APPENDIX B:

NATIONAL RENEWABLE ENERGY LABORATORY ESTIMATES OF WIND ENERGY RESOURCES ON BLM-ADMINISTERED LANDS

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The U.S. Department of the Interior's Bureau of Land Management (BLM) and the U.S. Department of Energy's (DOE's) National Renewable Energy Laboratory (NREL) have established a partnership to conduct assessments of wind energy on BLM-administered lands in the western United States. An initial assessment of renewable energy potential on BLM-administered lands was published in 2003 (BLM and DOE 2003). This assessment, which looked at an array of renewable resources, including wind, involved the application of various screening criteria to geographic information system (GIS) data for analysis and evaluation of the potential for renewable energy development.

This programmatic environmental impact statement (PEIS) evaluates the potential environmental and socioeconomic impacts associated with wind energy development on BLM-administered lands in 11 western states over the next 20 years (i.e., 2005 through 2025). To determine where potential development might occur on the basis of land status and wind energy resources, NREL constructed a maximum potential development scenario (MPDS) by using the same methodology that was employed for the 2003 renewable energy assessment. NREL used a different model, the Wind Deployment System (WinDS), to project the amount of wind power that might be generated over the next 20 years in the 11-state study area. The projection included an assessment of the potential wind power supply and demand. The WinDS model results were used to define the total number of acres of BLM-administered land that might be economically developable as well as potential economic impacts.

This appendix to the PEIS describes the methodologies NREL used to (1) construct the MPDS, and (2) project the amount of wind power generation over the next 20 years.

B.1 MAXIMUM POTENTIAL DEVELOPMENT SCENARIO

The MPDS was constructed by using the same general methodology that was employed for the 2003 renewable energy assessment. Wind resource data, GIS data, and general screening criteria were used to identify the spatial distribution of the maximum possible extent of future wind energy development activities that might occur on BLM-administered lands over the next 20 years. Maps depicting BLM-administered lands with low, medium, and high potential for wind energy development were constructed for each of the BLM Field Offices in the 11-state study area. These maps are provided at the end of this appendix and are arranged alphabetically by state. An index map showing the Field Office boundaries precedes the maps for each state. The PEIS team used these maps to assess (1) the distribution of BLM-administered lands on which wind energy development activities might be conducted, and (2) the total number of acres that might be impacted.

B.1.1 Wind Resources

The wind resource information used in this analysis was developed and validated by NREL with support from TrueWind Solutions, LLC (now AWS Truewind, LLC) and other wind energy meteorological consultants. The maps were produced from three regional data sets: (1) the Pacific Northwest (Washington, Oregon, Idaho, Montana, and Wyoming) data set produced in 2001 and 2002 at a 1,312-ft (400-m) spatial resolution, (2) the California data set produced in 2002 at a 656-ft (200-m) spatial resolution, and (3) the Southwest (Arizona, Colorado, Nevada, New Mexico, and Utah) data set produced in 2003 and 2004 at a 656-ft (200-m) spatial resolution. Because these data were developed regionally, inconsistencies may exist at regional borders. The regional GIS data can be downloaded from NREL (2004). More detailed information about the validation of the regional wind resource data sets can be obtained from Elliott and Schwartz (2002).

Wind resources are assigned to seven different power classes on the basis of their resource potential. Table B-1 lists the characteristics of each power class, and Figure B-1 shows the distribution of wind resources across the United States.

B.1.2 GIS Data

GIS-based land jurisdiction data identifying BLM-administered lands and Field Office boundaries were provided by the BLM's National Science and Technology Center. They were

TABLE B-1 Wind Power Classification

Wind Power Class	Resource Potential (Utility scale)	Wind Power Density (W/m^2) at 164 ft (50 m) above Ground Level	Wind Speed[a] (mph) at 164 ft (50 m) above Ground Level
1	Poor	0 – 200	0.0 – 12.5
2	Marginal	200 – 300	12.5 – 14.3
3	Moderate	300 – 400	14.3 – 15.7
4	Good	400 – 500	15.7 – 16.8
5	Excellent	500 – 600	16.8 – 17.9
6	Excellent	600 – 800	17.9 – 19.7
7	Excellent	> 800	> 19.7

[a] Mean wind speed is estimated by assuming a sea level elevation and a Weibull distribution of wind speeds with a shape factor (k) of 2.0. The actual mean wind speed may differ from the estimated values shown here by as much as 20%, depending on the actual wind speed distribution (or Weibull k value) and elevation above sea level.

