Section 2: Alternatives Analysis

2.1 Introduction

Various alternatives for energy technologies and geographic coverage were considered while the scope of the EIS was being developed. The Technology Alternative analysis determined the types of energy production facilities to be covered in depth by the EIS. Therefore, the Technology Alternatives analysis narrowed the scope of the EIS to eliminate certain energy uses from further study. Energy production alternatives were omitted from further analysis if they were not likely to be developed within the County or if they were likely to have significant, adverse impacts that could not be mitigated. The Technology Alternatives are discussed in detail below.

The size of the Energy Overlay was initially considered for the entirety of Klickitat County and then narrowed through the Geographic Alternative Analysis based on location of infrastructure, energy resources (such as wind), and particularly environmentally sensitive areas. The Energy Technology and Geographic Alternative analyses are discussed in detail below.

The Energy Technology and Geographic Alternatives were assessed through a preliminary alternatives analysis to focus the efforts and narrow the scope early in the EIS. Areas within the Overlay were then studied in more depth throughout the EIS. During this study, the EIS considered whether other areas should be excluded from the Overlay. Areas less likely to meet the criteria for inclusion in the Overlay were identified and eliminated during the preliminary alternatives analysis in order to simplify and focus the EIS analyses.

After narrowing the energy technology and geographic scope of the EIS in this section, Procedural Alternatives were developed. These alternatives are more fully described in Section 2.4 below. These include Procedural Alternative 1 – which allows energy development outside the Overlay through the County's existing Conditional Use process, and Procedural Alternative 2 – which excludes energy development outside the Overlay. The No-Action Alternative is also carried through the entire EIS.

2.2 Technology: Summary of Alternative Technologies Considered and Those Eliminated from Detailed Evaluation

One goal of the EIS is to encourage development of energy facilities that are consistent with existing land uses in Klickitat County. For example, wind generation farms are typically compatible with the use of land for ranching. Large, coal-fired plants have negative impacts on air quality that can affect valuable timberlands and view sheds. Development goals and aesthetic values are more difficult to quantify. Hence, technologies were eliminated from further consideration when a preponderance of the energy development goals could not be met. Goals and criteria for energy development in the County are summarized below:

- Resources and transmission infrastructure currently exist within Klickitat County
- Does not significantly impact current and planned land use
- Does not have a significant impact on air quality/visibility
- Does not require significant work force from outside Klickitat County

- Does not significantly increase truck or rail traffic within the County outside of existing corridors
- Environmental impacts less difficult to mitigate. Unlikely to be sited within the county.

All reasonable forms of commercial energy generation technologies were initially considered for inclusion in the Overlay ordinance. The technologies considered are summarized on Graphic 2-1.

Graphic 2-1. Summary of Energy Technologies Considered in Alternatives Analysis

Energy Technology	Description
Cogeneration Biomass Fired	Combust waste wood to generate steam to run turbines for electrical generation; excess steam used for industrial processes (e.g., wood drying kilns)
Cogeneration – Natural/biogas Gas Fired	Combust natural gas or biogas to generate steam to run turbines for electrical generation; excess steam used for industrial processes (e.g., wood drying kilns)
Geothermal	Use natural geothermal heated water or steam to drive turbines for electrical generation
Hydroelectric	Use water power from dam or channel to turn electrical generators
Nuclear	Use heat from fission of radioactive materials to generate steam for electrical generation turbines
Solar – Photovoltaic	Large arrays of photovoltaic cells to convert light directly to electrical energy
Solar – Thermal	Large arrays of mirrors to concentrate light energy to generate steam to turn electrical generation turbines
Thermal – Biomass Fired	Combust wood or other plant material to generate steam for electrical generation turbines
Thermal – Coal Fired	Combust coal to generate steam for electrical generation turbines
Thermal – Diesel Fired	Combust diesel fuel to generate steam for electrical generation turbines, or in internal combustion engines to turn generators
Thermal - Landfill/Biogas Fired	Combust landfill or sludge digester gas to generate steam for electrical generation turbines
Thermal – Natural Gas Fired	Combust natural gas to generate steam for electrical generation turbines
Wind Turbine	Single or multiple wind-powered generators using various designs

To provide background on what realistically may be developed in the County, energy generation projects recently permitted or currently being permitted in Washington and Oregon are summarized in Table 2-1.

Table 2-2 is a matrix that summarizes the results of screening technologies for further assessment in the EIS. The energy technology screening uses feasibility, availability of infrastructure, and compatibility with land use development goals as a basis for screening technologies to be included in the proposed Overlay. Based on this screening, the following Technology Alternatives will be carried through the full EIS analysis:

- Cogeneration - Biomass Fired
- Cogeneration – Natural/Biogas Gas Fired
- Solar - Photovoltaic
- Thermal - Biomass Fired
- Thermal - Landfill/Biogas Fired
- Thermal – Natural Gas Fired
- Wind Turbine

These technologies were selected because construction and permitting appear feasible, infrastructure necessary to support the technology exists in the proposed Overlay, and because the technologies are consistent with County Development goals, such as having minimal impacts to land use, air quality, exiting workforce, transportation, and habitat. The following technologies were eliminated from the scope of the EIS and proposed overlay for the reasons given:

- Geothermal technologies were excluded because sufficient geothermal resources are not known to exist in the county, and because geothermal may impact land use because geothermal resources are rare.
- Hydroelectric energy generation was excluded because permitting may not be currently feasible, infrastructure may not be available near water power resources, and significant land use impacts from new reservoirs would be expected.
- Nuclear power generation was excluded because permitting may not be currently feasible. Impacts to land use would be anticipated due to the buffers typically required, transportation impacts from fuel and waste transportation is anticipated, and because of potential impacts to habitat.
- Coal fired thermal power generation was excluded because of potential impacts to air quality, transportation impacts due to movement of fuel and ash, and potential habitat impacts from storing fuel and ash.
- Solar thermal plants were excluded because of feasibility (commercial scale solar thermal plants are still very experimental), and low temperatures in winter which could limit thermal resources.

