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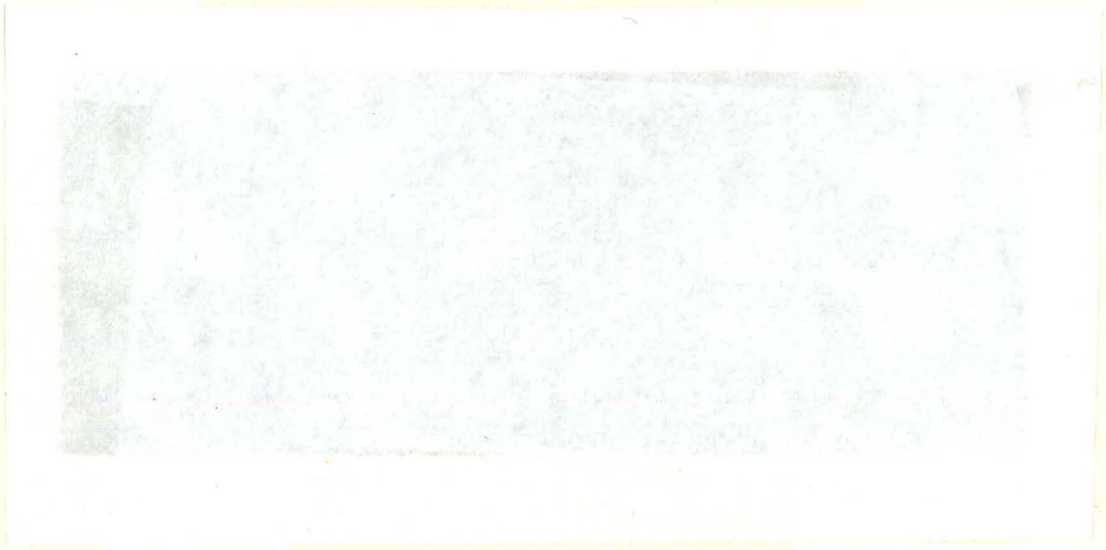

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DEVELOPMENT REGULATION CHANGES LOCAL ELECTED LEADERS CAN MAKE TO PROMOTE ENERGY CONSERVATION

by

N.F. Kron, Jr.

Energy and Environmental Systems Division

July 1980

Work Sponsored by

U.S. DEPARTMENT OF ENERGY
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DEVELOPMENT REGULATION CHANGES LOCAL ELECTED LEADERS CAN MAKE TO PROMOTE ENERGY CONSERVATION

ABSTRACT

This report lists actions local officials can make to change their community's development regulations and thereby lessen the effects of local energy problems. The term "development regulations," as used here, is a general reference to local or state controls over land use and development that affect design, orientation, placement, location, and related characteristics of buildings and infrastructure. The regulations include items such as zoning, subdivision controls, setbacks, yard and height requirements, and solar access ordinances.[1]

1 INTRODUCTION

1.1 PURPOSE, AUDIENCE, AND STUDY BOUNDARIES

The purpose of this report is to provide local officials, citizens, and planners with a list of actions they may want to consider in making their development regulations* more energy efficient.

The wide range of local regulations made it necessary to place two limits on the scope of this document. First, the list of actions presented here is limited to those from sources available at Argonne National Laboratory in early 1980. The most used sources were:

(1) an American Planning Association report[2] based on surveys of local officials on their energy-related local actions, and

(2) non-proprietary data contained in proposals sent to Argonne for the funding completion of RFP 79-20-0007: *Preparation and Evaluation of Energy-Conserving Development Regulations for Site and Neighborhood Design.*[3]

Reference 3 provides ideas on what planners at the forefront in energy management considered worth suggesting for use in their own communities.

A workable definition of "development regulations" has been critical in limiting consideration of the infinite range of options a community may pursue to alter its energy consumption. This definition follows.

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*The Appendix contains a glossary.

