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The Renewable Electric Plant Information System

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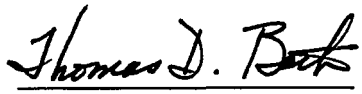
Preface

This report on the *Renewable Electric Plant Information System* (REPiS) summarizes the data contained in the REPiS database. The report also describes the fields in the database and illustrates various ways of using the data for analysis. REPiS should be viewed as an evolving collection of information, especially for planned plants or units. REPiS users may have an interest in helping to improve the database by providing additional information on an ongoing basis.

REPiS was compiled by the Analytic Studies Division at the National Renewable Energy Laboratory (NREL) for the Office of Utility Technologies (OUT) in the Office of Energy Efficiency and Renewable Energy in the U.S. Department of Energy (DOE). The author thanks Joe Galdo of DOE for his support on this project. The author also thanks Tom Skubal for his significant contribution to the development of the database and Stuart Smoller for his editorial support. Susan Anson, Troy Davig, Aysin Erdener, Natalie Mullis Smith, Rea Perez, and Shan Ring also contributed to the research support. The author extends special thanks to all the individuals who took the time to respond to the researchers' questions regarding their renewable energy plants. Without their input, compiling the data would have been more difficult.

The text of the report was greatly improved through comments received from several peer reviewers, including: Joe Galdo (DOE), Kevin Porter (NREL), Glenn Strahs (DOE), and Blair Swezey (NREL). However, the interpretation of the data and information presented in this report remains the sole responsibility of the author.

Approved for the
NATIONAL RENEWABLE ENERGY LABORATORY



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1.0 Introduction

The U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL) have undertaken a periodic effort to develop and update the Renewable Electric Plant Information System (REPiS)[1] database. The REPiS database provides comprehensive information on grid-connected renewable electric generation plants in the United States. It was originally designed in 1987 and updated in 1990. The data is now current through 1994.

This document summarizes the data contained in REPiS. These data come from publicly available sources including federal and state agencies, electric utilities, and trade groups. Data sources include information reported by the utilities to the Federal Energy Regulatory Commission (FERC) and Energy Information Administration (EIA), which are available in electronic form. Other data sources include peer review by DOE technology programs and other databases.

The report describes the fields in the database and illustrates various ways of using the data for analysis purposes. The report also summarizes the methodology used in compiling the data and the validation effort used for controlling the quality of the data. In addition to updating the database, a primary focus of this work was data verification and validation.

During the updating process, a number of enhancements were made to the database. The two most notable enhancements include information on planned units and the ability of REPiS to provide unit-level information. In addition, REPiS now contains information on retired and cancelled renewable units.

[1] The current version of REPiS is technically referred to as REPiS IIIb. It is the beta version of the third update of the database.

2.0 Description of Database

A distinguishing design feature of the current version of REPiS is that it has been redesigned to accommodate unit-level data. Capacity is stored at the kilowatt level, which better accommodates small renewable plants. If the database were maintained at the megawatt level, it would be difficult to capture the contribution from many PV and wind plants.

REPiS is maintained in Paradox for Windows. It has been streamlined to include all relevant fields in two principal tables. By compressing the tables, the database is user friendly, allowing for quicker, more efficient sorts of the data.

The database contains information on all renewable technologies, including bioenergy,[2] geothermal, hydroelectric, photovoltaic (PV), solar thermal, and wind electric generation units. The type of data associated with each renewable unit includes name, technology type, system type, number of units, fuel type, size, location, on-line date, operating status, name of operator, name of owner, and purchasing utility of nonutility-owned plant output.

The database is designed to contain other plant information, such as generation data for utility-owned units, power-sold data for nonutility-owned units, and revenue and cost data. Such data, however, are limited at this time. These data fields have not been included in the beta version of the database because of the incompleteness of these fields.

The time frame of the data contained in REPiS varies by the type of unit status. Generally, data on operating units are current through 1994. Some 1995 data are also contained in the database. Information on planned plants or units covers the period from 1995 through 2005.

[2] Although the database contains current data on municipal solid waste (MSW) units that generate electricity, the MSW data is not included in the data summaries prepared for this report.

3.0 Data Collection and Validation Methodology

REPiS is a compilation of data from a variety of sources. The database was compiled, based in large part, on utility filings with FERC and the EIA. Other sources of information included state governments, electric utilities, trade association publications, and other databases.