For much of the EIS impacts analysis, cogeneration and thermal power can be combined because the impacts are very similar. Likewise, biogas fired thermal plants have similar impacts to natural gas fired plants and can be combined. Biomass plants are treated separately

because the fuel source has different impacts to land use and air quality. The following definitions are used in the EIS in discussions of impacts from these combined energy technologies:

Thermal Power Plants – includes natural gas and biogas fired power plants, both electrical and cogeneration

Biomass Power Plants – includes all technologies that use solid fuels at the site (e.g., wood chips or vegetation), both electrical and cogeneration.

A mix of electricity generation technologies could potentially be sited in Klickitat County. The following sections describe the generation technologies that appear most likely to be developed within the County based on the current status of technologies, their costs, and their siting requirements. For each technology, a description is provided of how the technology operates and a brief summary of its typical key environmental impacts. This section also includes a brief summary of a number of other current energy generation technologies that seem less likely to be sited in the County, and an explanation of why they are less likely to be developed here. Chapter 3 describes the environmental effects of each energy generation technology in more detail.

2.2.1 Gas-Fired Generation

In recent years, the majority of new electricity generation in the western United States has been natural-gas fired, for a number of reasons, including the relatively low initial costs to develop gas generation, the availability and price of natural gas, and the low air emissions and other environmental impacts compared to some other thermal generation types such as coal. The western United States is served by a network of high-pressure natural gas pipelines that transport natural gas from gas fields in Alberta and Wyoming to the Pacific Northwest states and on to California and the southwest. A 26-inch-diameter high-pressure natural gas pipeline owned by Williams Gas Pipeline runs from east to west along the length of Klickitat County, connecting supplies in the Rocky Mountain States and Canada with western Washington and Oregon.

Combustion turbines (CTs) produce electricity by compressing air at high pressure into a combustor. In the combustor, fuel is added to the air and burned, releasing heat energy and producing a high-temperature, high-pressure exhaust gas. This gas is expanded through a turbine, which powers a generator and the compressor. Natural gas or distillate oils can be used in combustion turbines, although for modern utility use, natural gas, because of its currently low cost, is the fuel of choice.

In some cases, the waste heat from the fossil –fuel-based generation is used to support industrial processes that require heat or steam—for example food processing. This use of the waste heat is called “cogeneration,” and several of the projects shown in Table 2-1 are cogeneration projects. Such projects typically are found where there is an existing major industrial use with a substantial need for heat or steam for an industrial process, such as pulp-and-paper manufacturing or potato-processing.

2.2.2 Wind Energy

Commercial wind energy generation has grown rapidly in the United States as the cost of electricity from utility-scale wind systems has dropped by more than 80 percent during the last 20 years. In the early 1980s, when the first utility-scale wind turbines were installed, wind-

generated electricity cost as much as 30 cents per kilowatt-hour (kWh). Now, state-of-the-art wind power plants, at excellent sites, are generating electricity at well below 5 cents/kWh. Costs are continuing to decline as more and larger plants are built and advanced technology is introduced. As a result, the amount of installed wind energy capacity in the United States has grown from 10 megawatts (MW) in 1981 to more than 4,000 MW in 2001.

Currently, commercial wind generation turbines are in the range of 660 kilowatt (kW) (0.66 MW) to 2 MW, and the trend in recent years has been toward larger turbines. Commercial scale turbines generally have hub heights of 150 to 300 feet and rotor diameters of 150 to 250 feet. Newer turbines may be even larger. In commercial-scale projects, groups of turbines are linked in strings of 2 to 50 turbines, typically perpendicular to the prevailing wind and, where possible, along ridges or higher elevation points where wind speeds are higher. Turbines typically are spaced 1.5 to 3 rotor-diameters (i.e. 225 to 750 feet) apart within the string, and, to minimize the "wake effect" of one turbine on down-wind turbines, turbine strings typically are set at least 10 rotor diameters apart. Access roads that run the length of each turbine string are used to construct the wind turbines and to provide access for maintenance.

Turbines typically generate power at low voltages (e.g., 9.5 kV), and pad-mount transformers at each turbine step up power to a higher voltage (e.g., 34.5 kV). Energy from each turbine is collected by underground electric collector cables (often at 34.5 kV), with one cable collecting electricity from several turbines in one string. Sometimes some of the collector cables are above ground on wooden poles—especially if steep and narrow canyons must be crossed. Typically, a project substation collects power from multiple strings and steps up power to transmission voltage (typically 115 kV or 230 kV). From the project substation, electricity is delivered to the regional power grid over 115- or 230-kV transmission lines (the length of transmission depending on how close the project is to existing transmission lines with available transmission capacity).

Development of this energy is dependent on making good siting decisions. Like other energy projects, wind energy requires preliminary site investigation before an actual siting decision is made. Developers typically invest significant time studying on-site wind resources before making final decisions on a project location. This type of investigatory work often involves the use of equipment such as meteorological towers, which measure wind speed, and typically have minimal environmental impacts. Generally, it is after this preliminary work is complete that permits are applied for.