Source: Elliott et al. (1987).

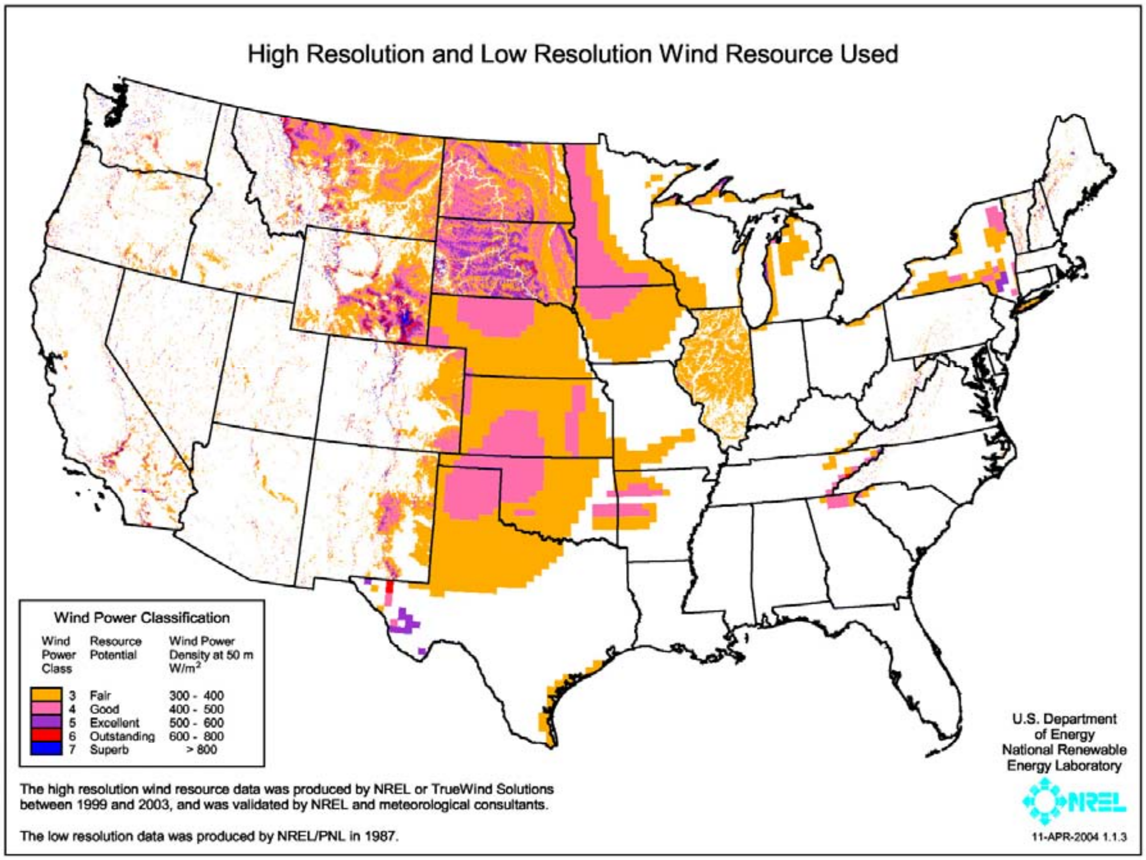

FIGURE B-1 Wind Resource Distribution Map

used to define the distribution of lands within the 11-state study area. In addition, GIS data depicting major cities and towns, major roads, and transmission lines were assembled as follows:

- *Major cities and towns*. The major cities and towns included on the maps were chosen to provide reference points throughout the mapped region. Population was one factor in choosing a city for display, but more important was the distribution across the region. These data were obtained from Environmental Systems Research Institute, Inc. (ESRI 2004).

