ENERGY
CONSERVATION
ELEMENT
ENERGY CONSERVATION

Introduction

Oregonians have, until recently, enjoyed inexpensive and abundant energy. Even today electrical energy costs in the Northwest are lower than in any other region of the country. In recent years, however, Oregonians have become increasingly concerned about the rising cost and decreasing availability of energy and we are beginning to realize that our past rate of energy consumption is in many ways less significant than our attitude about how energy is used.

There is little that can be done about current energy supplies and costs; especially at the local level. Conversely, the most effective measures to conserve existing energy supplies can most efficiently be carried out at the local level. This is particularly evident when we realize that in 1975, Americans wasted more energy than 2/3 of the world's population used.¹ It has been estimated that up to 30 percent or more could be conserved through the development of local resources, enactment of conservation measures, modification of building techniques and land use patterns, and local encouragement of private and public use of natural renewable resources. U.S. energy needs could be met for the next 25 years through conservation and improved efficiency of existing uses.²

More efficient energy use can result in reduced operating costs and energy consumption in a residence or commercial building. Likewise, transportation energy consumption can be limited through reduced trip frequency and duration. Energy consumption is not only affected by the heating and cooling of structures, but significantly by the location of land uses in relation to one another. Conservation measures can be effectively implemented only at the local community level because this is where land use decisions are made. Cities are finding that conservation is the cheapest source of power. The energy saved can be used to accommodate prudent future growth.

² Ibid.
The State of Oregon has taken steps to initiate energy planning. Goal 13 of the Land Conservation & Development Commission's (LCDC) Goals & Guidelines mandates local governments in Oregon to establish comprehensive energy policy as an element of long range land use. Goal 13 states:

"Land and uses developed on the land shall be managed and controlled so as to maximize the conservation of all forms of energy, based upon sound economic principles."

Oregon is concerned about conservation because its population growth rate has doubled the United States growth rate in the period of 1970 to 1980. Roseburg's growth rate has equaled that of Oregon during the same period. This rapid growth means that proper land use and energy planning is imperative. Several cities in Oregon have approached their energy planning with great success. Each city has its separate and unique problems, but two points hold true in every case. Point one is concerned with changing from a basic thinking of "leave it to the federal government" to undertaking a more active approach of "let's do it ourselves." The second point is that every successful city has had broad citizen support of an energy program.

It is important to understand from the outset that the Energy Conservation Element of the Roseburg Urban Area Comprehensive Plan must, because of the limiting constraints of time, staff and currently available data, fall short of being regarded as a comprehensive energy study. This in no way lessens the need for an in-depth study and the City should seriously consider the formulation of an Energy Plan in the near future. Such an Energy Plan would be formulated with the following objectives in mind:

1. To identify current energy consumption patterns;
2. To project future energy consumption patterns;
3. To identify possible future energy constraints and possible consequences of such constraints;
4. To identify and evaluate in more detail techniques for conserving energy and increasing energy efficiency;
5. To more fully evaluate the consequences of alternative land uses and development patterns; and,
6. To identify a broader range of policy options for achieving energy efficiency and economy.

The Energy Conservation Element then should be regarded only as a preliminary study, with its scope broadly focused on problems of energy consumption and on related planning and economic policy issues. The generalized calculations and analyses contained in this element are all based on information which is highly variable and continually subject to change. Finally, the contribution to the Comprehensive Plan that is intended by this study is not so much a definitive calculation of energy consumption, conservation, and related economic impacts, but is rather an approach to providing a basis for decision-making during the planning process.

ENERGY SOURCES AND AVAILABILITY

The types of energy (energy forms) used in the Roseburg urban area are either produced locally or imported from outside the region. Imported energy forms include petroleum products, natural gas and electricity. These imported energy forms usually require large capital investments to be produced and distributed, and have been readily available for use. Local energy forms include wood products, solar energy, and human activity (bicycle riding, walking, etc). The cost of producing and distributing many of these energy forms is relatively lower than for imported energy. However, not all urban area residents have access to them.

Local Energy Sources

Energy forms that are locally produced are not subject to the same magnitude of cost and supply fluctuations experienced by imported energy forms. These energy forms are usually obtainable directly from the source by individual consumers, and are inherently low in cost or present in abundance. At the present time wood products are the most widely used local energy form. Other examples of local energy forms are solar and human power.

In Roseburg, the majority of the energy provided by wood products is used for residential space heating. They also provide a portion of the energy used by lumber
manufacturers and are used to generate electricity at the Roseburg Lumber Company mill in Dillard. The supply of this locally available energy resource is to a significant degree dependent on the activities of the timber industry, as the majority of firewood and other wood products used for energy production are made available as a by-product of timber harvesting and/or manufacturing operations. Uncertainties about future production levels in the area's wood products industry also creates uncertainty about the future availability of wood products used for energy purposes, unless there is a corresponding increase in the amount of timber harvested solely for energy production. At the same time, the cost of this resource can be expected to increase when its availability as an industrial by-product decreases.

Solar power is readily available in many parts of the Roseburg urban area for space and water heating. Locations on the north side of hills and other sites with tall obstructions to the south do not receive enough direct sunlight to economically use "active" solar systems (see next paragraph for a detailed explanation of "active" and "passive" solar systems). An on-site investigation of each location is needed to determine the amount of solar energy which is "available" for use. Generally, at least some of the benefits of passive solar systems are available to almost all Roseburg area residents, while the use of active solar systems is more limited.

Passive solar space heating systems utilize inactive elements of home design and construction to provide heat. These elements can include house color, building orientation to receive maximum solar exposure, and the placement and design of windows to receive maximum sunlight during the heating season. The cost of utilizing these techniques is relatively low, especially for new construction. Active solar heating systems use pumps, fans, or other equipment in their operation, rather than the "passive" techniques mentioned earlier. The most commonly used active solar heating systems are solar water heaters. A more detailed discussion of passive solar techniques is contained in a later section of this element.

According to Oregon State Department of Energy, active solar systems can economically provide over 25 percent of the space and water heating needs of many
homes. At the present time, manufactured active solar systems are not cost competitive with conventional energy forms such as electricity or natural gas due to current energy prices. In the future, this relationship will change due to the increasing cost of these conventional energy forms. The cost of active solar energy systems to the individual user is reduced through the subsidy provided by state and federal tax credit programs.

Human activity is one locally available source of energy that is often overlooked, perhaps because it is taken for granted. Many human activities can eliminate the consumption of other forms of energy. For example, walking and bicycling can take the place of motor vehicles for many transportation needs. These activities are available to anyone in good health and at relatively low cost, in terms of the equipment that is needed.

Imported Energy Sources

The major energy forms imported to the urban area are natural gas, electricity, and petroleum products. At the present time, petroleum provides by far the largest portion of the urban area's total energy needs. Unrefined crude petroleum is not used as a source of energy in Roseburg, but in its refined forms provides all the energy used for transportation purposes and a small portion of the energy used for residential space heating. The supply and cost of this energy form is affected by the actions of many groups: The Organization of Petroleum Exporting Countries (OPEC), other oil producing nations, the U.S. government, multinational, oil corporations, and local petroleum retailers.

The supply of petroleum products has fluctuated during the past few years in the Roseburg area as well as in the rest of the U.S. During this period, the price of these products has rapidly increased.

The future supply of petroleum may increase from present levels as a result of potential OPEC, U.S. government, and/or oil company actions. However, if demand for petroleum continues to increase as it has in recent years, there will probably be

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shortages of supply regardless of what measures are taken to increase petroleum production. The future cost of petroleum can be expected to increase at an average rate greater than inflation due to OPEC pricing policies, deregulation of domestically produced petroleum prices, and increasing production costs.

Natural gas is supplied to the Roseburg area by California Pacific National. Residential users consume about 65 percent of the natural gas used in the Roseburg urban area while commercial users consume the remaining 35 percent. California Pacific reports no "industrial" gas users in the Roseburg area. About 60 percent of California Pacific's natural gas is imported from Canada, but this supply may be reduced in the future due to the Canadian national policy of curtailing energy exports when their energy needs increase. Reductions in Canadian gas supplies may be offset by natural gas from Alaska's North Slope and other locations in the continental U.S.