2.2.3 Biomass

Biomass can be described as solar energy stored in biological organisms or material that can be burned or converted to fuel to generate electricity. Examples include:

- Fast growing trees and grasses, such as hybrid poplars
- Agricultural products or residues, such as corn, rice straw, wheat straw, or used vegetable oils
- Wood waste, such as sawdust and tree prunings, paper trash, and yard clippings
- Organic matter in solid waste
- Wastewater solids.

The energy value of organic material can be converted to electricity through a variety of means, including the following:

- At the Roosevelt Landfill methane gas that is created through the decomposition of organic matter in the landfill waste is collected and used to fuel generators.
- At the SDS Lumber's cogeneration facility in Bingen, Washington, wood waste from forestry operations is the fuel source for a steam turbine to generate electricity.
- At several locations in the Midwest, corn and other agricultural products are used to create ethanol, which is used to generate electricity.
- At dairy farms, cow manure is composted to generate biogas (a mixture of methane and other gases), which is used to generate electricity.

The technologies employed for biomass are varied, but generally include the following elements:

- Biomass production, harvesting, collection, and transportation. This can be the cultivation of a crop, such as corn, or the collection of wastes from another process, such as gathering wood waste from logging and milling operations
- Conversion to fuel at a manufacturing plant (for example, as corn is converted to ethanol), in a landfill (as waste is composted and turned into methane), in a digester, or burned in a boiler. The technologies include a variety of thermal and thermo-chemical processes for converting biomass by combustion, gasification, and liquefaction, and the microbial conversion of bio mass to obtain gaseous and liquid fuels by fermentative methods (Bio Mass Energy Research Association: http://www.bera1.org/).
- Electricity generation by burning fuel to operate a combustion turbine or internal combustion engine. If the waste heat can be captured and used, the project becomes a cogeneration project. Frequently the generation occurs at or near the site where biomass is converted to fuel, but that is not always the case (for example, methane from landfills can be transported short distances by pipeline to another location where it is burned to generate electricity).

Biomass facilities tend to have smaller generation capacities than CT and combined-cycle combustion turbine (CCCT) installations. Biomass facilities require a substation and transmission line if the power is used offsite, but sometimes the power is used onsite. Depending on the generation capacity, a new transmission line may be needed.

In the Pacific Northwest, by far the most common current use of biomass is for cogeneration of electricity at forest products operations.

2.2.4 Solar Energy

Solar generation is the renewable technology that most directly draws on the energy of the sun. There are several types of solar electric plants. Photovoltaic (PV) technology directly converts sunlight to electricity. Solar thermal technology converts light into heat to drive a shaft or turbine to generate electricity. If electricity is to be generated, PV technology is the most likely to be developed in the Pacific Northwest. Therefore, in order to simplify the scope of this EIS

analysis, solar thermal energy will not be considered. Solar thermal systems are likely to have similar land area requirements as PV facilities, but they also require water resources.

PV systems use the sun's energy to make electricity by using photons to create an electrical potential across solid state collectors. A PV cell is the basic building block, which can be connected to form a module, and modules can be interconnected to form arrays or panels. A 1-kW system typically requires 100 to 200 square feet of area, depending on the type of PV module. Data indicate that a 1-kW (1,000 watts) PV solar installation in Klickitat County can be expected to produce 1,500 to 1,600 kWh per year. As there are 8,760 hours in a year, the average output would be about 200 watts, or 20 percent of the installation's capacity, usually referred to as the annual capacity factor.

A complete system usually includes one or more modules, an electrical inverter to change the electricity from direct current (DC) to alternating current (AC), and equipment to connect to the building's electrical system and the electric utility.

Energy Northwest's White Bluffs Solar Station demonstrates that PV technology can be used for commercial-scale electricity generation. It should be noted, however, that PV electricity generation is expensive and is not competitive with other forms of large-scale power generation. If coupled with other energy efficiency efforts at the end-use level, PV systems may offer cost-effective solutions.

A current emphasis in PV development is to build integrated facilities (e.g., roof panels) that serve as both the roof and as a PV resource (as opposed to PV panels laid over an existing roof).

2.2.5 Ethanol

Ethanol is a type of biomass in which an agricultural crop or agricultural residue is converted to ethanol, which then is used to generate electricity (or to power vehicles). The economic viability of large-scale ethanol production may depend on federal energy policy. Ethanol is a substitute for methyl tert-butyl ether (MTBE), a gasoline additive that lowers emissions but has been found to be a groundwater pollutant. Ethanol can act as a substitute in oxygenated fuels.

It is generally thought that ethanol plants would be built to serve the gasoline market, not the electricity generation market. However, an ethanol plant would be an excellent host for a cogeneration project and could use the waste heat in the ethanol- making process.

An ethanol plant would need a good transportation infrastructure system for bringing in the feedstock (e.g., corn, and wheat) and transporting the ethanol to market. Klickitat County sites along the Columbia River could provide barge, rail, and truck access.

The current potential Pacific Northwest ethanol market is estimated at about 220 million gallons annually. A 100 million gallon-per-year project is being proposed on the lower Columbia River at Port Westward, Columbia County, Oregon. This project would have an electrical load of 10 to 20 MW.

If such a facility were proposed in Klickitat County, it would not be treated as an electricity generation facility, except to the extent it incorporated cogeneration.

2.2.6 Diesel

Internal combustion engines with generators in the size range of 0.5 to 2 MW can be used to generate electricity using natural gas, fuel oil, or biodiesel oil. They are relatively fuel inefficient and expensive to operate.

