

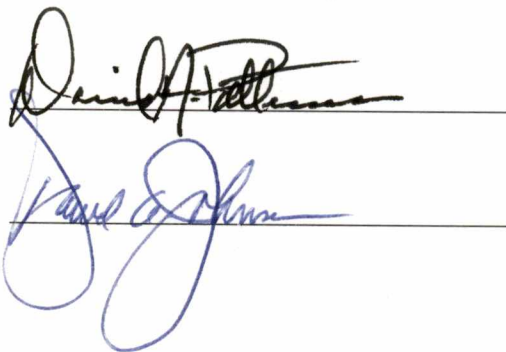
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**ENERGY PLANNING:
LOCAL FRAMEWORK TOWARDS SUSTAINABILITY**

A Thesis
Presented for the
Master of Science in Planning
Degree
The University of Tennessee, Knoxville

Motoko Shimizu

December, 1994

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DEDICATION

This thesis is dedicated to all the people who have helped me,
and especially to my grandmother

Mrs. Miyae Kishi

(岸 みやえ)

and my parents

Dr. Shojiro Shimizu

(清水 正二郎)

and

Mrs. Tomiko Shimizu

(清水 登美子)

who have given me moral support and invaluable educational opportunities.

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ABSTRACT

This study analyzed the sustainable development issues associated with energy planning. Energy planning was identified as a local framework of sustainability which has a global significance. This study started by examining the concept of sustainability in its historical context, and attempted to extract the applicable sustainable development conceptual framework for urban planning. Next, the linkage between sustainable city planning and energy issues was reviewed to see how energy planning can be a tool for local sustainable development. The majority of this study is an examination of case studies which specifically address the issue of energy tied to the concept of local sustainability. Three cities; the City of Portland, Oregon; the City of San Francisco, California; and the City of San Jose, California, engaged in a "Sustainable City Project", were used for the case studies.

The findings indicate that the sustainable development concept and energy planning can be linked. A planning process that links energy with community issues enables the development of an energy program based on principles of sustainability which encompass environmental issues, social equity, quality of life, and economic concerns. Energy can work as a catalyst to tie all these factors together. However, the achievement of sustainable cities will require continued research, new tools and technology, and intergovernmental, business, and public cooperation.

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CHAPTER I

INTRODUCTION

Overview

Broadly defined, "sustainable development" means "meeting the needs of today's communities without compromising the ability of future generations to meet their own needs [89, p.43]." The need for comprehensive approaches to global environmental, economic and social issues, which were previously considered as isolated, puts a great deal of emphasis on promoting the concept of sustainability, especially in the 1990s.

"Sustainable development" calls for balanced development in the developing countries. However, these problems have global significance. Global sustainability issues reinforce the promotion of sustainable development, not only in developing countries, but also in developed countries which contribute to the massive consumption of non-renewable resources and pollution.

The world population is now almost 50 percent urban and about 85 percent of the people in the U.S. live in cities [30, p.iii]. Cities are experiencing air and water pollution and hazardous and solid waste accumulation that threaten the quality of life.

Many of these environmental problems result from our dependence on non-renewable energy resources, such as oil and coal. To reduce natural resource depletion and adverse impacts on ecosystems, changes in energy consumption patterns will be needed, as well as changes in economic structures, life styles, and a

variety of other consumption activities [30, p.1]. As more people move to cities, and as we consume natural resources, balanced, efficient, and renewable energy use emerges as a crucial factor in the future. The urban environment is both a source of the problems, and could be the framework for many solutions [94, p.1].

One concept fundamental to sustainability is a system that recycles resources and reduces waste streams. This system should be integrated into land use and other physical development factors. The concept of sustainability should also become a means of encouraging and supporting a stronger economy and improving the quality of life. This thesis views energy as a catalytic factor to enhance sustainability. The existing patterns of energy production and distribution are a key measure of sustainability. Energy consumption patterns affect not only future energy resources, but also the future of economic, atmospheric, climatic and other environmental conditions.

The sustainable energy concept relates to the development process by searching for ways that synergism can promote economic and social development as well as environmental equilibrium [16]. Energy planning integrated into a sustainable community scheme will require a holistic approach in order to merge energy use with other issues, such as increasing recycling, decreasing waste, development of telecommunications, economic growth and enhancing quality of life.

This thesis looks at local governments as energy-efficiency promoters and focuses on energy as one of the crucial elements in sustainability strategies. A wide range of energy-efficiency programs are available to local governments. Energy

efficiency programs can help local government cut costs and stimulate the local economies, thereby producing more revenues which can be used to deliver needed services, such as welfare, education and crime prevention. By launching an energy program, local governments can impact local energy use in three ways: as energy consumers, as energy providers, and as energy-efficiency promoters [79, p.7].

The environmental reason for energy-efficiency improvements is also important. To the degree that a community depends upon fossil fuels for its energy supply, their negative impacts on air quality and human health can be diminished through conservation and energy efficiency. In promoting energy-saving programs, local governments can intervene in several ways including technical assistance, public education, and regulation.

Though the concept of sustainability is still evolving, this study will explore the role of cities and effective strategies to move them towards increased sustainability. The following case studies of urban sustainability efforts examine how cities can incorporate concepts of sustainability into their urban planning, and how they can link municipal policies and practices in energy and land use planning as a major part of sustainable city strategies.

The City of Portland, Oregon; the City of San Francisco, California; and the City of San Jose, California; launched the Sustainable City Project between 1989 and 1990, by focusing on energy factors which link energy, environment, and economic development as local government policies. This Tri-City collaboration for developing and implementing sustainable urban energy practices aimed to serve as an

example for the current situation which lacks models for guiding urban development in a way that promotes sustainability.

There is no one solution. A big part of the solution to the problem depends on technological advances. Yet there are also planning implications that would alter current unsustainable trends. By examining transportation and land use policies, as well as by undertaking energy-efficiency projects, local governments can improve their own economies and environments [79]. Cities demonstrate the complex and dynamic relationships between energy, the environment, and economic growth.

Research Questions

This study discusses the following research question: *What is urban sustainability?* To understand this question, the thesis is structured as a case study of sustainable development efforts associated with energy use. The study starts with exploring the broader conceptual framework of sustainability and focuses on its linkages with energy elements. Some limited case studies are conducted to illustrate sustainable city projects with an emphasis on municipal energy practices.

Chapter II provides a brief overview of ideas, historic perspectives, and issues in the literature on sustainability. In the second stage, it focuses on sustainability in an urban context. It explains why the global issue of sustainability reinforces the importance of urban sustainability practices. Some current urban sustainability efforts are also introduced.

In chapter III, the subsidiary questions are looked at: *Can energy planning be integrated into major aspect of urban planning that contributes to sustainability?*

Sustainability implies the proper balance of production and consumption in the natural environment and the built environment. The modern, industrialized lifestyle has a major impact on natural resource use. Today's patterns of energy production and distribution represents "unsustainability." Therefore, the link between urban sustainability and energy use are sought in this chapter. The question is examined mainly through a literature review, including analysis of the various resource and energy related data.

Cities have tremendous potential to impact local energy use through their planning and policy activities. In chapter IV, questions about urban sustainability practices and energy issues are addressed. The questions are: *How can energy planning be integrated into municipal planning and what are the tools and implementation strategies?* The questions will be answered partially by the case studies of municipal efforts to incorporate sustainable energy concepts into city policies and planning. Interviews with various experts on sustainability helped determine the answers to the questions. The following issues were also examined: *At the municipal level, what kind of organizations have taken a lead in promoting sustainable energy projects and what does the future hold for urban sustainability efforts?*

The study aims to identify ways in which the planning process can be improved to aid sustainability. The approaches and methods being used to bring

sustainability concepts into the urban setting are examined in the case studies.

Problems and opportunities are also identified in the case studies.

Methodology

The research design consisted of a literature review, interviews with sustainability experts, comparative case studies and an evaluation and analysis of existing data. The initial search of literature was undertaken to gain insight into the conceptual framework of sustainability, current perceptions, and currently practice as regards urban sustainability including supporting theory, tools, and strategies. The second stage of the literature review focused on urban energy practices that are incorporated into the sustainable development framework, and the issues, barriers and constraints encountered.

The concept and practice of "urban sustainability" is still evolving. Therefore important information was drawn from current journal articles and conference reports. This review also included various environmental and energy related data. The review process helped identify the major issues and focused on the energy perspective of urban sustainability.

The study also included conducting interviews with individuals and agencies who are serving as information sources on sustainable urban practices, energy planning, and related environmental issues.

The case examples were drawn from three municipalities: Portland, Oregon;

San Francisco, California; and San Jose, California. These three cities launched the *Sustainable Cities Project* from 1989 to 1990 funded by the U.S. Department of Energy through a cooperative agreement with the Urban Consortium Energy Task Force. During the project period, the three project cities worked in parallel, yet pursued independent courses to develop appropriate sustainable urban energy practices to meet local needs [30, p.1]. They included examples of adapting energy policy through a strategic planning process. Their project intention was to provide a useful urban sustainable development road map for other cities. A comparative evaluation of the ongoing projects shows how sustainability concepts were developed and implemented at the local level.

It is recognized that there are certain limitations to a thesis. This thesis is not be in-depth research but, rather a broad overview of the various related subjects under the goal of bringing sustainability to cities. The intention of the study is to find common sustainable development strategies leading to implementation at the local level which may contribute to sustainability in the long run. State, national and international perspectives are required by the very nature of the sustainability issue; however, they are beyond the scope of this study.

CHAPTER II

SUSTAINABLE DEVELOPMENT: CONCEPTUAL FRAMEWORK

Historical Perspective

Human beings have substantially expanded their "niche" in the biosphere by what can be called "development," with a steady increase in the world human population that now stands at 5.6 billion [102]. To some extent, this growth is perceived as "progress," resulting in an improvement in mankind's condition. Also, the process has resulted in a continual expansion of the total mass of human artifacts.

In addition there are unintended byproducts like air and water pollution, soil depletion, waste accumulation, and so on. Most of these are perceived as "negatives" which when increased worsen rather than improve humanity's conditions. Often suffering and loss of a major scale occur before the problems are resolved and adaptation occurs. It is the need to mitigate suffering and loss that drives the search for solutions [36, p.247].

The duration of the crisis phase determines the extent of damage incurred before successful adaptation occurs. In environmental matters, this is often a long time. According to Paul Harrison in his book *The Third Revolution*, the crisis phase consists of four main stages: perception of the problem, understanding the causes, development of technologies, and application of those technologies [36, p.249].

Perception in environmental matters is not simple; it depends partly on the

speed and visibility of the change. Perceiving a problem is only the first step; the causes have to be understood before the problem can be addressed. The constituent parts of ecosystems are interdependent in complex ways, and our knowledge of these links is relatively poor. For example, the symptoms of forest death in Europe were first perceived in the late 1960s. However, the range of interacting causes was still not fully understood at the beginning of the 1990s [36].

Once problems are perceived and their causes understood, then the technology and social organization to deal with them have to be developed. The length of time this takes depends on the extent to which existing technology and organization can be adapted to the problem, and the complexity of the task to be dealt with. Another important factor standing between perception of environmental problems and action is readiness to act [36].

Today, many people feel that their existence will be threatened by environmental pollution, non-renewable resource shortages, poverty, growing population pressures and other related issues. "Sustainable" simply means long lasting [97]. "Sustainable Development" is the comprehensive concept that many believe to be the reverse of the current "unsustainable" trends, though critics point out the definition's ambiguity. In Harison's four phase crisis, the dialogue around the definition of "Sustainable Development" falls into the primary stage: perception of the problem. Broad consensus about the need to reverse existing "unsustainable conditions" exists, but agreement about ways to bring it about has yet to emerge.

Historical Perspective of Evolving "Official" Definitions

In the 1960s, the awareness of the complex, interactive ecosystems and the force of exponential growth problems also ushered in a wide range of environmental advocacy movements [52, p.27]. The "official" definition of sustainable development in the international context has evolved through the world's attention to the seriousness of our global predicament, through some world leaders' efforts, and through landmark meetings and publications [96, p.5].

The Limits to Growth. Among these landmark documents, *The Limits to Growth: A Report of the Club of Rome's Project on the Predicament of Mankind* published in 1972, was of major importance. The Club of Rome, consists of various experts from ten countries. It first met in Rome in 1968, under the chairmanship of Dr. Aurelio Peccei, an Italian economist, and grew as an informal organization to focus the attention of policy-makers and the public worldwide on the varied but interdependent components that make up the global system. This work resulted in the publication of *The Limits to Growth* in 1972 [52].

The Limits to Growth observed the interplay among five basic factors that ultimately limit growth on this planet: population, agricultural production, nonrenewable resource depletion, industrial output, and pollution generation. It presented evidence that due to severe biophysical constraints, the global system probably cannot support present rates of economic and population growth much beyond the year 2100 [52, p.9]. This conclusion received almost instant worldwide attention. *The Limits to Growth* has become the "center of a wide ranging debate

over the future development of both the industrialized and developing countries" [42, pp.92-95].

UN Conference on Human Development and the Environment. It was at this time that the United Nations organized the first major conference on "Human Development and the Environment" in Stockholm in 1972. At the Stockholm conference, the importance of managing the environment was raised on the international agenda, and the *Declaration on the Human Environment* was adopted to foster the establishment of the United Nations Environmental Program (UNEP).

Brandt Report. In 1980, the report, *An Emergency Program: 1980-85* was published under the chairmanship of Willy Brandt. The report emphasized the need to take actions inspired by the warnings presented in earlier documents. It called for an immediate action program to avert the most serious dangers for the next five years. The principal elements were as follows:

1. A large scale transfer of resources to developing countries;
2. An international energy strategy;
3. A global food program; and
4. A start on some major reforms in the international economic system [81].

1980 World Conservation Strategy. In 1980, UNEP released the *World Conservation Strategy*. The aim of the World Conservation Strategy is to help advance the achievement of sustainable development through the conservation of living resources. Its main objectives included the maintenance of essential ecological life support systems and the preservation of genetic diversity [90].

Global 2000. In the same year, *The Global 2000: the Report to the President: Entering the Twenty-First Century* was prepared for United States President Jimmy Carter and published in 1982. This publication surveyed global demographic and environmental issues. It also called for world collaboration to alter current trends of resource and environmental management [80]. The report stated; "The Global 2000 Study is the first U.S. Government effort to look at population, resources, and environment from a long-term global perspective that recognizes their interrelationships and attempts to make connections among them" [96, p.5].

Brundtland Commission Report, Our Common Future. In 1983 the General Assembly of the United Nations set up the World Commission on Environment and Development (WCED) in Stockholm, chaired by the Prime Minister of Norway, Gro Brundtland. The Commission, formed by representatives from 21 countries, studied and discussed peace, development and environmental issues. In 1987, the results, published as *Our Common Future*, listed the problems in need of urgent discussion and offered a definition of "sustainability" that was used as the basis of the one offered at the Rio Conference in 1992 [96, p.5]. "A global agenda for change" was what the World Commission on Environment and Development was asked to formulate by an urgent call by the General Assembly of the United Nations:

1. To propose long term environmental strategies for achieving sustainable development by the year 2000 and beyond;
2. To recommend ways concern for the environment may be translated into greater co-operation among developing countries and between countries at different stages of economic and social development and lead to the achievement of common and mutually supportive objectives that take

account of the interrelationships between people, resources, environment, and development;

3. To consider ways and means by which the international community can deal more effectively with environmental concerns; and
4. To help define shared perceptions of long-term environmental issues and the appropriate efforts needed to deal successfully with the problems of protecting and enhancing the environment, a long-term agenda for action during the coming decades, and aspirational goals for the world community [89, p.ix].

In its general content and scope, the *Brundtland Report* is in the tradition of such publications as *The Limits to Growth* (1972), *The Brandt Report* (1980), and *Global 2000* (1980). The core message was that existing global economic expansion could not continue forever, since the world would run out of natural resources, and the environment would become poisoned. There are two aspects that distinguished *Our Common Future* from the other studies. In the first place, the Brundtland Commission pointed out the strong link between poverty and environmental problems. It stressed that environmental challenges arise both from a lack of proper development and from the unintended consequences of some forms of economic growth. In the second place, the Brundtland Commission emphasizes that the idea of sustainable growth is compatible with both environmental concerns and economic growth [89].

Our Common Future has stirred up many reactions. Worldwide environmental and peace organizations criticized contradictions between the concepts of "development" and "sustainability." Many argued that "standard of living" used

here meant the "Western scale", and this has caused problems. An Indian environmentalist, Anupam Mishra stated that, "All governments today are united in their efforts to achieve a Western standard of living for their people. And in this process they are ready to sell their nation's soil, water, forests, air and even people" [24, pp.13-14].

Although the number of problems facing the world seems infinite, *Our Common Future* highlighted some central themes. The report set "sustainable development as the key concept, defining it as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* [89, p.43]. The report explains that; many present efforts to guard and maintain human progress, to meet human needs, and to realize human ambitions are simply unsustainable, in both the rich and poor nations. We borrow environmental capital from future generations with no intention or prospect of repaying [89].

One of the Brundtland Commission's most important conclusions is that, sustainable development should be everyone's responsibility. The report insists that governments and development agencies should realize that policies for economic development must be integrated with environmental considerations [89]. Efforts are called for by each nation as well as collaborative actions. *Our Common Future* has played a remarkable role in educating the public about these issues. For the term "Sustainable Development," the Brundtland Commission was the political turning point, making the concept one of geopolitical significance. It was not a closed discussion, but rather offers a good starting point for discussion [40, p.20].

1991 World Conservation Strategy. A more clear and implementation oriented definition was offered in the report, *Caring For The Earth: A Strategy for Sustainable Living: Second World Conservation Strategy* (IUCN/UNEP/WWF 1991). The report defines sustainability as "a characteristic of a process or state that can be maintained indefinitely." As an update of the World Conservation Strategy first published in 1980, under the principle statement: *If an activity is sustainable, for all practical purposes it can continue forever*, the report emphasizes three objectives:

1. Essential ecological processes and life-support systems must be maintained;
2. Generic diversity must be preserved; and
3. Any use of species or ecosystems must be sustainable [15, p.6].

Rio Summit: Agenda 21. Since the United Nation convened its Conference on the Human Environment in 1972 in Stockholm, concern has been mounting over the human deterioration of the environment and lack of adequate development in developing countries. The UN General Assembly resolved to convene a United Nations Conference on Environment and Development (UNCED), commonly known as "Earth Summit," to take place in Rio de Janeiro, Brazil, in June 1992.

Thirty-five hundred diplomats and advisors, 700 UN officials, and 120 heads of state debated and agreed to elaborate strategies for promoting sustainable development and reversing global issues of environmental degradation, such as climate change, ozone layer depletion, trans-boundary air and water pollution, and the contamination of the oceans and seas [82].

A series of international agreements were made, including two "framework conventions," one on climate and the other on bio-diversity. The outcome of the Conference is *Agenda 21*, an action plan to lead sustainable development in the 1990s and will into the twenty-first Century. *Agenda 21* is based on the premise that sustainable development is not an option but an imperative, in both environmental and economic terms. The integration of development and environment at all levels of political and economic decision-making is essential to ensure sustainability. Six major themes comprise *Agenda 21*:

- (1) *The quality of life on Earth;*
- (2) *The efficient use of the world's natural resources;*
- (3) *Protection and management of our global commons;*
- (4) *Management of human settlements;*
- (5) *Use of chemicals and the management of human and industrial waste;*
- (6) *Global economic growth based upon sustainability [96, p.7].*

Special attention had to be given to developing countries with serious debt-servicing problems. The idea underlying these themes are that the global environmental deterioration has been a result of unsustainable patterns of certain kinds of consumption and production processes found especially in the industrialized countries. These countries are responsible for the largest proportion of the world's current emission of pollutants, including toxic and hazardous wastes. These developed countries bear the capacity, and the responsibility, to mitigate the global impacts of their pollution. *Agenda 21* is addressed to governments, agencies, organizations, and programmers of the United Nations system, to other inter-governmental and non-governmental organizations, to constituency groups, and to the

public at large, all of whom must be involved, in various ways, in its implementation.

Continuing United Nations Discussions. Since the Rio Earth Summit, continuing "official" discussions by the United Nations and other world organizations have emphasized the relationship between population, poverty, family planning, and women's rights, and will be discussed for the International conference on Population and Development planned in Cairo, Egypt in September, 1994. The continuing effort to apply sustainability to worldwide planning and architecture will be represented by The United Nations Conference on Human Settlements (Habitat II) scheduled to be held in Turkey, in 1996. The conference goals are to "stop the deterioration of human settlement conditions, and ultimately, to improve the living environments of all on a sustainable basis," and to determine policies and practices of "sustainable human settlement in an urbanizing world" and "adequate shelter for all" [96, p.7].

President's Council on Sustainable Development (PCSD). The President's Council on Sustainable Development (PCSD) was formed in 1993 to:

help craft U.S. policies that will encourage economic growth, job creation and environmental protection and to develop specific strategies for sustainable agriculture and land use, efficient energy and transportation systems, environmental justice, eco-efficient manufacturing, environmental education, and setting environmental priorities" [White House News Release June 14, 1993.][96, p.7].

The Council has adopted the Brundtland Commission's definition of sustainability and has released for public comment a vision statement and set principles [67] (Appendix B). In the next section, concepts of sustainable development is examined in more detail.

Concept of Sustainable Development

Popularized by the *Brundtland Report* and the Rio Summit, "Sustainable Development" has become a household term. Many political leaders have used the expression, and reams of papers have been published on the subject. Many definitions of "Sustainable Development," "Sustainable Resource Use" and "Sustainable Economic Growth" exist, and today some seventy definitions are in circulation [40, p.20]. In one way or another all express concern about:

- The effects of present day activities on the future;
- The importance of maintaining the ecological process; and
- The improvement of the quality of life now without denying future generations a similar opportunity.

Also the following issues are associated with the discussion of sustainability including:

- Population growth;
- Global demographics and politics;
- Environments at risk, including disruption and destruction of habitat biological diversity, and biospheric climatic patterns;
- Technology as problems and as solutions; and
- Ideology associated with human thought and culture [96, p.2].

The International Institute for Environment and Development (IIED) has been using the idea of sustainable development, as an indispensable instrument of policy analysis. In its document *Making Development Sustainable*, IIED proposes:

We need to recast our vocabulary. Words are not only a means of expression but also the building blocks of thought. The instruments of economic analysis are blunt and rusty. Such words as 'growth',

'development', 'cost-benefit analysis', even 'gross national product', are used in such a misleading way that they are more than ripe for redefinition. We need to realize that conventional wisdom is sometimes a contradiction in terms....We need to change culture. Many have lamented the division between the cultures of science and the arts. We need to recast parts of our educational systems to promote better understanding of the environment....We need a value system which enshrines the principle of sustainability over generations [40, p.11].

This set of issues has a global nexus which makes the present discussion about sustainability new in the evolving history of ideas [96].

Even in the *Brundtland Report* itself, more than one definition appears, but the one most quoted is: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The *Brundtland Report* explains that sustainable development contains two key concepts:

1. The concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
2. The idea of limitations imposed by the state of technology and social organization on the environment's ability [93, p.59].

The definition of the sustainable development has been criticized as ambiguous and contradictory. According to *Caring for the Earth*, which is a comprehensive global approach developed by collaboration of IUCN, UNEP, and WWF, in 1991, the confusion has been caused because "Sustainable Development," "Sustainable Growth" and "Sustainable Use" have been used interchangeably, as if their meanings were the same. They are not:

"Sustainable Growth" is a contradiction in terms: nothing physical can grow indefinitely. "Sustainable Use" is applicable only to renewable resources: it

means using them to rates within their capacity for renewal. "Sustainable Development" means improving the quality of human life while living within the carrying capacity of supporting ecosystems. "Sustainable Economy" is the product of sustainable development. It maintains its natural resource base. It can continue to develop by adapting and through improvements in knowledge, organization, technical efficiency and wisdom. "Sustainable Living" describes the life-style of an individual who feels the obligation to care for nature and for every human individual, and who acts accordingly [84, p.i].

"Sustainable Development" is a way to help achieve a "Sustainable Society" and a

"Sustainable Society" lives by the "Nine Principles" :

- (1) *Respect and care for the community of life;*
- (2) *Improve the quality of human life;*
- (3) *Conserve the earth's vitality and diversity;*
- (4) *Minimize the depletion of non-renewable resources;*
- (5) *Keep within the Earth's carrying capacity;*
- (6) *Change personal attitudes and practices;*
- (7) *Enable communities to care for their own environments;*
- (8) *Provide a national framework for integrating development and conservation; and*
- (9) *Create a global alliance* [84, pp.29-30].

The international process established by UNCED merged the concept of sustainable development into the UN system, with Agenda 21 as a focus. There are so far, five pillars in the UNCED Agreements that would guide sustainability practices. These five principles are following:

- (1) *Framework Convention on Climate Change: The Framework Convention on Climate Change* establishes principles that climate change is a serious problem; that action cannot wait upon the resolution of scientific uncertainties; that the developed countries should take the lead; and that they should compensate developing countries. As a first step,

industrialized countries should aim to return greenhouse gas emissions to 1990 levels by the year 2000. Governments must submit reports on their relevant policies and projections, and meet regularly to evaluate process.

- (2) *Convention on Biological Diversity: The Convention on Biological Diversity* aims to preserve the biological diversity of the planet. Through the protection of species and ecosystems, and to establish terms for the associated uses of biological resources and technology. Countries must develop plans to protect bio-diversity and submit some information on them.
- (3) *Agenda 21: Agenda 21* has 40 chapters outlining an action plan for sustainable development, covering a wide range of specific natural resources and the role of different groups, as well as issues of social and economic development and implementation. It effectively integrates environmental and developmental concerns. It is strongly oriented toward public participatory and community-based approaches in many areas, including population policy, and market principles.
- (4) *Rio Declaration: The Rio Declaration* comprises 27 principles for guiding action on environment and development. Many address developmental concerns, stressing the right to and need for development and poverty alleviation.
- (5) *Forest Principles: The Forest Principles* form the attempts to negotiate a convention on forests. It emphasizes the sovereign right to exploit forest resources along with recommending various general principles of forest protection and management [34, p.xv].

The IIED publication *Making Development Sustainable* pointed out that "the concept of "Sustainable Development" has a complex pedigree" [40, p.20]. The concept of sustainable development has evolved by encompassing three main issues: (1) environmental concern, (2) economic growth, and (3) social equity.

Environmental Concern

This century, humanity's capacity to destroy the environment has increased dramatically. Several, perhaps many, changes appear irreversible. We do not know how they will impact on future generations. Examples include a significant loss in species diversity; the emergence of a hole in the stratospheric ozone layer; and the still controversial prospect of global warming.

Another problem is the expectation that over the next 50 years the number of people in the world will double [11, p.181] (Table 1). This increase of the world human population implies a massive increase in the demands on global resources (Table 2). Developing countries' population growth alone would account for a 75 percent increase in their commercial energy consumption by 2025, even if per capita consumption remains at current inadequate levels [93, p.22].

Table 1 Current and Projected Population Size and Growth Rates*

Region	Population (billion)			Annual Growth Rate (per cent)		
	1985	2000	2025	1950 to 1985	1985 to 2000	2000 to 2025
World	4.8	6.1	8.2	1.9	1.6	1.2
Africa	0.56	0.87	1.62	2.6	3.1	2.5
Latin America	0.41	0.55	0.78	2.6	2.0	1.4
Asia	2.82	3.55	4.54	2.1	1.6	1.0
North America	0.26	0.30	0.35	1.3	0.8	0.6
Europe	0.49	0.51	0.52	0.7	0.3	0.1
USSR	0.28	0.31	0.37	1.3	0.8	0.6
Oceania	0.02	0.03	0.04	1.9	1.4	0.9

Note: *Medium-variant projections.

Source: Department of International Economic and Social Affairs, *World Population Prospects: Estimates and Projections as Assessed in 1984* (New York: UN, 1986).

Table 2 Comparison of Key Global Indicators in the Economic Era and the Environmental Era

Indicator	The Economic Era: 1950-90	The Environmental Era: 1990-2030
World Population	More than doubled from 2.5 to 5.3 billion, adding 2.8 billion or 70 million per year and slowing progress.	Projected to increase from 5.3 to 8.9 billion, adding 3.6 billion or 90 million per year. For much of humanity, this may reverse progress.
Grain Production	Nearly tripled from 631 million tons to 1,780 million tons, or 29 million tons per year.	Expanding by 12 million tons per year (rate of last eight years) may be best that can be expected.
Beef and Mutton Production	Increased 2.6 times, from 24 to 62 million tons.	Little growth expected.
Fish Catch	From 22 to 100 million tons; per capita up from 9 to 19 kilograms.	No growth expected; per capita dropping from 19 kilograms to 11 kilograms.
Economic Growth	Economy expanded 4.9-fold from nearly \$4 trillion to \$19 trillion, an annual gain of 4.2 percent. Growth is focus of national economic policymaking.	Averaging even half the 1950-90 rate may be difficult. Focus will shift from growth to sustainability and distribution.
Growth in Grain Demand	Two thirds from population growth; one third from rising incomes.	Nearly all expansion will be needed to sustain population growth.
National Security	Largely ideological and military in nature; defined by the cold war.	Food and job security will dominate, often driving hungry and jobless people across national borders.

Source: Lester R. Brown et.al., *State of the World 1994: A Worldwatch Institute Report on Progress Toward a Sustainable Society* (New York: W.W. Norton & Company, 1994).

Ecologists are warning that if existing per capita rates of consumption and pollution continue and human populations double, we may become vulnerable to dramatic change, such as famine. Concerned about irreversibility, they suggest that

we must expect ecological surprises, and take a precautionary approach to investment and resource use [103]¹. Out of these concerns, some key environmental notions intrinsic to sustainable development emerged.

Carrying Capacity. Carrying Capacity regards the development within the earth's ecological reproductive limits. The maximum impact that the planet or any particular ecosystem can sustain is called its carrying capacity. We can expand this carrying capacity through technology, but this can reduce biological diversity or ecological services. The protection of *Biological Diversity* is thus important. In any case, carrying capacity cannot be expanded forever. It is limited ultimately by the ecosystem's capacity to renew itself or to safely absorb waste [93, p.17] (Figure 1).

Minimum Safe Standard. *Minimum Safe Standard* is a substantial safety margin between our total impact and our estimate of what the earth can withstand. Sustainability will be impossible unless the number of humans and their demand for resources levels off. It is important to remember that not just survival but a sustainable improvement in the quality of life of several billion people is sought. Since we do not know Earth's limits, prudent and precautionary action is required [40].

¹Three types of surprises exist. Type I: understood with historical experience but unpredictable, like cyclones, earthquakes, etc. Type II: understood but not experienced, like ozone depletion, global warming etc. Type III: totally unexpected, like the emergence for a hole in the stratospheric ozone layer, power failure throughout New York etc., [103].

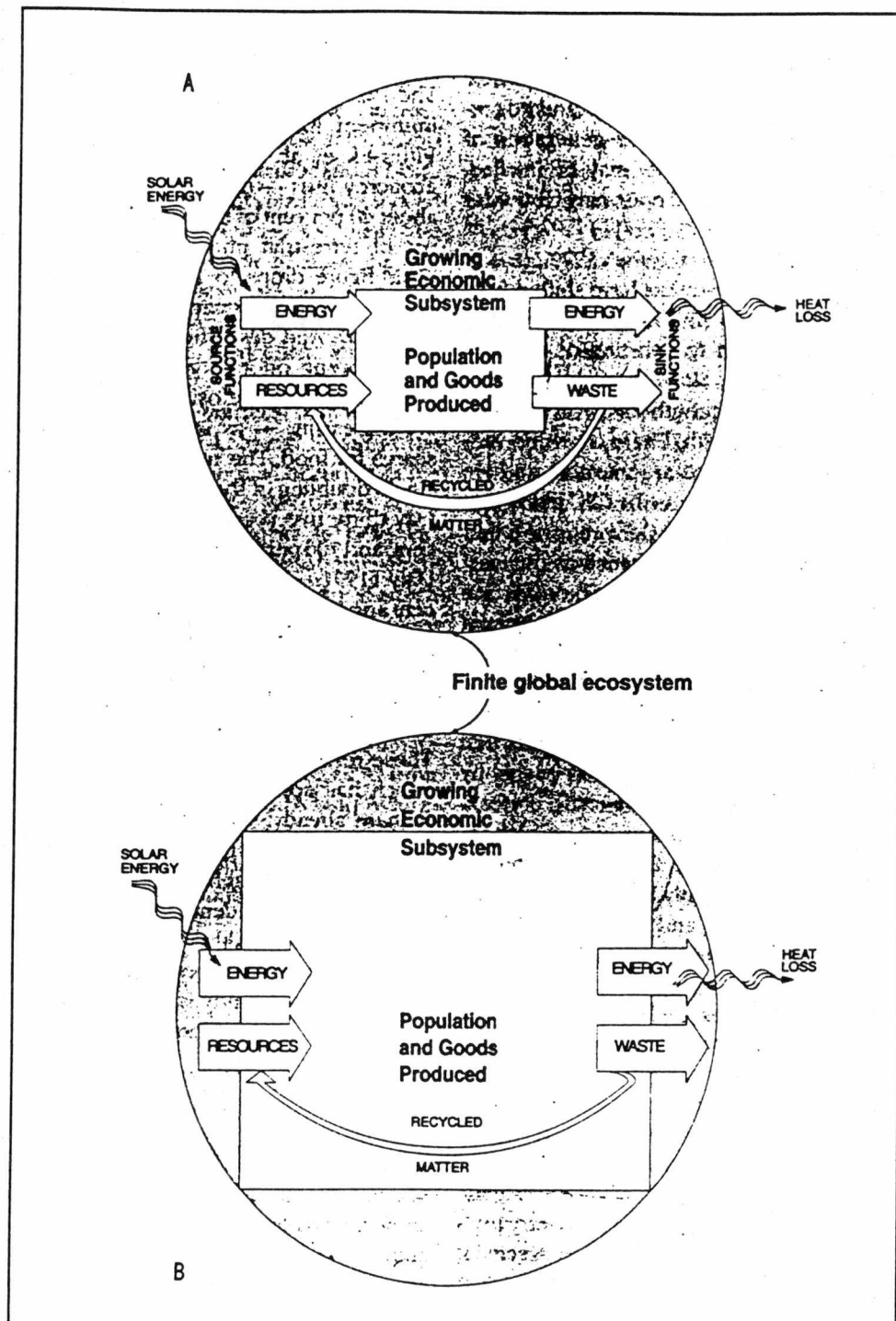


Figure 1 The Finite Global Ecosystem Relative to the Growing Economic Subsystem

Source: H.E. Daly, *Towards and Environmental Macroeconomics*, Paper presented at the conference on the *Ecological Economics of Sustainability: Making Local and Short Term Goals Consistent with Global and Long Term Goals*, held at the International Society for Ecological Economics (Washington, D.C., May 1990).

Economy

Economy and environment interface is also an important component of the sustainable development concept. The World Watch Institute warned that "The pace of environmental deterioration quickens, the consequences of failing to bridge the gap between the workings of economic systems and natural ones are becoming all too clear" [10].

This warning reflects the growing recognition of the importance of investment as a driving force of environmental change. The level and nature of past and present human investments (e.g. capital time, etc.) determine contemporary resource use. Changes in investment patterns are a necessary precondition to improved resource use and development.

Growing interest in the subject is reflected in such initiatives as the publication of a professional journal *Ecological Economics* (1989) and the conference of the International Society for Ecological Economics launched on the theme: *Investing in Natural Capital: A Prerequisite for Sustainability* in August 1992. The United Nations Man and Biosphere (MAB) program (1986), exhibiting a new research emphasis on "human investment and resources use", has introduced work on economic forces and their implications in different development options [103].

The challenge in establishing a new economic order that includes the environment in economic decision making is enormous. We have to find forms of investment that increase production while maintaining ecological equilibrium. To make development be quality improvement, investment in education and improved

knowledge about ecosystem functioning must be enhanced . The search is for quality investments that simultaneously improve environmental and human living standards [103].

Social Equity

Advocates of sustainability propose to engage all nations and peoples of the world in addressing global issues through a shared agenda in what the Brundtland Commission calls "Our Common Future." Such proposals raise ethical, political and ideological issues such as fair distribution of the limited natural resources [96, p.1]. The development gap between the industrialized and developing countries continues to widen. More than 1 billion people in the developing world live without adequate food, health care, education and housing. Between the discussion of quality of life in terms of a "Western world" standard and the real condition of these 1 billion people, there is a big discrepancy.

The criticisms are not about how their environment should be managed, but who will manage it and for whose interest. The criticisms reject UNCED's rhetoric of a world where all humanity is united by a common interest in survival, but it conflicts of race, class, gender and culture. The question is "Whose common future is to be sustained?" [78, p.2]. An important point was made that "while there is broad general agreement about what such terms mean, the actual achievement of human freedom, justice and sustainable development will be specific to local conditions" [38, p.23].

The publication *Caring for the Earth* brought forward an ethic--a set of moral principles or values--respect and care for each other and the Earth, the foundation for sustainable living. "People with an ethic for sustainable living will adopt life-styles that respect other people and nature and will work within nature's limits" [84]. The publication insists that most people need to change their attitudes towards nature. Also, development should not harm other people or later generations, nor threaten the survival of other species. We have a responsibility to all forms of life with which we share this planet. The movement to sustainable societies will require changes in how people think about each other, other life forms, and the Earth, because individual actions are, perhaps for the first time, have global effects. "It will require changes in how people judge their needs and priorities. It requires changes in how people behave" [84, p.1].

According to *Gaia Atlas*:

Perhaps our most turbulent transition will be the establishment of equity among ourselves. When the planet's resources are equitably shared, then the transition to sustainable management of our natural environment can succeed....The transition to sustainable society....will demand from each of us a high sense of responsibility for our planet, and for each other [57, p.252].

The basic implication of the concept of sustainable development, as embraced by the Brundtland Commission and others, is that we should leave to the next generation a stock of *quality of life* assets no less than those we have inherited [40, p.21].

Criticisms

There are some complex interactions among "Sustainable Development" factors that make its definition difficult. When people define an activity as sustainable, it is on the basis of what they know at the time. There can be no long-term guarantee of sustainability because many factors remain unknown or unpredictable. Intrinsic conflict between growth, and sustainability have been pointed out.

Sustainable development is a comprehensive concept. Yet Thijs de la Court remarks in his book, *Beyond Brundtland*, that it is in danger of becoming another catchword to which "everyone merely pays lip service" [24, pp.13-5]. Others say that, "sustainable development as a concept has become devalued to the point where, to some, it is now just a cliché" [40, p.20]. If a phrase becomes all things to all people, it is soon of no value to any one--catch phrases come and go. Authors such as Redclift have already arrived at the conclusion that sustainable development is a truism or, more negatively according to O'Riordan, a contradiction in terms [63, pp.1431-46].

Many environmentalists, since the term sustainable development appeared, have used the term with a passion. The conflicts between states of ecological equilibrium and economic development in the long term are still not resolved. Another gray area in the literature is between what sustainable development fundamentally involves and what is desirable in its pursuit.

The meaning of sustainability becomes more diffuse as it is enlarged to

include more constituencies and perspectives. But the term has a "meaning sufficient to attract its advocates as well as its critics" [96, p.1]. The idea of sustainability has forced attention to global issues and prompted much needed critical perspectives of what was previously considered as isolated and local economic, social or environmental concerns. Gro Harlem Brundtland emphasized this point in the introduction to the Rio Summit stating that, "Poverty, environment, and population can no longer be dealt with--or even thought--as separate issues" [89, p.ix-xv].

The term has emerged as a broad concept advocating comprehensive and coordinated policies and practices for global economic, social and environmental development. James Gustave Sethe, Administrator of the United Nations Development Program writes: "Sustainability is the new world order....now essentially to achieve all of the major intention goals of peace, democratization, migration control, environment protection and population stabilization" [89].

The concept of sustainable development offers new opportunities for initiating and interacting programs to manage our global resources prudently, and to meet human needs into the twenty-first century and beyond. It puts forth a set of principles, policies, and practices intended to guide collective international action [40, p.23]

Equity, economic efficiency and environmental integrity, this framework,- dubbed the "3 Es", arose from a workshop held to develop a new UNESCO-MAB orientation. Environmental integrity refers to identifying and developing ecologically favorable management regimes, and places due recognition on the dynamics of

ecosystem functions and their resilience and response to change. Economic efficiency requires that all internal and external costs, including long-running costs which affect future generations, be included in the costs imposed on resource users. Equity considerations relate to patterns of distribution of benefits, incomes and profits among socioeconomic groups [103, p.ii].

Similarly, Ed Barbier in his article, *The Concept of Sustainable Economic Development* (1987), sought reconciliation among interpretations and introduced the idea of "Trade Offs". The reconciliation starts from the premise that development intrinsically involves trade-offs between conflicting goals, such as between economic growth and environmental conservation, or between introducing modern technology and preserving traditional culture, or between reconciling growth with improved social equity. Given that many of the qualitative dimensions of trade offs cannot be accurately measured, the process inevitably become subject to judgement based on prevailing values and ethical norms [4, pp.101-10].

Barbier identified three systems as basic to any process of development:

(1) the biological or ecological resource system, (2) the economic system, and (3) the social system. The objective of sustainable development will be to maximize goal achievement across these three systems, at the same time working through an adaptive process of trade-offs. It will not be possible to maximize all goals all the time, and there may be conflict among intra-system goals. Choices must therefore be made as to which goals should receive greater priority. Different development strategies will assign different priorities. Figure 2 illustrates how these three systems

work, as development becomes increasingly sustainable and system goals overlap. In an unsustainable development process, maximum production of goods and services is attempted, with no regard to biological resilience, genetic diversity, social justice or public participation [40, p.24] (Figure 2).

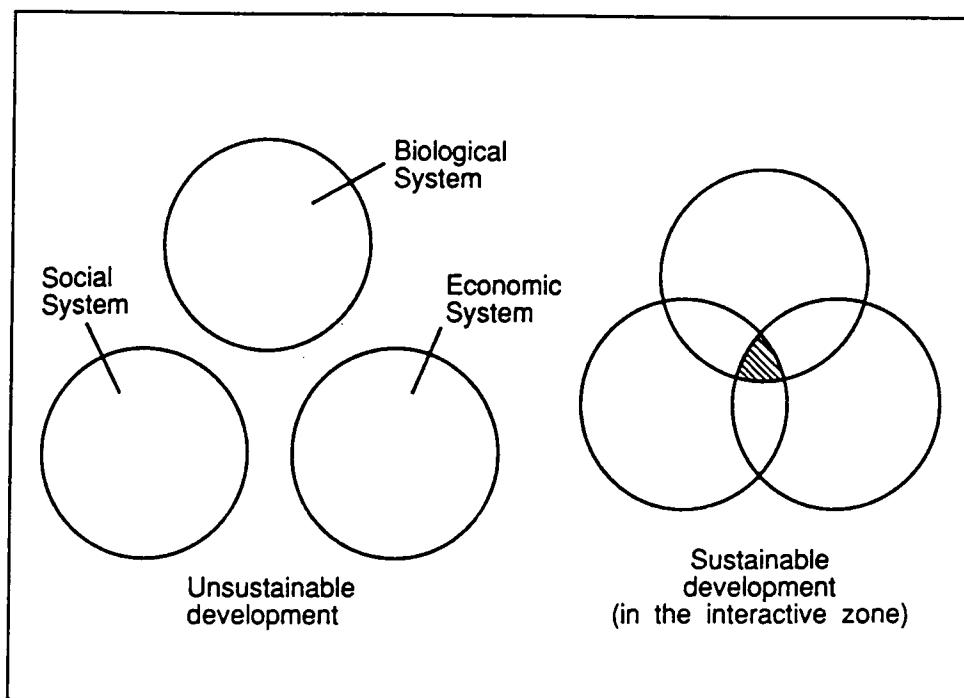


Figure 2 Sustainable Development as a Process of Trade-Offs

Source: Johan Holmberg ed., *Making Development Sustainable: Redefining Institutions, Policy and Economics* (Washington, D.C.: Island Press, 1992).

The words "sustainable" and "development" may seem contradictory to some. However, the organization IIED argues that a precise definition of sustainable development is inappropriate [40]. Sustainability is intimately connected with the issues of justice, human rights, and obligations. John Rawls's idea of overlapping consensus affirms this statement [68]. A consensus that is affirmed by opposing theoretical, religious, philosophical, and moral stances is likely to be a just one, and

likely to thrive over generation [103]. It is not simply a matter of controlling the intensity of resource use. Johan Holmberg, the editor of *Making Development Sustainable* asserts that, "vagueness of the term is no real drawback, because attempts to present a single definition tend to be counter productive" [40, p.23]. The powerful intuitive idea underlying the concept is that of inter-generational equity; our development is sustainable only to the extent that we can meet our needs with those of future generations. One finds even more assertive proclamations as to the importance of the concept. Young writes,

A sustainable future is dependent upon the retention of a diverse range of approaches to and definitions of the most appropriate ways to achieve "Sustainable Development," so that the socioeconomic and ecological systems necessary to realize the goals implicit in each definition continue to evolve and adapt" [103, p.13].

Sustainable development is best understood as a process of change in which the use of resources, the direction of investments, the orientation of technological development and institutional change all enhance the potential to meet human needs both today and tomorrow [96, p.6].

Dr. Noel J. Brown, director of the Regional Office for North America of the United Nations Environmental Program stated: "a fundamental requirement in our new "Earth Approach" is to translate its principles into practice." Another is to integrate conservation and development: conservation to keep our actions within the earth's capacity, and development to enable people to find fulfilling lives. Unless we use the resources of the earth sustainability and prudently, we deny people their future [40]. Stabilizing human population and increasing resource consumption on a

more equal and sustainable basis are the greatest challenges of our time. But all of us, especially those who live in industrialized countries, need to alter our life-styles now for the sake of a decent standard of living for the people with whom we share the planet, now and for a livable future for our descendants. The moral is; be conservative in actions that could affect the environment and study the effects of such actions carefully and learn from mistakes quickly. Economic growth is part of development, but it cannot be a goal in itself. Universal goals that people have for development include: (a) a long healthy life, (b) education, (c) access to the resources needed for a decent standard of living, (d) political freedom, (e) guaranteed human rights, and (f) freedom from violence.