Natural gas prices have experienced recent increases, but at a much lower rate than petroleum price increases. In the future, gas prices can be expected to increase as the price rate is tied to the prevailing world price of crude oil. The price of natural gas has been regulated by the Federal Energy Regulatory Commission (or its predecessors) since 1954. Gas produced in the U.S. is subject to the provisions of the Natural Gas Policy Act of 1978, which is part of the National Energy Act recently passed by Congress. Under the provisions of this law, the price of certain types of gas (such as gas discovered after 1984) will be deregulated, while the price of the remainder of gas would increase at the rate of inflation. Certain industrial consumers may initially pay more than other gas consumers under the present pricing policy. Briefly, natural gas prices will rise in the future, with the exact increase determined by the source of the gas which is used, and the type of users.

Electricity is the most commonly used energy form in the Roseburg urban area for all purposes except transportation. Within the urbanized area electricity is supplied by Pacific Power & Light Company. Much of the rural area outside the urban area is served by Douglas Electric Cooperative.

Unlike other energy forms, such as natural gas, it is not possible to assign a specific generation source for electricity. While PP & L operates hydroelectric
generation facilities on the upper North Umpqua River about fifty miles east of Roseburg, the generation and transmission system within Douglas County is an integral part of a much larger regional system. It is not possible to evaluate or examine one part of the system without considering the entire system. More than a cursory description of the overall system would be beyond the intended scope of this element. However, in order to gain some perspective of the relationship between the urban area and the larger electrical supply picture, a brief review is presented.

Pacific Power & Light currently produces about 80 percent of its power through 33 hydroelectric plants and seven steam electric plants. Two-thirds of PP & L's electricity comes from coal-fired steam plants that are located in Wyoming and Washington. The hydroelectric plants produce 13 percent and the remaining 21 percent is purchased, primarily from the Bonneville Power Administration.

The amount of electricity consumed in the urban area and the Pacific Northwest is increasing, primarily due to population growth.

During the past ten years PP & L has experienced an average annual growth rate of 4.5 percent in its Roseburg District and the company projects the growth rate in electrical use to level off at around four percent in the near future.

As demand increases, new generating facilities must be built and ways must be found to make existing supplies serve greater numbers of people. The expansion of existing and construction of new hydroelectric facilities is not expected to provide an adequate amount of power to meet anticipated demands. The best hydroelectric sites have in many cases already been developed and the maximum number of generators have already been installed or are under construction, thereby eliminating further expansion. Environmental considerations, such as salmon migration, act to restrict the number and size of potential hydroelectric projects.

PP & L planners estimate that the company can realistically expect to bring new power on line at an average rate of 3.7 percent, or slightly less than anticipated demand. PP & L is actively pursuing a course to head off the potential shortfall through conservation. Conservation is discussed in a latter section of this element.
ENERGY CONSUMPTION

This section of the Energy Conservation Element attempts to describe, in general terms, the amount and manner in which energy is consumed in the Roseburg urban area and ideas for greater efficiency through conservation. Unfortunately, very little information is currently available showing specific consumption patterns for the urban area; or for Douglas County for that matter. Energy suppliers by nature are relatively unconcerned with such arbitrary geographic distinctions as city limits or county lines and look instead at a broader, regional view of energy flow. Also, individual sectors of the economy consume energy for different purposes, or end uses.

On the brighter side, however, significant amounts of data have been gathered on the energy consumption picture at the state level, from which many assumptions can be drawn and applied locally. Throughout this section of the element, the assumption is made that the Roseburg urban area is an integral, and to a degree, typical and representative subsample of the larger state energy picture.

The discussion of energy consumption and conservation in the urban area is broken into Transportation, Industrial, Commercial, and Residential sectors. Chart E-1 illustrates the direct use of total energy consumed in Oregon by each of these sectors.

Transportation Sector

More energy is consumed for transportation purposes than for any other use in the urban area. Virtually all of this energy comes from petroleum. This relatively large use of energy for transportation is not peculiar to Roseburg, as Oregon and the U.S. as a whole use more energy for transportation than for any other purpose.

CHART E-1
OREGON’S DIRECT ENERGY
USE BY SECTOR - 1977

TRANSPORTATION

OTHER
This sector is unique in that its end uses are required by all other sectors for both business and personal use. Business end uses include the transportation of raw materials and finished goods and the distribution of products to wholesale and retail outlets. Personal end uses include commuting to work and shopping.

The amount of energy consumed by the transportation sector has been projected to significantly increase in the future, given present rates of transportation energy consumption (see Transportation Element. The estimated number of average weekday vehicle trips generated within the Roseburg urban area is expected to increase by about 70 percent from 1977 to the year 2000 (from 83,000 trips to 142,000 trips). Given this projected increase in travel, substantial improvements in transportation efficiency will need to be implemented in order to minimize increases in energy consumption.

Because so much energy is used for transportation, primarily for private automobiles, this is one of the most important areas to institute conservation practices. There are a number of policies which the City can implement to help reduce vehicle consumption in the urban area. Possibly the most pertinent is to encourage a shift of some traffic to more fuel-efficient modes. Such policies are found throughout the Comprehensive Plan. With the exception of the airplane, the private auto consumes more BTU's per passenger mile than any other form of transportation. Table E-1 compares the energy efficiency of various transportation modes.

COMPARISON OF ENERGY EFFICIENCY
OF TRANSPORTATION MODES

<table>
<thead>
<tr>
<th>Urban Mode</th>
<th>Energy (BTU/Passenger-mile)</th>
<th>Inter-City Mode</th>
<th>Energy (BTU/Passenger-mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>200</td>
<td>Bus</td>
<td>1,600</td>
</tr>
<tr>
<td>Walking</td>
<td>300</td>
<td>Railroad</td>
<td>2,900</td>
</tr>
<tr>
<td>Mass Transit</td>
<td>3,800</td>
<td>Automobile</td>
<td>3,400</td>
</tr>
<tr>
<td>Automobile</td>
<td>8,100</td>
<td>Airplane</td>
<td>8,400</td>
</tr>
</tbody>
</table>


Railroads are the most fuel-efficient means man has yet devised for overland transportation of freight, using only one-quarter as much energy to carry cargo as a truck. Their operation for this purpose should be encouraged by any means at the disposal of the City, including the use of caution in regulating railway operation within the urban area.

Probably the greatest fuel savings, however, could result from increased use of the City's transit system. Although ridership on the system has increased steadily since its initiation in 1976 (See Transportation Element), it still operates at an inefficient level.

To be widely used a public transit system requires high densities of living areas and working/shopping places along major transportation corridors. This must be a factor considered in the community planning process if the public bus system is ever to become an efficient energy saver. Distribution of population and businesses over a large area makes public transit too costly and inefficient to operate.

It is assumed that the economic impact of increasing petroleum prices will continue to encourage transportation energy conservation. Bicycle use will continue to increase, mass transit ridership will increase and sales of new vehicles that are relatively energy-inefficient will continue to decline.

A number of factors such as vehicle emission controls, vehicle weight and engine efficiency can also greatly effect the magnitude of transportation energy consumption,
but can only be affected at the state and federal levels of government, while other factors such as individual trip length and choice of transportation mode (such as bicycle versus auto) can be influenced by local land use policies.

**Industrial Sector**

Examination of industrial energy consumption presents difficult analytical problems. In many cases energy suppliers make no distinction between "industrial" consumers and "commercial" consumers. Others define "industrial" consumers by the amount of energy purchased, while others make the distinction based on type of operation involved. For this reason, there is no data available on actual energy consumption by the industrial sector in the urban area.

