overall system issues and the scope of local action. Together these obstacles reinforce one another, creating an inhospitable environment for action and preventing local governments from taking advantage of most of the available opportunities—or sometimes from even taking the first step.

Local governments can engage in sustainable energy planning in three primary ways. First is within their own operations. Local governments are often large users of electricity in buildings and public facilities, in water systems, and in other capital infrastructure such as streetlights. Efficient energy use within the public realm is directly tied to cost reductions and provides the most direct incentive for local action.

Second, local governments can promote efficient energy use and alternative resources in the private sector through their dominant role in shaping the built environment. Potential areas for action include: improving building efficiency in existing construction; promoting energy efficiency in new buildings (in both commercial and residential sectors); facilitating the siting of distributed generation resources; and incorporating energy-efficient site planning and urban design in new development.

Third, local governments can help shape long-term development patterns in order to promote location efficiency and reduce the effects of urbanization on the energy system and the environment in general. Measures include growth management planning at both the city/neighborhood and regional scale, and this planning necessarily involves linkages with the transportation system that facilitates and underpins development. Apart from these direct local actions, effective planning support tools can help planners, citizens, and policy makers visualize the long-term consequence of alternative growth choices and improve the overall decision making process, while alternative planning techniques may help provide local governments with supplemental information for consideration within state and federally mandated planning.

This Public Interest Energy Research Environmental Area (PIER-EA) roadmap identifies four research goals that should be addressed to help localities and regions in California develop sustainable urban energy plans and benefit from the energy and environmental savings:

1. Develop a better understanding of the environmental, economic, and equity impacts of embedded and operational energy needs of urban infrastructure systems and urbanization. The energy profiles of alternative development patterns and alternative water supply and treatment strategies are not well known. Because many urban management decisions occur without the benefit of such information, officials are unable to adequately assess the full impact of their decisions. This situation perpetuates and extends potential inefficiencies and delays adoption of new technologies and practices that would benefit California and its citizens.

2. Identify the local environmental, economic, and equity benefits of sustainable urban energy planning, particularly with respect to the private sector. The area for the greatest gains in energy resource efficiency within an urban center rests with the private sector; yet local governments without their own electric utilities often see energy-related activities (outside of managing their own consumption) as the province of the state or of the investor-owned utilities. As such, they are reluctant to expend their scarce resources in this area or attempt unproven policies with uncertain ends. Even though local governments recognize that an assurance of stable prices and reliability give them a comparative advantage and better-positions them to compete for economic development opportunities, the fear of unintended consequences and diminished private sector revenue-generating activities leaves them reluctant to be proactive in that area.

Scientific assessment of the local costs, benefits, and impacts of energy-related activities and policies would help local officials make informed decisions regarding these measures, increasing the likelihood of acceptance by the private sector and subsequent local action.

3. Develop information and materials that lead to a better understanding of sustainable urban energy planning options and practices. Local officials often face significant constraints and are unable to devote the fiscal, technical, and institutional resources necessary to operating active and effective energy programs. The costs of simply tracking certain regulatory processes related to energy issues of interest to local governments are high, and statewide efforts to coordinate and educate local energy practitioners and promote new local activities are inadequate. Although there exist myriad best-practice manuals, model policies, and case studies, the information is scattered among a variety of disparate sources, lacks extensive evaluation, and is less than comprehensive. Virtually every local government energy practitioner interviewed as part of this roadmap noted the significant technical, fiscal, and programmatic constraints facing their jurisdiction.

4. Develop effective decision support tools and methods for sustainable urban energy planning. Although local and regional governments across California have taken on energy-related activities as part of their greenhouse gas reduction plans, sustainable development strategies, or general operations, they have a limited set of tools for their efforts. Current planning processes do not incorporate energy considerations into their frameworks, and the tools and techniques used to carry out them out provide no information of their energy-related impacts. The development of effective decision-support tools and techniques will help local California officials and citizens take informed steps to smarter energy use in the built environment.

In the short-term (1–3 years), this roadmap recommends that research address the objectives in the table on the following page. This research covers a broad spectrum of work ranging from comparative case studies of current local efforts to complex multivariate analyses of the links between urbanization and energy use to improved street lighting technology. This roadmap also identifies mid-term (3–10 year) and long-term (10–20 year) objectives, all of which build on the work listed in the table. This roadmap outlines a comprehensive research agenda to fully address the gaps identified in this document. Due to limited funding and critical research needs in other areas, PIER will only be able to support some of the identified projects. PIER will consider this roadmap and other research priorities to determine the level of support for research stemming from this roadmap.

The successful completion of the projects identified by this roadmap will help California's local governments take a more proactive and informed role in furthering more efficient energy use and reducing the environmental impacts of energy production, transmission, and consumption. The projects contained in this roadmap address a number of municipal functions, concerns, and areas for local involvement that will influence statewide energy use and infrastructure.

The products of this research will be useful to local, regional, and state planners; citizens; and elected officials by helping them better understand the energy-related impacts of their public investment and regulatory decisions. Moreover, it will help planners and decision-makers craft appropriate programs and policy responses to address those impacts. For example, this research can help build the policy and business cases for aggressive incorporation of high-performance building practices into public and private projects, spur integration of community development and energy efficiency programs, or provide additional reinforcement to growth management efforts. The information and tools generated should be useful for policy makers, municipal managers, businesses, and citizens in shaping local responses to ameliorate the energy-related impacts of urbanization.

Short-term Goals

Goal	Projected Cost ($)
Develop a better understanding of the embedded environmental impacts and operational energy needs of urban infrastructure systems and urbanization	
Water and Wastewater Systems	
1. Investigate distributed/decentralized wastewater treatment and reclamation as a more energy efficient design alternative for a long-term infrastructure planning process.	500,000
2. Continue PIER activities and research to evaluate the life cycle energy intensity and costs of traditional, decentralized, and other alternative systemic approaches to water delivery and wastewater treatment/reclamation, with an emphasis on savings for local and regional water agencies.	150,000
3. Conduct investigations of the whole system benefits of employing conservation strategies and technologies as a means of reducing the energy and environmental costs of interbasin water transfers, with an emphasis on savings for local and regional water agencies.	150,000
4. Continue PIER activities and research into the energy profiles and efficiency of emerging advanced water treatment techniques and technologies, with an emphasis on savings for local and regional water agencies.	75,000
Street and Highway Lighting	
5. Determine the composition of the ownership of street and highway lights by local governments, utilities, the state or others; identify appropriate stakeholders; and assess the standards that are used for the deployment of street and highway lights.	150,000
6. Conduct research to identify the extent of barriers (e.g., lighting preferences, maintenance, safety, ownership arrangements, and tariff structures) to efficient street lighting technologies.	75,000
Site Design	
7. Conduct comparative studies of different community types to precisely identify the electricity-system-related economic and environmental benefits of alternative urban design and site planning features.	250,000
Urban Growth	
8. Identify the energy efficiency impacts of local smart growth policies and projects.	250,000
9. Conduct analyses of utility energy requirements, impacts on the distribution system, and environmental impacts of alternative urban growth scenarios.	250,000
10. Develop methodology and conduct case studies to assess life cycle energy costs of current and projected growth scenarios throughout California's regions.	500,000
Demonstrate the local environmental, economic, and equity benefits of sustainable urban energy planning, particularly with respect to the private sector	
1. Conduct studies to identify the environmental, economic, and equity costs and benefits to local governments of mandates and voluntary programs for energy efficiency in new buildings.	200,000
2. Conduct comparative empirical studies to evaluate the direct and indirect benefits of high-performance, energy-efficient buildings to owners and tenants.	200,000
3. Evaluate the effectiveness, costs, and benefits of local time-of-sale energy-efficiency upgrade mandates in order to improve energy efficiency in existing buildings.	200,000

Short-term Goals (continued)

Goal	Projected Cost ($)
Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices	
1. Conduct comparative analyses of organizational and funding models of local energy programs to assist interested local governments in structuring programs and effective partnerships to overcome technical, institutional, and other obstacles to implementing sustainable urban energy planning initiatives and achieving local and state energy goals.	250,000
2. Conduct case studies of local, government-supported, community-based efforts for energy and water use efficiency.	125,000
3. Review California-specific manuals and case studies of energy-efficiency activities in public facilities, to identify information gaps and assess research needs.	75,000
Develop effective decision support tools and methods for sustainable urban energy planning	
1. Develop energy cost assessment and environmental impact analysis capability for popular decision support tools, such as $PLACE^3S$.	400,000
2. Design sustainable energy indicators to provide benchmarks for local activities and harness local initiatives towards the support of the state's energy goals.	500,000
3. Develop neighborhood- and community-level smart growth guidelines that establish and incorporate energy efficiency objectives.	250,000
4. Develop methodologies and approaches to readily incorporate energy supply and infrastructure analysis into existing regional housing, land-use, and transportation planning processes.	200,000
Total Projected Cost for Short-term Projects	**4,750,000**

Roadmap Organization

This roadmap is intended to communicate to a broad audience with varying levels of knowledge about the issue. The sections build upon each other to provide a framework and justification for the proposed research and development—both for stakeholders well versed in sustainable urban energy planning issues, as well as for those new to such issues.

Section 1 states the issue to be addressed.

Section 2 articulates the public interest vision behind the report and outlines its proposed research goals.

Section 3 provides background for this topic through a discussion of sustainability and California's energy picture within the national and global contexts; the nexus of urban sustainability, energy, and local government; and the obstacles to effective local and regional involvement in the energy arena.

Section 4 reviews the diverse body of literature and activities of relevance for this topic and outlines the major research gaps for sustainable urban energy planning. The section is organized into five subsections. The first discusses programmatic and organization issues related to local energy planning; the next three represent a hierarchy of local government involvement in energy-related matters; and the fifth discusses several crosscutting issues not accommodated by that framework.

Section 5 synthesizes the findings of the review of current research and activities into a four-part research agenda covering 20 short-term projects. This research agenda focuses on: (1) developing a better understanding of the energy needs of urban environments; (2) strengthening the case for greater local involvement in energy planning; (3) increasing local and regional capability to engage in energy planning activities; and (4) reducing the transaction costs to planners, citizens, and decision-makers of local and regional involvement in energy matters.

Section 6 examines how this roadmap leverages existing PIER and non-PIER programs and investments.

Finally, Section 7 offers a brief discussion of the items not covered by this roadmap but still relevant to its goals.

Because the PIER program is funded by a surcharge on electric utility ratepayer bills, this report is primarily concerned with electricity production and use. Although some of the recommended research agenda will also have implications on transportation energy use, transportation research is handled by other divisions and agencies mandated for such research.

1. Issue Statement

There is a need for improved methods, tools, and data to support the involvement of local and regional governments in sustainable urban energy planning.

2. Public Interest Vision

Local and regional governments are crucial stakeholders in California's energy future. California's local governments also provide up to a quarter of the state's electricity generating capacity. Most of the state's energy use occurs either within urban areas under the jurisdiction of a city or county, or in support of their populations and economies. Although California's future growth is projected to occur within already urbanized jurisdictions, the amount of urbanized land in California's 36 most urban counties is expected to increase over 25% in the next twenty years and more than double by 2100 (Landis and Reilly 2003).

During the 2000–2001 energy crisis, local governments played a crucial part in helping the state adjust and avoid extensive power disruptions. They continue to be extensively involved in a variety of efforts to promote smart energy use and further the state's energy policies, but they face a number of obstacles to greater participation. With this recognition, the California Energy Commission's Public Interest Energy Research Environmental Area (PIER-EA) prepared this research plan (roadmap) for Sustainable Urban Energy Planning.

This roadmap will benefit California by identifying ways to support the development of tools and programs that will help the state's local and regional governments effectively engage in sustainable urban energy planning activities. By engaging in these activities, local governments will be able to reduce the statewide environmental costs of energy production, transmission, distribution, and reap and use local public health, economic, and environmental benefits. The roadmap and its suggested research will help local and regional governments take a more active role in furthering California's energy objectives, as articulated in the 2003 *Energy Action Plan* (CEC et al. 2003) and the *Integrated Energy Policy Report* (CEC 2003).

This PIER-EA roadmap is based on a comprehensive review of the domestic and international literature of relevance to this subject and is supplemented by extensive interviews and other communications with a number of local officials, Energy Commission staff, and researchers involved in the broad range of activities discussed herein.

The roadmap identifies four research goals that should be addressed in order to help localities and regions in California realize benefits from sustainable urban energy planning activities that heighten energy conservation and efficiency, increase the deployment of distributed generation (DG) resources, improve reliability, promote renewable energy sources, and decrease generation and emissions.

First, there is a need to better understand the energy needs of urban environments. This need is particularly true in the area of profiling the energy costs and efficiencies of alternative development patterns and alternative water supply and treatment strategies. Because many urban management decisions occur without the benefit of such information, officials and citizens are unable to adequately assess the full impact of their planning and policy choices.

Second, there is a need to develop greater information to demonstrate the broad range of benefits of sustainable urban energy planning—particularly with respect to the private sector. Local governments without their own electric utilities often see energy-related activities (outside of managing their own consumption) as the province of the state or of the investor-owned utilities (IOUs). As such, they are reluctant to expend their scarce resources in this area, or attempt unproven policies with uncertain ends such as potentially driving away business. Scientific assessment of the local costs, benefits, and impacts of energy-related activities and policies would provide information for informed decision-making regarding these measures, enhancing the likelihood of private sector acceptance, increased local involvement, and the benefits that accrue from that participation.

Third, there is a need to increase local and regional capability for sustainable urban energy planning by improving the knowledge base of local practitioners and evaluating the effects of programs and policies. Local officials often face significant constraints and are unable to devote the fiscal, technical, and institutional resources necessary to operating active and effective energy programs. The costs of simply following certain regulatory processes related to energy issues that are of interest to local governments are extensive, while statewide efforts to coordinate and educate local energy practitioners and promote new local activities are insufficient. Although there exist myriad best-practice manuals, model policies, and case studies, the information is scattered among a variety of disparate sources, lacks evaluation, and is less than comprehensive.

Fourth, there is a need to reduce the transaction costs for sustainable urban energy planning by creating effective decision-support tools and techniques to help local officials and citizens take informed steps to smarter energy use in the built environment within the context of existing planning processes. Current planning processes generally do not incorporate energy considerations into their frameworks, and the tools and techniques used to conduct such planning do not provide information of their energy-related impacts.

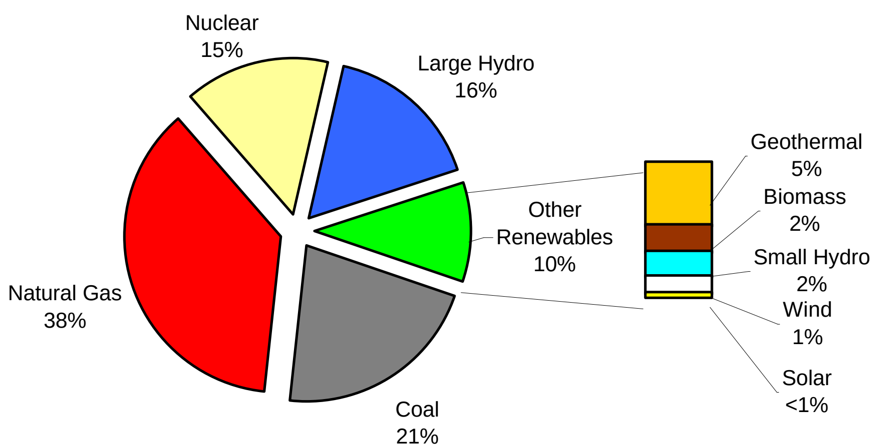
The successful completion of the projects listed in the Goals section (Section 5) will help California's local governments take a more proactive and informed role in furthering more efficient energy use and reducing the environmental impacts of energy production, transmission, and consumption. The projects contained in this roadmap address a number of municipal functions, concerns, and areas for local involvement that will influence statewide energy use and infrastructure.

The products of this research will be useful to local, regional, and state planners; citizens; and elected officials by helping them better understand the energy-related impacts of their public investment and regulatory decisions. Moreover, it will help planners and decision-makers craft appropriate programs and policy responses to address those impacts. For example, this research can help build the policy and business cases for aggressive incorporation of high-performance building practices into public and private projects, spur integration of community development and energy efficiency programs, or provide additional reinforcement to growth management efforts. Ultimately, the information and tools generated should be useful for policy makers, municipal managers, businesses, and citizens in shaping local responses to ameliorate the energy-related impacts of urbanization.

3. Background

3.1 Energy Use in California

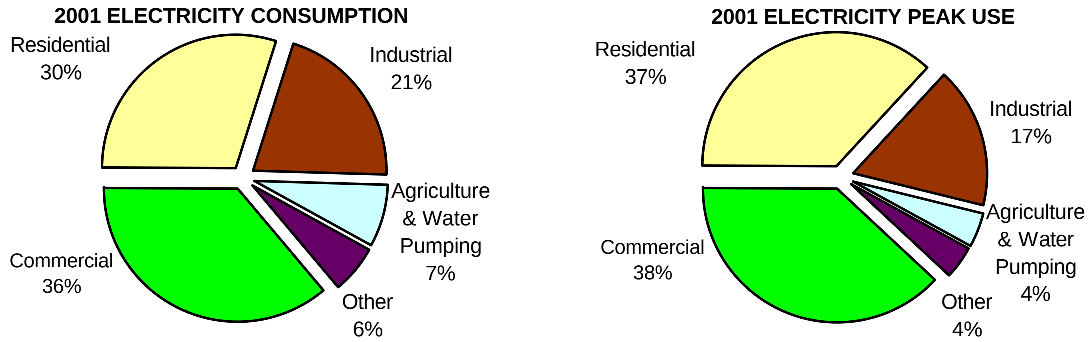
Californians used more than 276,000 gigawatt-hours (GWh) of electricity in 2003, with a peak demand of 52,000 megawatts (MW). More than 75% of this energy was produced within the state from a variety of fuels. Non-renewable resources—primarily natural gas along with nuclear and coal—constituted more than 70% of the fuel used to generate the electric energy used by Californians in 2003. Renewables fuels such as hydropower (large and small), wind, solar, and geothermal comprise the balance (Pan and Wetherall 2004). Figure 1 shows the mix of fuels used to produce the electricity consumed by Californians in 2003, from both in-state and imported sources.



Source: Pan and Wetherall (2004)

Figure 1. California energy in 2003 use by fuel type

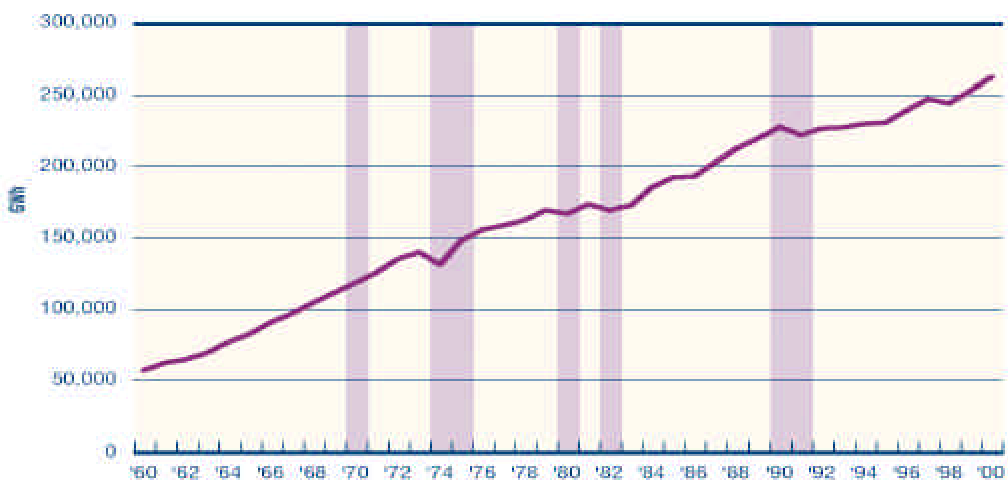
Electricity demand can be grouped into five major sectors. Listed in declining order by their overall share of consumption, these are: (1) commercial, (2) residential, (3) industrial, (4) agriculture, and (5) other. The commercial sector has accounted for an increasing share of overall energy use. Figure 2 shows the proportions of total and peak electricity that these sectors used in 2001 and reflects the changes in California's economy over the past decade away from manufacturing.



Source: Bender et al. (2003)

Figure 2. Electricity consumption and peak use by sector

Energy demand is principally driven by economic and population growth, and peak electricity demand is further influenced by weather conditions (Miller et al. 2002). The Department of Finance forecasts that more than 45 million people will live in the state by 2020. That figure will rise to 66 million people (double the 2000 population) by 2050, and then rise further, to 92 million by 2100.[1] Figure 3 charts California's historic electricity use, with the shaded years representing times of economic recession. Every recession since 1970 has been accompanied by a contraction in energy demand.



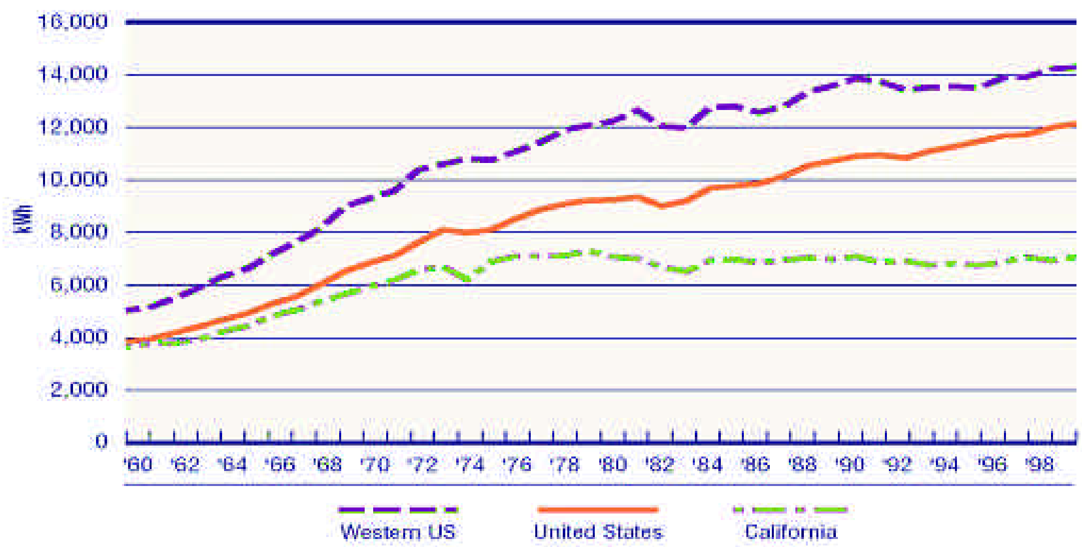
Source: Miller et al. (2002)

Figure 3. Historic electricity demand 1960–2000

[1] The Department of Finance revised its population projections downward in October 2004. However, overall growth is still expected to be significant. The works referenced in this report refer to projections before the revision.