The update of REPiS is the result of extensive data collection and validation. As with any database, the value of the final product is directly related to the quality of the data. Along with updating the information on renewable electric units, data validation was a key goal in this project.

This update was complicated by the number of years that had passed since the last update, the pressing need to validate the data (which had not been done previously), and the desire to enhance the database to respond to special requests from previous users.

3.1 Federal Data Sources

There are many differences between renewable data taken exclusively from FERC and EIA filings and those that are contained in REPiS. Although utility- and nonutility-owners may be required to file specific forms with FERC and the EIA, the reporting threshold of 1 MW may systematically overlook small renewable plants that do not meet the reporting threshold. Because a number of renewable electric units fall below the reporting threshold, they are left out of compilation efforts. Therefore, although the FERC and EIA reports capture a significant portion of the utility-owned renewable electric units, coverage for small renewable electric units, which are primarily nonutility owners, is not comprehensive.

Another reason the federal reports cannot be used exclusively to provide information on renewables is that there are often inconsistencies in the way information is reported. For example, when reporting on generation, the individual reports may reflect net or gross generation. In addition, utilities are inconsistent in reporting nonutility-related information on the FERC Form 1. Without validation, it is difficult to determine whether the information has been reported in a consistent and comprehensive manner.

A third issue with the federal reports is that nonutility-owned units may or may not be reported on federal forms. In addition to the threshold for reporting, there are documented cases where a nonutility owner either reported on the wrong form or simply did not report at all. Sometimes it is simply a case of the nonutility owner not knowing that government forms must be filed. For example, there appears to be an inconsistent understanding of reporting requirements for EIA Form 867. EIA 867, which requests information on nonutility power producers for facilities 1 MW or greater, is only sent to developers that have either previously submitted completed Form 867 EIA filings, or of whom the EIA is aware. Some nonutility developers are not aware that they are required to file Form 867.

Finally, some electric generation information reported to the EIA is proprietary. This information is publicly available, but only on an aggregated basis. Thus, it is impossible to break out renewable-

specific plant or unit information for inclusion in REPiS. Table 3-1 provides a description of the reporting requirements for each of the major reports filed with federal agencies.

Table 3-1. Description of Federal Reporting Forms

Form	Description
FERC Form 1	An annual restricted-universe census of the major investor-owned electric utilities in the United States having, in each of the last 3 consecutive years, sales or transmission service that exceeds one of the following: (1) 1 million megawatt-hours of total sales, (2) 100 megawatt-hours of sales for resale, (3) 500 megawatt-hours of power exchanges delivered, or (4) 500 megawatt-hours of wheeling for others (deliveries plus losses). Financial statistics including income, taxes, depreciation and amortization, electric operating revenue, electric maintenance expenses, year-end balance sheets, and, general corporate information are reported by approximately 180 major investor-owned electric utilities.
Form OE-411	An annual report supplied to DOE by the 10 North American Electric Reliability Councils (NERCs). These reports have been compiled from data furnished by the member electric utilities. The form is used to collect information on electric utility 10-year plans and peakload information at the NERC region level. The responsibility for collecting these data has been delegated to the Office of Emergency Planning and Operations within DOE.
Form EIA-412	A restricted-universe census used annually to collect accounting, financial, and operating data from major publicly owned electric utilities in the United States. Publicly owned electric utilities engaged in the generation, transmission, or distribution of electricity that had 120,000 megawatt-hours of sales to ultimate customers and/or 120,000 megawatt-hours of sales for resale for the 2 previous years as reported on Form EIA-861, "Annual Electric Utility Report", must submit the Form EIA-412. These criteria result in approximately 450 submissions from publicly owned electric utilities.
Form EIA-860	This form is used to collect data annually from all electric utilities in the United States that operate power plants or plan to operate a power plant within 10 years of the reporting year. The survey is used to collect data on power plant site information, generator specifications including maximum generator nameplate capacity, net summer and winter capability, heat rate, in-service date, status, prime movers, energy sources, and the ownership of generators. Information on electric generators is reported by approximately 900 electric utilities.
Form EIA-861	This is a census of electric utilities in the United States, its territories, and Puerto Rico. The survey is used to collect annual information on the production, sales, revenue from sales, trade of electricity, and demand-side management activities from approximately 3,250 electric utilities.
Form EIA-867	A restricted-universe census used to collect annual data from all existing and planned nonutility power producers in the United States. In 1992, the reporting threshold of the Form EIA-867 was lowered to include all facilities with a combined nameplate capacity of 1 or more megawatts (MW). Previously, data were collected every 3 years from facilities with a nameplate capacity between 1 and 5 MW. For the purpose of this data collection, a nonutility power producer is an enterprise that has electric generating capacity and is not an electric utility. They include qualifying cogenerators, qualifying small power producers, and other nonutility generators (including independent power producers) without a designated franchised service area. The form is used to collect data on the installed capacity, energy consumption, generation, and electric energy sales to electric utilities from approximately 2,000 facilities.