Consumption of energy in the industrial sector is best estimated using the quantity of energy needed to produce one dollar of value added to a product for each industrial group (i.e., lumber, paper, primary metals). "Value added" is an indicator of an industry's net contribution to a product's finished value. There are other estimating methods available, such as the energy per employee ratio for each industrial group, but this method does not account for changes in substitution of energy and equipment for labor.

From value added estimates, each industry group's share can be estimated for: (1) contribution to Douglas County's economy* (as indicated by number employed and value added) and (2) energy intensity. Energy intensity is a measure of the quantity of energy consumed to produce employment, wages and profits. In terms of energy conservation, a benefit occurs when industry is able to decrease the quantity of energy consumed for production without decreasing employment, wages or profit.

Data necessary for calculating energy density will not be available until new census is published. However, the Oregon Department of Energy has calculated energy intensity and other data for Oregon which can be used to discuss energy consumption in Douglas County's industrial sector. Table E-2 shows percent of total for major industries energy consumption, employment and value added for Oregon and employment for Douglas County. As indicated, lumber and other manufacturing are the
largest employment groups in Oregon. Value added generally follows the percent employed ranking with minor variations. Percent employment for each group in Douglas County, however, controls that for Oregon. Employment is heavily concentrated in the lumber industry with other industrial groups each employing ten percent or less of the total work force.

*NOTE: Statistics necessary to determine "value added" are currently only available on a county-wide basis (see Economic Element).
<table>
<thead>
<tr>
<th>SIC Code</th>
<th>Industry Group</th>
<th>Total Energy</th>
<th>Employment</th>
<th>Rank</th>
<th>Value**</th>
<th>Rank</th>
<th>Employed</th>
<th>Employment</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Food</td>
<td>8</td>
<td>12</td>
<td>3</td>
<td>12</td>
<td>3</td>
<td>600</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>24</td>
<td>Lumber</td>
<td>25</td>
<td>40</td>
<td>1</td>
<td>34</td>
<td>1</td>
<td>8,653</td>
<td>73</td>
<td>1</td>
</tr>
<tr>
<td>26</td>
<td>Paper</td>
<td>28</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>4</td>
<td>920</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>28</td>
<td>Chemicals</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>----</td>
<td>--</td>
<td>-</td>
</tr>
<tr>
<td>33</td>
<td>Primary Metals</td>
<td>21</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>475</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Other Mfg.</td>
<td>14</td>
<td>38</td>
<td>2</td>
<td>36</td>
<td>2</td>
<td>1,200</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SOURCE:** Derived From ODOE, 4th Annual Report, and Directory of Oregon Mfgs.

* Standard Industrial Classification

** “Value added” is an indicator of an industry’s net contribution to a product’s finished value.
Assuming that percent value added and employment are similar (for ranking purposes) as found for the state, then by rank the lumber industry is the largest energy consumer in Douglas County. Without detailed data pertinent to Douglas County, further ranking of industrial groups is inappropriate.

Chart E-2 shows the quantity of energy needed to produce a dollar of value to a product for each industrial group.

Although additional inferences cannot prudently be made from this data, general conclusions can be made from a similar energy study completed by the Mid Willamette Valley COG. They are:

(1) "It is the resource-based industries that show large amounts of energy consumption . . . to the amounts of value added and jobs that they produce. In contrast, the industries that show very small energy investments relative to the same value added and numbers of jobs are those whose finished products are not directly related to extracted resources." (e.g., Electrical and electronic machinery.)

(2) " . . The larger the energy cost ratio in an industry, the more exported out of the community to pay the cost of fuel.

The urban area's economy is largely resource-based, a characteristic that will probably continue in the future. Therefore, it is reasonable to assume that local industries will continue to need a high ratio of energy consumed to employee and energy consumed to value added of product. It is further reasonable to assume that Douglas County and the urban area will continue to be dependent on imported refined energy (e.g., petroleum, electricity) or consume renewable energy that could be exported in raw form (wood) or embodied in a manufactured product (lumber).
CHART E-2

QUANTITY OF ENERGY REQUIRED TO PRODUCE ONE DOLLAR OF ADDED VALUE

INDUSTRIAL GROUP

*There are no chemical industries in Douglas County
Commercial Sector

The commercial sector is in many ways the most difficult part of the economy to analyze from an energy point of view. There are three Principal impediments to the identification of problems and the formulation of policies for energy conservation in commerce. First, energy consumption in the commercial sector is difficult to quantify because commercial buildings differ in structure, in use, and in the internal systems which make them function. Second, in the Roseburg urban area there is insufficient data on the history, efficiency and outlook for energy use in this sector. Without such information, it is difficult to determine what can or should be done to improve conservation. Third, there is substantial disagreement over what methods or programs would be effective in saving energy in the commercial sector and to what extent state and local government should be setting policies and creating programs to achieve greater energy conservation in this sector. It is generally agreed, though, that not enough is known about commercial consumption and waste for such policy and program initiatives to go forward intelligently.

The Oregon Department of Energy has conducted some cursory surveys of commercial energy use and has drawn some generalized conclusions about this sector.

It is estimated that approximately ten percent of the urban area's energy supply is consumed by commercial business. Office buildings account for only a small portion of commercial energy use. Service buildings such as hotels, medical facilities and cultural structures account for 43 percent, while retail and wholesale buildings consume almost half at 49 percent.

The commercial sector is similar to the residential sector (see following section on Residential Sector) in energy consumption and potential available energy savings. The differences, of commercial buildings to residential units, is that the commercial buildings typically have limited building usage, and a potential to overheat; which means heating a building while not occupied, higher lighting levels, and a higher density of human occupation. Energy use in a commercial building depends on its size and the particular activities that take place. The largest portion of commercial energy is
consumed by lighting, 30 percent; followed by space heating, 21 percent; air conditioning and ventilation, 18 percent; refrigeration, 16 percent; and water heating, 14 percent. Estimates in breakdown of energy used by function differ greatly.

Like residential units, existing commercial buildings can be weatherized, while future buildings, in some instances, can be solar oriented. It has been estimated as much as 43 percent energy savings is possible through conservation in the commercial sector. The American Institute of Architects states that improvements in building operations can save 30-50 percent of the operating energy in existing buildings and 50-80 percent in new buildings. The older commercial buildings in Roseburg's downtown have the advantage of attached walls, which increases insulation and decreases outside wall exposure.

The following is a list of energy saving considerations specifically aimed at commercial establishments:

1. Increase the use of sunshades, both interior and exterior;
2. Use reflective or heat-absorbent glass;
3. Locate structures to minimize "heat-loading" (30% heating or cooling load reduction can occur through proper orientation);
4. Increase structural mass and use highly insulative materials;
5. Increase plantings;

As in the construction or repair of new homes, greater attention must be given to the "lifecycle cost" of commercial buildings so that the end use and operating efficiency maximize the concept of energy conservation.

A successful commercial energy program whether at the local, state, or national level, will depend upon involvement by the commercial sector. Significant energy reduction could take place with combined efforts by business operators and owners. Through education programs, including advertising, workshops, individual consultation, and appliance labeling, the commercial sector could begin to realize the problem of lack of energy and the need to conserve. By implementing incentive programs, which would
make the conservational adjustment easier and more profitable, the business sector could check their rising retail prices and keep their percentage of profit. Example programs include: government low interest loans or direct grants, utility bank loan, tax credits, investment tax credits and accelerated depreciation. A significant impact could be made by the commercial sector in the overall total energy use in the Roseburg urban area.

Residential Sector

Residential energy consumption is assumed to be significantly less than the sectors previously discussed. Current estimates suggest that no more than twenty percent of total energy consumption is attributed to the residential sector. Chart E-3 illustrates how energy is used by the average household (this section only deals with in-home energy use; actually, about 56 percent of a household's total energy consumption is attributed to operation of the private automobile).