California is the nation's most efficient user of electricity on a per capita basis. Per capita consumption has remained steady since the mid-seventies, in contrast to the United States as a whole, where it has increased by 50% since that time. California's 12% of the national population uses only 7% of the total electricity consumed in the nation. Figure 4 shows the dramatic difference in efficiency between California, other western states, and the nation as a whole.

California's energy demand is growing. Overall demand is expected to rise to between 321,400 and 335,300 GWh by 2012; and peak demand is expected to rise up to 66,500 MW (Miller et al. 2002). The 2003 forecast projects slightly lower demand than in the 2002 projection, but the overall growth trend continues to move upwards. The potential environmental impacts and economic consequences of such growth are driving policymakers to question the sustainability of the state's energy system.



Source: Miller et al. (2002)

Figure 4. Historic per capita electricity consumption 1960–2000

3.2 Sustainability

The term *sustainability* means different things to different people. The Brundtland Commission first articulated the most basic definition in 1987 as "meeting the needs of the present without compromising the needs and opportunities of future generations" (Naess 2001). The concept of global sustainability and sustainable development is based on five interrelated premises: (1) human well-being depends on the health, stability, and productivity of the earth's natural life-support systems; (2) the scale and scope of human activities is beginning to affect the integrity of these systems; (3) population and consumption growth are key impact drivers; (4) population growth is inevitable for decades; and (5) economic growth will and must continue in order to provide for this population (Lash 1999). This is equally true for California as it is for the rest of the world.

The term has evolved since the Brundtland Commission's seminal report, and is now widely seen as the necessary integration of the social, economic, and environmental domains (Cameron 1991; Bajura 2002).[2] Taken further, urban sustainability can be understood as the "balance of urban systems with their long term environmental base" through linkage of economic development objectives such as long-term resilience, competitiveness, employment, and equitable resource distribution with social progress measures such as security, public health, education, cohesion, diversity, and equity (Ravetz 2000).

A full discussion of sustainability is beyond the scope of this paper. It is an inherently complex and multifaceted concept, covering a plethora of environmental, economic, and social issues. However any sustainability strategy must address energy generation, distribution, and use as a social good, as well as an input into the economic production process.

3.2.1 Energy Sustainability

In the ideal, *energy sustainability* means the harnessing of resources that: (1) are not substantially depleted by continued use; (2) do not emit substantial pollutants or other hazards to the environment; and (3) do not involve the perpetuation of substantial health hazards or social injustices. Yet, there is no environmentally cost-free energy production or use—even renewable technologies such as wind, solar, geothermal, and biofuels require industrial infrastructure and life cycle energy inputs. As such, energy sustainability is a relative, rather than absolute concept.

Under such circumstances, it is then imperative to identify a comprehensive set of criteria and indicators for what constitutes energy sustainability, then develop an agenda to achieve energy sustainability through a combination of incentives and regulatory measures for conservation and efficient use, research, and development of advanced technologies and methods (Bajura 2002). This process is inherently political, dynamic, and shaped by a variety of social, environmental, technological, and economic factors.

In an article in *Foreign Affairs* magazine, Amory Lovins (1976) laid out the concept of a "soft path" for energy sustainability. This idea was based on the understanding that consumers and firms desire the particular service or product that energy is used for rather than absolute quantities such as kilowatts. Unlike the traditional U.S. approach to energy policy (which focused on sustaining growth in energy demand because of the conventional viewpoint that causal links existed between energy use, economic development, and social welfare), Lovins' alternative view was based on providing the "least cost" alternative to achieving the desired "end-use service."

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[2] The California Governor's Office of Planning and Research has similarly defined "sustainable development" as "the three E's: environment, economy, and equity" in its General Plan Guidelines (OPR 2003b) and combined that general definition with examples from a variety of California communities.

The technologies that constitute a "soft path" energy policy are defined by five characteristics. First, they rely on renewable energy flows that exist whether or not they are used, such as biomass, solar, and wind. Second, they are diverse and make the overall energy supply the aggregate of these multiple sources. Third, they are flexible and often relatively lower-energy-intensive technologies, rather than the traditional "hard path" alternatives discussed in the previous paragraph—though by no means primitive. Fourth, they are scaled and geographically distributed to their end use in order to take advantage of the attributes of the natural energy sources noted by the first characteristic. And fifth, they are matched in energy quality to the ultimate end-use need in order to reduce conversion losses and superfluous use of premium energy sources.

3.2.2 Energy Sustainability in California

California has long been recognized as one of the nation's policy leaders and its actions have often set the trend for the United States as a whole, in a variety of areas. As noted above, the state has made tremendous strides in advancing efficient energy-use practices and is the nation's leader in reducing *energy intensity*—the amount of energy used to produce one dollar of gross domestic product. A substantial share of the state's energy intensity reduction can be attributed to the changing composition of California's economy. However, policy instruments to reduce the environmental impacts of energy generation, transmission, delivery, and use—and to promote alternative energy technologies—have played a significant role.

On the whole, the state's energy policies, particularly in recent years, have approximated the soft path outlined by Lovins (1976). As noted earlier, California is already the country's most efficient user of electricity. Further, California's energy agencies have established an Energy Action Plan (CEC et al. 2003) and an Integrated Energy Policy (CEC 2003) that prioritize sustainable energy strategies built around efficiency, renewable resources, and clean DG technologies. The PIER program supports energy research, development, and demonstration projects that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The Legislature has adopted a Renewable Portfolio Standard (RPS) to increase the share of non-fossil fuel energy resources to 20% of the overall supply mix of the IOUs by 2017. The Energy Commission has taken that vision further and recommended that the goal be met by 2010 and that 33% of the state's energy be procured from renewable sources by 2020. This effort will help ensure that renewables have a larger place in the market and may alleviate needs to use more-polluting generation sources during periods of constrained demand.

In the broader energy arena, the Legislature also approved the establishment of the California Climate Action Registry (Registry), a nonprofit voluntary registry for greenhouse gas (GHG) emissions. The purpose of the Registry is to help companies and organizations with operations in the state establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied. In 2002 Governor Davis signed AB1493[3] and put California at the forefront of national efforts to reduce GHG emissions. This is the first law in the country to reduce GHG emissions from cars and light trucks (starting in 2009). It also provides an opportunity for automobile manufacturers to take advantage of incentives for early action.[4] A number of California local governments are members of the International Council for Local Environmental Initiatives (ICLEI) and have adopted local sustainability and GHG-reduction plans.

Despite this progress and initiative, there is still much to do. California's expanding population and economy are creating a demand for increased electricity generation. Because much of that energy is currently derived from fossil fuels, many have concerns about its energy future. The state's energy agencies have acknowledged that more can be done to promote further efficient energy use and reduce its future generation needs, through measures such as dynamic pricing and expanded efficiency and conservation programs, and are encouraging policy makers to embark on those efforts.

3.3 Energy Sustainability and Cities

Today's cities—or rather the metropolitan city-regions that constitute urban settlements—face deep challenges to achieving sustainability. Cities in the United States are intensely linked by myriad connections to global markets for their food, energy, raw materials, consumer goods, and economic output, and these long-distance transactions generate significant GHG emissions. Cities pull resources from outside in far greater quantities than are available within their own geographic areas and generate waste streams that exceed their own carrying capacities. In essence, cities externalize impacts by pushing out their environmental loads to larger geographic and temporal scales (Martinez-Alier 2003).

Yet the current unsustainability of cities exists in tension with the growing recognition that cities are strategic sites for (and engines of) sustainable development. Any attempt to achieve more sustainable energy use must target urban areas (Rotmans et al. 2000). This tension exists for three principal reasons. First, the overwhelming amount of energy demand is the result of urban populations and the economy they support. Second, and related to the prior point, the bulk of day-to-day decisions about the form and extent of new development occur in cities and cities themselves often have tremendous influence on those decisions. Third, because the majority of wealth is both generated and concentrated in cities, there exists the economic capacity within the private sector to undertake alternative energy approaches, particularly those soft path strategies that require investment in new and advanced technologies (McGranahan and Satterwhaite 2003).

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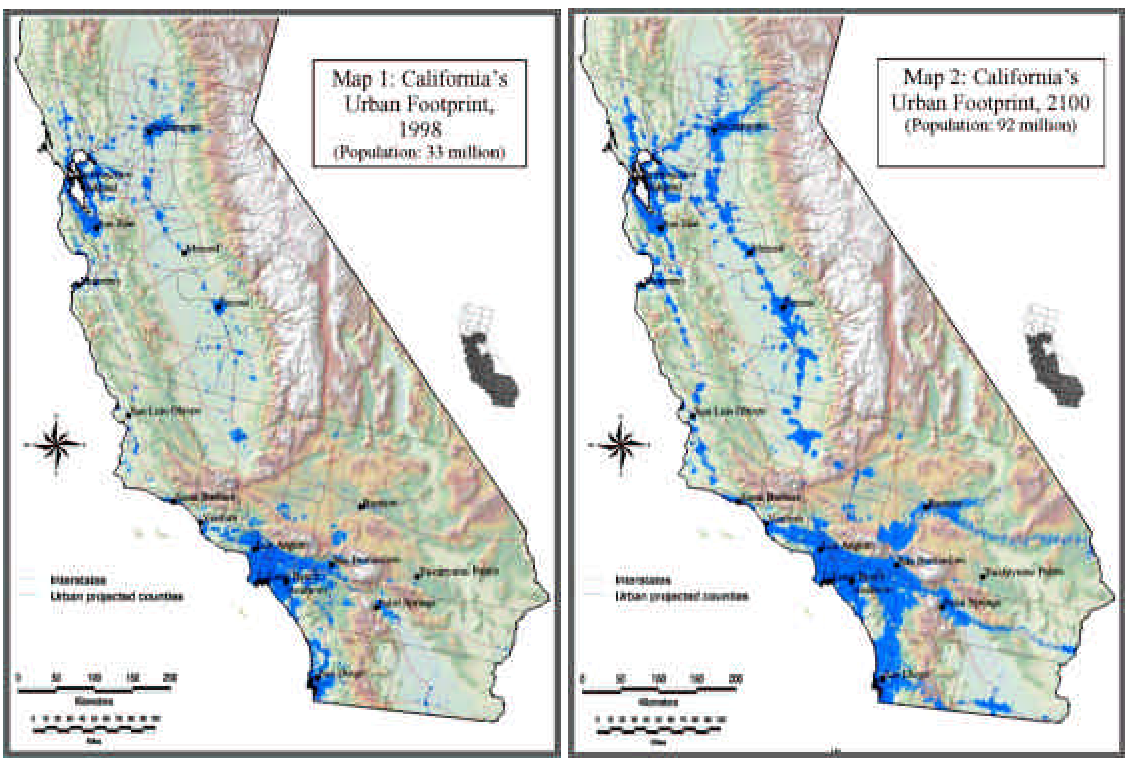
[3] Assembly Bill 1493, Pavley, Chapter 200, Statutes of 2002; http://198.104.131.213/docs/ABOUTUS/AB1493.pdf

[4] Through Senate Bill 1771, Sher, Chapter 1018, Statutes of 2001, and Senate Bill 527, Sher, Chapter 769, Statutes of 2001; www.climateregistry.org/ABOUTUS/Legislation/

3.3.1 Urbanization Trends in California

The strategic importance of cities is particularly true in California, where the population is overwhelmingly urban; according to the 2000 U.S. Census over 94% of the state's residents (slightly more than 32 million people at that time) live within urbanized areas. The sectoral composition of energy demand suggests that urban residents and their associated economies consume more than 95% of the state's energy demand. Over the next 100 years, urbanization is predicted to proceed apace.

The amount of urbanized land in California's 36 most urban counties will increase over 25% in the next twenty years and more than double by 2100.[5] Over the next century, 11 counties are likely to see their urbanized land area at least triple, and one of those counties will see more than a six-fold increase. San Bernardino and Riverside counties are expected to surpass Los Angeles County as the state's most urbanized counties. Figure 5 shows the transformation of California's urban footprint into large metropolitan areas connected by virtually continuous urban strips along the freeway corridors.



Source: Landis and Reilly (2003), maps 2 and 5.

Figure 5. California's urban footprint, 1998 and 2100

5 This projection is based on a model developed by Landis and Reilly (2003), built off the Department of Finance's projections and the development trends of the past 30 years. These trends include job decentralization, the influence of freeway access and affordable land on greenfield development, the targeting of growth within existing cities, and specific land attributes that often vary by region.

3.4 California's Local Government – Sustainable Energy Planning Nexus

Urban planning focuses on ensuring the orderly growth of human settlements and the systems that support them. Through its specializations like land use, transportation, community development, environmental, economic, and regional planning, the field provides a natural fit for discussions of the integration of energy policies and programs within municipal governance. According to the Gas Technology Institute (GTI), sustainable urban energy planning can be said to "promote the efficient use of energy resources in the development of economically, socially and environmentally healthy communities."[6]

3.4.1 The Policy Context

The federal government is active in a number of areas with regards to energy but leaves much policy discretion to the states. In turn, California is deeply active in the realm of energy policy.

Three federal bodies have primary responsibility for the various aspects of the nation's energy system with respect to electricity. The U.S. Department of Energy (DOE) engages in research and development and technology promotion; conducts energy efficiency programs, and sets end-use efficiency standards. The U.S. Environmental Protection Agency (EPA) sets health and environmentally based emission standards and oversees enforcement of the Clean Air and Clean Water Acts. The Federal Energy Regulatory Commission (FERC) mainly focuses on the wholesale electric markets; rates charged by federal power marketing administrations; interstate pipelines; and to some extent, corporate governance of energy firms. With the exception of hydropower projects, FERC has no jurisdiction over the construction or maintenance of power generating plants or transmission lines. Although FERC does have the power to impose price caps for wholesale power sales, it has not been predisposed to use these powers in recent years. Both DOE and EPA conduct their own sustainable energy programs.[7]

At the state level, a patchwork of regulatory agencies influence California's energy system (Weare 2003). The Energy Commission regulates power plant development of thermal generators greater than 50 megawatts (MW),[8] conducts market and system planning and analysis, sets end-use efficiency standards, and funds public interest energy research and public sector efficiency programs through the PIER program. The California Public Utilities Commission (CPUC) regulates rates, transmission and delivery infrastructure development, and funds a host of efficiency and education programs. The California Independent System Operator (CAISO) maintains the integrity of the overall electric grid and conducts its own system planning and analysis activities. In addition to these three pillars of the state's energy system oversight regime, other agencies have significant influence in energy-related issues. The

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6 Based on a personal communication with Marek Czachorski, GTI

7 Department of Energy's Smart Communities Network, www.sustainable.doe.gov; Environmental Protection Agency's Community Based Environmental Protection (CBEP) program, www.epa.gov/ecocommunity.

8 Although power plants must be in compliance with local land use regulations, the Energy Commission has the power to override local land use decisions.

California Air Resources Board (CARB) sets emission standards for small generators. Regional water and air quality boards, which include local officials and individuals appointed by the Governor, are responsible for issuing and enforcing compliance with air and water discharge permits for power plants.

Prior to the changes in California's energy industry ushered in by AB 1890,[9] most cities (except for those being served by various types of public power agencies) relied on investor-owned utilities in their respective service areas and the state's regulators at the Energy Commission and the CPUC. These entities were viewed as being responsible for ensuring a stable, reliable, and affordable source of electricity for their residents and businesses, and conducting efficiency and other outreach programs.

The centerpiece of the new market rules allowed energy consumers to obtain "direct access" to independent non-utility electricity providers. The state continued to serve a critical role with respect to power plant siting, distribution, research, and efficiency; however, many of the mechanisms that addressed the variety of public interest concerns with the energy system were removed and local governments were left with significantly more responsibilities.

Since the energy crisis of 2000–2001, California has reasserted itself in the regulatory arena. The direct access provisions of AB 1890 have since been eliminated, and the utilities have once again become the primary electric service providers for the state's residents and businesses.[10] California's legislative and executive branches have actively considered further restructuring of the state's energy markets—spanning the spectrum from re-regulation to more extensive liberalization—with little resolution of the issue at this time.

3.4.2 The Role of Local Government

The state's influence in regulating the energy sector in California will continue to be predominant. However, regardless of the regulatory regime that California ultimately settles on, local governments are in a position to play a much larger role in furthering its energy goals. The particular characteristics of California's local governments make this especially the case. Additionally, other sub-state government entities such as school districts and special districts can play important roles in furthering energy conservation, efficiency, and renewables objectives, even though they do not have the land use authority of cities or counties.[11]

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[9] Assembly Bill 1890, Brulte, Chapter 854, Statutes of 1996. AB 1890 provided the legislative guidance for the restructuring of the California electric industry.

[10] Elements of a competitive energy market remain, in that some users are able to procure electricity from their choice of suppliers. However, the state has retaken an active regulatory role over the utilities.

[11] A *special district* is defined by state law as "any agency of the state for the local performance of governmental or proprietary functions within limited boundaries." California's more than 3,400 special districts provide a variety of services including: water and sewer, trash collection, electricity, fire protection, parks and recreation, and mosquito abatement.

Public Agencies with Significant Influence on Electricity Production, Distribution, and Use in California

Federal

Federal Energy Regulatory Commission – Wholesale rates; interstate and international transmission; and hydropower licensing.

U.S. Environmental Protection Agency – Setting national standards for Clean Air Act and Clean Water Act compliance; overseeing enforcement/regulatory actions delegated to the states.

U.S. Department of Energy – Technology research, development, and promotion; efficiency programs; setting national appliance end-use standards.

State

California Energy Commission – Licensing thermal generators 50 MW or greater; setting end-use efficiency standards; system analysis, planning, and forecasting; planning intrastate electricity transmission infrastructure; public interest energy research and development and demonstration.

California Public Utilities Commission – Rate setting for IOU retail customers; system analysis, planning, and forecasting; monitoring the electricity market; public and private sector efficiency and education programs; representing the state at FERC; and transmission delivery infrastructure.

California Independent System Operator – Monitoring/planning system reliability; system analysis, planning, and forecasting; planning electricity transmission infrastructure.

California Air Resources Board (CARB) – Setting emission standards for distributed generation resources and diesel backup generators.

Regional

Regional Water Quality Control Boards – Issuance and enforcement of Clean Water Act permits and California regulations for discharges into and usage of regulated water bodies by power generators.

Regional Air Quality Management Districts – Issuance and enforcement of Clean Air Act permits and California regulations for air emissions from power generators.

Local

Cities and Counties – Long-term land use planning; setting and enforcement of building code standards; approval of site plans and urban design in private development; permitting and siting of all power plants under 50 MW.

First, local governments are the primary regulatory decision-makers over urbanization with vast powers to shape where and how land is developed, through the traditional planning tools of zoning and permitting. General plans are the main mechanism for setting local (and to an extent, regional) development priorities; however, energy-related considerations are not a requirement and often do not receive much attention in the overall long-term land-use planning process.

Although the state has significantly reduced the energy demands of the built environment through its building code and end-use efficiency standards, and continues to spur further reductions, it has little influence on the details of projects that can generate significant energy savings. Market-based efforts to speed deployment of sustainable energy resources have clearly been successful, but there remains a sizeable efficiency gap. Local government is in a unique position to influence the ultimate decision to be more or less energy-wise (Sanstad 2003).

The Governor's Office of Planning and Research (OPR) has identified a variety of ways to include energy considerations into overall land development planning in its General Plan Guidelines; however, each of these strategies requires local government decision to implement. California's strong tradition of "home rule" (i.e., keeping land use decisions at the local level) and hostility to top-down planning through either direct state involvement in local affairs or mandates for regionalism requires that local governments must be willing partners in undertaking these strategies (Barbour and Teitz 2001; Burke 2003). The CPUC's recent rules allowing local governments to compete for up to 20% of the public goods charge (and partner with utilities for the remaining 80%) will likely increase local government involvement in promoting energy efficiency.

In addition to this direct influence, local governments are also economic actors and market participants that are able to wield significant influence. They are able to pursue a variety of social, environmental, and economic goals through municipal purchasing and investment decisions, entrepreneurial opportunities offered to redevelopment agencies, and through the Community Choice Aggregation (CCA) opportunities opened up by Assembly Bill 117, passed by the California legislature in 2002.[12]

The purpose of CCA is to allow local governments to pool the electricity demand of their residents and businesses in order to lower prices and promote cleaner sources of power. This allows cities to have local control of electricity supply and energy efficiency programs, giving city councils decision-making power over resource planning and rate-setting. The CPUC issued a draft decision for CCA rulemaking on October 29, 2004.[13] Among the draft decision's major provisions are the establishment of a methodology for calculating and allocating cost recovery surcharges, ratemaking, and cost allocation principles by CCA entities, and utility mandates for supplying physical energy and necessary customer information to CCAs. The rulemaking process remains ongoing, and an analysis of the decision could not be obtained as of the publication of this roadmap.

Perhaps most important is that local governments are well connected to the needs of their constituents, representative of community values, and often have the trust required to promote innovative planning and management approaches that can filter out and diffuse to other jurisdictions. Because community issues are often unique, new approaches must be tailored to fit a particular locale, or they risk failure. (Gilliland and Wesley 1983; Burke 2003).

3.4.3 Progress and Evolution of Local Involvement in Energy Policy and Planning

The energy crises of the mid- and late-seventies brought energy awareness to the forefront and spurred government action in the energy arena at all geographic scales of government. Research describing this work, exploring the role of energy within the urban realm, and seeking what can now be called "sustainable urban energy solutions" proliferated.

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[12] Assembly Bill 117, Migden, Chapter 838, Statutes of 2002.

[13] CPUC. http://www.cpuc.ca.gov/PUBLISHED/COMMENT_DECISION/40913.htm

California's local governments were at the forefront of this movement—sometimes along with, and sometimes leading, the state's efforts. Local governments began taking energy seriously and adopting a range of policy measures to promote smarter energy use, such as improved facility management and energy-efficient building codes. The City of Davis began to address energy efficiency and conservation as early as 1968.

Throughout the seventies, cities, counties, and regional bodies across California adopted various forms of energy programs. The Local Government Commission (LGC)—a nonprofit organization that provides technical support and resources to local governments on a variety of sustainable development issues—formed in 1979 to identify and implement local solutions to the energy crisis, based on conservation and the use of renewable resources. Since then, it has worked extensively to develop policy and educate public officials and citizens on these issues. Private developments like Village Homes, in Davis, have demonstrated energy-efficient forms of urbanization. Within the planning profession, the American Institute of Planners (AIP) (now part of the American Planning Association (APA)) revised its energy policy in 1976—placing an emphasis on a national strategy offering implementation strategies. The AIP also published a revised version of its "Comprehensive Energy Planning Guide" to help planners develop comprehensive energy planning documents (Lang and Lounds 1979).[14]

3.4.4 Local Energy-Related Concerns

Local governments have recognized the shifting terrain. Cost is the primary energy-related concern of local government. However a number of other factors, including the public health and safety considerations of reliability, economic development, quality of life, environmental quality, and environmental justice of energy production and use have led local governments to consider energy within their own policymaking. Although these are all very much interrelated, they are discussed individually.