When wholesale power market prices reached unprecedented levels in 2000 and 2001, a number of diesel engine installations were developed because they could be acquired relatively quickly, installed, permitted on a temporary basis, and brought online for use during times of peak power prices.

After power prices returned to levels more consistent with historical levels, the cost of power from these installations became uneconomical, and the projects were either taken out or mothballed. To the extent possible, owners are selling the equipment.

Regulatory mechanisms are under development with the intent of preventing wholesale power market prices from reaching the same extreme levels. New diesel engine-based generation is not likely unless development of other forms of generation comes to a standstill, and the wholesale market once again experiences extreme prices.

2.2.7 Hydroelectricity

There are limited opportunities for hydroelectric development in Klickitat County. Condit Dam, with its 15-MW powerhouse on the White Salmon River, is undergoing a FERC relicensing process and the owner, PacifiCorp, is proposing to remove the dam. If PacifiCorp succeeds in this effort, it is unlikely that any new hydroelectric development on the White Salmon River could be successfully licensed, particularly as portions of the White Salmon River are designated as a Wild and Scenic River. If PacifiCorp fails to remove the dam, the dam and power generation would remain in place as a permitted use.

The other river of consequence in Klickitat County is the Klickitat River, which has been investigated for hydroelectric development in the past. It is designated a Wild and Scenic River from the town of Pitt to its confluence with the Columbia River. As a result of the Wild and Scenic River designations, further hydroelectric development in Klickitat County is unlikely.

2.2.8 Nuclear

Typical nuclear reactors use mildly enriched uranium to create energy through nuclear fission. Typically, the uranium is formed into pellets with approximately the same diameter as a dime and a length of an inch or so. The pellets are arranged into long rods, and the rods are collected together into bundles. The bundles are typically submerged in water inside a pressure vessel. The water acts as a coolant. In order for the reactor to work, the submerged bundle must be slightly supercritical. In other words, if left alone, the uranium would eventually overheat and melt.

To prevent this, control rods made of a material that absorbs neutrons are inserted into the bundle using a mechanism that can raise or lower the control rods. Raising and lowering the control rods allow operators to control the rate of the nuclear reaction. When an operator wants the uranium core to produce more heat, the rods are raised out of the uranium bundle. To create less heat, the rods are lowered into the uranium bundle. The rods can also be lowered

completely into the uranium bundle to shut the reactor down in the case of an accident or to change the fuel.

The uranium bundle is an extremely high-energy source of heat. It heats the water to produce steam. The steam drives a steam turbine, which turns a generator to produce electrical power. In some reactors, the steam from the reactor goes through a secondary, intermediate heat exchanger to convert another loop of water to steam, which drives the turbine. The advantage to this design is that the radioactive water/steam never contacts the turbine. In new generation reactors, the coolant fluid in contact with the reactor core is gas (carbon dioxide) or liquid metal (sodium, potassium); these types of reactors allow the core to be operated at higher temperatures. Other than the reactor itself, there is very little difference between a nuclear power plant and a coal-fired or oil-fired power plant except for the source of the heat used to create steam.

Nuclear power produces waste in the form of spent uranium rods and thermal pollution from cooling water. There is currently no national facility for nuclear waste disposal, although one has been proposed. The core of the reactor facility itself becomes radioactive over time and at the end of its useful life, it must be disposed of as radioactive waste.

Because of the low demand for new nuclear power development and complexity of permitting and analysis of impacts, nuclear power was excluded from the Overlay and EIS impact assessment.

2.2.9 Alternative Fuels

Combustion of alternative fuels produces different levels of emissions. Without specific design data, it is difficult to estimate emissions and impacts to compare the impacts associated with CTs or hog fuel (wood-chip-fired) boilers. However, readily available emission factors can be used to estimate uncontrolled emissions for a 248-MW power plant fueled by alternative fuels. This analysis is presented in Section 3.2.3.2.

New power plants that use alternative fuels would be subject to the same permitting requirements described in Section 3.2, including the following:

- Notice of Construction (NOC) application
- Best Available Control Technology (BACT) analysis
- A demonstration of compliance with the ambient air quality standards (AAQSs) and acceptable source impact levels (ASILs)
- Compliance with applicable new source performance standards (NSPSs)
- Possible evaluation of cumulative impacts, visibility degradation in the Columbia Gorge National Scenic Area, and acid deposition in Class I areas through the SEPA process.

Noise impacts associated with alternative fuels will be similar to those described in Section 3.3.4.2. Noise impacts would be mitigated with standard control practices and methods.

2.3 Geography: Summary of Areas Considered and Eliminated from Detailed Examination and Description of Proposed Boundaries of Energy Overlay

Klickitat County covers approximately 1,900 square miles, with approximately 85 miles bordering the Columbia River along the southern portion of the County. Terrain ranges from exposed bedrock "scab lands" exposed by the Missoula Floods along the Columbia River to the south, to rolling hills, farmland and ranches in the interior, and timberlands to the north. Most of the larger towns, infrastructure, and roadways are located in the southern portion of the County.

Developing an Energy Overlay that covers the variety of habitat and range of development present in the County would be too complex and far-reaching to be useful. Hence, the following factors were considered in setting the boundaries of Overlay to focus the analysis efforts:

- Available energy resources, such as wind energy, natural gas pipelines, and power transmission lines
- High concentrations of special habits, such as avian migratory corridors, which would be adversely impacted by energy development
- Existing roads, water resources, and other infrastructures likely to be necessary for energy development.