As can be seen in Chart E-3, over 60 percent of a typical household's energy consumption is for space heating. In some homes as much as 80 percent of the household energy budget goes for space heating. The amount of energy required for space heating depends to a large extent on how well a house is insulated, the temperature setting of the thermostat, the size of the house, and to a lesser extent, the number of household members. Tables E-3 and E-4 show estimates of the amount of energy by fuel type needed to heat typical new and existing homes in the urban area.
PERSONAL CONSUMPTION WAS 45% OF TOTAL DIRECT ENERGY USED. 100 MILLION BTU'S PER CAPITA

SOURCE: ODOE, COMMUNITY ENERGY PLANNING

TABLE E-3
AVERAGE ANNUAL ENERGY REQUIRED FOR SPACE HEATING NEW UNITS
(Constructed Since 1975)

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>Typical New</th>
<th>Typical New</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Family</td>
<td>Apartment</td>
</tr>
<tr>
<td></td>
<td>Btu's (million)</td>
<td>Btu's (million)</td>
</tr>
<tr>
<td>Fuel Oil #2</td>
<td>860 gal. 119.4</td>
<td>340 gal. 47.2</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1,015 therms 101.5</td>
<td>400 therms 40.0</td>
</tr>
<tr>
<td>Electricity</td>
<td>14,700 kwh 50.2</td>
<td>5,800 kwh 19.8</td>
</tr>
</tbody>
</table>
TABLE E-4  
AVERAGE ANNUAL ENERGY REQUIRED FOR SPACE HEATING EXISTING UNITS  
(Constructed Prior to 1975)

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Typical Existing3 Single Family</th>
<th>Typical Existing2 Apartment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Btu's (mil-lion)</td>
<td>Btu's (mil-lion)</td>
</tr>
<tr>
<td>Fuel Oil #2</td>
<td>1,000 gal. 138.8</td>
<td>409 gal. 56.8</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1,180 therms 118.0</td>
<td>483 therms 48.3</td>
</tr>
<tr>
<td>Electricity</td>
<td>17,070 kwh 58.3</td>
<td>7,000 kwh 23.9</td>
</tr>
</tbody>
</table>

NOTE:  
1. 1700 square feet, three bedroom average.  
2. 700 square feet, 1 1/2 bedroom average.  
3. 1300 square feet, three bedroom average.

SOURCE:  
Energy consumption and efficiencies were based on field survey data from PP & L, NW Natural Gas, and the Oil Heat Institute. These numbers were verified in *Energy Consumption in the Pacific NW*, 1971, Washington State Environmental Research Center (1974).

Energy use efficiency (right hand column) tells us how much heat is actually derived from fuel delivered to a house. For example, for each British thermal unit (Btu) of natural gas delivered, 53 percent is wasted while less than half (47 percent) is converted to heat energy. In practice, natural gas heaters are considered to be the most efficient of all traditional forms of space heating. While the "end use efficiency" of electricity is high, a large amount of energy is lost in thermal generating plants and in transmitting electricity to the home.

Tables E-3 and E-4 show that a typical new home is larger (1700 vs. 1300 square feet) than typical older houses but requires significantly less energy to heat. This difference can be attributed to differences in insulation levels in older homes. Houses built prior to 1950 have either no insulation or only loose filled insulation that has since settled and now offers little or no protection. Between 1950 and 1975 houses were built with somewhat better insulation than previously, with up to two inches of insulation in the walls and four inches in ceilings. In April, 1975, the Oregon State Building Code was
revised to require three inches in walls and six inches in ceilings for all new construction. The result is a family living in a typical Post-1975 house will use about 34 percent less energy per square foot than the same family living in a house of equal size built prior to 1975. Obviously, improved insulation of older homes can produce a significant reduction in energy consumption.

Housing data from the 1970 U.S. Census, plus records of the City Building Department reveal that about 45 percent of the homes in Roseburg were constructed prior to 1950 and 43 percent were constructed between 1950 and 1975. Table E-5 provides a breakdown of Roseburg's housing stock by age.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>NUMBER</td>
<td>1564</td>
<td>1230</td>
<td>1463</td>
<td>814</td>
<td>434</td>
<td>725</td>
</tr>
<tr>
<td>PERCENT</td>
<td>25</td>
<td>20</td>
<td>23</td>
<td>13</td>
<td>7</td>
<td>12</td>
</tr>
</tbody>
</table>


Space heating in Roseburg area houses is provided by three basic energy sources: natural gas, electricity, and stove oil. In 1970 these three basic energy forms were used in Roseburg homes in nearly equal proportions. There is no information readily available to show what percentage of the current housing stock now uses gas or electricity for space heating compared to the percentage using stove oil. However, in recent years there has been marked trend away from oil. It is estimated that about 40 percent of all new dwelling units constructed in the Roseburg urban area use natural gas for space heating. This compares to a statewide average of 60 percent natural gas use in new homes.

In 1970, about two percent of the area's homes relied on wood or wood waste products as the primary heating fuel. Information on current use of wood fuel is not available; however, it is known that its consumption for residential space heating has increased dramatically during the last few years. It is likely that as the cost of traditional
energy sources increases, more families will turn to wood for some or all of their heating needs. Indeed, the long-term prospects for wood as fuel appear good in the Roseburg area. Chart E-4 illustrates the declining percentage of Oregon households which use petroleum (stove oil) for space heating.

Water heating consumes approximately 16 percent of the energy used in the residential sector. The amount of energy used to heat water is directly related to the number of people in the household. An average household uses about 50 gallons of hot water each day. Of that amount approximately half is for showers and baths, 29 percent for washing clothes, 12 percent for dishwashing and ten percent for kitchen and washbasin tap uses.

Table E-6 lists appliances commonly found in Roseburg urban area households and the energy requirements of each. Appliance usage in apartments is somewhat below that of single family use because there are fewer people in apartment households.

Almost all of the appliances listed in Table E-6 use electricity. The only significant exceptions are gas ranges and clothes dryers. In the future only 5 percent of all new ranges are expected to be gas fired while few, if any, gas dryers will be delivered.* A typical single family household would use approximately 4.1 million Btu's annually cooking with an electric range. The same household would use over 11 million Btu's cooking with a gas range.* Until recently the pilot light in most gas stoves burned continuously, consuming about six million Btu's annually. Today, new stoves are equipped with electric starters in place of pilot lights.

*SOURCE: Northwest Natural Gas Company
CHART E-4
CHANGING COMPOSITION OF ENERGY CONSUMPTION IN THE RESIDENTIAL SECTOR IN OREGON

### TABLE E-6
ANNUAL ENERGY USED FOR TYPICAL APPLIANCES

<table>
<thead>
<tr>
<th>Appliance Type</th>
<th>Single Family</th>
<th>Apartment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million Kwh/Yr</td>
<td>Million Kwh/Yr</td>
</tr>
<tr>
<td>Refrigerator (frost free)</td>
<td>1,600</td>
<td>1,400</td>
</tr>
<tr>
<td>Range (electric)</td>
<td>1,200</td>
<td>1,100</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>300</td>
<td>---</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>100</td>
<td>---</td>
</tr>
<tr>
<td>Clothes Dryer</td>
<td>1,000</td>
<td>---</td>
</tr>
<tr>
<td>Color TV</td>
<td>500</td>
<td>450</td>
</tr>
<tr>
<td>Other Miscellaneous</td>
<td>700</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clock</td>
<td>(12)</td>
<td>(12)</td>
</tr>
<tr>
<td>Coffee Maker</td>
<td>(144)</td>
<td>(110)</td>
</tr>
<tr>
<td>Food Blender</td>
<td>(12)</td>
<td>(5)</td>
</tr>
<tr>
<td>Hair Dryer</td>
<td>(24)</td>
<td>(20)</td>
</tr>
<tr>
<td>Iron</td>
<td>(156)</td>
<td>(110)</td>
</tr>
<tr>
<td>Radio</td>
<td>(84)</td>
<td>(60)</td>
</tr>
<tr>
<td>Toaster</td>
<td>(20)</td>
<td>(15)</td>
</tr>
<tr>
<td>Vacuum Cleaner</td>
<td>(72)</td>
<td>(45)</td>
</tr>
<tr>
<td>Sewing Machine</td>
<td>(12)</td>
<td>(8)</td>
</tr>
<tr>
<td>Other</td>
<td>(164)</td>
<td>(115)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>5,400</strong></td>
<td><strong>3,450</strong></td>
</tr>
</tbody>
</table>

**SOURCE:** Oregon Department of Energy, Fourth Annual Report.

As noted above, lighting accounts for only two percent of a typical household energy budget. The average single family household uses about three million Btu’s per year for lighting (900 kwh). An average apartment will use slightly less energy for lighting.