> The term "development regulations" is a general reference to local (or state) controls over land-use and development such as the design, orientation, placement, location, and related characteristics. Such regulations may include zoning, use restrictions, subdivision controls, setbacks, yard and height requirements, solar access, etc. Possible techniques (or controls) may also include any official maps, incentives, compensatory devices, transferable development rights, taxation, or other fiscal tools.[1]

Although this report lists several zoning ordinance modifications, nothing is said about items such as building codes or actions specifically designed to lower energy use in municipal operations. For example, this report *does not* list items such as increasing insulation standards for new residential structures or mandatory caulking programs for publicly-owned buildings. However, the report *does* list many energy-conserving actions that can be implemented by changing subdivision regulations and altering infrastructure requirements.

1.2 EXPECTED USE OF THIS REPORT

This report only lists actions with little supporting commentary and no analysis of how much energy a particular action will save. It is designed to be a beginning from which more thorough local studies and debate can proceed.

1.3 CLASSIFICATION OF DEVELOPMENT REGULATION CHANGES

Development regulation changes may be classified in at least three ways. Under the first classification scheme, actions could be separated by type of regulation. For example, actions would be listed under headings such as "zoning ordinance amendments" and "subdivision regulations revisions." Although this classification might be convenient for those drafting changes to a single regulatory instrument, a detailed list of changes would require considerable duplication. Moreover, because not all the listed actions would be appropriate for every climatic area of the country, confusion could result.

A second method of classification would be to list actions under the general intent of what the action is trying to promote. For example, classifications could include regulations, policies, and measures for summer shading of structures or pavement and regulations, policies, and measures for wind buffering (in cool and cold climates).[2] This scheme, although potentially less repetitive than the one based on development regulations, looks only at *intermediate* results of changes in regulations. The question of *why* a community would want to shade structures or do any of the other actions is not addressed.

A third scheme, and the basis for the classifications used in this report, approaches the problem from the perspective of *service demand*. In this approach, it is assumed that changes in development regulations are made because they conserve energy or make use of renewable resources in the provision of the basic services that people need. By focusing on services, discussions about regulations can be made less abstract, and the ultimate purpose for the changes can be stressed.

Five basic, people-oriented services are defined below:

- *Space Heating*: the provision of heat to the interior space of a building.
- *Space Cooling*: the removal of heat from the interior space of a building.
- *Domestic Water Heating*: the provision of hot water for bathing, washing dishes, and the like.
- *Electricity*: the provision of power to operate such things as fan motors, radios, televisions, and lights.
- *Transportation*: the movement of people and goods from place to place.

These basic services will not classify the entire range of energy-saving actions. Because national policy is to pursue a general reduction in energy consumption, a cut in imports, and an assurance of energy supplies for vital purposes, the following non-service classification was created for use in this report.

- *General Energy-Saving Actions*: these actions cannot be cleanly tied to a single service. The actions listed in this classification include: (1) changes in regulations that can conserve energy, (2) encouragement (or at least not discouragement) of the implementation of community energy systems, (3) a decrease in embodied energy use, and (4) improvement of general land-use policy and local regulatory review procedures.

To illustrate how the classification system works, assume the reader's community is in a northern climate using oil -- an expensive, scarce, imported fuel. Conserving oil while keeping people warm would probably be an important local goal. To discover development regulation actions that would conserve fuel used for space heating, the reader would consult the space heating and general space conditioning sections.