2.3.1 Wind Energy Resources

This section identifies and assesses areas within the Klickitat County Energy Overlay Zone that have the potential for wind energy development. The assessment is based on recently updated wind maps and other available wind data. A complete discussion of the typical process developers would follow to collect wind data to further characterize and evaluate the commercial potential of wind energy at a particular site is Provided in Appendix A. This detailed description of the wind resource assessment process provides an understanding of the kinds of data wind energy project developers use to characterize a site for project development.

2.3.1.1 Description of Wind Power Density and Wind Power Classes

The best indicator of the wind resource in any particular area is determined by calculating the wind power density (WPD) based on available wind speed data. To calculate WPD, an annual average of the wind speed data for a specific location is determined along with other climatological factors.

Wind Power Class Determination

Annual averaged wind speed data are evaluated by characterizing the wind speed and WPD into wind power classes—the higher the class, the higher the wind energy potential. These classes are based on the annual WPD for a specific location. Class 1 and 2 areas are unsuitable for development because of low mean winds. Class 3 areas are marginal for development. Generally, Class 4 areas or higher are considered favorable for most wind power projects. These sites are suitable for development using turbines mounted with the rotating hub of the turbine located at least 50 meters above the ground (referred to as hub height).

Graphic 2-2 shows the wind power class ranges for wind speed measurements at 10 meters above ground and 50 meters above ground. The shaded rows of the table indicate classes that are favorable for development.

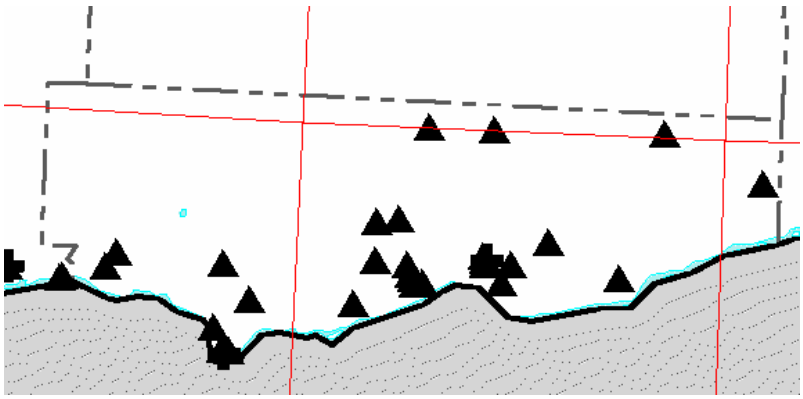
Graphic 2-2. Wind Power Classification

	10 meters (33 feet)		50 meters (164 feet)	
Wind Power Class	**Wind Power Density (watts/m^2)**	**Wind Speed meters/second (mph)**	**Wind Power Density (watts/m^2)**	**Wind Speed meters/second (mph)**
1	≤ 100	≤ 4.4 (9.8)	≤ 200	≤ 5.6 (12.5)
2	≤ 150	≤ 5.1 (11.5)	≤ 300	≤ 6.4 (14.3)
3	≤ 200	≤ 5.6 (12.5)	≤ 400	≤ 7.0 (15.7)
4	≤ 250	≤ 6.0 (13.4)	≤ 500	≤ 7.5 (16.8)
5	≤ 300	≤ 6.4 (14.3)	≤ 600	≤ 8.0 (17.9)
6	≤ 400	≤ 7.0 (15.7)	≤ 800	≤ 8.8 (19.7)
7	≤ 1000	≤ 9.4 (21.1)	≤ 2000	≤ 11.9 (26.6)

(a) Note: Shaded classes are favorable for wind power development.
m^2 = meter squared.
mph = miles per hour.

2.3.1.2 Analysis of NW SEED Wind Resource Map for Klickitat County

This section summarizes existing information about the wind resource in Klickitat County, based on the NW SEED map and associated data. An analysis of existing data helps identify the locations for field measurement that would provide the most useful additional information to form the basis for a definitive wind resource assessment of the Overlay zone's wind resources. Graphic 2-3 shows the location of non-proprietary data available in Klickitat County for validation of the model.



Graphic 2-3 Non-Proprietary Data Validation Locations in Klickitat County.

As can be seen in Graphic 2-3, the non-proprietary validation points are clustered in certain areas of Klickitat County. Data validation (see Appendix A) indicates a high confidence level in estimates in the southern part of the county along the Columbia River Gorge. This conclusion was confirmed during a telephone conversation on 17 July 2002 with Dr. Mark Schwartz of NREL, one of the principals to validate the map. Fewer validation points are located in the

northern part of the County. Areas such as High Prairie in the west and the plateaus above Alder, Stegman, and Douty Canyons to the east are under-represented with validation points, and thus these estimates have a somewhat lower confidence level

Estimates may be questionable along north-south- and northwest-southeast-oriented ridges on the western border of Klickitat County. The NW SEED map indicates an excellent wind resource in this area. Even though the wind resource is likely to be excellent at well-exposed locations, the terrain is complex and the roughness varies from meadows to heavy tree cover. Additionally, the area's possibility of rime (white) icing could reduce wind plant output by 1 to 3 percent. Rime icing can be expected in the winter at most locations above 2,000 feet in Klickitat County. Typically wind turbines are shut down during ice accumulation conditions.

Other meteorological data sets may be available At least two such sites are located in the Klickitat County Energy Overlay Zone: 1) a 10-meter-tall meteorological station operated by the Columbia Aluminum Plant near Goldendale, Washington; and 2) a 10-meter-tall meteorological station operated at Klickitat County's Roosevelt Landfill. These data sets may be useful in determining the viability of certain nearby areas for potential wind resource development.