- *Major roads.* The major roads included on the maps are state and federal highways. These data were also obtained from ESRI (2004).

- *Transmission lines.* The transmission line data included on the maps were extracted from POWERmap, ©2003 (Platts, Inc. 2004a), a national-level GIS data product marketed by Platts, Inc. The maps show all existing transmission lines present in the POWERmap data set, categorized by voltage. The data set has consistent coverage of lines that are 100 kV and higher throughout the 48 contiguous states. The lower-voltage lines that are covered in this data set are shown on the maps; many transmission lines that are less than 100 kV, however, are missing.

B.1.3 Screening Criteria

The assembled wind resource data and GIS data described above were compiled and screened to construct the MPDS. The screening criteria were used to find lands excluded from wind energy development by virtue of their status, classification, or some other administrative determination and to eliminate them from the MPDS. In addition, lands were screened on the basis of their wind resource classification.

B.1.3.1 Land Exclusions

The areas excluded from the maps are Wilderness Areas, Wilderness Study Areas, National Monuments, and National Conservation Areas. These data were provided by the BLM National Science and Technology Center. As part of the Wind Energy Development Program, the BLM is recommending the establishment of a policy by which right-of-way (ROW) grants will not be issued for lands where development would be incompatible with specific resource values (see Section 2.2.3.1). Although not all of these lands were excluded from the MPDS, in large part because such identification needs to occur at the Field Office level, these lands will be excluded from development.

B.1.3.2 Wind Resource Screening Criterion

BLM-administered lands were categorized into areas having a low, medium, or high potential for development over the next 20 years on the basis of their wind power classification. Lands categorized as having low potential fall in wind power Classes 1 and 2. Lands with a medium potential fall in wind power Class 3. Lands with a high potential fall in wind power Class 4 and higher. Wind resources in Class 4 and higher are generally considered to be economically developable with current technology. Class 3 wind resources are expected to become more economical when low-wind-speed turbines, which are currently in development, become available. In some areas, a Class 3 wind resource may be economical when current technology is used, depending on project-specific financing and incentives.

B.2 WinDS MODEL ANALYSES

The WinDS model is a multiregional, multi-time-period, GIS and linear programming model of capacity expansion in the U.S. electric sector. WinDS is designed to address the principal market issues related to the penetration of wind energy technologies into the electric sector. These principal market issues include access to transmission, the cost of transmission, and the intermittency of wind power. WinDS addresses these issues by implementing a highly discretized regional structure, explicitly accounting for the variability in wind output over time, and considering the requirements and costs of ancillary services. WinDS also can be used to examine the impact of various policy initiatives, such as federal and state renewable portfolio standards (RPSs) and production tax credits (PTCs), on future wind capacity.

In support of this PEIS, the WinDS model was used to project the amount of wind energy supply that might be economically developable over the 20-year study period (i.e., 2005 through 2025) in each of the 11 western states included in the scope of analysis. From this projection, the total number of potentially economically developable acres of BLM-administered lands was calculated. The WinDS model was also used to project the portion of total electricity demand that might be met by wind energy power. The model results were analyzed within the GIS to estimate the amount of supply in each state that might be developed on BLM-administered lands by looking at the land ownership distribution of the wind resource assigned in each region. The results of the WinDS model were used in the economic impact evaluation in Section 5.1.13.

B.2.1 Background

Several models exist that forecast capacity expansion in the U.S. electric sector. Many of these models were built to address the entire U.S. energy market, with its emphasis on fossil fuels and nuclear energy. Thus, although these models generally include the more prominent renewable energy technologies, their large scope and their focus on today's dominant conventional energy forms do not allow for a detailed treatment of the more important issues that pertain to wind energy technologies. For example, in many existing models, conventional energy technologies can be adequately captured by regionally disaggregating to the 13 North American Electric Reliability Council (NERC) regions and subregions. However, at this level of regional aggregation, the models cannot capture the transmission requirements that are unique to wind, because they assume that the resource is next to the load.