Sustainable development means different things to different people, but it represents a productive way to approach the "crisis which is unique in its range and scope including energy, resource use, climate, waste management, technology, cities, agriculture, water, biological resilience, international security, politics, and human values" [40, p.11]. Now is the time to move beyond mere concept of sustainable development toward putting it into an operation, and a workable framework.

Urban Focus of Sustainability

Overview

One notion fundamental to sustainable development is the concept of carrying capacity. The actions needed to keep within the Earth's carrying capacity will vary greatly from place to place, because differences in local environment, population size, population growth rates, human needs, resource consumption patterns, and availability of resources require different responses.

Traditionally, there has been a sustainable development emphasis on developing countries, which can be called *the third world approach* to sustainability. However, in *Agenda 21*, the responsibility of implementing sustainable development is not only on developing countries, but also on developed countries. Timothy Beatley, associate professor of the Urban and Environmental Planning Program at the University of Virginia pointed out that:

It is a mistake to associate the idea of sustainability only with the developing countries and global issues....It must be accepted by developed countries because they are the major consumers of the world's resources and major producers of its waste and pollutants. They are the countries most in need of what has come to be called 'sustainable development' [7, p.6].

Today, some 25 percent of the world people, who live in the industrialized countries, consume 75 percent of the world's primary energy (Table 3, Table 4). The United States, which possesses only 5% of the world's population, accounts for 25% of the energy consumed and 22% of the world's carbon dioxide emissions [30, p.5]. Each day, the average urban resident in the United States uses approximately 150 gallons of water, three pounds of food, and sixteen pounds of fossil fuels.

Table 3 Global Primary Energy Consumption per Capita, 1984

World Bank GNP Economy Category	GNP Per Capita (1984 dollars)	Energy Consumption (kW per capita*)	Mid-1984 Population (million)	Total Consumption (TW)
Low Income	260	0.41	2,390	0.99
Sub-Saharan Africa	210	0.08	258	0.02
Middle Income	1,250	1.07	1,188	1.27
Lower-middle	740	0.57	691	0.39
Upper-middle	1,950	1.76	497	0.87
Sub-Saharan Africa	680	0.25	148	0.04
High-Income	11,250	5.17	19	0.10
Oil Exporters				
Industrial Market Economies	11,430	7.01	733	5.14
East European Non-Market Economies	—	6.27	389	2.44
World	—	2.11†	4,718	9.94

Note: *kW per capita is kW years/year per capita.

Source: World Bank, *World Development Report 1986* (New York: Oxford University Press, 1986).

Table 4 Selected Countries by Income, Consumption of Commercial Energy per Person and Total Fertility Rates

Country	Income ¹ US\$	Energy Consumption ²	Total Fertility Rate ³
Brazil	4,620	22	3.3
China	2,470	22	2.4
Costa Rica	4,320	15	3.1
Ethiopia	350	1	6.8
India	870	8	4.2
Japan	13,650	110	1.7
New Zealand	11,310	113	2.0
Poland	4,190	141	2.2
United Arab Emirates	19,440	552	4.6
United States	19,850	280	1.8

¹ Real Gross Domestic Product (GDP) per capita (1985-1988) in PPP\$ (purchasing power parities) rounded to the nearest \$100.

² Consumption of commercial energy per person (1987) in gigajoules.

³ The average number of children born alive by a woman in her lifetime.

Source: The United Nations Environment Programme, *Caring for the Earth: A Strategy for Sustainable Living* (1992).

Roughly 120 gallons of sewage, three pounds of refuse, and one pound of air pollutant are discharged daily by the average urban dweller. Moreover traffic congestion, air and water pollution, and inadequate waste disposal systems in U.S. cities have global repercussions. These problems contribute ozone layer depletion, smog, acid rain, deforestation, species extinction, toxic contamination, ground water overdrafting, and global warming. Furthermore, stressful living conditions and environmental pollution have an adverse impact on human health [30, p.5] (Figure 3).

To accomplish sustainability, which is the globally shared agenda, relying only on the third world approach to sustainable development fails to address the partner of the global community most in need of adjusting sustainability objectives. Making the industrial world sustainable is a challenge no less important. Today, the world population is almost 50 percent urban (Table 5). In the United States, about 85 percent of the people live in cities. In an industrialized nation sustainability for the city and community level should be the focus of reform efforts [40, p.20]. In this chapter, how sustainability relates to urban planning, and how the idea can be incorporated into planning practice are the focus.

The City as a Framework for Urban Sustainability Effort

What does it mean for a city to be sustainable and how does one achieve sustainability? The present urban system draws resources from the environment, many of them non-renewable, and often destroys the earth's ability to regenerate key resources. In the process of using these resources, they are often returned

	Sulphur ²			Nitrogen ²			Carbon ³		
	1990	2020	Change	1990	2020	Change	1990	2020	Change
	Mt	Mt	%	Mt	Mt	%	Gt	Gt	%
North America	12.1	5.8	-52	5.5	3.2	-42	1.55	1.49	-4
Latin America	3.2	7.1	+122	1.4	2.7	+93	0.26	0.68	+162
Western Europe	10.4	4.5	-57	3.7	2.3	-38	1.00	1.06	+6
Central and Eastern Europe	3.9	2.2	-44	1.0	0.7	-30	0.25	0.23	-8
CIS	12.4	7.4	-40	4.0	2.9	-28	1.08	1.03	-5
Middle East and North Africa	2.2	4.9	+123	1.0	2.0	+100	0.22	0.59	+168
Sub-Saharan Africa	1.9	4.4	+132	0.7	1.6	+129	0.11	0.31	+182
Pacific ¹	15.1	22.2	+47	5.7	9.1	+60	1.27	2.43	+91
	6.9	14.4	+109	3.2	6.3	+97	0.72	1.56	+117
South Asia	3.4	7.5	+121	1.1	2.4	+118	0.20	0.55	+175
World	64.6	66.1	+2	24.0	27.0	+13	5.90	8.37	+42

¹ Data for the Pacific Region include Centrally Planned Asia (CPA), which are also shown separately.

² The emissions are calculated as millions of metric tonnes of elemental sulphur and nitrogen

³ The emissions are calculated as 1000 millions of metric tonnes (Gtonnes) of elemental carbon

Based on projection by WEC - Case B

Figure 3 Emission of Sulphur, Nitrogen and Carbon

Source: World Energy Council Commission, *Energy for Tomorrow's World: The Realities, the Real Options and the Agenda for Achievement* (New York: St. Martin's Press, 1993).

Table 5 The Percentage of Population Living in Urban Areas by Continent, 1920-2025

Region	Year					
	1920	1940	1960	1980	2000 (projections)	2025
World	19.4	24.5	33.9	41.3	48.2	62.5
More Developed	37.9	46.9	58.7	70.7	77.8	85.4
Less Developed	8.4	12.6	21.9	30.5	44.4	57.7
Europe	46.2	52.8	62.6	75.9	78.9	85.9
Oceania	47.1	54.6	66.2	75.7	73.1	78.4
N. America	51.9	58.9	67.1	73.7	78.0	85.7
S. America	22.4	30.8	49.4	64.8	76.6	84.2
USSR	16.1	30.8	48.8	64.8	74.3	83.4
Asia	8.8	12.9	20.8	27.4	35.7	53.7
Africa	7.0	10.4	18.2	28.9	42.2	58.3

Source: Philip M. Hauser and Robert Gardner, *Urban Future: Trends and Prospects*, Paper presented at the *International Conference on Population and the Urban Future*, held in Rome, Italy (New York, 1980).

contaminated residues to the ecosystem that are detrimental to the environment and our health. Although the structure of the modern urban system is designed to enhance the quality of life, it is not in balance and is not sustainable. As Mary Tucker, project manager of the Sustainable City Project of City of San Jose, conveys in her report "Incorporating Concepts of Sustainability in Large Urban Areas", commitment to sustainability is a commitment to more responsible environmental decision making [92].

Opportunities to promote sustainability exist at each level of urban planning practice. Sustainable decisions are possible and desirable at each decision making levels [20] (Table 6). According to Andrew Euston, the energy program officer at the U.S. Department of Housing and Urban Development, "the real action is on the

Table 6 Significant Structural Variables at Different Scales

STRUCTURAL VARIABLE	SCALE
Settlement pattern (eg. rank-size, geometrical arrangement etc.)	REGIONAL SUB REGIONAL
Communication network between settlements	
Size of settlements (area)	INDIVIDUAL SETTLEMENT
Shape of settlement (circular, linear etc.)	
Communication network within settlement (radial, grid etc.)	NEIGHBOURHOOD
Density	
Interspersion of land uses	BUILDING
Degree of centralisation of facilities	
Layout (estates etc.)	BUILDING
Orientation (of buildings or groups of buildings)	
Siting (in relation to microclimate)	BUILDING
Design	

Source; David R. Cope, Peter Hills, and Peter James eds., *Energy Policy and Land-Use Planning: An International Perspective* (New York: Pergamon Press, 1984).

local level" [91]. While the urban environment is a source of problems, it may also be the framework for solutions to many of problems. In the urban sustainable scheme, cities should be primary planners for a sustainable future. Local governments make decisions affecting land use, building codes, transportation systems, and waste disposal. Because these are among the public services most connected with our daily lives, it is easier to organize citizen action within their own communities than on the state or federal governments. In addition, each community has political, cultural and physical qualities that make it flexible and unique [91].

Planning Urban Sustainability

Planning, architecture, and relevant professions have begun to pay more attention to advancing sustainability of our cities, towns and communities [6]. This new interests in sustainable communities is reflected in publications and conference programs on a variety of aspects of sustainability. For example, American Institute of Architecture (AIA/UIA) World Congress of Architects June 1993 in Chicago, they adopted a "Declaration of Interdependence" to affirm a professional commitment to principles of sustainability [5, p.16]. The American Planning Association (APA) conference held in San Francisco in April 1994, sustainability was at the heart of many sessions, including one titled "Sustainability and Growth" [86, p.15]. Some planning school, such as the University of Virginia and the University of North Carolina, have begun courses in sustainable development.

The concept of sustainability has the potential to make connections between

the traditional concerns of city and regional planning and more recent concerns such as global environment and social inequity. David Browner, a professor at the University of North Carolina says, "continuing our current development patterns and practices will lead to catastrophe. It is our obligation to move the world toward the objective of sustainability" [46, p.18].

The urban planning profession has seen an evolution of orientations through its history, beginning with the City Beautiful Movement at the turn of the 20th century, through garden cities in the 1920s, social awareness paralleling with civil rights movements in the 1960s, and resource conservation and environmental awareness in the 1970s. Collectively, these aspects when combined with transportation and land use comprised the comprehensive planning movement of the 1950s and 1960's [43, p.1].

City planning has tended to focus on the need to solve pressing problems of a particular time. The polycentric form produced during the 1960-1990 growth boom that created a much larger and more decentralized city is largely in place. In many cities, the 1990s are expected to be a time to absorb vacant commercial space built in the boom years, and a time to develop growth management techniques to meet chronic housing and transportation problems. Other social problems, including poverty, crime, and illegal drug trade must also be addressed [43]. The public outcry of regarding environmental issues and the international call for sustainability are seen as contemporary needs which should be incorporated into current city planning.

Urban planning is an advisory function of decision-making to the broad based

interdisciplinary process that design to solve a wide range of urban problems.

Components of planning may be divided into four broad categories:

- (1) planning for physical development, (2) planning for economic development,
- (3) planning for capital improvements and public facilities, and (4) long-range planning for social well-being. Timothy Beatley wrote:

Sustainability is a fundamental organizing principle against which to evaluate all of a community's proposed actions and policies. It implies a search for creative ways of accomplishing change. Sustainable communities treat land use, the environment, housing, transportation, social services, and safety as overlapping issues that require integrated strategies [7, p.16].

The Sustainable City

Definitions of sustainable development and sustainable communities are still evolving. Sustainability has gained an official meaning through several international conferences, but the concept is also modified by governmental agencies, both international and in the United State. For example, the White House announcement of the U.S. President's Council on Sustainable Development uses the term "Sustainable Development" to put more emphasis on economic growth policies to correspond contemporary interests. The Seattle Regional Plan referred to sustainability as a "three legged stool, combining economic opportunity, social equity, and environmental responsibility" [96, p.1]. Among those different perspectives in planning for sustainability, there are some basic beliefs:

Recognition of Ecological Limits. City planners must accept the ecological limits of their communities. The contemporary pattern of urban growth and development is not sustainable. Such development is characterized by low-density,

scattered, land-consumption patterns, and is heavily dependent on the automobile.

The impact of such patterns on the environment are: air and water pollution; loss of animal habitat, wetlands, and other sensitive lands; loss of farmland and open spaces; and excessive energy consumption. These are all results of ecologically unsustainable patterns of growth and development [6, p.10].

Population growth will be the major problem planners and designers confront. Because it relates to the issues of housing, work places, spatial organization, transportation, environmental damage, and environmental resource consumption. Predictions are the global population levels may rise to approximately 12 billion by 2050, from the current 5.6 billion, and that U.S. population will likely rise to 330 million by 2020 [11]. A move in the direction of sustainable communities requires a serious and critical assessment of such impacts and an intelligent attempt to plan sustainability implementation [6. p.10]. Sustainable communities acknowledge local, regional, and global carrying capacities of the environment, and respect the Earth's carrying capacity--the finite limits to land, energy, water, and other resources, and the extent to which natural systems can assimilate human wastes [6. p.11].

Sustainable communities seek ways to reduce the environmental damage caused by humans. In a practical sense, changes in the form and operation of urban communities to make them more sustainable must include: more compact and contiguous high density development patterns; mixed land uses, greater reliance on mass transit, bicycles and walking; emphasis on infill; solid waste reduction and

recycling programs; avoidance of ecologically sensitive lands. They must require serious efforts at energy conservation and the development of renewable resources, and the encouragement of green industries, and a environmentally friendly economic basis [6].

Integrated Holistic Approaches. Sustainable communities employ strategies and solutions that integrate holistic. They look at multiple objectives. For example, instead of encouraging constructing more roads and highways in response to traffic congestion, land use and development decisions that reduce demands in the first place. They see that transportation investment and land use are integrated and coordinated to accomplish a variety of common goals; including air quality enhancement, open space preservation, and affordable housing [6].

Social Equity. The concept of sustainable communities, though, is not only an ecological sustainability, but also a social sustainability. Contemporary patterns of development are not sustainable socially. Contemporary patterns of development are often inequitable and unjust, serving to sharply separate income and racial groups. Such developments are neither sustainable nor community-based [6, p.10].

An Ethical Posture. "Ethics of development" is another source of sustainable community development. The evolution of environmental ethics associated with development (land and resource use) can be traced back to its roots in the United States in the wilderness preservation movements of the late nineteenth and early twentieth centuries. The notion of sustainability originates, in one way, from the ideas of ecology. An early example of environmental ethics was suggested in the

essay *The Land Ethic*, written by Aldo Leopold in 1949. In the essay, Leopold stated: "there is yet no ethic dealing with man's relation to land and the animals and plants which grow upon it....the extension of ethics to this third element in human environments is....an evolutionary possibility and an ecological necessity..."[96, p.3].

Subsequent books of classic environmentalism built on these ideas, including *Soil and Civilization* by Edward Hyams (1952), and *Topsoil and Civilization* by Dale and Carter (1955) which states, "the destinies of most of man's empires and civilizations were determined largely by the way the land was used" [96, p.4].

The dilemma or intrinsic contradictions among growth, development and limited resource problems was expressed by Richard Meier in his book, *Planning for an Urban World: The Design of Resource Conservation* (1974). In the 1960s, when Meier was working on development plans in developing countries, he addressed the need for a conceptual framework that indicated "how an assembly of new facts and ideas might shift strategies for development" [53, xii]. He writes,

That framework did not exist in any single discipline,...(it is) a number of cross-level principles. The achievement of social justice, also to introduce a major reformulation of city planning that will soon be needed" [53, pp.xii-1].

E.F. Schumacher attempted to bridge economics, technology, natural resources and developing world cultures, through the concept of intermediate and appropriate technology in a chapter "The Proper Use of the Land" in his book, *Small is Beautiful: Economics as if People Mattered* (1973) [96].

Visions of Sustainable Design

The idea that the physical environment affects the social environment has long enjoyed support among planning related professionals. The urban environment is made up of a number of elements, and the process of manipulating these elements is a major part of the designer's concern. The physical form of a city is usually classified as either geometric or organic. Building may also be kinetically or sequentially ordered. Using the elements of change and modulation, the environment is divided into a series of zones which creates a progression of visual expressions.

Another important factor that influences the physical form is the transportation network. It divides public and private areas and channels the flow of traffic, both pedestrian and vehicular. Transportation networks are geometric and can usually be classified as either net or tree type. The provision of open space within the urban form has become a major concern of urban design. The incorporation of amenities into urban design is important and is unique to both the culture and the setting of city (Figure 4-Figure 7).

Urban design is a difficult term to define. It is correct to say that urban design involves both planned and unplanned efforts. The term urban design as used today, however, usually refers to a planned effort at producing results that are aesthetically pleasing, as well as socially redeeming [7]. The ideology of urban design usually involves one of three philosophies. One ideology is concerned with creating an ideal social environment. One such concept that worked successfully in England during the first half of this century was proposed by Ebenezer Howard. His



Figure 4 Welwyn Garden City,
Ebenezer Howard & Louis
Soissons

Source: Peter Calthorpe, *The Next American Metropolis: Ecology, Community, and the American Dream* (New York: Princeton Architecture Press, 1993).

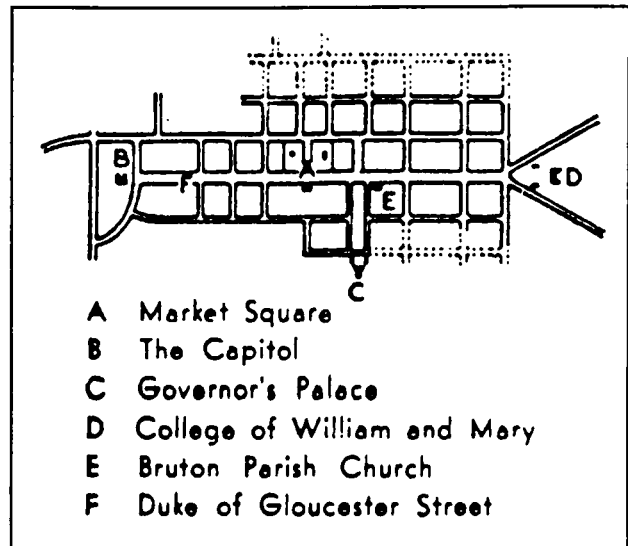


Figure 5 Williamsburg Settled in 1632

Source: Simon Einser, Gallion Arthur, and Stanley Einser, *Urban Pattern* (New York: Van Nostrand Reinhold, 1993).

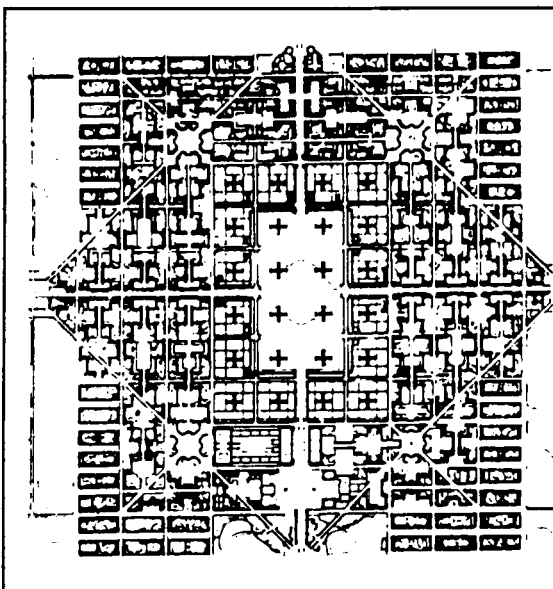


Figure 6 Contemporary City,
Le Corbusier

Source: *The Next American Metropolis*.

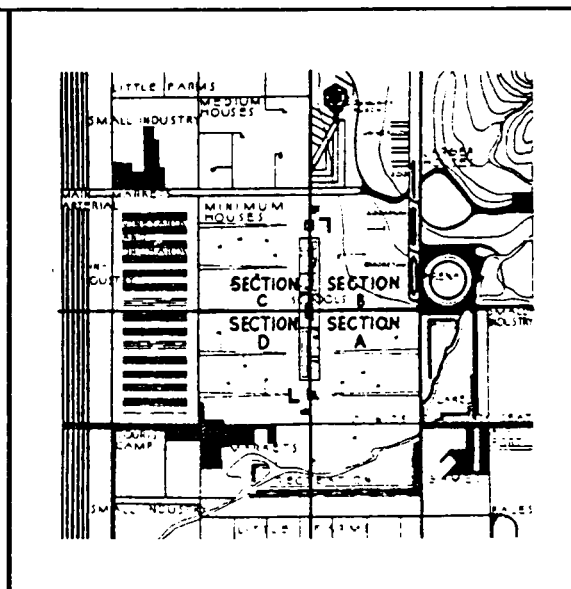


Figure 7 Broadacre City,
Frank Lloyd Wright

Source: *The Next American Metropolis*.

garden city proposal sought to provide a low-density living environment where social life could be promoted on a human scale by limiting the population to 30,000.

Several of these landscaped small cities could be clustered around a central city whose growth, in turn would be limited by the presence of garden cities (Figure 4).

A second ideology is that of creating a city based on aesthetic principles. The English Renaissance style found in colonial Charleston, Williamsburg demonstrates this philosophy (Figure 5).

Another ideology combines social and physical ideals. Le Corbusier and Frank Lloyd Wright developed proposals for cities of this nature. Le Corbusier proposed a city with high-rise development situated in an extensively landscaped common public space in a park like setting (Figure 6). Wright's proposal suggested an environment that would maximize individual freedom. In his Broad Acre City, each lot occupied one acre (Figure 7).

C.A. Doxiadis proposed another style, called Ecumenopolis. It refers to a continuous form of settlement consisting of cities and their surrounding agricultural support areas that Doxiadis envisioned evolving across the earth. In his hierarchical urban organization, the key element to the ecumenopolis form is its focus on proportions that are sustainable for humans. A city in this system would be limited to dimensions that are humanly manageable, such as walking distances of a maximum comfortable range of about 10 minutes. A population of about 50,000 is seen as the maximum community size for physical, mental and social well-being. An area of 7,000 square feet would contain a single city cell. Several cells would be

linked into an integrated whole by communication and transportation systems [27].

Not all urban designers agree that cities must be built on a modest scale to incorporate the human dimension. Paolo Soleri, for example, believes that his high density, three-dimensional cities are also designed to accommodate the human scale. The concept of *arcology*, based on a blending of architecture and ecology, infuses Soleri's city. Each city uses its local setting to take advantage of natural heating and ventilation processes, to conserve land, and to minimize energy consumption. His cities can be up to several hundred stories in height, housing a half-million people or more. They incorporate all functions of industry, commerce, housing, agriculture and transportation under a single roof. Soleri's cities are quite unlike the sprawling two-dimensional cities we have today. He feels that the present city style alienates people because of the irrational placement and separation of activities. Many observers have linked Soleri's approach to a "rat colony," pointing out that when rats are overcrowded, their behavior degenerates. Soleri purports that his approach creates minimal environmental disruption and energy exploitation, whereas traditional cities use up excessive quantities of land and green space [37, p.449] (Figure 8).

Current Sustainable Cities Project Examples

In the United States, the concept of sustainable development has been advanced by several recent developments. In cities across the country, information networks and "sustainable community" coalitions have been formed to promote the concept. Following are the examples listed in an article, "Sustainability Comes To

Main Street," by Timothy Beatley in *Planning* magazine of May, 1993 [7].

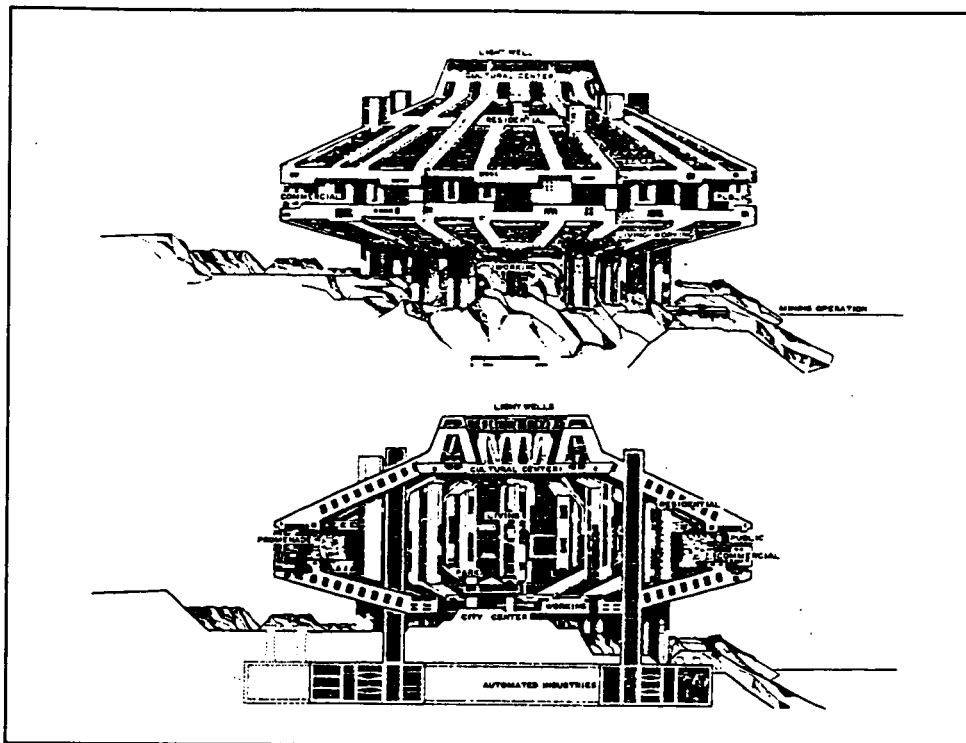


Figure 8 Arcology and the Three-dimensional City

Note: Paolo Soleri envisions an ideal urban environment in which residential, cultural and work spaces cluster together in one setting in conjunction with public and commercial uses. Sources: Paolo Soleri, *Arcology* (Cambridge, Massachusetts: MIT Press, 1969).

Many localities already have begun to protect sensitive land through open space preservation and growth management systems. Boulder, Colorado, designated more than 20,000 acres of open space. Austin, Texas, in collaboration with Travis County and others, has developed a wildlife habitat conservation plan covering some 30,000 acres.

Sustainable communities are coalitions work to reduce the exposure of people and property to natural hazards. In North Carolina, both Charlotte and Raleigh have created greenways that lessen flood hazards and create public open spaces. Portola

Valley, California, is steering new construction away from areas of high geologic risk, and Los Angeles requires that buildings be retrofitted to withstand earthquakes and other natural hazards.

Sustainable communities seek to reduce air and water pollution and the consumption of nonrenewable resources. In 1990, for example, Toronto, Canada resolved to reduce its net carbon dioxide emissions by the year 2005. Portland, Oregon, has attracted commuters from their cars into an extensive light rail system. Davis, California, has long pushed for bicycle use. The "Sustainable Cities Project" has focused on energy conservation activities in three cities, San Jose and San Francisco, California, and Portland, Oregon. This energy focus of the sustainable community approach will be discussed in detail in Chapter IV.

Many cities have attempted to reduce solid waste through curbside recycling programs and collection pricing systems. Seattle, Washington, has set a goal of reducing its waste stream by 60 percent in the next five years and through its recycling and waste reduction efforts, is moving in that direction. Berkeley, California, prohibits the use of CFC creating polystyrene plastic foam containers. Austin, Texas has a Green Builder program for evaluating the ecological soundness of design and building materials proposed by participating builders.

Sustainable communities try to lessen the wasteful consumption of land by promoting compact and contiguous development patterns by encouraging infill development. Boulder and Portland have imposed urban growth boundaries to contain sprawl, to separate urban and rural areas, and to protect open space.

Reducing urban sprawl and encouraging high average densities helps, in turn, to achieve many of the goals of environmental sustainability, from energy conservation to sensitive lands protection.

Sustainable communities promote a sense of place. The city of Denver, Colorado has for many years restricted development in certain view protection zones to ensure the city's visual connection to the Rocky Mountains. Sustainable communities are also aesthetically pleasing and visually stimulating.

Such communities share a concern for all their citizens. They involve all social and economic groups in decision making. A socially just city provides equal participatory opportunities to all its residents. Sustainable communities provide housing opportunities for all residents. Under Oregon's state land-use planning law, for example, all cities must ensure that enough land is zoned to accommodate the full spectrum of housing types. In New Jersey, state law obliges localities to provide their fair share of the affordable housing needed in their region.

Some of these sustainable city examples were presented at the 1991 The First Ecological City Conference (Ecocity) in Los Angeles. For example, in the Ecocity Conference, a plan by Joseph Smith of Thousand Oaks, California for converting an old shopping center in Anaheim, California into a sustainable community was included. Other leading architects and planners, like Peter Calthorpe, are publishing and gained recognition by producing a model of a "transit oriented development" for 1000 Friends of Oregon. In Calthorpe's plan, the light rail station is surrounded by the village green, with commercial development and high-density housing nearby.

Radial streets connect to the town house and single family neighborhoods [46, p.19]

(Figure 9.1-9.2, 10).

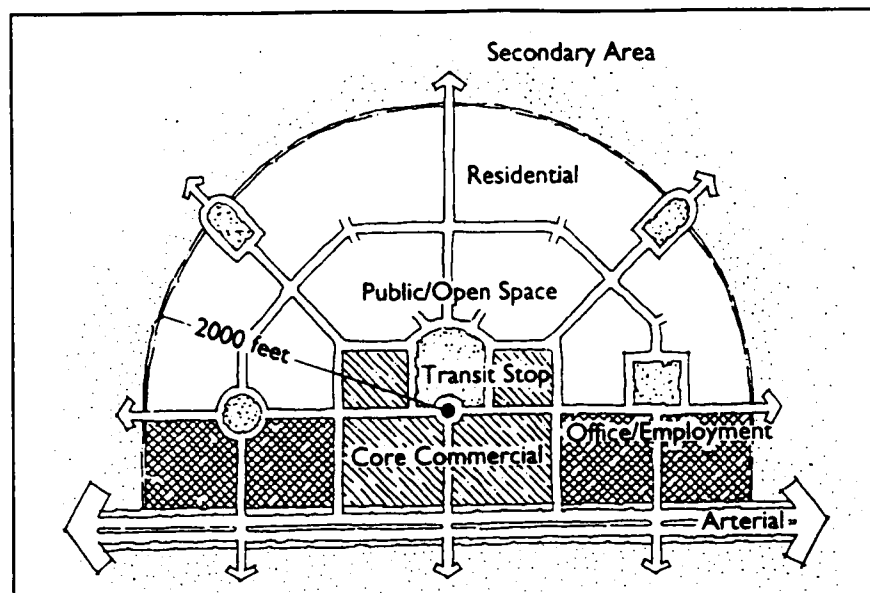


Figure 9.1 Transit Oriented Development (TOD)

Source: *The Next American Metropolis*.

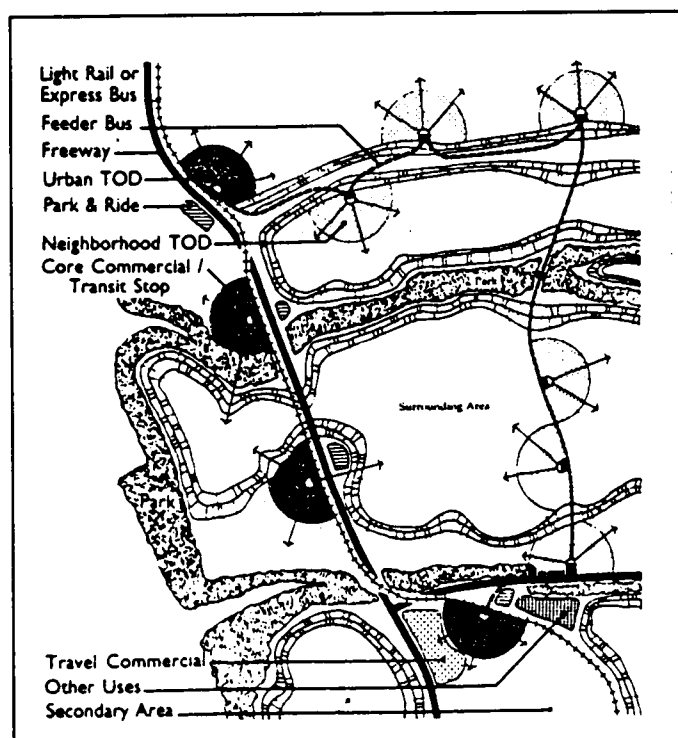


Figure 9.2 Transit Oriented Development (TOD)

Source: *The Next American Metropolis*.

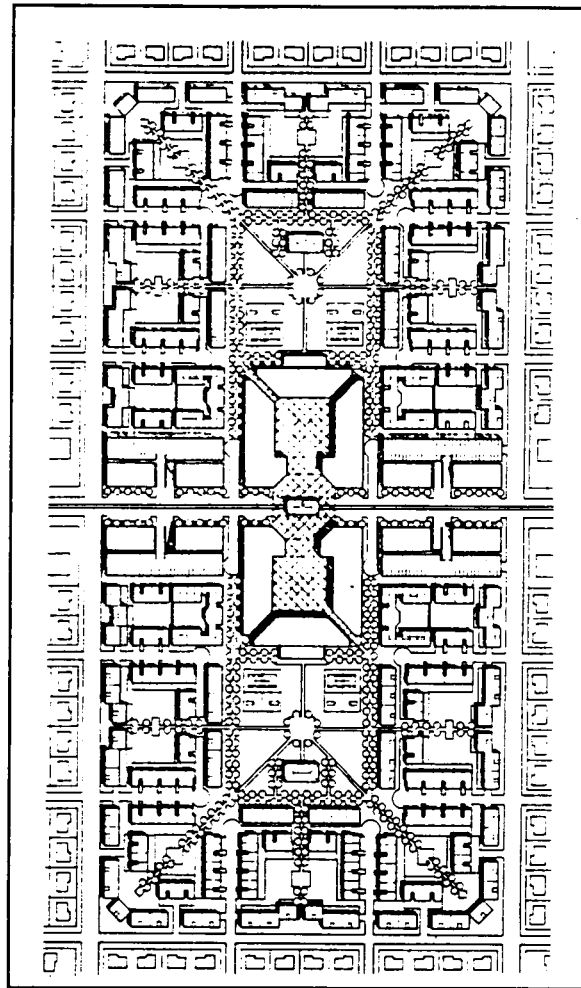


Figure 10 Pedestrian Pocket
Source: *The Next American Metropolis*.

Putting It All Together

Sustainable community is a catch-all term. Under the term, there are many goals and programs. So far each organization and each municipality interpret sustainability based on their own environment, situation and political situation. The problem is that we are not sure that these interpretations of sustainable development actually bring the sustainability. We know that the ozone layer is thinning. The world leaders in 1990 agreed to a protocol that allowed a 50 per cent increase in

CFC output before phasing it out. But we do not know for certain, for which the consequences of these changes are. We can make efforts to direct the future, but what we believe to be sustainable may not bring sustainability. These uncertainties make planning for sustainable framework difficult.

The goal of development is to improve the quality of life, though there is some debates about what constitutes quality of life. Indicators of development range from statistics, such as those relating to life expectancy and literacy, to less measurable evidences of environmental quality and cultural spiritual fulfillment. Increasing Gross National Product (GNP) can provide the means to meet basic needs and improve living conditions, but it does not guarantee a humane "quality of life" for all citizens.

Caring for the Earth pointed out: "No nation has a system of resource use and social policy that is likely to be sustainable without major adjustment. Those adjustments begin with steps to enhance the quality of human life" [84, p.7]. The transition to sustainability requires a much more effective use of resources, as well as greater accountability for the environmental and economic impacts of such use.

The call for action to achieve sustainability is becoming louder. More and more people are becoming aware that development and environmental protection are interrelated issues. High-income and high consumption countries should give priority to curbing wasteful over-consumption and pollution. National polices and development projects should take full account of their effects on the environment. They should include the cost of natural resources depletion in determining the value

of environmental quality in national accounting systems. There has been an incremental implementation of the idea of sustainable development, however, cities and community have the potential to promote sustainability in meaningful ways. A sustainable community approach is a key that has the potential to connect many elements in compelling ways. In the next chapter, the energy aspect in urban planning is the focus to help localities respond to sustainability challenges.

CHAPTER III

ENERGY PLANNING: A FRAMEWORK FOR LOCAL SUSTAINABILITY

The Multifaceted Energy Crisis

Energy and Environment

To deliver energy to an end user, energy resources generally must be explored and discovered, extracted, collected, processed, and transported [42, p.146]. It takes energy to get energy.

Also, waste streams are a byproduct of that process. The major impacts of energy use on the environment are air pollution, water pollution, solid waste disposal, degradation of land, effects on health and quality of life, and the possibilities of large scale disasters. For many energy resources, especially nuclear power, the key environmental issue is risk. Risk is real as demonstrated by the Three Mile Island, and Chernobyl nuclear reactor failures. Waste heat is emitted and other environmental degradation may result such as destruction of a certain kind of species due to micro temperature change of its habitat. Many ecologists feel that the biosphere is limited in its ability to absorb waste heat. This limitation could conceivably result in a disrupting of global climatic patterns--perhaps leading to a diminished ability of the earth to support human life [38].

Energy is at the very center of many of the current concerns over the global environment and the degradation of local, regional and national environments. Beginning in the mid 1980s, nations witnessed a flurry of concern about world

energy use. Many scientist believe that the future health of the planet rests in controlling energy use, at least until energy sources can be developed that do not produce dangerous emissions [79]. At the Rio Earth Summit meeting in June, 1992, the deliberations of the world's government leaders demonstrated that the interrelations among the issues of global energy, environment, and economic development have become critically important to the earth's future. Issues raised were resource depletion, potential global climate change, acid rain and air pollution. The issues raised in those debate were:

Resource Depletion: The modern, industrialized, energy-rich lifestyle has a major impact on natural resource use. Since World War II, the world's energy consumption has increased about fourfold, most of it in the use of fossil fuels. A study completed in the 1970s envisioned that the real energy crisis was the depletion of both United States and foreign supplies of economically recoverable reserves of petroleum, natural gas, and uranium, would occur in the year 2000 to 2020. As a result, human societies will be forced to decrease thus per capita use of energy and there standards of living. Today, technological advances have increased depletable energy resources by making it possible, for example, to extract oil from sand shale. However, the non-renewable resources, if we continue to exploit them, is still finite (Figure 11,12).

Potential Global Climate Change: Burning coal, oil and natural gas produces carbon dioxide (CO₂), "The atmosphere now contains 25 percent more CO₂ than it did a century ago" [79]...."CO₂ buildup--which accounts for about half of the

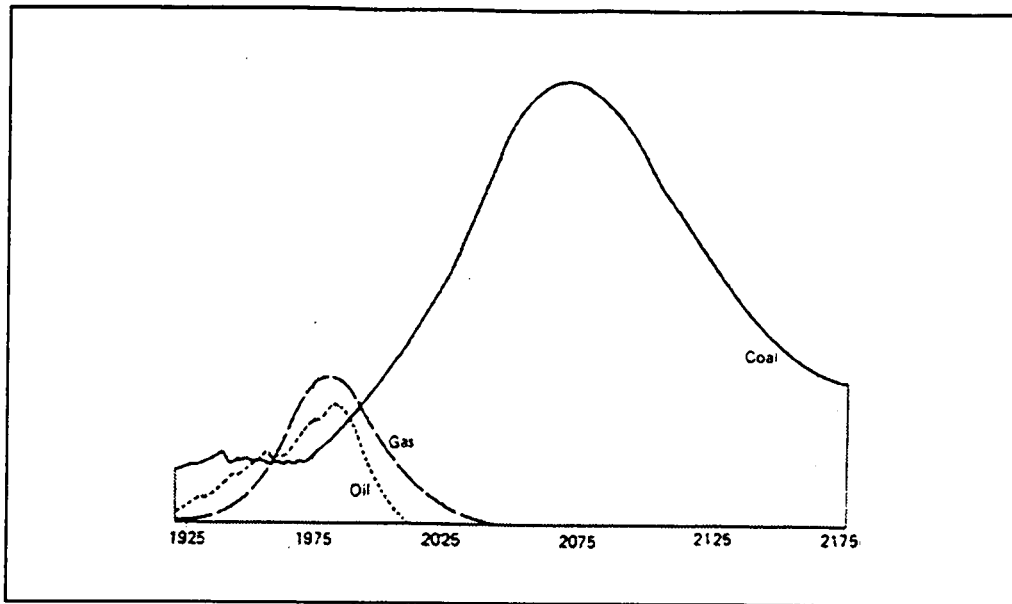


Figure 11 Fossil Fuel Reserves

Source: Based on Benjamin Stein and John S. Reynolds, *Mechanical and Electrical Equipment for Buildings* (New York: John Wiley & Sons, Inc., 1992).

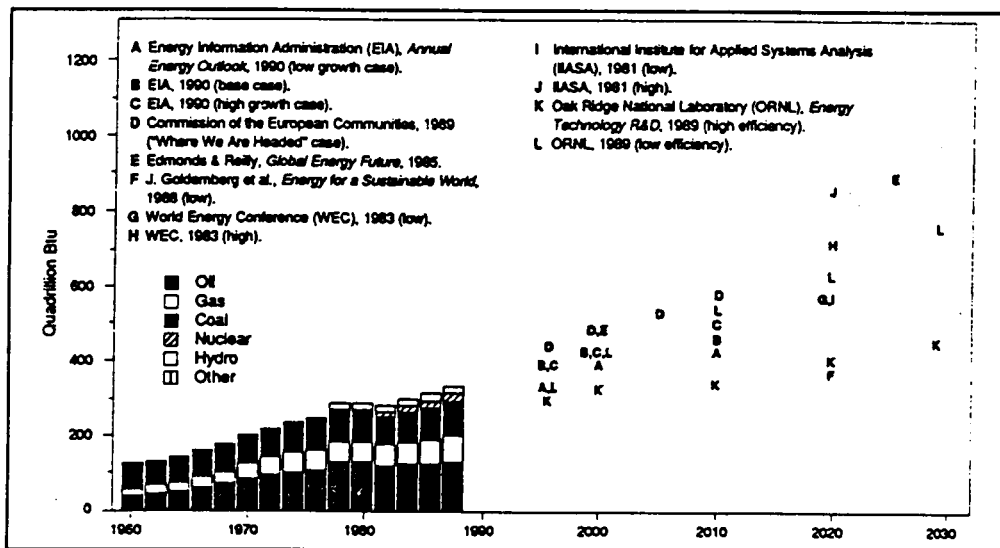


Figure 12 Historical and Projected World Energy Consumption, 1970-2030

Note: Differences in projections are caused, in part, by varying assumptions concerning energy prices, economic growth, consumer and producer behavior, and rates of technological change, including replacement of capital stock. The shaded area represents an envelope bracketing these differences.

Source: U.S. Department of Energy, *National Strategy: Powerful Ideas for America* (Washington, D.C.: U.S. Government Printing Office, February 1991).

greenhouse effect--can be traced to the burning of those fuels" [21]. Human fossil fuel burning accounts for 3% of total global annual carbon emissions. The emissions from soil forests and oceans account for 96%, although each of these also provides a substantial carbon sink [79]. Global energy experts say conservation and efficiency are the cheapest and fastest ways to cut carbon emissions. The Worldwatch Institute says efficiency alone could cut global CO₂ emissions from today's 5.6 billion tons to 2.6 billion tons a year by 2010 [79].

Many of the poorest developing countries are the most likely to suffer global climate change--because they lie in tropical latitudes and are often afflicted by drought and famine already, or by inundations of coastal zones and deltas (Table 7.1-7.4).

Acid Rain: Power plants that burn coal often emit sulfur oxides and nitrous compounds that combine with monoxide in the air to develop acid rain. Nitrogen oxides, too, are responsible for acidic rain. They are also formed when cars are used. The revised Clean Air Act (1990) is expected to cut emissions of sulfur and nitrous oxides by conservation [21].

Air Pollution: According to the Worldwatch Institute, the world environment can no longer tolerate the existing level of carbon dioxide emissions produced by use of fossil fuels [10]. Many U.S. Cities are now spending millions of dollars to comply with the new federal Clean Air Act's smog requirements. The American Lung Association says that health costs from smog-related respiratory diseases add as much as \$90 billion to the nations' medical bill each year [77, p.61]. In addition to

Table 7.1 Illustrations of Possible Long-Term Impacts of Energy Use on Climate

Case	1990	A		B		C	
		2050	2100	2050	2100	2050	2100
Global Energy Demand (Gtoe)	8.8	27	42	23	33	15	20
Fossil Fuels (% of Primary Energy)	77	58	40	57	33	58	15
Nuclear (% of Primary Energy)	5	14	29	15	28	8	11
New Renewables (% of Primary Energy)	2	15	24	14	26	20	50
Annual CO ₂ Emissions from Fossil Fuels (GtC)	5.5	13.7	15.3	11.3	10.8	6.7	2.3
Annual CO ₂ Emissions from Fossil Fuels and Traditional Fuels (GtC)	5.9	14.3	15.9	12.0	11.4	7.2	2.8
Annual CO ₂ Emissions from Fossil Fuels % Change on 1990		+149	+178	+105	+96	+22	-52
Atmospheric CO ₂ Concentrations (ppmv)	355	536	708	494	617	449	469
Increase in Atmospheric CO ₂ Concentrations - Change on 1990 (ppmv)		+181	+353	+139	+262	+94	+114

Table 7.2 Atmospheric CO₂ Concentrations (parts per million by volume)

	IS92a	WEC Case			
		A	B ₁	B	C
1990	355	355	355	355	355
2020	426	434	426	416	404
2050	523	536		494	449
2100	733	708		617	469
Note: The pre-industrial atmospheric concentration of CO ₂ (1750-1800) is believed to have been 280 ppmv					

Table 7.3 Rise in Global-Mean Temperature (°C) on 1990 Levels

	IS92a	WEC Case			
		A	B ₁	B	C
2020	0.52	0.56	0.53	0.49	0.44
2050	1.16	1.22		1.02	0.82
2100	2.46	2.42		2.05	1.37

Table 7.4 Rise in Mean Sea Level (cm) on 1990 Levels

	IS92a	WEC Case			
		A	B ₁	B	C
2020	9.3	9.6	9.4	9.0	8.5
2050	21.9	22.9		20.2	17.6
2100	48.0	48.2		42.4	32.6

Note: The World Energy Council's (WEC) Commission makes three cases for a realistic framework for the solution of regional and global energy issues in the report *Energy for Tomorrow's World*. The base case, "Case B-References", which is an update for 2020 based on the Dr. J. R. Frisch and the PMU of the Moderate Economic Growth Scenario in the report *World Energy Horizon 2000-2020*. This results in a projection which indicates only a slight increase in energy demand (6%) from 1990 to 2020. This scenario gives a global energy demand by 2020 of 13.4 Gtoe. "Case A-High Growth", which assumes a higher economic growth in developing countries, 1% p.a. higher than the Case. These changes would drive global energy demand up to about 17.2 Gtoe. "Case C-Ecologically Driven" assumes a greater improvement of energy intensity than Case B (2.4% p.a. instead of 1.9% p.a.) which curbs the global energy demand to 11.3 Gtoe by 2020.