Source: Adapted from *Electric Power Annual*. 1992. Energy Information Administration, January, 1994.

3.2 Validation

The initial validation focus was on federal- and utility-owned renewable units. Because utilities are required to report to the federal government on electric generation resources using a number of different reporting forms, this information is publicly available. These sources include FERC Form EIA Forms 412, 759, 860, 861, and 867, and Rural Electrification Administration (REA) Forms 7 and 12.

Utilities and federal entities were sent printouts of renewable plants contained in REPiS. They were asked to validate the information on the printouts and to provide information on missing and/or planned units. Once this process was completed, the information received was cross-checked with other data sources, including the filings mentioned above that were accessed electronically.

In previous updates, information from federal forms was manually entered into REPiS. There are several electronic databases available that are compiled versions of this publicly available utility industry data. These databases were used to validate and assist in updating REPiS. Productivity gains were made by converting from a manual input process to an electronic data input process based on links that were made between the various databases.

Information on nonutility-owned units came from a variety of sources. These sources include state government agencies, trade association and utility industry publications, other technology-related databases, project developers, and FERC's *Hydroelectric Power Resources of the United States.*

Technology-specific printouts of the updated database were sent to the geothermal, PV, solar thermal, and wind program offices at DOE for review. Technology-specific printouts were also sent to the American Wind Energy Association, Geothermal Resources Council, and Utility Photovoltaic Group for review. Information received from this review exercise was input into the database.

3.3 Verification

Printouts from the previous version of REPiS, which was last updated in 1990, were sent to all state energy and regulatory offices. The intent was to have the states review the data to begin the update process. Based on the responses (80% of the states were represented by a response from either the state energy office or the regulatory agency), we found that much of the data was out of date. Although many states were able to comment on the printouts, many state government offices indicated that they did not have detailed information on operating renewable resources in their state.

4.0 Data Findings

This chapter provides examples of the data contained in the REPiS database. It provides illustrations of unit data, capacity by company type, state and FERC regions, ownership, location, and planned renewable units. The presentation of the data in this chapter is in part motivated by the numerous external data requests already received. Many of the tables and figures included in this chapter are similar to those that have been produced to meet these specific requests.

4.1 Summary of Data

REPiS contains information on 4,222 plants. The plant count includes units that are operating, planned, and retired (including cancelled units). Table 4-1 provides a breakdown, by current status, of the renewable units in REPiS. There are 7,123 units and 128,139 MW of total capacity in REPiS. (The capacity represents the gross nameplate capacity of all generating units.) Of these, 6,131 units (86%), representing 103,847 MW of capacity, are currently operating.

Table 4-1. Summary of Units and Capacity (kW) in REPiS, by Current Status

Status Classification	Number of Units	Total Capacity (kW)
Operating	6,131	103,846,649.69
Planned	299	9,809,727.00
Retired	693	14,482,764.05
Total	7,123	128,139,140.74

Table 4-2 presents a summary of operating capacity in REPiS by owner classification. Utilities and government entities own most of the hydropower capacity while nonutility entities own the majority of the nonhydroelectric renewable electric capacity in the United States, primarily bioenergy. Approximately 4 MW of hydroelectric capacity is owned by Canadian entities, but located in the United States.

Table 4-2. Operating Capacity (kW), by Owner Classification for Each Technology

Owner Classification	Bioenergy	Geothermal	Hydro	Photovoltaic	Solar Thermal	Wind	Totals
Canadian			3,900				3,900
Cooperatives	4,000		308,183	104		42	312,329
Investor Owned Utilities	341,422	1,354,350	30,607,924	1,552		1,999	32,307,247
Nonutilities	5,285,372	1,186,238	1,673,242	2,317	367,748	2,151,156	10,666,073
Publicly Owned	108,421	364,270	60,078,448	4,805		1,157	60,557,101
Total	5,739,215	2,904,858	92,671,697	8,778	367,748	2,154,354	103,846,650

Of the nonhydroelectric capacity generating electricity in the United States, 51% is biomass, 26% is geothermal, and 19% is wind. Figure 4-1 reflects the distribution of nonhydroelectric capacity, by technology.