The WinDS model is designed to represent the most significant market issues pertaining to wind energy. These include issues related not only to the transmission but also to the intermittency impacts of wind on grid ancillary service requirements. By explicitly addressing these issues, WinDS is able to remove many of the constraints caused by large regions that the other models impose on wind energy.

B.2.2 Model Description

B.2.2.1 Structure

WinDS models the expansion of generation and transmission capacity in the U.S. electric sector over the next 50 years. It minimizes systemwide costs of meeting loads, reserve requirements, and emission constraints by building and operating new generators and transmission in each of 25 2-year periods from 2000 through 2050. It considers a wide range of generator types, including natural gas combined-cycle generation, natural gas combustion turbines, gas and oil steam generation, several coal-fired generator options, nuclear power, hydroelectricity, wind, and other renewable electricity technologies (e.g., landfill gas, concentrating solar power, biopower).

The core of the WinDS model is a linear programming optimization of the expansion of the electric sector's capacity in each 2-year period. However, much of the data that are input to this optimization are derived from a detailed GIS model/database of the wind resource, transmission grid, and existing plant data. The GIS utilizes updated wind resource assessments validated by NREL (2004), and it excludes resource areas that may be environmentally sensitive or unlikely to be developed because of their ownership, designation, land use, or physical attributes (see Table B-2). In addition, a 2-mi (3-km) area surrounding lands that are completely excluded from development and small, isolated wind resource areas with a low likelihood of utility-scale development are also excluded. These wind resource exclusions differ significantly from the MPDS exclusions (see Section B.1.3). The exclusions used in the MPDS are used to define the maximum potential, whereas the exclusions used in WinDS are intended to better represent areas that are likely to be available for wind development. Transmission lines and power plant locations are extracted from POWERmap. The WinDS model utilizes regions that were created within the GIS from county boundaries. The geographically summarized information and other inputs are transferred to the optimization through a spreadsheet input interface. The results from the optimization are output through a similar spreadsheet interface, facilitating the review and production of graphical output.

One of the unique features of WinDS is its regional discretization of the U.S. electric sector. (See Figure B-2 for a map of all regional levels.) At the highest level, it distinguishes among the three major synchronized interconnections within the United States: (1) Eastern interconnect, (2) Texas (basically the Electric Reliability Council of Texas [ERCOT]), and (3) Western interconnect (basically the Western Electricity Coordinating Council [WECC]). Below the interconnection level, it considers ancillary service requirements at the NERC region and subregion level (13 regions in the continental United States). Capacity expansion decisions are made one level lower for 134 power control areas. Finally, wind power is supplied from 356 wind regions (NREL 2004). The fine regional disaggregation of wind supply allows WinDS to calculate transmission distances and the benefits of dispersed wind farms supplying power to a demand region.

WinDS is also disaggregated with respect to time. Within each year, dispatch decisions are made separately for four different load levels in each of the four seasons. Although data are currently sparse, WinDS accounts for the variation in wind output in these different time "slices" within each wind supply region. The time disaggregation not only helps in capturing the correlation between wind output and loads but is also important in capturing the dispatching of peaking units, spinning reserve requirements, transmission loading, etc.

WinDS disaggregates the wind resource into five classes ranging from Class 3 to Class 7 (Figure B-1). The amount of each class of wind available within each of the 356 wind supply regions (along with the capacity factor for each class, in each region) is derived by means of the GIS capability and input to the optimization. In addition, the GIS capability supplies the optimization with a supply curve for the cost of building access from each wind site within a

TABLE B-2 Land Exclusion Criteria Used in the WinDS Model

Category	Description
Ownership	All National Park Service lands All U.S. Fish and Wildlife Service lands 50% of U.S. Forest Service lands[a] 50% of U.S. Department of Defense lands[a]
Designation	National Parks Wilderness Areas Wilderness Study Areas Wildlife Refuges Wildlife Areas National Recreation Areas National Battlefields National Monuments National Conservation Areas Wild and Scenic Rivers All state and private lands in the highest protection category and 50% of state and private lands in the second-highest protection category[b]
Land use	Urban areas Airports/airfields Wetlands Water bodies
Physical attributes	Slope[c] Terrain[d] Forest terrain type[e]
Other	2-mi (3-km) buffer[f] Wind resource density[g]

[a] Fifty percent of lands owned by this agency not already excluded by virtue of designation are excluded to account for probable competing land uses.