Source: *Energy for Tomorrow's World*.

smog's direct health cost, losses to U.S. agriculture are estimated to be \$5 billion a year, a loss that drives up food prices [77].

The environmental and health consequences associated with various cycles of energy production and consumption are, for a large part, very similar among energy sources. Differences exist mainly in terms of the magnitude of effects. Coal and uranium cycles, for example, are considered more troublesome environmentally than oil and natural gas because the quantity and composition of their toxic by-products predicate. Descriptions of environmental and health impacts of energy production and use are listed on Figure 13 (Figure 13.1-13.2).

The hierarchy of energy planning concerns is matched by a hierarchy of environmental concerns. First there are truly global problems, such as the potential worldwide warning due to the increasing accumulation of greenhouse gases like carbon dioxide, produced in fossil fuel combustion but not in nuclear power generation, or the pollution of the marine and oceanic environment by oil spills and other wastes.

Second in scale are the transnational issues such as acid rain, or the radioactive fallout in one European country due to nuclear emissions in a neighboring nation, or the excessive downstream siltation of river water in one nation, such as Bangladesh, due to deforestation of watershed and soil erosion in, another nation, such as upstream Nepal. There are the national and regional-scale issues, typically at the river basin level, such as those involving the Amazon Basin in Brazil. River basin development is generally for multiple purposes, bringing energy planners and

Gas	Greenhouse Effect	Stratospheric Ozone Depletion	Acid Deposition	Smog	Corrosion	Decreased Visibility	Decreased Self-Cleaning of Atmosphere
Carbon monoxide (CO)	+	1/- ^a					+
Methane (CH ₄)	+	1/- ^a					1/- ^c
NO _x : nitric oxide (NO) and nitrogen dioxide (NO ₂)	+	1/- ^a	+	+			
Nitrous oxide (N ₂ O)	+	1/- ^a					
Sulfur dioxide (SO ₂)	-		+				
Chlorofluorocarbons	+				+		
Ozone (O ₃)	+	+					

Part B. Concentrations of Gases Today and Predicted for the Future						
Gas	Major Anthropogenic Sources	Anthropogenic Total Emissions per Year (Millions of Tons)	Average Residence Time in Atmosphere	Average Concentration 100 Years Ago (ppb)	Approximate Current Concentration (ppb)	Projected Concentration in Year 2030 (ppb)
Carbon monoxide (CO)	Fossil-fuel combustion, biomass burning	700/2000	Months	7, n. hem. 40-80, s. hem. (clean atmosphere)	100-200, n. hem. 40-80, s. hem. (clean atmosphere)	Probably increasing
Carbon dioxide (CO ₂)	Fossil-fuel combustion, deforestation	5500/-6500	100 years	280,000	350,000	400,000-550,000
Methane (CH ₄)	Rice fields, cattle, landfills, fossil-fuel production	300-400/550	10 years	900	1700	2200-2500
NO _x gases	Fossil-fuel combustion, biomass burning	20-30/30-50	Days	0.001-7 (clean to industrial)	0.001-50 (clean to industrial)	0.001-50 ^d (clean to industrial)
Nitrous oxide (N ₂ O)	Nitrogenous fertilizers, deforestation, biomass burning	6/25	170 years	285	310	330 to 350
Sulfur dioxide (SO ₂)	Fossil-fuel combustion, ore smelting	100-130/150-200	Days to weeks	0.03-7 (clean to industrial)	0.03-50 (clean to industrial)	0.03-50 ^d (clean to industrial)
Chlorofluorocarbons	Aerosol sprays, refrigerants, foams	~1/1	60 to 100 years	0	About 3 ^a (chlorine atoms)	2.4-8 ^a (chlorine atoms)

Figure 13.1 Air Pollution and the Atmosphere

Note: ^a Gas contributes to the effect; ^b Gas ameliorates the effect; ⁺ Effect of the gas varies. ^b Effects depend on the altitude. ^c Generally ameliorates the effect in the northern hemisphere, contributes to effect in the southern hemisphere. ^d Concentrations over highly industrial sites may not rise much, but the number of such chlorine atoms because the molecules generally contain more than one ozone-destroying atom.

Source: Thomas E. Graedel and Paul J. Crutzen "The changing atmosphere," *Scientific American* (Scientific American Inc., September, 1989).

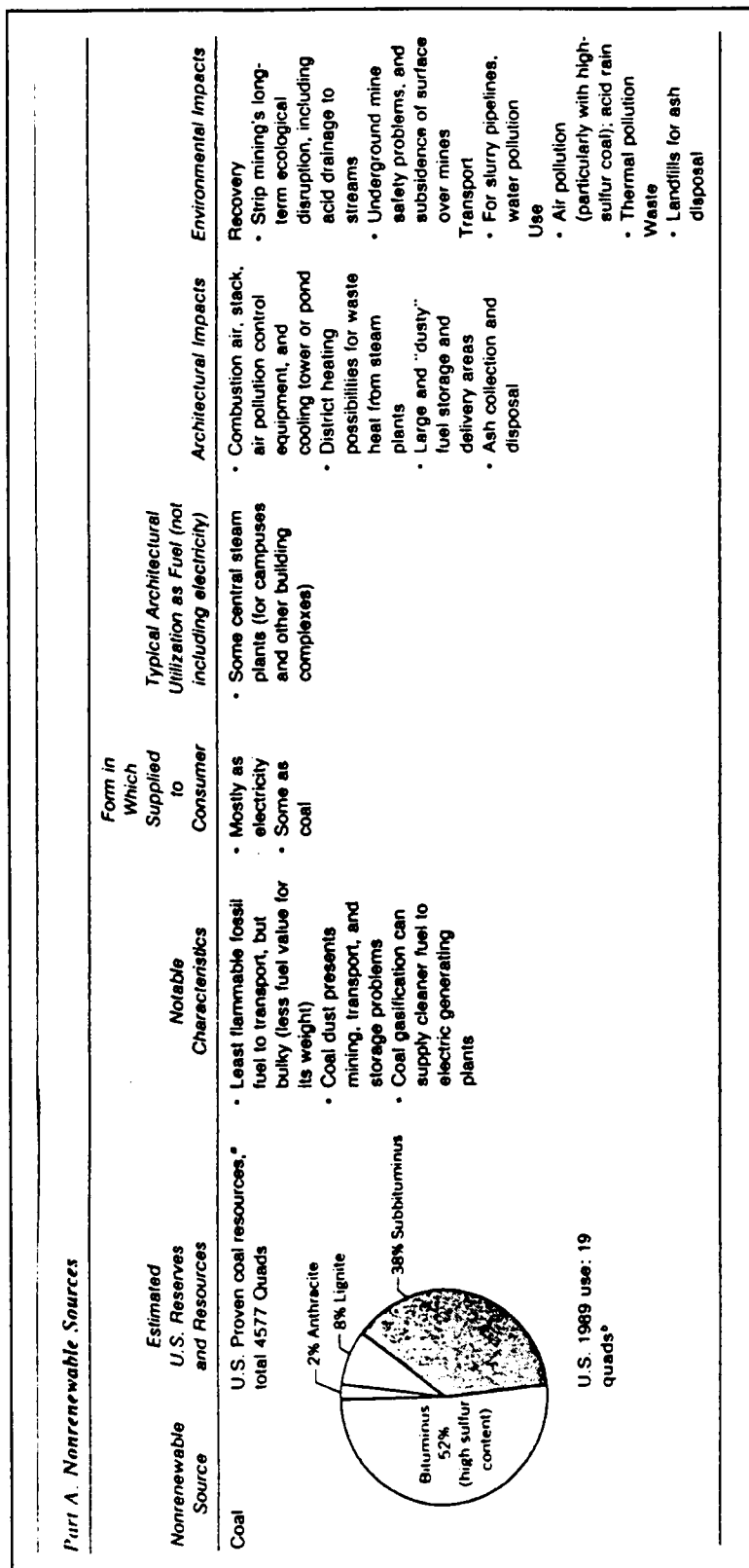


Figure 13.2 U.S. Energy Sources and Environmental Impacts

Part A. Nonrenewable Sources (Continued)

Oil U.S. Oil resources* (estimated recoverable in billions of barrels) 1 quad = 0.17 billion barrels Shale oil 1,026 Conventional Reserves 27 Potential 133 Unconventional Tar sands 15 Heavy oil 30 Geopressured zones 3000 U.S. 1989 use: 34 quads	• Flammable but less explosive than natural gas, readily transported • Stored on site where used • Fuel-price manipulation by cartels • Mostly as gasoline • Much as fuel oil • Much as electricity • Some for nonenergy usages • Space heating • Some water heating • Some central steam plants • Some large motors • Combustion air, flue (and waste heat recovery opportunities) • Oil storage tank and delivery area Recovery • Offshore oil spills • Saltwater intrusion and surface subsidence near oil fields Transport • Oil spills, especially on water • Pipeline causes ecological disruption, especially during construction Refining • Air and water pollution Use • Air pollution • Thermal pollution
Natural gas U.S. Natural gas resources* (in trillion cubic feet) 1 quad = 1 billion ft³ Devonian shale 600 Coal seams 500 Conventional Reserves 195 Potential 1,019 Unconventional Tight sands 800 U.S. 1989 use: 19 quads	• Explosive, harder to transport and to store • High fuel content burns relatively cleanly • Distributed by piped networks (except as propane) • Mostly as natural gas • Much as electricity • Some for nonenergy usages • Space heating • Water heating • Cooking • (Some lighting, cooling) • Some central steam plants • Combustion air, flue (and waste heat recovery opportunities) • Meter accessible to utility • Care in locating gas lines, especially underground on site • (For propane, outdoor storage tank, and delivery area) Transport • Pipeline causes ecological disruption • For liquefied natural gas, potential for a spreading icy vapor cloud, which is highly explosive • For bottled gas, hazard of explosive contents under pressure on site with buildings Use • Air pollution (though less than with oil, coal) • Thermal pollution • In fuel cells, almost no pollution

Figure 13.2 U.S. Energy Sources and Environmental Impacts (Continued)

Nonrenewable Source	Estimated U.S. Reserves and Resources	Form in Which Supplied to Consumer	Typical Architectural Utilization as Fuel (not including electricity)	Architectural Impacts	Environmental Impacts
Uranium	- U.S. uranium recoverable reserves: 220 Quads* - U.S. 1989 Use: 5.7 quads	Almost all as electricity	(Radioactive materials utilized in some medical and scientific equipment)	(Radioactive materials require heavy shielding for delivery, storage, use, and waste pickup areas) "Fallout shelter" designation for qualifying spaces	- Recovery - Mining problems similar to coal, less bulky, but with additional problem of radioactive tailings - Transport - Radiation shielding and security needs for nuclear wastes - Refining - Large amount of energy consumed in fuel enrichment - Radiation shielding and security needs for waste reprocessing - Use - Potential for catastrophic radiation release - Radiation shielding and security needs - Thermal pollution - Waste - Long-term radiation shielding and security needs
Geothermal energy	U.S. potential* estimated 18.5 quads/year	Renewable, from earth's core, but millions of years after heat is removed from outermost layers of rock	Direct heating of buildings	"Hot springs" water often highly corrosive - Source usually must be very near to point of use	- Unknown impacts of large-scale removal of heat from outer crust - Subsidence of surface is possible where water is removed without recharging to the earth

Figure 13.2 U.S. Energy Sources and Environmental Impacts (Continued)

Part B. Renewable Sources				
Renewable Source	Estimated Maximum U.S. Arrival Rate (quads (10 ¹⁵ Btu) per year)	Notable Characteristics	Form in Which Supplied to Consumer	Typical Architectural Utilization as Fuel (not including electricity)
Solar radiation	47,000 ^a	• Thinly spread, with large daily and seasonal variations in most of the United States		
Fuel wood	Estimated U.S. yearly capture ^a by year 2000 3 ^d			
Farm waste	6 ^d	• Methane gas highly explosive	• Wood fuel • Methane gas • Gas or oil	• Daylighting • Space and water heating • Some cooling • Some cooking (wood and gas)
Photosynthesis fuel	15 ^d			
Solar heating and cooling of buildings	9 ^e		• Heated air or water	• Window and skylight areas for daylighting • Internal arrangement of thermal storage materials in passive solar buildings • Large collectors, storage volumes • Less densely built complexes for solar buildings
Photovoltaics	7 ^e	• Varies with seasonal river flows	• Electricity	
Hydropower	9 ^e		• Electricity	
	U.S. 1989 use: 3 quads			
Wind power	6 ^e	• Varies considerably between sites	• Electricity	
Waste paper and plastic incineration	2 ^f		• Electricity	• Air pollution • Thermal pollution
Tidal power	3 ^g		• Electricity	• Ecological disruption of estuaries

Figure 13.2 U.S. Energy Sources and Environmental Impacts (Continued)

Source: ^aNational Geographic Society (1981). ^bU.S. D. O. E., *Monthly Energy Review*. ^cFisher (1974). ^dStarr (1971). ^eJewell (1978). ^fR. Berry & H. Makino, "Energy thrift in packaging and marketing," *Technology Review*, 1974 by the Alumni Association of the Massachusetts Institute of Technology, Cambridge, Mass.

electric utilities concerned with hydroelectric development into contact with agencies involved in irrigation and regional development. Finally there are the local impacts associated with specific projects: acid drainage from coal mines, resettlement problems at the hydroelectric dam, the loss of wildlife habitat from a reservoir.

It is important to note that environmental influences are not limited to national boundaries, individual energy sources, or supply systems. Even in cases of national energy strategies, one environmental destruction may have global consequences. Just as the activities of different sectors within a national economy have impacts that affect the quantity, quality, and price of energy supplied, the activities of different nations create important transnational and worldwide effects.

Energy and Society

Fred Cottrell, a pioneer sociological analyst of energy and human societies, pointed out that "the energy resources of a given society set limits on the organizational and ideological characteristics that the society may exhibit" [22]. Cottrell reminds us that the survival of societies is dependent on the continuing flow of its characteristic energy resources. Interruptions in these flows foreshadow social dislocation and perhaps social change. For example, the exhaustion of wood supplies to fuel the Industrial Revolution in Great Britain during the eighteenth century stimulated the development of coal and steam as the predominant energy sources. In addition, all means of energy utilization involve environmental degradation.

Each year, over three million acres of prime agricultural land are developed.

However, Miller argues that the real energy crisis facing human societies today is food: "Perhaps half the world's population does not receive the minimum 2,000 calories of food per day required to maintain adequate health" [55, p.217]. Without food life is impossible. To get food, for example, growing and harvesting crops, energy is required. Most people deprived of this basic energy source are in underdeveloped nations and are deprived of the other benefits that energy can bring. In the short run, war and other forms of international politics trigger modern energy crises. Dependence upon external sources constitutes a vulnerability. Since supply lines are usually quite long, they are vulnerable to disruption. Two-thirds of world petroleum reserves are in the Persian Gulf, and the region's political instability has produced three oil price shocks in the past 17 years [55].

Miller pointed out that "today's energy crisis is policy crisis" [55]. The distribution of energy caused by inappropriate government policies is a key components of the problems. The power and narrow interests of oil companies and electric/natural gas utilities, and the absence of policies that reduce per capita energy consumption and waste contribute to the problem. Consequently, in spite of the energy policy crisis of 1985, in the Gulf oil crisis, has failed to develop a national energy policy that would decrease dependence on foreign sources of petroleum and natural gas, and promote the development of domestic and renewable natural energy sources, such as solar and wind.

A political scientist, Lynton Caldwell, suggested that, "if there is a comprehensive energy problem, it is a problem of choice and value in a world of

finite capabilities" [12, p.32]. The maturation of the energy crisis has been one of learning exactly what those choices and values are, and the costs and rewards of each particular choice. Part of the problem in making choices is our own cleverness, with respect to the arguments of environmental protection versus energy supply needs, of price mechanisms versus regulatory mechanisms for controlling energy use, of the links between Gross National Product and the growth of energy demand, of the risks and benefits of new technologies are expressions of society's problem: ie. how to choose; how to use the finite supplies of energy [60].

Energy and Economy

There is a direct relationship between energy use and social development. Sociologists and other social scientists typically use per capita annual energy consumption as a key, and sometimes the only, indicator of the level of social development [42]. The Figure 14 shows the close association between the level of development and the level of energy use in societies (Figure 14). The Table 8 demonstrates the importance of the level of social development in shaping energy use (Table 8).

Cook has estimated the per capita daily energy consumption of several historical and contemporary societies [19]. Primitive societies, according to Cook, consumed approximately 2,000 calories of energy per capita per day, nearly all in the form of food. Hunter-gatherer societies, early agricultural societies, and advanced agricultural societies consumed roughly 5,000, 12,000, and 26,000 calories of energy

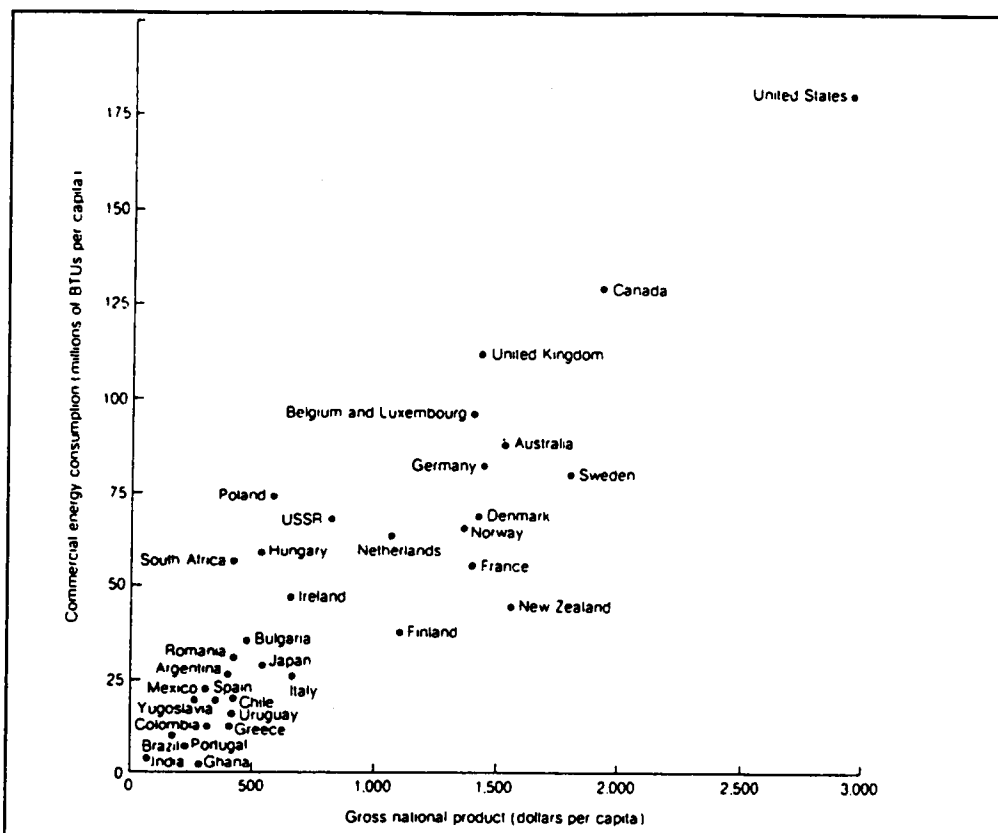


Figure 14 Relationship between per Capita Energy Consumption and Gross National Product for Selected Countries

Source: Earl Cook, "The flow of energy in an industrial society," *Scientific American* (Scientific American, Inc., 1971).

Table 8 Distribution of World Consumption, Averages for 1980-82

Commodity	Units of Per Capita Consumption	Developed Countries (26 per cent of population)		Developing Countries (74 per cent of population)	
		Share in World Consumption (per cent)	Per Capita	Share in World Consumption (per cent)	Per Capita
Food:					
Calories	Kcal/day	34	3,395	66	2,389
Protein	gms/day	38	99	62	58
Fat	gms/day	53	127	47	40
Paper	kg/year	85	123	15	8
Steel	kg/year	79	455	21	43
Other Metals	kg/year	86	26	14	2
Commercial Energy	mtce/year	80	5.8	20	0.5

Source: The World Commission on Environment and Development (WECD).

per capita per day, respectively. Early industrial societies such as nineteenth-century England consumed 70,000 calories of energy per capita per day. Modern industrial societies such as the United States have escalated their per capita daily energy consumption to 230,000 calories. It is important to recognize that the favorable living standards that modern industrial societies have been able to achieve are in substantial measure to their high levels of energy consumption [42].

The reason for this large amount of energy for societies is to achieve higher levels of per capita income and generally reflects the amount of goods and services produced in and consumed by these societies. Large amounts of energy are needed to perform the work from which these goods and services are derived.

High levels of per capita income, standards of living, and per capita energy consumption tend to be related because the energy converters and sources used by a society are related. Energy converters are technologies that enable humans to convert energy from a useless potential or kinetic form into useful work. The fact that primitive agricultural societies existed in regions with substantial deposits of petroleum, coal, natural gas, and uranium demonstrates that the existence of particular energy resources by itself does little to determine the amounts and types of energy used. Energy can only be converted if technologies and exist to convert it.

Energy Projections

It is likely that the pattern of energy source mix will change only modestly between 1990 and 2020 (Table 9). Carbon dioxide emissions are likely to rise globally over the next 30 years (Figure 15, Figure 16). However, one of the problems both scientists and policy makers are facing is that the uncertainty of the various linkages of causes and effects of today's unsustainable state of the world, and their net impacts. This presents a strategic dilemma faced by planners and practitioners.

It cannot be justifiably argued that the existing amount of pollution whether emissions which may have global impacts or is "economically optimal", in the sense that the costs of reducing pollution exceed the identifiable benefits. If this were the case, an economic cost-benefit appraisal might well be appropriate. The balance of costs and benefits would reflect society's judgement about the value of further reductions in pollution, but would also be consistent with continuing or increasing emissions which cause environmental damage. This is because the costs of stabilizing these emissions outweigh the benefits to be gained. The question includes '*opportunity costs*' by spending money on tackling emissions which may sacrifice other benefits. For example, the problem with greenhouse gas emissions is that their damaging effects have not yet been identified with precision or certainty. Yet potentially catastrophic real damage from the polluting effects and consequential climatic changes may already be occurring and getting worse. Yet these damaging effects cannot yet be reflected in a cost-benefit calculation.

Table 9 Change in Regional Fuel Mix 1990-2020 (percent)

	Fossil fuels:			Nuclear Energy	Renewables:			Total
	Coal	Oil	Natural Gas		Hydro.	Traditional	"New"	
North America	-21	-2	+21	+30	+28	+21	+332	+8
Latin America	+259	+122	+270	+767	+194	+43	+98	+142
Western Europe	+6	-6	+39	+44	+51	0	+284	+18
Central and Eastern Europe	-37	+37	+64	+145	+20	+25	+175	+9
CIS	-35	-6	+31	+47	+16	+19	+227	+6
Middle East and North Africa	+143	+120	+252	n.a.	+260	+81	n.a.	+172
Sub-Saharan Africa	+107	+334	n.a.	n.a.	+244	+112	+217	+158
Pacific ¹	+94	+64	+217	n.a.	+177	+18	+261	+89
(includes CPA) ¹	(+101)	(+173)	(n.a.)	(n.a.)	(+250)	(+18)	(+350)	(+112)
South Asia	+129	+245	+276	n.a.	+250	+43	+240	+128
World	+31	+36	+73	+80	+98	+42	+227	+52

¹ Data for the Pacific Region include Centrally Planned Asia (CPA), which are also shown separately.

n.a. Not appropriate to express the change as a percentage (zero or very low value in 1990)

Based on projection by WEC - Case B

Source: *Energy for Tomorrow's World*.

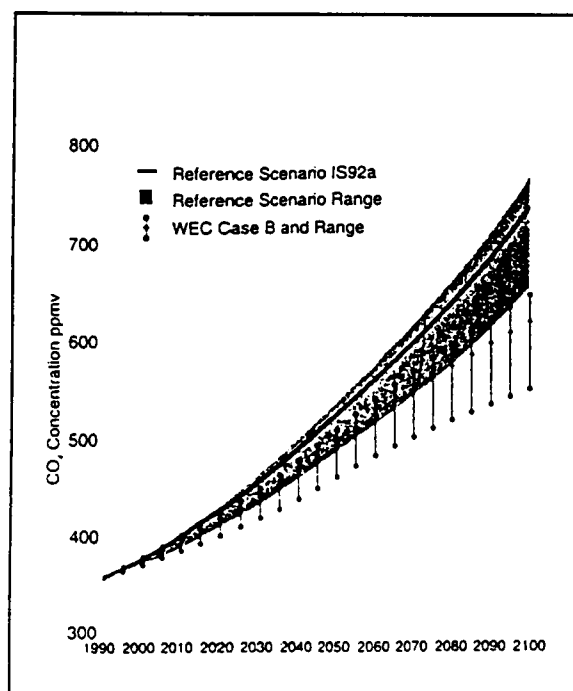


Figure 15 Atmospheric CO₂ Concentrations, WEC Case, B

Source: *Energy for Tomorrow's World*.

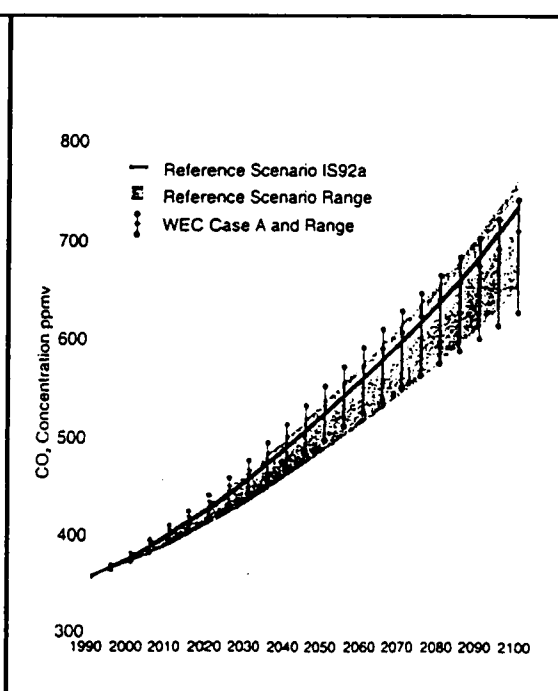


Figure 16 Atmospheric CO₂ Concentrations, WEC Case, A

Source: *Energy for Tomorrow's World*.

Nevertheless, within the context of what is economically and politically feasible, greater effort should be made to reduce local and regional pollution arising from energy perspective in terms of improved efficiency; cleaner fuels, improved distribution; full cost pricing and tighter regulation; more effective competition; and better information and education.

These policy proposals embody the essence of one of the major debate of our times: the trade-offs between economic energy efficiency and environmental gains. Gains in some areas almost always involve losses in others [99]. The network that distributes energy is making one ecosystem out of the world. Eventual One World concept applies not only to man, but to animals and plants as well [53].

By raising energy efficiency in use, and by adopting cleaner and more efficient technology in the conversion and provision of energy, environment impacts will be mitigated. The simple adoption of the economist's concept of opportunity costs, that the cost of having something such as, cleaner environment, is in other things foregone.

Energy and Urban Sustainability

Energy Use and U.S. Cities

There are many elements to be considered in the sustainable development approach to the urban setting. However, to take coherent approaches and avoid arbitrary actions, elements which prudently contribute to sustainability need to be sought.

In the industrialized nations more than four-fifths of all people live in cities. Increasing urbanization is a driving force behind non-renewable capital, material, and energy resources consumption and resulting environmental degradation. Environmental destruction is the principal limit on sustainability. Also the world at large is presently compromising the resources available to future generations.

Table 10 shows total electricity consumption and per capita consumption in the United States from 1960 to 1990 [42] (Table 10.1-10.2). These Tables of energy end uses can be somewhat arbitrary, depending on the types of categories and criteria used. Nevertheless, as Table 11 and Figure 17 shows, transportation and home heating constitute the primary U.S. energy uses [42] (Table 11, Figure 17).

In particular, what people demand is the services which energy can provide: heating, cooling, cooking, lighting, mobility and motive power. Living in cities without it may become a significant deprivation. The contemporary energy crisis brings into question many prevailing assumptions about the physical and ecological limits of our cities in enhancing human welfare. Energy provision and use contributes to environmental degradation, especially of air quality, but also of land

Table 10.1 Total Electricity Consumption (not as Primary Energy),
TWh

	1960	1970	1980	1990	2020*
North America	958.0	1 844.4	2 731.4	3 475.5	4 650
Latin America	72.0	160.5	385.0	598.1	2 350
Western Europe	611.7	1 238.6	1 892.1	2 468.4	3 900
Central and Eastern Europe	74.5	184.1	336.0	362.0	600
CIS	292.1	735.6	1 274.9	1 718.4	2 400
Middle East & North Africa	10.2	36.6	117.2	311.4	1 350
Sub-Saharan Africa	30.2	74.2	148.2	224.6	700
Pacific ¹ (includes CPA) ¹	230.0 (70.3)	615.1 (140.4)	1 196.9 (354.6)	2 106.0 (699.0)	5 700 (2 650)
South Asia	22.8	71.2	139.9	343.3	1 350
World	2 301.5	4 960.3	8 221.6	11 607.7	23 000
¹ Data for Pacific Region include Centrally Planned Asia, which are also shown separately * Projection by WEC - Case B Sources: UN Energy Statistics Yearbook; WEC					

Table 10.2 Growth Rates for Electricity Consumption,
% per Annum

	1960- 1970	1970- 1980	1980- 1990	1990- 2020*
North America	6.8	4.0	2.4	1.0
Latin America	8.3	9.1	4.5	4.7
Western Europe	7.3	4.3	2.7	1.5
Central and Eastern Europe	9.5	6.2	0.7	1.7
CIS	9.7	5.7	3.0	1.1
Middle East & North Africa	13.6	12.3	10.3	5.0
Sub-Saharan Africa	9.4	7.2	4.2	3.9
Pacific ¹ (includes CPA) ¹	10.3 (7.2)	6.9 (9.7)	5.8 (7.0)	3.4 (4.5)
South Asia	12.1	7.0	9.4	4.7
World	8.0	5.2	3.5	2.3
¹ Data for Pacific Region include Centrally Planned Asia, which are also shown separately * Projection by WEC - Case B Sources: UN Energy Statistics Yearbook; WEC				

Source: *Energy for Tomorrow's World*.

Table 11 End Uses of Energy in the United States in 1970

	Percent of the general category	Percent of the whole
Transportation		25
Automobiles	55	
Trucks	21	
Commercial aircraft	8	
Other aircraft	4	
Railroads	3	
Pipelines	1	
Water freight	1	
Buses	½	
Other	4	
Space heating		20
Residences	60	
Commercial buildings	30	
Industrial buildings	10	
Industrial process steam		16
Industrial direct heat		11
Industrial electric drive		8
Nonenergy uses of fuels (lubricants, synthesis, asphalt, etc.)		6
Water heating		4
Residences	75	
Commercial buildings	25	
Air conditioning		3
Residences	33	
Commercial buildings	67	
Lighting		3
Residences	30	
Other	70	
Refrigeration		2
Residences	50	
Commercial	50	

Source: John P. Holdren and Paul R. Ehrlich eds., *Global Ecology: Readings Toward a Rational Strategy for Man* (New York: Hartcourt Brace Jovanovich, Inc., 1971).

and water. Mary Tacker and John Bidwell, a Director and Manager of The City of San Jose Sustainable City Project, pointed out that whether speaking of global conditions, or of conditions in one urban area, the existing patterns and trends of energy consumption are key measures of sustainability [17]. According to the World Energy Conservation report, energy issues should be viewed in their total, global, social and institutional, as well as economic and environmental perspective [99].

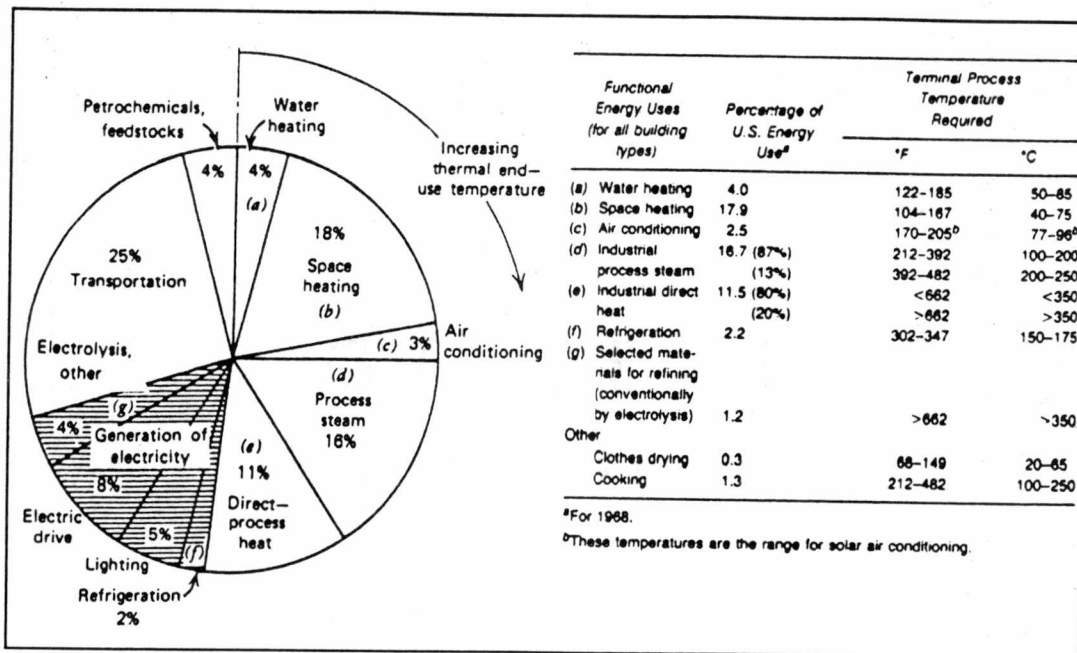


Figure 17 Percentage and Quality of Energy Use in the United States as of 1968

Source:: Source: E Lazslo and J. Bierman, eds., *Goals in a Global Community* (New York: Pergamon Press, Inc., 1977).

The role of energy, both in the biosphere and in society, is dominated by the fact that energy is essential to any process of production. Energy is brought in mostly as fossil fuel, but increasingly it will take the form of electricity generated at distant sites. Both sources are non-renewable, so the present metropolitan community lives off the expenditure of geological capital [53].

Almost everyone raised in an urban setting takes energy and water for granted. Richard Meier pointed out: "Citizens naturally assign greater importance to other matters" and the supply is set up in such a way that there is little thought of strict economizing--bills come a month later, or costs are hidden within rent changes--until some political and environmental changes creates a shortage which brings the

issue to public attention [53, p.225]. The presence of energy supply regional grids has, however, introduced a new unexpected vulnerability, such as the Great blackout of 1967 that affected almost twenty million urbanites in the New York, New Jersey, Pennsylvania, and Ontario area for a whole night [53].

To summarize, energy:

- Activates the machine populations, including vehicles,
- Produces the materials from which machines and shelters are made,
- Keeps the environmental conditions of human and machines within a tolerable range,
- Processes food and water required by humans,
- Activates the telecommunications circuits that extend the spatial range of both human and man-machine interactions [53].

Energy and Urban System

For the basic analysis of urban sustainability and energy interfaces, the idea of *urban ecology* is worth examining.

The term urban ecology was appropriated by sociological and bio-ecological investigations analogize to natural ecosystems. Aldo Leopold, the author of the essay, *The Land Ethic* (1949) helped to define the ecological approach to land and landscape. He describes the "biotic pyramid" as "a foundation of energy flowing through a circuit of soil, plants and animals." He writes, "Food chains are the living channels which conduct energy upward; death and decay return it to the soil... it is a sustained circuit" [96, p.4].

A professor at the University of California, Berkeley and an urban planner,

Richard Meier analyzed the urban system in his book, *Planning for an Urban World*:

A living system is characterized by a set of inputs (or resources) and a set of outputs, with multiple, cybernetically stabilized pathways inside the system that effect the transformation. The metropolis therefore converts resources into something else; resources, together with the internal institutional environment, are used to grow people" [53, p.11].

In urban settlements, fossil and fissile fuel energize the machine populations.

Materials from all parts of the world are funneled into urban areas through pipelines, railroads, and ships. The ultimate destination for 80% or more of the tonnage of these commodities is a metropolitan area where complex, market-oriented manufacturing is carried out. Once the skeleton of a metropolis has been laid down, the food, fuel and other basic materials are distributed to the urban population; this is the flow of inputs. Electrical power is distributed by means of a grid throughout the urban settlement. Finally, energy is used to moderate uncomfortable micro-environments by changing temperature, humidity, or air velocity in the vicinity. Energy reduces inconvenience by generating light, precipitating dust, and performing similar tasks (Figure 18). These are the end uses of energy [53].

Outputs within the urban systems are the fate of the natural resources. The usefulness of the natural resources, generated in the process of refiners, graded, and standardized, and manufactured products become scrap. Polluted water, solid waste, carbon dioxide, noxious gases, and escape heat are generated in the process. The material balances and the energy accounts for the urban system are thereby settled. It is important to consider these residues over the long run, because they change the immediate physical environment. The solid materials transported to an urban

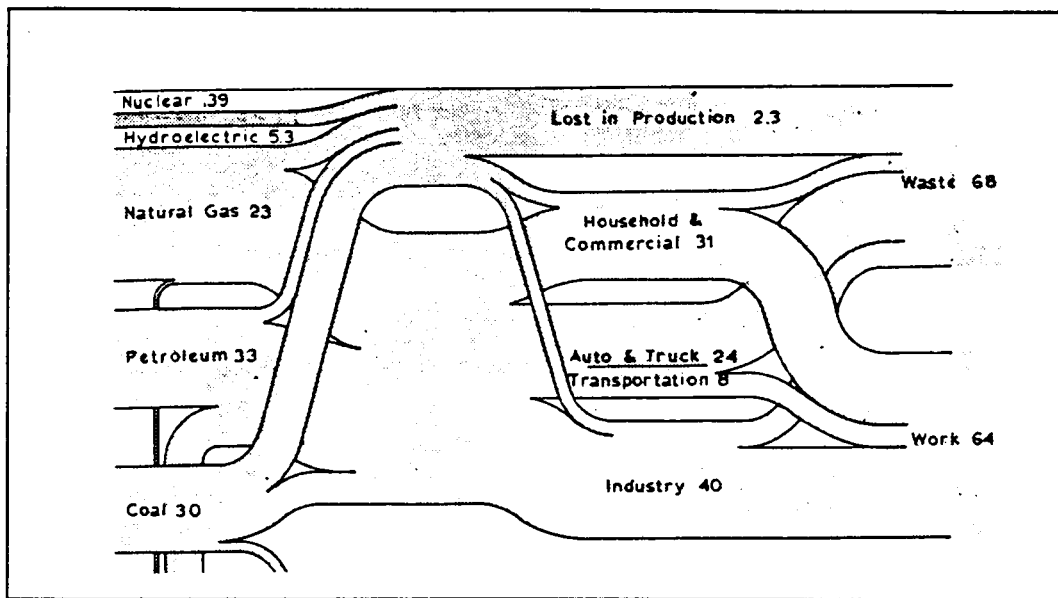


Figure 18 U.S. Energy Flow 1970: 126×10 Kcal/capita/year

Source: Richard L. Meier, *Planning for an Urban World: The Design of Resource-Conserving Cities* (Cambridge, Massachusetts: The MIT Press, 1974).

Settlement becomes an indigestible waste. Also, in general, the air and water temperatures around conurbations will be raised $2-5^{\circ}\text{C}$ above the surrounding regions [53] (Figure 19.1-19.2, Table 12). These food chain and energy cycle, populations, including human beings, with all other relationships and transformations, are not so simple as to be easily generalized, however, this description conveys intuitive concept of energy and urban system interfaces.

According to the *Sustainable City Project* report of three cities: the City of Portland, Oregon; the City of San Francisco, California; and the City of San Jose, California: "More efficient pattern of energy use can make an important contribution to sustainability, but only within the context of a society that is moving toward sustainability in its economic and social spheres as well" [30, p.6]. The long term

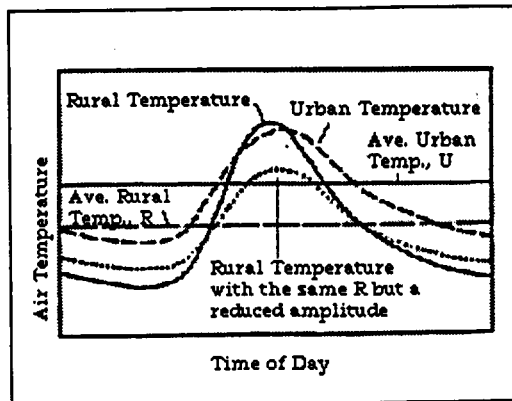


Figure 19.1 Rural and Urban Air Temperature

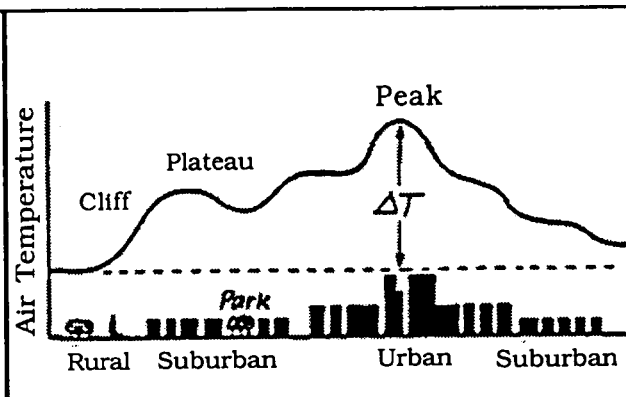


Figure 19.2 Rural and Urban Air Temperature (Profile)

Source: Based on *Mechanical and Electrical Equipment for Buildings*.

Table 12 Average Changes in Climatic Effects Caused by Urbanization*

Effect	Comparison with Rural Environment
Contaminants	
Condensation nuclei and particulates	10 times more
Gaseous admixtures	5 to 25 times more
Cloudiness	
Cover	5 to 10% more
Fog, winter	100% more
Fog, summer	30% more
Precipitation	
Totals	5 to 10% more
Days with less than 5 mm	10% more
Snowfall	5% less
Relative humidity	
Winter	2% less
Summer	8% less
Radiation	
Global	15 to 20% less
Ultraviolet, winter	30% less
Ultraviolet, summer	5% less
Sunshine duration	5 to 15% less
Temperature	
Annual mean	0.5 to 1.0°C more
Winter minima (average)	1 to 2°C more
Heating degree days	10% less
Wind speed	
Annual mean	20 to 30% less
Extreme gusts	10 to 20% less
Calms	5 to 20% more

Note: *These effects vary from city to city and from day to day.

Source: H.E. Lansberg: Climate and urban planning," *Urban Climates*, WMO Technical Note No.108, p.372. World Meteorological Organization, 1970.

goal for urban sustainability is to develop a prosperous and healthful urban system which can provide for the physical, social and psychological needs of all the people and, at the same time, reverse the trends of increasing pollution and environmental degradation now threatening the quality of urban life. Planning urban sustainability means examining all impacts of all decisions that need to be made today with a view toward tomorrow. The general attributes of a sustainable system have much in common with the characteristics of natural ecosystems. Like them, sustainable systems are "consistent, renewable, diverse, inclusive and interdependent" [30, p.7].

Many of the attributes of a sustainable system do not exist in the current urban system. The present urban system draws numerous resources from the environment, many of them nonrenewable, and destroys the earth's ability to regenerate resources [30] (Figure 20). In addition, certain sectors of society consume far more resources than is necessary for their real needs. These consumption practices are promoted by an economic system that habitually undervalues resources because the worth of the resources is not immediately visible or the cost of the resources is borne by others later or in distant places. While the structure of the modern urban system is ostensibly designed to improve human life, it also serves to destroy the viability of the urban system as a whole. Sustainability means lasting long. Material flows in sustainable urban system should be cyclical: nothing should be wasted but recycled, however the contemporary urban system is not structured that way. Therefore the present urban system is not a sustainable system.