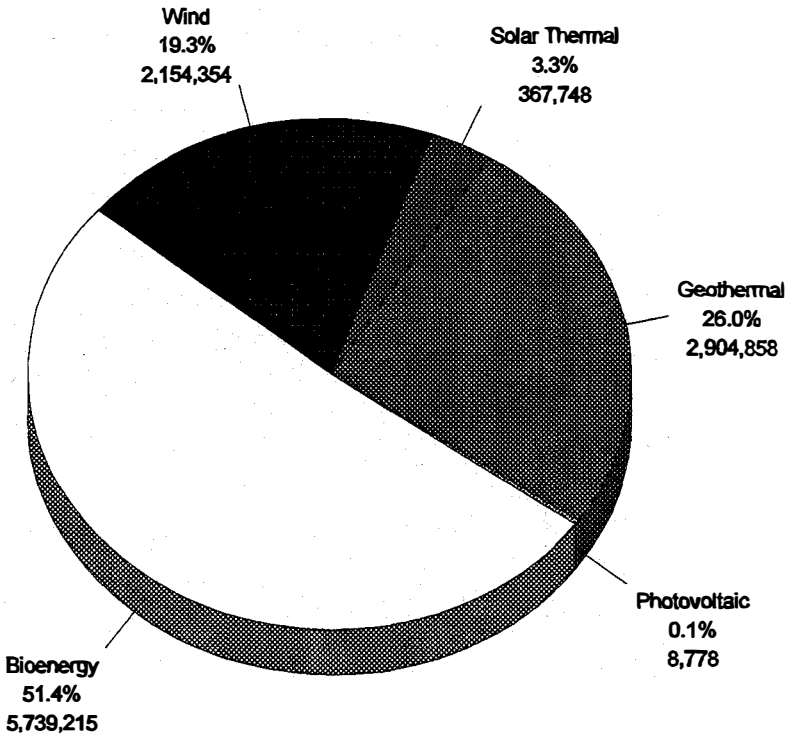


Figure 4-1. Operating nonhydroelectric renewable capacity (kW), by technology

4.2 Capacity by State and FERC Region

Table 4-3 provides a technology breakdown of the capacity of operating units contained in REPiS both by state and by Federal Energy Regulatory Commission (FERC) region. At the state level, Washington has the most renewable capacity (20,780 MW), primarily hydroelectric. California, meanwhile, has the second largest total renewable capacity (19,003 MW) and is also the most diverse, with operating units in all technology groups.

On a regional basis, FERC Region 10, which includes Washington, has the most renewable capacity, with over 32,000 MW of renewables, mostly hydro. FERC Region 9, which contains California, has the second largest amount of renewable capacity, with over 23,500 MW.

Nonhydroelectric renewable capacity in the United States is approximately 11% of the total renewable capacity. California contains, by far, the most nonhydro capacity, with 57% of the capacity (6,401 MW). Outside of California, Georgia makes the next largest contribution from nonhydroelectric renewables, with 566 MW of operating capacity, primarily from bioenergy.

Table 4-3. Total Renewable Operating Capacity (kW) in the United States, by State and FERC Region