[b] Based upon protection categories assigned by the U.S. Geological Survey (USGS) Gap Analysis Project (USGS 2004). Data were not available for all states.

[c] Slopes >20% are excluded on the high resolution wind resource datasets.

[d] Terrain exposure factors of 5% (ridgecrest), 35%, 65% and 90% (relatively flat areas) are from Elliot et al. (1987).

[e] Fifty percent of nonridgecrest forest areas are excluded to reflect the additional efforts that may be necessary for development on forested lands.

[f] An additional 2-mi (3-km) area surrounding National Park Service lands, U.S. Fish and Wildlife Service lands, and areas excluded by designation or land use is excluded.

[g] Isolated wind resource areas that would be less attractive for wind farm development are excluded. A criterion of 2 mi^2 (5 km^2) within the 100-km^2 area surrounding a Class 3 or higher resource is used to exclude these areas.

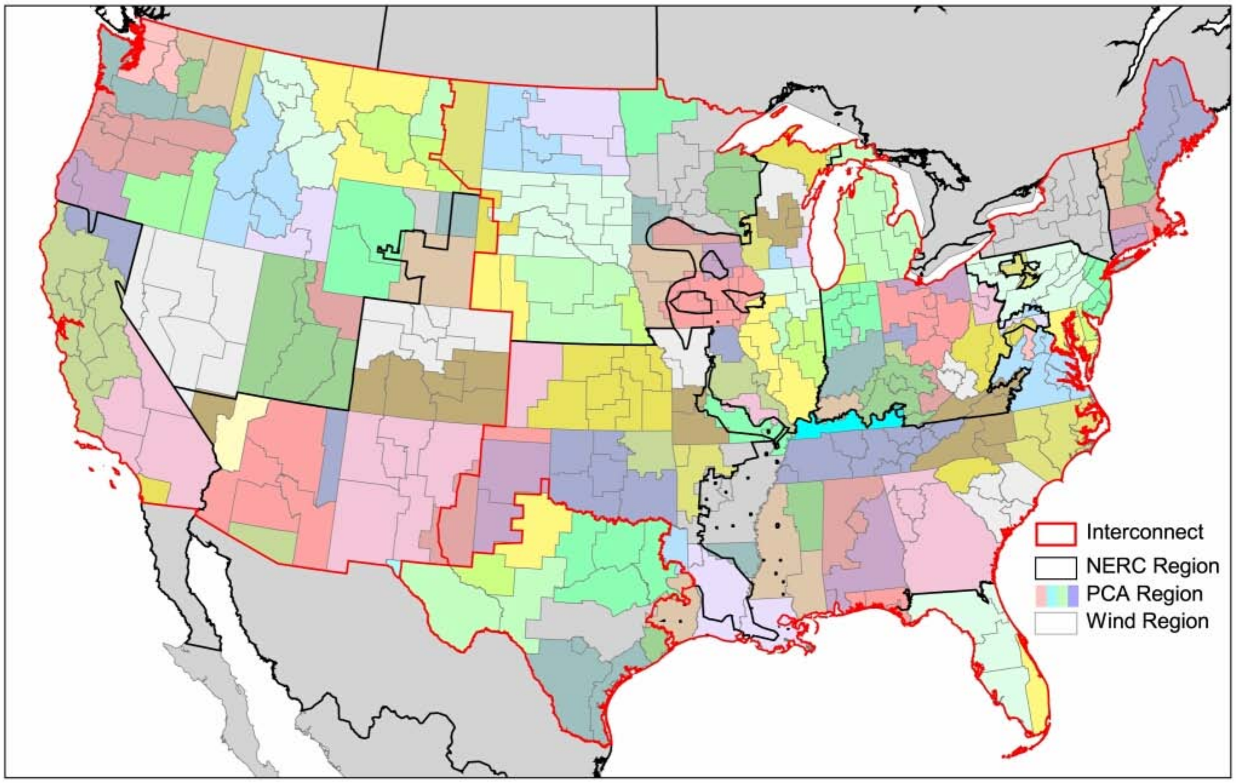

FIGURE B-2 Regions within WinDS

region to an available transmission line within the existing grid. The GIS provides a second supply curve for the cost of building access directly from the wind sites to the load centers in the same region for use when the cost to access the grid is too high.