Two recent factors are acting to reduce energy consumption in the residential sector. Oregon's Uniform Building Code has been recently revised to require additional insulation and other energy conserving features for new residential and commercial buildings. These features will act to reduce heat losses and thereby reduce the energy consumed for space heating. In addition, both Pacific Power and Light Company (PP&L) and California-Pacific (CP) are providing, free of charge, energy conservation
assistance to their customers who use natural gas or electricity for space heating. These individuals can receive an energy audit of their home or building showing how their energy needs for space heating can be reduced. These services are also available to industrial consumers of these fuel forms. PP&L and CP energy conservation specialists also encourage the use of energy conserving features in the design of new residential and commercial buildings through the advice they provide to local builders and designers.

The total amount of energy consumed by the residential sector will almost certainly increase in the future, as the construction of nearly 10,000 new housing units in the Roseburg urban area is anticipated over the next 20 years. Even if all of these new units utilized the most cost-effective methods of energy conservation that are available, the total amount of energy consumed by this sector will increase. However, the amount of energy consumed by each residential unit is quite likely to decrease as a result of the conservation measures discussed in the following section of this element.

As the price of imported electricity, natural gas and fuel oil continues to rise, residential users will have greater economic incentives to use less of these fuels. The State Building Code changes that were mentioned earlier will act to build in energy conservation features in all new units, assuming that the provisions of the code are followed correctly.
RESIDENTIAL ENERGY CONSERVATION

As noted in the preceding section, space heating is the single greatest user of energy in the home, sometimes using as much as 80 percent of the household energy budget. The chief reasons for this are inadequate insulation, heat loss through windows and doors, and housing designs which do not utilize the sun as a source of heat. Because the Pacific Northwest has always enjoyed very low electrical rates, many older homes were built with no insulation whatsoever. The dollar savings were not enough of an incentive to encourage installation of insulation. Since the State made major revisions to the Uniform Building Code in 1975, all new housing must have insulation, but the requirements are minimal and the Code says nothing about solar utilization or heat loss through windows and doors.

Generally, it is the renter or homeowner who is unnecessarily carrying the burden of poor housing design by paying excessive bills for heating and cooling. This situation does not need to exist. Certain cooperative actions on the part of the City, local community developers, and the area’s residents can not only cut individual energy bills, but can reduce local dependence on outside sources of energy.

Existing Housing

Older homes present different problems from newly-constructed ones. Many of them were built in a time when no thought was given to energy conservation. To remedy this, some local governments in Oregon are applying performance standards to the sale of a house. Before a house can be sold it must meet certain heat loss standards. The seller must provide evidence that the house conforms to a list of weatherization standards, or the seller may show by calculations that the house meets a certain minimum heat loss requirement. Additionally, local government can provide public education and consulting programs for homeowners who wish to weatherize their homes.
The continuing rise in energy costs will force future homeowners to weatherize beyond current state requirements. This retrofitting will be expensive since the most cost effective way to weatherize is during construction.

One approach toward community residential energy savings has been taken by the City of Eugene, Oregon, in cooperation with the Eugene Water and Electric Board (EWEB), a publicly owned utility. The City has adopted a set of "Energy Efficient Building Standards." These standards are not made mandatory by the City of Eugene, but rather are strongly encouraged by EWEB. EWEB provides free inspection of houses at several times during construction to ensure that buildings conform to the standards and issues a special certificate when construction is completed. Although the voluntary standards do contribute to initial construction cost, such certified houses are in high demand by energy conscious home buyers. The house design advocated by EWEB is similar to the "Arkansas House" which has recently gained much publicity nationwide.

The basic idea behind the design of these houses is to conserve fuel by minimizing heat loss. An average 1250 square foot conservation house currently costs about $2,000 more to build but cuts fuel costs as much as 80 percent over houses of similar size and style built to the existing state code. The typical heating season is reduced to about three months. Other advantages of the conservation type construction are that summer cooling need is eliminated and the building method can use up to 1500 board feet less lumber than conventional designs. Once these houses gain broader acceptance, labor costs should also decline.

The principal design features which create the conservation effect include:

1. Approximately twice as much insulation (in floors, ceilings, and walls).
2. Approximately 45 percent less glass area.
3. Double glazing on windows.
4. Outside air infiltration reduced 60 percent.
Solar Utilization

One of the most serious obstacles to the utilization of solar energy for heating is design that does not pay proper attention to the possibilities of good solar orientation. It should be emphasized that solar orientation techniques are not the same as conservation, and in fact solar orientation is only effective if the building already has insulation, storm windows and doors, and weather stripping to prevent heat loss.

Often lot layout and lot shape prevent proper orientation of buildings. Large areas of wall and window are forced to face west and east where they cannot take advantage of winter sun and get too much summer sun. In other cases, buildings shade each other in winter.

Where the lot layout and buildings are designed together, buildings, lots and streets can be coordinated so that each building gets optimum solar orientation. Solar orientation can provide the homeowner with a free source of winter heat and is obviously important to those people considering investing in special solar utilization systems. As the price of conventional fuels rises and solar technology develops and becomes more available, it is likely that a site with good solar utilization potential will be significantly more valuable than other sites.

Where lots are planned before buildings are designed or where future improvements may drastically change the shadows cast, it is important that provisions be made to guarantee that the designer or future owner can anticipate what will happen to his view of the sun. Some cities have adopted ordinances, or amended their zoning ordinances, to permit acquisition of "airspace easements" so that a property owner can protect his right to use the sun for heating.

Following are some principles of solar orientation:

1. The largest wall and window areas should face north and south rather than east and west. The south side of a building at 40 latitude receives three times as much winter sun as the east or west sides.
2. To benefit most from this sunlight/heat, major living area (such as living room and kitchen) should be where the large south-facing windows are.

3. A large thermal mass located where the winter sun will shine on it provides heat storage within the house, so the sun's heat can be used even after the sun has set, and tends to moderate day/night temperature swings.

4. Shading should be provided to prevent overheating in summer. It can be in the form of shade trees (deciduous if on the south side of the house) or eaves with a sufficient overhang to block the summer sun.

5. Windows on other sides of the house should be kept to a minimum. Particularly on the west side, windows should be eliminated or provided with adequate shading so the late afternoon summer sun won't overheat the house.

**Landscaping**

Generally an airspace easement contains provisions concerned with landscaping to protect a homeowner from having the sun blocked by trees. But landscaping can have positive benefits for energy savings. Although this discussion deals specifically with homes, these ideas apply to all buildings.

An especially beneficial effect of trees is their thermal performance. In winter they can act as windbreaks and reduce heat loss from buildings. In summer the surfaces of grass and leaves absorb radiation, provide generous shade, and create cooling by evaporation processes.

To achieve efficient shading, trees need to be placed strategically. This is why pre-planning of lot layout is important. For example, with the sun at a low altitude in the morning and late afternoon, trees give their best performance if located on the southeast, southwest or west sides of a home. Because the mid-day sun is high, trees placed due south will cast a shadow close to themselves. Direct south side shading of a home can be more effectively accomplished with an overhanging eave.
While shade is valuable in summer, sunlight is more welcome in winter. Therefore, trees located on the south, southeast or southwest sides of a home should be the type that shed their leaves in winter. The white oak, for example, provides a large densely shaded area in summer and has an open-branched structure in winter which does not significantly impede the sun. It is also a native tree to this area. Often a prospective development site already has many large white oaks. Strategic location of houses among the trees can assure adequate summer shading while also providing access to winter sun.