State/FERC Region	Bioenergy	Geothermal	Photo-voltaic	Solar Thermal	Wind	Total Nonhydro	Hydro	Total Including Hydro
Region 1								
Connecticut	3,461		0		55,980	59,441	154,890	214,331
Maine	545,890		2		15,164	561,056	708,381	1,269,437
Massachusetts	8,730		240		360	9,330	1,735,178	1,744,508
New Hampshire	142,145		11		100	142,256	365,746	508,002
Rhode Island	13,000		13			13,013	9,403	22,416
Vermont	55,670					55,670	410,234	465,904
Region 1 Total	**768,896**	**0**	**266**	**0**	**71,604**	**840,766**	**3,383,832**	**4,224,598**
Region 2								
New Jersey	5,940		21			5,961	404,444	410,405
New York	58,023		69		2,031	60,123	5,331,398	5,391,521
Region 2 Total	**63,963**	**0**	**90**	**0**	**2,031**	**66,084**	**5,735,842**	**5,801,926**
Region 3								
Delaware	600		13		2	615	500	1,115
District of Columbia			300			300		300
Maryland	10,300		15		4	10,319	494,550	504,869
Pennsylvania	129,900		19		3,645	133,564	1,942,510	2,076,074
Virginia	196,300		65		10	196,375	3,084,771	3,281,146
West Virginia						0	242,670	242,670
Region 3 Total	**337,100**	**0**	**412**	**0**	**3,660**	**341,173**	**5,765,001**	**6,106,174**
Region 4								
Alabama	523,955					523,955	2,886,570	3,410,525
Florida	326,900		112			327,012	42,310	369,322
Georgia	565,820		4		25	565,849	2,418,220	2,984,069
Kentucky						0	747,150	747,150
Mississippi	109,022					109,022		109,022
North Carolina	123,580		4			123,584	2,050,832	2,174,416
South Carolina	202,500					202,500	3,444,312	3,646,812
Tennessee	117,950		33		20	118,003	3,730,660	3,848,663
Region 4 Total	**1,969,727**	**0**	**153**	**0**	**45**	**1,969,924**	**15,320,054**	**17,289,978**
Region 5								
Illinois	33,700		15		39	33,754	30,598	64,352
Indiana			4		62	66	89,552	89,618
Michigan	250,111		4		65	250,180	2,400,400	2,650,580
Minnesota	23,054		4		27,898	50,956	220,920	271,876
Ohio	29,500					29,500	128,500	158,000
Wisconsin	181,355		31		125	181,511	508,594	690,105
Region 5 Total	**517,720**	**0**	**58**	**0**	**28,189**	**545,967**	**3,378,564**	**3,924,531**

Table 4-3. Total Renewable Operating Capacity (kW) in the United States, by State and FERC Region

State/FERC Region	Bioenergy	Geothermal	Photo-voltaic	Solar Thermal	Wind	Total Nonhydro	Hydro	Total Including Hydro
Region 6								
Arkansas	1,750					1,750	1,195,730	1,197,480
Louisiana	13,000					13,000		13,000
New Mexico	150		171		80	401	66,220	66,621
Oklahoma			153		201	354	1,027,678	1,028,032
Texas	8,300		894		2,487	11,681	737,840	749,521
Region 6 Total	**23,200**	**0**	**1,218**	**0**	**2,768**	**27,186**	**3,027,468**	**3,054,654**
Region 7								
Iowa	4,933		4		1,504	6,441	130,035	136,476
Kansas					1,137	1,137	3,860	4,997
Missouri						0	1,098,400	1,098,400
Nebraska						0	183,930	183,930
Region 7 Total	**4,933**	**0**	**4**	**0**	**2,641**	**7,578**	**1,416,225**	**1,423,803**
Region 8								
Colorado	9,605		28		64	9,697	1,098,306	1,108,003
Montana	12,650				280	12,930	2,399,354	2,412,284
North Dakota	9,000				431	9,431	517,750	527,181
South Dakota					10	10	1,741,308	1,741,318
Utah	4,000	39,100				43,100	282,039	325,139
Wyoming	6,500					6,500	287,837	294,337
Region 8 Total	**41,755**	**39,100**	**28**	**0**	**785**	**81,668**	**6,326,594**	**6,408,262**
Region 9								
Arizona	405		257		38	700	1,957,100	1,957,800
California	1,375,061	2,633,100	6,231	367,748	2,018,825	6,400,964	12,602,525	19,003,489
Hawaii	186,100	25,000	30		23,510	234,640	24,072	258,712
Nevada	10,000	207,658	15		37	217,710	2,093,425	2,311,135
Region 9 Total	**1,571,566**	**2,865,758**	**6,532**	**367,748**	**2,042,410**	**6,854,014**	**16,677,122**	**23,531,136**
Region 10								
Alaska	43,000		5		30	43,035	510,821	553,856
Idaho	25,490		0		127	25,617	1,679,607	1,705,224
Oregon	218,400		11		64	218,476	8,823,982	9,042,458
Washington	153,465		1			153,466	20,626,585	20,780,051
Region 10 Total	**440,355**	**0**	**18**	**0**	**221**	**440,594**	**31,640,995**	**32,081,589**
United States Total	**6,739,214**	**2,904,858**	**8,778**	**367,748**	**2,154,354**	**11,174,953**	**92,671,697**	**103,846,650**
Percentage of Nonhydroelectric Renewable Capacity								11 %

More than 61% of the country's nonhydro capacity can be found in FERC Region 9, which includes California. Bioenergy development in the South Atlantic region (Region 4) is the primary technology, which results in that region's 18% contribution from nonhydro renewables. Figure 4-2 provides a map of the states in each FERC region.