The WinDS model estimates the amount of wind power that will be generated. These estimates can be converted to an estimated number of acres developed on the assumption that 1 MW of power requires approximately 50 acres (20 ha) of land.

B.2.2.2 Objective Function

The driver in any optimization is the objective function. In WinDS, the linear program minimizes the total cost of providing power for the next 20 years by deciding which generators and transmission lines should be built in the current 2-year period and how they should be dispatched. The costs to be minimized are:

- Present value of the cost of both generation and transmission capacity installed in this period,

- Present value of the cost of operating that capacity during the next 20 years (fixed and variable operation and maintenance [O&M] and fuel costs) to meet load or for spinning reserve, and

- Cost of reserve capacity.

The capital costs for new-generation equipment change over time according to direct user specifications on input or on the basis of a learning curve. For new generators, the user can also define the O&M costs, fuel costs, heat rates, and wind capacity factors as they change over time. Financing can be explicitly modeled by using either corporate financing or project-specific financing, with the consequent debt service coverage requirements. Depreciation for income tax purposes and federal tax credits are explicitly accounted for. Escalation of fuel prices over time can be input.

Costs for transmitting wind on existing lines consist of the capital cost to build a new line from the wind site to the grid and a service charge per megawatt-hour to use the existing lines. The capital cost of a new line is a linear function of the number of megawatts that the line must be able to carry and the length of the line. Lines built to transmit wind are assumed to do so exclusively (i.e., only wind is carried on the line). Thus, the cost of such lines is amortized over the relatively low capacity factor of wind.

B.2.2.3 Constraints

The cost of capacity expansion and operation in the electric sector is minimized in each of the 2-year optimization periods subject to a set of constraints. The principal constraints are described briefly here.

Wind resources. The total amount of wind energy capacity that can be developed in each of the 356 wind supply regions is constrained to be less than the wind resources shown in Figure B-1.

Wind access to existing transmission lines. There are several constraints on the use of existing lines to transmit the electricity from new wind installations.

- For each of the five classes of wind within each of the 356 wind supply regions, a GIS is used to develop a small supply curve for the cost of building a transmission line from the wind site to the existing grid. Because the GIS program considers the load on the existing grid transmission lines (a user input) and the amount of wind from other sites that is on the grid line, the length of this connecting line is typically much more than the shortest distance to the existing grid.

- In the linear programming optimization for each 2-year time period, the amount of wind energy that can be developed and connected to existing lines is constrained by the transmission cost supply curve developed by the GIS (see paragraph directly above).

- When the cost to reach the grid is excessive, the optimization may elect to build a new transmission line from the wind in a region to load centers in the same region. The GIS also provides a supply curve for this purpose.

- The amount of wind transmitted to meet the demand in another one of the 356 wind supply regions is limited to the available capacity on the transmission lines entering the destination region.

Load. The primary load constraint is that the load in each power control area must be met in each time slice throughout a year. The load is assumed to increase exponentially from one year to the next according to the user inputs. The load in a given power control area can be met by either (1) generation from conventional technologies or wind generation within the power control area, or (2) power transmitted from other power control areas or wind supply regions. Wind generation in a given time slice is determined by the wind capacity available and the capacity factor for that time slice. The model dispatches conventional generation to minimize total costs while meeting the load constraint.

There is a secondary load constraint on wind. To better estimate the transmission distance required for wind, WinDS actually tracks the delivery of wind to demand subregions within the power control area. These demand subregions have the same geographic boundaries as the wind supply areas. WinDS does not allow the wind shipped from one wind supply region to a demand subregion (a different wind supply region) to exceed some user-specified fraction of the peak load in the demand subregion. This ensures that all the wind is not simply sent to the closest demand subregion. The peak load of a demand subregion is the peak load in the power control area to which it belongs multiplied by the fraction of the power control area population that is within the demand subregion.