3.4.4.1 Price Stability

Electricity is the second largest expenditure of local governments, behind human resources (Means 2004). Energy expenses directly take away funds available for other programs and raise the costs of fee-based services, such as sewer charges or public pool fees. The combination of price hikes caused by the 2000–2001 energy crisis and of economic downturn only aggravated the fiscal crisis facing local governments. Price stability is in fact a major reason why local governments begin to consider their options for various forms of municipal utility arrangements (Kelly 1997)—a fact confirmed in interviews to support this report.

3.4.4.2 Reliability for Public Health and Safety

During the energy crisis, many governments realized that the impacts of energy disruptions were akin to those occurring during major natural disasters such as earthquakes and floods, but without the physical destruction. Electric reliability became a public health and safety issue. For

[14] This document is no longer in print. The APA also revised its energy guidelines in 2004, which are noted in the references.

example, during forced energy blackouts, police were forced off their regular rounds to traffic duty, as roads became congested and dangerous because traffic signals became inoperable. In addition, since these blackouts were likely to occur during hot days as a result of surging demand from air conditioners, at-risk populations became vulnerable to dangerous heat levels. Far less catastrophic but nonetheless disruptive, public facilities shut down—denying citizens access to their government (Burke 2003).

Other public health impacts included the potential worsening of local air quality as diesel-fired peaker plants and smaller backup diesel generators (which are more polluting than other conventional stationary energy sources) came online or were planned in major urban load centers. Recent work at the University of California, Riverside, funded by PIER-EA examines the air quality issues associated with the use of backup generators during the 2000–2001 energy crisis, and suggests that, while they were used less than expected, diesel backup generators may have had unacceptable urban air quality impacts.[15] Although it can be argued that planners considered the tradeoffs between air quality and blackouts and decided that blackouts were of greater concern, this decision was relevant to the crisis atmosphere and not entirely applicable to long-term planning.

As long as these communities are connected to a larger grid, their sustainable energy efforts will benefit everyone on the grid; and the savings associated with peak load reductions will accrue to all ratepayers, not just to those who undertook one measure or another. Transmission and distribution constraints are likely to be experienced by entire sections of the grid, not just the local communities. Unless other communities undertake similar sustainable energy efforts, there could be limited impacts on peak demand. Municipalities that serve their own needs will of course have benefits more closely related and relevant for those communities.

3.4.4.3 Economic Development

Although California’s economy has shifted away from energy-intensive manufacturing industries, today’s service and information economy places a greater premium on reliable, competitively priced, high-quality power supplies (EPRI 1999). Energy service disruptions can have significant impacts on a firm’s bottom line and can be a deciding factor in relocation or expansion decisions; during the depths of the energy crisis it was not uncommon to see other states enticing California firms with promises of secure and reasonably priced energy. Major price fluctuations will also have profound effects on a firm’s profitability and its ability to effectively plan its operations. Cities that can provide assurance of price and reliability stability gain comparative advantage, and are thus better positioned to compete for economic development opportunities, both inter- and intra-regionally.

Further, a number of reports have estimated extensive job development potential from investment into energy efficiency and renewable energy (Clemmer et al. 2001; Barret and Hoerner 2002; Kammen et al. 2004). The most recent study by Kammen et al. (2004) estimates

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[15] Modeling Air Quality Effects of NO_X and PM Emissions from Backup Diesel Generators, www.energy.ca.gov/pier/notices/2004-09-29_seminar_bugs.html#presentations

that an additional 666,000 jobs by 2010 and 1.4 million addition jobs by 2020 could be created as a result of a suite of energy efficiency and carbon reduction policies. Some local governments may seek to capture such gains within their jurisdictions by integrating energy and water use efficiency programs with their community and economic development activities. This community development aspect is discussed in greater detail in Section 4.2.5.

3.4.4.4 Environmental Quality

Californians are strongly concerned about the environment, with public opinion polls repeatedly showing it to be at the top of their priority list. A 2004 survey by the Public Policy Institute of California (PPIC) found that a sizeable majority of the state's residents and likely voters consider the environment to be their top policy concern—across political groups and even at the expense of economic growth. Nearly three quarters of Californians believe that global warming is a consequence of unchecked emissions of carbon dioxide.[16]

Such concerns carry over into the realm of local policymaking and serve as fundamental drivers of local activities. By supporting local efforts to focus on sustainable energy planning, the state may be able to leverage local initiatives and help improve overall environmental quality. At the same time, most local efforts to use renewable energy technologies or institute energy efficiency measures may not have widespread direct local environmental benefits, because urbanized areas are generally net energy importers of their energy. For example, air quality improvements or reductions in water use for cooling power plants will occur, if at all, at the point of electricity *generation,* not necessarily at the point of use.

Sustainable energy planning may result in direct local land use benefits and a reduction in urban heat island effect, as well as non-energy-related environmental benefits, such as those resulting from improved stormwater handing by new and retrofitted "green" buildings. However, the majority of benefits are likely to be distributed throughout the system at a regional, statewide, and global scale. Communities controlling their own municipal utilities and generation facilities will of course have a greater chance of managing resources for local environmental benefits. In order to realize widespread environmental benefits, a substantial number of cities and regions would need to be proactive in becoming more energy efficient and supporting clean DG. As a result, the state's support of these efforts becomes all the more important.

3.4.4.5 Quality of Life

Quality of life is a perennial concern for municipal officials and planners. They are recognizing the central importance of quality-of-life factors in their city or region's ability to attract and retain the skilled workers and high-quality employers that are fundamental to supporting and sustaining their tax bases (Florida 2002). To the extent that sustainable urban energy planning—for example an initiative to dramatically reduce the city's urban heat island effect and stormwater impacts through increased tree cover, green roofs, and stormwater diversion—can help improve livability, local governments have greater incentive to undertake such activities.

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[16] PPIC Statewide Survey. http://www.ppic.org/main/publication.asp?i=539

The attention to quality-of-life issues is built on the premise that highly talented workers are able to select from among a variety of cities and regions within which they can live, giving non-monetary factors such as environmental quality more weight. The availability of a talented workforce not only attracts firms seeking to relocate or expand—a prominent concern for local political leaders and their local economic development department heads—but also provides fertile ground for the innovation-led economic growth in industries such as high technology, bioscience, finance, and high-end business services. Although this theory has been critiqued by commentators on both ends of the political spectrum and raises the proverbial “chicken or the egg” issue, the idea has gained wide currency among civic leaders and economic development planners.

3.4.4.6 Social Equity

The combination of stagnant real incomes and rising energy prices places the greatest burden on low-income populations that cannot bear the increases. This in turn reverberates through the places where the affected groups live, resulting in negative effects on both public health and economic output. Local governments may thus be directly affected by higher costs and lower tax receipts as a consequence of an energy budget squeeze.

Sustainable energy planning can help to mitigate these problems by reducing total household utility expenditures on top of the discounts offered to poor families through reduced “lifeline” rates and other energy discount programs for lower-income energy consumers.[17] For example, the City of San Francisco recently ensured that nearly four thousand units of housing at two planned major redevelopment projects —many of them to be rented at subsidized rates to lower income families—would be ultra-efficient and utilize photovoltaics.

3.4.4.7 Environmental Justice

Electricity production and use raises issues of environmental justice, as low-income and minority communities assert their rights for their neighborhoods to be free of industrial facilities that will add a disproportional level of pollution to their environment. This is especially the case in urban areas. The issue has gained traction at all levels of government in the past several years:

- In 1994 President Clinton issued Executive Order 12098, directing all federal agencies to consider environmental justice in their decision-making.
- The EPA maintains an office of Environmental Justice.
- The California Legislature and governor’s office have addressed the issue (OPR 2003a).
- In 2000, the Energy Commission began a roundtable discussion on environmental justice and energy development, and later that year Senate Bill 89[18] established the California

[17] California Public Utilities Commission Low Income Discount programs, http://www.cpuc.ca.gov/static/consumers/programs/lowincome.htm

[18] SB 89, Escutia, Chapter 728, Statutes of 2000.

Environmental Protection Agency as the lead state agency for environmental justice matters.

- A number of proposals for merchant plants that would have served the California marketplace have been scuttled in recent years,[19] and aging urban plants have been slated for closure—due in part to local environmental justice campaigns.
- Local government and regional bodies have been targeted by lawsuits related to air quality, which is in part affected by energy use and development patterns.

With California's population and level of urbanization expected to increase significantly over the next 100 years, these concerns will likely be amplified. Accommodating such population growth without compromising environmental quality for current residents is a significant challenge.

3.4.5 Obstacles to Sustainable Urban Energy Planning

Local governments have compelling reasons to become involved in energy-related activities, but a majority of them continue to look to the state, the IOUs, and the private sector to continue to handle the issue. In a survey of local governments, 35% of the respondents said they had energy policies or strategies, and an additional 14% had policies under consideration. More than half of the local governments in this group adopted their policies after 2001 (Burke 2003). It is uncertain how energy programs will fare during tight fiscal climates.

A number of governments continue to regard energy planning as outside of their scope, while others—including those with energy programs—are discouraged and hampered by the interrelated barriers that increase risk, create uncertainty, and prevent these public bodies from making the most of the opportunities available to them (LGC 2003). Together these barriers foster a "path dependence" that perpetuates the status quo[20] and undermines the capacity (defined as the wherewithal to design and successfully implement projects or initiatives) of local governments to involve themselves in sustainable energy planning efforts or adopt policies to improve energy efficiency and deploy advanced energy technologies. These barriers

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[19] These plants include SF Energy in 1996, South Gate Nueva Azalea in 2002, Richmond/Chevron in 2003, and SF Potrero in 2004.

[20] *Path dependence* occurs when a technology achieves historic market dominance, thereby creating conditions where investment into alternative technologies becomes impractical because of the significant sunk capital investment and the resulting economic interdependencies that have arisen. Networked systems that exhibit increasing returns to scale are especially susceptible to this condition. This is particularly an issue with respect to major infrastructure systems on which taxpayers and ratepayers have spent hundreds of billions of dollars. For example, the electric system has been primarily designed around the model of an interconnected regional grid fed by large central station power plants. As a result, most system users are content to develop their own project in a way that allows them to easily connect into the existing system to reduce their own transaction costs. Key market stakeholders become wary of a too-rapid introduction of DG resources that may lead to stranded costs.

include: insufficient knowledge of the costs and benefits of various energy-related policies or actions; technical gaps; regulatory obstacles; and the institutional mismatch between local government and the scope of the energy system. It should be noted that given all the competing demands, priorities, and informational gaps, getting local governments to agree on an energy policy is a major event.

3.4.5.1 Knowledge Gaps

Local policies are framed by local community values and the information readily available to decision makers. Local government leaders will be rightfully reluctant to use the powers vested in them without an adequate understanding of the opportunities available to them or the costs and benefits of various actions. This is particularly true in relation to the built environment—both above and below ground—where well-established practices for infrastructure development and management are the norm. In the absence of clearly visible benefits or explicit fiscal or other incentives (something many local governments are reluctant to extend), developers and other stakeholders may also be hesitant to take innovative steps in their own projects.

3.4.5.2 Technical Gaps

Local planners do not have the tools to make energy planning a regular part of their jobs, and this occurs for several reasons. Urban planners have not traditionally thought of themselves as having a significant role with the logistics of energy infrastructure, because this has been a function primarily handled by the state and utilities. In parallel, planning evaluation and decision support tools used by planners largely ignore electric energy considerations.[21] Reinforcing this vacuum, academic urban planning programs do not incorporate “energy” as a singular issue within their curricula, as they do with transportation, for example.

3.4.5.3 Competing Priorities

Unless there is significant community support or political leadership, cities see little incentive to undertake energy-related activities outside of managing their own consumption. While the local issues discussed in Section 3.4.4 provide justification for local involvement in energy-related matters, many local governments have myriad high-priority concerns besides energy, most of which require immediate attention and financial resources. Furthermore, local governments are often under pressure to facilitate development in order to increase sales tax revenue to fund their operations. The tremendous energy savings achieved by local governments during the energy crisis were largely brought about by the state’s fiscal and technical support and by the crisis atmosphere itself. Because planning departments are funded primarily through development fees, they have reduced ability to take on longer-range planning efforts beyond the statutory requirements of their general plan updates, which do not include energy.

[21] Based on a personal communication with Gina Barkalow, the PIER-EA SUEP project manager.

3.4.5.4 Regulatory Obstacles

Some aspects of the regulatory system hamper local efforts and amplify the fiscal and technical shortcomings noted above. The state and federal governments play overriding oversight roles within energy policy, as the interconnected grid, transmission lines, and natural gas pipeline networks span across multiple states, three nations, and dozens of private and public utilities and generators. Some aspects of the regulatory system, however, hamper local efforts and amplify the fiscal and technical shortcomings noted above. The state's patchwork of regulatory agencies with a responsibility for the electricity system can be difficult to navigate, particularly for local governments (LGC 2003; Weare 2003). Simply participating in CPUC proceedings requires significant policy and legal expertise, and staying abreast of the latest developments on the technical and program side of the energy arena requires additional staff time.[22] The City of Chula Vista has spent upwards of $500,000 to follow the CPUC's proceedings on community choice aggregation.[23] The grant-funded nonprofit LGC actively follows energy policy and attempts to keep local governments abreast of the latest developments; however, local practitioners have noted that the current level of support is insufficient in light of the pace of activity and change in the regulatory and legislative arena.

Some regulatory measures discourage local involvement. For example, the CPUC recently issued a discussion draft of rules that put the IOUs in charge of administering most of public-goods-charge-funded efficiency programs, while giving third parties (including cities) an opportunity to compete for 20% of projects. Cities can also partner with utilities for the other 80% of funds. However, based on interviews conducted for this roadmap, some cities feel that they can provide these services more effectively and achieve better results than the utilities. Additionally, several cities noted that the viability of other energy-related strategies depend largely upon the decisions that will be made in the CPUC's rules for implementing AB 117. The ultimate resolution of these issues will in many ways determine the level of participation by local governments in energy-related activities.

3.4.5.5 Institutional Mismatch

Local governments do not have adequate control of the resources required to engage in comprehensive energy sustainability planning. Statewide agencies and utilities conduct energy resources planning primarily at a macro-regional or service-area scale, and the process generally (except in the case of municipal utilities) tends not to lend itself to the institutional arrangements and geographic limits of local government. Local governments will normally only get involved when they are stakeholders in a geographically specific matter. This is largely appropriate; however, the high costs of participation in proceedings and planning efforts noted above reinforce this mismatch, and further discourage local action.

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[22] In April 2004 the CPUC began a monthly e-newsletter updating local governments on various proceedings, actions, and public forums that they may wish to know about and participate in. Archives are available at www.cpuc.ca.gov/static/aboutcpuc/divisions/csid/public+advisor/lgnews/index.htm.

[23] From a personal communication with Scott Anders, San Diego Regional Energy Office.

4. Research, Program Activities, and Knowledge Gaps

This section provides an overview of the current literature and research of relevance to sustainable urban energy planning. It is organized into five major subsections that identify and discuss general strategies that are available to local governments to address the many aspects of sustainable urban energy planning.

1. Institutional and Programmatic Factors
2. Efficiency and Renewable Energy Within the Public Realm
3. Capturing Efficiencies in the Private Sector
4. Shaping Long-term Development and Land Use Patterns
5. Crosscutting Issues

Each of the main subsections is based on a review of the current (within the past decade) domestic and international literature and is supplemented by extensive interviews and other communications with a number of local officials, Energy Commission staff, and researchers involved in the broad range of activities discussed herein. Organizations conducting research on these issues are listed in Appendix A, and the persons interviewed for this report are identified in Appendix B. Research needs, a number of which are common across subsections, are primarily based on gaps identified in the literature; however, some issues were identified by interviewees and are attributed as such. They are listed at the end of each discussion of the specific subsection's elements, along with a notation of whether they are short-term (1- to 3-year) goals (ST) or mid-term (3- to 10-year) goals (MT). Recommendations for addressing these research needs are categorized in Section 5.

Subsection 4.1 begins with a general overview of the institutional and programmatic aspects of current energy planning measures that must be addressed in any public endeavor.

Subsections 4.2 through 4.4 look at ***what*** local governments can, should, and to an extent are doing with respect to energy; ***why*** they should be doing it; and the practical questions of ***how*** they can do it. This is organized in a three-part framework for local action, focusing on the following elements:

1. **Energy efficiency and generation in the public realm,** because the economic benefits of more efficient energy use are immediately reflected in a local government's overall expenditures and are a direct incentive for cost-effective improvements.
2. **Capturing untapped energy efficiencies within the private sector,** because the private sector uses the most energy and local governments can play a unique role in affecting that use. The most dramatic energy efficiency gains and improvement will be made in the private sector.
3. **Shaping long-term urban development patterns,** because increasing urbanization could result in serious energy and environmental consequences as it stresses existing urban infrastructure for energy transmission and delivery; water, wastewater, and stormwater treatment; and transportation.

Subsection 4.5 looks at crosscutting issues that do not readily fit into the above framework.

4.1 Institutional and Programmatic Factors

The public policies and strategies enacted during and after the energy crises of the seventies were critical to setting a more efficient and more cost effective energy path, both nationally and in California. Although these energy crises were primarily related to transportation fuel, they set off a broad conversation about energy policy. As the crises receded from memory and the issues waned from public consciousness, research in the field declined, though it by no means ceased.

The increased recognition of the realities and consequences of climate change, public environmental consciousness, and rapid urbanization—along with recent energy crises (this time with electricity and natural gas)—have once again brought energy issues forward for policy makers and researchers. Moreover, new technologies have redefined small-scale generation, distribution, and efficiency opportunities at the urban scale (Vaitheeswaran 2003; Gellings and Lordan 2004). Local and regional governments across the state, country, and world have responded with their own energy strategies and plans.

This subsection addresses two issues: (1) how local government energy programs are institutionally and programmatically organized and supported by local governments, and (2) the effectiveness of local programs and strategies. Although research projects in this area may address both issues as part of the same investigation, it is important to consider their particular aspects separately, because effectiveness is a criterion used to evaluate the programs and determine what is and is not working.

4.1.1 Organization of California's Local Government Energy Programs

California's local governments organize and fund their energy programs in a variety of ways that are typically very different from one another. These differences occur in part, because the reasons for taking on energy activities vary from one local government to the next. Programs are considered at the city, county, and regional levels.

For example, every local government official interviewed during the course of this roadmap's development approaches energy programs differently. A number of jurisdictions include their energy-related activities as part of overall GHG-reduction plans, while others take an ever-broader view by placing their energy programs as part of sustainable economic development strategies. Dozens of local governments feature energy elements as part of their general plans (Roberts et al. 2002). Officials from the City of Berkeley noted that they reinvest their utility franchise fee into energy programs, thus ensuring that fees from energy consumption are used to promote energy efficiency. It should be noted however that a successful energy efficiency program that significantly reduces consumption will result in a corresponding reduction in the utility franchise fee, which itself is based on overall consumption.

Several studies have examined the institutional aspects of local energy programs. Burke (2003) conducted a broad-brush survey of local government energy activities in California, identifying the breadth of activities and their general funding sources. The LGC has conducted extensive outreach in its energy activities and in 2002 held a workshop to specifically discuss the development of sustainable institutional structures for local energy activities. The Governor's OPR publishes an annual survey of local government activities in municipal matters that includes several questions about the presence of local energy activities (Roberts et al. 2002). Despite these extensive activities, no comprehensive review of energy plans has identified how programs around the state are organized and funded.

Although there is little detailed comparative work, California local governments that seek to undertake energy-related activities have access to a variety of resources. The Urban Consortium's sustainable energy planning guide (Anderson et al. 1992), funded by the DOE, provides a simple, step-by-step framework for developing a local energy plan and highlights examples of policies in San Francisco, San Jose, and Portland, Oregon. The Energy Commission's *Energy Aware Planning Guide, Vol. 1* (1993) is a valuable tool that offers guidance on local programs and provides local government officials with concrete examples of energy-efficient management and planning practices; however, it has not been updated since its publication, despite the changes and advances in the energy field. In April of 2005, the Energy Commission's Public Advisor began sending out an eNewsletter on various energy-related topics, many of which should be of interest to local and regional governmental staff, community leaders, and others.[24] The LGC provides links to technical assistance and funding opportunities,[25] but still points to the insufficiency of current support systems for local programs. Virtually every municipal official interviewed during the course of this project noted the institutional barriers and capacity constraints discussed in Section 3.4.5, and some indicated the need for comprehensive training to develop local energy program professionals.

However, tools to support the establishment of local government energy programs are being developed. In January 2004 Navigant Consulting began work on the California Energy Efficiency Project (CALeep) to produce a process template for creating community energy efficiency programs that can be used by a variety of local public entities to stimulate energy efficiency activity in their jurisdictions. The project is now in its third phase, where Navigant is testing the effectiveness of its draft template by developing, implementing, and evaluating six one-year-long pilot projects customized to meet the needs of a variety of jurisdictional settings.[26] Lessons from these pilot projects will be incorporated into a "prototype" energy program for California's local governments that will be disseminated though partnerships with state and federal energy agencies, and with industry associations.

The introduction of community choice aggregation (discussed in Section 3.4.2) into a local government's toolbox has the potential to dramatically change the landscape for local activities.

[24] For more information on the eNewsletter, contact Mike Monosmith in the Energy Commission's Public Advisor's Office at: Mmonosmi@energy.state.ca.us.

[25] LGC. Financing and Project Assistance for Energy Efficiency in Buildings. www.lgc.org/freepub/energy/funding.html#finance.

[26] The project is being conducted in partnership with local governments, regional agencies, and public-private initiatives. These entities are the City of Oakland, County of Sonoma, South Bay Cities (LA) Council of Governments, Inland Empire Utilities Agency, Fresno Regional Jobs Initiative, and Ventura County Regional Energy Alliance. Information about the program is available at www.caleep.org.

Additionally, it may provide a source of stable funding for other local energy-related activities and speed introduction of demand-based pricing, net metering, energy efficiency, and renewable energy. For example, one preliminary study has shown that local governments may be able to reach a renewable portfolio of up to 40% and remain competitive with IOU rates, depending on the ultimate rule structure.[27]

Research Needs

1. Conduct comparative analyses of organizational and funding models of local energy programs to assist interested local governments in structuring programs and effective partnerships to overcome technical, institutional, and other obstacles to implementing sustainable urban energy planning initiatives and achieving local and state energy goals. **(ST)**
2. Conduct mid-term evaluation of local CCA efforts. **(MT)**

4.1.2 Local Energy Program Effectiveness

The sustainable development, sustainable energy, and urban planning fields have all developed a rich literature of research, and there exist numerous excellent recent resources for national (and to an extent, state-level) energy policies and programs. Until recently there has not been an adequate amount of research integrating these three fields or assessing the effectiveness of the various approaches (Naess 2001; McGranahan and Satterwhaite 2003).

Several studies have conducted extensive evaluations of the efforts of a number of European cities taking part in European Union-supported energy programs (Nijkamp 1994; Butera 1998; Nijkamp and Pepping 1998; Capello et al. 1999; Qlerup 2000). McGeough et al. (2004a) provide a corresponding effort for a systematic examination and evaluation of the energy policies of selected American cites, along with a comprehensive overview of the range of energy-related actions that local governments can take. Burke (2003) outlines the various types of energy-related activities undertaken by California's local governments, but this is not a comparative analysis. Neither Burke nor McGeough et al. evaluate the effectiveness of local government programs in terms of costs or energy savings.