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2 CHANGES IN DEVELOPMENT REGULATIONS THAT PROMOTE ENERGY CONSERVATION

2.1 ACTIONS THAT INVOLVE DECREASING THE USE OF NON-RENEWABLE ENERGY REQUIRED FOR SPACE CONDITIONING

2.1.1 Space Heating

- *Actions That Encourage Passive Use of Solar Energy*

	Action	Source*
1.	Designate solar districts with proper orientations, setbacks, and height restrictions laid out in the zoning ordinance.	3C
2.	Place highest densities on south-facing slopes; lower densities on north-facing slopes, and minimize development of north slopes.	4
3.	Change building, fence, and hedge setbacks and related regulations to permit flexible control and access of sun exposure on the south faces of buildings (avoid blockage). Site taller buildings north of shorter ones.	3A,2
4.	Require solar access easements.	3B
5.	Initiate the concept of "transferable development rights" that can promote setting aside open solar space across adjacent properties.	3C
6.	Base density bonuses and other developer incentives on the number of units that will have clear access to direct sunlight or have correct solar orientation.	4
7.	Orient axes of buildings east/west. Buildings should be sited as close to north lot lines as possible. Zero lot line and clustering techniques should be used to improve solar access in single-family developments.	4
8.	Orient streets on east/west axes; consider topography in variations.	4
9.	Locate side lot lines for single-family subdivisions due north or due south, regardless of the resulting angle of incidence with the street, to permit south orientation of buildings.	3A

*As listed in the Reference section.

	Action	Source
10.	Design building shapes to maximize passive solar energy and minimize exposed surface area.	4
11.	Permit use of clothes lines.	2
12.	Increase density to allow flexibility in residential building arrangement to permit district heating, solar pools, or similar devices.	3D
13.	Pass zoning amendments or incentives to encourage the use of greenhouses, air-lock porches, or other passive additions.	2

- *Actions That Encourage Active Use of Solar Energy*

	Action	Source
1.	Pass solar-access regulations to cover zoning, subdivision, or landscaping, or initiate incentives to protect access to direct sunlight for solar collectors or probable collector locations. These solar access regulations could control the height and setback of buildings and, in some cases, the location of vegetation. Regulatory approaches that have been used include performance standards and prescriptive regulations.	2
2.	Allow variable shape of lots and proper clearances between structures for use of solar collectors without shadows and use of wind collection devices without breeze blockages.	3C,3D
3.	Pass zoning amendments to permit solar and wind collectors, including making solar and wind energy systems a permitted use, exempting collectors from height or lot coverage restrictions, aesthetic considerations, and others In addition, the locality can allow for solar collection on roof tops and permit structures currently restricted from modifications to install energy-saving devices.	2,3C,3D
4.	Pass environmental, glare, and visual guidelines for solar collectors, solar ponds, wind towers, and cooling towers to provide clear rules for potential builders to follow during construction.	6,7
5.	Allow development of neighborhood or group solar energy systems. (This may require modifications of utility franchising laws that may be beyond the locality's regulatory powers.)	3A

- *Actions That Encourage Wind Buffering*

	Action	Source
1.	Pass subdivision regulations or incentives for siting development so that topography will buffer it from prevailing winter winds.	2
2.	Pass regulations for preserving or replacing trees to provide wind buffering for structures.	2
3.	Pass regulations and incentives for placement of buildings for mutual wind buffering.	2

- *Other Actions That Aid in Space Heating*

	Action	Source
1.	Use special zoning procedures to manage the exploration and development of local geothermal energy resources.	2
2.	Consider special provisions for in-town "energy farms," agricultural land preservation, woodlot protection, and community gardens for biomass production.	6,7
3.	Allow mixed land uses to allow the use of thermal pollution from one building as a heat source for another.	3D

2.1.2 Space Cooling

- *Actions That Encourage Summer Shading*

	Action	Source
1.	Implement regulations for preserving or replacing trees to provide summer shade in new construction and to promote evapotranspirative cooling. The regulations can require the planting of shade trees in parking lots and on commercial sites.	2
2.	Landscape to provide maximum summer shade without blocking solar access. The mature height and canopy size should be considered in selecting tree species.	4
3.	Minimize paving of streets and parking lots to restrict heat concentration around habitable structures. Establish a shading ratio over paved areas to serve the same purpose. Narrow streets with canopy shading reduces heat buildup on pavement.	3C