Besides their aesthetic and shade-giving properties, properly placed trees can cause diversions in air flow which can be utilized beneficially. Windbreaks divert air currents upward creating an area of relative calm on the leeward side and thereby lessening the home’s heating need. Calculations indicate that the heating load on a house with a 20 mph wind is about 2.4 times as great as with a 5 mph wind.

**Setback Requirements**

Requiring that energy conservation be made a consideration in developments might also encourage greater flexibility in the way houses are situated on lots and the way land is used in a neighborhood. Since much of the buildable land in the Roseburg area is located on prime agricultural soil which should be conserved, and since property values are high, it is important that all outdoor spaces be used to their fullest advantage.

Historically, setbacks for front and side yards have been such that the lot would provide ample space for the house. With today's trend toward smaller lots this often means that a house sitting in the middle of a lot has little usable yard space. Front yards and side yards especially are underused land space.

The zero lot-line house is an example of eliminating one side yard in order to gain one larger side yard. It combines the desirability of the detached single family house with improved utilization of the site for outdoor space. Historically, the use of zero lot-line residences has been limited to planned developments or PUD'S.
Clustering of houses near lot lines is another way of providing more usable space in a neighborhood. It can have the additional advantages of saving energy and money because of reduced road and utility runs, and providing more opportunity to preserve the natural features of the site.

These energy and land efficient concepts have several benefits. They provide for higher densities and smaller lot sizes while still allowing for open spaces. Because lot sizes are small, per unit land costs are kept low. The greatest benefits, however, arise from the potential energy savings. The most obvious is that energy conservation requires orientation of houses in order to respond to solar radiation utilization and wind protection. It should be emphasized that south facing windows receiving full winter sun provide the only form of direct solar space heating which can compete favorably with electricity at this time. Flexibility in site planning is necessary for this, and rigid setback requirements do not normally provide this flexibility.

Residential Streets

Much energy is consumed in construction, use, and maintenance of residential streets. Unnecessarily wide streets consume land that could be placed in other, more productive uses. The City Subdivision Ordinance currently provides for street widths generally 34 to 40 feet wide, but does allow a minimum width of 28 feet within a 50-foot right-of-way in special situations. Although some energy conservation could result from the construction and maintenance of narrower streets, these widths have been deemed the narrowest that proper function will allow. Although the 28-foot width could be reduced in PUD areas or other unique situations where parking and vehicle density could be controlled, the net energy conserved should be carefully weighed against function, site conditions, and long-term use projections. More realistic energy benefits could be achieved by careful planning and design of street layout to reach the most efficient combination of narrow cul-de-sac and sub-collector streets with the wider collector and arterial streets.
RENEWABLE ENERGY RESOURCES

There are various renewable energy resources which, if used, could stem the increasing consumption of conventional energy forms. Although consumption of these resources can not be expected to completely replace conventional fuels, they can fulfill a portion of future energy demand, especially in applications requiring low grade energy or special land uses. This final section of the Energy Conservation Element examines potential renewable energy resources which may or may not be available in the Roseburg urban area. Much of the information contained in this section is the result of research by the Douglas County Planning Department. However, to better understand the potential for the various forms of renewable energy use in the urban area, a brief discussion of some basic principals is required.

Conventional energy forms (electricity, petroleum, natural gas and coal) are in reality refined and stored solar energy (since the sun is the ultimate source of all energy on earth), which we refer to as high grade energy forms. These high grade energy forms are often consumed for work that could be adequately accomplished with low grade energy (renewable resources), but due to their convenience, relative historic low price and the cost of converting equipment, fuel and work are often mismatched. The greatest energy waste occurs by mismatching a high grade energy form to a low grade use. An example: Energy is wasted when petroleum is fired to produce steam for electricity and the electricity is in turn consumed for space heating. Efficiency loss in this example accrues first as the conventional fuel is fired (loss is approximately 65 percent); and secondly during electrical transmission.*

*Nearly 80 percent of the electricity generated from coal fired power plants in Wyoming is lost in transmission before it reaches Western Oregon.

The same space heating is accomplished by substituting low grade energy (e.g., solar, wood, geothermal) thereby freeing refined high grade energy for applicable high grade uses.
Solar Energy

Solar energy is virtually unlimited in supply and poses few environmental problems. It is especially effective as a small scale, on site, supplemental energy potential for heating and cooling.

A passive solar heating system integrated into a dwelling in the Roseburg area can supply 50 percent of the dwelling's annual space heating load. Active solar water heating systems designed for dwellings in the Roseburg area are capable of producing approximately 50 percent of the heat for domestic hot water use and can pay for itself in two to three years.*

A basic problem with using the sun as an energy source for space heating is the economical adaption of solar collectors to existing dwelling units. Solar design is easily and economically integrated into new construction but adaption and conversion of existing dwellings and their heating plants are more difficult and often not economical at present fuel prices. Secondly, not all existing dwellings are located to take advantage of the low winter sun. Existing dwellings located in the shadow of a hill, trees, or other buildings cannot use solar energy as a source of space and/or water heating.

The basic technology exists but the greatest obstacle to common use of solar heating and cooling in the Roseburg urban area lies within the engineering and economic refinements needed to increase efficiencies of heat storage systems and conversion of existing dwellings to solar systems.

*Conversation with Bruce Richey, solar builder and designer, by Douglas County Planning Department.

Geothermal

Data concerning geothermal potential is limited to test holes drilled in a few locations in Oregon and the recording of hot spring locations. This data extrapolated to the State of Oregon as a whole indicates high and low areas of geothermal potential.
Areas of high geothermal energy (temperature over 1500°C) are located along the High Cascade Range which transacts the eastern portion of Douglas County. Potential for energy production decreases rapidly west of the Cascades and only low temperature energy (less than 1000°C) will possibly be found if at all. The area of potential is located within U.S. National Forests which will possibly complicate development, especially in sensitive ecological areas.

Transmission of hot water from geothermal sources is feasible for distances of 100 km with approximately 3 percent energy loss dependent upon volume and market. Technology also exists for transmission of high temperature hot water for generation of electricity and use of the spent water for low grade uses over 100 km, with as little as 5 percent energy loss. This method is considered more economical than parallel transmission of electricity and hot water.

In summary, the potential for production of energy from geothermal resources in Douglas County is virtually unknown. The greatest temperatures are theoretically found in the unpopulated eastern portion of the County. Technology is available to transmit hot water over distance for electricity generation and low grade heating.

Low Head and Micro Hydro Power

Low head and "micro" hydro power generation are possible means of tapping energy from Douglas County's small streams on a small scale.

A theoretical low head hydroelectric study of Oregon's rivers and streams identifies only two Douglas County streams with generation potential. Each drainage basin was examined for potential without the need for reservoir storage on reaches (lengths) of rivers and streams with gross hydraulic heads ranging from 3 to 20 meters and capable of generating 200 kilowatts or greater.

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Of the 114 reaches studied in the Umpqua Basin, similar to the boundaries of Douglas County only two streams (Calapooya Creek and Elk Creek) passed the preliminary screening process. Screening process constraints included land use restrictions, i.e., wild and scenic rivers, parks, natural areas and/or archaeological sites. Displacement of existing major highways, railroads and energy or communication utilities were also considered. If relocation of any of these were required, then the reach was eliminated. Uniqueness of aquatic ecosystems was also included in the screening criteria--reaches with known habitats of salmonoids and/or endangered population of sturgeon were eliminated. Finally, screening criteria included distance from the nearest power lines and from the nearest towns.

Although this study is the first systematic, statewide study of low head generating potential in Oregon, it does not recognize unique opportunities for low head generation in Douglas County.