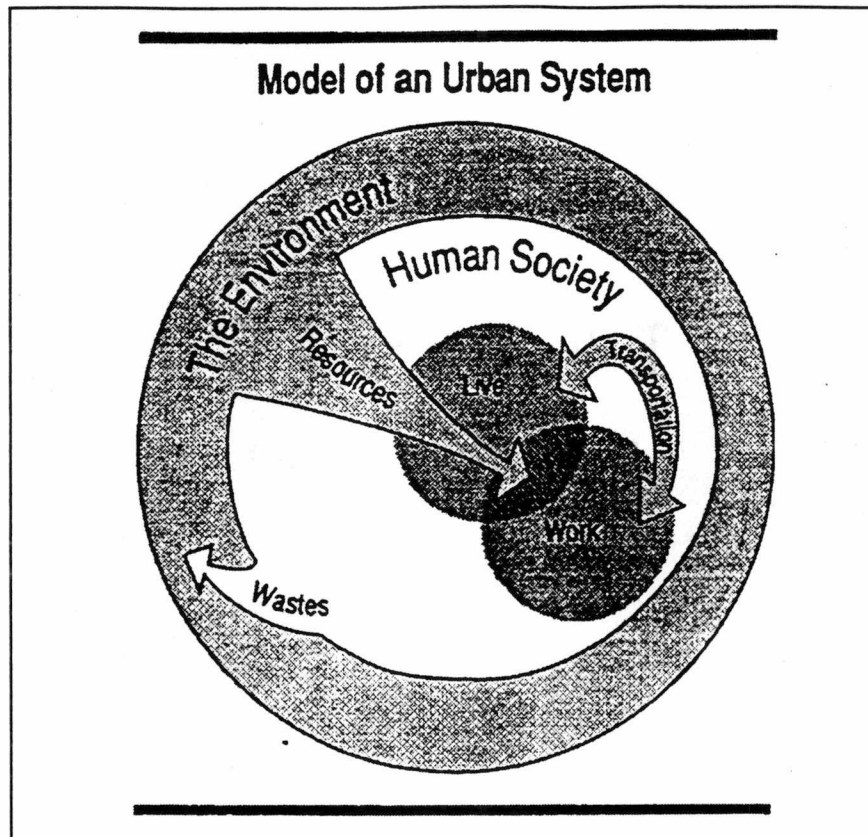


Figure 20 Model of Urban System

Source: Energy Task Force of the Urban Consortium, Energy, Environment and Economic Development Unit, *The Sustainable City Project: A Tri-City Collaboration for Developing and Implementing Sustainable Urban Energy Practices* (August, 1991).

Building the key elements of a sustainable system into an urban system make it more flexible, creative, resilient, and healthful. This is the path toward sustainability. A commitment to sustainability is a commitment to more responsible environmental decision making. If cities are to become sustainable, they must draw from the environment only what is necessary. And what is used must be recycled or returned to the environment in a form which nature can use for regeneration of more resources. The natural environment systems upon which humans depend must be allowed not only to survive but to thrive. To apply the philosophical ideals of

sustainability to urban energy systems, three cities of the Sustainable City Project--Portland, Oregon; San Francisco, California; and San Jose, California--developed some principles to guide their work. Sustainable cities are to:

- Use energy effectively in achieving other municipal goals such as affordable housing, efficient transportation systems, economic development, and job creation,
- Protect and maintain the quality of life by reducing environmental problems associated with inefficient energy use,
- Contribute to national security by reducing vulnerability to predicted oil shortages and price increases [30].

Urban Development Patterns and Energy

Energy has been a major determinant of urban form [75, p.2]. The spatial development of American cities closely parallels the adoption of different energy sources and their associated transportation systems [49, p.120] (Figure 21). To facilitate commerce, American cities grew along strategic waterways or railroad routes. To power the machinery that drove the economy, fossil fuels were extracted to provide "cheap" sources of energy. New technologies enabled adequate food supplies to be produced and transported to large urban centers, and new city industries attracted workers [30].

Energy and the evolution of American urban form can be roughly broken down into events occurring during three time frames: pre-steam age, steam age and the oil/electric age.

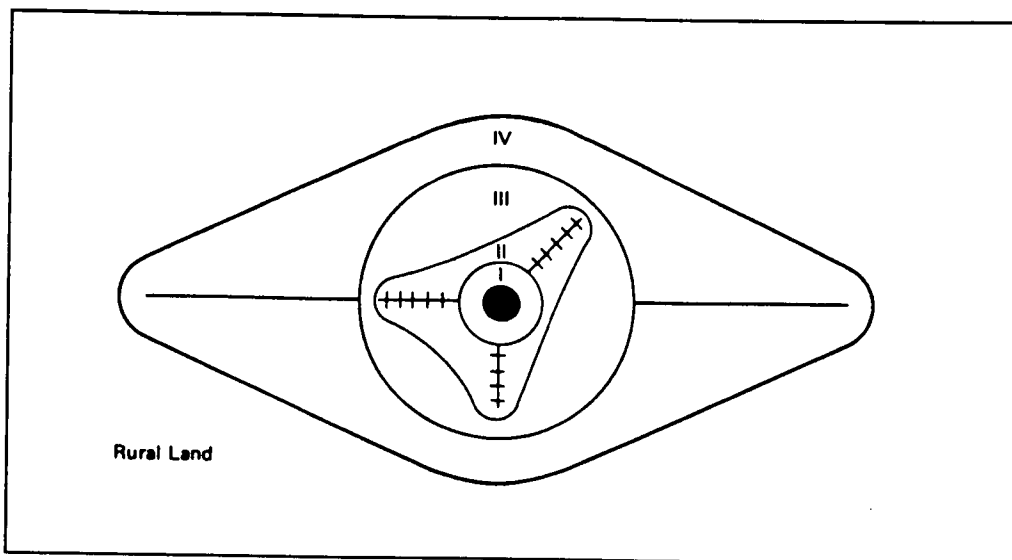


Figure 21 Intraurban Transport Eras and Metropolitan Growth Patterns

Note: (I) Walking-Horsecar Era, (II) Electric Streetcar Era, (III) Recreational Auto Era, and (IV) Freeway Era.

Source: J.S. Adams, "Residential Structures of Midwestern Cities", *Annals of the Association of American Geographers*, 60 (Association of American Geographers, 1970).

Pre-Steam Age. Before the widespread use of steam power, cities were generally compact and relatively densely settled by pedestrian oriented transportation necessity. Few cities had more than 2500 people and almost all were one mile in diameter. Homes were located within reasonable walking, or horse riding distance of work. Likewise homes were convenient to shopping and other activities. Commercial and industrial activities were located adjacent to one another and these, plus residential uses, were in turn intermingled with small scale agricultural, educational, religious, and other uses. Agricultural production sites was also within the transportation limits [49, p.3].

The Steam Age. In the previous century, the development of the steam engine and its application to transportation, industry, and agriculture allowed cities to

expand in population, change spatially, become less dependent upon their immediate hinterlands for sustenance. The introduction of steam trolleys for transportation allowed the spatial expansion of cities. Consequently axial patterns of urban growth grew up along the new transportation arteries. The combination of agricultural mechanization and the advent of cheap, fast transportation had the effect of enabling cities to grow in population beyond what their immediate hinterlands could support.

Oil/Electric Age. The adaptation of oil and electric powered devices had a phenomenal impact on urban form. Devices such as the automobile and the telephone freed cities from almost all topographic, climatic and geographic constraints on their spatial growth. The increased mechanization of agriculture and the refinement of agriculture transportation systems has almost totally detached cities from their hinterlands for their sustenance, and reversed the historic dependence between the two. The use of all these devices led to a high degree of land-use socialization, a set of activity nodes composed largely of industrial and/or commercial uses of residential and associated commercial sprawl tied together by highways and electric communications.

The Energy Intensity contributing to Sprawl. The fact that the United States consumes 40-50% more per capita energy than the other western industrialized countries with similar standards of living can be attributed to the energy intensity style of urban sprawl and of the automobile centered life style [18, p.15] (Figure 22). In the larger highly industrialized European countries, per capita travel is roughly half that of the United States [73, p.152]. The energy intensity of the American pattern

of urban development can be traced back to three factors: the predominance of low density single family residential development, the spatial arrangement of urban land uses, and the ad hoc nature of land development in the United States [49, p.147].

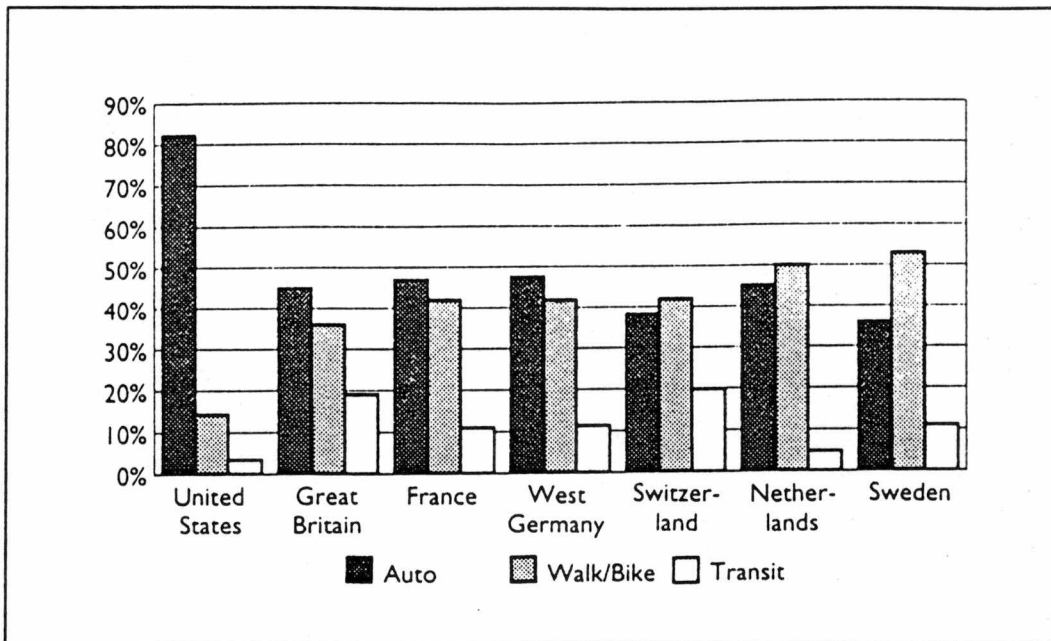


Figure 22 Mode Split as Percent of Total Trips

Source: *The Next American Metropolis*.

The first of these factors, the predominance of low density single family residential development, intensifies energy consumption in the residential, commercial, and transportation sectors. Low density single family residential development decreases the use of mass transit and creates a dependency upon the automobile for transportation purposes. The second factor of the energy consuming urban pattern is the spatial arrangement of urban land use, which also impacts the transportation sector. The failure to develop complementary land uses adjacent to each other instead of mixed use development, resulting in low density residential

development, resulting in a further dependency upon automobiles for local transportation. The third factor, the ad hoc land development process, led to and intensifies many of the negative impacts associated with the other two factors. They have made the predominant American land use patterns what they are today: unplanned--wasteful of land and energy [49].

A detrimental factor for urban planning is that it is difficult to define clear boundaries of planning responsibility for energy use. For example, the policies affecting the transportation sector, such as subsidies to public transportation, construction or non-construction of super-highways or airports, the amount of license fees for vehicles or excise taxes on diesel versus gasoline vehicles, tax credits for energy conservation, pollution control legislation or specific end-use planning policies, may have a profound impact on energy demands and allocation management.

Energy Sustainable Strategies

There are some suggestions toward energy sustainability, which ultimately contribute to both local and global sustainability. Energy conservation creates the most dramatic energy savings [42, p.153]. Conservation involves increasing the energy efficiency, or lowering the energy intensity, of a given process. It generally has two components. The first is the substitution of non-energy resources for energy consumption--for example, using more household insulation so that less energy is required for home heating. Another example is procuring smaller, lighter

automobiles that use less energy. The second facet of conservation is to change the behavior of individuals, on the one hand, and society, on the other. Conservation thus could be achieved if persons drove fewer highway miles. Aggregated to the social level, use and development of mass transit would demonstrate societies' effort to practice conservation.

Energy efficiency helps energy conservation. There are several reasons for seeking to improve energy efficiency. The regional reports by World Energy Conservation (WEC) highlighted:

- Improving economic efficiency and international competitiveness,
- Reducing adverse environmental impacts,
- Reducing dependence on imported energy, especially oil,
- Increasing the efficiency with which scarce domestic resources of energy are used,
- Conserving finite global energy reserves, and
- Inhibiting future energy price rises [99, p.110].

More than 2,000 cities in the United States operate their own electric utilities. They either generate or buy the power they need to supply their citizens. Local governments can lower their energy bills. The average city is believed to spend between 8 and 10 percent of its operating budget for energy. About one-quarter of a city's energy consumption could be saved with little or no capital investment through conservation [79]. The promotion of energy efficiency is not the role of utilities alone. Cities and counties can bring new dynamics to their economies and protect their environments through the active promotion of energy efficiency.

An important contributor to the solution of local and global environmental

problems, it is needed to raise the efficiency with which energy is provided and used around the world. *Energy Mix*, to obtain energy from not only oils for example, but also various sources, is also a suggested energy conservation strategy. Major change of energy supply structures and of energy utilization systems cannot be achieved rapidly. They must be adopted over time. During the process of change, it is important to ensure the sustainability of economic development, environmental protection and social equity by strategic planning.

There is a large potential for meeting economic and social aims by using less energy. One of the basic contradictions in the structure of society is the expansionism of its production institutions and the finiteness of its resources. To direct growth from resource intensive economic growth to qualitative growth, society needs to change the perception of "growth." This kind of change is brought about largely by government encouragement and regulatory support and impacted by unpredictable market forces. When working toward sustainability, community planners need to anticipate the dominant role of these factors [49].

The Rocky Mountain Institute, which is working on various energy efficient and economic development projects, describes sustainability as development which "creates economic prosperity without creating environmental degradation" [41]. In terms of economy, urban energy and dollars can be saved in areas such as transportation, industrial processes, and building heating, cooling, and lighting. At the same time, cities can improve the efficiency of their urban systems, protect their quality of life from problems such as pollution and traffic congestion, and improve

the local economy. Urban energy planning is becoming a focus to link the complex issues of energy, environment, and economic growth [71]. The benefits of energy planning, such as environmental and quality of life enhancement, and local economic stimulation will be examined in following section.

Sustainable Community Energy Planning

Towards More Energy Efficiency

In the 1970s, the economic shocks produced by recurring petroleum shortfalls and price increases, coupled with growing public awareness of environmental issues, made the world realize the importance of the need to manage energy resources. At the same time, controversy over nuclear power has shown that technological innovation alone are not sufficient to meet the demands of an energy-hungry society. The growing knowledge that renewable resources could be important in meeting the world's future energy needs has led to large sums of money being spent on solar research and development [31].

In some countries, where the scale of energy resource extraction and air pollution has reached significant levels, environmental concerns are already beginning to influence national and regional energy policies [56, p.97]. In the United States, for example, environmental considerations have greatly influenced efforts to change the energy mix from imported oil to domestic coal, domestic oil, and nuclear energy. Legislation and programs to promote domestic energy use, such as Project

Independence Energy Systems (PIES) of the former Federal Energy Administration (FEA) of 1974 and the National Energy Plan (NEP) of 1977 which formulated goals on oil imports. For example, Project Independence that was a response to the oil crisis, recommended reducing oil imports [31, p.182]. Also those legislation such as the National Environmental Policy Act (1970), The Clean Air Act (1970) and Clean Water Acts (1972), designed to protect the environment, that were a part of a new awareness process.

As a result, since the oil crises of the 1970s, the United States has made progress towards a more energy efficient system. Automobiles now get better gas mileage and energy efficiency codes for new construction have become more prevalent in many states. Many houses and buildings have been weatherized. Due to these energy conservation measures, the U.S. economy has saved about 13 million barrel per day over 1973 consumption levels, an energy savings valued at \$150 billion per year [79, p.1].

These improvements are only a first step. Energy use in the U.S remains high when compared to other Western industrialized nations. Energy use per capita in the United States is more than double the consumption rate in the United kingdom, Japan, Italy and Spain. North America, consisting of United States and Canada, currently has 5% of world population, and is responsible for 24.5 % of the world's economic activity measured by volume. North America consumes 27% of the world's commercial primary energy, and has 4% of the world's proven oil reserves, 6% of natural gas reserves and 25% of the coal reserves [79, p.1] (Table 13).

Table 13 Regional Fuel Shares 1990, percent

	Fossil fuels:			Nuclear Energy	Renewables:			Total
	Coal	Oil	Natural Gas		Hydro.	Traditional	"New"	
North America	23	38	23	7	6	2	1	100
Latin America	4	38	14	0	14	22	8	100
Western Europe	23	39	17	12	7	1	1	100
Central and Eastern Europe	53	17	22	4	2	1	1	100
CIS	25	26	39	3	4	2	1	100
Middle East and North Africa	2	52	37	0	2	7	0	100
Sub-Saharan Africa	26	14	2	< 0.5	3	53	2	100
Pacific ¹	40	26	6	3	4	19	2	100
(includes CPA) ¹	(61)	(11)	(1)	(0)	(3)	(23)	(1)	(100)
South Asia	28	14	6	< 0.5	4	46	2	100
World	26	31	20	5	5	11	2	100

¹ Data for the Pacific Region include Centrally Planned Asia (CPA), which are also shown separately.

Source: *Energy for Tomorrow's World*.

As with the other developed regions, North Americans see no problem of a shortage of global energy reserves in the period to 2020. However, they are concerned with security of energy supplies. The region has the highest per capita income in the world, and as such can afford to implement high standards of environmental protection. In many parts of North America, the public is looking for an assurance of secure low-cost energy on the one hand and an unspoiled environment and high quality of life on the other. For a host of reasons and in particular because of mounting pressures in the region for a cleaner environment. North America's appetite for energy will be reduced in the near future [99].

The World Energy Conservation (WEC) report put emphasis on the importance of economic growth calls for more emphasis placed on decreasing environmental impacts of energy production and distribution. It is stressed in this

respect that all economies must increase the attention given to developing mechanisms for internalization of environmental costs. Energy efficiency and energy conservation programs must be strengthened and should be supported in national energy policies by government programs which provide appropriate incentives and remove barriers. It says that: "It is important that the energy policies adopted by the United States and Canada strengthen economic growth and competitiveness, not only domestically but throughout the world" [99, p.167].

In particular the report put emphasis on the mobilization of public and private leadership to formulate explicit energy efficiency goals, increase commitments to energy efficiency for government buildings and vehicle fleets, activate corporate programs and develop demand-side programs including energy awareness and education as well as support for global energy efficiency initiatives.

Technological developments and technology transfers will also have significant effects on the global energy economy during the next few decades. The advancement of technologies such as telecommunications should lessen commuting by autos and reduce emissions which contribute to air pollution.

National Energy Planning Framework

As the price of oil began to fall, gradually in the first half of the 1980s, then collapse in 1986, other issues joined the forefront of energy planning. Energy related environmental concerns have emerged recently and are likely to dominate in the 1990s and beyond. The need to expand energy supply infrastructure and distribution,

especially electricity, also has become more acute [56].

Energy plays a pervasive and important role in economic and social development. The identification and analysis of energy issues, and the development of energy policy options, are therefore important to governments, researchers, and the development of communities. In the first oil price shock of 1973, neither developed nor developing countries conducted sector-wide energy planning; the planning was done that was left to the sub-sectoral institutions with little attempt at coordination. This has been changed in the aftermath of the first oil crisis, with countries everywhere struggling with the establishment of effective policies and institutions to deal with energy sector problems. These efforts intensified in the aftermath of the second oil price shock, and by the early 80s most developing and developed countries had established some formal energy planning activity.

Traditional energy planning problems have usually considered a single high priority objective such as minimizing costs, maximizing availability, or ensuring reliability. Energy planning in the United States is polynucleotide [31, p.182]. Given the ubiquity of energy use and the federal approach to problem solving, each center of interest addresses energy issues and developed individual methods for dealing with questions of energy policy. This results in a large number of energy models with different aims and purposes [56].

To understand both what lies behind the models and what has developed from them, it is worth examine the objectives of the National Energy Plan. Quoting from the 1977 National Energy Plan (NEP), the United State has three important energy

objectives:

1. As an immediate objective, and one that will become even more important in the future, to reduce dependence on foreign oil and vulnerability to interruptions in supply;
2. In the medium term, to keep the United States oil imports sufficiently low to weather the period when world oil production has reached its limit; and
3. In the long term, to have renewable and essentially inexhaustible source of energy for sustained economic growth.

The plan suggest the following measures:

1. Conservation and fuel efficiency;
2. Rational pricing and production policies;
3. Reasonable certainty and stability in government policies;
4. Substitution of abundant energy resources; and
5. Development of new energy technologies for the future.

The national objectives have been embodied in a series of goals. These goal are:

1. Reduce the annual growth in total energy demand to below 2%,
2. Reduce gasoline consumption by 10% of its current level,
3. Reduce oil imports from a potential level of 16 million barrels per day to 6 million which would be roughly equivalent to one-eighth of total energy consumption,
4. Establish a strategic petroleum Reserve of 1 billion barrels and increase coal production by two-thirds, to more than 1 billion tons per year,
5. Bring 90% of existing American homes and all new buildings up to minimum standards of energy efficiency, and
6. Use solar energy in more than 2.5 million homes [31, p.182].

Local Government Initiative in Promoting Sustainable Energy Planning

It is often assumed that environmental issues are too large and complicated to be addressed on the city and county level, therefore they should be left to federal and international agencies. Yet, in many cases changes at the local level have led to change at higher levels. Just as local communities and organizations led the way in recycling in the early 1970s, they now have the opportunity to take a leadership role

in a variety of other important environmental areas. Local governments today are experimenting with alternative vehicle fuels, environmentally sound land use practices, and water reclamation.

The importance of the environmental roll of cities is illustrated by the rising proportion of total environmental spending that occurs at the local level. But the challenge to local communities is increasing. Landfills are closing, federal aid to cities is declining, air quality standard are tightening, local budget deficits are more severe, and state and federal laws are mandating local governments do more to protect the environment.

Individually, local governments have the power to adopt environmental policies that affect the immediate surroundings. Collectively, they can change the world. By demonstrating how environmental principles are implemented on a practical level, cities can become tomorrow's environmental leaders [79].

Research on energy use and local economies shows why local governments should encourage efficiency community-wide: "Typically 80 to 90 cents of every dollar spend on energy leaves the community and never returns. Thus, the amount of money that leaves a community each year can be quite large" [71]. If governments, businesses, and residents are spending less on energy, then more dollars will be circulating in the local economy. Thus local governments have three functions in energy (1) as energy providers, (2) as energy consumers and (3) as energy efficiency promoters.

Urban areas, with their high energy intensities, can make a significant

contribution to enhancing national energy security. Local governments manage land use, building codes, transportation systems, waste disposal, and even utilities in order to promote urban sustainability, cities can take the following actions:

1. Set examples as model energy consumers in the operation of municipal facilities, vehicle fleets, and mass transit systems,
2. Plan, finance, and operate energy-efficient infrastructures for major water, waste water, and solid waste management systems,
3. Regulate and plan for efficient energy use through local land use policies that affect the patterns of residential, commercial, and industrial development,
4. Promote policies that improve air and water quality,
5. Enforce more stringently energy efficiency standards of state or local building codes,
6. Institute energy efficiency service programs such as weatherization of residential for low income, renter and homeowners,
7. Adapt site standards for renewable and alternative energy resources use renewable resources such as solar, geothermal, hydroelectric, biomass, and wind at city-owned facilities,
8. Develop local renewable resources such as hydroelectric power generation in municipal water systems, and
9. Advocate and facilitate the development and implementation of energy policies and programs [79].

A survey, undertaken in 1980, of over 1400 planning agencies across the country supplemented by an extensive literature review identified thirteen units of local government which have enacted a total of twenty two separate land development regulations designed specifically to reduce local energy consumption [2]. The regulations include seven designed to reduce the space conditioning demands of buildings, four which promote the use of alternative/renewable energy resources, three designed to reduce the dependency on cars for local transportation, and one designed to reduce the energy embodied in building materials and construction [56].

Most of the regulations identified incorporate energy conservation objectives into such widely used and accepted land use controls as zoning, subdivision regulations, site plan reviews, landscaping requirements, and incentive provisions. The regulations themselves take three forms: (1) those which remove institutional barriers to the use of energy conservation land development practice, (2) those which provide incentives to encourage the voluntary adaption of such practices, and (3) those which mandate the use of energy conservation in practices. The survey results also show that of the communities which have enacted energy oriented land use regulations, only half had also adopted comprehensive energy plans or programs.

The implementation of policies which support sustainability is both beneficial and cost effective for cities. A dollar spent on energy usually leaves the local economy rapidly, bound for domestic or foreign energy supplies. However, a dollar spent on energy conservation measures will likely support local businesses providing energy efficiency services as well as benefit the environment. Subsequently, the estimated 20% to 75% energy savings realizable by households and businesses is likely to be spent on other goods and services, thus stimulating the local economy. Furthermore, the annual savings gained by making a city's own operations more energy efficient can potentially save millions of dollars that may more appropriately be applied to such programs as housing, health care, or education [71].

The promulgation of new land use regulations should be undertaken within the context of the general plan and as part of an overall energy conservation program. Otherwise, higher density residential areas, mixed use developments, and

small power generation facilities within residential areas will lead to the very conditions which forces society to encourage low density housing and single use districts in the first place. Meier points out that:

If a different kind of city is built, the demands for resources could be eased without significant detracting from quality of life potentials. Consumption could be held well within the carrying capacity of the earth, moreover, the economical solution presumes a future world society that is predominantly metropolitan [53, p.318].

Energy Planning Strategies Examples

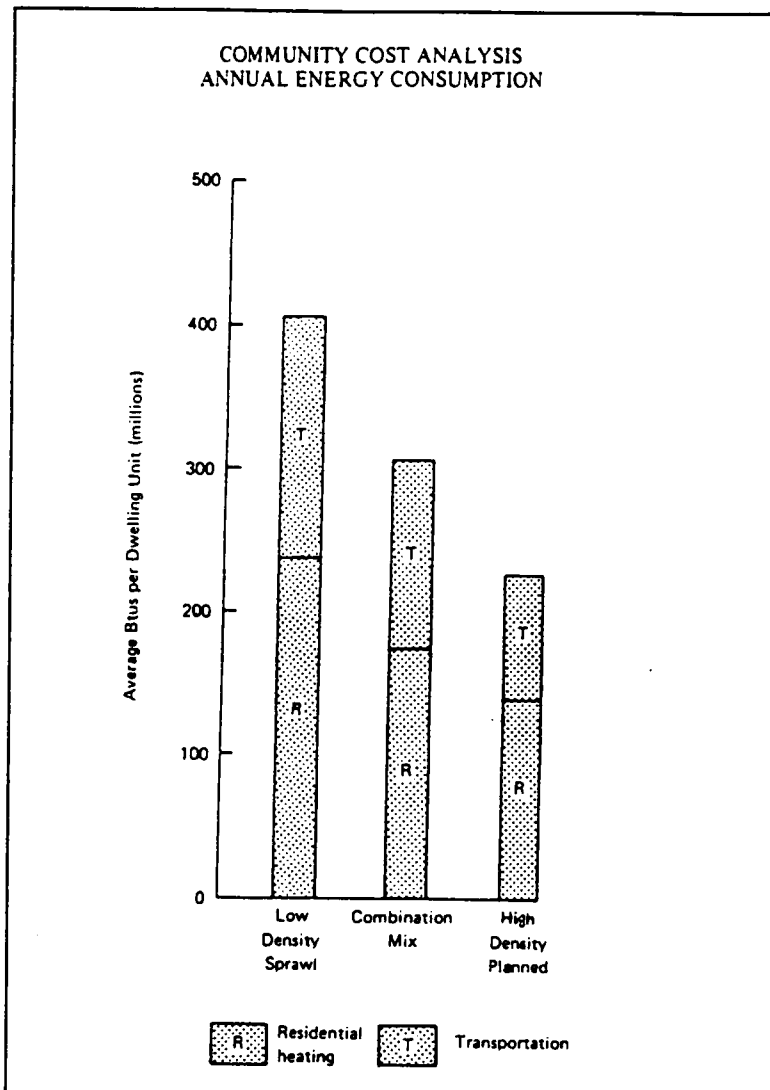
Energy consumption patterns affect not only the future energy resources, but the future of economic, atmospheric, climatic and other environmental conditions and resources. Urban sustainability, particularly as regards energy resources, will be an increasingly important principle to apply in the land use planning process, and will require a new perspective and new criteria. Incorporating energy issues in land use and urban design decision making can and should be carried out in a way that helps to promote other sustainability-oriented community goals, such as affordable housing, economic development, preservation of open space, maintenance of the quality of air and water, and other quality of life issues.

In 1975 by James Roberts, building on experience from his work on *The Cost of Sprawl* wrote for the Metropolitan Washington Council of Government (COG) *Energy, Land Use and Growth Policy: Implications for Metropolitan Washington* [70]. In this report, Roberts identified energy consumption by energy source and end use in order to set a base line of consumption. He then developed a number of scenarios describing alternative patterns of future land development. Using computer

models, he manipulated land uses according to various scenarios and measured the energy consumption associated with each of the resultant patterns of development. The studies were consisted in their findings. Among his alternative land development patterns were "wedges and corridors," "dense center," "transit oriented," "wedges and corridors with income balance," "sprawl," and "beltway oriented". Roberts found the alterative most energy intensive was "sprawl" and the least intensive patterns were "dense center" and 'transit oriented " [70, p.1-3]. The study concluded that one-half of the additional energy needed by the transportation sector and one-quarter of additional energy needed by the residential sector between the base year and 1992 could be saved by arranging future development in denser patterns rather than in sprawl [70, pp.6-8].

A critic of Roberts and Dale, L. Keyes of the Urban Institute, points out that while compact contiguous high density cities are energy efficient, so are urban patterns in which both population and employment are equally dispersed [45, p.9]. Nevertheless, his research still found that 'acceptable levels' of land use controls could produce a 15% savings in the transportation sector alone by 1985, although he notes that higher mandatory fuel mileage requirements for new cars would contribute to the efficiency [45] (Figure 23).

They also found that a shift from single family detached houses to low rise apartment buildings could save between 30 % and 40% of what is consumed by the residential sector. He adds, however, that research has shown that people will give up almost anything before giving up their single family detached houses [45].



**Figure 23 Community Cost Analysis
Annual Energy Consumption**

Source: Dale L. Keyes and George Peterson, *Metropolitan Development and Energy Consumption* (Washington D.C.: The Urban Institute, 1987).

Local officials who recognize the potential value of energy saving measures, therefore, are finding creative ways to improve energy use both within local government operations and the community at large. Many of these ideas are outlined in *Global Cities Project*, which initiated the Global Cities Project's publication of

Energy efficiency and Production, a part of "Building Sustainable Communities Series" identified the items to help local government be environmental leader, such as adopting a comprehensive energy policy [79].

According to the California Energy Commission's publication, *Energy Aware Planning Guide, Land Use/Transportation Planning Opportunities*, the following are some implementation examples:

1. Mixing residences and work-sites;
2. Shops and services within walking distance of homes;
3. Shops and services at work-sites, transit and park and ride lots;
4. Density near transit housing, and job aspects;
5. Diverse and compact housing;
6. Design for transit access;
7. Street widths and pavement;
8. Street trees;
9. Integrated circulation system;
10. Bikeways, parking and facilities;
11. Pedestrian facilities;
12. Creating complete, pedestrian and transit oriented communities;
13. Trip reduction ordinances;
14. Transportation management association;
15. Parking pricing;
16. Reduce employee parking;
17. Guaranteed ride home programs;
18. Tel-commuting;
20. Alternative work schedules;
21. Reducing city and county employee commute trips;
22. Traffic signal timing; and
23. Fleet efficiency [13].

Many traditional planning problems such as optimal resource allocation, transportation network planning, or corporate planning can be shown to have specific solutions. On the other hand, today energy planning should have a much broader scope. The boundaries of these modern planning problems often cannot be well defined since they involve such a wide range of factors; social, environmental,

technological, political etc., [9].

The most energy conservation parts of development were those which featured compact, contiguous neighborhoods of a moderately high density with a predominance of low and mid rise multi-family housing types spatially related to complimentary activities and offering a variety of transportation options. Since higher density is not always desirable, some of the studies suggested that where residential development could not be done, that significant energy saving could still be had by locating new residential development around employment nodes and /or along transit routes. The savings in all cases resulted from reduced automobile transportation, reduced space conditioning demands, the utilization of decentralized energy technologies, and from the use of less building materials and reduction in the amount to energy involved in construction.

There are a number of factors which will affect energy sensitive planning. The key factors will come from the political culture of an area. In Davis, California, land use regulations have contributed to saving a considerable amount of energy. Ms. Gloria McGregor, Director of Davis' Community Development Department at the time their program was initiated, attributes the success of Davis' program to citizen support, "the system works because citizens have common purpose, energy conservation and because citizens are able to make clear cut choices between energy savings and waste." Without the proper political climate, successful planning and implementation is impossible [50, p.16].

There is no general formula which can be applied universally. The supply of

critical fuels, the climate, various other environmental factors, population size, the institutional framework of the community, and other local conditions will act to inhibit or enhance the possibility of inserting energy into the planning agenda.

Another factor will be that of keeping energy considerations in perspective. Conservation should be seen as but one more community goal, co-existing with other goals. Even if conservation become the dominant community goal, it should be remembered that, given local energy consumption patterns, manipulation of uses is one way to achieve the goals. Educating and cooperating with the development industry are essential as well. Cultivation of support from utility companies and development of public support are other ways to effect energy use. In the next section, how these energy planning elements have been incorporated to the concept of sustainability in urban systems and what kind of strategies have been used will be expanded by examining Tri-City Sustainable City Project.

CHAPTER IV

CASE STUDIES

The Sustainable City Project

Project Background

As the urbanization of humanity accelerates, as natural resources become scarce, and as global ecology asserts its certain limits, urban energy balancing has become a strategic matter of greatest urgency [23]. However, "A problem for urban America is having no models for guiding overall local action: the absence of coherent, strategic, decision-making formats with which to encourage action" [30, p.iii].

As a result, during 1989 to 1990, three cities, San Francisco, California; San Jose, California; and Portland, Oregon, launched the Sustainable Cities Project, funded by the U.S. Department of Energy through a cooperative agreement with the Urban Consortium Energy Task Force. Three cities worked together but pursued independent courses to develop energy policies that meet unique local needs and aspirations.

Preceding the efforts of the Sustainable City Project, many component elements have shaped such an overview of urban society's energy issues. Sources have included the Department of Energy (DOE)'s Comprehensive Community Energy Management Program grants; the Landmark thirteen-volume energy plan for Portland, Oregon funded under a major HUD grant; the HUD/DOE-funded local District

Heating and Cooling Community Energy Systems projects; and other renewable energy technologies.

In the summer of 1987, the energy office of the cities of Portland, San Francisco, and San Jose--already distinguished for their pioneering urban energy conservation efforts--began discussions on the concept of sustainable city development. Their coordination had been encouraged by the U.S. Department of Housing and Urban Development. The cities benefitted from peer exchanges as well as the technical support provided by a National Advisory Committee, the Lawrence Berkeley Laboratory, and the Washington State Energy Office [30, p.3].

Project Purpose

The purpose of the Sustainable City Project was to develop a planning process to identify and implement energy policies and program options for promoting urban sustainability.

As a part of the Sustainable City Project, the three cities produced a report, *The Sustainable City Project*, and the planning guide, *Sustainable Energy: A Local Government Planning Guide for A Sustainable Future*. The first report was published in August, 1991, to provide an "overview of the coherent urban energy efficiency and security choices" [30, p.iii]. The planning guide was published in December, 1992, to assist other jurisdictions in developing local policies and implementation procedures appropriate for sustainable energy planning. The guidebook contains a definition of sustainability and its importance, sustainable city planning process, the

key role for cities to promote a sustainable future. The rest of the guide suggests a process to develop a plan appropriate for each community [94].

The guidebook begins with a commonly held definition of sustainability as, "Development that meets the needs of the present without compromising the ability of future generations to meet their needs," as defined by The United Nations World Commission on Environment. The three cities in the Sustainable City Project focused on energy factors and defined sustainability as "managing today's urban energy needs without jeopardizing the needs of future generations" [94, p.2].

A sustainable city draws from the environment only those resources that are necessary and can be recycled perpetually or returned to the environment in a form nature can use to generate resources again. It involves complex and dynamic relationships between energy, the environment, natural resources, and economics.

Project Design: The Structure of Collaboration

The cities coordinated their efforts via bi-weekly teleconferences and project meetings that coincide with unit meetings of the Urban Consortium Energy Task Force. Each city follows the steps of a common planning process while pursuing separate research paths (Figure 24).

To take advantage of expert knowledge on urban energy issues, a National Advisory Committee was established (Appendix C.1). Over the course of two years, the committee helped to refine the focus, to approach problems pragmatically, and to maintain a national perspective on energy concerns. The Lawrence Berkeley

Laboratory drafted technical reports on three subjects which impact sustainable city development: (1) competitive bidding, (2) building code compliance and enforcement, and (3) development of a supply curve analysis to evaluate energy conservation programs. The Washington State Energy Office shared the strategies and results of its own Project Rebound. It was a program designed to assess the impact of energy efficiency measures on economic development in the distressed, rural community of Ellensburg, Washington [23].

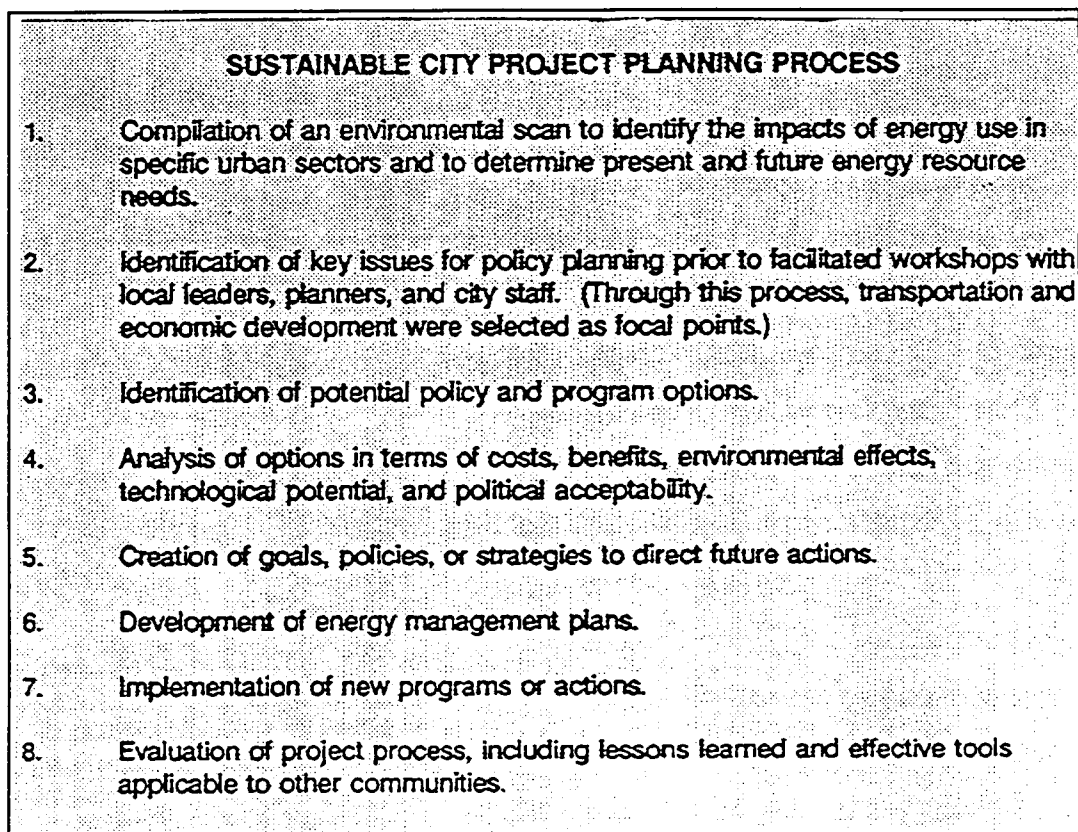


Figure 24 Project Planning Process

Source: *The Sustainable City Project*.

Although each of the cities followed a similar planning process, the variety of procedural methodologies and policy options reflects the unique characteristics of each city's physical development, community input, as well as the placement of each city's energy office within its government structure [94] (Appendix C.2). Each city's work plan reflected its physical and geographic layout, current energy use patterns, prior accomplishments in urban energy management, and anticipated future energy needs. These are important attributes because sustainable systems also must be both flexible and creative.

Following are each city's individual project focus and objectives. Figure 25.1 through 25.7 compare the demographic and energy use patterns of the three project cities, that are based on the most recent data from each city's environmental scan (Figure 25.1-25.7). The next section examines the overall process that Portland, San Francisco, and San Jose used to link their energy policies to broad community goals in an effort to promote sustainable development. A step beyond the Three City Sustainable City Development, which ended in 1990, is also discussed.

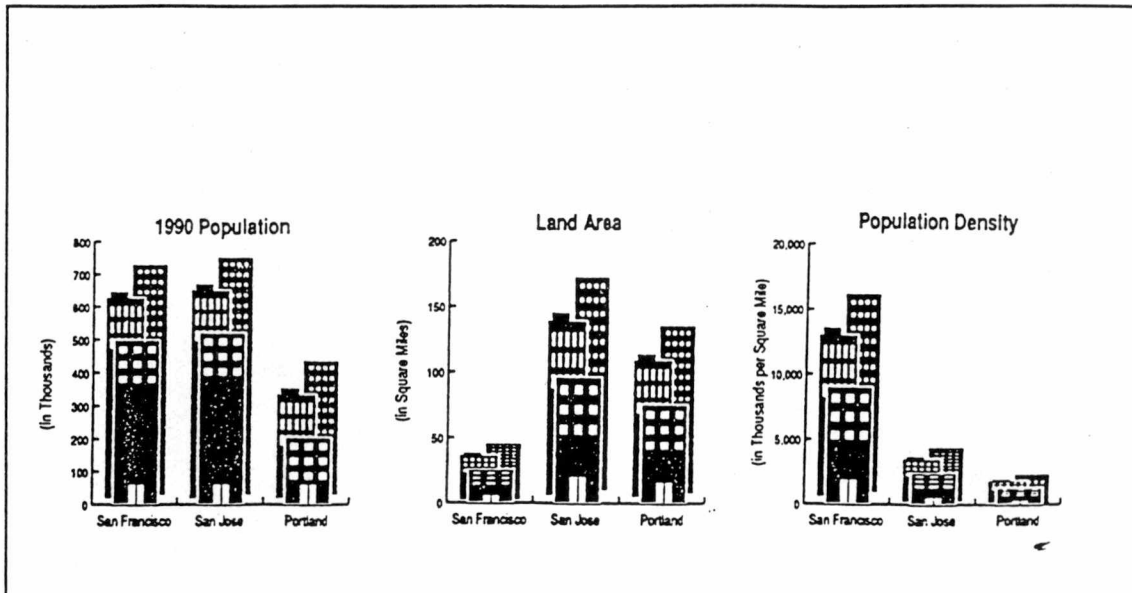


Figure 25.1 Comparison of Population, Land Area, & Population Density
Source: *The Sustainable City Project*.

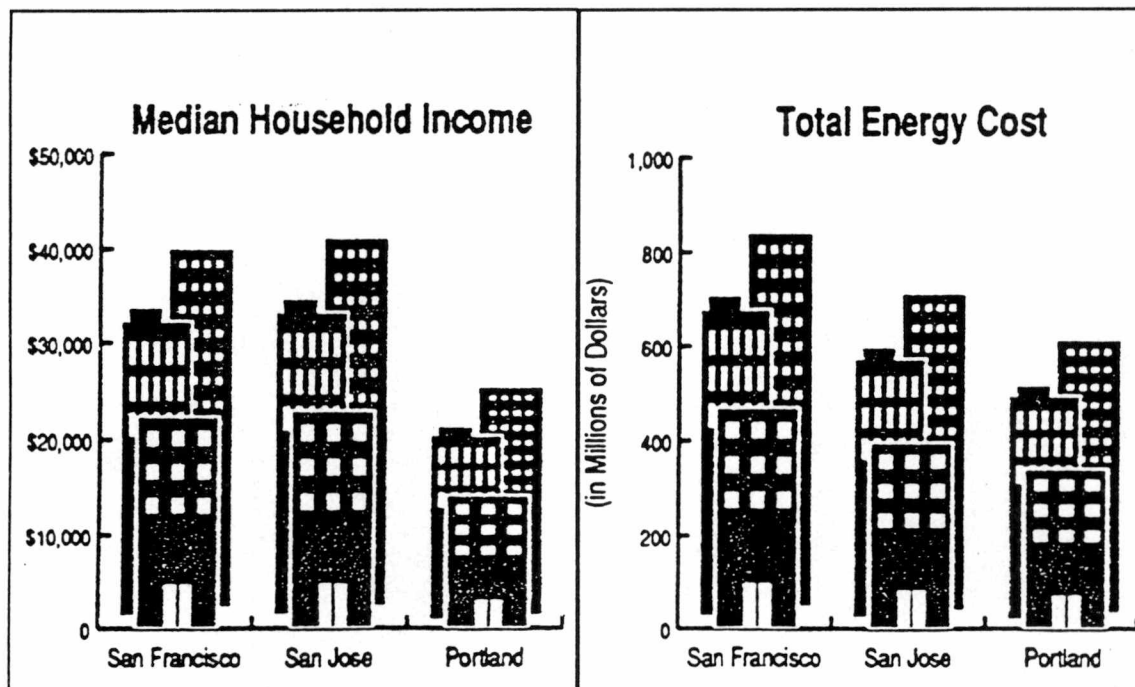


Figure 25.2 Comparison of Median Household Incomes
Source: *The Sustainable City Project*.

Figure 25.3 Comparison of Total Energy Cost
Source: *The Sustainable City Project*.