In February 2005—shortly before the completion of this report—a consortium of IOUs, municipal utilities, and municipal utility districts, and independent power producers launched the Energy Efficiency Best Practices Project (EEBPP),[28] a systematic nationwide evaluation of energy programs designed to improve the design, implementation, and effectiveness of energy-related activities. The EEBPP uses a benchmarking methodology to identify best practices for public education and improving efficiency in residential and commercial structures. The

[27] Based on an interview with Pat Stoner, LGC. Updates on this project are available at www.lgc.org/cca/.

[28] Pacific Gas and Electric Company managed the project under the auspices of the California Public Utility Commission in association with the California Energy Commission, San Diego Gas and Electric Company, Southern California Edison Company, and Southern California Gas Company. Quantum Consulting, Inc. conducted the project. A complete list of participants is at www.eebestpractices.com.

database also provides examples of 90 different energy efficiency programs, 11 of which are implemented by public agencies. The pilot projects undertaken by CALeep (discussed in Section 4.1.1) and other similar efforts can offer additional data points for continued evaluation and refinement of local energy programs.

A debate exists about who is best equipped to administer energy-efficiency programs (Blumstein et al. 2003; Didden and D'haeseleer 2003). On one hand, Burke (2003) suggests increasing local government involvement in California's energy policy through "subsidiarity."[29] A number of city representatives interviewed for this roadmap also suggested maximum local involvement while pointing to their own examples of improving upon what they perceive as inadequate IOU efforts. On the other hand, the IOUs and the Natural Resources Defense Council have advocated for the utilities to take the central role. This viewpoint is based on the three premises. First, the IOUs have developed years of experience running efficiency programs and, by virtue of their large service territories, are best positioned to make the most cost-effective efficiency opportunities. Second, energy efficiency is a resource on par with supply-side resources and the IOUs are the best entities to bear the responsibility for procurement of this resource, particularly with the CPUC stipulations for the loading order and the RPS. Third, because of its regulatory authority over the IOUs there exists a level of control that simply cannot be replicated in the case of third parties. The CPUC is signaling that it will likely take a middle road by making some activities open to non-IOU third parties such as local governments and private firms, but the debate will likely continue, and there will be extensive opportunity to evaluate the success of these alternative approaches.

Research Needs

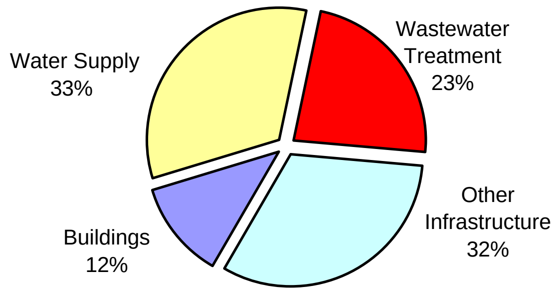
1. Design sustainable energy indicators to provide benchmarks for local activities and harness local initiatives towards the support of the state's energy goals. **(ST)**
2. Monitor the development of projects such as EEBPP and CALeep to determine whether further comparative analyses of the effectiveness of California's local government energy programs are warranted. **(MT)**
3. Conduct mid-term evaluation of local government energy planning activities to examine the circumstances under which local and regional governments are best equipped to provide energy-related services. **(MT)**

4.2 Efficiency and Renewable Energy Within the Public Realm

The benefits of more-efficient energy use are reflected directly in the local government's overall expenditures and are a direct incentive for cost-effective improvements. The most obvious focus for local governments are those facilities and operations that are under their direct control, and a great deal has been written by independent researchers and public agencies regarding the action areas contained within this broad topic. These areas include: public buildings and

[29] *Subsidiarity* is defined as the devolution of government decision making to the most local level at which efficiency can be maintained.

facilities, water supply, wastewater treatment and disposal, and other infrastructure systems, such as streetlights and stoplights that can be made either more efficient or lend themselves to distributed and renewable energy resources. A breakdown of energy costs for the average California city is shown in Figure 2. Additional transportation energy-related measures include fuel-efficient and alternative-fuel vehicles for municipal fleets; however, these are not discussed in this roadmap.



Source: Means (2004)

Figure 6. Typical city energy use

4.2.1 Public Facilities

Local governments use large numbers of buildings and vast amounts of office space in order to carry out activities on behalf of their constituents. These structures and spaces include city halls and civic centers, police and fire stations, hospitals and health centers, park and recreational facilities, and schools; together they constitute about 12% of a city's energy use (Wilkinson 2000).

Local governments have a direct incentive to reduce the utility energy demands of their publicly controlled facilities and infrastructure, and an overwhelming number of California governments are already doing so. Almost 70% of California's local governments have in-house building lighting efficiency and conservation programs for their facilities (Burke 2003). This direct fiscal motivation, along with citizens' environmental concerns, has also spurred local governments throughout the state to adopt policies to make existing public facilities more efficient and expand the use of renewable generation technologies. A few cities now build new public facilities to the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED)[30] standards or otherwise exceed existing building codes, while others are considering taking such steps.

Local governments seeking to reduce their energy consumption have a number of resources at their disposal. The Urban Consortium's Energy Task Force published a guide to intervention strategies for public buildings in partnership with the City of San Francisco (O'Sullivan et al. 1993). In California, more than 20 local public agencies participate in DOE's Rebuild America

[30] U.S. Green Building Council. www.usgbc.org/leed/leed_main.asp.

program, which also partners with private firms, universities, and nonprofits to promote energy efficiency and renewable energy.[31] The most successful efforts by California's local governments, special districts, and the state have been summarized in a variety of case studies by the "Flex Your Power" campaign[32] and the LGC.[33] Examples from across the United States and the world can be found at the International Council for Local Environmental Initiatives, which maintains a Berkeley office and counts fifteen California municipalities with a total population of 6.5 million as members.[34] Overall the area of public building efficiency appears well covered; however, the lack of coordination among these resources suggests that consolidation and effective organization of this information would be helpful.

Research Needs

1. Review California-specific manuals and case studies of energy-efficiency activities in public facilities, to identify information gaps and assess research needs. **(ST)**

4.2.2 Water Infrastructure

Drinking water delivery and treatment are large energy users; energy is required throughout the diversion, pumping, transmission, treatment, and disposal process. Drinking water and wastewater systems account for about 4% of the nation's electricity demand. That share is significantly higher in California—almost 7% of the state's total electricity demand—because large amounts of water are moved to the arid southern areas from the north or from the Colorado River basin (Means 2004).

Water systems comprise approximately 56% of a city's total energy use and the cost of pumping constitutes the largest portion of a water system's energy demand. In Southern California almost 70% of the energy needs of urban water systems stem from the supply component, translating into approximately 33% of a home's energy bill (Means 2004). Only 6% of respondents with energy programs consider water-related energy issues (Burke 2003).

The water-energy connection receives a fair degree of attention from researchers. Lawrence Berkeley National Laboratory (LBNL)[35] and the Electric Power Research Institute (EPRI) both have programs addressing the energy-water nexus. The Energy Commission actively funds efforts to improve the efficiency and reduce the energy consumption of water delivery systems, as well as to capture the methane produced by anaerobic digestion of wastewater sludge.[36] The

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[31] These include cities, school districts, housing authorities, community development agencies, regional energy authorities, and municipal utility districts. There are forty partners in California in addition to the Energy Commission. www.rebuild.org.

[32] Flex Your Power, www.fypower.org/inst.

[33] Local Government Commission, www.lgc.org/freepub/energy/casefacts.html.

[34] International Council for Local Environmental Initiatives (ICLEI), www.iclei.org.

[35] LBNL. Water and Energy Technology Team, http://water-energy.lbl.gov/water.html.

[36] According to the EPA's 2000 Clean Watershed Needs Survey (CWNS), fewer than 25% of California's publicly owned wastewater treatment plants that use anaerobic sludge digestion technology have

American Waterworks Association Research Foundation (AwwaRF) has an active program in partnership with the Energy Commission's PIER Industry/Agriculture/Water (PIER-IAW) group[37] and publishes a variety of reports on better energy management in water operations,[38] and has recently developed a research and development roadmap for water industry efficiency, with over 44 projects for both water and wastewater systems. Among the notable ongoing projects are investigations of best practices for energy management and energy use benchmarking for water supply and wastewater treatment. However, there remains potential for significant opportunities for reducing energy use for both water supply as well as wastewater treatment, which are discussed below.

4.2.2.1 Water Supply

Hunter Lovins (2004) notes that "we are making the same conceptual mistakes in water policy that we did in energy: seeking centralized, capital-intensive supply answers when efficient distributed solutions work better." This is an important observation, particularly in light of looming population growth, degradation of source watersheds, declining availability of fresh water supplies, and greater pressure for energy-intensive advanced treatments such as desalination.

There is an emerging understanding of the efficacy of alternative water supply solutions. Wilkinson (2000) has evaluated the energy intensity of California's water systems. In the report, Wilkinson highlighted the high energy costs of interbasin water transfers and benefits of integrated, whole system strategies for water and energy conservation. In a subsequent interview for this roadmap, he reiterated the need to identify the energy-related benefits that occur throughout the system from targeted urban water efficiency programs. Similarly, Dale et al. (2003) studied the sensitivity of the feasibility of various water supply strategies to energy costs, showing the centrality of water efficiency and reclamation as supply strategies, particularly as energy prices rise. Not surprisingly, the feasibility of energy intensive options such as desalination is greatly reduced when electricity prices are high.

Most recently, the Natural Resources Defense Council and the Pacific Institute published a report looking at urban water use in San Diego, and agricultural uses in the Westlands Water District and in the Columbia River basin. Among the most notable findings, the report shows that use of water reclamation as a supply option for Southern California will have half the energy intensity of interbasin transfers from the North and is more energy efficient than even local groundwater pumping (Cohen et al. 2004). The potential need for advanced drinking

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methane recovery systems; however, these recovery systems are in use at most of the large urban utilities. A 2004 CWNS is in progress as of the publication of this report.

37 Awwa Research Foundation, Programs, www.awwarf.org/theFoundation/ourPrograms/PartnerDescription.aspx?partnerid=0007886.

38 AwwaRF Reports Related to Energy Management, www.awwarf.org/research/TopicsAndProjects/reports.aspx?Topic=EnrgyMgm.

water treatments to meet health standards as source watersheds urbanize will likely result in even greater energy costs for long-distance water. PIER-EA also has two ongoing projects, to assess the life-cycle energy needs of California's water systems[39] and to quantify the potential air quality impacts from electric demand embedded in water management choices.[40]

There exist extensive opportunities for the simplest of these supply strategies—conservation and end-use efficiency. The Pacific Institute has conducted a comprehensive review of the opportunities for urban water conservation and found that urban water use can cost-effectively be reduced by 33% through a combination of regulatory and economic policy instruments, technology deployment, and public education (Gleick et al. 2003). This body of work builds a strong case for greater integration of energy-related analysis into water supply planning efforts for new growth and infrastructure improvements for existing systems.[41]

Research Needs

1. Conduct investigations of whole system benefits of conservation strategies and technologies as a means of reducing the energy and environmental costs of interbasin water transfers, with an emphasis on savings for local and regional water agencies. **(ST)**
2. Continue PIER activities and research into the energy profiles and efficiency of emerging advanced treatment techniques and technologies, with an emphasis on savings for local and regional water agencies. **(ST)**
3. Continue PIER activities and research to evaluate the life cycle energy intensity and costs of traditional, decentralized, and other alternative systemic approaches to water delivery and reclamation, with an emphasis on savings for local and regional water agencies. **(ST)**

4.2.2.2 Wastewater Treatment and Reclamation

In 2000, California's existing publicly owned wastewater treatment systems were operating at an average of more than 80% of present capacity.[42] Hence, new facilities will be needed to accommodate population growth, and existing facilities (many of which are decades old) will need improvements because of deterioration and more stringent water quality standards.

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[39] www.energy.ca.gov/pier/environmental/project_fact_sheets/500-02-004_EEGP_Horvath.html.

[40] www.energy.ca.gov/pier/environmental/project_fact_sheets/500-02-004_WOLFFF~1.html.

[41] Two recent laws, SB 610 (Costa, Chapter 643, Statutes of 2001) and SB 221 (Kuehl, Chapter 642, Statutes of 2001) require long-term water adequacy for new development and call for review at different stages in the project approval process, albeit with broadly similar criteria. Both laws define "long-term" as a 20-year planning horizon, and they share a common trigger for review of residential development: more than 500 residential units or projects that will increase the utility's water demand by 10 percent or more. SB 221 is focused almost exclusively on residential development, while SB 610's provisions extend to industrial and commercial developments as well. SB 221 also contains provisions to exempt infill development from review (Hanak and Simeti 2004).

[42] U.S. Environmental Protection Agency 2000 Clean Watersheds Needs Survey, www.epa.gov/owm/mtb/cwns/index.htm.

Academic research[43] and the state's research and development funding activities[44] are understandably targeted towards methane recovery, improvements in pump efficiency, and other mechanical aspects of urban water systems. Similarly, water agency officials concentrate primarily on keeping their systems operating smoothly and efficiently. A preponderance of the research projects in the AwwaRF/PIER-IAW roadmap are focused on these areas (Means 2004). Similarly, Zakkour et al. (2002) have examined sustainability strategies for London's wastewater treatment utility and have identified a number of technological upgrades and management strategies for improving energy efficiency and promoting sustainability, including the adoption of off-the shelf and emerging technologies.

Although Hunter Lovins' (2004) observation of the limits of capital-intensive solutions was in response to a question about water supply options, her suggestion of distributed solutions is entirely applicable to wastewater reclamation and stormwater management. Small-scale, decentralized water reclamation plants could be co-located with new urbanization and sized to the scale of new development to avoid the growth-inducing impacts and energy-intensive pumping requirements of large, far-flung treatment plants and similarly dispersed end uses. In already urbanized areas they can be integrated into existing wastewater systems near both sources of effluent and final recycled water demand, reducing both energy needs and overall costs.

Wastewater management practitioners have recently begun to recognize the limits of centralized wastewater management solutions in urban areas and have placed the investigation of alternatives on their research and development agenda (Nelson 2003). Some research has also addressed decentralization (Means 2004). The energy-related consequences of different *systemic* approaches to urban sewage management based on advanced decentralized and smaller-scaled water treatment and reclamation technologies have not been considered. However, the Gas Technology Institute (GTI) envisions neighborhood scaled decentralized wastewater management co-located with micro-generation as part of the sustainable urban system of the future (McGeough et al. 2004b).

Investment into new or expanded sewage is virtually certain, because development will be unable to occur without it. This investment will open a window of opportunity to target funds for energy-efficient solutions. Improved understanding of the energy implications of alternative infrastructure design and management strategies has the potential to play a critical role in guiding these expenditures.

Research Needs

1. Investigate distributed/decentralized wastewater treatment and reclamation as a more energy efficient design alternative for a long-term infrastructure planning process. **(ST)**

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[43] Personal communication with Dr. George Tchobanoglous, Professor Emeritus, University of California, Davis.

[44] PIER Industrial/Agricultural/Water Program Area Final Reports, www.energy.ca.gov/pier/iaw/reports/index.html.

2. Continue activities and research to evaluate the life cycle energy intensity and costs of traditional, decentralized, and other alternative systemic approaches to wastewater treatment and reclamation. **(ST)**
3. Continue investigation of whole-system benefits of conservation and reclamation strategies in order to reduce the energy and environmental costs of interbasin transfers, with an emphasis on savings for local and regional water agencies. **(ST)**

4.2.3 Other Capital Infrastructure

The balance (32%) of a city's electricity consumption is for other capital infrastructure, such as streetlights and traffic lights (which comprise up to 67% of that amount). In 2000, the CPUC estimated that electricity demand could be reduced by 1800 MW through increased funding for efficiency measures for streetlights and traffic signals (Lynch and Kahn 2000). The energy costs of streetlights can be up to 10 times higher than for traffic lights.[45]

Traffic safety and cost savings are key motivations for traffic light improvements. The City of Pleasanton has upgraded its key intersections with traffic signals using light emitting diodes (LEDs). This has not only reduced energy use but has allowed about 30% of its traffic lights to be operated with ultra-efficient battery backup-equipped units that will function up to 2 hours in the event of an outage.[46] Nearly 94% of California's cities either have light-emitting diode (LED) stoplights or are planning to convert to the technology (Burke 2003). The state's efficiency standards for traffic signal lamps took effect in March 1, 2003. The standards require that any traffic signal lamp, manufactured on or after March 1, 2003, and sold or offered for sale in California, must consume no more than a specified amount of power. The only technology that is currently capable of meeting those requirements is LEDs. This standard will ensure that any traffic signal lamp will use about 80–90% less energy than incandescent equipment.

Streetlights represent a significant energy savings opportunity. They are however complicated by aesthetic factors, differences in design standards among local jurisdictions, ownership, and tariff issues. Lighting quality can have significant influence on the nighttime environment. Different lighting types can affect depth perception and the ability to differentiate certain colors, potentially creating traffic and other public safety problems and affecting the mood of a street.

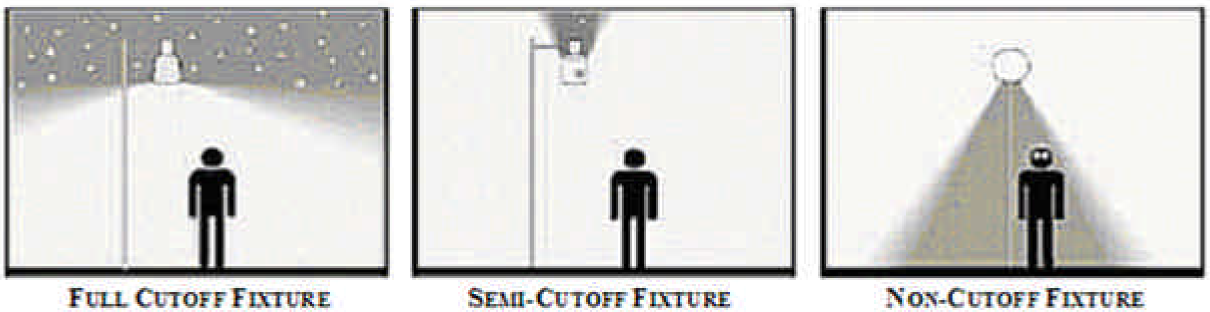
Figure 7 illustrates how certain types of fixtures contribute to light pollution and energy inefficiency.[47] For example, the non-cutoff fixture on the right spreads its light in all directions. Because much of the useful light is directed away from the street, there is a temptation to compensate for the loss by increasing the streetlight's overall wattage. On the other hand, full

[45] Personal communication with Mike Grimes, the facilities energy manager for the City of Santa Barbara.

[46] The conversion to LEDs made it possible for the city to operate some intersections with battery backup systems. LEDs save energy, battery backup systems do not.

[47] The Energy Commission and Illumination Engineering Society use four categories for lighting fixtures: full cutoff, cutoff, semi-cutoff, and non-cutoff; however, a good illustration showing the effects of the four fixture types was not available. Cutoff fixtures, which are not shown in Figure 7, direct slightly more light to the street than semi-cutoff fixtures, and slightly less than full-cutoff fixtures.

cutoff fixtures direct the light to the street where it is needed, allowing for lower energy use. Semi-cutoff fixtures are somewhere in between. Although cities have been moving away from non-cutoff fixtures, it is unclear how many of each type of fixture exist throughout the state or what the energy savings from their conversion would be. It is also uncertain whether full cutoff fixtures would save energy because the use of full cutoff fixtures could require more lights (lamp poles). While the wattages of the lights would be reduced, the savings could be offset by the need for more lamps and more maintenance. Glare from semi or non-cutoff fixtures could contribute to the need for higher wattage lamps in adjacent areas to compensate for the sharp contrast between the brightly lit and low light areas.[48] This information would be helpful to statewide policymakers in determining the overall level of investment for energy efficiency activities in this area.



Source: *Currents:* Street Lighting, LGC (1999)

Figure 7. Lighting effects of alternative streetlight fixtures

Many local governments do not directly own their streetlights.[49] While this constrains their ability to influence the technology used along the right of way, lighting guidelines for parking lots or new development give local governments an opportunity to affect the type of lighting technology used in private developments. Some cities are participating in proceedings at the CPUC to obtain ownership of streetlights in the right of way; however, the extent of inefficient streetlight energy use result resulting from ownership issues was unclear. Regarding tariff issues, Virginia Lew, an energy efficiency program manager at the Energy Commission, notes that because some cities pay a fixed fee per streetlight, they have little incentive to invest in more-efficient technologies without an adjustment of the cost structure. The ultimate impact of these issues is that efficient use of street lighting technologies remains unclear.

As with energy management in public facilities, the Local Government Commission,[50] Flex Your Power,[51] and the Energy Commission and the California Public Utilities Commission help to

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48 Personal communication with Gary Flamm, California Energy Commission.

49 Personal communication with Virginia Lew, California Energy Commission.

50 LGC. *Currents:* Street Lighting, www.lgc.org/freepub/PDF/Energy/currents/09_streetlighting99.pdf
LGC. *Currents:* Jan/Feb 2000, www.lgc.org/freepub/PDF/Energy/currents/11_janfeb00.pdf
LGC. *Currents:* May/Jun 2000, www.lgc.org/freepub/energy/newsletter/may_jun2003/page03.html

raise local governments' awareness of opportunities for energy efficiency with traffic and street lighting. Additionally, the International Dark Sky Association[52] conducts extensive research to address outdoor lighting issues; however, the overall attention paid to street lighting appears to be disproportionately smaller than its overall share of municipal energy use. The high current and planned adoption rate for LED traffic lights suggests most efforts in this area should be targeted toward improving energy efficient lighting power of streetlights, as well as overcoming non-technical obstacles.

Research Needs

1. Determine the composition of the ownership of street and highway lights by local governments, utilities, the state or others, identify appropriate stakeholders, and assess the standards that are used for the deployment of street and highway lights. **(ST)**
2. Conduct research to identify the extent of barriers (e.g., lighting preferences, maintenance, safety, ownership arrangements, and tariff structures) to efficient street lighting technologies. **(ST)**
3. If earlier research demonstrates that more efficient street and highway lights would reduce typical municipal energy use and barriers can be overcome, conduct research of efficient street and highway lighting and control technologies, with an emphasis on reducing operating cost (energy and maintenance), replacing bulbs based on mean lumen equivalents rather than on a watt-for-watt basis, and safety concerns. **(MT)**

4.2.4 Local Generation

California's public agencies[53] generate almost a quarter of the electricity consumed in the state. The growing viability and cost effectiveness of alternative energy resources like clean DG, photovoltaics, and wind power offers the potential to increase local production in load centers. Solar is particularly attractive because its viability rises on the hot sunny days when air conditioning use rise.