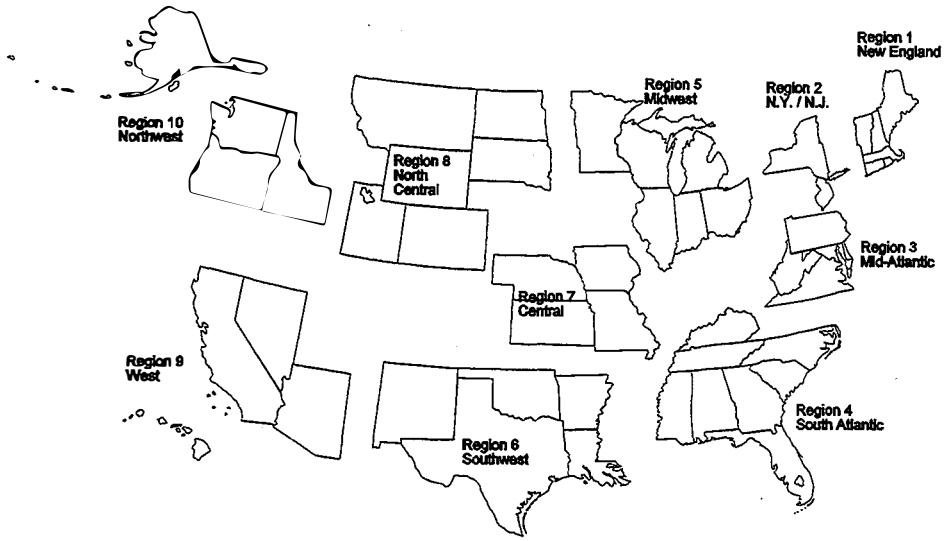


Figure 4-2. FERC regions

Figure 4-3 represents the breakdown of operating units by technology. More than three-quarters of the units represented in REPiS are hydroelectric. Over 10% of the operating units are wind.

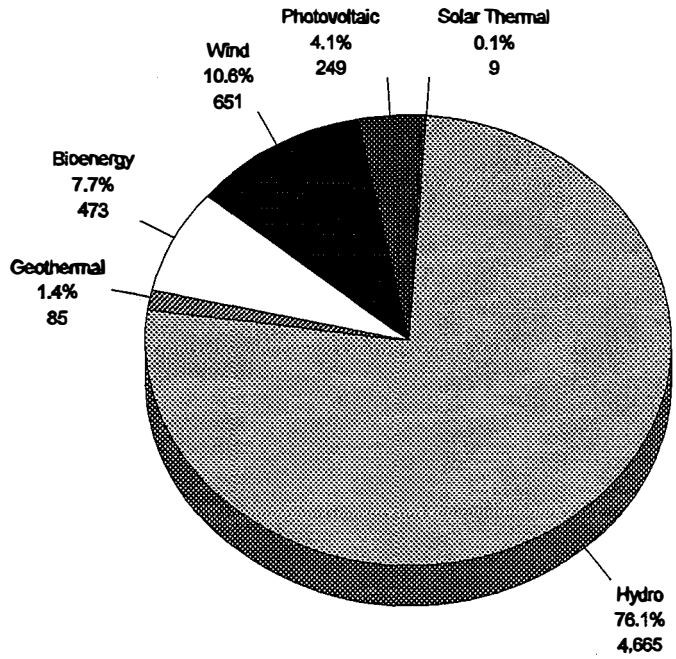


Figure 4-3. Operating renewable units, by technology

Figure 4-4 indicates that more than 44% of the currently operating nonhydroelectric renewable units are wind units. Bioenergy units (excluding MSW) account for more than 32% of the nonhydroelectric renewable units.