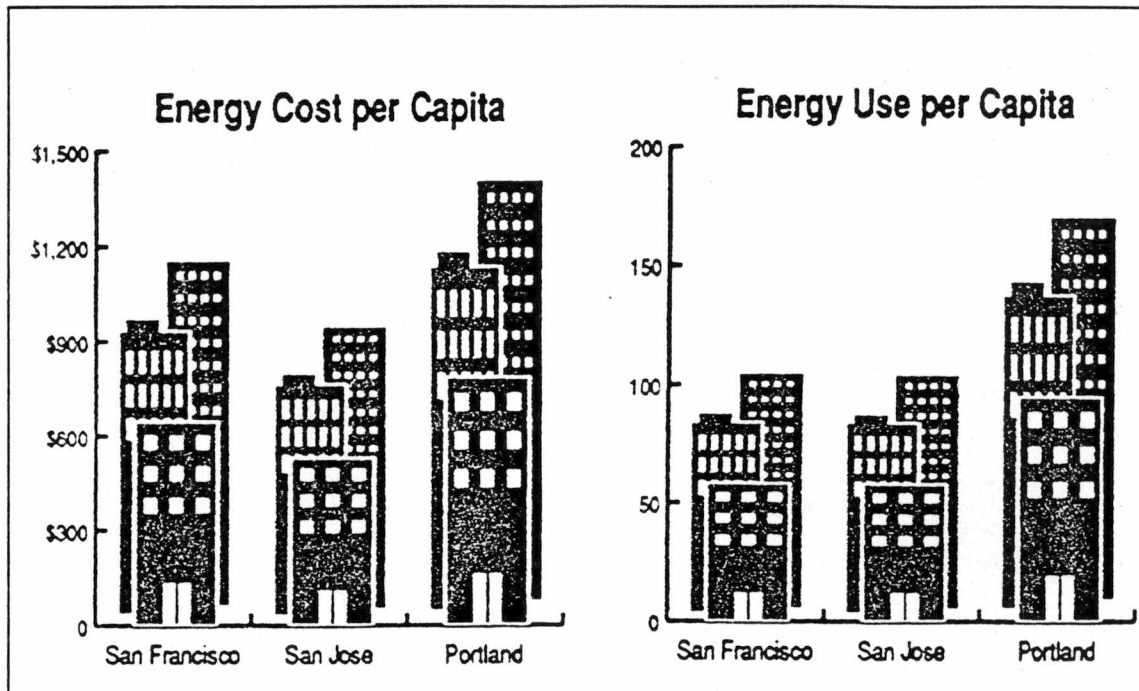


Figure 25.4 Comparison of Energy Use & Costs
Source: *The Sustainable City Project*.

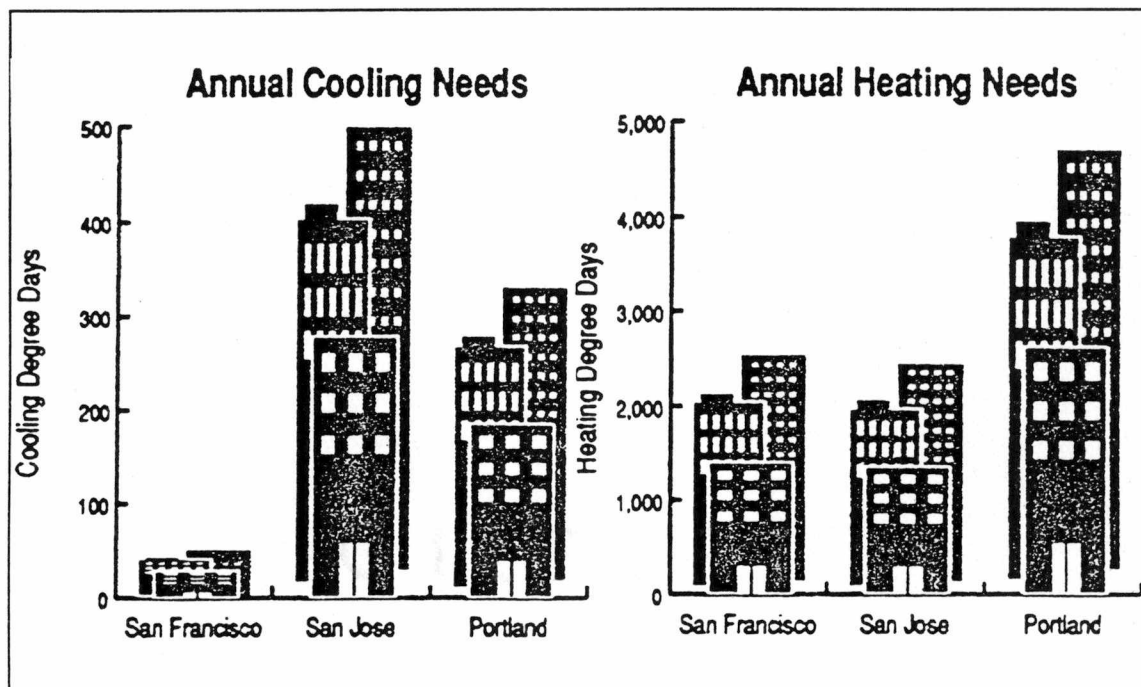


Figure 25.5 Comparison of Climate & Building Energy Use
Source: *The Sustainable City Project*.

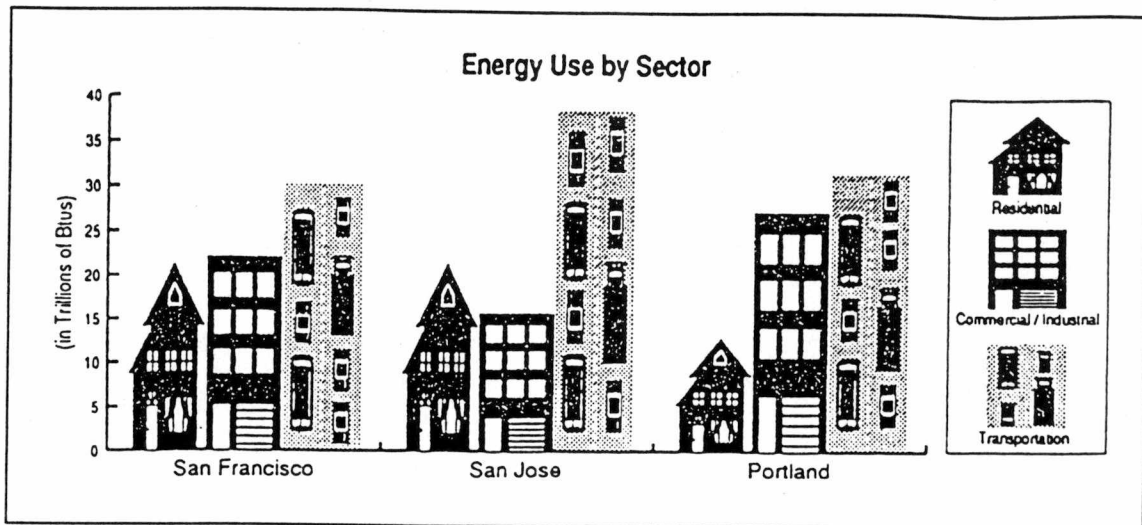


Figure 25.6 Comparison of Energy Use by Sector
 Source: *The Sustainable City Project*.

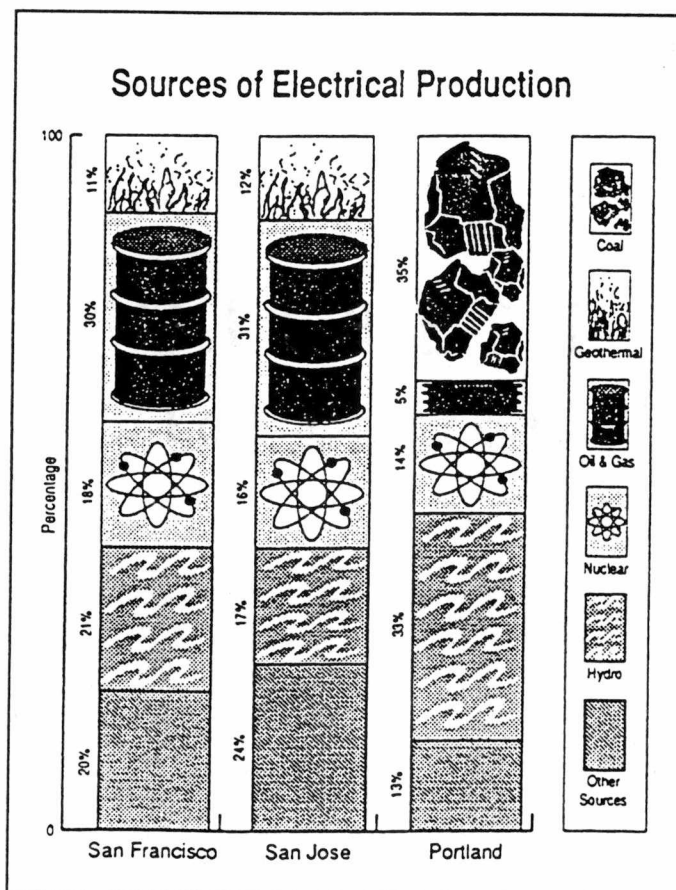


Figure 25.7 City Source of Electrical Production
 Source: *The Sustainable City Project*.

Portland's Approach to Sustainability

City Profile

Portland, known as the "City of Roses," is the result of both chance and planning. Today, the city serves as a model of a metropolitan area that has been effectively integrated with its environment through controlled growth and development. Portland encased in 124.7 square miles (1990) and located 65 miles from the Pacific Ocean, lies between two mountain ranges, the Cascade Range to the east and the lower Coast Ranges to the west, in the Willamette River Valley with the elevation of 39.0 feet above sea level (Figure 26). Winters are rainy, but the marine air keeps temperatures moderate, and the summers are mild, with temperatures rarely over eighty degrees [32, pp.373-375].

The city was founded in 1845 and incorporated in 1851. Portland grew steadily with the advent of the California gold rush, and today, the Metropolitan Area Population (PMSA) is 1,240,000 (1990) with a percent change of 12.1 % (1980-1990). The city population is 437,319 (1990) with a percent change of 18.8 % (1980-1990). Density is 3,507.0 people per square mile (1990).

A deep water port and a diverse economy make Portland a strong commercial center. Major economic sectors are services, trade, manufacturing, and government. The unemployment rate was 5.8 as of September 1992 and per capita income in 1989 was \$14,478. Statistical data including energy use is indicated on Figure 25.1-25.7 [32, p.377].

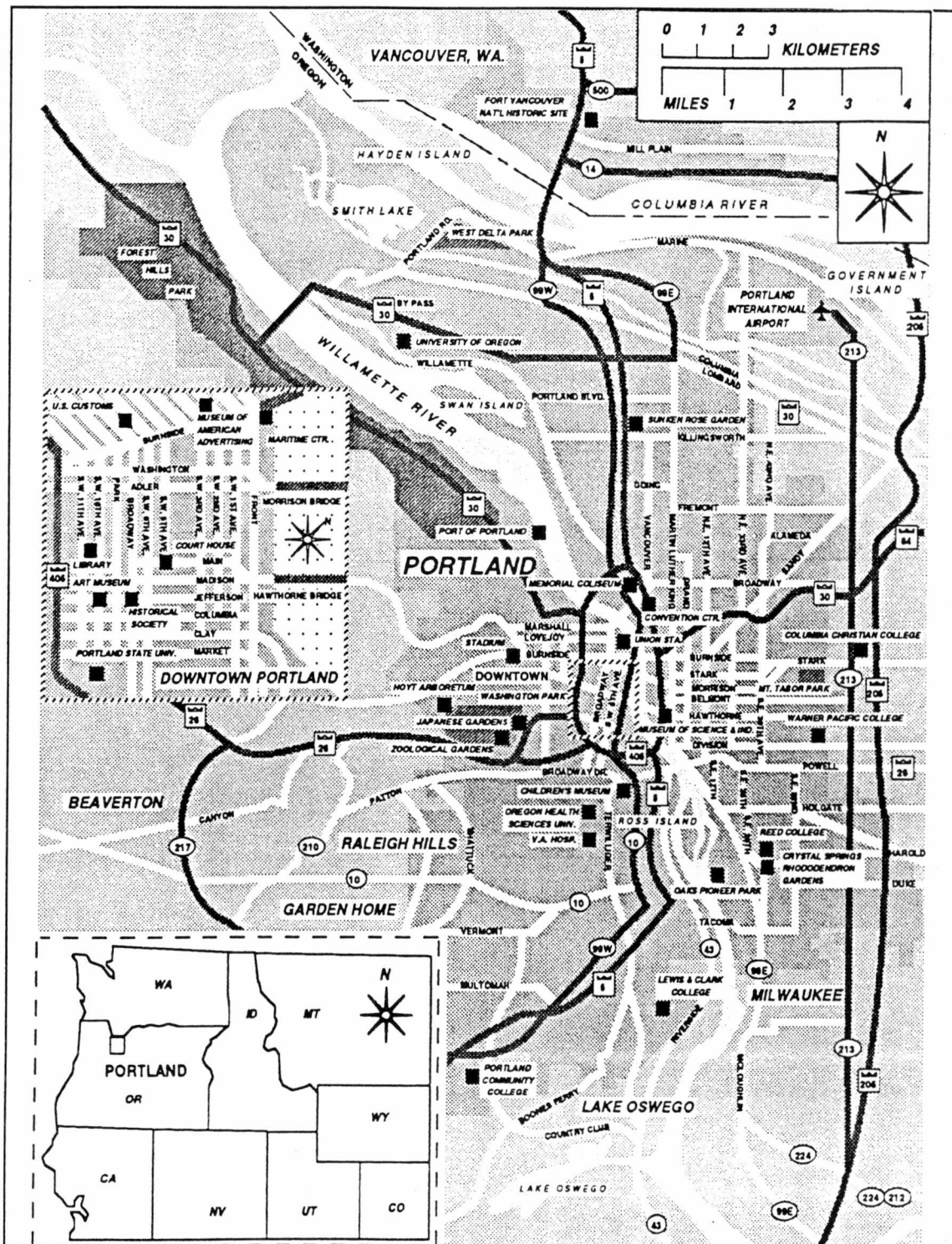


Figure 26 Portland, Oregon

Source: Gale Research Inc., *Cities of the United States: A Compilation of Current Information on Economic, Cultural, Geographic, and Social Conditions: The West, Volume 2*. ISSN 00899-6075 (1994).

Project Background

Portland's first energy policy was adopted in 1979. The sense of urgency surrounding the nation's energy crisis paved the way for a city energy policy based on conservation and new development [30, p.20]. The policy also established an Energy Office and Energy Commission. This helped Portland become the first major city in the United States to adopt a comprehensive energy conservation policy and become a model for over 150 cities across the United States [30, p.14].

Through the mid 1980s, energy conservation efforts slowed throughout the country along with the stabilized energy supplies and prices. However, by the end of the decade, an end to the electricity surplus and a need for new power sources were addressed. A better understanding of the implications of global warming, ozone depletion, and environmental pollution caused people in Portland to be more receptive to reducing dependency on fossil fuels and increasing energy efficiency [30, p.20].

By 1989, Portland's Energy Commission, the advisory committee of the city council, was responsible for assessing and updating the original policy. To reflect Portland's concern about its energy future, the city decided that a new city energy policy should be developed. In 1988, the Portland City Council passed a resolution supporting the development of a new energy plan. The Energy Commission envisioned a policy framework that would go beyond energy conservation to establish a link between sustainable energy use and planning goals in such areas as housing, transportation, solid waste, and business development. Consequently, this

project became Portland's vehicle for shaping its new energy policy consistent with the broader goal of achieving sustainability.

Goals

To guide the planing process, the Energy Commission stated its mission as follows:

To enhance the livability and the economic strength of the City of Portland through programs and policies that increase the ability of the City to control its energy future [30, p.21].

The new Portland's Energy Policy is:

To promote a sustainable energy future by increasing energy efficiency in all sectors of the City by 10% by the year 2000 [30, p.23].

Overall, Portland has set a goal of increasing energy efficiency citywide of 10% by the year 2000. In dollars, Portland expects its total energy consumption in all sectors to reach \$1 billion by the year 2000. The energy efficiency increase means that \$100 million will be retained within the local economy. The new ten-year plan divides 89 objectives into the following nine categories:

- The Role of the City;
- Energy Efficiency City-Owned Facilities;
- Energy Efficiency in Residential Buildings;
- Energy Efficiency through Land Use Regulations;
- Energy Supply;
- Energy Efficiency in Commercial and Industrial Facilities;
- Energy-Efficiency Transportation;
- Telecommunications as an Energy Efficiency Strategy;
- Waste Reduction and Recycling; [30, p.24]

To achieve this energy efficiency goal, the energy policy sets forth fifty-three two-year objectives and 36 long-term objectives (Appendix D.1).

Energy Policy Planning Process

The Energy Commission adopted an eighteen-month timetable to review the existing energy policy and to develop the new plan. Five independent task forces were established to gather information on energy use and technologies in the following areas: buildings, energy supply, industry, transportation and telecommunications, and data/background information. Each task force was composed of local experts in government, business, and technology. The groups held brainstorming sessions to generate ideas, and those ideas were refined into eight to twenty-five policy recommendations per task force.

In June 1989, Portland's Energy Office compiled a list of over 100 policy options based on task force recommendations and additional staff input. In July 1989, Energy Office staff completed a draft of the new Energy Policy. Figure 27 shows the Portland's 1990 Energy Policy development process (Figure 27).

Policy Review Process

As a first step in the policy review process, the Energy Office circulated the policy draft among members of a Technical Review Committee. The Committee was comprised of all Task Force chairs, administrators from each city department, officials from regional government bodies and energy offices, and some consultants. The Energy office staff met individually with each member to address any difficulties.

The revised version of the policy draft was submitted to the Energy

City of Portland 1990 Energy Policy Development Process

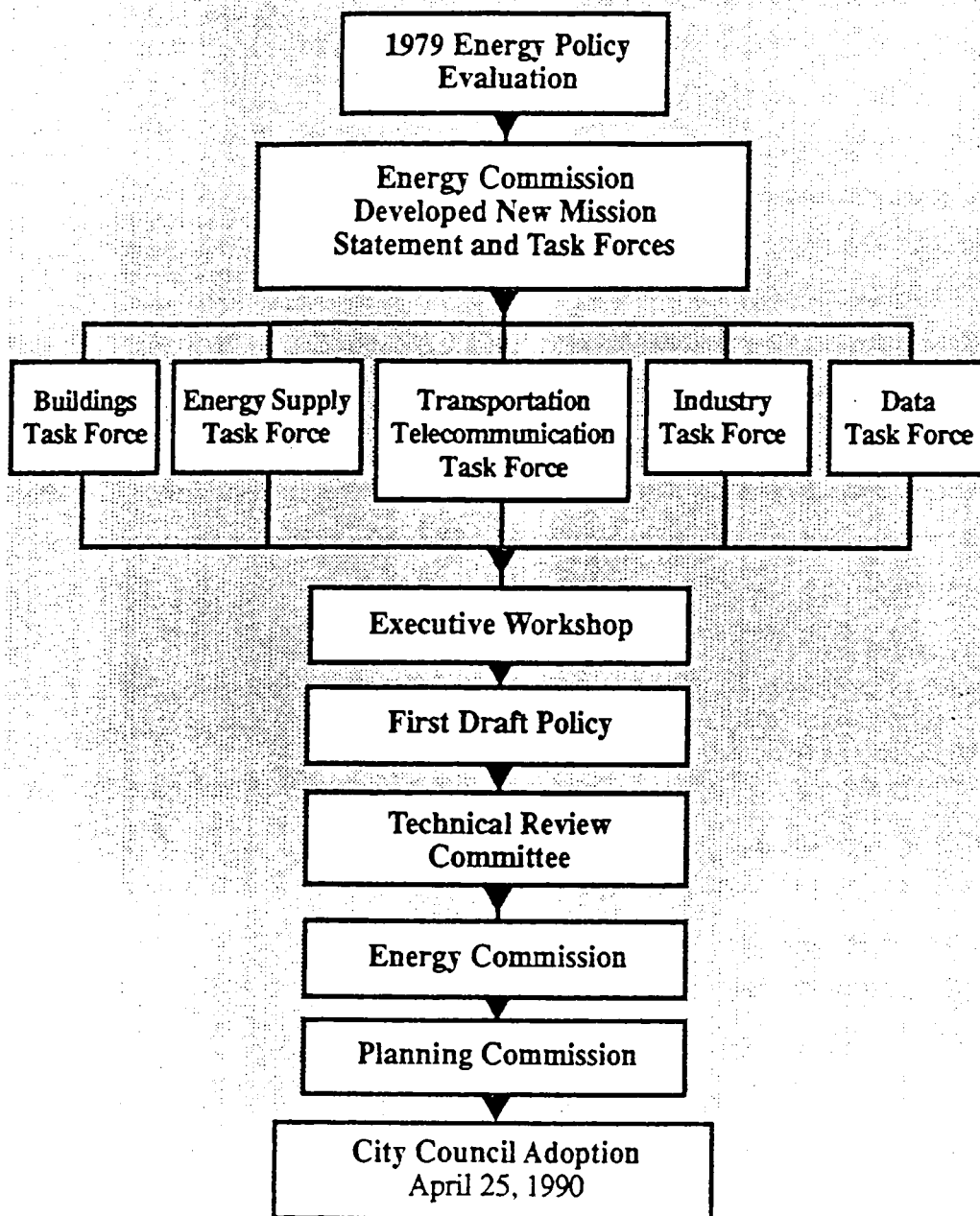


Figure 27 Portland's Policy Development Process

Source: *The Sustainable City Project*.

Commission, which gave its approval in January 1990 for beginning a six-week public policy review process. During the policy review period, more than 1,200 copies of the draft energy policy were distributed to interested groups.

Subsequently, the Energy Commission held a public hearing on the draft energy policy, amended the policy, and approved it for review by the Planning Commission. Because energy issues are within the scope of Portland's Comprehensive Land Use Plan, the new energy policy required the approval of the Planning Commission. The draft energy policy was approved by the Planning Commission in March 1990. The final step in the public hearing was held, and Portland's City Council adopted the new Energy Policy on April 25, 1990.

Participatory Process

Unique to Portland's policy planning process is the emphasis placed on a broad-based citizen participation process. The five task forces for the information gathering, composed of local experts in government, business and technology. Wide involvement of the city's other department was also important. The Technical Review Committee for the policy review comprised of all Task Force Chairs, administrators from each city department, officials from regional government bodies and energy offices, and some consultants.

Energy staff gained feedback on the draft by communicating with over fifty community groups via presentations, meetings, or extended telephone conversations. Contacts included neighborhood associations and coalitions, associations of home

builders, commercial builders, managers, architects, the Multi-family Housing Council, university and college groups, such as the civic and business leaders. The Energy Office states that "One of the most difficult but important tasks is to enlist the aid of people respected in the business community and public arena who will endorse and help to sell your policy" [87].

Implementation

Since the adoption of the new Energy Policy in April 1990, Portland's Energy Office reexamined the objectives in the two-year action plan to set priorities. Staff evaluated the economic costs and benefits, energy savings, and political expediency of each objective. From the list of eighty-nine objectives specified in the ordinance, thirty-eight objectives were selected as priorities for the first fiscal year. Next, the staff in the Energy Office designed appropriate implementation plans.

The City Energy Challenge program was launched in July 1992. The goal of this program was to identify and implement energy-efficiency projects that would cut \$1 million from the city's annual energy bill by 1997. Based on energy costs to city facilities in 1991, which totaled \$9.14 million, the \$1 million reduction in energy bills [59]. To achieve this goal, the city imposed a 1% fee on all city government energy bills. Totalling about \$70,000 per year, these fees were used to hire an energy management coordinator for city facilities. The result was that by the end of 1992, Portland had already implemented measures of identified opportunities to save more than \$775,000 annually [87].

The Sustainable City Project has placed Portland in a better position to leverage support for implementing its new energy plan. Since city funds for operating the Energy Office are limited, the Energy Office developed working partnerships with other agencies with interests in effective energy management. During the fiscal year 1990-1991, Portland contracted almost \$3,000,000 from the Urban Consortium, the Oregon Department of Energy, Portland General Electric, and Pacific Power and Light to support innovative energy programs. Many of the new Energy Office projects are integrated into the budgets and work plans of other appropriate city bureaus. For example, solar access ordinance were developed by the Energy Office but are implemented by the Planning Bureau. Alternative fuel research is being conducted by the Energy Office, but the Fleet Bureau will be the agency to integrate new vehicles into the city's fleet.

The development of Portland's new Energy Policy brought many diverse groups together, including city administrators, builders, environmentalists, transportation experts, financiers, utility representatives, and neighborhood organizations. The process of building a community-wide consensus to promote the economic development and a clean environment has been supported by many other actions that promote sustainability. These actions include:

- A city ban on chlorofluorocarbon (CFC) packaging in restaurants and grocery stores;
- Commitment to the expansion of the light rail system;
- A METRO-wide solar access ordinance;
- Energy Efficiency through Land-use regulations;
- Curbside recycling for all residents and businesses;
- A regional composting facility;
- A clean river program [87].

Following are brief examples of some other implementation programs.

Energy savings for New Commercial Buildings. Since June 1990, Portland has required all commercial building permit applications to show compliance with the energy efficiency standards in the Oregon Building Code. The code includes energy-efficient measures for mechanical, structural, plumbing, and lighting systems.

Building designers can use a manual provided by the City to make compliance calculations easier. A computer software version of the manual, compliance forms and a computerized, self-paced training program for building official developed by the Oregon Department of Energy is also available [30, p.20].

BEST Program. The Portland Energy Office's Businesses for and Environmentally Sustainable Tomorrow (BEST) program provides consultants to help local businesses save energy, conserve water, reduce waste generation, and promote clean and efficient transportation. The program, begun in January 1992, was intended to help fifty businesses during its first year. By the end of 1992, it had helped sixty-three. Through the BEST program, the Portland Energy Office helps businesses. Following are the contents of the BEST program:

- Obtain energy design assistance;
- Apply for state credits;
- Obtain rebates and incentives offered by local utilities;
- Select appropriate and energy efficient technologies;
- Get long-term, fixed-rate financing for energy projects;
- Recycle construction waste;
- Use water more efficiently;
- Find transportation alternatives for employees;
- Receive recognition as energy and environmental leaders [87].

Weatherization Program. The energy policy included plans to facilitate the weatherization of 8,000 units in low-income, multifamily housing complexes by 1992 and 20,000 such units by the year 2000. Portland's award winning Block by Block weatherization program aims to make housing more affordable by directing a portion of the city's 5% utility tax back to low-income neighborhoods. Working under contract with three local utilities and the Oregon Department of Energy, the Portland Energy Office recruited apartment owners for the program and helped them to apply for more than \$2.9 million in utility and state cash rebates and tax credits. By October 1992, Portland apartment owners had spent more than \$6 million weatherizing some 8,300 apartments. Buildings weatherized through this program achieved an average energy savings of at least 26% on space heating. During this period, another 4,000 apartments received energy audits, had weatherizing work in progress, and had an additional 1,300 apartments had energy audits pending [30, p.22].

Clean Driving. Portland's City Fleet revs into the future within five new natural gas vehicles. Natural gas vehicles improve air quality by producing less carbon monoxide than gasoline and other alternative fuels. Portland's new vehicles also help to reduce the level of ozone and the eye stinging, lung-burning substance of urban smog. Oregon's Department of Energy funded Portland's vehicle of Energy funds. Portland's vehicle conversing as part of a pilot project. To evaluate vehicle maintenance, vehicle performance, driver acceptability and air emissions, the Portland Energy Office is working jointly with fleet services [30, p.25].

New Horizons: City of Portland Carbon Dioxide Reduction Strategy

Portland is one of fourteen local governments to take internationally the lead on jointly developing local global warming solutions [66]. The focus of the effort is to show how local communities can have a major impact on slowing the atmospheric build-up of carbon dioxide (CO₂), which is the primary gas contributing to the threat of increased global warming.¹

At the 1992 Global Summit in Rio de Janeiro, Brazil, the United States and 154 other countries committed to decrease greenhouse gas emissions, developed national action plans, and increased scientific research and monitoring. But, there was no international agreement on an emissions reduction goal. For the effort of the United States, President Clinton has recently announced a goal of stabilizing U.S. greenhouse emissions at 1990 levels by 2000.² The National Energy Policy Act of 1992 requires the U.S. Department of Energy (US DOE) to study the feasibility of stabilizing and reducing greenhouse gas emissions. It also requires the USDOE to study the feasibility of reducing CO₂ emissions 20% below 1988 levels by 2005.

The local CO₂ reduction goals have a broader context of national and international responses. Along with the other international cities, Portland is also

¹ The other project participants are Ankara, Turkey; Bologna, Italy; Copenhagen, Denmark; Dade County, Florida; Denver, Colorado; Hannover, Germany; Helsinki, Finland; Minneapolis and Saint Paul, Minnesota; Saarbrücken, Germany; San Jose, California; and Toronto and METRO Toronto, Canada [66].

² The United Kingdom, Canada, Australia, Austria, Belgium, France, Finland, Sweden, Norway, Switzerland, the Netherlands, Germany, New Zealand Japan, and Denmark have all set CO₂ reduction Targets. In addition, the 12 countries of the European Community agreed to stabilize carbon dioxide emissions at 1990 levels by the end of the century [66].

setting a goal to reduce CO₂ emissions. Portland is participating with the other local governments in the Urban CO₂ Reduction Project, coordinated by the International Council for Local Environmental Initiatives (ICLEI). ICLEI is an international environment organization of local governments established in 1990 by more than 200 municipal officials at the World Congress for a Sustainable Future.

The Oregon Progress Board, chaired by the Governor, had adopted a state-wide benchmark to stabilize Oregon's CO₂ emissions at 1990 levels. The Oregon Department of Energy (ODOE) will develop the strategy to achieve it, which will be published in 1995. Appendices E.1-7 provide detail on the 1988 energy end use and CO₂ emissions, the targets, and the 2010 forecast (Appendix E.1-E.7).³

In the context of international, national , and state directions toward setting goals, the City proposes the following CO₂ reduction goal for the Portland Metropolitan area:

- *By 2010, reduce carbon dioxide emissions 20 percent below the 1988 level [66].*⁴

This goal was established as a target by the fourteen communities and suggested as significant target at the World Conference on the Changing Atmosphere held in Toronto, Canada in 1988. Portland Global Warming Strategy elements encompass the following: transportation, energy efficiency, renewable resources and co-generation enhancement, recycling, tree planting, and incorporation with Federal

³Forecast models was based on Oregon Fourth Biennial Energy Plan in 1991 [66].

⁴This will mean cutting the carbon dioxide emissions to about 42 percent below the 2010 forecast [66].

Actions.

The Portland's Energy Policy will have been updated in 1995, and the elements in the Carbon Dioxide Reduction Strategy will be integrated. The Sustainable City Project and Carbon Dioxide Reduction Strategy were planned separately but will be integrated to have broader perspectives with a workable implementation plan because these two projects are under the same objectives: toward more sustainability [59].

San Francisco's Approach to Sustainability

City Profile

San Francisco is one of the international cities in the Unified States and its scenic beauty and cultural diversity attract many people. San Francisco occupies the tip of a peninsula halfway up the coast of northern California and is surrounded on three sides by the Pacific Ocean, the Golden Gate strait, and the San Francisco Bay. The City of San Francisco contains approximately 46.7 square miles (1990), with an elevation of 155 feet above sea level [32, pp.169-173, 376] (Figure 28).

The Pacific air keeps the temperatures generally moderate. The temperatures are rarely above seventy-five degrees or below forty-five degrees, but the city's hilly topography sometimes causes wide variations in local climate. Over eighty percent of annual precipitation takes place between November and March and the most distinctive feature of the local climate is the fog banks.

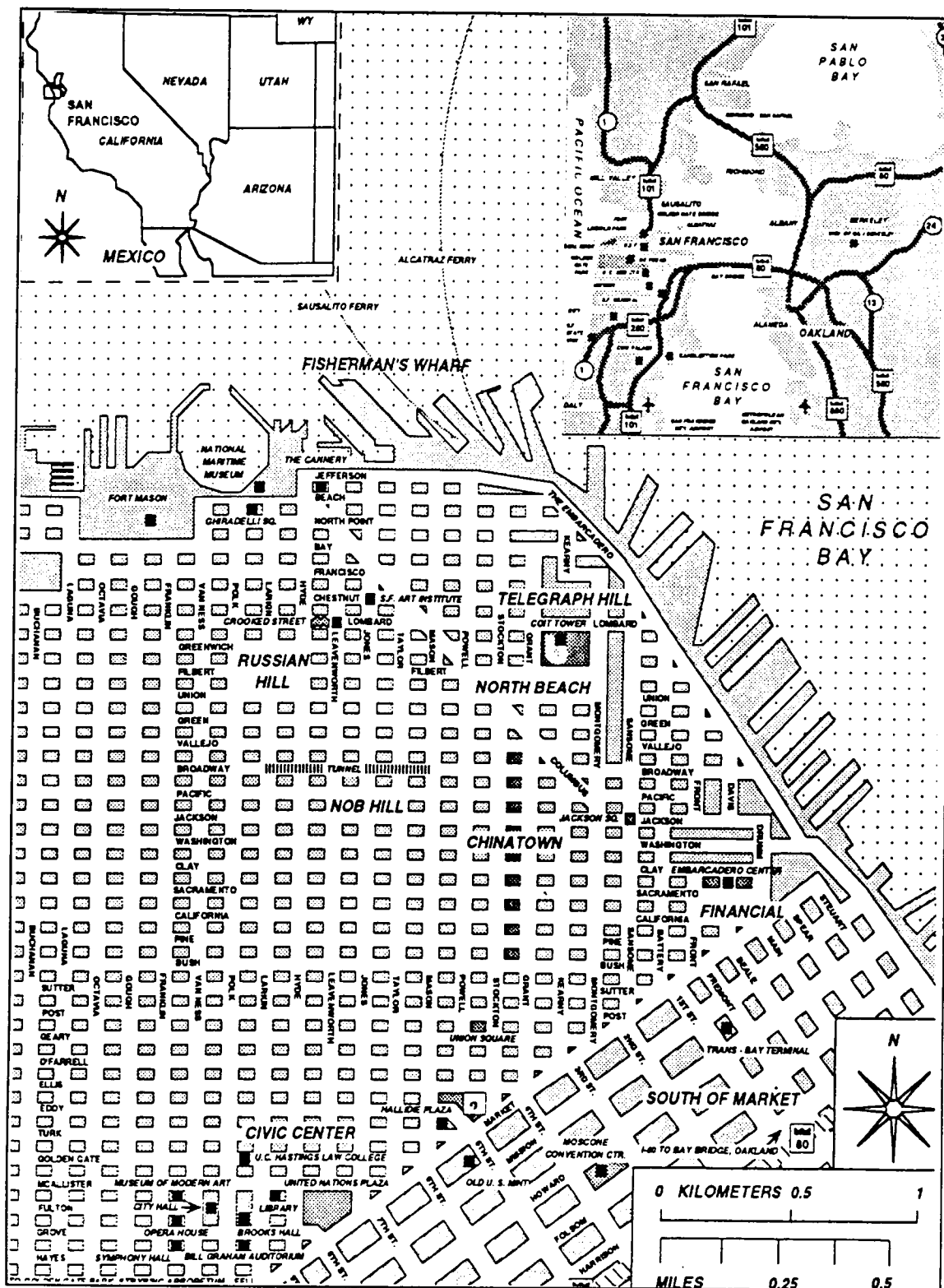


Figure 28 San Francisco, California

Source: *Cities of the United States*.

The city was founded in 1776 and was incorporated in 1850. The population of the Metropolitan Area (MSA) is 1,604,000 (1990) with a percent change of 7.7% between 1980 and 1990 and the city population is 723,959 (1990) with a percent change of 6.6% (1980-1990). The population density is 15,502.3 people per square mile.

San Francisco is also a major financial and insurance center and international port. Major economic sectors are services, trade, finance, insurance, real estate, and government. Per capita income is \$19,695 (1989) [32, pp.174-175]. Statistical data including energy use is indicated on Figure 25.1-25.7.

Project Background

The Sustainable City Project was initiated during a time of financial retrenchment. Furthermore as a large population center in the most energy intensive society, San Francisco is a contributor to the 'potentially dangerous changes' taking place in the global atmosphere [30, pp.27-28]. Each year, the use of nonrenewable energy resources in San Francisco produces over 186,000 tons of air pollutants and drained nearly \$750,000,000 from the local economy. This is a threat to the health of residents, a waste of economic resources, and contributes to a deteriorating environment, because San Francisco's natural environment is a major attraction of the city and thus major economic resources.

In response to citizen environmental advocacy interest, during the late 1970s San Francisco established the Bureau of Energy Conservation, and in 1982, adopted

an Energy Element in the General Plan. The Plan includes energy policies in transportation, land use, municipal buildings, residential and commercial buildings, industrial facilities, alternative energy, and the financing of related projects. Since then, the Bureau of Energy Conservation has been responsible for implementing the energy policies set forth in the plan [30, p.28].

The Bureau's involvement in Mission Bay, a project with a twenty to thirty year planning horizon created the opportunity to develop a comprehensive energy plan. This pointed to the need for a long-term vision for San Francisco's energy future. While the Bureau's various projects provided measurable benefits to energy efficiency, together they did not form a coherent, long-term program. In the past, the Bureau's conventional energy planning process has been to evaluate alternative conservation measures with respect to their impact on energy costs. Potential reductions in energy costs were then weighted against the availability of necessary resources for implementation and the likelihood of success given the political support of the moment. While this planning process is responsive to the perceived priorities of the times, it does not provide a long-term plan [30, p.28].

Thus, San Francisco participated in the Sustainable City Project to develop a long-term planning process that would help the city decide how to allocate limited resources to meet energy efficiency opportunities that would shape the City's energy programs towards the long-term goal of sustainability [30, p.29].

Goals

The goal for long-term sustainable urban planning is "to develop a prosperous and healthful urban system which can provide for the physical, social, and psychological needs of the population and, at the same time, reverse the trends of increasing pollution and environmental degradation now threatening the quality of city life" [30, p.30]. The general characteristics of a sustainable system have much in common with attributes of the natural ecosystem. the key element of sustainable systems are the following:

- Consistent:** *The short-term acts of individual elements within the system are compatible with the long-term viability of the whole.*
- Renewable:** *The system depends on resources that potentially cannot be used up.*
- Diverse:** *Distinct characteristics and capabilities among the individual elements of the system make the system better able to change.*
- Inclusive:** *All elements of the system are valued and utilized for the good of both the individual parts and the whole.*
- Interdependent:** *Each element of the system is both dependent on and depended on by several other elements; the greater the interconnection, the stronger the system [94, p.3].*

Energy Policy Planning Process

The alternative to the conventional energy planning process is to design a decision-making strategy which recognizes the needs of the future as well as those of the present. Sustainability concepts present a more difficult challenge: how to

identify and build the key components to a sustainable urban energy system. For example:

- (1) Priorities of energy policies over the long-term, yet are flexible enough to accommodate short-term decision-making needs
- (2) Defines the criteria of sustainability; to determine what the future should look like and determine the appropriate level of resources to invest
- (3) Illuminates strategies for overcoming political or financial barriers
- (4) Which essential components of sustainability are not being considered due to a lack of awareness of their importance [94].

To discover the answers to these questions, the Bureau sought to develop a long-term planning process and examine what the goals might be. Figure 29 shows the planning process (Figure 29).

Appropriate policy options also include those for which effective action may be taken at a municipal level rather than at regional, state, federal, or global government levels, though cities must work to influence actions at the other governmental levels as well. Finally, for more equitable assessment, policy options need to be defined at comparable levels or scopes when possible [30, p.32].

The Bureau of Energy Conservation developed energy-related policy options to meet each of the objectives in the Sustainable City Framework. Policy options were developed from the City's General Plan Energy Element, from other cities' policies, and from work by the Lawrence Berkeley Laboratory and other research groups (Appendix D.2)

The objectives shown below provided San Francisco with a framework for developing city policies which, when implemented, will contribute to the

City of San Francisco Sustainable City Planning Process

Defining the Sustainable Urban System

- The Key Elements
- A Framework for Sustainability

Policy Selection

- Defining the Policies
- Evaluating the Policies

Implementation Planning

- Investigating the Linkages
- Identification of Other
Interested Parties

Ongoing Development

- Continued Implementation Planning
- Monitoring and Evaluation
- Information Systems Management

Figure 29 San Francisco's Policy Planning
Process

Source: *The Sustainable City Project*.

achievement of urban sustainability:

- Promote environmental protection,
- Develop self-reliant resources,
- Improve waste management,
- Develop efficient resource delivery,
- Develop efficient production of goods and services,
- Promote integrated community design,
- Develop transit alternatives,
- Develop appropriate housing,
- Promote a participatory society [94].

Policy Review Process

To evaluate the list of alternative policies, it is necessary to determine what benefits each may contribute to the sustainability of the city as a whole. Such assessment enables policies to be prioritized as scarce resources are allocated. It is also necessary to determine the linkages between policies to understand the full impact of each policy and to identify the key components of a sustainable system. Potential policies were rated for their benefits to sustainability and divided into priority groups. The rating scale used by San Francisco's Bureau of Energy

Conservation are as follows:

- 0: None or insignificant contribution toward achieving objective.
- 1: Minor contribution toward achieving objective.
- 2: Significant contribution toward achieving objective or a small yet essential contribution.
- 3: Major contribution; an indispensable element toward achieving objective [30, p.34].

Costs were set aside for later evaluation during program implementation. The assessment process was designed to help select a course of action and to avoid using scarce resources in extensive evaluation.

The benefits of each policy option were scored with respect to their impact on all of the Sustainable City framework objectives. The score reflected both the direct and indirect impacts of either energy saved or energy produced that may be attributable to a policy. Once completed, the evaluation exercise resulted in a division of the potential policy alternatives into four major priority groups.

As the next step in the policy evaluation process, a diagram was developed to show the linkages between policies within and between the four priority groups (Figure 30). Producing the diagram required an additional assessment of the impact that each policy may have on the implementation of the policies. For example, programs for implementing a policy to improve the energy efficiency of commercial buildings will also provide the markets for a policy to develop business providing resource-efficient goods and services. The diagram of the top priority group shows that some policies only impact one or two others while some contribute to the implementation of many. The latter type of policies help to achieve other seemingly unrelated objectives. For San Francisco, the two policy areas that appear to have the most impact on other policies are Commercial Building Regulations and Large Project Resource Planning. Therefore, these two policies were selected for early implementation planning [30, p.34].

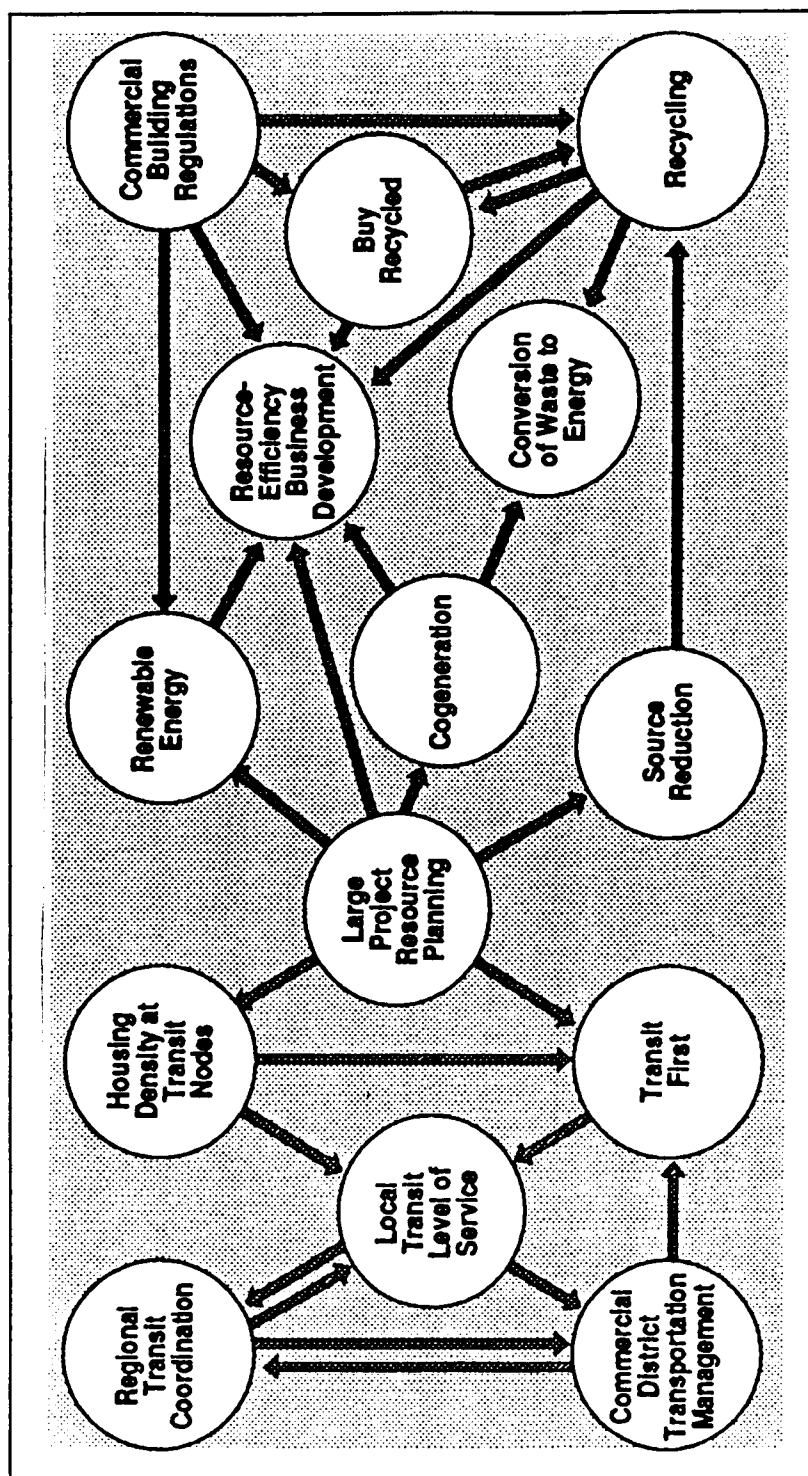


Figure 30 San Francisco's Top-Ranking Policy Options
Source: *The Sustainable City Project*.