	Action	Source
4.	Pass requirements for overhangs, patios, trellises, or other shade control devices on buildings.	2
5.	Propose covenants for solar screening of east and west windows and shading of south facing windows.	4
6.	Site buildings as close to the north lot line or lines as possible to increase southern yard space and give owner more control of shading.	3A

- *Actions That Encourage Natural Ventilating/Cooling*

	Action	Source
1.	Implement subdivision regulations, PUD guidelines, or incentives for topographic siting to maximize breezes.	2
2.	Pass regulations for landscaping to channel wind through buildings and neighborhoods.	2
3.	Implement subdivision regulations prohibiting parking lots and large buildings from immediate windward side of buildings to minimize cooling requirements.	2
4.	Allow varied setbacks for wind circulation.	7

2.1.3 General Actions That Promote Space Heating or Cooling Depending on Application

	Action	Source
1.	Alter zoning and related regulations dealing with:	
	a. setbacks to encourage more thermally-efficient common wall construction and minimize utility and street lengths;	2
	b. minimum building size, building shape, minimum lot size, and maximum lot coverage to require or allow building shapes or volumes which promote energy conservation by minimizing weather exposed surfaces and minimizing building envelope materials;	2
	c. building height;	3A
	d. building, lot, and street orientation;	3B
	e. building on hillsides to allow improved solar orientation provided no environmental hazards exists; and	3D,7

	Action	Source
	f. density, to allow increases in thermal efficiency.	2
2.	Modify ventilation standards to avoid excessive air changes.	5
3.	Produce regulations to encourage the use of ponds for heat sources/sinks, and provide clear standards on the use of reinjection of aquifer waters for heat pump applications.	7
4.	Allow all or major portions of buildings to be built below grade.	3A
5.	Recommend standards for landscaping earth covered structures to encourage use of these energy conserving buildings.	7
6.	Require preservaton of natural landscaping.	3D

2.2 ACTIONS THAT DECREASE USE OF NON-RENEWABLE ENERGY FOR DOMESTIC WATER HEATING

	Action	Source
1.	Require use of solar water heaters in all new residential development.	3F
2.	Allow space for solar water heater collectors. The regulatory changes involved here are the same as the solar access regulations listed in Section 2.1.1.	3F
3.	Require solar heating of swimming pools.	2

2.3 ACTIONS THAT CONSERVE (OR INCREASE) SUPPLY OF ELECTRICITY

	Action	Source
1.	Eliminate height restrictions for windmills.	7
2.	Discourage excessive minimum lighting standards for indoor/outdoor applications.	5
3.	Use landscaping to reduce irrigation requirements and thus decrease electricity used for pumps.	3F
4.	Increase use of natural lighting in buildings via proper orientation and solar access.	7

	Action	Source
5.	Assure proper consideration of topography to minimize the need to use electricity to pump wastewater uphill.	7
6.	Encourage on-site detention of storm water to reduce pumping costs.	3E
7.	Encourage application of gray water and treated wastewater to open spaces on the site where health and environmental hazards do not exist.	3E

2.4 ACTIONS THAT DECREASE ENERGY NEEDS FOR TRANSPORTATION

2.4.1 Take Fewer Trips

	Action	Source
1.	Encourage greater use of electronic communication to reduce travel (i.e., cable TV).	3A
2.	Encourage use of public and group transportation (i.e., vanpooling) by arranging land uses in "corridors" or compact multi-purpose activity centers.	3A
3.	Provide adequate park and ride facilities and special express lanes for public transportation vehicles and car and vanpools.	3A
4.	Provide a "shop and ride" free bus fare program to encourage use of public transit for shopping trips.	3A
5.	Design or redesign activity centers, housing complexes, etc. to better accommodate public transportation.	3A
6.	Prohibit high density areas not served by public transportation through zoning policies.	3A
7.	Improve traffic circulation to save energy; thus subdivision regulations or incentives for efficient circulatory patterns should be encouraged. This includes shorter streets through innovative design, reduced number of intersections, and requiring design for more efficient traffic movement and others.	3A
8.	Provide incentives, such as free parking or tax relief, to encourage vanpooling.	3A