Reserve. There are two types of reserve constraints: the planning reserve margin and operating reserve. These constraints require the calculation of the variance in the wind output from all the wind supply regions contributing to the demand region. This wind output variance is calculated by explicitly considering the dispersal of wind farms. If two wind farms are far apart, their output will be less correlated than the output from two farms that are contiguous to one another. WinDS assumes that the amount of correlation between the output of any two wind farms is proportional to the distance between the two wind farms. Thus, the variance in the total output from the two separated farms will be less than that of the two contiguous farms. This reduced variance for dispersed wind farms leads to a higher wind capacity value and less need for reserve. The variance in output from all the wind generation is recalculated at the end of each 2-year optimization period and used to calculate the coefficients on wind in the linear reserve constraints for the next 2-year period.

The planning reserve margin constraint is applied to each NERC region. It requires that the conventional capacity within the region, plus the product of the wind nameplate capacity, multiplied by an effective load-carrying capability (ELCC) for the wind, exceed the peak load of the interconnection plus a reserve margin. The wind ELCC is the amount of additional load that can be met by the addition of one more megawatt (1 MW) of wind capacity without changing the reliability of the grid. It is based on stochastic calculations of the loss-of-load probability (LOLP) that use the variance in wind output.

The operating reserve constraint is applied at the NERC region/subregion level. It captures the need for reserves to meet both contingencies (generation- and transmission-forced outages) as well as short-term (10 to 30 minutes) load-following requirements. These reserve requirements can be met by spinning reserves from hydroelectric facilities and combustion turbines, quick-start capacity, and interruptible loads controlled by the electric distribution company. Because the conventional generation that contributes to operating reserves can occur in different states (generating or idle) in different time slices (peak, off-peak), the operating reserve requirement is applied to each time slice within a year. Wind generation can increase the need for operating reserves because wind generation can unexpectedly increase or decrease. However, the changes in wind generation are not correlated with the conventional capacity contingency requirements or load changes. Thus, the additional operating reserve requirements due to wind are not proportional to the amount of wind but rather to the variance in the sum of the normal operating reserve and the amount of reserve that can be met by wind generation. In effect, this means that the operating reserves induced by wind per unit of wind capacity are generally low initially and can grow quickly if significant numbers of wind farms are installed close to one another (i.e., with highly correlated generation).

Wind-generated electricity that is lost because it is surplus is also accounted for within WinDS at the interconnection region level. When demand is low and the wind is blowing, there can be times when all the wind generated is not used. WinDS uses the variance of the sum of all wind generation, together with a load duration curve and the forced outage rates of conventional technologies, to stochastically compute the expected amount of wind that cannot be used. This surplus wind is calculated after each period’s optimization and used in the next period to reduce the amount of generation contributed by wind (and effectively to increase the cost of new wind power).

Emissions**.** At the national level, WinDS has the ability to cap the air emissions of sulfur dioxide, nitrogen oxides, mercury, and carbon from fossil-fueled generators. For this analysis, only sulfur dioxide emissions are capped at the levels specified by the Clean Air Act Amendments.

B.2.2.4 Variables

By minimizing the objective function cost subject to the constraints described above, WinDS endogenously calculates the following variables for each time period:

- Wind capacity installed in each wind supply region,
- Wind generation transmitted from each wind supply region to each demand region by existing transmission lines,
- Wind generation transmitted from each wind supply region to each demand region by new transmission lines,
- New transmission lines built to transmit wind from supply regions to demand regions,
- Conventional capacity by type installed in each power control area,
- Conventional generation by type dispatched in each power control area in each time slice within a year,
- Transmission built in each year to transmit power between power control areas,
- Power transmitted in each time slice in each year between power control areas,
- Interruptible load under contract in each power control area, and
- Spinning reserve operating in each time slice within a year in each NERC region.