Energy Commission subsidies for solar resource on public buildings and hospitals have been extensive, but local governments have taken the initiative to support renewables both with and without the state's support. San Francisco's Generation Solar and solar bond initiative represent the largest municipal effort (see below). With the support of the DOE, Marin County and the City of Santa Monica have conducted "solarability" analyses to assess the total potential and

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[51] Flex Your Power provides an external link to an EPA case study of LED use in Denver, Colorado; http://yosemite.epa.gov/globalwarming/ghg.nsf/CaseStudiesNew/LED+Traffic+Signals+(Colorado)/$file/CO_LED.pdf

[52] www.darksky.org

[53] These public agencies include independent municipal utility districts, city or county controlled municipal utilities, multi-jurisdictional joint powers authorities, and other publicly controlled institutions.

identify potential areas for solar resources throughout their jurisdictions. Many of the issues faced by local governments in promoting DG resources are similar to those faced within the private sector, which are discussed in Section 4.3.2, *Distributed Generation Resources.*

One unique issue, however, is the question of financing. Several of the municipal officials interviewed for this roadmap noted the financing constraints that have been obstacles to undertaking potentially worthwhile projects. In 2001, San Francisco voters approved a $100 million revenue bond initiative to pay for solar panels, energy efficiency, and other clean resources for public facilities. As envisioned, the measure pays for itself entirely from energy savings resulting from bundling low-cost efficiency activities and cost-effective renewables with the higher-priced photovoltaics, at no additional cost to taxpayers. A nonprofit organization, the Vote Solar Initiative, formed to promote this idea with the goal of increasing municipal demand for photovoltaics and thus spurring cost reductions due to higher economies of scale.[54]

Research Needs

Although the development of other feasible financing strategies for local governments would be helpful, this work falls outside the scope of PIER-EA, which must focus on research and development that will advance energy-related science and/or technology.

4.2.5 Community Development through Energy and Water Use Efficiency

Section 3.3.3 noted the growing body of work regarding the economic development potential of policies to promote investment into energy efficiency. This work offers guidance to opportunities for integrating a local government's community development activities with efforts to improve energy and water use efficiency. The availability of Community Development Block Grant (CDBG) funds provides local governments with a potential funding source to put such strategies into practice. While the use of CDBG funds for neighborhood improvement and job development is widespread, there is a distinct shortage of research into the prevalence and efficacy of local government-led and community-implemented efforts to promote efficient resource use; PIER funding could help bridge the gap.

The Mothers of East Los Angeles (MELA) represents how such an integrated strategy can be used for water efficiency. Since 1992, MELA has conducted water-efficient toilet replacements throughout Los Angeles's low-income Hispanic community. Although the practice of toilet replacement is a long-used water conservation strategy, MELA was able to reach communities that were not participating in the programs for a variety of language and cultural reasons. MELA's approach was unique in that they hired local community members to conduct outreach and installation efforts. This strategy simultaneously broke down the barriers to greater participation while offering valuable opportunities for citizen education, reducing water bills, and bringing much needed income into the community (Dickinson 2000).

MELA's work reduced Los Angeles' water consumption during a severe drought and avoided the steep energy costs of supplying and treating the region's water demand, all the while

[54] Vote Solar. www.votesolar.org

serving a critical community development function. The lessons of MELA's success have spurred similar community-based toilet replacement programs throughout Southern California. MELA's effort has also been instrumental to demand reductions that have helped free up water for restoration in the Owens Valley, which supplies Los Angeles' water.

In San Francisco, the SF Power Co-Op conducts community-based energy efficiency programs targeted to local residents and small businesses, particularly in lower income communities. The Co-Op is funded by a combination of sources such as the state's utility public goods charge, the City of San Francisco, and private foundations and it serves a similar function as MELA, though on less ambitious scale. Nonetheless, it shows that community based strategies can be used for other water use efficiency and energy efficiency measure and that their costs and benefits should be more widely investigated.

Research Needs

1. Conduct case studies of local government-supported, community-based efforts for energy and water use efficiency. **(ST)**

4.3 Capturing Efficiencies in the Private Sector

The *private sector* is an extraordinarily broad category; therefore, it is important to identify the areas where local governments have the opportunity to affect energy consumption and grid congestion within the overall private economy.

The many aspects of land use and development make the clearest and most effective connection. As stated in Section 3.4.2, *The Role of Local Government*, local governments shape both ***how*** and ***where*** land will be used and developed. ***Where*** land is developed will be discussed in Section 4.4, *Shaping Long-Term Development and Land Use Patterns*; however, targeting ***how*** land is developed provides opportunities for action in a number of specific areas. These areas include: improving building efficiency in existing construction; promoting energy efficiency in new buildings (in both commercial and residential sectors); facilitating the siting of DG resources; and incorporating energy-efficient site planning and urban design for new development.

4.3.1 Improving Building Efficiency

In a recent study, DOE concluded that the nation could save $100 billion—about 30% of its total energy costs—if the 25 million new housing units and 17 billion square feet of commercial development projected to be built over the next 15 years were to be constructed using sustainable design and energy-efficient technologies and practices (McGeough et al. 2004b). A comparable analysis has not been conducted for California or its regions.

Local government authority in the permitting of new development and in influencing the terms of sale of existing buildings provides an ideal opportunity for market transformation towards energy efficiency practices and technologies. PIER's Building End Use Efficiency and Renewable Energy Technologies groups are actively working to speed the development of a "zero energy home" that will reduce peak energy demands and local governments may play a key role in helping to push the technology.[55] Moreover, a number of local governments have adopted policies to pursue such ends and utilities are partnering with local communities to promote energy efficiency as a means to reduce grid-congestion. What is less clear is the rationale for ***why*** a local government would want to intervene in the private sector in order to promote smarter energy use.

There needs to be a compelling public interest to justify government intervention within the private sector. For land use interventions, the U.S. Supreme Court has established that a government must demonstrate a "reasonable nexus" and "proportionality" between the impact and remedy. There are legitimate public health and safety reasons for ensuring compliance with building codes and standards. However, the links between energy-related interventions or voluntary programs and a local government's direct interests are not readily visible, particularly in relation to the concerns noted in Section 3.4.4, *Local Energy Related Concerns*.[56] Under such circumstances, local government officials may be unwilling to undertake policies with uncertain ends, especially if there is a risk of negative economic impacts.

For example, a hypothetical city in the Silicon Valley region decides to institute a "green building ordinance" mandating that all residential and commercial buildings built or significantly renovated within its borders exceed the state's building efficiency guidelines by at least 10%, or meet a certain LEED, Energy Star, or Home Energy Rating System (HERS) standard. Because the region imports a substantial amount of its energy, the policy may reduce the region's overall dependence on imported energy supplies and grid-congestion but would not necessarily provide any direct energy-related benefits to the city itself. Disruptions, which are distributed across sub-regional outage blocks, would not abate solely within the city's limits any more than they would in a neighboring municipality. Local generation-related air and water quality improvements could be substantial if the policy leads to a reduction in local generation. Even then, significant benefits would also accrue to the city's neighbors that do not have such a policy. Under most circumstances, generation-related air and water quality benefits of greater energy efficiency and reduced overall consumption would likely be statewide and global.[57]

Yet green building policies do offer distinct local environmental benefits. For example, an LEED-certified building that collects roof runoff reduces stormwater discharges into receiving bodies and provides a source of water for landscaping. The consequential demand reduction on the public water system reduces pressure on the water supply and correspondingly reduces the

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[55] *Research, Development, and Demonstration Projects Focused on Zero-Energy New Homes (ZENH),* Request For Proposals #500-04-501. September 1, 2004.

[56] These concerns are: (1) price stability, (2) reliability, (3) economic development, (4) environmental quality, (5) quality of life, and (6) environmental justice.

[57] The benefits would of course be "local" in the areas where power generation is reduced (if it is indeed reduced and the power is not just redirected elsewhere); however, that does not necessarily matter to the city or county instituting such regulation.

energy costs of transporting and treating the potable water. Similarly, ”green office parks” can incorporate various ecological features that double as habitat or public open space.

Such “green building” policies could however have unintended consequences, such as pushing revenue-generating development to less restrictive areas, as occurs with growth control ordinances (Landis et al. 2002), and creating “free riders” of other cities that enjoy the potential regional reliability and environmental benefits without incurring any of the costs. At the same time there are environmental benefits that accrue locally from green building practices. Although this may be the case, cities still are deciding to adopt stringent standards. The drive to do this presumably comes from the environmental concerns of their constituents and elected officials who want to take a bold stance in support of the environment in general, even if the air quality benefits accrue outside their jurisdiction.

The Cities of Santa Monica and Pleasanton have adopted such ordinances, while Marin County has adopted an ordinance to cap energy consumption in residential structures at the Title 24 rating for 3500 sq. ft., meaning that new homes larger that 3500 sq. ft. must implement energy efficiency measures to reduce their overall consumption. Others, like the cities of Berkeley and San Jose, and San Mateo County encourage private developers to use high-performance, energy-efficient building practices but do not mandate their use. All of these governments provide some form of technical assistance and referrals to statewide publicly funded programs such as “Savings by Design” and the “Community Energy Efficiency Program.” Interviews with representatives of the cities of San Jose, Santa Monica, Berkeley, and Pleasanton revealed that there have been no observable impacts on development activity as a result of these ordinances. Nonetheless, several individuals interviewed during the course of this project noted the general reluctance of their local governments to intervene in the private markets. Similar questions arise in the case of voluntary programs that expedite permitting, provide density bonuses, or give other non-financial incentives to “green projects,” such as in Santa Barbara. There has been no thorough evaluation of the impacts of such policy measures.[58]

In addition to uncertain benefits to the city, the problems are compounded by the uncertainty of benefits to the developer and end-user (Lutzenhiser and Janda 1999; Lutzenhiser and Biggart 2001; Cassidy 2003; Kats et al. 2003). Developers often see only the costs in their economic analyses without any corresponding of quantification of benefits (Miller 2003). According to the Center for Green Building Research, formed jointly by EPRI and LBNL in early 2004,

> …there is a clear lack of demonstrated, directly verified benefits [from high-performance buildings]. This is true for both direct benefits such as reduced energy usage and improved indoor environmental quality (IEQ), as well as indirect effects such as improved occupant health, comfort, and productivity. No

[58] Personal communication with Robert Wilkinson, UC Santa Barbara.

scientifically rigorous examination of IEQ or energy usage in as-built green buildings has been carried out to date.[59]

These questions are receiving considerable and growing attention. For example, a report by Kats et al. (2003) to the State's Sustainable Building Task Force highlighted a number of case studies that identified observed and projected benefits of high-performance building design. Major developers have begun to attest to its benefits and a growing body of domestic and international architects is becoming familiar with high-performance building design (PLEA 1998; Lippe 2003). The Center for Green Building Research was established specifically to address the comparative questions that can only be addressed through controlled rigorous statistical studies. Further demonstrating the comprehensive benefits of high-performance buildings will increase the likelihood of market penetration and the associated energy use benefits.

Energy-efficiency upgrades in existing construction at the point of sale or other trigger events provide another opportunity for cost-effective solutions, particularly in older buildings built or significantly renovated before the state's energy-efficiency building codes (CEC 1993). Indeed, as noted earlier, the Energy Commission has identified 5,400 MW of market-feasible efficiency that is not being deployed due to a variety of factors. Among its proposed solutions (which are considered within a statewide policy context) is to build on the success of local time-of-sale energy efficiency retrofit (CEC 2004). Yet, similar questions remain with these policies, as with those for new construction.

Research Needs

1. Conduct studies to identify the environmental, economic, and equity costs and benefits to local governments of mandates and voluntary programs for energy efficiency in new buildings. **(ST)**
2. Conduct comparative empirical studies to evaluate the direct and indirect benefits of high-performance, energy-efficient buildings to owners and tenants. **(ST)**
3. Evaluate the effectiveness, costs, and benefits of local time-of-sale energy-efficiency upgrade mandates in order to improve energy efficiency in existing buildings. **(ST)**

4.3.2 Distributed Generation Resources

The Energy Action Plan (CEC et al. 2003) makes increased use of DG resources,[60] particularly those using renewable fuels—an explicit policy goal. The push for DG is driven by a number of economic, technical, and regulatory factors. These include: reliability considerations, peak demand reduction, transmission congestion relief, reduction of transmission losses, increased

[59] Center for Green Building Research. Green Buildings: Evaluating the Benefits. www.epri.com/green-buildings-research-org/.

[60] Distributed generation (DG) can be defined as "electricity production that is on-site or close to the load center and is interconnected to the distribution system" (Rawson 2004). There are other definitions as well, some of which include off-grid production.

effectiveness of renewable resource technologies, and higher fuel-to-energy conversion efficiencies when partnered with combined heat and power systems (Allison and Lents 2003).

The urban air quality impact of increased reliance on non-renewable DG resources is uncertain. To address the potential air quality impacts of DG units, the CARB has adopted emissions standards for DG. Any new DG unit that is installed in California today must meet the CARB 2003 standards. Beginning in 2007, new DG installed in California must meet the CARB 2007 standards. Thus, the increasingly more stringent air emission standards in California will require cleaner technologies, which could hamper the new installation of DG technologies, particularly in air quality non-attainment areas (Bluestein et al. 2002).

To better understand the potential environmental implications of DG, the PIER-EA Air Quality Program is funding research looking at the air quality and environmental life-cycle implications of DG compared to those of combined–cycle, natural-gas-fired central station plants. PIER-EA is also working with the University of California at Irvine (UCI) to determine the regional air quality impacts of widespread DG implementation in Southern California. Researchers will develop and analyze likely DG implementation strategies and evaluate the associated air quality impacts that would result from using those technologies. PIER-EA and UCI will also collaborate with the South Coast Air Quality Management District and ARB to assess the potential impact of DG on air quality.[61]

Combined heat and power (CHP) systems[62] have been used in industry for years and European cities have been particularly apt to promote CHP district heating systems in their energy strategies (Nijkamp 1994; Nijkamp and Pepping 1998; Capello et al. 1999; Cormio et al. 2003). In the U.S., DOE set a goal of doubling the nation's CHP by 2010. To support this goal, DOE has funded research to reduce the cost of CHP and district heating systems and established CHP Regional Application Centers throughout the U.S.;[63] all but one of the Centers are in their early stages of development. The Gas Technology Institute has developed a guide on CHP and district heating systems, and offered some examples of how they have been incorporated into urban systems as part of DOE-funded research (McGeough et al. 2004b).

The Energy Commission funded a report in 1999 that assessed the CHP market in California, and will likely update this report in the near future.[64] According to interviews with PIER staff, studies have shown that CHP dramatically increases the viability of non-renewable DG technologies. In 2003, the PIER's Environmentally Preferred Advanced Generation (EPAG) program issued a solicitation for CHP research projects and is currently managing the projects selected for funding. The Energy Commission expects to look at CHP policies and how

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[61] www.energy.ca.gov/pier/environmental/project_fact_sheets/500-00-033.html

[62] CHP is sometimes known as "cogeneration" and dates back to the earliest days of electricity production. CHP systems capture and reuse waste heat from power generation for water heating, thermal space conditioning, and industrial processes.

[63] Pacific Region Application Center, www.chpcenterpr.org.

[64] Based on a communication with Mr. Rawson, PIER Distributed Generation Program Lead.

California can better support CHP development as part of the 2005 Integrated Energy Policy Report. A comprehensive review of local CHP efforts in California and analysis of how support of CHP can benefit local economies and the environment have not been done, but would further reinforce the state's overall DG efforts.

Wind power has become an increasingly cost-effective energy resource, but has until recently been confined to a limited geography and has not been applicable as a distributed resource. Wind power has not been a significant issue or consideration for most governments, except in cases of local permitting in the five major private wind-producing areas.[65] In 1999, Alameda County, which is responsible for wind turbine permitting in the Altamont Wind Resource Area, placed a moratorium on increasing wind generation capacity until problems with avian fatalities could be resolved. In turn, PIER-EA funded research to help provide information and tools necessary to develop mitigation guidelines.[66] The increasing viability and state support of small wind generation suggests that local governments may have an increasing role in their regulation; small wind turbines are spread across 36 California counties (Nakafuji et al. 2002).[67] Although legislation passed in 2001 removes a variety of local obstacles to small wind turbines,[68] it is unclear how such resources would affect and be integrated into existing urban areas. Kern County's Planning Director noted that the County's planners have increasingly been involved with issues related to siting wind generation.

The major private sector adoption drivers of DG are economic—driven by the cost of the base fuel, competing IOU tariffs, or reliability needs.[69] Outside of certain permitting issues,[70] local governments and other authorities (such as homeowners associations) have minimal influence on private deployment of these technologies unless they operate their own utilities, although future increases in DG deployment may raise public concerns about environmental justice and local air quality issues.

In some cases, as in San Francisco, local governments have stepped in to assist with siting DG and resolving technical issues with existing infrastructure. As a result of their increasing attention to DG (and in renewables in particular), local practitioners have identified two major technical issues preventing greater deployment of these technologies: (1) interconnection to the transmission system, and (2) the metering of multi-family buildings.

A number of interviewees noted that the lack of consistent transmission system interconnection rules hampers their ability to site these technologies at public buildings and promote them at

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65 These areas are Altamont Pass, Pacheco Pass, San Gorgonio Pass, Tehachapi Pass, and Solano (Solano County).

66 *Developing Methods to Reduce Bird Fatalities in the Altamont Pass Wind Resource Area.* www.energy.ca.gov/pier/final_project_reports/500-04-052.html

67 Small wind turbine resources generally comprise small turbine facilities of operations below 50kW.

68 AB 1207, amending Government Code Section 65892.13.

69 Personal communication with John Paul, RealEnergy.

70 Building safety in the case of solar systems and industrial land-use and air quality criteria for diesel generators, small internal combustion engines, and microturbines.

private ones. In a larger sense, this raises issues of the general incompatibility of existing infrastructure with advanced and emerging energy technologies. San Francisco has attempted to address this problem by establishing a working group with several DG firms, however this represents just one local effort. The Energy Commission, in conjunction with the CPUC, utilities, and the DG industry, has established a larger collaborative effort to develop and implement standardized interconnection rules. Revised interconnection rules went into effect in 2001 and have been adopted by Pacific Gas & Electric, Southern California Edison, San Diego Gas & Electric, and several municipal utilities. The rules continue to be improved upon, but a learning curve does exist and some DG developers have been unhappy with the speed at which utilities have internalized the new rules. Also, the broader issue of a general lack of infrastructure to support new advanced energy technologies was also mentioned as an issue discouraging better planning and hampering the implementation of innovative energy alternatives.[71]

A second barrier preventing greater deployment of DG is the "split incentive" issue related to multi-family buildings. Building owners have no incentive to site these technologies, because they are often not the ones paying the majority of a building's electric bills; common areas constitute only a small proportion of an apartment building's total demand, and they are not allowed by law to sell the generated electricity to their tenants.[72] Although this issue can in part be resolved with alternative tariff models—(for example, the building owner simply sells power into the grid)—local practitioners continue to struggle with this issue.

In the broader sense, the Energy Commission is also looking into how DG can provide local benefits to utility systems and non-DG participating ratepayers. Of interest is what kind of benefits DG can provide to address local distribution system congestion. The PIER Energy System Integration (ESI) Research Program is leading several research projects that are assessing the engineering and economic benefits of DG to the utility system.[73] This research will determine a monetary value for these benefits and link the results of this research to current regulatory proceedings at the CPUC considering this issue. PIER ESI is also supporting a pilot program with Southern California Edison to solicit third-party DG for the purposes of deferring several distribution system upgrades they need for reliability purposes in 2005 and 2006.

Research Needs

1. Conduct analysis of the environmental, economic, and equity costs and benefits of local government support for DG, CHP, and district heating. **(MT)**
2. Conduct mid-term review of current efforts to resolve energy system interconnection issues for DG resources. **(MT)**
3. Conduct mid-term review of current efforts to identify urban air quality impacts of DG, CHP, and district heating deployment scenarios. **(MT)**

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[71] In comments by John Kelly and Jay Wrobel of the Gas Technology Institute, December 2004

[72] Although when multiplied by the number of multi-family buildings in California, the total amount of energy used in common areas becomes significant.

[73] Personal communication with Mark Rawson, California Energy Commission.

4.3.3 Energy-Efficient Site Planning

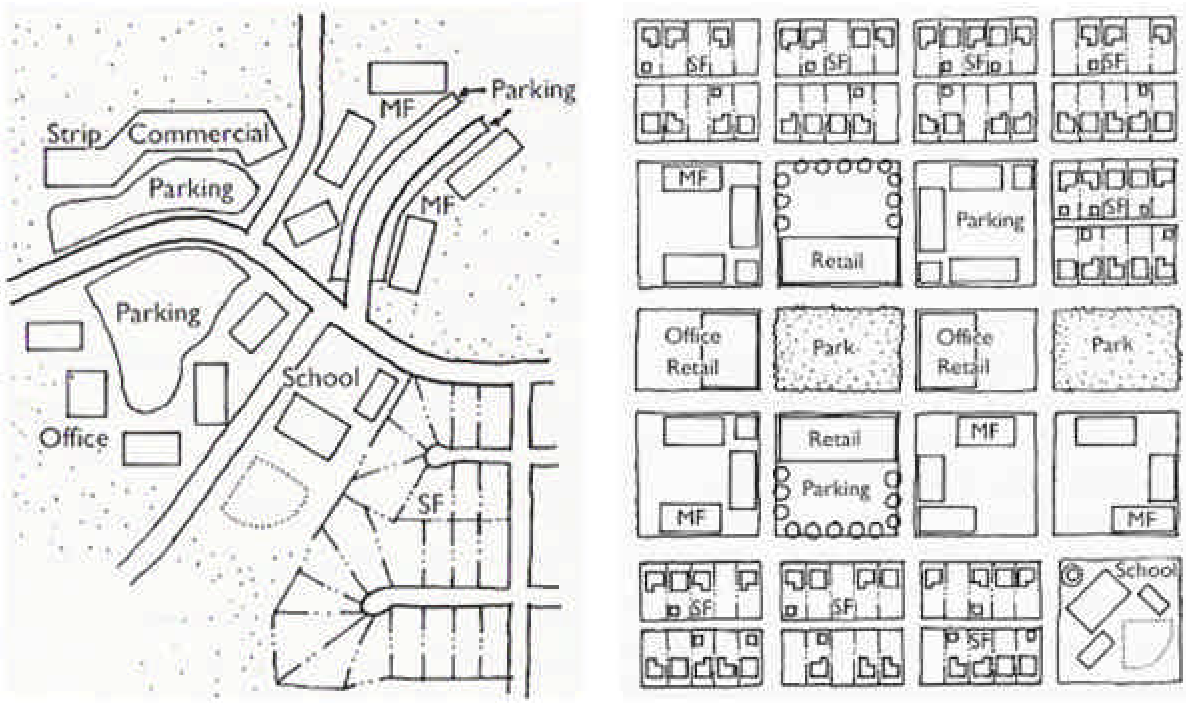
Immediate benefits can be captured through energy-efficient site planning techniques. For example, solar-friendly alignment techniques (Littlefair 1998), narrower street widths, and broad-canopied trees (CEC 1993) are effective ways to reduce peak energy use while simultaneously creating aesthetically pleasing residential communities, industrial parks, and commercial areas (Moughtin 1996). Many of these features can be incorporated into existing communities, as well as designed into new ones. These features, often called “new urbanism” or “traditional neighborhood design” (TND), are gaining in popularity and can be used regardless of where development actually occurs as part of any land development approval process. Unlike the benefits associated with high-performance buildings, the benefits of efficient site planning techniques are visible for developers as well as the public. An extensive and growing body of work is showing market acceptance of TND communities and further building a public case for more extensive use of such techniques in residential development.