Participatory Process

A key step in the implementation process is identifying the interest of other city departments and people in the community. For example, the Bureau of Energy Conservation interest in water resources centers on the cost of energy for pumping water. San Francisco's Water Department is interested in limiting cost by minimizing water use, and the Clean Water Department is interested in reducing the volume of sewage to be treated. Other community groups with interest in water use and efficiency include the Sierra Club, San Francisco Tomorrow, and Save the San Francisco Bay Association. Involving these departments and community groups in the development and implementation of a water efficiency program will increase the likelihood of an effective program to meet both energy efficiency and other related objectives, as well as build the support for program implementation.

Implementation

The implementation of policies to achieve sustainability considers the linkages to other policies and objectives in the Sustainable City framework. It is essential to investigate any policy not only for its apparent purpose but also for its links to other policies and objectives. This type of investigation provides a deeper understanding of the potential impacts and indicates the important areas for coordination with other departments and community organizations. The process not only enhances sustainability, but builds support of implementing the policy [30, p.35] (Figure 30).

Each link between the policy and energy use anywhere in the system must be

assessed. The assessment must include:

- A description of the existing conditions;
- Identification of any barriers to implementation;
- Creation of initiatives to overcome the barriers to assure successful policy implementation [30, p.35].

With respect to policies for commercial buildings, for example, assessment means looking beyond the energy used by the lighting, heating, cooling and motor-driven systems. The linkages to energy issues involved in the construction, use, and even the eventual demolition of a building must also be considered. Similarly, to include the energy use related by the usage or location of the building, such as impacts on recycling or the modes of travel to and from the building, and an integrated package of policies emerged will contribute to sustainability more effectively.

The immediate, direct energy issues involving commercial buildings consist of updating and enforcing current energy codes, encouraging builders to go beyond code requirements, and maintaining or replacing energy-using equipment to improve energy efficiency. However, indirect energy issues to be examined include transportation, water use, and even the management of materials used in operating the businesses in the buildings.

With regard to use of materials, for example, offices in San Francisco currently recycle white paper through a wide-spread, organized program. One barrier to more widespread recycling is that building in San Francisco's high-occupancy commercial realty market contains insufficient storage space for recyclable. Therefore, for example, the inclusion of adequate storage space for recyclable in

building code can be viewed as a step toward the achievement of urban sustainability in new office development [30, p.39].

The selection of appropriate policies and the development of implementation plans are not intended to create a fixed plan or blueprint for all future activities. Then, each year implementation plans already developed need to be reviewed and modified as new conditions emerge. The highest priority groups and the linkage analysis described above will be the primary tools for selecting the next policies to be developed.

Changing conditions can also open implementation opportunities previously buried by unfavorable economic, political or technological conditions. To detect changing conditions, it is necessary to stay abreast of developments in energy technologies, to update the environmental scan, to stay in contact with community groups, and to monitor the programs for implementing the Sustainable City energy policies. This will allow the Bureau to re-evaluate the policies and improve the implementation planning within the Sustainable City framework annually.

Following are brief descriptions of some other implementation programs:

Commercial Building Efficiency: The commercial sector spends more on energy purchases than any other sector in San Francisco, accounting for 40% of the \$800 million annual city-wide energy expenditures. To reverse the trend for increasing energy consumption by San Francisco's commercial sector, building energy performance needs to be improved. The San Francisco Commercial Energy Conservation Ordinance is designed to affect existing building stock by requiring

basic energy measures at the time of sale or during major renovations.

The Bureau is also working with the Small Business Commission through the Green Ribbon Panel. The Panel is composed of broad as well as industry-specific task forces and expert advisory committees in the areas of energy, water, hazardous wastes, materials, management, and transportation. The goal of the panel is to assist the 30,000 businesses city-wide to operate in an environmentally sound manner and to convince the public to patronize Green Ribbon businesses [59].

Recycling, Buy Recycled, Source Reduction: San Francisco produced over 1,000,000 tons of solid waste and sludge annually, 75% of which is hauled out to a landfill 60 miles away. To achieve sustainability, eventually all materials must be recycled or returned to the natural ecosystem in a form that can be reconverted into new resources [30, p.40].

San Francisco, like many other California cities, has started several recycling and source reduction programs. However, the economic health of recycling programs is subject to the commercial value of the recycled materials. Therefore, the purchase of materials made from recycled content is fundamental to the development of markets for the raw recycled materials.

To further these markets, the Bureau is participating in a multi-agency task force formed by the Solid Waste Management Office and assigned to develop a municipal policy and ordinance for purchasing products with recycled content. The city's actions demonstrate to local businesses that "buying recycled" is both a prudent and a responsible path to follow [30, p.40].

Regional Transit Coordination and Commercial District Transportation

Management: To achieve sustainability, the need to own or operate a vehicle must be vastly reduced. Steps in this direction would all but eliminate energy-wasting traffic congestion and reduce the space, materials, and energy needed for moving and parking vehicles. San Francisco has 360,000 registered vehicles, and each day an additional 100,000 vehicles commute to the City. Although 60% of downtown workers' trips are made by public transit, many people find waiting for transit connections too time consuming.

To develop influence in the transportation arena, the Bureau of Energy Conservation has begun working with the Department of City Planning, which has some transportation planning responsibility and also coordinates the Transportation Management Association. The organizational structure is shown in Appendix C.3. To support the Department of City Planning's effort, the Bureau distributed pledge cards to 27,000 municipal employees to encourage their participation in "Beat the Back-up Day." Through the event, city employees are being integrated into the rideshare system, and at the same time the Bureau is building a relationship with a key transportation planning office [30, p.41].

New Horizons: Environmental Education Program

Bureau of Energy's efforts to be a facilitator to involve other cities departments, and citizens has been made, and eventually "sustainable concept has began to spread." At the beginning stage of the Sustainable City Project, the staff

sought the conceptual framework of urban sustainability; however, emerging new issues, economic situations and new technologies may affect the course of change. Furthermore, the overall Sustainable City framework itself is something that will be regularly re-evaluated and modified to reflect new understandings. If in the current stage of project implementation, results turned out to contribute to overall sustainability, further enhancement will be needed. If not, changes should be made. Also the city recognizes the importance of education, not only citizens but also decision makers. The city currently operates various educational programs, and one example is the "Environmental Fair Booth" which demonstrates various kinds of energy conservation and which households can participate. The exhibition is scheduled to be held in the summer of 1994 as a part of City Fair and is planned to make learning about energy conservation enjoyable. Education is a basic tool to form consensus and further enhancement of the Sustainable City Project [8].

San Jose's Approach to Sustainability

City Profile

As the result of the computer revolution, San Jose became the capital of the Silicon Valley a vast complex of electronics industries that stretches throughout California's Santa Clara Valley. The city of San Jose encompasses approximately 173 square miles at an elevation of sixty-seven feet above sea level. The hillsides surrounding the city are an extensive land resource devoted to non-urban uses such

as watershed and wildlife habitat. Permanent bodies of water include several reservoirs, and the San Francisco Bay forms in the area [32, pp.183-186] (Figure 31).

The city was California's first civic settlement founded in 1777 and was incorporated in 1850. Today, the metropolitan area population (MSA) is 1,498,000 (1990), with percent change of 15.8% between 1980 and 1990. The City population is 782,248 (1990), with percent change of 24.3% (1980-1990), and the density is 4,566.5 people per square mile (1990) [32, pp.183-186].

Major economic sectors are manufacturing, services, and government. The unemployment rate was 6.7% in September 1992. Per capita income in 1989 was \$16,905 [32, pp.183-186].

Statistical data including energy use is shown on Figure 25.1-25.7.

Project Background

A report entitled "*Toward a Sustainable City*" was prepared for the San Jose's City Council in 1980. It identified public policy issues in natural resource management and presented recommendations for the city to take that would improve the City's efficient resource use and economy [92].

Initial steps taken by the city council included the creation of an Energy Office. The energy programs conducted by the office included replacement of the mercury vapor lamps in all streetlight with low pressure sodium fixtures that used half the electricity. The result was a 41.5 million dollar drop in San Jose's annual energy bill. Later, the Energy Management Program included residential

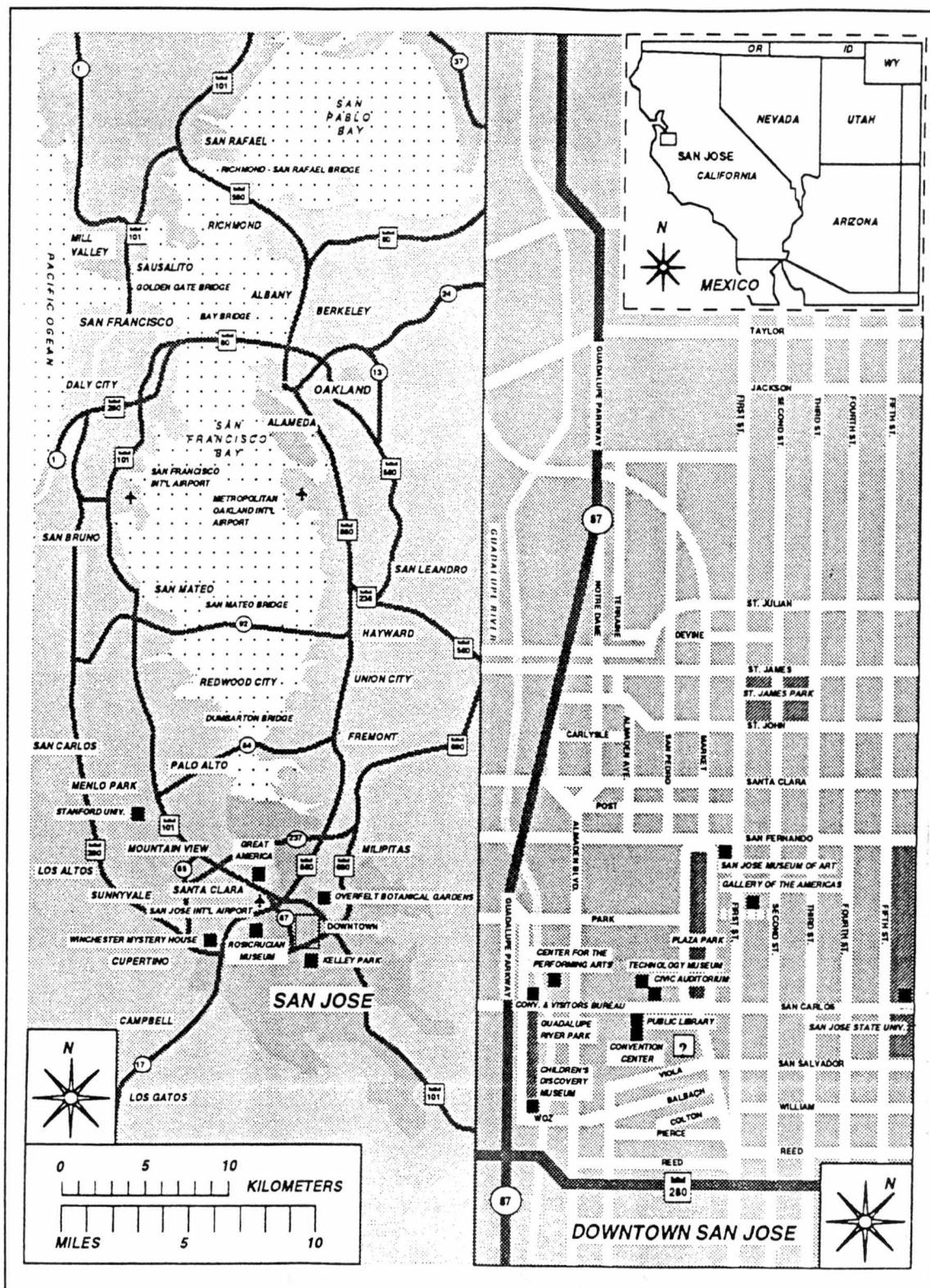


Figure 31 San Jose, California

Source: *Cities of the United States*.

weatherization projects and an innovative cogeneration project for the city's new Convention Center (Figure 32). Through the cogeneration project, San Jose pioneered the development of community scaled energy systems and analyzed how lowered energy costs benefitted the community. Over the years, the Energy Management Program has received wide recognition for undertaking over 100 innovative projects to promoting energy efficiency, conservation, and savings in the commercial and residential sector as well as in the operation of municipal facilities.

In 1986, San Jose combined its energy, water, and solid waste programs and created the Office of Environmental Management (OEM), located in the city manager's office. The primary function of the OEM is to provide information on policy development to the city council. Appendix C.2 shows the organizational chart of the San Jose's Sustainable City Project and the Office of Environmental management (Appendix C.2).

In 1986, the Energy Management Program produced a study entitled, "*Options for the Future.*" This study marked San Jose's first attempt to establish principles of a comprehensive energy policy. As a result, since the 1980s, San Jose residents, businesses, and agencies have together trimmed \$5.5 million off the annual energy bill which each year saves enough energy to power 7,600 households [30, p.44].

Aware of the likelihood of a third energy crisis during the early 1990s, San Jose's Energy Management Program joined the Sustainable City Project to lay the groundwork for new policies that linked energy concerns with environmental and economic issues affecting life in San Jose.

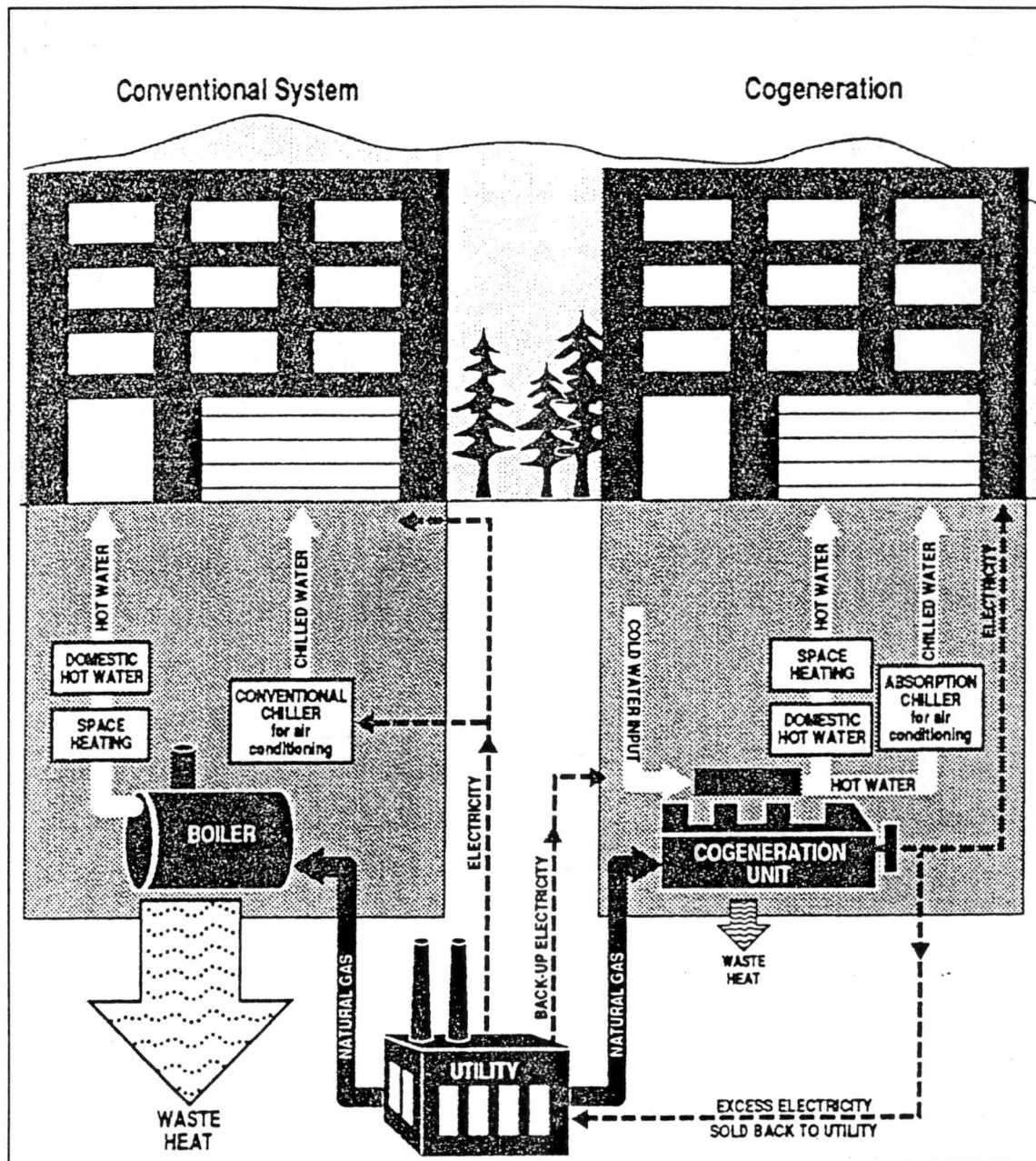


Figure 32 Cogeneration Compared to Conventional Building Heating Systems
Source: *The Sustainable City Project*.

Policy Planning Process

In 1988, the Energy Management Program explained to the Council of the Environment Committee the likely benefits that participation in the Sustainable City Project would bring to San Jose and requested approval of the project work plan. The staff aimed to coordinate a city-wide analysis of energy conserving strategies and to develop and propose an integrated, long-term, community energy plan. The city council approved the Sustainable City Project work plan [30, p.52] (Figure 33).

Work began with the data collection on growth trends and city policies that influence energy use patterns and conservation of resources. An energy database was drafted based on an Environmental Scan (Appendix F).

At the executive workshop held in May 1989, the energy staff presented the Sustainable City concept to workshop participants and used the environmental scan to provide background on San Jose's current and future energy requirements. Overall, San Jose's annual energy consumption was expected to increase from about 113 to 130 trillion Btus between 1990 and the year 2000. The level of estimated consumption represented an increase of 14.5 % over ten years for an average annual rate of nearly of 1.4% [30, p.48] (Figure 34). The executive workshop helped San Jose's energy staff to link energy planning with the larger community goals, particularly within the context of transportation and local economic development.

Over the summer, the energy staff with support from the Project's technical advisors, examined the residential, commercial, industrial, and transportation sectors to determine conservation potential across different end-uses such as heating,

City of San Jose Sustainable City Program Development Process

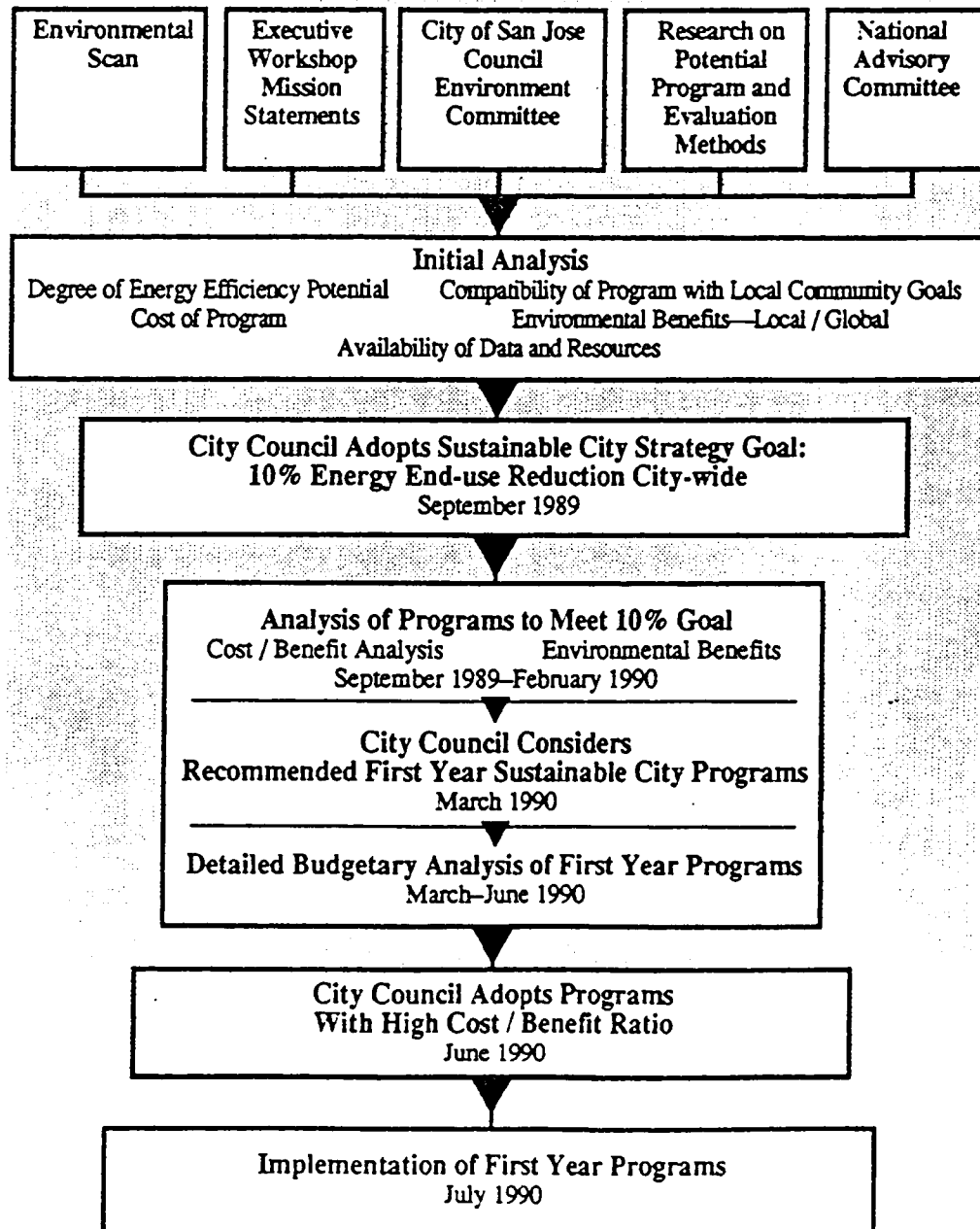


Figure 33 San Jose's Policy Planning Process

Source: *The Sustainable City Project*.

lighting, and water heating. Through their research, the staff sought a realistic, quantitative goal as the basis for developing an integrated Sustainable City Strategy and for measuring program achievements [30, p.48].

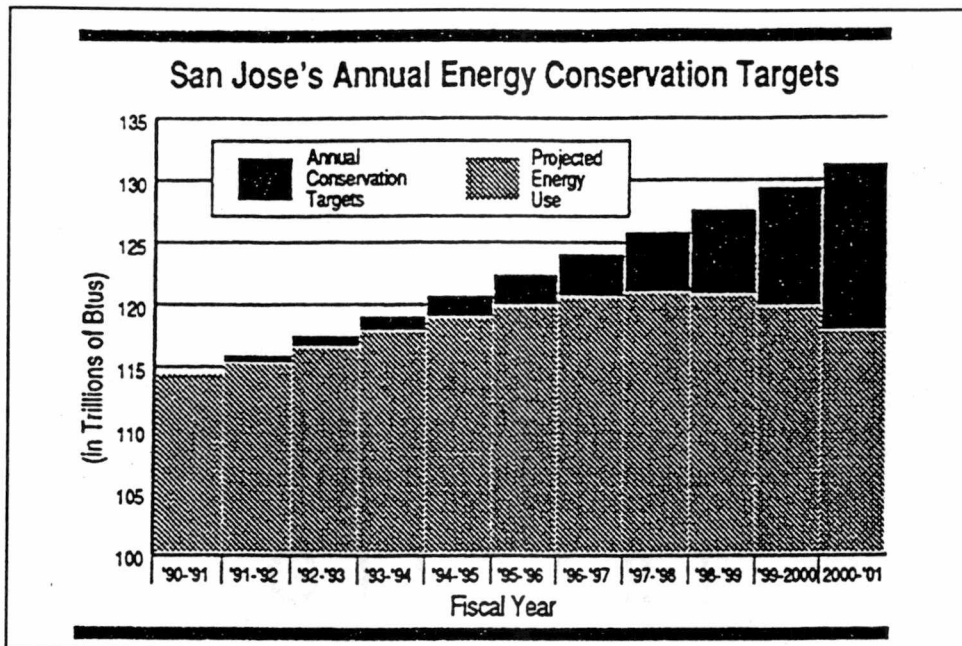


Figure 34 Toward San Jose's Sustainable City Strategy Goal
Source: *The Sustainable City Project*.

Goals

The projects that over time, urban sustainability can be achieved in part by rebuilding cities at high densities, by mixing urban activities at several sites, by shortening travel distances, by creating less resource-intensive structures and infrastructures, and by facilitating the efficient movement of people, goods, and information. The Sustainable City Strategy's overall energy conservation goal is the following:

To promote a sustainable future by conserving 10% of the projected energy use in all sectors by the year 2000 so as to enhance the livability, economic strength and well-being of the City's residents and businesses and reduce environmental problems, particularly emissions that contribute to global warming [30, p.50].

Based on this goal, an analysis was conducted to uncover other City programs and policies' interrelationships. The results of the study indicated that (1) an overall 10% energy-use reduction was feasible and (2) the 10% goal could be set to achieve a level of conservation exceeding the goals already set by state and federal conservation programs. Therefore, the energy staff recommended the goal of the Sustainable City Strategy, and this goal was adopted by the city council in September 1989 [30, p.50].

Policy Review Process

The council directed the energy staff to develop the first year work plan for reaching the 10% reduction goal. By November 1989, the energy staff had devised a master list of 185 program options linked to the 10% reduction goal. The review committee screened the master list and selected nineteen program options for the first year program, including currently operated programs. Initial screening criteria included the cost of the program, availability of resources, degree of energy efficiency potential, availability of data, compatibility of the program with local community goals, and environmental benefits. The nineteen program options were subjected to an in-depth analysis by energy staff and technical consultants [30, p.50].

The Office of Environmental Management presented the Sustainable City

Project Annual Report and recommendations to the council's Environment Committee in February 1990. The report stated that policies that conserve natural resources and the built environment serve as the broad framework for urban sustainability, of which energy conservation is a part.

At its March meeting, the council's Environment Committee directed the staff to reassess the list of proposed programs and to identify those most essential for maintaining the continuity of program development for the Energy Management Program. In June 1990, the energy staff reported its findings to the Environment Committee. To determine a level of activity and funding that would be relatively cost-effective, staff analyzed the programs with respect to the following factors:

- *One-year program costs at a minimum operating level,*
- *Predicted level of program adoption by the targeted sector,*
- *Predicted amount of energy savings in Btus and dollars,*
- *Program spending compared to the benefit/cost ratio of energy bill savings,*
- *Predicted level of difficulty for monitoring program impacts [30, p.53].*

Of the energy conservation impacts of the eight recommendations, the Office of Environmental Management programs was estimated to attain approximately 23% of the first year's energy use reduction goal of 651 billion Btus. Contributions to the first year target, ranging between 17% to 51%, were expected to be made by other programs in the Sustainable City Strategy which were the primary responsibility of other city departments. Thus the core programs of the Office of Environmental Management, in conjunction with the activities of other city departments based on funding levels; would net 40% to 74% of the adopted first-year target based on the Ten-year Sustainable City Strategy [30, p.53]. Following the adoption of the first

year Sustainable City Strategy Programs in June 1990, the San Jose City Council approved funding for a research, development and monitoring program for all Sustainable City Strategy programs.

Implementation

The programs recommended in the Annual Report for implementation during the first year of San Jose's Sustainable City Strategy were chosen because they were ranked high in energy, economic, and environmental evaluations or, in some cases, because they directly supported other important community goals (Appendix D.3). The report explained that municipalities can effect change in the community through five approaches: education and persuasion, technical and design assistance, financial incentives, municipal operations, and policy and regulation [30, p.52].

Participatory Process

While the Office of Environmental Management has taken the lead in the implementation and monitoring of the core programs of the Sustainable City Strategy shown on Figure 35, other city departments also play vital roles in program implementation (Figure 35). Figure 36 lists the programs conducted primarily by other departments with input from the energy staff (Figure 36).

The research, development and monitoring program conducts research on viable alternative funding sources. As far as alternative, non-city funding sources are concerned, the most feasible prospects for the first year were (1) a revolving Energy Efficiency Investment Fund; (2) grant funding form the Urban Consortium Energy

PROGRAMS ESSENTIAL TO SAN JOSE'S SUSTAINABLE CITY STRATEGY

■ Educational Programs

- **Residential Information & Education Program:** Information & education; interagency energy service provider coordination; targeted workshops; marketing of brochures, fact sheets and other educational materials.
- **Public School Educational Program*:** Introduction of energy conservation materials, curriculum and projects as a part of a coordination effort with other Office of Environmental Management water and solid waste efforts to carry out school outreach programs.
- **Energy Conservation Measures / Lighting & Appliance Point of Sale & Educational Program*:** Intensive education program to provide technical assistance and education to retailers and consumers on the availability and energy savings potential of new heating/cooling, lighting and appliance measures.

■ Municipal Operations

- **In-House Energy Management Program (Five-Year Capital Improvement Plans):** Identification, implementation, and monitoring of energy conservation improvements, operations, and maintenance in all city-owned facilities.

■ Technical Assistance Programs

- **Innovative Design & Energy Analysis Service (IDEAS Program):** Full service planning and design assistance for developers, architects, and engineers through the use of a complete matrix of energy conservation options, design guidelines, and computerized energy analysis.
- **Integrated Environmental Audit:** On-site audits for the commercial/industrial sector for the identification and promotion of measures for energy and water conservation and waste reduction.
- **Solar Access Design Guidelines:** Technical assistance to builders or developers on solar access design techniques or redesign of an infill design project.

■ Policy and Regulation

- **Housing Energy Efficiency Rehabilitation Program:** Use of city funds in housing rehabilitation is conditioned upon inclusion of certain minimum energy conservation measures being in place or installed at the time of rehabilitation.

* recommended new programs

Figure 35 Programs Essential to San Jose's Sustainable City Strategy

Source: *The Sustainable City Project.*

PROGRAM	AGENCY
Street Maintenance & Surface Improvement	Department of Streets & Traffic
Traffic Operations Management	
Urban Forest Program	Office of San Jose Beautiful
Transportation Demand Management Programs	Department of Public Works
Growth Management & Land Use Planning	Department of Planning

Figure 36 Citywide Sustainable City Strategy Programs

Source: *The Sustainable City Project*.

Task Force; and (3) a cooperative funding agreement with Pacific Gas and Electric Company to promote energy efficiency in new commercial construction. Some of other energy program's implementation examples are discussed briefly.

Demand Side Bid in Pacific Gas & Electric Power's Saving Partners Program:

As part of Pacific Gas & Electric's (PG&E) Bid program the city submitted, and was awarded a bid to the utility to produce a 287kw energy conservation package. The initial investment of \$345,000 is estimated to produce a net financial benefit of \$989,000 over nine years to the City of San Jose while helping PG&E to avoid expensive investments in fuel-intensive power plants [91].

San Jose's Municipal Facilities Energy Management Program: Since 1986, San Jose's Office of Environmental Management has been responsible for identifying,

recommending and monitoring the performance of energy conservation projects for all 400 municipal facilities. Implementation of these measures has contributed to local air quality improvements and reduced CO₂ emissions by at least 50,000 tons per year. Technology improvements for the new area regarding HVAC and lighting provide annual projected savings of almost \$320,000. In addition, the city is scheduled to receive a rebate from the local utility of almost \$400,000.

San Jose has spent approximately \$2.2 million on conservation measures for city structures during the 1980s and has netted annual savings of \$315,000 for 3.5 million kilowatt-hours and 300,000 therms conserved each year. Due to energy conservation investments, the city's annual energy bill is \$7 million less than it would have been if no investments had been made since 1981. Key to the city's energy savings is the energy audit that is performed on each municipal building every five years [30, p.51]. The city provided various programs. For examples, Solar Access Design Guidelines that the city has prepared residential design guidelines regarding the proper orientation of residential buildings to maximize the substitution of solar energy for utility supplied energy [88]. San Jose's IDEAS Program (Innovative Design & Energy Analysis Services) provides a free service to architects and developers building projects in San Jose and has already netted energy savings of about 32 billion Btu during its first year of implementation. The IDEAS Program offers a binder of information of energy-efficient design strategies for new commercial and industrial construction focusing on site planning, architecture, lighting and heating, ventilation and air conditioning [30, p.49] (Figure 37).

IDEAS INNOVATIVE DESIGN AND ENERGY ANALYSIS SERVICE													
Energy Conservation Opportunity Matrix				BUILDING TYPES									
SITE PLANNING				Small Office	Medium Office	Large Office	Small Retail	Large Retail	Supermarket	Convenience	Regional Mall	Auto Dealer	Fast Food Restaurant
				Full Service Restaurant	Warehouse	Manufacturing	Laboratory	Computer Rooms	Hotel: Guest Rooms	Hotel: Public Areas			
Orient buildings with the majority of glazed surfaces facing north and south.				●	●	○	◆	◆	◆	◆	◆	●	●
Use landscaping to shade glazing on the east, south and west building facades.				●	○	×	○	×	◆	×	◆	○	◆
THERMAL MASS													
Use thermal mass in exterior walls.				●	○	×	○	○	○	○	○	◆	○
Expose thermal mass surfaces to room conditions to increase the building diurnal heat capacity.				○	○	◆	○	○	○	○	○	○	○
Consider passive solar applications.				○	×	×	×	×	×	×	×	◆	×
LAMP AND BALLAST COMBINATIONS													
Replace standard T-12 F40 34-watt energy-saving lamps with F032 (F32T8 or "Octron") lamps and matching 265 ma energy-saving ballasts.				●	●	●	●	●	●	●	●	●	●
Replace standard T-12 F40 34-watt energy-saving lamps with F032 lamps and matching 265 ma solid state rapid start ballasts.				○	○	○	○	○	○	○	○	○	○
Replace standard T-12 F40 34-watt energy-saving lamps with F032 lamps and matching 265 ma solid state instant start ballasts.				◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
MECHANICAL SYSTEMS													
High-efficiency packaged equipment.				●	○	○	●	○	○	●	○	◆	○
Direct digital controls.				○	●	●	○	●	○	○	○	○	○
Integrated airside economizers.				○	○	○	○	○	○	○	○	○	○
Evaporative condensing.				×	◆	●	×	◆	×	×	×	×	×
Variable air volume/changeover system.				●	○	×	●	◆	×	×	○	○	○
Gas-fired furnace options.				○	○	×	○	×	○	○	○	○	○
Fan-powered VAV boxes in lieu of reheat boxes.				×	●	●	×	◆	×	×	×	○	×
Variable speed fan drives.				×	○	●	×	●	×	○	×	◆	×
Multiple steps of compressor unloading on direct expansion VAV systems.				○	●	●	×	●	×	○	×	○	○
				○	●	●	×	●	×	○	×	○	○
				○	●	●	×	●	×	○	×	○	○

● Highly recommended ○ Recommended ◆ Should be considered × Generally not recommended ✖ Not recommended

Figure 37 Energy Conservation Opportunity Matrix

Source: *The Sustainable City Project*.

New Horizons: City of San Jose Sustainable City Project Phase II

The Sustainable City Strategy brought the full recognition that using urban energy resources more efficiently supports a broad range of local economic goals and enhances the environmental quality of life locally, regionally, and ultimately, globally. The initial focus of the project was on existing, established programs that promoted energy efficiency. At about the same time when San Jose witnessed the opening of the first corridor of its light rail line, city staff were beginning to recognize the need for developing implementation mechanisms for reducing energy use via the land use planning process and by applying urban design techniques.

In effect, the city recognizes the Sustainable City Project as Phase I on the "learning curve of launching a municipal energy strategy," with city-wide benefits [17]. In 1991, the Office of Environmental Management (OEM, later recognized as the Environmental Services Department (ESD) initiated "The Sustainable City Phase II Project", funded by the California Energy Commission.

The basis for starting this project was the belief that cities such as San Jose have a tremendous potential for impacting local energy use trends through their planning and policy documents. Then the General Plan review became the focus of the Phase II Project.

Technical Advisory Panel (TAP) as a Participatory Device: The wide range of involvement is also a strategy in San Jose's Sustainable City Project's scheme. Broad citizen participation is an integral part of a community's planning. In order to assist staff to form an overall view of the project, a Technical Advisory Panel (TAP)

was formed. The panel included representatives from city, county, regional and state organizations, as well as from the environmental, ethnic, academic, business and the development community. The ideas and viewpoints expressed at the meetings provided valuable insights for the project staff.

General Plan Review: The city has tremendous potential for impacting local energy use trends through their planning and policy documents such as General Plans. The General plan consists of strategies, goals, and policies addressing urban growth; containment of urban sprawl, jobs and housing balance issues; and regional cooperation and the protection of resources within the city's sphere of influence. As such, it represents the official city policy regarding the future character and quality of development, and many of its provisions have very significant direct and indirect impacts on energy consumption.

In order for the Sustainable City Program to be totally successful, all other city programs and policies should ideally support the overall energy conservation goal of the strategy. Conservation of 10% of the projected energy use in all sectors in the year 2000. The decision to review the city's General Plan was made.

A review was conducted to identify the interrelationship between the Sustainable City Strategy and Programs and the city's General Plan and determined to what extent the General Plan supports the strategy. Preliminary policy changes that would improve energy efficiency and community sustainability were identified as follows:

- Generalized energy efficiency in relation to General Plan designation;
- Density, mixtures and emissions of uses;

- Distances to energy consuming mandatory services;
- Distances to preferential areas, infill target areas and redevelopment areas;
- Distances to energy consuming support features, natural gas, rail and bus transit, residential areas, neighborhood and major shops, education institutions, park and open space, commercial and industrial zoning and air and rail shipping [17].

San Jose's General Plan, with a few exceptions, did not conflict with the Sustainable Strategy. Many of the components of Sustainable City Strategy were already a part of the plan. In particular, a series of land use goals and policies encouraged compact, efficient infill development and high density residential development near transit that would support the urban form aspect associated with the Sustainable City Strategy.

However, the Plan did not provide sufficient direction to meet the basic policy goal for reducing energy consumption by 10% in the year 2000. Therefore, specific policy amendments were made to sections of the plan to strengthen the following:

- Analysis of the energy consequences of different policy choices such as minimum and maximize density along transit corridors;
- More emphasis on the cause and effect relationship between land use pattern and transportation needs;
- Additional emphasis on providing transportation linkages between residential and commercial services, especially pedestrian, bicycle and transit linkages [17].

In addition, a separate section for the Sustainable City Strategy was included in the General Plan. The developed draft strategy for further discussion was presented to the task force, and it was adopted at its meeting in March, 1993.

Major City Strategy. During the course of the Phase II Project, a ten-year update process for making major revisions to the General Plan was integrated. The General Plan of the City of San Jose, *Horizon 2000*, was undergoing a major review and was updated as to be *San Jose 2020* from 1992 to 1993. One of the newer strategies proposed by the task force at a January 1993 meeting, was the adoption of a Sustainable City Major Strategy. The strategy is a statement of San Jose's commitment to becoming an environmental and economically sustainable city. Recently, San Jose Mayor, Susan Hammer, in her recent inaugural address, invoked the vision of San Jose as a sustainable city [92].

The new Major Strategy of San Jose's General Plan provided a framework for the principal objectives the city would like to achieve by the year 2020. However, the major strategies of the General Plan do not operate independently of each other. They broadly justify and reinforces the importance of the Sustainable City Energy Strategy [91].

The current Major Strategies cover the area of economic development, growth management, urban conservation/preservation, downtown revitalization, and the green line which defines where the city begins and ends. The Sustainable City Major Strategy is not synonymous with the proposed Sustainable City Energy Strategy. The former Sustainable City Energy Strategy is a more broadly defined policy, and the new Major Strategy broadly justifies and reinforces the importance of the Sustainable City Energy Strategy, particularly through the Phase II Project [17].

The inclusion of this new Major Strategy was reviewed by the community

during the summer of 1993, with adoption by the Planning Commission and City Council in the fall of 1993. Final approval of the Sustainable City Major Strategy by the City Council is expected by June, 1994. The following are examples of tools which help the implementation of the Major Strategy.

Residential, commercial and industrial design guidelines: *Residential, Commercial and Industrial Design Guidelines* are documents used by the planning department to inform various members of the development community about the design standards to which the projects are encouraged to conform. The document includes a number of energy design features.

The CHOICES Model: Measurement Energy Efficient Urban Design: Choosing Integrated Community Energy Solutions (CHOICES) is presented as energy efficient measurement tools. CHOICES is a computer spreadsheet program that estimates energy savings potentially achievable through energy-efficient urban design measures that merit from the detailed analysis [91].

Findings

The Sustainable City Project was structured to serve as a planning model for evolving to urban sustainability. The Sustainable City Project was originally proposed to follow a strategic planning process, and although the planning process was adapted to conform to each city's decision-making system and to receive community input, as a result, each city pursued a different path toward sustainability. By working on

parallel but separate tracks, the energy offices took advantage of peer exchange to probe common concerns [30, p.1].

Portland, Oregon

Portland's program is recognized as "one of the nation's best examples of how energy planning can become an integral part of comprehensive urban planning" [87]. There are some elements that led to Portland's policy success. The city has a lead office for the planning effort and the Energy Office saw their primary role to be the facilitator [94].

The second reason for Portland's policy success is its' clear goal of increasing energy efficiency city-wide by 10% by the year 2000. Based on that framework, the city set thirty-six short-term and fifty-three long-term specific goals. In the Portland Energy Policy, short-term plans are re-evaluated and updated every two years, and long-term plans are updated every five years. The Energy Commission actively oversees implementation. Also, a methodical participatory process which achieved consensus and started with achievable goals increased the project's success.

San Francisco

In understanding the Sustainable City Project, the San Francisco Bureau of Energy Conservation set out to develop a process for evaluating both the various energy program options and the allocation of resources.

The Sustainable City Project provided a clear picture of the long-term goal

and insight about its key elements. Because the Bureau of Energy Conservation can now see how individual policies fit into the whole sustainability framework, the bureau can consequently select a policy based on its contribution to energy sustainability, begin to plan their implementation; and appropriately allocate resources to those efforts. Also, because the framework illuminates and develops the linkages between policies, the framework provides a clearer picture of the implications of new or seemingly unrelated events [30, p.61].

San Jose

As the initial step is the learning process, San Jose's Energy Management Program documented and assessed current and projected energy use trends and energy conservation potentials across all economic sectors. Based on this research, the city council adopted a new policy, which set the target of a 10% energy use reduction across all sectors by the year 2000.

As a result of the Sustainable City Project, two other means of institutionalizing these sustainable practices have evolved. First, the mayor has announced her intention to create a Sustainable City Committee. Second, the implementation of the Sustainable City Strategy has led to closer coordination between the City of San Jose, the utility company, the Office of Environmental Management and other city departments and community groups, and the separate energy programs within the Energy Management Program. It is believed that such coordination will serve the public much better as well as serve as a mechanism to

capture opportunities for less costly program delivery.

San Jose's approach to sustainable development effectively demonstrates the influence of the role that the city council has in the policy planning process. As the city's guide for growth and development, the General Plan is a tool for dealing with the future and minimizing the impact on resource consumption and helping maintain the city's overall quality of life. San Jose's plan seeks a strong link between land use, environmental concern, and energy conservation factors. Future land use will be developed in a manner of energy conservation.

Implementation Methods

To develop energy policies for achieving urban sustainability, the energy offices of Portland, San Francisco, and San Jose used various methods for evaluating policy options and building support for the planning process. Some strategies and processes are illustrated in the handbook, *Sustainable Energy*, which is the project product of the Sustainable City Project. The following examines the methods used in the Sustainable City Project for facilitating community process, program planning, and quantitative analysis.

Methods for Facilitating Community Concern. Inherent to the development of urban sustainability is effective citizen participation in the decision-making process. The involvement of a broad spectrum of the citizen organizations and government agencies is important to generate and review ideas that would later become the basis for public policy. It also helps building of consensus of energy policies linked to

sustainable development.

Executive Workshops. Early in the Sustainable City Project, executive workshops were held in the three project cities. Outside consultants were hired to work together with staff from each city's energy office and evolve the executive workshop procedures. Transportation and economic development were selected as the key issues for discussion because of their bearing on energy demand and the energy savings potential.

The workshop participants were policymakers and program managers from various development sectors. Participants first identified and ranked the energy linkages associated with major community issues, and then they drafted policy statements and specific recommendations for each statement.

Community Task Forces. The formation of task forces is an effective way for energy offices to incorporate citizens with technical expertise into the planning process on an ad hoc basis. The City of Portland, for instance, established five independent task forces to gather the information on energy use and technology in specific areas.

Networking. Networking with community groups is another important mechanism that energy offices can use to exchange ideas and coordinate actions reflecting mutual interests. Interagency networking should also be encouraged to link energy programs with broader community goals. Today, advanced and prevailing telecommunication and computer network technology will make broader and effective operation of networking possible.

Project Planning Tools

For energy planners, how to begin the planning process and when to make the links between energy programs and broader community goals is an issue [30, p.60].

Working with City Council. In the case of the three project cities, the initiative to develop Sustainable Energy practices came from staff, who presented these concepts to community leaders. Directed by their city councils to prepare policy drafts and analyze options, the Energy Offices of Portland and San Jose used the Sustainable City Project to assist their respective city council to make informed decisions on future energy planing.

In the case of Portland, the City Council Energy Commission designed an eighteen-month review period to develop and draft an updated energy policy.

In the case of San Jose, the city council's approval of the Sustainable City work plan paved the way for the Energy Management Program to evaluate and recommend new policy options, consistent with the council's adopted goal of reducing energy consumption by 10% by the year 2000.

City Opportunities Lists. To develop energy policies compatible with the principles of sustainable development, each city generated a master list of opportunities and determined their own criteria for policy selection. The purpose of this expansive thinking was to extend energy programming beyond the limits of existing programs and to search for ways of using the energy offices' limited resources more effectively toward the goal for sustainability not just energy efficiency.