Action	Source
9. Expand the list of permitted home occupations in zoning ordinances to decrease the need for travel.	3A

2.4.2 Switch Trip Modes to Less Energy-Intensive Modes

Action	Source
1. Provide more and improved facilities for movement by non-automotive means, principally walking and cycling. This may call for a modification of subdivision standards or providing incentives to require different design standards on streets and/or a provision of separate cycle-walkway systems.	3A
2. Pass regulations to promote bicycle and pedestrian safety and convenience. This includes cleaning of bikepaths, bike parking, facilities, provision of drinking fountains, and others.	2
3. Encourage use of public transportation facilities by concentrating origins and destinations within walking distance of them.	3A
4. Require developers to dedicate conveniently located land for recreational use.	3D
5. Concentrate development in multi-purpose activity centers or nodes to facilitate the use and operation of transit and multiple-occupancy vehicles. This may call for an intensification and infilling of areas around existing regional and community shopping centers and balancing of employment and housing opportunities, revitalization and rebuilding of existing older downtown and institutional centers.	

2.4.3 Decrease Length of Trips

Action	Source
1. Change zoning to require or encourage mixed land uses and mixed-use buildings. This includes expanding permitted and conditional uses in some districts so that compatible commercial, industrial, and residential uses may be located in close proximity to each other; developing mixed use districts in downtowns or other appropriate areas and residential, commercial, entertainment hotel, and recreational uses in a high intensity core.	2

	Action	Source
2.	Provide a finer-grain mix of land-uses to enable non-automotive travel. This may call for a greater decentralization of park, recreation, library, and other public facilities as well as the introduction of more local, neighborhood retail and service facilities and relatively less emphasis on major regional centers.	3A
3.	Allow density increases in zoning regulations aimed at conserving energy by reducing travel distances, and increasing the thermal efficiency of buildings. This includes raising density near downtowns, transit stops, areas of employment, etc.	2
4.	Encourage development to occur in areas contiguous to existing development. But, depending on the local situation, discourage strip commercial development in favor of clustered commercial areas.	3A,3C
5.	Utilize the concept of superblocks and cul-de-sacs, which emphasize pedestrian-open space systems and minimizes streets and utility systems.	3A
6.	Zone for high density on main transportation corridors.	3D
7.	Reduce the relative amount of space devoted to streets through clustering and more intensive land development.	3A
8.	Allow for conversion of single family residences into multi-family homes.	3D

2.5 ACTIONS THAT DECREASE ENERGY USE THROUGH GENERAL ENERGY-SAVING PRACTICES

2.5.1 Encourage Construction of Community Energy Systems*

	Action	Source
1.	Allow for high density so that co-generation and other energy systems needing high-energy load densities can work.	3D
2.	Revise regulations to permit, encourage, or relax restrictions on, or require the use of on-site energy facilities, including district heating and cooling, integrated community energy systems, waste heat recycling, common septic systems, heat pump systems, and power generation systems connected to existing electric power grids. Energy sources may	2,3C

*Defined in the Appendix.

	Action	Source
	be solar, fossil fuel, solid waste , or other. This includes provisions for special easements, amending lists of permitted uses, and others.	
3.	Modify permitted use or special use or accessory use sections to allow solar energy use and other centralized or decentralized supply, distribution, or energy storage systems.	3B
4.	Consider the use of performance standards for new alternative energy systems to allow design development flexibility.	3C
5.	Reduce line loss in utility conduits by restricting service of leapfrog developments.	3C
6.	Pass reasonable regulations for shielding fuel storage and rail yards from view, thus providing clear standards for developers.	7
7.	Allow relaxation of "nuisance restrictions" such as glare/odor, noise, fire/explosion hazard restrictions, stack height restrictions, and air pollution in non-industrial areas (to a reasonable limit).	7