The rationale for TND is primarily from the standpoint of reducing the need for automotive transportation, and Figure 8 offers a simple illustration of how similar uses can be spatially arranged to achieve this goal. The typical suburban development encourages sprawl by completely segregating the various land uses, providing only a few roads for getting between two points, and ultimately necessitating driving and the large infrastructure needed to support it. On the other hand, the TND counterpart diversifies the land use mix and creates a street system that provides multiple access routes to different locations, offering opportunities for non-motorized travel. The resulting reduction of concentrated parking lots mitigates urban heat island effects and provides opportunities for more effective stormwater handling measures.

Although there exists a general understanding that these alternative site designs have implications on energy use, the full extent of the potential environmental benefits from energy efficient design techniques are not available. A deeper understanding of the energy effects of alternative urban design approaches will help local decision makers and citizens incorporate such development guidelines in their jurisdictions. This is particularly true in areas that are predisposed against public intervention in the land development process.

Research Needs

1. Conduct comparative studies of different community types to precisely identify the electricity-system-related economic and environmental benefits of alternative urban design and site planning features. **(ST)**
2. Develop model energy efficient urban design and site planning guidelines to reflect findings of research to identify electricity-system-related economic and environmental benefits of alternative urban design and site planning features. **(MT)**



TYPICAL SUBURBAN DEVELOPMENT

TRADITIONAL NEIGHBORHOOD DESIGN

Source: Calthorpe (1993)[74]

Figure 8. Alternative community designs

4.4 Shaping Long-term Development and Land Use Patterns

California's urban footprint continues to spread across the landscape. Driven by a combination of deeply ingrained cultural values, job dispersion, population growth,[75] lower land prices at the urban fringe, pro-auto policy bias, and exclusionary zoning policies that have separated land uses, American cities have been decentralizing for decades (Garreau 1991; Nye 1998). The fact that much of California has been developed since the advent of the automobile has especially assured its automobile-dependent sprawl. Forecasts of long-term development patterns (shown previously in Figure 5) project increasing urbanization throughout the state. Sprawling urbanization pushing out the edges of metropolitan areas has long been a staple of the American landscape, and overcoming this habit has proven extremely difficult.

This subsection will examine how energy is considered within the main analytical frameworks for understanding the spatial growth of urban settlements, first by looking at links in the

[74] The designation SF and MF in Figure 8 refers to residential building types. SF is single family and MF is multi-family.

[75] Nationally between 1982 and 1997 the amount of land consumed for urban development increased by 47% while population grew by only 17% (Friedman 2004). California-specific data were not readily available.

research between energy and the spatial configuration of urban areas, and then by examining how local governments are responding to the development pressures that drive continued urbanization.

4.4.1 Understanding the Energy Effects of Urban Form

Urban form—the spatial arrangement of fixed items in an urban system—can be analyzed through multiple lenses. Measures of compactness,[76] land use diversity,[77] street and road connectivity, accessibility, and "excess commuting"[78] help provide quantitative descriptions of the basic elements that constitute the outward shape and internal structure of the built environment at the town and regional levels (Horner 2002; Song 2003).

Figure 9 illustrates the various urban forms that regions can take on. In this illustration, the light yellow circles represent current centers of development and the darker orange areas represent new growth. New growth is accommodated in a variety of different scenarios, depending on the planning decisions made by the region's citizens and officials. Each alternative urban form will have a different energy use profile.

The most direct energy-related impact of urban spatial growth is in the area of transportation and there has been extensive work to catalog the transportation energy impacts of urban growth patterns (Longmore and Musgrove 1983; Anderson et al. 1996; Kenworthy and Laube 1999; Holtzclaw et al. 2002). Transportation energy research is outside the scope of this roadmap. However, it must be understood that achieving progress towards urban sustainability is impossible without considering the role of the transportation system that underpins and facilitates development and growth (Cervero 2000). Apart from transportation energy, there is a growing body of research to understand the broad range of social costs and benefits of alternative growth scenarios (Wievel and Schaffer 2001; Burchell 2002; Agyeman and Evans 2003; Sturm and Cohen 2004). There has, however, been remarkably little done to understand the efficiency and impacts of alternative urbanization scenarios on the electricity system.

Yet the expansion of California's metropolitan areas clearly has consequences for the non-transportation energy system. A growing urban footprint implies increased need for electricity and gas delivery infrastructure to areas beyond the reach of existing capital stock. It also results in a need for a variety of other services, such as water provision and wastewater treatment, public buildings, street and stoplights, and road building to serve the newly urbanized areas (Burchell 2002). Demand for these services will directly and indirectly impact energy consumption.

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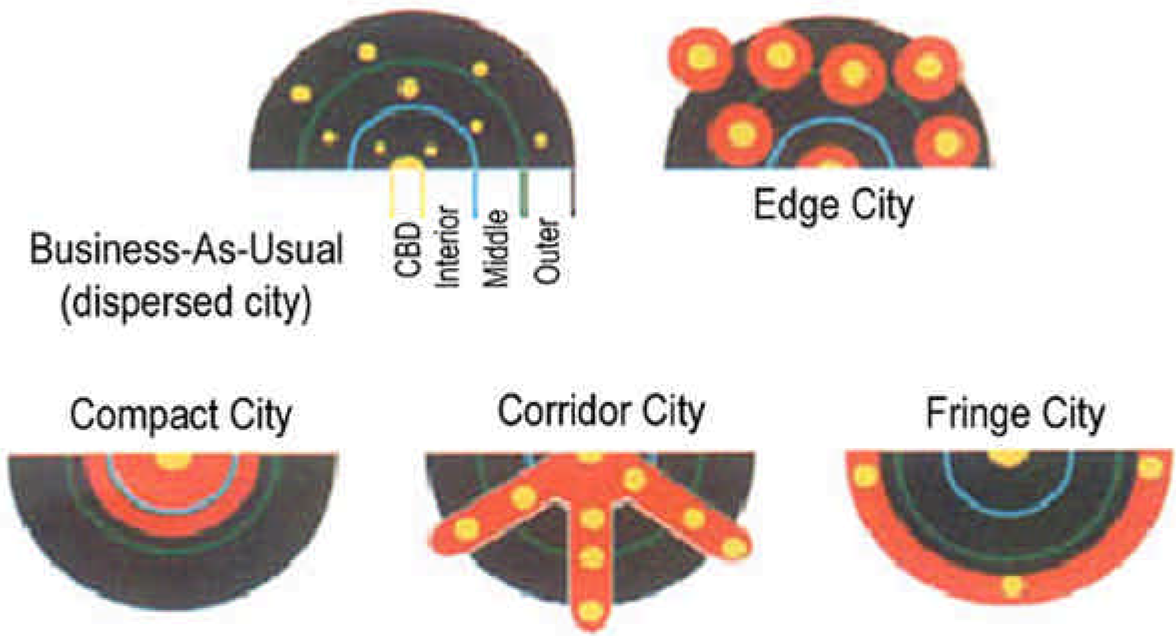
[76] These include residential (dwelling units per acre) and commercial (floor-area ratio) densities.

[77] For example, through indexes that look at the degree of segregation of residential and commercial land uses.

[78] Excess commuting is a product of urban economic theory, which uses information about land-use and the transportation network to calculate optimal travel times based on the spatial distribution of residential and workplace location.



Business-As-Usual	Extrapolation of current sprawling development patterns into the future*
Compact City	Increased population and densities of inner suburbs
Edge City	Increased population, housing densities, and employment at selected nodes within the region that are connected by freeways
Corridor City	Focus on growth along linear corridors emanating from the central business district and supported by public transportation investment
Fringe City	Additional growth predominately at the fringe of the city

* CBD – Central Business District

Source: *Reshaping the Future of Cities,* Ecos (2002)

Figure 9. Alternative urban forms

While it is known that compact and connected urban form reduces the demand for transportation energy, the overall extent of non-transportation energy impacts of urban form and increased densities is uncertain. This occurs in part because there are in fact two issues to consider: (1) the embedded utility energy impact of development alternatives—how much energy it takes to build in a certain way, and (2) the ongoing public and private operational costs of such development patterns.

For the first, it has long been known that typical suburban greenfield development requires greater material inputs for infrastructure than comparable development in an already urbanized area. In 1980 researchers examining new ultra-efficient low-density residential development in Davis, California showed it to have far greater resource needs than their "run of the mill" central city counterparts (McGeough et al. 2004a). In a recent comprehensive national study of the costs and benefits of sprawl, researchers again found similar results for building materials as well as urban services such as water and wastewater provision, roads, and other public services (Burchell 2002). Such cost-benefit analyses have not been examined within the context of utility energy requirements or impacts on the distribution system, leaving policymakers ignorant in this area of their specific development decisions. This also raises important questions about the overall level of energy savings that may be achieved and the efficiency tradeoffs that will be involved in the propagation of "zero energy homes" if they are of a low-density development type.

As for the second issue, while there is evidence that compact development may have positive energy effects, there is a lack of controlled studies on its non-transportation energy effects.[79] Work by Stone and Rodgers (2001) to analyze the urban heat island effect of urban form shows that low-density residential development patterns contribute more radiant heat energy to surface heat island formation than more compact alternatives. Looking specifically at electricity consumption, Lariviere and Lafrance (1999)—using a dataset of the 45 largest cities in Quebec, Canada—showed that electricity consumption would decrease by 7% if the cities with residential densities of less than 360 persons/square mile (mile^2) increased their densities to 1,080 persons/mile^2; the equivalent change would yield a 50% reduction in transportation energy demand. Although the reduction in electricity demand may not be as dramatic as with the transportation energy, it represents almost *half* of the state's targeted reserve margin. However, Quebec province is not readily comparable to California; in 2000, densities in the state's urbanized areas outside of central cities were more than 2,670 persons/mile^2 (U.S. Census Bureau 2000).

Conversely, an examination of densification options for Belfast—Europe's most automobile-dependent city—showed that improperly designed densification alternatives could increase building energy consumption, as increases in noise leads to increased air-conditioning use because building users are more apt to close windows and reduce natural ventilation, while sunlight obstructions force greater use of artificial lighting (Cooper and Smyth 2002). Hui's (2000) analysis of low-energy building options in Hong Kong's dense urban environment reaches similar conclusions and also suggests that care should be taken in promoting densification as an energy efficiency strategy. Steiner (1994) suggests that there may be instances where well-planned, low-density development is preferable, such as in desert climates, to allow for more efficient water management practices through the use of native vegetation and on-site stormwater retention, as well as solar efficient site-design.

Similar studies have not been conducted for California. One study attempted to identify utility energy location efficiency but was unable to find the data to conduct the analysis.[80] Theoretically, the Energy Commission's PLACE^{3}S planning decision support tool[81] will be able to model the data necessary for conducting an analysis of both embedded and operational costs once an energy module is completed. The costs of water supply, treatment, and reclamation are

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79 Personal communication with Dr. David Goldstein, NRDC.

80 From a personal communication with John Holtzclaw, Sierra Club.

81 PLACE^{3}S is an acronym for **PLA**nning for **C**ommunity **E**nergy, **E**conomic and **E**nvironmental **S**ustainability. It is discussed in Section 4.5.1.

not currently planned to be part of the model.[82] According to GTI, which conducted a broad overview of the most popular planning decision support tools, none were found to have the ability to evaluate the non-transportation energy use of alternative planning scenarios.

Research Needs

1. Conduct analyses of utility energy requirements, impacts on the distribution system, and environmental impacts of alternative urban growth scenarios. **(ST)**
2. Develop a methodology and conduct case studies to assess the life cycle energy costs of current and projected growth scenarios throughout California's regions. **(ST)**

4.4.2 Smart Growth

Growth management has been the purview of California's municipal governments for the past century and "smart growth" is the latest response to the concerns about increasing problems in the built environment, such as congestion, long commutes, unaffordable housing, and disappearing open space. Smart growth forms an integral part of the sustainability toolkit along with energy efficiency, yet the two fields have "mostly operated in different worlds" (Friedman 2004).

Local governments have recognized that urban spatial growth and decentralization are today inevitable. Moreover, they have understood that isolated and uncoordinated growth control measures can be locally precise but regionally blunt, locking in sub-optimal land uses and exacerbating the negative impacts of unplanned development by displacing growth to less restrictive areas (Burchell 2002; Landis et al. 2002). A recent analysis of the 2004 election by the Michigan Land Use Institute suggests that smart growth "transcends partisanship."[83]

Smart growth is built on the new urbanist site planning and urban design techniques discussed in Section 4.3.3, with an explicit recognition of the spatial dimension of urban development. Its proponents point to fundamental flaws within the dominant framework of twentieth century urban planning: the segregation of what used to be complementary land uses into separate geographic areas through the mechanism of zoning and subordination of land use to the automobile.

Rather than being a specific and circumscribed development type or a stringent top-down growth control, smart growth is a proxy for an overall concept of development. Its main focus is on minimizing the human spatial and environmental footprint through the infill of already urban but neglected areas with simultaneous protection of unurbanized land. Its elements include the remediation and reuse of contaminated former industrial brownfields, redevelopment of outdated structures and vacant properties, mixed-use projects, higher residential densities, diversity in building and housing types, and multi-stakeholder collaboration in the development of shared regional strategies.[84] It is envisioned as interrelated

[82] From a personal conversation with Nancy McKeever, the Project Manager for the PLACE^{3}S program.
[83] Michigan Land Use Institute. www.mlui.org/growthmanagement/fullarticle.asp?fileid=16773.
[84] Smart Growth Network, www.smartgrowth.org/sgn/default.asp.

scales of development at the neighborhood, citywide, and regional levels that prioritize compact patterns built around existing infrastructure and multi-modal transportation choices (Calthorpe 1993).

4.4.2.1 Neighborhood and City Scale

Many California cities are undertaking smart growth planning efforts (Fresno, Anaheim, Sacramento, and San Diego to name but a few). There also exist a variety of resources for cities wishing to embark on a smart growth path. Many smart growth elements are incorporated into the *Energy Aware Planning Guide* (CEC 1993) and the OPR's *State of California General Plan Guidelines* (2003b). The League of California Cities (LCC) conducts outreach and education to its members and the LGC maintains an extensive library of smart growth literature and offers technical support.

In addition to these California-specific resources, there exists a broad national network of support for smart growth. The American Planning Association (APA) regularly addresses the topic in its journal. The APA has also published a legislative guide to facilitate regulatory changes that remove obstacles to such projects[85] and has analyzed progress towards smart growth on a state-by-state basis.[86] In 2004 the APA adopted an energy policy whose first major initiative is centered on smart growth (APA 2004). The Smart Growth Network (SGN) is a broad-based coalition of real estate industry, social justice, and community development, and environmental organizations that was originally formed with the assistance of the EPA. The Smart Growth Network promotes smart growth best practices, information, innovative policies, tools and ideas among its members and other interested parties. The Congress for New Urbanism (CNU), an advocacy group of professional planners, designers, and architects, maintains an extensive, up-to-date bibliography on the subject, publishes its own research, and provides references for smart-growth-friendly zoning and planning codes that can serve as models for interested cities. Environmental organizations like the Natural Resources Defense Council (NRDC), the Sierra Club, and others also conduct their own independent research and advocacy activities with strong support from private and community foundation funders.

A LEED standard for residential communities, currently under development by the U.S. Green Building Council (USGBC), NRDC and CNU will add momentum to market transformation efforts (Friedman 2004) by providing permitting authorities, private developers, and buyers with objective guideposts for what constitutes smart growth. Stronger linkages between energy and smart growth would significantly contribute to the LCC's local government outreach and education efforts.[87]

A final point to note, however, is that smart growth planning is unlikely to bridge the disconnect between local governments and the transmission infrastructure outside of municipally served service areas, unless the operators of the infrastructure actively engage the

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[85] APA. Growing Smart. www.planning.org/growingsmart/ .

[86] APA. California. www.planning.org/growingsmart/States/California.htm.

[87] Personal communication with Yvonne Hunter, League of California Cities,

local government. Although local governments may be able to take a variety of steps to affect consumption through their planning activities, they are neither in a position nor are they required to plan development or direct investments to strategic transmission infrastructure areas. Paul Richardson, Planning Director for the City of Roseville, noted that the participation of the City's municipal utility in growth planning greatly smoothed their long-term development planning process and helped guide both infrastructure investments as well as overall growth. Moreover, he compared the current situation favorably to his prior experience in an IOU service area.

Research Needs

1. Identify the energy efficiency impacts and opportunities of local smart growth policies and projects. **(ST)**
2. Develop neighborhood and community level smart growth standards that establish and incorporate energy efficiency objectives. **(ST)**

4.4.2.2 Regional Growth Planning

Ultimately, however, isolated local smart growth initiatives are insufficient for affecting regional form without complementary coordination and investment. New urbanist-type development can just as well occur in a distant greenfield linked to services only by automobile and massive infrastructure extensions, as it could in the central urban core or an older suburb where services are already established and new infrastructure needs are fewer. However, this is not a comprehensive approach, and the benefits, although real, will not be as widespread as they could be if efforts were on a regional scale.

Explicit state mandates were used to initiate regional planning in other parts of the country;[88] these do not exist in California. The closest that California comes to state-directed regional planning is with regional fair share housing allocations. According to Barbour (2002) "The 'fair share' requirements represent one of California's most active efforts to direct local planning—specifically, land use planning—toward a substantive policy goal, one that addresses unequal spatial opportunity in metropolitan areas. The Regional Housing Needs Assessment (RHNA) process is used to implement the state's fair share requirements. Under RHNA, the California Department of Housing and Community Development provides a target production number of housing units to a planning agency in each region, generally the Council of Governments, to distribute among all jurisdictions. The jurisdictions are then required to use these 'fair share' targets as the analytical basis for the housing elements of their general plans," which are updated every five years.

However, the absence of a statewide land-use planning framework and the "home rule" proclivities of California's residents on land use have not stopped regional planning efforts from taking shape in the State. California's regional planning efforts have been spurred by fiscal constraints and the quality-of-life impacts of sprawling urbanization. Enabled by a federal

[88] As in Washington, Oregon, Maryland, and New Jersey.

mandate for regional transportation planning, state devolution of transportation planning decisions to countywide authorities, and statewide mandates for regional fair-share housing needs allocations, a variety of regional planning efforts have taken hold (Barbour 2002).

California's largest and most urbanized regions are addressing smart growth and sustainability to one extent or another in their regional planning frameworks. In the nine-county Bay Area, five regional planning agencies joined to investigate smart growth and sustainable development through a Smart Growth Strategy/Regional Livability Footprint project.[89] In the six-county Los Angeles metro area, the Southern California Association of Governments conducted a growth visioning process called Southern California Compass.[90] The Sacramento Area Council of Governments, which also spans six counties, is actively promoting smart growth through its interactive Blueprint process[91] to plan for transportation investments and housing needs, which is described in greater detail in the following subsection.

Energy has been directly addressed in only one plan—the San Diego Regional Comprehensive Plan (SDRCP).[92] The SDRCP is organized along functional areas such as housing, the economy, and urban infrastructure. It treats energy as one of the fundamental components in its infrastructure strategy and sets out targets for indigenous regional production, deployment of renewable resources, energy efficiency, and imported supplies. Overall, the San Diego Association of Governments (SANDAG), which developed the SDRCP, has taken the lead in planning for the region's energy needs.

The lack of energy or GHG emissions as a consideration in regional growth planning is evident in a recent report by the Speaker's Commission on Regionalism (SCR 2002). The report discusses the need for regional decision-making and proposes an array of state-level policies and reforms to enhance regional action in California's most immediate and long-term issues: economic competitiveness, poverty and underemployment, traffic congestion and long commutes, unaffordable housing, and disappearing open space, among others. Neither energy nor CO_2 are mentioned, despite their clear relevance to environmental quality, equity, and economic competitiveness and the necessity of approaching these issues within regional planning framework. A significant cause of this gap is that the current planning structures within which local governments operate, and the analytical requirements to carry out mandated planning objectives are not available to consider such questions.

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89 These agencies are: Metropolitan Transit Commission (transportation), the Association of Bay Area Governments (land use and housing), the Bay Area Air Quality Management District (air quality), the Bay Conservation and Development Commission (bayfront development and bay use), and the Regional Water Quality Control Board (water quality).

90 Southern California Compass, www.socalcompass.org.

91 Sacramento Area Council of Governments, www.sacog.org.

92 The region's energy goals are articulated in detail in the San Diego Regional Energy Plan. It is incorporated by reference into the RCP and forms the basis of its energy section.

Research Needs

1. Develop methodologies and approaches to readily incorporate energy supply and infrastructure analysis into existing regional housing, land-use, and transportation planning processes. **(ST)**

4.5 Crosscutting Issues

Two research topics cut across the issues previously discussed: (1) decision support tools for local and regional planning, and (2) alternative approaches for sustainability planning.

4.5.1 Decision Support Tools

Technology is helping to make both local and region-wide planning processes interactive and visually concrete (Snyder 2001). Pitt, Valkenburg et al. (2003) have examined how the use of a geographic information system (GIS) in an exurban county on the edge of the Minneapolis-St. Paul metropolitan area helped residents develop a shared growth management strategy. The use of GIS has also helped local planners better analyze the solar potential of their respective jurisdictions (Rylatt et al. 2001; Gadsden et al. 2003a; Gadsden et al. 2003b), as well as to evaluate the efficacy of growth management measures (Landis et al. 2002) and forecast regional growth trends and alternatives (Landis and Reilly 2003).

Internet-based connectivity has been an especially useful tool for aiding community participation in planning (Craig 1998) and natural resources management (Kangas and Store 2003). The Sacramento Council of Governments' Regional Blueprint project is utilizing I-PLACE^{3}S, an updated web-based version of the Energy Commission's PLACE^{3}S GIS-based tool, to help citizen planners make informed choices in setting development priorities and reduce the transaction costs of evaluating the impacts of different scenarios.[93] Although the energy focus is weighted towards transportation, participation of the Sacramento Municipal Utility District helps ensure that electricity generation, transmission, and delivery issues are addressed through the process. An earlier version of PLACE^{3}S, without Internet capabilities, has also been integral to other local and regional planning efforts, including those in Los Angeles, San Diego, San Luis Obispo, the Eugene/Springfield area in Oregon, and the Tijuana River Watershed bi-national area. Although PLACE^{3}S is designed to be usable at the neighborhood, city, or regional level, the tool requires significant calibration in order to have accurate predictive capability of transportation-related impacts at multiple scales of development.[94] As noted earlier in Section 4.4.1, the energy costs of water supply, treatment, and reclamation are not currently part of, or planned for, the model.