Micro hydro power production is best defined as generation of energy from small streams that have smaller volumes than that required for "low head" generation and therefore, produce less energy. Energy production from small scale developments are envisioned as supplemental-power for private use, although selling of surplus is a possibility. There are neither specific studies identifying potential sites in Douglas County nor specific requirements for micro hydro power but rules of thumb do exist. Hydro energy potential is a result of "head" and "flow" of a stream. Head is the distance (measured in feet) that water drops before it strikes a water turbine. Flow is the volume of water passing the water turbine site. The head and flow may vary inversely to each other with the same potential present at the turbine. Although there is no specific minimum for head or flow, generally a head of at least three feet is required for power production and a head of ten feet or less is probably uneconomical to develop.

Municipal Waste

Energy potential from the reclamation of metallic and non-metallic materials from municipal waste generated in Douglas County is presently unknown. There is also a
lack of information concerning material content of the waste, methods for economically sorting materials and marketing the materials.

The Douglas County Public Works Department is presently conducting a study of Douglas County's municipal wastes and the feasibility of material reclamation. Preliminary data indicates that approximately 50 percent of the waste is composed of paper and eight to ten percent is metal. Until more information is available for analysis, no conclusion can be drawn concerning this potential local energy source.

Forest Waste

Wood is probably Douglas County's most plentiful renewable energy resource, but a competing wood chip market, collection costs and transportation costs inhibit the use of wood as a common fuel. At present, the market for wood chips is very competitive, driving the value of forest residue up. Chip prices increase when the demand for lumber products decreases, thereby decreasing the quantity of forest residue available for use as a fuel.

Collection and transportation costs of forest residue are high, but quantifiable data indicating the feasibility of extraction for power production is still in the writing. Two feasibility studies for the Willamette National Forest are currently being undertaken and should shed more light on this subject in the near future.

Although these factors inhibit power production from forest residue, wood is still the largest single source of industrial energy in Oregon, supplying half of the forest products and paper industries demand.

Gasification of wood is another method of extracting energy from forest residue. This gas can be transported by pipelines, similar to natural gas or used directly for unique applications. Research is now under way by the N. W. Natural Gas Company to study the feasibility of gasifying wood energy.
Wood can be gasified and directly used for unique application in stationary and vehicular internal combustion engines. In this process, gasification occurs within a few feet of the engine, thereby eliminating storage of the gas. This type of system is technically possible for vehicles, especially those used for heavy hauling.

The simplest form of energy extraction is by the consumption of cord wood, which is an increasingly more common practice in the Roseburg area, and throughout the state for that matter. It is, however, very difficult to estimate the amount of cord wood being consumed in the urban area. There are several reasons for this:
1. There is no single distributor of wood supply;
2. The suppliers service other communities besides Roseburg; and,
3. There is an incalculable amount of wood obtained by the user.

Although there are no statistics to reflect actual wood heat use in the Roseburg area, information from other cities in Western Oregon suggests that the sale of wood stoves has quadrupled in the past few years. It can be assumed that wood, in most cases, is a secondary residential heat source, backing up the primary sources of electricity, natural gas and oil.

The continued increase in wood use could result in air pollution problems due to inefficient wood stoves. Wood stoves must burn efficiently in order to limit particulate matter released into the atmosphere. Stricter controls may be required to ensure stove efficiency and safety. Proper installation and maintenance are necessary to avoid flue and chimney fires.

Wind

Quantifiable data for wind power specific to the Roseburg area is non-existent. General indicators, however, do show that power production from wind in some areas of Douglas County may be possible. These areas will most often be found where the topography concentrates air flow, projects air flow sharply upward or is on the leeward side of a smooth flat surface. Douglas County's many valleys, ridge tops, and its length
of coast line are logical wind turbine sites. Siting techniques include measuring the velocity of the wind by instruments, but more general widespread information is obtained by noting the wind's effect on trees. Both are systematic methods useful for site specific and general data collection.

Power generated from wind is a function of wind speed, diameter of the rotor disc and air density. Wind speed is the main factor for siting a turbine since the available power varies with the cube of the wind speed. For example; a change in wind speed from 9 to 10 mph increases available power by 30 percent. Average annual wind speeds greater than 12 mph are needed for economical electricity generation. Wind speeds in Douglas County are greatest along the High Cascade ridge and along the coastline. As noted in the Natural Resources Element, Roseburg experiences an average hourly wind speed of five miles per hour, with winds of less than three miles per hour occurring from 30 percent of the time in July to 80 percent of the time in November.

Summary

The City of Roseburg can control or influence a variety of decisions affecting energy production and consumption through its various official activities and powers. Government agencies have in the past tended to focus their energy conservation efforts on programs which achieve short term energy savings. While programs such as requiring increased residential insulation and providing weatherization incentives do attain significant energy savings within a short time period, energy conservation efforts should not be limited to only short term programs. Significant energy savings can be achieved in the future by developing a program of energy conscious land use planning implemented at the local level. While significant energy savings may not be immediately apparent, such savings will increase as time goes on. Energy conscious land use planning can have a direct positive impact on future energy use.

The need for energy conscious land use planning in the Roseburg urban area becomes apparent when examining the forms of energy predominately used. Petroleum products, natural gas and electricity, all of which require large capital investments to be
produced and distributed, have been the forms of energy the urban area has become dependent upon. Uncertainty concerning availability and price, coupled with increasing demand from every sector makes conservation essential.
FINDINGS

1. At the present time there is insufficient information relating to patterns of energy use, conservation, and alternative energy sources in the Roseburg urban area to conduct a comprehensive energy study; however, such a comprehensive study could provide the City with the impetus to develop effective energy policy tailored to the specific characteristics and needs of the urban area.

2. The types of energy (energy forms) used in the Roseburg urban area are either produced locally or imported from outside the region. Imported energy forms include petroleum products, natural gas and electricity. Local energy forms include wood products, solar energy, and human activity (bicycle riding, walking, etc.).

3. At the present time wood products are the most widely used local energy form; providing energy for residential space heating, industrial processing and on-site electrical generation.

4. Solar power is readily available in most parts of the Roseburg urban area for space and water heating; however, an on-site investigation of each location is needed to determine the amount of solar energy which is actually available for use.

5. At the present time, manufactured solar systems are not cost competitive with conventional energy forms, but this relationship should change due to the increasing cost of conventional energy forms.

6. Human activity such as walking and bicycle riding can reduce the demand for energy otherwise required for transportation.

7. At this present time, petroleum provides by far the largest portion of the urban area’s total energy needs. If demand for petroleum continues to increase as it
has in recent years, there will probably be shortages of supply and increasing costs.

8. Natural gas is supplied to the Roseburg urban area by California Pacific National. Residential users consume 65 percent of the natural gas used in the urban area while commercial uses consume about 35 percent. There are no reported "industrial" consumers of natural gas in Roseburg.

9. Like petroleum, natural gas supplies and costs are subject to influences beyond the control of the local area and may Well experience changes which are not beneficial to urban area gas users.

10. Electricity is the most commonly used energy form in the Roseburg urban area for all purposes except transportation. Within the urbanized area electricity is supplied by Pacific Power & Light Company. Much of the rural area outside the urban area is served by Douglas Electric Cooperative.

11. The amount of electricity consumed in the urban area is increasing, primarily due to population growth. During the past 10 years PP&L has experienced an annual growth rate of 4.5 percent in its Roseburg District. The company projects the growth rate in electrical use to level off at around four percent in the near future.

12. More energy is consumed for transportation purposes than for any other use in the urban area. Virtually all of this energy comes from petroleum. The amount of energy consumed for transportation has been projected to significantly increase in the future as the estimated number of average weekday vehicle trips in the Roseburg urban area is expected to increase by about 70 percent over the next 20 years.

13. The curtailment of energy consumption in the transportation sector can be most effective at the local level by developing land use patterns Which encourage and facilitate the use of more energy efficient transportation modes such as public transit, bicycle riding and walking.
14. The urban area's economy is largely resource-based. Resource-based industries, such as the wood products industry, are typically large consumers of energy relative to the value added to the manufactured product and the number of persons employed. This factor will continue to keep the urban area heavily dependent on imported energy sources unless there is a shift to local renewable energy sources.