Policy Linkage Analysis. Analytical tools are needed to identify the most effective programs, given the constraints of an energy office's limited resources. Conventional planners perform a cost/benefit analysis, giving highest priority to the most cost-effective measures. San Francisco's Bureau of Energy Conservation, however, devised a method of evaluating options with regard to their overall contribution toward sustainability. After ranking the options, the bureau diagrammed the linkages, or impacts, among the policies to determine which policies served as keys to an overall sustainable scheme (Figure 30).

Analytical/Quantitative Tools

To foster a systematic process of informed program planning and analysis of energy resources, the Sustainable City Project used a mix of analytical tools. While the sophistication of these tools varies, each tool has helped to clarify the options available to urban policymakers for fostering a sustainable future.

Environmental Scan. The purpose of the environmental scan is to profile a city's pattern of energy use, environmental characteristics, demographic patterns, and economic states. The environmental scan is divided into two sections general information and energy information (Appendix F). The general information section describes a city's natural traits, infrastructure, and socio-economic attributes, while the energy information section focuses on the costs of the various energy resources and the consumption patterns of the residential, commercial, industrial, and transportation sectors. The three project cities continue to update the information in

the initial scan, thereby maintaining a valuable databank to support ongoing analysis.

Conservation Potential Analysis. Before making first-year program recommendation, San Jose researched the feasibility of the year 2000 conservation goal of 10% reduction using two different analytic tools end-use potential analysis and conservation goal analysis

End-Use Potential Analysis. The End-Use Potential analysis examined energy consumption in both the building sector (residential, commercial, industrial) and the transportation sector. Data supplied by the local utility specified the percentages of energy used by a given type of end-use within each component of the building sector. From these figures, staff calculated the percentage of San Jose's total electric resources consumed across the range of major end-uses within each sector.

Conservation Goal Analysis. To diverse energy conservation targets based on the year 2000 goal, San Jose's energy staff calculated the total annual energy consumption to the year 2000. The staff first compiled the growth rates of energy consumption for each type of energy (electricity, natural gas, vehicle fuels) and for each sector. Using the environmental scan, an aggregate energy consumption annual growth rate was derived.

The conservation goal analysis revealed that in the year 2000, San Jose's total energy consumption would be approximately 130 trillion Btus. The 10% energy conservation goal was quantified as an annual goal of 13 trillion Btus in terms of primary energy to be saved. While San Jose's quantified projection is subject to change based on the uncertainties as time unfolds, the calculation provides San Jose's

Sustainable City Strategy with an annual target figure for gauging program activity.

Supply Curve Analysis of Energy. Supply curve analysis evaluates the relative cost-effectiveness of several related energy conservation measures. It requires information on the following: (1) available technologies for improving the efficiency characteristics in each end-use (lighting, heating, ventilation, cooling, office equipment, appliances, motors), (2) how much energy the conservation measures save; and (3) the costs and life expectancies of the conservation measures (Figure 38).

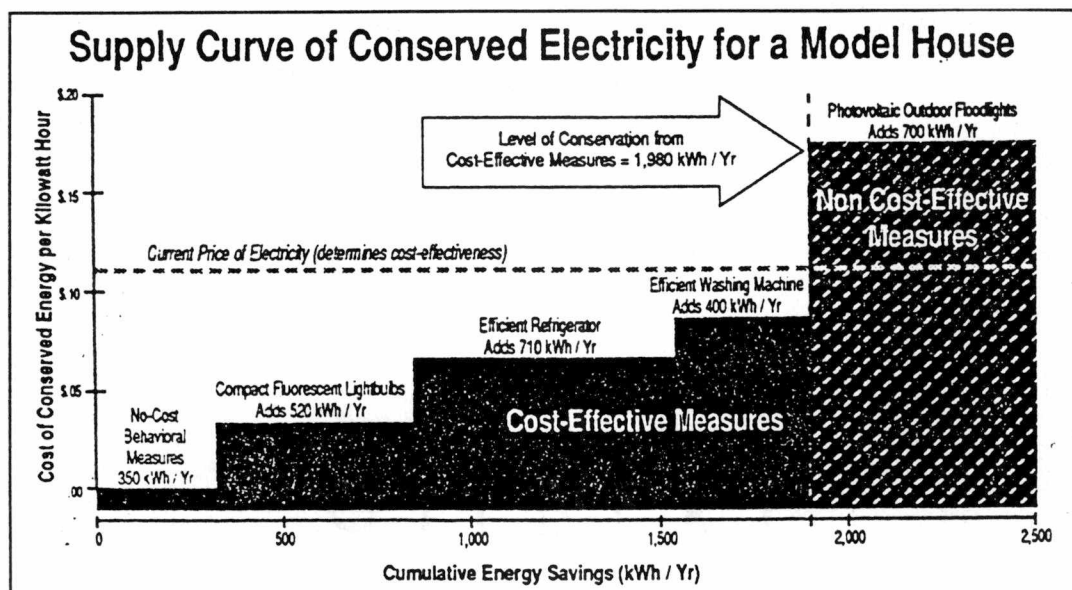


Figure 38 Diagram of an Energy Supply Curve

Source: *The Sustainable City Project.*

Economic Impact Models. Local investment in conservation technologies causes a net expansion of local economic activity, even in the sectors that are not directly involved in the provision of energy conservation goods and services. Since

these economic gains are associated with efficient use of limited energy resources, this type of investment promotes urban sustainability from both an energy perspective and an economic perspective.

Economic gains to be realized from investing in energy-efficient technologies are often termed the *multiplier effect* (Figure 39). Input/output models typically measure multiplier effects and gauge how changes in one economic sector impact other sectors of the regional economy. San Jose's Energy Management Program explored the use of two different computer programs for assessing the economic impacts of energy conservation technologies: IMPLAN and OPTIONS (Figure 40).

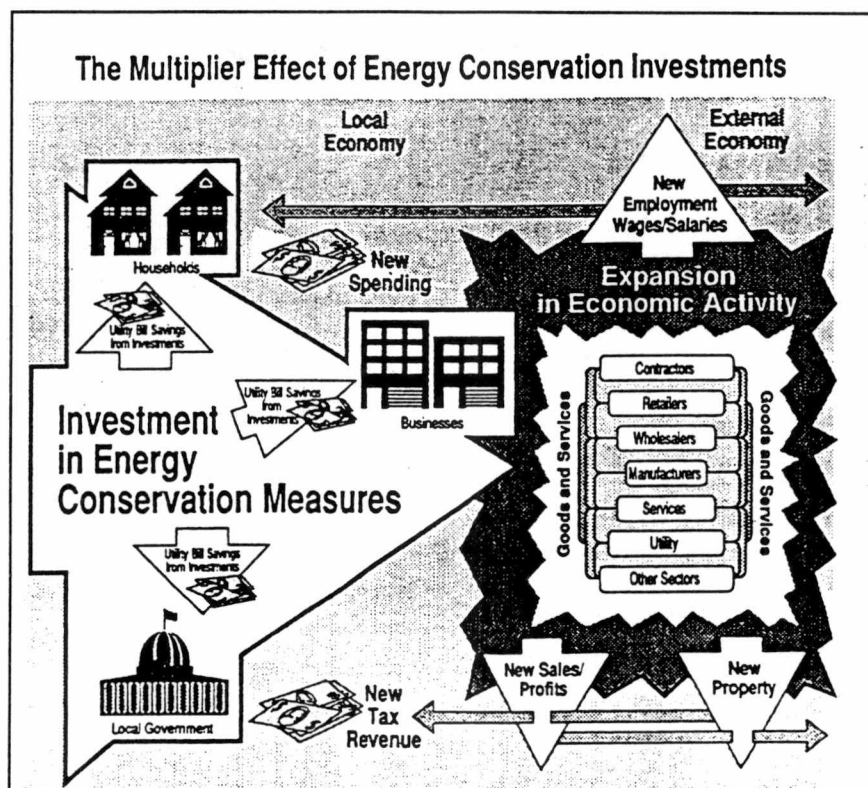


Figure 39 Investment in Energy Conservation Measures Drives Local Economic Expansions

Source: *The Sustainable City Project*.

ITEM	IMPLAN	OPTIONS
APPLICATION	Useful for evaluating impact of government policies aimed at market interventions in any sector(s).	Useful for evaluating impacts & planning program components of energy policies.
COST	\$15,000 - \$25,000.	\$1,000 - \$8,000.
REQUIREMENTS	Considerable training time & data collection.	Simpler training requirements & data entry.
ATTRIBUTES	• Flexible with respect to level of aggregation & size of region; well-suited to larger regions. • Flexible with regard to the number and level of sector aggregates. • Higher level of accuracy for multiplier analysis. • Data intensive.	• Flexible with respect to level of aggregation & size of region; well-suited to smaller regions. • Analysis is specific to energy conservation technologies & programs. • Diversity of analytical features for energy programs. • Appraises multi-objective, ranked planning criteria for optimal program selection.

Figure 40 A comparison of Economic Impact Modeling Software
Source: *The Sustainable City Project*.

IMPLAN. IMPLAN (Impact Planning) is a computer software package developed by the U.S. Forest Service. IMPLAN provides a standardized input/output economic model for projecting the regional economic impacts across all sectors resulting from changes in the spending activity in one or more sectors of a specified economic region, typically a county or state.

OPTIONS. Options is a "goal programming" software package, developed by Economic Research Associates of Eugene, Oregon, capable of assessing the impacts of individual or numerous energy conservation measures. The variety of features in the software package makes OPTIONS a comprehensive tool for monitoring the

performance of one or more existing energy conservation measures.

Options requires input information on (1) local economic parameters user for projecting the benefit performance and the multiplier effect of energy conservation investment and (2) technical parameters of the energy conservation measures to be examined. The OPTIONS model output provides a recommended investment for each of the conservation measures to satisfy performance levels associated with ranked program goals.

Environmental Impact Analysis. Maintaining environmental integrity is a fundamental principle of sustainable development. Therefore, it is important to develop techniques for determining the environmental impacts associated with various energy policy options.

Air quality impacts are the major environmental impacts associate with energy consumption. The level of atmospheric emissions depends largely on how the energy is created, as in the case of electricity, or on how it is consumed, as in the case of fossil fuels. The common indicator for atmospheric emissions are SO₂, NO_x, CO, CO₂, HC, particles, and dust [30, p.72].

To use at least one indicator emissions as a basis for comparing policy actions, San Jose selected carbon dioxide because it is a by-product of all nonrenewable energy consumed, and it is the central focus of the global warming issue. Simple coefficients were calculated from average levels of carbon dioxide emissions associated with units of electricity, natural gas and gasoline use. Given the levels of conserved energy by fuel type, total carbon dioxide reduction was estimated

for each program.

Accounting for environmental costs is also a priority for Portland. The city works closely with the State Department of Environmental Quality to promote energy- saving measures that will improve air quality, although Portland's primary focus is on reducing carbon monoxide and greenhouse gases.

Issues

Methods: For the most part, the analytical tools used in the Sustainable City Project are still in the rudimentary stages of development. Refined data gathering procedures will improve the reliability of the results. New techniques are needed to demonstrate the environmental and economic benefits of a sustainable approach to energy management. With improved analytical methods, energy programs will be better able to establish achievement targets for their policy objectives as well as measure policy impacts in quantifiable terms.

Economic Opportunities: Sustainable development presents new economic opportunities for resource efficiency. Recycling and remanufacture and solar technology are the examples of "resource efficiency" businesses. Local governments need to be active in developing markets and infrastructures to support newly emerging sustainable enterprises. Also, under new regulations, states and municipalities are now eligible to enter into long-term agreements either to sell their independently produced electricity to utilities or to receive reimbursement for conservation realized through municipal programs. This process should also be

reflected in the city's overall energy conservation scheme and local economic benefits.

Advocacy Efforts: Energy consumption patterns affect not only the future energy resources, but the future of economic, atmospheric, climatic and other environmental conditions and resources. Energy efficient communities should be a commonly held goal of citizens, businesses, local governments, utilities, design professionals, state and regional governments and environmental interest groups. Inclusion of energy issues in land use and urban design decision-making need to be presented in a way that helps to promote other community goals, such as affordable housing, preservation of open spaces, and maintenance of air quality. Therefore, the continuous educational input system for both citizen and decision maker should be factored as a part of the long-time framework to keep the plan sophisticated and workable. Additionally, local governments need to update local codes, general plans, and policies and develop ways to affect state and federal legislation in support of sustainable growth.

Municipalities should continue to build partnerships with community groups and environmental organizations. Local governments should not overlook using national environmental groups as a resource on local energy issues. Through concerted advocacy efforts, associations of governments can be persuaded to update the energy policies to incorporate the principles of sustainability as outlined in the Sustainable City Project. Ultimately, urban sustainability must be placed on the national agenda so that the needs for tomorrow can be planned for today [30, p.78].

Sustainability does not happen overnight. These example cities have begun on the path to become a Sustainable City. Continuous commitment, monitoring, evaluation and research, networking, and educational systems should be enhanced.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The term "sustainable development" became prominent when the World Commission on Environment and Development presented its report in 1987, and was promoted in the World Conservation Strategy in 1989. The concept of sustainable development has drawn attention and controversy because of its complex and seemingly contradictory elements.

The focus of city planning has corresponded to urban problems at particular time. Planning should be sensitive to worldwide concerns and should include sustainability considerations in the process. Cities must recognize their impact on both the regional and global environments, as well as on present and future environmental stress. In this regard, the decisions that are made today limit alternatives tomorrow. The sustainability conceptual framework provides an opportunity to determine what is important within ecological concerns, and what the ramifications of economic and equity issues and problems are with respect to implementation of sustainable development. Thus sustainable development is a "three legged stool, combining economic opportunity, social equity, and environmental responsibility" [96, p.1].

Sustainability implies that nothing should go to waste, but rather everything should contribute to the proper balance between the natural environment and the built environment. To apply this concept to urban sustainability, energy would be an

appropriate approach. The sustainable development strategy seeks to reduce traffic congestion, pollution, wastefulness, and degradation of our living environment, these are strongly associated with today's energy use pattern. Energy resources are fundamental to the creation, development, and use of other urban resources. Therefore, urban sustainability, particularly as regards energy resources, will be an increasingly important principle to apply in the land use planning process.

Cities have the potential to impact local energy use through planning and policy activities. Incorporating energy issues in land use and urban design decisions can be accomplished in ways that promote other sustainability-oriented community goals, such as affordable housing, economic development, preservation of open space, maintenance of air quality, and various other quality of life issues [92]. While many of the goals and programs discussed are not new, a vision which includes a sustainable community has the potential to interconnect needs in unique ways. The Director of the Energy Office in Portland, Ms. Susan Anderson, says, "the policy has given us credibility for a way of merging energy with other issues. Energy ties all of these individual issues together" [87].

Urban sustainability encompasses more than a local government instituting an energy management program or a comprehensive recycling program, or water conservation projects. It is a broad participatory process for a community to decide how to use its limited resources more efficiently in order to enhance the quality of life without degrading the environment. Sustainable urban energy systems encompass more than energy efficiency and energy conservation measures. Since

local governments make decisions affecting land use, building codes, transportation systems, waste disposal, and power plants--all of which impact energy resource use--local jurisdictions can do much to ensure their own sustainable energy future.

Also, decisions regarding natural resources have impacts outside of a city's jurisdiction. The decisions of others in the region impact a city's ability to meet its future needs. Sustainable development objectives should be incorporated by administrative and legislative agencies dealing with national economic policy and international concern. At the same time, the smaller the city or community the more manageable and flexible can be the implementation. Both the general public and the lawmaker need to be informed about the benefits of sustainable cities. Cities should be active in promoting public education on sustainability.

Central to the Sustainable City Project was finding ways to manage today's urban energy needs without jeopardizing the needs of future generations. The Tri-City Sustainable City Project originally followed a strategic planning process [30, P.73]. However, the planning process was adapted to conform to each city's decision-making system and to receive input from community leaders and organizations. Each of the cities pursued a different path toward sustainability while incorporating the cumulative and combined knowledge of energy specialists, local community leaders and organizations, and the project's National Advisory Committee.

Portland's approach to sustainable development stresses the importance of gaining expert technical advice and broad citizen support for developing a new Energy Policy [30]. Compared to the previous condition, Portland's energy planning

has been extended from piecemeal energy programs and isolated pockets of energy savings into every aspect of metropolitan life [87]. The Sustainable City Project has helped Portland lay the necessary groundwork for a sustainable future, "balancing energy needs with a strong economy and a clean environment" [30, p.25].

The publication of the Sustainable City Project for San Jose, *Sustainable City Major Strategy*, defines "sustainable city" as a city designed, constructed, and operated to efficiently use its natural resources, managing and conserving them and minimizing waste for the use of present and future generations" [17]. The City of San Jose's efforts to incorporate concepts of sustainability and energy elements into urban planning was included in the General Plan, and corresponds to the overall goals of the Sustainable City Program. San Jose's plan seeks strong ties between land use, environmental concerns, and energy conservation factors. The Sustainable City Project has provided San Jose with a realistic energy reduction goal and an integrated, long-term energy policy framework for achieving that goal.

The San Francisco Bureau of Energy Conservation's purpose in developing the Sustainable City Project was to define a path toward long-term energy sustainability for San Francisco. The ability to see these implication not only enables the Bureau to adjust current programs to changing conditions, but also provides the capability to understand and seize otherwise unforeseen opportunities.

The Sustainable City Project offers several lessons in planning for urban sustainability:

1. *Planning for urban sustainability changes the scope of policies considered for implementation as well as the content of program planning, program design, and program implementation,*
2. *Cities striving toward sustainability are likely to find success using the same (or similar) strategies employed by the three project cities,*
3. *Attaining sustainability means more than achieving the objectives of energy efficiency and use of renewable energy resources. These objectives must be integrated with other community needs,*
4. *Sustainability is not a "single interest" issue: it is multifaceted and before related to every aspect of urban life. The interconnections between the principles of sustainability, policy and program development and groups with vested interests are important and need to be cultivated,*
5. *Policies which promote sustainable urban energy practices not only need to be linked to other community goals, but they require champions as well. Otherwise such policies are not likely to be on the community's agenda,*
6. *Achieving sustainability does not happen overnight: it is a long-term process. Throughout the process, focus and objectives must be kept clearly in mind,*
7. *Gaining "buy-in" support from community leaders is essential for successful implementation. Workshop sessions for community leaders are especially useful for screening policy options and implementation plans for fostering sustainability. Periodic meeting with individual or small groups of community leaders are also important to sustain the momentum for effecting changes,*
8. *Trust needs to be built for facilitating collaboration between cities or government offices on achieving urban sustainability. Therefore, it is importance for key decision makers to get together for informal working sessions at least three to four times a year. Between working sessions, the fluid exchange of ideas can be maintained through frequent*

teleconferences in which all key decision makers participate.

Teleconfernece also aids in keeping the momentum going to follow through on assignments,

9. *A national advisory committee enables a tri-city research effort to gain credibility and support of projects. While a national advisory body is unrealistic for every city pursuing sustainable energy planning, local jurisdictions should utilizes the talents and resources of national and local experts and organizations,*
10. *Technical expertise is most useful during the analysis phases of goal setting and policy selection. Such expertise may be attained through advisory committees and through paid consultants [30, pp.74-75].*

The Sustainable City Project also provided insights for cities in working toward implementation of sustainable urban energy practices. In this regard cities should:

1. *Encourage local government to take the initiative in formulating energy policy,*
2. *Set sustainability as the long-term policy goal for designing an energy system that increases its reliance on renewable resources and is diverse, self-reliant, efficient, and integrated,*
3. *Make a master list of policy options,*
4. *Use appropriate tools for analyzing policy options in facilitating community process,*
5. *Select program options based on long-range understanding of their environmental impacts, their cost-effectiveness, and their impacts on other programs,*
6. *Develop management goals and quantity objectives according to low-impact energy principles,*
7. *Maximize effectiveness by integrating energy policy into broader community goals and by networking and collaborating with other city departments and community groups,*

8. *Continue to gather data to monitor program impacts* [30, p.76].

Criticism of sustainable development focuses on its lack of a unifying vision, and lack of cohesiveness. It is true that the definition of the word allow various interpretations, that may cause the word itself to be a mere fashion, a buzz word. Projects or plans which lack cohesiveness can be operated under the title of "sustainable development".

The fundamental conceptual framework along with the sustainability is equity contemporary and inter-generational. It suggest mitigating adverse impact today, not only for humans but other creatures as well, and also for future generations. However, equity itself is very ambiguous and subjective. Intrinsic to the problem is the dilemma of trade-offs. It is impossible to satisfy everybody's interests. In the zone between biological, economic and social systems, trade-offs exist (p.32). Who determines which area are more important? Sustainability depends upon a participatory society, involving the community in decisions on the use of limited resources, while at the same time allowing as many interests to come into play, recognizing that interests may change over the time, and among different groups.

There are also some confusion related to the concept, and the meaning of growth, as defined by the economy. Some growth is measured by consumption rate. There is no single indicator which shows sustainability and encompasses the environment, the economy and a equity. This makes the evaluation of sustainable development projects difficult. Today, advanced technologies, such as the Geographic Information System (GIS) and communication media, have made analysis

and implementation easier, yet real urban situations tend to be complex, and sometimes it is dangerous to oversimplify.

New techniques are needed to demonstrate the environmental and economic benefits of a sustainable approach to energy management. With improved analytical methods, local governments will be better able to measure policy impacts in quantifiable ways. Sustainable cities will require the continued development of new tools and technology, innovative economic strategies, and advocacy efforts. San Jose's efforts of devising various projects measurements reflects this situation.

Political difficulty to implement sustainable development is related to the incompatibility of long term environmental goals and the short and intermittent chronological cycle of the today's political system. These conflicts are commonly shared difficulties not only by the Tri-City Sustainable Development Project but by any other sustainable development planning activities. Thus continuous verification and determination of what sustainability meant will be needed. In this sense, the sustainability concept is unique. Although it has a framework, it is not a fixed, concrete concept, but rather a comprehensive term to evolve together with advancement of the human world. San Francisco's direction toward educational emphasis will be effective in terms of the continuous determination of the principle question, that is what sustainability means.

The problem is complicated, comprehensive and seemingly increasingly threatens not only human beings, but other creatures as well. To comprehend and conceptualize the problems to tackle, the word sustainability emerged as, so to speak,

an ideal stage toward which we should aim, but ultimate sustainability may never be achieved. So far, "sustainable development is an intuitively powerful concept, that as commonly understood, provides a useful guide for development practitioners [40, p.37]"

The concept of sustainability also helps localities respond to new challenges. It requires that development be viewed from a new perspective and new planning criteria be applied. In comprehending problems and deriving the solutions, our knowledge and techniques are limited, because the problems have both a local and global structure. The adverse impacts of modern energy-consumption patterns cannot be reversed overnight. Consequently, sustainable energy planning cannot be a short-term activity. Such planning will require careful long-range development, fostering, implementation, and review.

The three cities each take a different emphasis towards the goal of sustainability. The Sustainable City Project concluded that, "very likely, as more cities plan to achieve sustainable energy practices in accordance with their particular needs, different outcomes will result. There are many paths toward achieving urban sustainability" [30, p.76]. Due to the long-time span, quick conclusion and evaluation is difficult and dangerous. If a project want to have "sustainability" which is not limited to a man-made boundary, continuous collaborative efforts, such as feedback, information exchange, and evaluation efforts will be needed.

BIBLIOGRAPHY

BIBLIOGRAPHY

- [1] Abu-Lughod, Janet L. Changing Cities: Urban Sociology. New York: HarperCollins Publishers Inc., 1991.
- [2] American Planning Association. Energy Conserving Development Regulations: Current Practice. Argonne, Ill.: Energy and Environmental Systems Division, Argonne National Laboratory, 1980.
- [3] Angell, D.J.R., Comer, J.D., and Wilkinson M.L.N. Sustaining Earth: Response to the Environmental Threat. London: Macmillan Academic and Professional, Ltd., 1990.
- [4] Babier, Edward B., "The concept of sustainable economic development." *Environmental Conservation*. 14, 2, 1987. pp.101-10.
- [5] Bender, David L . et. al. eds. Global Resources:Opposing Viewpoints. San Diego, California: Greenhaven Press, Inc., 1991.
- [6] Beatley, Timothy. "Creating sustainable communities." The University of Virginia, School of Architecture, 1994.
- [7] Beatley, Timothy and Browner, David. "Sustainability comes to main street." *Planning*. May, 1993. pp.16-19.
- [8] Bloomhead, Calvin, City of San Francisco, Sustainable Energy Project Manager. Personal Interview, July 8, 1994.
- [9] Blaier, Peter. D. Multi-objective Regional Energy Planning: Application to the Energy Park Concept. Boston: Martinus Nijhoff Publishing, 1979.
- [10] Brown, Lester R., et al. State of the World 1991: A Worldwatch Institute Report on Progress Toward a Sustainable Society. New York: W.W. Norton & Company, 1991.

- [11] Brown, Lester R. et al. State of the World 1994: A Worldwatch Institute Report on Progress Toward a Sustainable Society. New York: W.W. Norton & Company, 1994.
- [12] Caldwell, Lynton K. "Energy and the structure of social institutions." *Human Ecology*. Vol. 4, No.1, 1976. p. 32.
- [13] California Energy Commission. Energy Aware Planning Guide. P700-93-001. January, 1993.
- [14] Calthorpe, Peter. Next American Metropolis: Ecology, Community and the American Dream. New York: Princeton Architectural Press, 1992.
- [15] Carley, Michael and Christie, Ian. Managing Sustainable Development. Minneapolis: University of Minnesota Press, 1993.
- [16] City of San Jose, Environmental Services Department. Linking Municipal Policies and Practices in Energy and Land Use Planning, March, 1994.
- [17] City of San Jose, Environmental Services Department. The Sustainable City Phase II Project: Linking Municipal Policies and Practices in Energy and Land Use Planning. March, 1994.
- [18] Conklin & Rossant/Flack & Kurtz with Brookhaven National Laboratory and Peter Wolf Associates. Reading the Energy Meter on Development. Washington, D.C.: Federal Energy Administration, 1976.
- [19] Cook, Earl. "The flow of energy in an industrial society." *Scientific American*. 224, No.3, 1971. pp. 134-47.
- [20] Cope, David R., eds. Energy Policy and Land-Use Planning: An International Perspective. New York: Pergamon Press, 1984.
- [21] Corson, Walter, H. ed. A Citizen's Guide to Sustainable Development. Washington D.C.: The Global Tomorrow Coalition..

- [22] Cottrell, Fred. Energy and Society. New York: McGraw-Hill, 1955.
- [23] DeFries, Ruth S. and Malone, Thomas F. eds. Global Change and Our Common Future: Papers from a Forum. Committee on Global Change National Research Council. Washington, D.C.: National Academy Press, 1989.
- [24] de la Court, Thijis. Green Development in the 1990s: Beyond Brundtland. New York: New Horizons Press, 1990
- [25] Darmstadter, Joel. ed. Global Development and the Environment: Perspectives on Sustainability. Washington, D.C.: Resources for the Future, 1992.
- [26] Daly, Herman E. and Cobb, John B. Jr. For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future. Boston: Beacon Press, 1989.
- [27] Doxiadis, C.A. and Papaioannou, J.G. Ecumenopolis: The Inevitable City of the Future. New York: W.W. Norton & Company, Inc., 1974.
- [28] Edmonds, Jae and Reilly John M. Global Energy: Assessing the Future. Institute for Energy Analysis. Oak Ridge Associated Universities. New York: Oxford University Press, 1985.
- [29] Eisner, Simon, Gallion, Arthur, and Eisner, Stanley. The Urban Pattern. New York: Van Nostrand Reinhold., 1993.
- [30] Energy Task Force of the Urban Consortium, Energy, Environment and Economic Development Unit. The Sustainable City Project: A Tri-City Collaboration for Developing and Implementing Sustainable Urban Energy Practices. August, 1991.
- [31] Foell, Wesley K. et.al. National Perspectives on Management of Energy Environment Systems. New York: John Wiley & Sons, 1983.

- [32] Gale Research Inc. Cities of the United States: A Compilation of Current Information on Economic, Cultural, Geographic, and Social Conditions: The West. ISSN 0899-6075. Second Edition. Volume 2., 1994.
- [33] Gore, Albert. Earth in the Balance: Ecology and the Human Spirit. Boston: Houghton Mifflin Company, 1992.
- [34] Grubb, Michael. et al. The 'Earth Summit' Agreements: A Guide and Assessment: An Analysis of the Rio '92 UN Conference on Environment and Development. London: Earthscan Publications Ltd., 1993.
- [35] Hanson, Susan. ed. The Geography of Urban Transportation. The Guilford Press, 1986.
- [36] Harrison, Paul. The Third Revolution: Environment, Population and a Sustainable World. New York: I.B. Tauris & Co ltd. Publishers, 1992.
- [37] Hartshorn, Truman. Interpreting the City: An Urban Geography. New York: John Wiley & Sons, Inc., 1992.
- [38] Holdren, John P. and Ehrlich, Paul R. eds. Global Ecology: Readings Toward a Rational Strategy for Man. New York: Harcourt Brace Jovanovich, Inc. , 1971.
- [39] Hollander, Jack M. eds. Annual Review of Energy and the Environment, Volume 17, Palo Alto, California: Annual Reviews Inc., 1992.
- [40] Holmberg, Johan ed. Making Development Sustainable:Redefining Institutions, Policy nd Economics: International Institute for Environment and Development. Washington D.C.: Island Press, 1992.
- [41] Hubbard, Alice, The Rocky Mountain Institute. Personal Interview. March 25, 1994.
- [42] Humpherey, Craig R. and Buttel, Frederick H. Environment, Energy, and Society. Malabar, Florida: Krieger Publishing Company, 1986.

- [43] Hunter, Thomas M. Environmental Considerations and the Planning Process: A Need for Re-Evaluation and Modification: A Major Paper Presented to the Graduate School of Planning. The University of Tennessee, March 1975.
- [44] International Energy Agency. Energy and the Environment: Policy Overview. Paris. OECD/IEA, 1989.
- [45] Keyes, Dale L. and Peterson, George. Metropolitan Development and Energy Consumption. Washington, D.C.: The Urban Institute, 1977.
- [46] Knack, Ruth. "Sustainability: what it means to you." *Planning*. May, 1993. pp.18-19.
- [47] Krueckberg, Donald A. ed. Introduction to Planning History in the United States. The State University of New Jersey, 1992.
- [48] Lovins, Amory and Hubbard, Alice. "Community Energy Planning: A Tool for Economic Development." *Environment & Development*. American Planning Association. February, 1993. pp. 1-3.
- [49] Luckens, Bennet J. Energy, Land Use Planning, and the Development of Energy Coservant Communities: A Thesis for the Master of Science in Planning Degree, The University of Tennessee, Knoxville. August, 1981.
- [50] McGregor, Gloria. "Davis, California: A Pacesetting Energy Conservation City." *Environmental Comment*. 1977.
- [51] McGregor, Gloria. "The Davis Program." *Practicing Planner*, 1978 7(4) p.33-34.
- [52] Meadows, et. al. The Limits to Growth: A Report for The Club of Rome's Projects on the Predicament of Mankind. New York: Universe Book, 1972.
- [53] Meier, Richard L. Planning for an Urban World:The Design of Resource-Conservation Cities. Massachusetts: The Massachusetts Institute of Technology, 1974.

- [54] Mesarovic, Mihajlo and Pestel, Eduard. Mankind at the Turning Point: The Second Report to the Club of Rome. New York: E.P. Dutton & Co., Inc. / Reader's Digest Press, 1974.
- [55] Miller, G. Tyler, Jr. Energy and Environment: Four Energy Crises. Belmont, California: Wordsworth., 1975.
- [56] Munasinghe, Mohan and Meier, Peter. Energy Policy Analysis and Modeling. Cambridge University Press, Cambridge, 1993.
- [57] Myers, Norman ed. Gaia: An Atlas of Planet Management. New York, Garden City: Anchor Press/Doubleday & Company Inc. , 1984.
- [58] National Commission on the Environment. Choosing a Sustainable Future: The Report of the National Commission on the Environment. Washington, D.C.: Island Press, 1993.
- [59] Nicollas, Curtis, Portland Energy Office. Personal Interview, July 10, 1994.
- [60] Oak Ridge Associated Universities. Future Strategies for Energy Development: A Question of Scale, Proceedings of a Conference at Oak Ridge, Tennessee. Oak Ridge Associated Universities, Oak Ridge, TN, October 20 and 21, 1976.
- [61] Odum, Howard T. Ecological and General Systems: An Introduction to Systems Ecology. University Press of Colorado, 1994.
- [62] Organization for Economic Co-operation and Development. Climate Change: Designing a Tradeable Permit System. OECD: Paris, 1992.
- [63] O'Riordan, T. "Future directions in environmental policy." *Journal of Environmental Planning*, 17., 1985. pp. 1431-46.
- [64] Pearce, David, Markandya, Anli and Babier, Edward B. Blueprint for a Green Economy. London: Earthscan, 1989.

- [65] Pearce, David W. and Turner, R. Kerry. Economics of Natural Resources and the Environment. New York: Harvester Whearshel, 1990.
- [66] Portland Energy Office. City of Portland, Carbon Dioxide Reduction Strategy. November 10, 1993.
- [67] President's Council on Sustainable Development. A Vision for a Sustainable U.S. and Principles of Sustainable Development. 9 June, 1994
- [68] Rawls, J. "The Idea of an Overlapping Consensus." *Oxford Journal of Legal Studies*. 1987. 7 (1):1-25.
- [69] Redclift, M. Sustainable Development: Exploring the Contradictions. New York: Methuen, 1987.
- [70] Roberts, James S. The Costs of Sprawl, prepared for Council on Environmental Quality. Department of Housing and Urban Development, and Environmental Protection Agency, Chicago: Real Estate Research Corporation, 1974.
- [71] Rocky Mountain Institute. Lecture presented by Alice Hubbard. Memphis state University, March 25, 1994.
- [72] Schmidheiny, Stephan with the Business Council for Sustainable Development. Changing Course: A Global Business Perspective on Development and the Environment. Cambridge, Massachusetts: The MIT Press, 1992.
- [73] Schurr, Sam H. , et al., Energy in America's Future.
- [74] Stein, Benjamin and Reynolds, John S. Mechanical and Electrical Equipment for Buildings. New York: John Wiley & Sons, Inc., 1992.
- [75] Technology and Economics, Inc. , An Overview and Critical Analysis of the Relationship Between Land Use and Energy Conservation. Washington, D.C.: Federal Energy Administration, 1976.

- [76] Turner, Kerry R. ed. Sustainable Environmental Management: Principles and Practice. Boulder, Colorado: Westview Press, 1988.
- [77] The Earth Works Group and Pacific Gas and Electric Company. 30 Simple Energy Things You Can Do to Save the Earth. San Francisco, 1990.
- [78] The Ecologist. Whose Common Future: Reclaiming the Commons. London: Earthscan Publishers Ltd., 1993.
- [79] The Global Cities Project. Building Sustainable Communities: An Environmental Guide for Local Government: Energy Efficiency and Production. San Francisco: The Global City Project, 1991.
- [80] The Global 2000 Report to the President: Entering the Twenty First Century. New York: Penguin Books, 1982.
- [81] The Report of the Independent Commission on International Development Issues Under the Chairmanship of Willy Brandt , 1978-80.
- [82] The United Nations. Agenda 21: Programme of Action for Sustainable Development, Statement of Forest Principles. The Final Text of Agreements Negotiated by Governments at the United Nations Conference on Environment and Development (UNCED). United Nations Publication, 1992.
- [83] The United Nations. Agenda 21: Rio Declaration: Forest Principles. United Nations, 1992.
- [84] The United Nations Environment Programme. Caring for the Earth: A Learner's Guide to Sustainable Living. United Nations Environment Programme, 1992.
- [85] *The Urban Ecologist: The Journal of Urban Ecology.* Berkeley, California, Fall 1993 (North)/Spring 1993 (South). pp.3-17.
- [86] *The Urban Ecologist: The Journal of Urban Ecology.* Berkeley, California, Spring 1994 (North)/Fall 1994 (South).

- [87] The U.S. Department of Energy/CH10093-255. "Linking Energy Use and City Planning." *Tomorrow's Energy Today: for Cities and Counties*. December, 1993.
- [88] The U.S. Department of Energy/CH10093-256. "Solar Access: A Winning Strategy." *Tomorrow's Energy Today: for Cities and Counties*. December, 1993.
- [89] The World Commission on Environment and Development. Our Common Future. Oxford, New York: Oxford University Press, 1987.
- [90] Thibodeau Francis R., & Field Herman H. Sustaining Tomorrow: A Strategy for World Conservation and Development. Hanover: Tufts University, University Press of New England, 1984.
- [91] Tucker, Mary. Incorporating Concepts of Sustainability and Renewable Energy into Urban Planning: Methods and Tools. Policy and Planning Division, Environmental Services Department, City of San Jose. San Jose, California, May, 1994.
- [92] Tucker, Mary. Incorporating Concepts of Sustainability within large Urban Areas: The San Jose Experience. City of San Jose. San Jose, California, May, 1994.
- [93] UNESCO. Environmentally Sustainable Economic Development: Building on Brundtland. UNESCO: Belgium, 1991.
- [94] Urban Consortium Energy Task Force. Sustainable Energy: A Local Government Planning Guide for a Sustainable Future. Portland Oregon, December, 1992.
- [95] Van der Ryn, Sim and Calthorpe, Peter. Sustainable Communities: A New Design Synthesis for Cities, Suburbs, and Towns. San Francisco: Sierra Club Books, 1986.
- [96] Watson, Donald. FAIA. Sustainability: A Literature Review. Seminar, Rensselaer School of Architecture, 1993-1994.
- [97] Webster's Dictionary. Nickel Press, Inc., 1991.

- [98] World Conservation Strategy (IUCN, WWF, and UNEP, 1980)

- [99] World Energy Council Commission. Energy for Tomorrow's World: The Realities, the Real Options and the Agenda for Achievement. New York: St. Martin's Press, 1993.

- [100] Walter, Bob, Arkin, Lois, and Crenshaw richard. eds. Sustainable Cities: Concept and Strategies for Eco-City Development. Los Angeles: Eco-Home Media, 1992.

- [101] World Resources Institute. Compact for a New World: An Open Letter to the Heads of State and Government and Legislators of the Americas from the Members of The New World Dialogue on Environment and Development in the Western Hemisphere. October, 1991.

- [102] *Yomiuri Shimbun*. "Can we save the spaceship Earth: Preliminary Report for International Conference on Population and Development, planned for Cairo, Egypt, funded by the United Nations. (Translated by Motoko Shimizu)." (Japanese Newspaper). Satellite Edition 13. September 4, 1994. p.6.

- [103] Young, M.D. Sustainable Investment and Resource Use: Equity, Environmental Integrity and Economic Efficiency. Man and The Biosphere Series. Paris: The Parthenon Publishing Group, UNESCO, 1992.

APPENDICES

APPENDIX A

LIST OF ACRONYMS AND ABBREVIATIONS

LIST OF ACRONYMS AND ABBREVIATIONS

AIA	.....	American Institute of Architecture
APA	.....	American Planning Association
CFC	.....	Chlorofluoro-carbon
DOE	.....	Department of Energy
GIS	.....	Geographic Information System
GNP	.....	Gross National Product
ICLEI	.....	The International Council for Local Environmental Initiative
IUCN	.....	International Union for the Conservation of Nature and Natural Resources
IIED	.....	The International Institute for Environment and Development
MAB	.....	The United Nations Man and Biosphere Program
MSA	.....	Metropolitan Statistical Area
NEP	.....	National Energy Plan
UN	.....	The United Nations
UNESCO	..	United nations Educational, Scientific, and Cultural Organization
UNEP	....	The United Nations Environment Program
UNCED	...	United Nations Conference on Environment and Development
PCSD	.....	The President's Council on Sustainable Development
WCED	....	The World Commission on Environment and Development
WEC	.....	The World Energy Conservation
WWF	.....	World Wildlife Fund

APPENDIX B

PRESIDENT'S COUNCIL ON SUSTAINABLE DEVELOPMENT PUBLIC COMMENT FORM

**Source: President's Council on Sustainable Development:
A Vision for Sustainable U.S. and Principles of Sustainable Development**

PRESIDENT'S COUNCIL ON SUSTAINABLE DEVELOPMENT
PUBLIC COMMENT FORM

PRESIDENT'S COUNCIL ON
SUSTAINABLE DEVELOPMENT

A VISION FOR A SUSTAINABLE U.S. AND PRINCIPLES OF SUSTAINABLE DEVELOPMENT

Public Comment Form

The President's Council on Sustainable Development welcomes your comments on the draft Vision and Principles of Sustainable Development by 15 July, 1994.

SUSTAINABLE DEVELOPMENT

"... to meet the needs of the present without compromising the ability of future generations to meet their own needs."

OUR VISION OF A SUSTAINABLE UNITED STATES

Our vision is of a life-sustaining earth. We are committed to the achievement of a dignified, peaceful, and equitable existence. We believe a sustainable United States will have an economy that equitably provides opportunities for satisfying livelihoods and a safe, healthy, high quality life for current and future generations. Our nation will protect its environment, its natural resource base, and the functions and viability of natural systems on which all life depends.

Please Review and comment on the draft vision statement as follows:

- A. If you believe the draft Vision statement might be improved with some minor editing, please make your suggested word changes in the text above.
- B. If you have substantive changes to recommend, perhaps an altogether different "vision" of a sustainable United States, please use the space provided below to write your statement.

C. How satisfied are you with the Draft Vision Statement as proposed? (Please Circle)

1 very dissatisfied 2 dissatisfied 3 neutral 4 satisfied 5 very satisfied



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PRINCIPLES OF SUSTAINABLE DEVELOPMENT:

1. We must preserve and, where possible, restore the integrity of natural systems — soils, water, air, and biological diversity — which sustain both economic prosperity and life itself.
2. Economic growth, environmental protection, and social equity should be interdependent, mutually reinforcing national goals, and policies to achieve these should be integrated.
3. Along with appropriate protective measures, market strategies should be used to harness private energies and capital to protect and improve the environment.
4. Population must be stabilized at a level consistent with the capacity of the earth to support its inhabitants.
5. Protection of natural systems requires changed patterns of consumption consistent with a steady improvement in the efficiency with which society uses natural resources.
6. Progress toward the elimination of poverty is essential for economic progress, equity, and environmental quality.
7. All segments of society should equitably share environmental benefits and burdens.
8. All economic and environmental decision-making should consider the well-being of future generations, and preserve for them the widest possible range of choices.
9. Where public health may be adversely affected, or environmental damage may be serious or irreversible, prudent action is required even in the face of scientific uncertainty.
10. Sustainable development requires fundamental changes in the conduct of government, private institutions, and individuals.
11. Environmental and economic concerns are central to our national and global security.
12. Sustainable development is best attained in a society in which free institutions flourish.

13. Decisions affecting sustainable development should be open and permit informed participation by affected and interested parties, that requires a knowledgeable public, a free flow of information, and fair and equitable opportunities for review and redress.
14. Advances in science and technology are beneficial, increasing both our understanding and range of choices about how humanity and the environment relate. We must seek constant improvements in both science and technology in order to achieve eco-efficiency, protect and restore natural systems and change consumption patterns.
15. Sustainability in the United States is closely tied to global sustainability. Our policies for trade, economic development, aid, and environmental protection must be considered in the context of the international implications of these policies.

Please review and comment on the draft Principles of Sustainable Development as follows:

D. Should any of the Principles as stated be omitted in their entirety? *If so draw a line through the Principle(s) you think should be deleted.*

E. Of the remaining Principles in the list, are there any that you believe could be improved substantially by editing or rewriting a key word or phrase? *Please clearly indicate the word changes that you would recommend in the space above and below each line of the specific numbered Principle(s).*

F. Should any new Principles be added to the above list? *If so, please feel free to write them in the space provided, numbering each one separately.*

If you would like to comment in greater detail on any of the Principles, please use the space below.