Research Needs

1. Develop energy cost assessment and environmental impact analysis capability for popular decision support tools, such as PLACE^{3}S. **(ST)**

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[93] PLACE^{3}S. www.energy.ca.gov/places/ .

[94] Personal communication with Dr. John Landis, UC Berkeley.

2. Incorporate findings of investigations into water-energy links discussed in Section 4.2.2 into popular decision support tools such as PLACE^{3}S. **(MT)**

4.5.2 Alternative Planning Approaches

Researchers have tried to integrate the economic, social, and environmental aspects at the core of sustainable development into other types of planning approaches for urban areas where resource flows—rather than functional sectors such as land use or transportation—are the main organizing principle. While these planning efforts are often voluntary exercises and may have only marginal impacts on policy, they are included here in order to recognize the continual evolution of efforts to positively affect the impacts of human activities.

Several notable efforts were identified during the course of this research. Ravetz (2000) describes the whole systems approach used to create an integrated sustainability plan for the Greater Manchester (UK) city-region that looks at the "metabolic" aspects of the city-region as a materials processor. Rotmans (2000) also describes an integrated planning tool—under development for the German city of Maastricht—that serves as both a real-time environmental information system as well as a dynamic planning model.

The Sustainable Silicon Valley project, an effort by a group of public, private, and public interest stakeholders[95] to develop an urban environmental management system for the Silicon Valley region, represents a version of such a planning process.[96] The Southwest Center for Environmental Research and Policy[97] is currently conducting a planning effort for the incorporation of renewable energy resources in the San Diego-Tijuana border region as part of its *Border+20* modeling project.[98]

Research Needs

1. Develop tools to integrate the energy analyses of emerging alternative sustainability and resource planning efforts into existing regional growth planning processes. **(MT)**

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95 Sustainable Silicon Valley, www.calepa.ca.gov/EMS/SiliconEMS/.

96 The group has so far addressed CO_2 emissions and sustainable water management.

97 Southwest Consortium for Environmental Research and Policy. www.scerp.org/.

98 Sustainable and Renewable Energy Resources for the U.S.-Mexico Border Region: Focus on the California- Baja California Border Region. www.scerp.org/scerp/projs/04rpts/E-04-4.htm.

5. Research Goals

The goal of this research is to help California benefit from the energy, environmental, and economic advantages of sustainable urban energy planning.

The achievement of that goal depends on the improvement of the methods, tools, and data used to conduct sustainable urban energy planning. This section addresses the gaps and needs identified in the previous section. These research areas can be grouped into four broad research goals:

1. **Develop a better understanding of the embedded environmental impacts and operational energy needs of urban infrastructure systems and urbanization.** This need is particularly pressing in the cases of the energy profiles of alternative development patterns and alternative water supply and treatment strategies. Because many urban management decisions occur without the benefit of such information, officials are unable to adequately assess the full impact of their decisions.
2. **Demonstrate the local environmental, economic, and equity benefits of sustainable urban energy planning, particularly with respect to the private sector.** Local governments without their own utilities often see energy-related activities—outside of managing their own consumption—as the province of the state or of the investor-owned utilities. Accordingly, they are reluctant to expend their scarce resources in this area or attempt unproven policies with uncertain ends. Scientific assessment of the local programmatic and capital costs, benefits, and impacts of energy-related activities and policies would help local officials make informed decisions regarding these measures, enhancing the likelihood of increased local involvement. Additionally, the largest potential for gains in energy resource efficiency within an urban center lies with the private sector; however, local governments are reluctant to be proactive for various reasons, including the concern of losing business investment.
3. **Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices.** Local officials often face significant constraints and are unable to devote the fiscal, technical, and institutional resources necessary to operate active and effective energy programs. The costs of following certain regulatory processes related to energy issues that are of interest to local governments are extensive, and statewide efforts to coordinate and educate local energy practitioners and promote new local activities are inadequate. And although there exist myriad best-practice manuals, model policies, and case studies, the information is scattered among a variety of disparate sources, lacks extensive evaluation, and is less than comprehensive.
4. **Develop effective decision support tools and methods for sustainable urban energy planning.** Current planning processes do not incorporate energy considerations into their frameworks and the tools and methods used to carry out them out provide no information of their energy-related impacts, harming the ability of local officials and citizens unable take informed steps to smarter energy use in the built environment.

PIER understands that a great deal of work is already under way in a number of these areas and seeks to draw from, build on, broaden the focus of, and synthesize these efforts wherever possible in order to make them relevant for local governments. Below are the short-, mid-, and long-term activities required to achieve these goals.[99] They are listed in decreasing priority as determined by the roadmap's author.

5.1 Short-term Goals

5.1.1 Develop a better understanding of the embedded environmental impacts and operational energy needs of urban infrastructure systems and urbanization

Activities needed:

Water and Wastewater Systems

1. Investigate distributed/decentralized wastewater treatment and reclamation as a more energy efficient design alternative for a long-term infrastructure planning process.
2. Continue PIER activities and research to evaluate the life cycle energy intensity and costs of traditional, decentralized, and other alternative systemic approaches to water delivery and wastewater treatment/reclamation, with an emphasis on savings for local and regional water agencies.
3. Conduct investigations of the whole system benefits of employing conservation strategies and technologies as a means of reducing the energy and environmental costs of interbasin water transfers, with an emphasis on savings for local and regional water agencies.
4. Continue PIER activities and research into the energy profiles and efficiency of emerging advanced water treatment techniques and technologies, with an emphasis on savings for local and regional water agencies.

Critical factors for success:

- Effective interdepartmental coordination and communication between PIER-EA and PIER-IAW.
- Identifying an appropriate water agency partner at an early enough stage of a long-term wastewater infrastructure planning process, to allow an opportunity to analyze a decentralized system alternative.
- Developing accurate energy-intensity profiles for water and wastewater systems throughout California.

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[99] S*hort-term* refers to a 1–3 year time frame; *mid-term* to 3–10 years; and *long-term* to 10–20 years. The activities specified in the roadmap are projected to begin sometime within the designated time frames, and the duration of actual projects may be less than the entire term specified.

- Developing accurate energy profiles of the spectrum of water and wastewater treatment techniques used in California's water systems.

Street and Highway Lighting

5. Determine the composition of the ownership of street and highway lights by local governments, utilities, the state or others; identify appropriate stakeholders; and assess the standards that are used for the deployment of street and highway lights.
6. Conduct research to identify the extent of barriers (e.g., lighting preferences, maintenance, safety, ownership arrangements, and tariff structures) to efficient street lighting technologies.

Critical factors for success:

- Determining the relative importance of streetlight energy use within the context of California's energy goals and local energy-related concerns.

Site Design

7. Conduct comparative studies of different community types to precisely identify the electricity-system-related economic and environmental benefits of alternative urban design and site planning features.

Critical factors for success:

- Obtaining precise data on electricity use across multiple community types and climate zones.

Urban Growth

8. Identify the energy efficiency impacts of local smart growth policies and projects.
9. Conduct analyses of utility energy requirements, impacts on the distribution system, and environmental impacts of alternative urban growth scenarios.
10. Develop methodology and conduct case studies to assess life cycle energy costs of current and projected growth scenarios throughout California's regions.

Critical factors for success:

- Obtaining precise data on electricity use across multiple community types and climate zones.
- Analytically distinguishing between population and urbanization driven energy demand growth.

5.1.2 Demonstrate the local environmental, economic, and equity benefits of sustainable urban energy planning, particularly with respect to the private sector

Activities needed:

1. Conduct studies to identify the environmental, economic, and equity costs and benefits to local governments of mandates and voluntary programs for energy efficiency in new buildings.

2. Conduct comparative empirical studies to evaluate the direct and indirect benefits of high-performance, energy-efficient buildings to owners and tenants.
3. Evaluate the effectiveness, costs, and benefits of local time-of-sale energy-efficiency upgrade mandates in order to improve energy efficiency in existing buildings.

Critical factors for success:

- Developing a comprehensive and robust database of the activities, organizational approach costs, funding streams, and outcomes of local energy programs and policies.
- Developing a robust database of economic and environmental metrics for high performance and traditional buildings to allow for comparative empirical evaluation between them.

5.1.3 Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices

Activities needed:

1. Conduct comparative analyses of organizational and funding models of local energy programs to assist interested local governments in structuring programs and effective partnerships to overcome technical, institutional, and other obstacles to implementing sustainable urban energy planning initiatives and achieving local and state energy goals.
2. Conduct case studies of local government-supported, community-based efforts for energy and water use efficiency.
3. Review California-specific manuals and case studies of energy-efficiency activities in public facilities, to identify information gaps and assess research needs.

Critical factors for success:

- Developing a comprehensive and robust database of the activities, organizational approach costs, funding streams, and outcomes of local energy programs and policies.

5.1.4 Develop effective decision support tools and methods for sustainable urban energy planning

Activities needed:

1. Develop energy cost assessment and environmental impact analysis capability for popular decision support tools, such as PLACE^{3}S.
2. Design sustainable energy indicators to provide benchmarks for local activities and harness local initiatives towards the support of the state's energy goals.
3. Develop neighborhood- and community-level smart growth guidelines that establish and incorporate energy efficiency objectives.

4. Develop methodologies and approaches to readily incorporate energy supply and infrastructure analysis into existing regional housing, land-use, and transportation planning processes.

Critical factors for success:

- Successfully establishing the energy effects and environmental costs and benefits of "traditional neighborhood design" and "smart growth" approaches.
- Effective integration of economic and environmental cost/benefit information from research undertaken in Section 5.1.1 into the PLACE³S database.

Table 1. Short-term goals

Goal	Projected Cost ($)
5.1.1 Develop a better understanding of the embedded environmental impacts and operational energy needs of urban infrastructure systems and urbanization.	
Water and Wastewater Systems	
1. Investigate distributed/decentralized wastewater treatment and reclamation as a more energy efficient design alternative for a long-term infrastructure planning process.	500,000
2. Continue PIER activities and research to evaluate the life cycle energy intensity and costs of traditional, decentralized, and other alternative systemic approaches to water delivery and wastewater treatment/reclamation, with an emphasis on savings for local and regional water agencies.	150,000
3. Conduct investigations of the whole system benefits of employing conservation strategies and technologies as a means of reducing the energy and environmental costs of interbasin water transfers, with an emphasis on savings for local and regional water agencies.	150,000
4. Continue PIER activities and research into the energy profiles and efficiency of emerging advanced water treatment techniques and technologies, with an emphasis on savings for local and regional water agencies.	75,000
Street and Highway Lighting	
5. Determine the composition of the ownership of street and highway lights by local governments, utilities, the state or others; identify appropriate stakeholders; and assess the standards that are used for the deployment of street and highway lights.	150,000
6. Conduct research to identify the extent of barriers (e.g., lighting preferences, maintenance, safety, ownership arrangements, and tariff structures) to efficient street lighting technologies.	75,000
Site Design	
7. Conduct comparative studies of different community types to precisely identify the electricity-system-related economic and environmental benefits of alternative urban design and site planning features.	250,000
Urban Growth	
8. Identify the energy efficiency impacts of local smart growth policies and projects.	250,000
9. Conduct analyses of utility energy requirements, impacts on the distribution system, and environmental impacts of alternative urban growth scenarios.	250,000
10. Develop methodology and conduct case studies to assess life cycle energy costs of current and projected growth scenarios throughout California's regions.	500,000
5.1.2 Demonstrate the local environmental, economic, and equity benefits of sustainable urban energy planning, particularly with respect to the private sector	
1. Conduct studies to identify the environmental, economic, and equity costs and benefits to local governments of mandates and voluntary programs for energy efficiency in new buildings.	200,000
2. Conduct comparative empirical studies to evaluate the direct and indirect benefits of high-performance, energy-efficient buildings to owners and tenants.	200,000
3. Evaluate the effectiveness, costs, and benefits of local time-of-sale energy-efficiency upgrade mandates in order to improve energy efficiency in existing buildings.	200,000

Table 1. Short-term goals (continued)

Goal	Projected Cost ($)
5.1.3 Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices	
1. Conduct comparative analyses of organizational and funding models of local energy programs to assist interested local governments in structuring programs and effective partnerships to overcome technical, institutional, and other obstacles to implementing sustainable urban energy planning initiatives and achieving local and state energy goals.	250,000
2. Conduct case studies of local, government-supported, community-based efforts for energy and water use efficiency.	125,000
3. Review California-specific manuals and case studies of energy-efficiency activities in public facilities, to identify information gaps and assess research needs.	75,000
5.1.4 Develop effective decision support tools and methods for sustainable urban energy planning	
1. Develop energy cost assessment and environmental impact analysis capability for popular decision support tools, such as PLACE^{3}S.	400,000
2. Design sustainable energy indicators to provide benchmarks for local activities and harness local initiatives towards the support of the state's energy goals.	500,000
3. Develop neighborhood- and community-level smart growth guidelines that establish and incorporate energy efficiency objectives.	250,000
4. Develop methodologies and approaches to readily incorporate energy supply and infrastructure analysis into existing regional housing, land-use, and transportation planning processes.	200,000
Total Projected Cost for Short-term Projects	**4,750,000**

5.2 Mid-Term Goals

5.2.1 Develop a better understanding of the embedded environmental impacts and operational energy needs of urban infrastructure systems and urbanization

Activities needed:

1. Evaluate findings of activities undertaken in pursuit of short-term goals and assess which urban infrastructure systems and aspects of urban growth warrant continued investigation.
2. If earlier research demonstrates that more efficient street and highway lights would reduce typical municipal energy use and barriers can be overcome, conduct research of (a) efficient street and highway lighting and control technologies, with an emphasis on reducing operating costs for energy and maintenance, (b) replacing bulbs based on mean lumen equivalents rather than on a watt-for-watt basis, and (c) safety concerns.

3. Conduct mid-term review of current efforts to identify urban air quality impacts of DG, CHP, and district heating deployment scenarios.

5.2.2 Demonstrate the local environmental, economic, and equity benefits of sustainable urban energy planning, particularly with respect to the private sector

Activities needed:

1. Evaluate findings of activities undertaken in pursuit of short-term goals and determine whether an information update is warranted.
2. Monitor the development of projects such as EEBPP and CALeep to determine whether further comparative analyses of the effectiveness of California's local government energy programs are warranted.
3. Conduct analysis of the environmental, economic, and equity costs and benefits of local government support for DG, CHP, and district heating.

5.2.3 Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices

Activities needed:

1. Evaluate findings of activities undertaken in pursuit of short-term goals and determine whether an update of information is warranted.
2. Conduct mid-term evaluation of local community choice aggregation efforts.
3. Conduct mid-term evaluation of local government energy-planning activities to examine the circumstances under which local and regional governments are best equipped to provide energy-related services.
4. Conduct mid-term review of current efforts to resolve energy system interconnection issues for DG resources.

5.2.4 Develop effective decision support tools and methods for sustainable urban energy planning

Activities needed:

1. Evaluate the accuracy and widespread applicability of PLACE^{3}S energy module, calibrating the model as needed.
2. Incorporate findings of water system energy intensity investigations into popular decision support tools such as PLACE^{3}S.
3. Develop model guidelines for ultra-energy-efficient building standards, urban design and site planning, and growth management that incorporate the findings of relevant research noted in Sections 5.1.1 and 5.1.2.

4. Continue efforts to develop methodologies and approaches to readily incorporate energy supply and infrastructure analysis into regional housing, land-use, and transportation planning processes.
5. Develop tools to integrate the energy analyses of emerging alternative sustainability and resource planning efforts into existing regional growth-planning processes.

5.3 Long-Term Goals

5.3.1 Develop a better understanding of the embedded environmental impacts and operational energy needs of urban infrastructure systems and urbanization

Activities needed:

1. Continue to monitor progress in pursuit of mid-term goals and determine whether further research, refinement, or policy development is warranted.

5.3.2 Demonstrate the local environmental, economic, and equity benefits of sustainable urban energy planning, particularly with respect to the private sector

Activities needed:

1. Continue to monitor progress in pursuit of mid-term goals and determine whether further research, refinement, or policy development is warranted.

5.3.3 Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices

Activities needed:

1. Continue to monitor progress in pursuit of mid-term goals and determine whether further research, refinement, or policy development is warranted.

5.3.4 Develop effective decision support tools and methods for sustainable urban energy planning

Activities needed:

1. Continue to monitor progress in pursuit of mid-term goals and determine whether further research, refinement, or policy development is warranted.

6. Leveraging Research and Development Investments

The research direction proposed in the roadmap represents an opportunity to support local governments in their efforts to become effective agents of sustainable energy practices. It does so by deepening the knowledge required for informed and efficient policymaking and by helping to make the sustainable energy planning process and decisions less burdensome for planners, citizens, and policymakers. It is also exploratory, in that it will provide a more thorough understanding of the extent to which local government efforts can achieve environmental and overall energy system goals through their sustainable urban energy planning activities.

6.1 Methods of Leveraging

Work on many of the elements that can be collectively considered *sustainable urban energy planning* spans a broad range of fields that have been (and continue to be) funded by a variety of public agencies, private foundations, and to some extent, industry associations. As a result, there may be opportunity to draw public and private support for the recommended research through existing funding programs across the spectrum of fields. Graduate students throughout California may be able to accomplish a significant portion of the research. PIER-EA could either co-fund projects by other PIER groups, other research organizations, or use outside funds to support its efforts. Additionally, PIER-EA funding of the suggested research should be considered “seed money.” That is, successful execution, with PIER-EA support, of the research topics proposed here is very likely to lead to new or intensified interest and support from other programs and entities.

6.2 Opportunities

New funding sources may likely be tapped and new research collaborations developed to supplement existing PIER programs and other traditional supporters of energy-related research such as DOE, EPA, EPRI, and AwwaRF. Smart-growth-related work obtains extensive support from the other federal agencies (such as the Department of Transportation), as well as from private foundations and the building industry. Efforts to strengthen links between smart growth and non-transportation energy efficiency may find assistance from these funders and research. Discussions of potential collaborative projects have not been held with prospective funding partners.

7. Areas Not Addressed by This Roadmap

This roadmap does not contain a recommended research area that is specific to the transportation or natural gas sector.[100] It should be noted, however, that transportation and natural gas are integral elements of urbanization and regional-development-related research. More generally, transportation issues will have a prominent place in any energy sustainability strategy in California. Implementation of work recommended in this roadmap should be coordinated with ongoing research and policy work on transportation by the Energy Commission, CARB, and other state agencies, academic institutions, and non-governmental organizations.

7.1 Outside Reviewers' Additional Research Suggestions that This Roadmap Did Not Address in Detail

During the course of finalizing this roadmap, the author received reviews from many individuals and organizations. Where possible, the suggestions, comments, and recommendations have been incorporated into appropriate sections within the roadmap, including research needs. Some suggestions were not incorporated for various reasons, including: the inadequacy of resources to investigate the points in sufficient detail to include them in the roadmap, the need for major restructuring of the roadmap to address the suggestions, the suggestions fell outside the roadmap's scope, or the suggestion fell outside of PIER's mandate. In an effort to ensure that these points are not missed, they are listed below. Future efforts in the area of sustainable urban energy planning may wish to consider these points in greater detail. Please note that these suggestions are NOT listed in order of priority.

- Instead of the four broad research categories used in the roadmap, divide the roadmap research goals into the following three categories:
    a. Efficiency/buildings/lighting and other efficiency programs.
    b. Models, mapping, tools and other quantitative approaches.
    c. Local government policy regarding energy use and generation.
- Identify how changes in the scale and location of electricity generation could affect local governments and how local governments/regional assemblies of local governments could affect the scale and location of electricity generation.
- Better understand the planning contexts for local jurisdictions and electricity planners, so that research and support tools will be effective. This includes linking planning tools and research to utility and community needs. Where applicable, it may be helpful if this is done as part of the long-term electric utility resource planning processes undertaken

[100] The Energy Commission received approval to develop a Public Interest Natural Gas Research Program that will allow for research concerning natural gas issues. As this program develops, future PIER-EA efforts in the area of SUEP may be expanded to include issues associated with natural gas.

under the auspices of the CPUC[101] and the Energy Commission's Integrated Energy Policy Report process.[102] Additionally, there is a need to document jurisdictional and planning frameworks in local communities and among electricity providers.

- Identify the specific characteristics of communities that are more willing and able to make energy efficiency decisions, how they make those decisions, and why. Identify new measures and implementation strategies with greater potential to contribute to sustainable urban energy planning.
- Identify how the public and private sectors of urban areas use energy. Develop an organizational framework that could be used to feed the data and the analysis into a model.
- Conduct research to estimate the benefits of sustainable urban energy planning to cities.
- Research ways for cities to implement effective district heating and cooling.
- Identify electricity significance criteria for the California Environmental Quality Act (CEQA).
- Conduct an analysis of whether or not transmission lines induce growth. Better identify the true drivers for growth.
- Prepare a case study of the San Diego REO experience, SACOG, and others that identifies their evolution and the implementation mechanisms that were successful.[103] The general topic being regional energy planning frameworks and processes.
    - Describe the pros and cons of the various approaches and recommend changes that might improve the process for others.
    - Discuss how lessons learned could be applied in other regions/communities.
    - For the SDREO Study Include:
        - A historical review of the evolution of the 1978, 1984, and 1994 energy plans.
        - Major focus on the process that led to the most recent 2003 Regional Energy Strategy, which included a detailed Energy Infrastructure Study,

[101] This is currently being undertaken under Rulemaking R-04-04-003. The full proceeding can be found at http://www.cpuc.ca.gov/proceedings/R0404003.htm.

[102] The IEPR planning process can be accessed at http://www.energy.ca.gov/energypolicy/index.html.

[103] Note: This research suggestion ties in with Short-term Goal 5.1.3 (Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices), Project #1: Conduct comparative analyses of organizational and funding models of local energy programs to assist interested local governments in structuring programs and effective partnerships to overcome technical, institutional, and other obstacles to implementing sustainable urban energy planning initiatives and achieving local and state energy goals.

public input process, and eventually the formation of an Energy Working Group through the San Diego Association of Governments.

- Identify ways that the Governor's Executive Order S-20-4[104] can support green building practices throughout the building industry supply chain and positively affect the public's perception of green building practices.
- Identify what makes for energy efficiency leadership at the local level.
  - Conduct research on the profile of leadership, both elected and staff.
  - Research the role of the champion and how to replicate.
- Develop initiatives in tandem with the Energy Commission phase one roll-out of *Zero Energy Homes*[105] that involve near-term partnerships between the home building industry and local governments.
- Conduct research that identifies how best to target urban programs—geographically, demographically, and technically.[106] This could include, for example, considering ways to maximize efficiency/sustainability benefits by focusing on areas of distributed congestion. If equity or environmental justice is the greatest concern, then "poverty pockets" might be the subject of particular focus.
- Consider setting basic technological goals and study the costs and benefits of these goals—such as retiring all pre-1996 refrigerators by 2010. If research shows that goals would result in cost-effective benefits, recommend adoption of these goals.[107] A least-cost curve of such strategies could be illuminating, depending on what goals are of interest. And highlighting "value-of service" differences–such as higher rates of outages, or higher demand for reliable service–as well as a description of flexible, small-scale, set of generation alternatives may valuable.