2.3.1.3 Energy Output Estimates

Klickitat County is fortunate because a high-quality, long-term database is available at the Goodnoe Hills site in the Columbia Hills near Goldendale, Washington. This site has been in operation continuously since 1980. Other long-term sites in the vicinity are the Seven Mile Hill site (since 1978) east of The Dalles, Oregon and the Jump-Off Joe site (since 1978) south of Kennewick, Washington.

The findings about wind energy potential described earlier in this section identify only general areas on the NW SEED wind map coverage of Klickitat County that merit additional evaluation. Additional site-specific meteorological studies may be needed to better characterize the local winds.

Data from SEED True Wind Solutions MesoMap wind energy maps were used to evaluate areas of potential wind energy for the EIS. The maps estimate wind power, which is a function of wind speed and time. The MesoMap system simulates the wind speed and direction over the region on a 400-meter grid at multiple heights (e.g., 40, 60 and 80 meters) above ground level. The results of the simulations are collected and processed into wind roses, speed frequency distributions, and color-coded maps of mean wind speed.

Figure 2-1 shows the SEED wind energy potential within the County. A criterion of 250 or greater watts per square meter wind power density (Class 4 or higher) was used to identify areas of potential wind development. The areas that meet this criterion are included in the geographic area consideration because the resources are readily available. Some areas of the County with sufficient wind power were excluded for other reasons, such as being inside the CRGNSA or in areas that lack nearby transmission lines or roads.

2.3.2 Infrastructure for Energy Development

Any power generation technology will require transmission over existing or planned high voltage transmission infrastructure within the County. Economic and environmental impact constraints limit the distance of connection to transmission lines to approximately 25 miles. Figure 2–1 shows the current transmission infrastructure within the County. The transmission lines are mostly present within the southern half of the County.

Natural gas-fired power plants require access to large-capacity gas pipelines for sufficient, reliable fuel supply. Typical gas-fired energy projects in the region were developed within about 15 miles or less of an existing gas pipeline source (however, several involved extending pipelines much further). For the purposes of the alternatives analysis, a 15-mile proximity to existing gas transmission pipelines was used as the criterion for geographic location of energy facilities that require a natural gas power source.

Current financial criteria for new natural gas-fired power plants indicate that a two-mile radius from existing gas pipelines is the maximum distance that is cost-efficient for construction. For natural gas-fired power plants under the Limited Geographic Alternative presented in the Final EIS, a two-mile proximity to existing gas transmission pipelines was used as a criterion for delineation.

Thermal power plants including natural gas and biomass-fired plants require water for cooling and steam generation when combined cycle turbines are used. Water demands depend on the type of system, water availability, and efficiency of the cooling systems. The Goldendale Energy project, which generates about 250 MW of power, requires about 780 acre-feet of water per year. Smaller, more efficient plants may use less water. For the purposes of this EIS, it is assumed a minimum reasonable water requirement for a thermal power plant is 500 acre-feet per year.

Energy facilities must develop infrastructure on site, including internal roads. Development projects in Klickitat County often use on-site aggregate where feasible and cost effective to address such on-site needs. If on-site aggregate were used, SEPA review would be included as part of the review for the project. Impacts would typically include concerns with drainage, erosion, and other impacts from disturbing the area. Appropriate mitigation may include reclamation and re-vegetation of the disturbed area, as well as including an analysis of impacts in technical reports and other analysis which address elements of the environment such as cultural resources and plant and wildlife impacts.

Roads, water supply, wastewater disposal, and other infrastructure are necessary for most energy development. Construction support facilities such as lodging, food sources, and local labor resources will also affect the viability and impact of energy development. By locating the Overlay within areas of existing development, the EIS seeks to encourage energy development projects that will not involve extensive major road building, pipeline construction, or other infrastructure improvements. Most road development, utilities, wastewater treatment facilities and other infrastructure are located near and between communities in the southern half of the County. If a project requires additional or enhanced infrastructure, this can be addressed on a project-by-project basis, as project impacts can be mitigated through SEPA and the County's development regulations.

2.3.3 Areas with Sensitive Habitat

Klickitat County hosts a variety of habitat types, including riparian zones along the Columbia River and other streams, rock cliffs, desert shrub-scrub, evergreen forest, and alpine areas. Habitats within urban and agricultural areas were also considered. To simplify the alternative analysis, broad habitat types were considered based on existing land use data. For the purposes of the preliminary Geographic Alternatives analysis, Kennedy/Jenks Consultants used existing land use maps and zoning information to group County land use into six major types: urban, industrial, rural, extensive agricultural, forest, and open space. Data on the presence of these land types in the County are from the following sources:

- Washington Department of Fish and Wildlife GAP land cover data
- Ecology lake polygons, general cartography, and county boundaries
- Washington Department of Transportation designated areas of national forests and recreational areas
- Washington State Geographic Information Council publicly owned land
- Cascade Planning Association Columbia Gorge Scenic Area boundaries
- The locations of airports or helipads throughout Klickitat County
- Klickitat County zoning maps.