B.2.3 Standard Assumptions

The WinDS base case is a business-as-usual case that relies heavily on the reference case scenario of the DOE Energy Information Administration (EIA) *Annual Energy Outlook 2004* (DOE 2004) to determine inputs that fall outside the scope of WinDS. These inputs include electricity demand, fossil fuel prices, existing federal energy policies, and the cost and performance of nonwind electricity-generating technologies.

Onshore wind-power cost and performance data in the WinDS base case are derived from projections made in 2002 by Princeton Energy Resources International (PERI) for the DOE Wind Program (Short 2002). In the base case, it is assumed that only one-half of the projected capacity-factor improvements and one-third of the cost improvements will occur through research and development (R&D). Table B-3 shows the resulting R&D-driven cost and performance improvements used in WinDS for the base case. In addition to allowing for the improvements over time shown in Table B-3 for the base case, WinDS also allows for “learning” improvements in both the costs and capacity factors. For each doubling of installed worldwide wind capacity (a scenario of wind installations outside the United States reaching 130 GW by

TABLE B-3 Base-Case R&D-Driven Wind Costs and Performance

Wind Class	Year	Capacity Factor	Capital Cost ($/kW)	Variable O&M (mil/kWh)[a]
4	2005	0.29	916	3.8
4	2010	0.35	914	3.7
4	2020	0.36	899	3.6
4	2030	0.36	899	3.6
4	2040	0.36	899	3.6
4	2050	0.36	899	3.6
6	2005	0.42	880	3.8
6	2010	0.45	880	3.7
6	2020	0.47	864	3.6
6	2030	0.47	864	3.6
6	2040	0.47	864	3.6
6	2050	0.47	864	3.6

[a] A mil equals a thousandth of a dollar.

2030 is input to WinDS), there is an 8% reduction in capital costs, and the capacity factor gets 8% closer to the projected PERI/NREL values. Table B-4 summarizes these and many of the other critical parameters used in the WinDS base case and also in this PEIS.

B.2.4 WinDS Model Application for Wind Energy Development PEIS

The data presented in Table B-4 make up the standard set of data that NREL used in its base case for all its analyses in early 2004. No input parameters were changed for this PEIS analysis, except that it was assumed that the PTC would be extended to the end of 2006. The U.S. Congress is seriously considering extending the PTC for wind energy that expired at the end of 2003. As proposed in the Corporate Tax Bill (S. 1637), the 1.8 cents/kWh PTC would be extended to the end of 2006. (It would also be expanded to cover other renewable technologies.) The WinDS model was run with the base-case data from above and with a tax credit of 1.8 cents/kWh for each kilowatt-hour of electricity produced in the first 10 years of production by wind plants built before 2007.

For this analysis, the base-case wind capacity results, including the PTC extension until 2006, were summed across all the wind supply regions in each state to determine the total wind installations by state. To estimate the fraction of the wind capacity installed on BLM lands in each state, the wind capacity results by region and 2-year time step were transferred back into the GIS. The GIS was used to disaggregate the wind capacity results at the wind region level back

TABLE B-4 Primary Data in the WinDS Base Case and PEIS Analysis

Parameter	Source or Value
Electricity loads	DOE (2004), reference case extrapolated to 2050
Fossil fuel prices	DOE (2004), reference case extrapolated to 2050
Wind cost/performance	Reduced DOE Wind Program goals
Wind resources	NREL internal data
Conventional plant cost/performance	DOE (2004), reference case extrapolated to 2050
Conventional plant sizes and locations	RDI BASECASE GIS data (Platts, Inc. 2004b)
Fossil fuel generation emissions	U.S. Environmental Protection Agency E-grid database (EPA 2004)
Financial analysis period	20 years
Real discount rate (weighted cost of capital)	8.5%
Combined marginal income tax rate	40%
Depreciation schedule for tax purposes	MACRS (Modified Accelerated Cost Recovery System, a provision of the Internal Revenue Service tax code)

down to the resource data level that was used to construct the wind-transmission supply curves for WinDS. The specific wind sites developed in each region were estimated to be those sites in the portion of the supply curve that was accessed by WinDS. Once the sites were known, their ownership was determined by using the BLM land status data set obtained from the BLM National Science & Technology Center in 2002.

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