2.5.2 Decrease Embodied Energy Use

	Action	Source
1.	Modify any requirements on width, depth, and materials needed for pavement, curbs, gutters, and sewers to reduce use of construction materials, heat from paving, and runoff.	3A, 3D
2.	Increase subdivision block sizes ("Radburn" concept) to reduce roadway length and width and minimize utility lines.	3A
3.	Reduce aggregate street length by restricting single family frontages.	3C
4.	Allow for shared facilities - e.g., walls, loading docks, heat systems, parking lots.	3D
5.	Require fewer parking spaces for some structures.	7
6.	Provide special compact car parking spaces.	7
7.	Encourage redevelopment of existing commercial strips to higher densities. (Requiring infills)	3A

	Action	Source
8.	Allow adaptive re-use and rehabilitiation of unoccupied buildings, especially gasoline stations. (Encourage or provide incentives for historic preservation.)	3A
9.	Encourage more efficient use of existing single-family homes and large older residential structures by permitting them to be remodeled to serve more than one household.	3A
10.	Develop urban homesteading acts and rehabilitation programs to encourage revitalization of existing areas, especially those near public transit routes.	3A
11.	Use various federal and state grants for energy-conserving new developments or retrofitting existing buildings.	3A
12.	Provide economic incentives for conducting energy audits and retrofitting existing buildings.	3A
13.	Cluster development, retain existing trees and plant materials, and selectively develop land to lower energy and other costs associated with land conversion.	3A
14.	Require construction materials which use less energy for production, possibly developing an energy co-operative to provide for low cost purchases of energy conserving materials and systems.	3A

2.5.3 Improve General Policy and Review Procedures

	Action	Source
1.	Implement comprehensive plan amendments aimed at increasing the overall energy efficiency of the community. This includes reorganizing land uses to reduce the need to travel and the length of trips, broad urban design changes based on microclimate, energy conservation policies in plans, and others.	2
2.	Prevent potentially inefficient and costly pre-mature annexation.	3D
3.	Provide adequate sewer, water, and utility lines and transportation networks to accommodate increased density in energy efficient locations (particularly areas well served by transportation).	3D

	Action	Source
4.	Prohibit developers of new areas and owners of existing developments to pass on increased energy costs from energy-inefficient development.	3A
5.	Include performance standards that specify maximum or minimum levels of performance rather than what can or cannot be done on a lot or parcel of land, etc.	3B
6.	Eliminate sales taxes on energy conserving equipment.	5
7.	Require energy impact statements for new developments to provide local officials a basis for comparing the energy efficiency of projects.	3G
8.	Establish a board to provide developers with low or no cost technical assistance in putting in energy conserving structures and design.	7
9.	Implement clear review procedures for special use permits for community energy systems components.	7
10.	Create a system which gives energy efficient development review and approval priority.	7
11.	Provide incentives, perhaps in the zoning ordinance, for developers to engage in energy conservation practices. Incentives may include density (residential) and floor area (commercial) bonuses for innovation in and use of passive solar techniques, wind buffering, breeze utilization, and on-site energy facilities.	3B
12.	Include energy-saving and energy-wasting characteristics as weighting factors in deliberations over variance requests, development proposals, nonconforming uses, and rezoning plans.	3C
13.	Require microclimate studies as part of the review process, so alternative energy conservation designs can be made site appropriate.	3D
14.	Provide recommendations of specific energy-efficient techniques as a supplement to the general requirements for energy conservation in the zoning ordinance.	3C

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3 CONCLUDING COMMENT

Each section of this report has provided a list of ideas that have been suggested, adopted, or recommended for communities. Not all of the actions will be appropriate for all communities, and in some cases, actions that promote savings in one sector could hamper conservation efforts in others. Local analyses -- both technical and political -- and evaluation of alternatives are important in developing programs for changing local regulations.