Figure 2-2 shows the general land cover categories present in the County. These categories include areas with the following types of land cover:

Developed
Agriculture
Conifer Forest
Hardwood Forests
Mixed Forest
Non-Forested, Grasslands, Meadows, Cleared Lands
Lakes
Riparian
Rivers
Wetlands

Figure 2-3 depict general zoning categories present within the County. To simply the analysis and mapping, the County zoning categories were grouped based on density of development, like uses, and habitats. The following general categories include these associated County zoning types:

Urban: This category includes zoning with densities of one-half acre or less per lot. The County zoning (that allows residential uses/purposes) falling under this category are General Commercial (GC), Multi-family residential (R-3), Public, Residential (R), Rural Center (RC), Single Family Residential (R-1), Two-Family Residential (R-2), Suburban Residential (SR), and Tourist Commercial (TC).

Industrial: This category includes areas zoned General Industrial (GI) or Industrial Park (IP).

Rural: This category designates areas where General Rural (GR), Rural Residential (RR), or Rural (RRL) zoning is applied.

Extensive Agriculture: This corresponds to the County's Extensive Agriculture (EA) zone

Open Space: This corresponds to the County's Open Space (OS) zone.

Forest: corresponds to the County's Forest Resource (FR) zone.

These land use and zoning groups were used to help define the Geographic Alternatives. Criteria used for developing the Geographic Alternative include geographic continuity (i.e., proximity to each other) and use by species of concern (e.g., avian use for foraging and nesting). Compatibility with development, data availability, and existing management policies were also factors considered in screening habitat alternatives.

Additional protection was considered for areas of high biodiversity and habitats that support special status (state or federal rare, threatened, or endangered) species. According to Priority Habitat Land Use data, forested areas host higher concentrations of owl and other sensitive species habitats. Specific habitat location data are not provided in the EIS to protect location information. A full discussion of impacts to habitats, plants, and animals is provided in Section 3.4.

Based on this screening of the Alternatives, areas with high concentrations of forested habitats are recommended to be excluded from the geographic scope of the Overlay because forest habitats have:

- Higher potential for use by sensitive species and avian species likely to be impacted by wind turbines
- Greater geographic discontinuity (more dispersed) within the County and less similarity compared with agricultural, commercial, and range land.

2.3.4 Areas Under Other Government Agency Management

The Geographic Alternative also considers areas within the County that are managed by other governmental entities, including federal land (National Forest, Bureau of Land Management land, and military sites), state land (state forest and state parks), and tribal lands. As shown on Figure 2-2, much of the land area under other governmental management is located in the northern portion of the County. These include areas managed by the Gifford Pinchot National Forest and the Yakama Nation, as well as the Conboy Lake National Wildlife Refuge. The locations of the properties under other land use management agencies were considered in placing the proposed Overlay boundary to include the southern half of the County.

2.3.5 Limited Geographic Alternative

The Final EIS includes a second geographic alternative (Limited Geographic Alternative), which would limit natural gas-fired facilities to areas within the Overlay where there are sufficient existing water rights or certificates to provide a minimum of 500 acre-feet per year. This does not include water right claims, which could be more difficult to substantiate and transfer. A criterion for water availability in the Limited Geographic Alternative would be:

> Within one mile of a section that has at least one water right or certificate equal to or greater than 500 acre-feet per year. Adjacent sections or portions of the sections that have the water right would not be included if it crosses a WIRA boundary.

Due to current economic constraints of developing new natural gas-fired facilities, the Limited Geographic Alternative also limits development of natural gas-fired plants to areas within two miles of an existing gas pipeline. Areas in the western and northern ends of the Overlay with potentially adequate water sources were eliminated under the Limited Geographic Alternative due to the excessive distance to an existing pipeline.

The Limited Geographic Alternative also limits development of biomass-fueled plants to the White Salmon-Bingen area. In addition to the need for adequate water availability, two key criteria for any potential future development of biomass are:

- Locating near a forest products manufacturer or other source of significant quantities of waste wood & bio mass fuel.
- Locating near a plant that has a demand for a high-pressure steam in a manufacturing process).

The White Salmon-Bingen area meets these criteria. Figures 2-6A through 2-6E show the boundaries for technologies in the Overlay. Complete water right information is summarized on Figure 3-5. Under the Limited Geographic Alternative, wind and solar power development would be possible throughout the Overlay.

2.3.6 Summary of Proposed Boundaries of Energy Overlay

Based on the geographic factors of wind power availability, habitat types, and infrastructure, summarized on Figure 2-4, the Geographic Alternative includes the non-riparian corridors of the southern portion of the County. The Geographic Alternative would apply to all energy technologies evaluated in the EIS. The boundary of the proposed Geographic Alternative Overlay that will be carried through the impact analysis is shown on Figure 2-5.

The Limited Geographic Alternative limits gas-fired development to areas within the Overlay with at least 500 acre-feet of established water rights and within two miles of an existing gas pipeline. The Limited Geographic Alternative also limits biomass development to the White Salmon-Bingen area. Wind and solar facilities would be possible throughout the Overlay. Figures 2-6A through 2-6E show the boundaries of the Limited Geographic Alternative.

2.4 Procedural Alternatives

In addition to the Technology and Geographic Alternatives, this EIS considers two Procedural Alternatives related to how the Overlay would be implemented. The No Action Alternative is also carried through the EIS evaluation. The following sections describe the procedural and no action alternatives considered in the impacts analysis for the Energy Overlay. Briefly, these are:

- ***Procedural Alternative 1– Permitting within overlay, allowing development outside of Overlay through the conditional use process***. This alternative addresses an Overlay in which certain energy development within the overlay would be permitted outright and the County's existing Conditional Use process would be used to permit energy development outside the proposed Overlay. This process would include required reviews under SEPA throughout the County and special study and mitigation requirements within the Overlay.