15. It is estimated that approximately 10 percent of the urban area's energy supply is consumed by commercial business. Office buildings consume a very small portion of the total, while service buildings such as hotels, medical facilities and cultural centers account for 43 percent and retail and wholesale buildings consume about 49 percent of the energy used in the commercial sector.

16. Like residential units, existing commercial buildings can be weatherized, while future buildings, in some instances, can be solar oriented. It has been estimated that as much as 43 percent energy savings is possible through conservation in the commercial sector.

17. The residential sector currently consumes about 20 percent of the energy used in the Roseburg urban area (not including energy used by the private automobile). The majority of a typical household's energy consumption is for space heating. In some homes space heating consumes as much as 80 percent of the household energy budget.

18. The single-most important factor determining the amount of energy required to heat a house is how well it is insulated. Older houses require significantly more energy for space heating than do newer houses because of the differences in the amount and type of insulation used.

19. Space heating in Roseburg area houses is provided by three basic energy sources: natural gas, electricity, and stove oil. In 1970 these three basic energy
forms were used in Roseburg homes in nearly equal proportion, but since 1970 there has been a dramatic shift away from oil.

20. As the price of imported electricity, natural gas and fuel oil continues to rise, residential users will have greater economic incentives to convert to alternate energy sources, improve the energy efficiency of their homes and in general consume less energy.

21. Historically low energy costs in the Northwest have provided a disincentive to construct energy efficient homes. Houses built prior to 1950 have little or no insulation while houses built between 1950 and 1975 usually have no more than two inches of insulation.

22. Houses constructed since 1975 have been built to insulation specifications contained in the Oregon State Building Code and on the average consume about 34 percent less energy for space heating than houses built prior to 1975. Improved insulation of the existing older housing stock can produce a significant reduction in energy consumption.

23. About 88 percent of Roseburg's existing housing stock was constructed prior to the adoption of stringent insulation standards in 1975. These older homes, if not properly insulated, could be wasting as much as twenty-two percent of the residential energy consumed in the urban area.

24. Solar orientation of buildings can contribute significantly to space heating needs. As the price of conventional fuels rises and solar technology develops and becomes more available, it is likely that a site with good solar utilization potential will be significantly more valuable than other sites.

25. Residential developments which utilize cluster development or zero lot line concepts tend to be more energy efficient than traditional subdivisions. In addition, they provide for smaller lot sizes while still maintaining open space.
26. Much energy is consumed in construction, use and maintenance of subdivision design and street patterns could accomplish some reduction in the present and future energy costs of residential development.

27. A passive solar heating system integrated into a dwelling in the Roseburg area can supply up to 50 percent of the dwelling's annual space heating requirements. Solar design is easily and economically integrated into new construction, but adaptation and conversion of existing dwellings is more difficult and often not economical at present fuel prices.

28. The potential for production of geothermal resources in Douglas County is virtually unknown. Areas of high geothermal energy are located along the High Cascade Range in eastern Douglas County. There are no known geothermal resources in the Roseburg urban area.

29. Low head and "micro" hydro power generation are possible means of tapping energy from Douglas County's streams on a small scale; however, findings from the limited studies thus far conducted suggest very little actual potential from this source.

30. Energy potential from the reclamation of municipal waste generated in the urban area is presently unknown.

31. Wood is probably Douglas County's most plentiful renewable energy resource, and is the largest single source of industrial energy in Oregon, supplying half of the forest products and paper industries' demand.

32. The simplest form of energy extraction from wood is through the burning of cord wood, which is an increasingly more common practice in the Roseburg area. It is very difficult to estimate the amount of cord wood being consumed, but it is estimated that the sale of wood burning stoves has quadrupled in the past few years.
33. The continued increase in wood use could result in air pollution problems due to inefficient wood stoves. Stricter controls may be required to ensure wood stove efficiency and safety.

34. Quantifiable data for wind power potential in the Roseburg area is non-existent; however, it is known that Roseburg has an average hourly wind speed of only three to five miles per hour. Average annual wind speeds greater than 12 miles per hour are needed for economical electricity generation.
ASSUMPTIONS

1. The cost of energy imported into the Roseburg urban area will continue to increase.

2. The amount of energy consumed in the urban area will continue to increase due to future population growth, but the per capita consumption of energy may decrease due to stronger conservation measures.

3. The resource-based industries found in the urban area will continue to be heavily dependent on increasingly expensive imported energy unless there is a significant shift to local renewable energy sources.

4. Rising energy cost will be an incentive to improve the energy efficiency of the urban area's existing older housing stock and will encourage future houses to be built to higher insulation and weatherization standards than are presently in effect.

5. Building sites with good solar utilization potential will become increasingly in demand as conventional energy costs increase and the utilization of solar heating systems becomes more economical.

6. Locally generated electricity from such resources as hydro, geothermal and wind may not significantly contribute to the area's future electrical needs.

7. Significant energy savings can be achieved in the future by developing a program of energy conscious land use planning implemented at the local level.
GOALS, OBJECTIVES AND POLICY STATEMENTS
FOR ENERGY CONSERVATION

Goal

To maximize the conservation and efficient utilization of both Renewable and non-renewable energy within the framework of sound I and use and economic principles.

Objectives

1. Encourage the minimization of energy consumption in determining the placement, density and design of all urban area land uses.

2. Encourage the utilization of renewable energy sources in order to conserve energy resources.

3. Support energy conservation efforts that are being undertaken by the public and private sectors.

4. Support efforts to increase public awareness of energy conservation issues and of methods to effectively utilize solar energy and other renewable energy supplies.

5. Promote the recovery and reuse of nonrenewable resources as an energy conservation measure.

6. Facilitate the use of solar energy and other decentralized energy sources.

Policies

1. The City of Roseburg shall undertake the development of a detailed urban area Energy Study with the active participation of local citizens in order to address local energy issues in greater depth than can be accomplished in the
Comprehensive Plan. The Energy Study, when adopted by the City, will be considered as part of the Comprehensive Plan and shall:

a. Establish the current demand and projected energy demand for the various sectors of the economy in the Roseburg urban area.

b. Inventory the current supply sources of energy for the urban area, include projected sources, renewable and nonrenewable, centralized and decentralized, and the price projections for each source.

c. Coordinate the development of a uniform reporting system to be used by the various energy suppliers in the urban area in order to generate an ongoing, accurate data base for energy planning.

d. Examine the potential economic impacts to urban area residents resulting from projected energy demand, supply and price.

e. Determine the impact of current land use policies and actions on energy use and reaffirm or point out needed adjustments to land use policies and regulations.

f. Research revisions to regulations which would have a positive effect on the use of renewable, decentralized energy sources, such as solar energy.

g. Research land use patterns which would facilitate the use of centralized, small-scale energy generation and storage in residential, commercial, industrial and mixed use applications.

2. The City shall incorporate into its land use ordinance provisions which encourage new development to utilize density and location, in balance with the requirements of other planning policies, in order to reduce the need to travel, increase access to transit, and permit building configurations which increase the efficiency of space heating in residences.

3. The City will encourage development that takes advantage of natural conditions such as microclimate, and use renewable energy supplies such as solar energy to minimize nonrenewable energy consumption.

4. As an energy conservation measure, the City will encourage the infilling of vacant land.
5. The City will encourage and support the development of a resource recovery program as an energy conservation measure.

6. The City will support efforts to develop industries that have a relatively high potential for utilizing renewable energy sources or waste heat.

7. When practical, the City will take the lead in demonstrating and implementing the cost-effective use of renewable and decentralized energy sources such as solar space and water heating systems, and the selection and use of energy efficient vehicles.

8. The City will continue to encourage cooperation and communication between citizens, utilities and local, state and federal agencies concerning energy-related issues.

The City will encourage efforts at the state level which promote energy conservation, such as in the statewide building code, utilize renewable sources of energy, and develop equitable energy allocation systems.