[104] The Executive Order was issued December 14, 2004 and named the California Green Building Action Plan. Its full text can be found at www.governor.ca.gov.

[105] http://www.energy.ca.gov/pier/renewable/new_activities.html For additional information on Zero Energy Homes see http://www.consumerenergycenter.org/pv4newbuildings/archdesign.html.

[106] Note: This research suggestion also ties in with Short-term Goal 5.1.3 (Develop information and materials that lead to a better understanding of local and regional sustainable urban energy planning options and practices), Project #1: Conduct comparative analyses of organizational and funding models of local energy programs to assist interested local governments in structuring programs and effective partnerships to overcome technical, institutional, and other obstacles to implementing sustainable urban energy planning initiatives and achieving local and state energy goals.

[107] Note: This research suggestion ties in with Short-term Goals 5.1.4 (Develop effective decision support tools and methods for sustainable urban energy planning). See Project #2: Design sustainable energy indicators to provide benchmarks for local activities and harness local initiatives towards the support of the state's energy goals, and Project #3: Develop neighborhood and community level smart growth guidelines that establish and incorporate energy efficiency objectives.

- Where possible, research should consider ways to best to integrate energy programs with other urban challenges. For example:
    - Food waste to energy could provide multiple urban benefits.
    - Energy efficiency and job creation provides another linkage.
    - Reducing energy costs to small businesses as a means to increase economic sustainability.
    - Tree shading and other vegetation strategies can reduce the need for heating and cooling.
- Develop concepts for accommodation of emerging sustainable energy technologies—developing design concepts that prepare structures for future technologies. California can expect an explosion of lower-cost, higher-performance clean energy and energy efficient technologies and should begin to design new structures to accommodate these technologies. This includes PV and solar thermal technology, LED lights, and expanded distributed generation.
- Develop packaged plug-and-play concepts utilizing technologies from multiple Energy Commission program offices while addressing multiple concerns for the State of California and cities. Examples of such concepts include, but are not limited to, combined water treatment and packaged power systems and modular biomass gasification systems.
- Develop creative approaches to regulations, utility rates, and codes and standards that maximize the rate of return on investments in and stimulate market demand for cleaner, more-efficient technologies and practices.
- Develop specific technology integration plans for alternative fuels, distributed energy, energy efficiency, electric grid utilization, and other targeted programs. This includes identifying specific penetration goals, deployment strategies, standard designs, procurement specifications, and financing mechanisms.
- Establish partnerships with several cities to create incubation labs to test and enhance research recommendations and results. These cities will become models for others to tour and see firsthand, the benefits of sustainable energy planning, design and development.
- Develop plug-and-play concepts for all new construction and targeted retrofits utilizing technologies from multiple Energy Commission program offices.
- Develop standards and energy rates that encourage energy-smart development and public choice, relative to alternative energy consumption options.
- With the large level of support for DG research and development at the state level, and where implementation naturally occurs at the local and regional levels, determine if and how the state is ready for the potentially significant changes that this support will affect in the next ten or so years. Assess the readiness of local and regional governments for this change. It appears that most local governments are not ready for such a change;

better understand local governmental policy for energy use and generation and the state's role in relation to it.

8. References

2002. ”Reshaping the Future of Cities.” *Ecos* (118): 8–9.

Agyeman, J., and T. Evans. 2003. ”Toward just sustainability in urban communities: Building equity rights with sustainable solutions." *Annals of the American Academy of Political and Social Science* 590: 35.

Allison, J. E., and J. Lents. 2003. *The Four ”E's“ of Distributed Generation Policy in California: Energy, Environment, Economics, and Education.* California Energy Commission PIER.

Anderson, S., et al. 1992. *Sustainable Energy: A Local Government Planning Guide for a Sustainable Future.* Urban Consortium Energy Task Force.

Anderson, W. P., et al. 1996. ”Urban Form, Energy and the Environment: A Review of Issues, Evidence and Policy.” *Urban Studies* 33(1): 7–35.

APA. 2004. *American Planning Association Energy Guide.* Chicago, Ill., American Planning Association.

Bajura, R. 2002. ”The Energy-Environment Nexus.” *The Bridge* 32(2): 11–17.

Barbour, E. 2002. *Metropolitan Growth Planning in California, 1900–2000.* Public Policy Institute of California.

Barbour, E., and M. Teitz. 2001. *A Framework for Collaborative Regional Decision-Making.* Public Policy Institute of California.

Barret, J. P., and J. A. Hoerner. 2002. *Clean Energy and Jobs: A Comprehensive Approach to Climate Change and Energy Policy*. Economic Policy Institute and Center for a Sustainable Economy.

Bender, S., et al. 2003. *Energy Efficiency and Conservation: Trends and Policy Issues.* California Energy Commission.

Bluestein, J., et al. 2002. *The Impact of Air Quality Regulations on Distributed Generation.* National Renewable Energy Laboratory.

Blumstein, C., et al. 2003. *Who Should Administer Energy-Efficiency Programs?* UC Berkeley Energy Institute.

Burchell, R. W. 2002. *Costs of sprawl - 2000.* National Research Council Transportation Research Board.

Burke, J. E. 2003. *The Challenge To Involve Local Government in California Electricity Policy.* Public Policy Institute of California.

Butera, F. M. 1998. ”Moving towards municipal energy planning - the case of Palermo: The importance of non-technical issues.” *Renewable Energy* 15(1-4): 349–355.

Calthorpe, P. 1993. *The Next American Metropolis: Ecology, Community, and the American Dream*. New York: Princeton Architectural Press.

Cameron, J. I. 1991. "Policies for achieving ecologically sustainable development." *The Science of The Total Environment* 108(1-2): 71–86.

Capello, R., et al. 1999. *Sustainable Cities and Energy Policy*. Berlin: Springer-Verlag.

Cassidy, R. 2003. *White Paper on Sustainability*. Building Design & Construction Magazine.

CEC. 1993. *Energy Aware Planning Guide, Part I.* California Energy Commission.

---. 2003. *Integrated Energy Policy Report.* California Energy Commission.

---. 2004. *Energy Savings Opportunities for Existing Buildings.* California Energy Commission.

CEC et al. 2003. *California Energy Action Plan.* California Energy Commission, California Public Utilities Commission, and the California Power Financing Authority.

Cervero, R. 2000. Transport and Land Use: Key Issues in Metropolitan Planning and Smart Growth. Berkeley, Cal., The University of California Transportation Center.

Clemmer, S., et al. 2001. *Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future.* Union of Concerned Scientists.

Cohen, R., et al. 2004. *The Energy Down the Drain: The Hidden Costs of California's Water Supply*. Natural Resources Defense Council and Pacific Institute.

Cooper, J. T. R., and A. Smyth. 2002. "Energy trade-offs and market responses in transport and residential land-use patterns: Promoting sustainable development policy." *Urban Studies* 38(9): 1573–1588.

Cormio, C., et al. 2003. "A regional energy planning methodology including renewable energy sources and environmental constraints." *Renewable and Sustainable Energy Reviews* 7(2): 99–130.

Craig, W. J. 1998. "The Internet aids community participation in the planning process." *Computers, Environment and Urban Systems* 22(4): 393–404.

Dale, L., et al. 2003. Electricity Price and Southern California's Water Supply Options. Lawrence Berkeley National Laboratory.

Dickinson, M. A. 2000. *Water Efficiency Case Studies from California: The reservoir that toilets built.* California Urban Water Conservation Council.

Didden, M. H., and W. D. D'haeseleer. 2003. "Demand Side Management in a competitive European market: Who should be responsible for its implementation?" *Energy Policy* 31(13): 1307–1314.

EPRI. 1999. *Electricity Technology Roadmap Initiative.* Electric Power Research Institute.

Florida, R. L. 2002. *The rise of the creative class: And how it's transforming work, leisure, community and everyday life.* New York: Basic Books.

Friedman, N. 2004. *Energy and Smart Growth: It's About How and Where We Build.* Funders' Network for Smart Growth and Livable Communities.

Gadsden, S., et al. 2003a. "Putting solar energy on the urban map: A new GIS-based approach for dwellings." *Solar Energy* 74(5): 397–407.

---. 2003b. "Predicting the urban solar fraction: A methodology for energy advisers and planners based on GIS." *Energy and Buildings* 35(1): 37–48.

Garreau, J. 1991. *Edge city: Life on the new frontier*. New York: Doubleday.

Gellings, C. W., and R. J. Lordan. 2004. "The Power Delivery System of the Future." *The Electricity Journal* 17(1): 70–80.

Gilliland, M. W., and L. C. Wesley. 1983. "Energy planning at the local level." *Resources and Conservation* 8(3): 253–269.

Gleick, P. H., et al. 2003. *Waste Not, Want Not: The Potential for Urban Water Conservation in California.* Pacific Institute.

Hanak, E., and A. Simeti. 2004. *Water Supply and Growth in California: A Survey of City and County Land-Use Planners.* Public Policy Institute of California.

Holtzclaw, J., et al. 2002. "Location Efficiency: Neighborhood and Socio-Economic Characteristics Determine Auto Ownership and Use—Studies in Chicago, Los Angeles and San Francisco." *Transportation Planning and Technology* 25(1): 1–27.

Horner, M. W. 2002. "Extensions to the concept of excess commuting." *Environment and Planning* 34: 543–566.

Hui, S. C. M. 2000. Low Energy Building Design In High Density Urban Cities. *World Renewable Energy Congress VI submissions.* Brighton, UK.

Kammen, D. M., et al. 2004. *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* Renewable and Appropriate Energy Laboratory, University of California, Berkeley.

Kangas, J., and R. Store. 2003. "Internet and teledemocracy in participatory planning of natural resources management." *Landscape and Urban Planning* 62(2): 89–101.

Kats, G., et al. 2003. *The Costs and Financial Benefits of Green Buildings.* California Green Buildings Task Force.

Kelly, S. G. 1997. "Municipalization of electricity: The allure of lower rates for bright lights in big cities." *Natural Resources Journal* 1(37): 43–58.

Kenworthy, J., and F. Laube. 1999. "A global review of energy use in urban transport systems and its implications for urban transport and land-use policy." *Transportation Quarterly* 53(4): 23.

Landis, J., et al. 2002. *Growth Management Revisited: A Reassessment of its Efficacy, Price Effects and Impacts on Metropolitan Growth Patterns.* UC Berkeley Institute for Urban and Regional Development.

Landis, J., and M. Reilly. 2003. *How Will We Grow? Baseline Projections of the Growth of California's Urban Footprint through the Year 2100.* UC Institute for Urban and Regional Development.

Lang, R., and J. Lounds. 1979. *Information Resources for Municipal Energy Planning.* York University.

Lariviere, I., and G. Lafrance. 1999. ”Modelling the electricity consumption of cities: Effect of urban density.” *Energy Economics* 21(1): 53–66.

Lash, J. 1999. ”Sustainable Communities.” *The Bridge* 29(4): 15–18.

LGC. 2003. *Action Plan for California Local Energy Programs.* Local Government Commission.

Lippe, P., Ed. 2003. *Lessons Learned: High Performance Buildings.* New York: Earth Day New York.

Littlefair, P. 1998. ”Passive solar urban design: Ensuring the penetration of solar energy into the city.” *Renewable and Sustainable Energy Reviews* 2(3): 303–326.

Longmore, J., and J. Musgrove. 1983. ”City development and planning as aids to transport system design and energy conservation.” *Habitat International* 7(3-4): 89–98.

Lovins, A. B. 1976. ”Energy Strategy: The Road Not Taken?” *Foreign Affairs* 55(1): 65–96.

Lovins, H. 2004. ”Lovins Spoonful: Interview with Hunter Lovins.” *Grist Magazine.*

Lutzenhiser, L., and N. W. Biggart. 2001. *Market Structure and Energy Efficiency: The Case of New Commercial Buildings.* California Institute for Energy Efficiency.

Lutzenhiser, L., and K. Janda. 1999. *Residential New Construction: Market Transformation Research Needs.* California Institute for Energy and the Environment.

Lynch, L., and M. Kahn. 2000. *Summer 2000 Report to Governor Davis regarding California's Electric System.* California Public Utilities Commission.

Martinez-Alier, J. 2003. ”Scale, Environmental Justice, and Unsustainable Cities.” *Capitalism, Nature, Socialism* 14(4): 43.

McGeough, U., et al. 2004a. *A Blueprint for Urban Sustainability: Integrating Sustainable Energy Practices into Metropolitan Planning.* Gas Technology Institute.

---. 2004b. *Model for Sustainable Urban Design.* Gas Technology Institute.

McGranahan, G., and D. Satterwhaite. 2003. ”Urban Centers: An Assessment of Sustainability.” *Annual Review of Environmental Resources* 28: 243–274.

Means , E. I. 2004. *Water and Wastewater Industry Energy Efficiency: A Research Roadmap.* Awwa Research Foundation and California Energy Commission.

Miller, C. 2003. ”Selling sustainability.” *Facilities Design & Management* 22(2): 24.

Miller, R., et al. 2002. *2002–2012 Electricity Outlook Report.* California Energy Commission.

Moughtin, C. 1996. *Urban design: Green dimensions*. Boston: Oxford.

Naess, P. 2001. ”Urban planning and sustainable development.” *European Planning Studies* 9(4): 503.

Nakafuji, D. Y., et al. 2002. *Wind Performance Survey 2000–2001.* California Energy Commission.

Nelson, V. 2003. *Soft Path Integrated Water Resource Management: Training, Research, and Development Needs.* National Decentralized Water Resources Capacity Development Project. Washington University.

Nijkamp, P. 1994. *Sustainable City Initiatives in Europe*. London: Earthscan Publications.

Nijkamp, P., and G. Pepping. 1998. "A meta-analytical evaluation of sustainable city initiatives." *Urban Studies* 35(9): 1481–1501.

Nye, D. 1998. *Consuming Power: A social history of American energies*. Cambridge, Mass.: MIT Press.

OPR. 2003a. *Environmental Justice in California State Government*. Governor's Office of Planning and Research.

---. 2003b. *State of California General Plan Guidelines*. Governor's Office of Planning & Research.

O'Sullivan, T., et al. 1993. *Intervention Strategies for Energy Efficient Municipal Buildings: Influencing Energy Decisions Throughout Buildings' Lifetimes*. Energy Task Force of the Urban Consortium for Technology Initiatives and the City & County of San Francisco.

Pan, A., and R. Wetherall. 2004. *2003 Net System Power Calculation*. California Energy Commission.

Pitt, D. G., et al. 2003. Socially Constructed Environmental Assessments for Smart Growth Planning. 2003 Public Participation GIS Conference.

PLEA. 1998. *Proceedings of PLEA 98*. Environmentally Friendly Cities: Passive and Low Energy Architecture, 1998, Lisbon, Portugal: James & James (Science Publishers) Ltd.

Qlerup, B. 2000. "Scale and Scope in Municipal Energy Planning in Sweden." *Journal of Environmental Planning and Management* 43(2): 205–220.

Ravetz, J. 2000. *City-region 2020: Integrated planning for a sustainable environment*. London: Earthscan.

Rawson, M. 2004. *Distributed Generation Costs and Benefits Issue Paper*. California Energy Commission.

Roberts, T., et al. 2002. *California Planner's Book of Lists*. Governor's Office of Planning and Research.

Rotmans, J., et al. 2000. "An integrated planning tool for sustainable cities." *Environmental Impact Assessment Review* 20(3): 265–276.

Rylatt, M., et al. 2001. "GIS-based decision support for solar energy planning in urban environments." *Computers, Environment and Urban Systems* 25(6): 579–603.

Sanstad, A. 2003. *The Economics of Climate Change Mitigation and Adaptation in California*. California Energy Commission, Public Interest Energy Research - Environmental Area.

SCR. 2002. *The New California Dream: Regional Solutions for the 21st Century*. Speaker's Commission on Regionalism.

Snyder, K. 2001. "Decision Support Tools for Community Planning." *Public Management* 83(10): 4–8.

Song, Y. 2003. *Impacts of Urban Growth Management on Urban Form: A Comparative Study of Portland, Oregon, Orange County, Florida and Montgomery County, Maryland.* National Center for Smart Growth Research and Education.

Steiner, F. 1994. ”Sprawl can be good.” *Planning* 60(7): 14.

Stone, B. J., and M. O. Rodgers. 2001. ”Urban form and thermal efficiency: How the design of cities influences the urban heat island effect.” *Journal of the American Planning Association* 67(2): 186–199.

Sturm, R., and D. A. Cohen. 2004. ”Suburban sprawl and physical and mental health.” *Public Health* 118(7): 488–496.

Vaitheeswaran, V. V. 2003. *Power to the People.* New York: Farrar, Straus and Giroux.

Weare, C. 2003. *The California Electricity Crisis: Causes and Policy Options.* Public Policy Institute of California.

Wievel, W., and K. Schaffer. 2001. ”Learning to Think As A Region.” *European Planning Studies* 9(5): 593–611.

Wilkinson, R. 2000. *Methodology for Analysis of the Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures.* Ernest Orlando Lawrence Berkeley Laboratory and California Institute for Energy Efficiency.

Zakkour, P. D., et al. 2002. ”Developing a sustainable energy strategy for a water utility. Part II: A review of potential technologies and approaches.” *Journal of Environmental Management* 66(2): 115–125.

Table of Abbreviations

ABAG	Association of Bay Area Governments
AwwaRF	American Water Works Association Research Foundation
CALeep	California Local Energy Efficiency Project
CARB	California Air Resources Board
CCA	Community choice aggregation
CHP	Combined heat and power
CDBG	Community Development Block Grant
CNU	Congress for New Urbanism
CPUC	California Public Utilities Commission
DG	Distributed generation
DOE	U.S. Department of Energy
EEBPP	Energy Efficiency Best Practices Project
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
FERC	Federal Energy Regulatory Commission
GHG	Greenhouse gas
GTI	Gas Technology Institute
GWh	Gigawatt hours
HERS	Home energy rating system
IOU	Investor-owned utility
ISO	Independent System Operator
kWh	Kilowatt hours
LBNL	Lawrence Berkeley National Laboratory
LED	Light-emitting diode
LEED	Leadership in Energy and Environmental Design
LCC	League of California Cities
LGC	Local Government Commission
MELA	Mothers of East Los Angeles
MW	Megawatt
NRDC	Natural Resources Defense Council
OPR	Governor's Office of Planning and Research
PGC	Public Goods Charge
PIER	Public Interest Energy Research
RHNA	Regional Housing Needs Assessment
RPS	Renewable portfolio standard
SACOG	Sacramento Area Council of Governments
SANDAG	San Diego Council of Governments
SCAG	Southern California Council of Governments
SDREO	San Diego Regional Energy Office
TND	Traditional neighborhood design
USGBC	U.S. Green Building Council
ZEH	Zero Energy Home

Appendix A Relevant Research Resources

Government

California Air Resources Board	www.arb.ca.gov
California Energy Commission	www.energy.ca.gov
California Public Utilities Commission	www.cpuc.ca.gov
International City/County Management Association	www.icma.org
Lawrence Berkeley National Laboratory	www.lbl.gov
National Renewable Energy Laboratory	www.nrel.gov
U.S. Department of Energy	www.doe.gov
U.S. Department of Transportation	www.dot.gov

Public Interest and Professional Organizations

American Council for an Energy Efficient Economy	www.aceee.org
American Planning Association	www.planning.org
Building Code Assistance Project	www.bcap-energy.org
Economic and Environmental Study Institute	www.eesi.org
Flex Your Power	www.flexyourpower.org
Funders Network for Smart Growth and Livable Communities	www.fundersnetwork.org/
International Council for Local Environmental Initiatives	www.iclei.org
Local Government Commission	www.lgc.org
Natural Resources Defense Council	www.nrdc.org
Redefining Progress	www.rprogress.org
San Francisco Community Power Cooperative	www.sfpower.org
Sierra Club	www.sierraclub.org
Smart Growth Network	www.smartgrowth.org
U.S. Green Building Council	www.usgbc.org

University Research Programs

UC Berkeley Institute for Urban and Regional Development	http://www-iurd.ced.berkeley.edu/
National Center for Smart Growth Research and Education	www.smartgrowth.umd.edu/
UC Berkeley Renewable and Appropriate Energy Laboratory	http://socrates.berkeley.edu/~rael/
UC Energy Institute	http://www.ucei.berkeley.edu/
UC Riverside Edward J. Blakely Center for Sustainable Suburban Development	http://cssd.ucr.edu/
UC Santa Barbara Donald Bren School of Environmental Science & Management Water Policy Program	http://www.bren.ucsb.edu/
University of Southern California Keston Institute for Infrastructure	http://www.usc.edu/schools/sppd/lusk/keston/research/index.html

Private Research Institutes

Electric Power Research Institute	www.epri.com
American Water Works Research Foundation	www.awwarf.org
Gas Technology Institute	www.gastechnology.com
Pacific Institute	www.pacinst.org
Public Policy Institute of California	www.ppic.org
RAND Corporation	www.rand.org
Rocky Mountain Institute	www.rmi.org

Appendix B Interviewees

Organization	Interviewees
California Energy Commission	Martha Brook, Pramod Kulkarni, Virginia Lew, Todd Lieberg, Nancy McKeever, Marla Mueller, Joe O'Hagan, Jason Otra, Mark Rawson, Elaine Sison-Lebrilla, Amanda Stenick, Alan Ward, Kate Zocchetti.
Center for a New American Dream	Naomi Friedman
City of Berkeley	Stephen Barton, Neil DeSnoo, Gil Friend, Dan Walters
City of Brentwood	Mike Merizon, Howard Sword
City of Chico	Dan Nguyen-Tan
City of Chula Vista	Mike Meecham
City of Fresno	Sarah Gerster, Karrana Hattersly-Drayton, Darrel Unruh, Nick Yovino
City of Pleasanton	Robin Eisenwinter, Craig Perkins,
City of Roseville	Carla Johannsen, Kevin Payne, Paul Richardson
City of San Francisco	Greg Asay, Jesse Blout, Calvin Broomhead, Ed Smellof
City of San Jose	Walter Lin, Laurel Prevetti, Mary Tucker
City of Santa Monica	Stuart Cooley, Susan Munves
County of Kern	Ted White
County of Marin	Gwen Johnson, Sam Ruark
League of California Cities	Yvonne Hunter
Local Government Commission	Patrick Stoner
Natural Resources Defense Council	David Goldstein
Public Policy Institute of California	Jim Burke, Mike Teitz
Real Energy	John Paul, Tom Adams
Sacramento Council of Governments	Mike McKeever
San Diego Association of Governments	Bob Leiter
San Diego Regional Energy Office	Scott Anders, Susan Freedman, Jason Knight, Dave Weil
San Francisco Community Power Co-operative	Steven Moss
University of California Santa Barbara	Robert Wilkinson
University of California Office of the President—California Institute for Energy and Environment	Carl Blumstein