- ***Procedural Alternative 2 – Permitting development within the Overlay, excluding energy development outside of the Overlay***. Under this alternative, the County would

incorporate an Overlay where energy development is permitted outright (with appropriate site-specific requirements), but would exclude energy development in areas located outside the boundaries of an Energy Overlay. This alternative has the benefit of minimizing significant, adverse environmental impacts outside an Overlay in areas containing a greater concentration of sensitive areas.

- ***No Action Alternative***. Currently, most energy projects are permitted through a Conditional Use permitting process. The EIS analyzes the disadvantages and advantages of retaining this current process.

Project review under existing SEPA regulations would still be required under all of the procedural alternatives above.

Through technology and geographic screening above, this EIS provides a preliminary screening that considers the types of energy development that could be covered by the Overlay and its geographic coverage. The preliminary screening focuses the EIS through the rest of the alternatives analysis without carrying through rejected technologies and land areas.

Permitting energy development within the overlay and allowing development through the Conditional Use Process (Procedural Alternative 1), adopting an overlay and excluding energy development outside the Overlay (Procedural Alternative 2), and the No Action Alternative of retaining the existing permitting structure were carried through the EIS as a baseline for assessing potential impacts. No Action in this case means not developing an Energy Overlay and allowing continued project-by-project planning and permitting under the existing permitting structure. These alternatives are described in detail below.

2.4.1 Procedural Alternative 1: Energy Overlay and Conditional Use (Uses within Overlay Permitted Outright; Uses without Permitted through Conditional Use Permit)

Procedural Alternative 1 addresses an Overlay where energy development is allowed outright within the Overlay and the Conditional Use permit process is used outside the Overlay. Development conducted in the County would still be subject to SEPA review and relevant local, state, and federal laws and regulations.

Conditional Use is defined as an activity specified by the Klickitat County Zoning Ordinance as a Conditional Use, permitted when authorized by the Board of Adjustment, and subject to reasonable conditions and/or restrictions which, when imposed, render the use compatible with the existing and potential uses in the vicinity which are permitted outright (amended 27 January 1986 Ordinance No. 0 012786).

Wind energy farms are more appropriately sited within ranch land and open space because of the need for unobstructed wind flow and large contiguous land areas. Areas zoned for Open Space (designated as Open Space on Figure 2-3), Extensive Agriculture (designated as Extensive Agriculture on Figure 2-3) and General Rural (designated as Rural on Figure 2-3), are most likely adaptable for wind and other energy development. The current land uses for these zones are described below.

- Open Space: Klickitat County has approximately 2.2 million acres zoned as Open Space; approximately 1.1 million acres would be within the proposed Overlay zone.

- Extensive Agriculture: Klickitat County has approximately 4.9 million acres zoned as Extensive Agriculture; approximately 4.5 million acres would be within the proposed Overlay zone.

- General Rural: Klickitat County has approximately 1.8 million acres zoned as General Rural; approximately 0.9 million acres would be within the proposed Overlay zone.

Areas zoned for Extensive Agriculture and General Rural include conditional uses for "utility facilities necessary for public service" and "buildings and uses of public works, public service, or public utility nature," respectively. These conditional uses include energy generation facilities.

2.4.2 Procedural Alternative 2: Exclusion of Energy Uses Outside Overlay

Procedural Alternative 2 would incorporate an Overlay and permit energy development within the Overlay outright, but would exclude energy development from areas located outside the boundaries of an Energy Overlay. Any proposed development within the Overlay would be required to complete the SEPA environmental review process and comply with local, state, and federal laws and regulations. Procedural Alternative 2 has the benefit of reducing significant, adverse environmental impacts outside an Overlay in areas containing a greater concentration of sensitive areas. However, the existing permitting structure does give the County the authority to deny projects under SEPA when significant, adverse environmental impacts cannot be mitigated. In addition, when a Conditional Use permit is required, projects can be denied if they cannot meet all Conditional Use criteria. The disadvantage of this alternative is that it may not achieve the County's goal to encourage energy development in optimal locations, because good locations exist for energy projects, depending on their size, precise location, and mitigation, outside an Overlay.

2.4.3 No-Action Alternative

The impacts and benefits of Comprehensive Plan and legislative amendments to plan for energy development will be compared to a No-Action Alternative of not amending the Comprehensive Plan. This No-Action Alternative of allowing energy development to occur in the County under existing land use regulations provides a baseline to assess the impacts of the Comprehensive Plan and legislative amendments (e.g., increased development, potentially less project review by stakeholders, and increased regulatory control on the County level) and benefits (planned land use, greater County-wide data, control for regional impacts). The No-Action Alternative will be carried through the detailed impacts analysis of this EIS. If the No-Action Alternative is chosen by the Board of County Commissioners as their preferred course of action, information contained in this EIS would be used as a resource for evaluating any future energy development projects.

2.5 Preferred Alternative

The FEIS includes a preferred alternative combining Procedural Alternative 1 with the Limited Geographic Alternative. The preferred alternative would allow wind, gas-fired, biomass, and solar energy development to be permitted outright within the Overlay subject to site-specific SEPA review and mitigation, and compliance with relevant local, state, and federal laws and regulations. Energy proposals outside the Overlay would be subject to the existing County conditional use process.

The Preferred Alternative restricts gas-fired proposals to areas within the Overlay that are within one mile of sections that have at least 500 acre-feet of established water rights and within two miles of an existing gas pipeline. Biomass facilities are limited to the White Salmon-Bingen area near sections with at least 500 acre-feet of established water rights. Wind and solar facilities could be sited anywhere within the Overlay (see Figures 2-6A through 2-6E).