G. _____

H. How satisfied are you with the set of Draft Principles of Sustainable Development as proposed? (Please Circle)

1 very dissatisfied 2 dissatisfied 3 neutral 4 satisfied 5 very satisfied

I. Please check [✓] the box that best identifies your affiliation:

☐ Government: Executive Branch ___ Federal ___ State ___ Local	☐ Religious Community
☐ Government: Legislative Branch ___ Federal ___ State ___ Local	☐ Nongovernmental Organization
☐ Industry	☐ Academic
	☐ Other _____

J. Identification (Optional)

Name: _____
Title: _____
Organization: _____
Address: _____
Phone: _____ Fax: _____

Return this form and additional comments by 15 July, 1994 to:

President's Council on Sustainable Development
MS 7456-MIB, 1849 C Street, NW, Washington, DC 20240
ATTN: PRINCIPLES

APPENDIX C

THE SUSTAINABLE CITY PROJECT: ORGANIZATION

**Source: The Sustainable City Project: A
Tri-City Collaboration for Developing and Implementing
Sustainable Urban Energy Practices**

**C.1 THE SUSTAINABLE CITY PROJECT:
NATIONAL ADVISORY COMMITTEE**

**THE SUSTAINABLE CITY PROJECT
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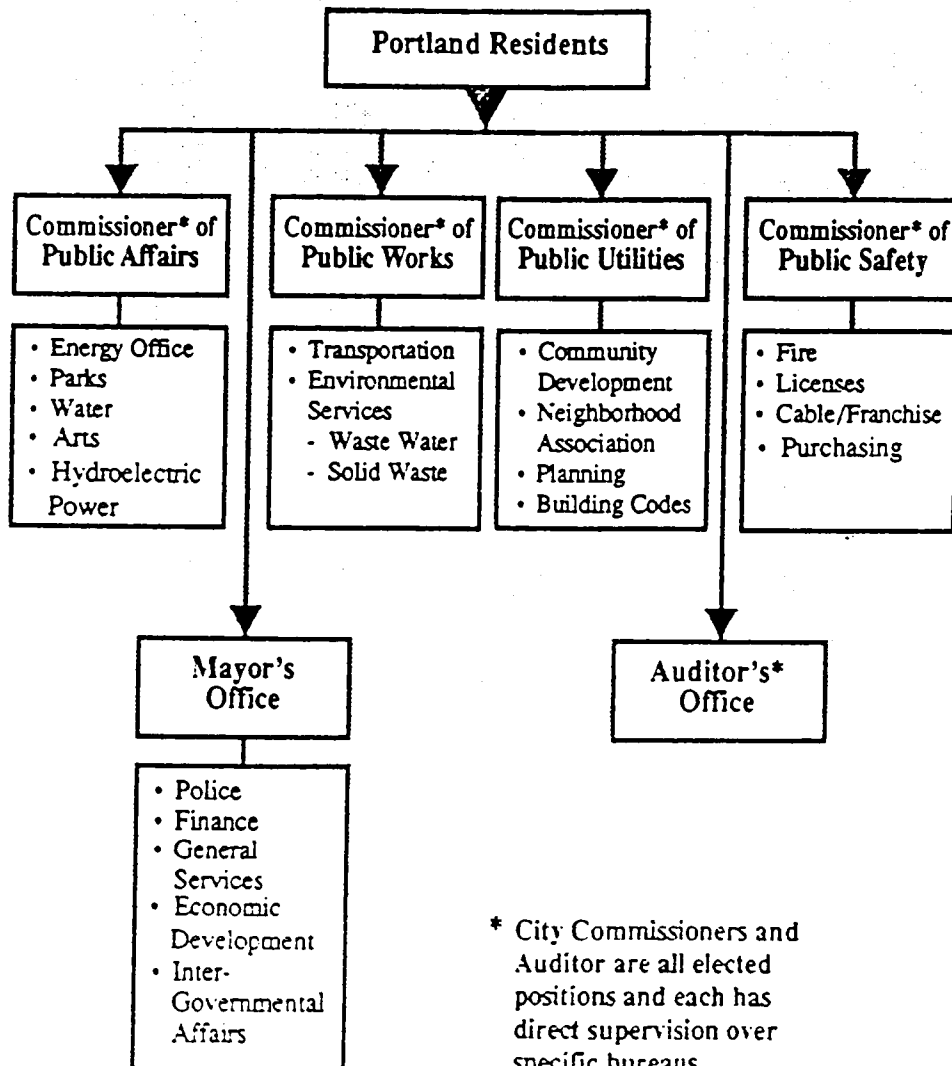
Anna Ferrara
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Richard Zelinski
Principal
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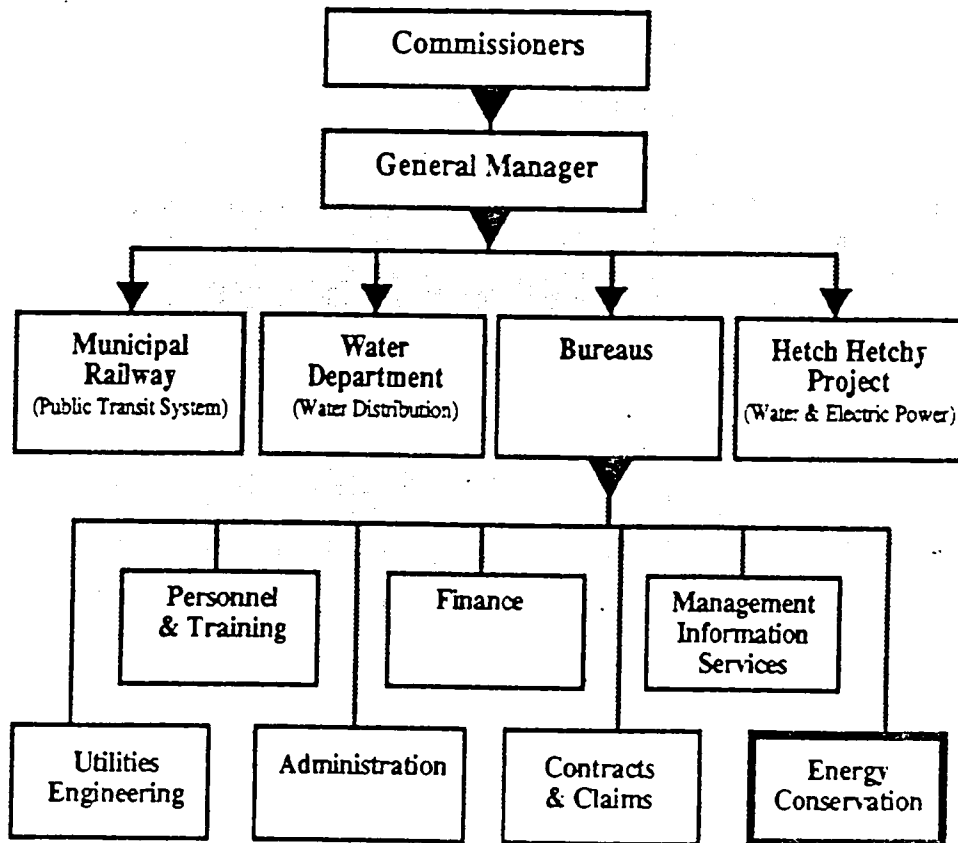
Source: *The Sustainable City Project.*

C.2 THE SUSTAINABLE CITY PROJECT:
ORGANIZATIONAL CHART

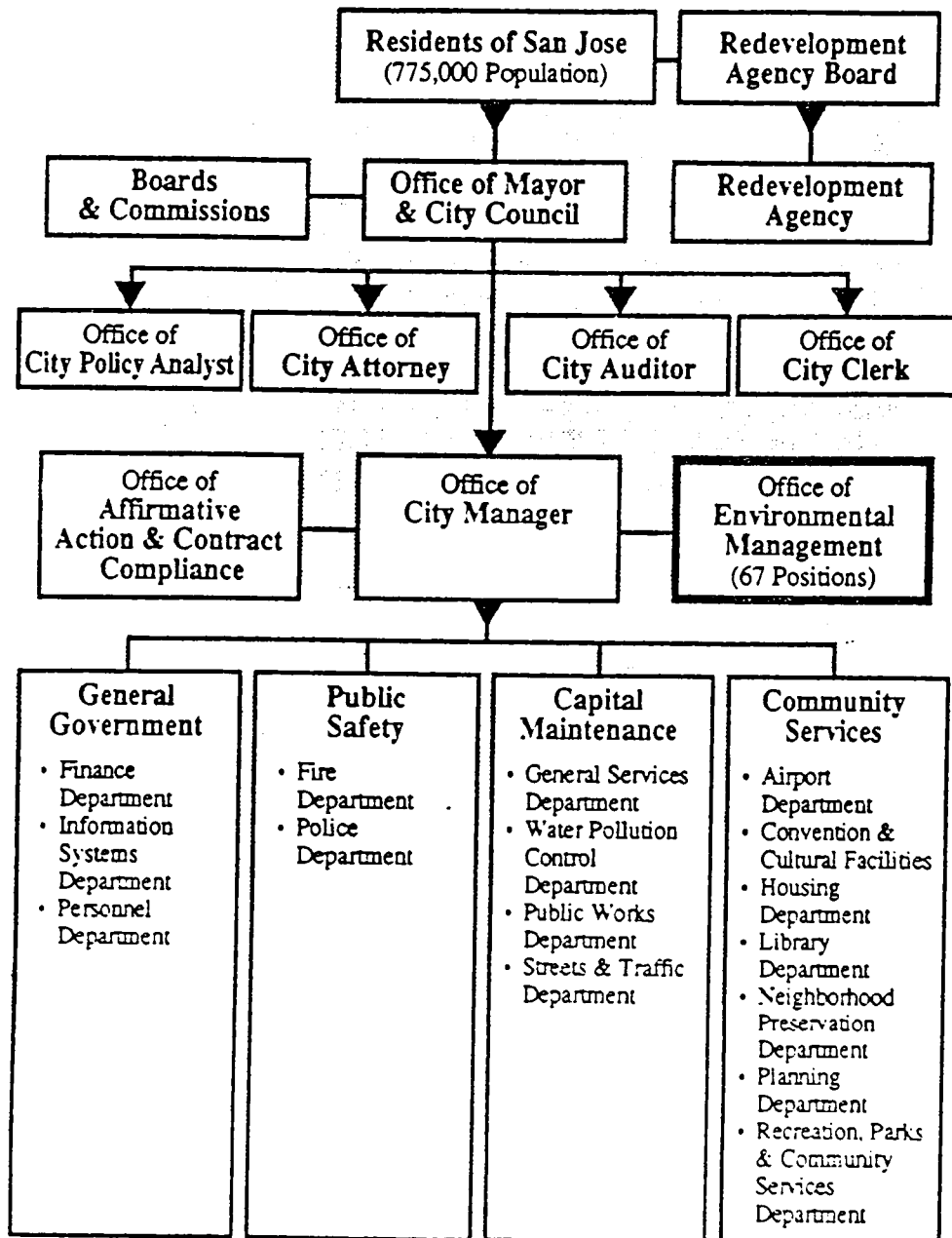
City of Portland Organizational Chart



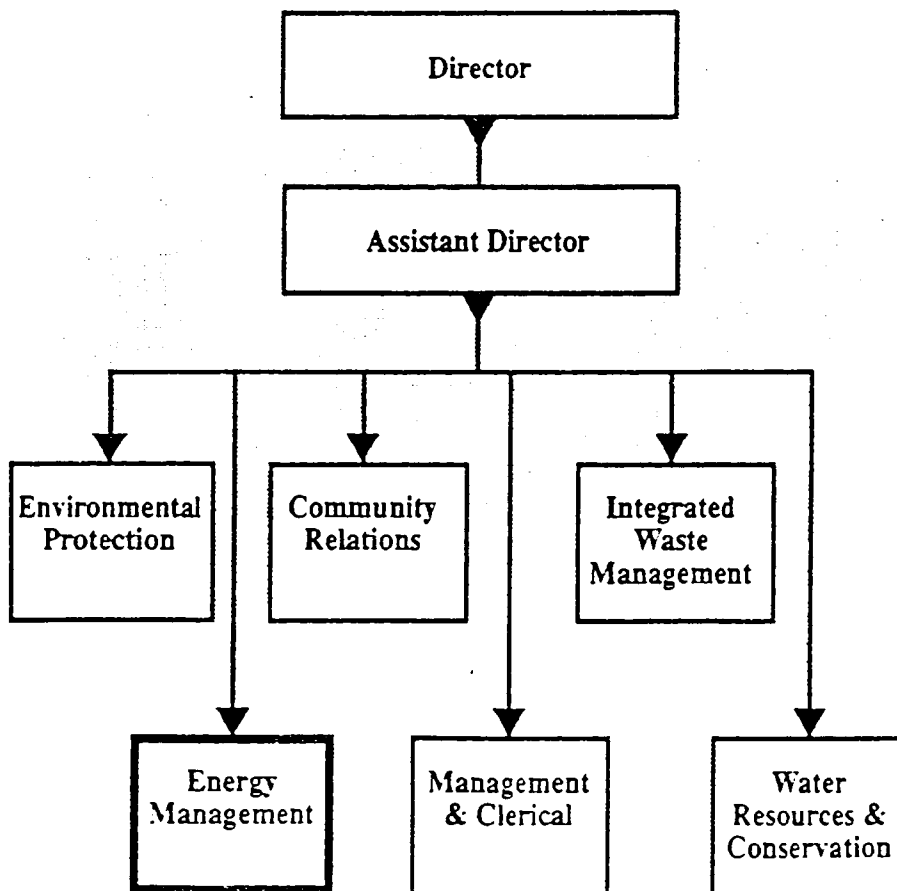
City of San Francisco Public Utilities Commission



City of San Jose Organizational Chart



City of San Jose Office of Environmental Management Organizational Chart



Source: *The Sustainable City Project*.

APPENDIX D

THE SUSTAINABLE CITY PROJECT: POLICY IDEAS

**Sources: The Sustainable City Project: A
Tri-City Collaboration for Developing and Implementing
Sustainable Urban Energy Practices,
Sustainable Energy: A Local Government Planning Guide
for a Sustainable Future**

CITY OF PORTLAND ENERGY POLICY

APRIL 1990

GOAL

Promote a sustainable energy future by increasing energy efficiency in all sectors of the City by ten percent by the year 2000.

POLICIES

In order to accomplish this goal, the following nine policies and related objectives are adopted as the Energy Policy of the City of Portland.

A. THE ROLE OF THE CITY

The City Energy Office shall take a lead role in developing new energy-saving programs and assist other City bureaus with energy programs and policies. The Energy Office in coordination with the Office of Intergovernmental Affairs will seek funding from City, State, Federal, and regional agencies, utilities, and others to implement, monitor, and evaluate programs.

Other City bureaus also shall develop policies and programs that affect energy use. Many of the programs will be developed with assistance from the Energy Office and then integrated into the budgets and work plans of the appropriate City bureaus. The City will consider public and private benefits and costs in the development of programs.

The City Energy Commission shall be an advocate for energy efficiency and advise the City Council on energy policies and programs.

Objectives

Two-Year Action Plan

1. Compile and update basic data on the sources, uses and costs of energy within the City and related air quality, solid waste, and environmental data.
2. Review major City policies and programs in the early stages of development to encourage energy efficiency.
3. Work with neighborhoods to include energy policies as a part of revitalization efforts, in neighborhood plans, and in the Neighborhood Needs process.
4. Compile information on new energy technologies, policies, and programs that may prove helpful to Portland's economy and environment.

-
5. Participate in the utilities' least-cost planning processes. Advocate the role of cities in the development and delivery of conservation and renewable resources.
 14. Investigate opportunities for supporting energy programs through utility franchise agreements.

B. ENERGY EFFICIENCY IN CITY-OWNED FACILITIES

6. Implement local programs that reduce the level of greenhouse gases to help meet the State's goal of a 20 percent reduction in emissions by 2005.
 7. Support Public Utility Commission regulatory changes to encourage more utility investments in energy efficiency.
 8. Support stricter Federal energy efficiency appliance standards.
 9. Review and update Energy Policy Two-Year Action Plan every two years.
 10. Actively solicit funding for energy efficiency projects to leverage city dollars and efforts.
- The City shall promote cost-effective energy savings (simple paybacks of ten years or less) in municipally-owned buildings and facilities and take advantage of utility, State, and Federal technical and financial assistance programs.

Objectives

Two-Year Action Plan

1. Determine total energy use and costs for municipal facilities and set up a system to track use and costs for major City facilities.
2. Identify energy-saving measures including opportunities for the use of renewable resources in City government buildings and facilities and seek funding for improvements. Use the Oregon Department of Energy (ODOE) Small-Scale Energy Loan Program, as appropriate.
3. Develop an energy-saving incentive program to encourage efficiency in City government by returning a portion of the money saved to the participating bureaus and for other energy projects.
4. Establish a set-aside fund for financing energy efficiency projects in City government buildings and facilities. Tar-

Long-Term Plan

11. Evaluate and update the Energy Policy every five years.
12. Support efforts to develop a Northwest energy research institute to provide technical and policy research for the substantial energy industry located in Portland.
13. Develop and promote energy education materials for the general public, elementary and secondary schools, and libraries.

get the fund to 6/100ths of one percent of the City's General Fund.

5. Provide energy education materials to City employees to encourage energy efficiency at work and home.
6. Promote the use and design of energy efficient street lighting systems, and continue to convert street lights to be more energy efficient.
7. Promote the use of life-cycle costing in purchasing decisions made by the City.

Long-Term Plan

8. Increase municipal energy efficiency by ten percent by the year 2000 by reducing total energy use in City-owned buildings, facilities, and fleet.
9. Promote a reduction in artificial lighting and the increased use of daylighting in all new construction or major remodeling of City buildings and facilities.
10. Investigate the budget process for increasing the priority of capital improvements that reduce energy operating costs.
11. Where practicable, exceed the energy efficiency standards of the Oregon building code for new municipal buildings, facilities and major improvements. Cost-effective energy efficiency measures shall be taken, such as energy efficient lighting, high-efficiency motors and appliances, district heating and cooling systems, and the use of renewable resources.

C. ENERGY EFFICIENCY IN RESIDENTIAL BUILDINGS

The City shall encourage energy efficiency in existing residences, focusing on the most energy-wasteful units, by helping to develop and promote public/private partnerships, utility, local, State, and Federal programs. The City also shall promote energy-efficient new housing by enforcing the energy saving standards in the State building code.

Objectives

Two Year Action Plan

1. Facilitate the weatherization of 8,000 low-income, multi-family units through the City's Multi-Family Weatherization Program by 1992.
2. Expand the Multi-Family Weatherization Program to include single-family rental homes, when funding is available.
3. Actively promote utility-sponsored energy efficiency programs for Portland homeowners.
4. Identify ways to meet the weatherization needs of elderly residents. Provide services in conjunction with agencies that serve the elderly.
5. Better serve low-income households, including Section 8 recipients, by coordinating with social service agencies and utilities through programs such as the Block-By-Block Weatherization Program and the Low-Income Energy

Assistance Program. Investigate ways to share costs with property owners.

6. Promote energy efficient new construction by actively supporting the inclusion of cost-effective residential energy-saving measures for all home heating fuels in the State Building Code. The code should be similar to the Northwest Power Planning Council's Model Conservation Standards.
7. Support the development of a uniform home energy rating system to provide information on the energy performance of new and existing homes.
8. Investigate requiring energy audits for any residential structure receiving financing from the Portland Development Commission.
9. Avoid lost conservation opportunities by encouraging property owners to install all cost-effective weatherization measures when weatherizing their rental properties.

Long-Term Plan

10. Identify ways to encourage local lenders to promote energy-efficient homes by counting future energy savings as income when determining the size of a home loan.
 11. Investigate options for time-of-sale weatherization for residential properties.
 12. Facilitate the weatherization of 20,000 low-income multi-family units by the year 2000.
-

D. ENERGY EFFICIENCY THROUGH LAND USE REGULATIONS

The City shall promote residential, commercial, industrial, and transportation energy efficiency and the use of renewable resources.

Objectives

Two-Year Action Plan

1. Promote land use patterns that increase energy efficiency in buildings and transportation systems by making energy efficiency a critical element when developing new zoning regulations and modifying old regulations and the comprehensive map. This objective applies to the following long-range planning efforts:
 - (a) Downtown, regional and neighborhood commercial service centers and central industrial areas with a balance of complementary retail and employment activities. Locate them near major arterials and transit lines.
 - (b) Medium- and high-density residential zones in and adjacent to the downtown core. Develop other general commercial centers and medium-density residential zones adjacent to neighborhood service centers.
 - (c) Housing adjacent to employment areas.

d) Planned unit developments to include mixed uses.

region to promote both mass transit and compact urban growth.

(e) Zero lot line/common wall construction in designated low- and medium-density residential zones.

(f) Buildable "substandard" lots.

(g) Secondary rental units in single family, owner-occupied homes.

2. Promote density, location, and mix of land uses that decrease the length of required daily trips and encourage the consolidation of related trips.

3. Promote medium- to high-density residential near proposed transit stations and medium density residential development along major transit routes.

4. Reduce energy consumed for space heating residential buildings by promoting the construction and renovation of attached single and multi-family dwelling units.

5. Promote tree planting as a way to reduce summer cooling loads and air pollution, making sure the trees do not cause the need for additional street lighting.

Long-Term Plan

6. Investigate the potential for energy savings from solar access standards for commercial buildings and multi-family housing.

7. Work with other governments in the

E. ENERGY EFFICIENCY IN COMMERCIAL AND INDUSTRIAL FACILITIES

The City shall encourage energy efficiency in existing commercial buildings and institutions by facilitating utility, local, State, and Federal financial and technical assistance.

Objectives

Two-Year Action Plan

1. Help 100 Portland businesses access existing utility, State, and Federal financial and technical assistance programs by 1992.

2. Actively support utility programs for commercial and industrial energy efficiency.

3. Support the amendment of the Business Energy Tax Credit program to offer up-front energy efficiency tax credits for businesses, similar to the incentives offered to multi-family building owners.

4. Continue to promote the inclusion of cost-effective commercial energy saving measures in the State building code, similar to the Northwest Power Planning Council's Model Conservation Standards, and require that commercial building designers submit energy code compliance forms with their applica-

tions for building permits.

5. Train Bureau of Buildings plans examiners to review plans for compliance with the commercial energy code with emphasis on lighting code requirements.

Long-Term Plan

6. Provide information to developers, architects, builders, and others interested in improving energy efficiency in new construction.
7. Help local schools, hospitals, and other public and non-profit groups to participate in State, Federal, and utility-sponsored energy efficiency programs.
8. Help set up training for businesses, schools, and institutions on operation and maintenance, energy accounting, life-cycle costing and other energy efficient management practices. Target small and medium businesses and major energy-using buildings.
9. Explore opportunities for promoting solar energy use and daylighting in commercial buildings.
10. Work with industry to identify opportunities for improving energy efficiency in process applications, including waste-heat recovery for cogeneration and district heating and cooling. Promote applicable State, Federal, and utility programs or incentives.
11. Study the impacts of reducing Multnomah County personal property tax for new investments in energy effi-

cient equipment.

12. Encourage district heating and cooling, and renewable resources in new commercial and institutional buildings.
13. Study and provide information to the development community on the costs and benefits of certification of commissioning of air balancing, controls, and HVAC equipment in commercial buildings. (Commissioning means that energy systems in new buildings are certified to work the way they were designed in the original plans.)

F. ENERGY-EFFICIENT TRANSPORTATION

The City shall provide opportunities for non-auto transportation including alternative vehicles, buses, light rail, bikeways, and walkways. The City shall also promote the reduction of gasoline and diesel use by conventional buses, autos and trucks by increasing fuel efficiency and promoting the use of alternative fuels.

Objectives

Two-Year Action Plan

1. Conduct an alternative fuels demonstration project in conjunction with appropriate utility, local, and State government agencies.
2. Initiate the amendment of current ODOE Business Energy Tax Credit and Small-Scale Energy Loan Program

-
- legislation to include financial incentives for transportation options that reduce greenhouse gases and improve air quality.
3. Support efforts to ensure the energy efficiency of the transit system, including good street maintenance and traffic light synchronization.
4. Promote shared recreational use of school facilities and City parks, close-in recreation opportunities, and improved scheduling of events to reduce recreation-related transportation needs.
5. Promote the construction of a regional light rail transit system.
6. Support efforts to remove the limitation in the State Constitution affecting local vehicle registration fees. Additional fees could be used for non-highway projects such as alternatives to auto-based transportation, if local voters authorize.
7. Support an increase in the Federal mileage standards for new cars.
8. Promote walking and bicycle commuting by identifying routes, encouraging spot hazard improvements on city streets, the provision of bicycle lockers at park-and-ride lots, and investigating bicycle commuter service centers and covered walkways/sidewalks.
- Long-Term Plan*
9. Support an increase in the number of preferentially located parking spots available for carpools. Promote their availability.
10. Match carpool riders and provide transit information to City employees. Promote public/private partnerships to increase employee rideshare, transit use, and flex-time.
11. Investigate offering reduced cost bus passes to City employees and encourage similar action by the State, Multnomah County, and private employers.
12. Promote and provide technical assistance on alternative fuels for downtown business fleets.
13. Support changes in Federal tax laws to increase deductions for employer paid transit.
14. Promote efficient transportation options for commuting between Northwest urban centers.
-

G. TELECOMMUNICATIONS AS AN ENERGY EFFICIENCY STRATEGY

The City shall research and support telecommunication opportunities that reduce the need for travel.

Objectives

Two-Year Action Plan

1. Develop a telecommunications policy for internal City use.
2. Examine City-wide telecommunication needs with local businesses, agencies, and developers.

Long-Term Plan

3. Investigate opportunities for City employees to allow off-site work and telecommuting, when appropriate.
4. Work with neighborhood commercial districts to identify and put into use telecommunication applications.
5. Investigate opportunities for a "24-hour City Hall" to provide information by computer access on City activities, services, hearings, and cultural/recreational events.

H. ENERGY SUPPLY

The City shall promote conservation as the energy resource of first choice. The City shall also support environmentally accept-

able, sustainable energy sources, especially renewable resources such as solar, wind, hydroelectric, geothermal, biomass (wood, farm and municipal waste), cogeneration, and district heating and cooling.

Objectives

Two-Year Action Plan

1. Investigate and advocate opportunities for competitive bidding to "sell" conservation to utilities or the Bonneville Power Administration (BPA). The City could operate conservation programs and deliver "saved energy" in the form of less electricity or gas used. Assist the Oregon Public Utility Commission (PUC), and others on the development of competitive bidding policies.
2. Promote the continued long-term production and use of methane at City-owned facilities, such as the St. Johns Landfill and Columbia Boulevard Wastewater Treatment Plant.
3. Develop an energy supply assessment for the City, including solar, biomass, and opportunities for using district heating and cooling, when funding is available.

Long-Term Plan

4. Develop an energy contingency plan based on the State's plan to protect against fuel shortages.
5. Investigate the potential for using the City's groundwater system and wastewater treatment plant for district heating and cooling.

I. WASTE REDUCTION AND RECYCLING

The City shall promote energy-saving activities such as 1) reduced use of excess materials, such as packaging; 2) recovery of materials from the waste stream for direct reuse and remanufacture into new products; 3) recycling; and 4) purchase of products made from recycled materials.

Objectives

Two-Year Action Plan

1. Continue to support both City and inter-governmental efforts in the recycling of office wastepaper and other recyclable materials, the curbside recycling program and composting.
2. Set up recycling programs for 500 multi-family buildings and 20 downtown commercial buildings by 1992.
3. Help local businesses develop markets for recyclable materials.
4. Develop a plan, including targets and a schedule, to increase residential recycling.

Long-Term Plan

5. Promote economic reprocessing and reuse of asphalt removed from City streets. Promote the use of recycled asphalt and rubber (from tires) for paving.
6. Promote voluntary recycling of major glass, metal and wood products at con-

struction and demolition sites.

7. Investigate opportunities for waste to energy and other waste recovery technologies.
8. Support activities to help METRO reach its goal of a 56 percent waste reduction in the METRO area by 2010.

D.2 SAN FRANCISCO'S LIST OF POLICY OPTIONS

SAN FRANCISCO'S LIST OF POLICY OPTIONS THAT CONTRIBUTE TO ENERGY SUSTAINABILITY

ENVIRONMENTAL PROTECTION:

Use limits. Allow only a specified number of visitors or vehicles to a site at a given time, reducing visitors, energy use and impact.

SELF-RELIANT RESOURCES:

Renewable energy. Use renewable resources. (Renewables include solar, wind, ocean, hydro or any other feasible technology.)

Resource access ordinance. Protect access to resources for facilities with renewable energy equipment or which incorporate passive design.

Alternative vehicle fuel. Promote use of alternative fuels (such as compressed natural gas or electricity) through proactive marketing and coordination.

Urban gardens. Promote the development of urban gardens in places such as parks, empty lots, rooftops, and window boxes to reduce energy use in the production, distribution and processing of food.

Import replacement. Develop local sources of raw materials, goods or services to replace those currently imported.

Energy emergency alternatives. Develop independent resource supply or fuel switching capability for essential public and private services in case of disaster or energy curtailment.

Bicycles. Increase bicycle use for commute and personal trips. Develop the supporting infrastructure (such as slow streets, safe bikeways, parking facilities).

Pedestrian. Increase walking as a means of travel by providing beautiful walkways and supporting infrastructure (such as benches, water fountains, restrooms).

WASTE MANAGEMENT:

Recycling. Recover materials from the waste stream for either direct re-use or as a raw material for other products. This will reduce energy use for transporting solid waste to the land fill and recover energy costs embedded in the materials.

Building conservation. Promote re-use of existing buildings to conserve resources used in construction and to reduce demolition waste.

Source reduction. Decrease the use of materials, including packaging and toxic materials, that cannot be recycled cost-effectively or have other negative environmental impacts.

Waste-to-energy processing. Identify opportunities for utilizing waste from the municipal waste stream as fuel for local or regional power plants.

Buy recycled. Promote use of products made from recycled and/or recovered materials.

Fuel-efficient vehicles. Educate the public and identify incentive programs to promote the purchase of fuel efficient vehicles.

EFFICIENT RESOURCE DELIVERY:

Peak load management. Promote strategies to shift peak electric usage to off-peak hours (such as thermal energy storage, process re-scheduling, time of use metering, demand metering).

Cogeneration. Identify and implement opportunities for utilizing cogeneration technology in public buildings. Provide administrative assistance to private facilities owners interested in cogeneration.

Adjacent transmission. Allow alternative energy generators to transmit excess electrical power or heat to adjacent properties.

District heating and cooling. Development of district heating and cooling systems to reduce energy use of residential and commercial buildings in mixed use neighborhoods.

COMMUNITY DESIGN:

Jobs/housing preference. Balance jobs and housing by giving preference to occupants with local jobs.

Neighborhood services. Identify and implement strategies to increase the availability of essential goods and services in existing neighborhoods. This will reduce trip demand.

Neighborhood activities. Promote small scale neighborhood recreational and cultural activities to reduce travel outside of the neighborhood.

Large project resource planning. Develop high level coordination in community development projects to provide consistency with other community goals and capture energy efficiency opportunities in the planning stage.

Housing density at transit nodes. Review current zoning and infill opportunities for increasing housing density near BART stations, major MUNI stops and along permanent transit lines.

Mixed use. Balance housing and commercial space. This includes zoning for mixed use, placing housing and commercial spaces in the same building, and live/work spaces.

APPROPRIATE HOUSING:

Residential building standards. Selected renewable energy and energy efficiency technologies will be recommended for inclusion in the Municipal building code, the planning code or the Residential Energy Conservation Ordinance.

Home energy rating system. Assist the development and implementation of a rating system of home energy efficiency for all residential structures (new, old, owner-occupied, and rental).

Design beyond code. Assist architects and contractors in using state-of-the-art energy technology for more efficient or self-reliant housing.

Appliance and lighting. Promote the use of resource-efficient lighting and appliances.

Loan benefits. Assist consumers in securing more favorable loan conditions for purchasing resource-efficient homes or home improvements.

Water conservation. Promote water conservation efforts to reduce water end-use and increase reuse. This reduces energy use in pumping the water supply and sewage treatment.

TRANSIT ALTERNATIVES:

Local transit level of service. Increase the convenience of using public transit by improving routes, frequency, speed, and cost.

Ridesharing/jitneys. Promote use of ridesharing and jitneys to and from both commercial and residential districts.

Transit incentives. Provide incentives for using public transit to shop, to attend events, and to pursue other activities.

Commercial district transportation management. Establish transportation management associations in all commercial districts to assist in managing the volume of traffic and to advocate for local transit improvements.

Transit coordinator. Extend the Transportation Coordinator Ordinance to all buildings throughout the city which have a specified number of employees. This includes special events attracting large numbers of people and municipal facilities.

Regional van pools. Promote the development and use of van pools.

Freight delivery. Improve the efficiency of commercial freight delivery to reduce the impedance of traffic flow of double parking or find an alternative to the use of delivery trucks and vans.

Work scheduling. Decrease the commute volume and peak demand through alternative work arrangements such as flexible hours, telecommuting, and other strategies.

Transit first. Use transportation funds for the construction of public transit systems rather than auto roadways. Give preference to public transit vehicles in roadway regulation and design.

Transit funding and land use. Advocate that regional transit funding be spent only in communities that have effective land use policies that are harmonious with regional plans to reduce inter-regional traffic.

Auto disincentives. Charge full rates for parking and bridge tolls and use proceeds to subsidize incentives for public transit.

Car care and operation. Use public classes on car care and operation to promote fuel-efficient driving techniques. Incorporate such instruction into the driver training curriculum of public and private schools programs.

Road system design. Design roadways to move traffic efficiently and reduce energy lost from stop and go driving through such features as turn lanes, synchronized traffic signals, and improved placement of stop signs.

Regional transit coordination. Coordinate connections between regional and local transit systems to provide greater convenience for transit users.

EFFICIENT PRODUCTION OF GOODS AND SERVICES:

Commercial building standards. Establish municipal codes for the energy-efficient construction, renovation and operation of commercial buildings.

Small business support. Facilitate the use of resource efficiency products and services in small business facilities and nonprofit organizations.

Resource efficiency business development. Assist the establishment and promotion of businesses which produce resource efficiency products or provide services which can reduce resource use.

Integrated audits. Promote the integration of facilities auditing so that the interrelationship between energy, water, hazardous waste, and solid waste in a facility can be studied in a single audit to maximize the potential for resource conservation and waste reduction.

Appliance efficiency education. Promote the use of the most resource-efficient electrical appliances.

Design beyond code. Assist architects and contractors in using state-of-the-art energy technology for more efficient or self-reliant commercial and industrial buildings.

Preventive maintenance. Promote the use of preventive maintenance programs in all commercial and industrial buildings. This will maintain the operating efficiencies and prolong the life of both buildings and equipment.

Industrial modernization. Assist local industry in modernizing with processes which allow them to operate more energy and resource efficiently.

Municipal facilities. Municipal facilities will be retrofitted with energy-efficient equipment and incorporated into renovations and new construction. Municipal facilities serve as an important example for all other citywide efforts.

Urban forestry. Plant trees on western and southern exposures to reduce spring and late fall cooling loads.

Water conservation. Promote water conservation efforts to reduce water end-use and increase use of reclaimed water. This reduces energy use in the pumping of the water supply and sewage treatment.

PARTICIPATORY SOCIETY:

K-12 education. Integrate renewable resource and resource efficiency concepts into the K-12 education program.

Family planning. Provide family planning services to reduce energy demands of population.

**D.3 CITY OF SAN JOSE SUSTAINABLE CITY STRATEGY:
YEAR ONE IMPLEMENTATION**

**LIST OF PROGRAMS RECOMMENDED TO SAN JOSE CITY COUNCIL
FOR SUSTAINABLE CITY STRATEGY YEAR ONE IMPLEMENTATION**

EDUCATIONAL PROGRAMS:

Residential Energy Information and Education.

Residential information and education, interagency energy service provider coordination, targeted workshops, marketing of brochures, fact sheets and other educational materials.

Energy Conservation Measures, Lighting and Appliance Point of Sale and Educational Program.

Intensive education program to provide technical assistance and education on the availability and energy savings potential of new heating/cooling, lighting and appliance measures.

Public School Educational Program.

Coordination of educational school outreach programs with other Office of Environmental Management water and solid waste efforts to introduce energy conservation materials, curriculum, and projects.

Vehicular Care, Purchase and Driver Efficiency Education Program.

Educational clinics to inform participants of auto maintenance measure, encourage drive behavioral changes for achieving improved fuel efficiency and improved air quality, and for the purchase of high mile per gallon automobiles and transportation demand options such as telecommuting.

TECHNICAL ASSISTANCE PROGRAMS:

Innovative Design and Energy Analysis Service.

Full service planning and design assistance for developers, architects, and engineers through the use of a complete matrix of energy conservation options, design guidelines, and computer software energy analysis.

Solar Access/Home Energy Rating System Pilot Program.

Technical assistance to builders or developers on solar access design techniques, redesign of an infill site design project, and a pilot program on establishing a home energy rating system.

Integrated Environmental Audit.

On-site audits for the commercial/industrial sector in the areas of energy and water conservation and waste reduction.

LEADERSHIP BY EXAMPLE:

Municipal Buildings and Facilities Energy Management Program.

Identification, implementation, and monitoring of energy conservation improvements, operations, and maintenance in all municipal buildings and facilities.

Street Maintenance and Surface Improvements.

Pavement management system to prevent deterioration and maintain infrastructure.

Traffic Operations Management.

State-of-the-art centralized traffic control system, replacement of existing traffic signal controllers and monitoring and recording capability of the traffic flow.

Growth Management and Land Use Planning.

Proactive approach to housing development which supports public transit, facilitates economic development, and encourages higher density housing and the use of underutilized land.

POLICY AND REGULATION:

Housing Energy Conservation Rehabilitation Measures.

Process whereby the use of city funds in housing rehabilitation has, as part of the requirements, the stipulation that certain minimum energy conservation measures are in place or installed at the time of rehabilitation.

Urban Forest Program.

Coordinating an Urban Forest Task Force, developing an urban forestry data base, tree master plan, citizen/volunteer/school planting effort, landscape guidelines, and educational program.

Transportation Demand Management Programs.

Transportation Demand Management strategies to enrich commute options, manage congestion, regulate driving, restrict auto facilities, and provide education and information.

Source: *The Sustainable City Project.*

APPENDIX E

CITY OF PORTLAND: CARBON DIOXIDE REDUCTION STRATEGY

Source: City of Portland Carbon Dioxide Reduction Strategy

CITY OF PORTLAND CARBON DIOXIDE REDUCTION STRATEGY

PORTLAND METRO AREA CARBON DIOXIDE EMISSIONS 1988 (Million Metric Tonnes)

	Petroleum	Natural Gas	Electricity	Total	Percent
Sector					
Residential	0.540	0.482	0.334	1.356	13
Commercial	0.190	0.395	0.301	0.885	9
Industrial	0.192	0.609	0.260	1.062	11
Transportation	<u>6.816</u>	<u>0.000</u>	<u>0.001</u>	<u>6.816</u>	<u>67</u>
Total	7.738	1.486	0.895	10.119	100

Per Capita Carbon Dioxide Emissions: 9.0 Metric Tonnes

Population: 1.12 million

PORTLAND METRO AREA CARBON DIOXIDE EMISSIONS 2010 (Million Metric Tonnes)

	Petroleum	Natural Gas	Electricity	Total	Percent
Sector					
Residential	0.324	0.762	1.090	2.176	16
Commercial	0.177	0.662	1.305	2.145	15
Industrial	0.248	0.724	0.334	1.306	9
Transportation	<u>8.282</u>	<u>0.000</u>	<u>*</u>	<u>8.282</u>	<u>60</u>
Total	9.031	2.148	2.729	13.909	100

2010 Target: 8.1 MMT

**Target Reduction: 5.8 MMT, or 42% less than forecast
(13.9 MMT - 8.1 MMT = 5.8 MMT)**

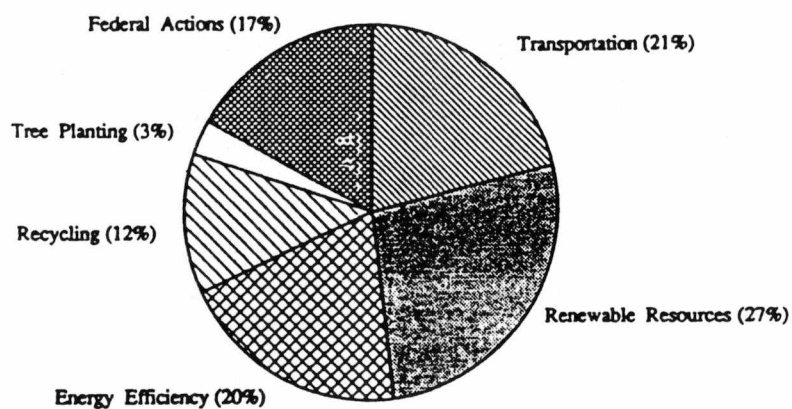
Per Capita Carbon Dioxide Emissions: 9.7 Metric Tonnes

Population: 1.436 million

**SUMMARY OF EMISSION REDUCTION FROM
STRATEGY ELEMENTS AND OBJECTIVES**

	<u>Million Metric Tonnes</u>		
	<u>CO₂ Emission Reductions</u>	<u>Element Sub-Totals</u>	<u>Percent Contribution To Target</u>
Transportation			
1. Reduce per capita VMT	1.220		
2. Buy efficient and low-emission vehicles	0.008		
3. Expand traffic signal optimization	0.011		
4. Improve incident management	<u>0.004</u>		
		1.243	21
Energy Efficiency			
1. Improve efficiency to reduce emissions from homes 25%, from businesses 20%, and from industry 15%	<u>1.169</u>		
		1.169	20
Renewable Resources and Co-Generation			
1. Use methane from landfills and sewage treatment plants	0.116		
2. Use renewable resources to generate 400 average megawatts	<u>1.432</u>		
		1.548	27
Recycling			
1. Recycle 60% of the solid waste	0.704		
2. Buy paper products with at least 25% recycled content	<u>0.011</u>		
		0.715	12
Tree Planting			
1. Reforest 75,000 acres in the state	0.154		
2. Increase urban tree planting	<u>0.002</u>		
		0.156	3
Federal Actions			
1. Increase fuel efficiency standards to 45 mpg	<u>0.982</u>		
		<u>0.982</u>	<u>17</u>
TOTAL		5.813	100

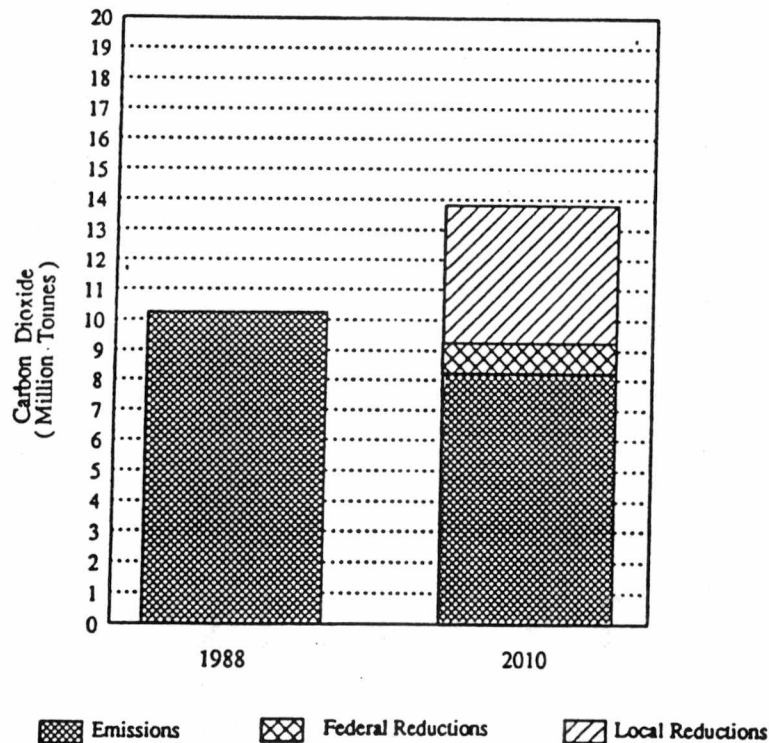
CONTRIBUTION OF ELEMENTS TO MEETING GOAL



CARBON DIOXIDE EMISSION FORECASTS AND TARGET REDUCTIONS FOR THE PORTLAND METRO AREA 2010 (Metric Tonnes)

Sector	2010 CO ₂ Emissions	2010 CO ₂ Reduction Targets	Percent Reduction
Residential	2,176,000	544,000	25
Commercial	2,145,000	429,000	20
Industrial	<u>1,306,000</u>	<u>196,000</u>	15
Total	5,627,000	1,169,000	21

1988 EMISSIONS AND 2010 FORECAST WITH PORTLAND METRO AREA STRATEGY



CARBON DIOXIDE REDUCTION SOURCES

	MMT CO ₂ Reduction	Percent Contribution to Target
• Transportation	1.2	21
• Energy Efficiency	1.2	20
• Renewable Resources	1.5	27
• Recycling	0.7	12
• Tree Planting	0.2	3
• Federal Actions	1.0	17

Source: Oregon Department of Energy.

APPENDIX F

THE SUSTAINABLE CITY PROJECT: ENVIRONMENTAL SCAN

**Source: The Sustainable City Project: A
Tri-City Collaboration for Developing and Implementing
Sustainable Urban Energy Practices**

THE SUSTAINABLE CITY PROJECT: ENVIRONMENTAL SCAN

■ General Information

- **Weather:** heating & cooling degree days, wind speeds, insolation (amount of sunlight penetration)
- **Land:** total land area and developable land by land-use category
- **Population:** total & daytime populations, employed residents
- **Income:** mean salary, per capita and median household incomes, distribution of income across income classes
- **Housing:** number of households, single & multi-family units, rented & owned units, median home value & rents, average persons per household, number of units built to state energy-efficient building codes, age of housing stock, homeless persons in shelters
- **Business Development:** employment by major SIC codes; unemployment; commercial, industrial, & office building space per district; retail & taxable sales volumes; income from tourism
- **Community Contacts and Energy Issues:** compilation of community groups concerned with issues of urban sustainability, list of journals on energy and related issues for ongoing information gathering

■ Energy Information

- **Energy Sources:** electricity production (fossil fuels, hydro, nuclear, geothermal, other), level of dependency on foreign oil, solar energy resources (expressed as a percentage of residential space and water heating needs)
 - **Total Energy Use* in Buildings:** total use by fuel type (electricity, natural gas, other) & sector (residential, commercial, industrial), total use by type of residential dwelling & fuel type, percentage of commercial energy use by type of business, peak electricity demand
 - **Total Cost of Energy Use* in Buildings:** total cost by fuel type & sector, costs per capita & per household by dwelling & fuel type, energy cost as percentage of household median income, changes in unit energy cost by energy type over time
 - **End-Use Patterns*:** percentages of total energy (electricity & natural gas) used for specific end-uses (lighting, space & water heating, refrigeration, ventilation, appliances), end-use percentages by dwelling type
 - **Transportation Energy Use and Costs:** total vehicle fuel consumption by cost & fuel type, average fuel cost per vehicle & per household, total mass transit passenger miles, fuel use per passenger mile on transit modes (by fuel type)
- * utility-supplied energy

Source: *The Sustainable City Project.*

VITA

Motoko Shimizu was born in Maebashi City, Gunma, in Japan on June 10, 1965. She graduated from Ota Girls High School in March, 1984 and International Christian University in Tokyo, Japan, in March of 1988, with a Bachelors of Art degree in History of Art and Architecture.

Ms. Shimizu returned to her home town and taught English in the public senior high school from 1988 to 1992. She conducted various educational programs such as "Motivating Students to Learn English by Introducing the English Certificate Test" and " International Friendship Programs," and published their reports.

In June 1992, she was awarded the Rotary Foundation Scholarship and entered the University of Tennessee, Knoxville, as a graduate student in the School of Planning. While at the University of Tennessee, she worked as a graduate assistant for the McClung Museum, the School of Planning, and the Center for International Education. Also, she was a Graduate Teaching Assistant in the Department of Asian and Romance Languages.

She is pursuing a Master of Architecture degree with an emphasis on environmental aspects of city design.