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1. Request for Proposal No. 79-20-0007, *Preparation and Evaluation of Energy Conserving Development Regulations for Site and Neighborhood Design*, Argonne National Laboratory (June 1979).

2. Erley, D., *Energy-Conserving Development Regulations: Current Practice*, prepared by American Planning Association for Argonne National Laboratory, ANL/CNSV-TM-38 (April 1980).

3. The proposals containing usable information were those from:

   A. DuPage County, Illinois or East Lansing, Michigan

   B. Ft. Collins, Colorado

   C. San Antonio, Texas (Data here is from an article appearing in the proposal: Thomas R. Sokol, *Zoning for Energy Conservation: Texas Architect*, July/August 1979, p 50-52.

   D. Waukesha, Wisconsin

   E. Schaumburg, Illinois

   F. San Diego Comprehensive Planning Organization, California

   G. Bellevue, Washington

4. The APA report in Ref. 2 above contains this information from Lincoln, Nebraska.

5. Lang, Reg and Audrey Armour, *Energy Conservation Opportunities for Municipalities*, Ontario Ministry of Energy, October 1978.

6. _____. *Sourcebook, Energy Conservation in Twenty Canadian Cities*, for the Cities Energy Conference, Toronto, January 31 and February 1, 1980.

7. Argonne National Laboratory, unpublished information (1980).

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APPENDIX

GLOSSARY OF TERMS USED IN THIS REPORT

Active Solar	The collection and use of solar energy using special mechanical equipment.
Cogeneration	The production (generation) of electricity while using heat (normally wasted) for useful purposes.
Community Energy System	An energy supply system using several technologies and as little fuel as possible to supply services to a number of buildings.
Cooling Tower	A heat exchanger that cools the water by evaporating a portion in the outside air.
Demands (Service, Energy)	The quantity of energy required during a particular period of time.
Development Regulation	A general reference to local controls over land use and development. Examples include zoning codes, subdivision controls, setback, yard, and height requirements, solar access ordinances, official maps, transferable development rights, taxation and other fiscal tools. Building codes, however, are explicitly excluded from this definition.
Distribution System	The piping or wiring that transports hot water, steam, chilled water, or electricity from a central plant to the buildings where it will be used.
Domestic Hot Water	Hot water used in residences or for uses normally found in residences.
Energy Demand	Requirement for energy in a particular form, e.g., electricity, hot water, steam, chilled water, gas and oil. As used in this document, these energy forms are supplied to the end-use conversion devices and converted into the desired services (also see Service Demand).
Gray Water	Wastewater that does not carry human body wastes, dangerous chamicals, or radioactive substances.
Heat Pump	A mechanical device which transfers heat from a cooler place to a hotter one.

Infrastructure	The man-made public utilities and conveniences built to service a development. It includes items like streets, curbs, gutters, storm sewers, sanitary sewers, gas mains, water mains, steam pipes, electric lines, street lights, etc.
Microclimate	The meteorology or weather conditions affecting a single building site or development.
Passive Solar	The use of solar energy by proper building design and siting without the use of any special mechanical equipment.
Service Demand	Requirements for energy in the form in which it is delivered to the end-users, e.g., heating, cooling, lighting, cooking, refrigeration, snow melting. Note the distinction between service and energy to the end-use systems for subsequent conversion to services.
Site & Neighborhood Design (SAND)	A DOE-sponsored program in which DOE is funding land developers to develop energy-conserving site designs. Using the designs, DOE will put together a number of manuals for local use that describe methods for encouraging conserving development.
Space Cooling	Commonly known as air conditioning. Space cooling is the mechanical removal of heat from a building's interior area.
Space Heating	The addition of heat to a building's interior area.
Trip Mode	The conveyance used to take a trip. Automobiles, busses, and trains are three potential trip modes.
Waste Heat	Heat (usually at relatively low temperature) that is being dissipated to the environment but that could be put to a useful purpose.