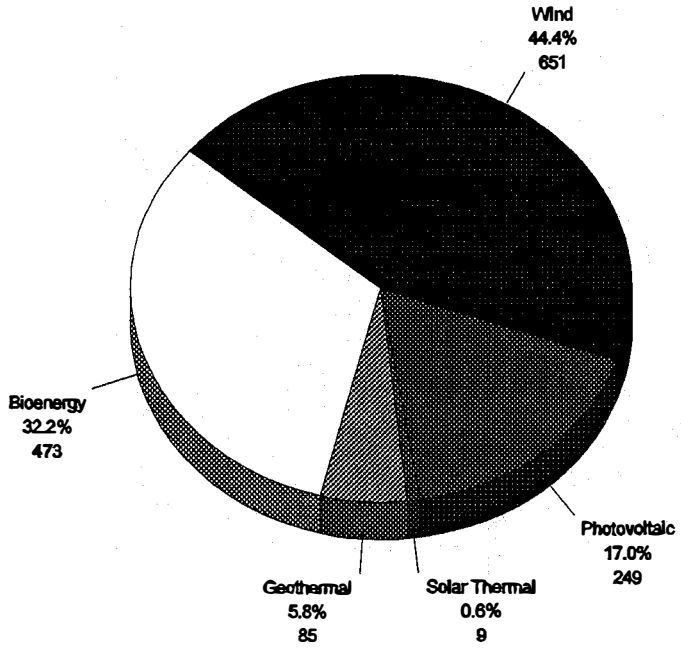
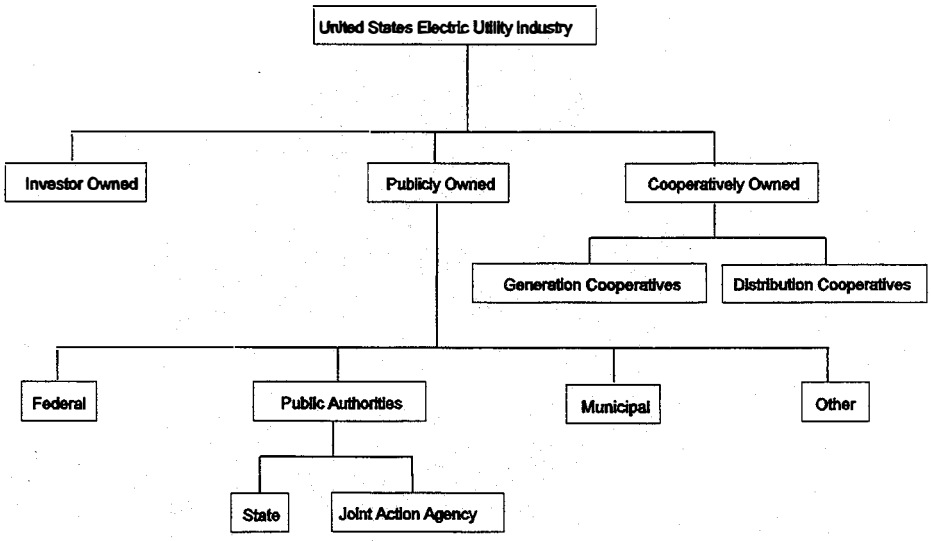


Figure 4-4. Operating nonhydro renewable units, by technology

4.3 Ownership

Unit ownership can be categorized in a number of different ways. Figure 4-5 presents a schematic of the U.S. electric utility industry that has been adopted for REPiS.



Source: Adapted from Garrick & Associates, 1994

Figure 4-5. Electric utility industry organizational chart

The database contains an ownership code for each renewable unit. Table 4-4 shows a breakdown of unit ownership for all operating units based on the conventions presented in Figure 4-5. Approximately 37% of the renewable units, and 31% of the renewable capacity, are owned by investor-owned utilities. Nonutility-owners own 35% of the renewable units and 10% of the capacity. Public authorities own the majority (34%) of the operating renewable capacity and 12% of the total units. Federal entities own 18% of the renewable capacity, which is almost entirely hydro based.

Table 4-4. Ownership of Operating Renewable Units in the United States

Owner Description	Nameplate Capacity (kW)	% of Capacity	Number of Units	% of Units
Canadian	3,900	0.0	1	0.0
Distribution Cooperatives	171,141	0.2	45	0.7
Federally Owned	18,967,209	18.3	334	5.4
Generation Cooperatives	141,190	0.1	27	0.4
Investor-Owned Utilities	32,307,246	31.1	2,253	36.8
Municipal	6,317,596	6.1	587	9.6
Nonutilities	10,666,073	10.3	2,133	34.8
Public Authorities	35,272,296	34.0	750	12.2
Total	103,846,652	100.0	6,131	100.0

Note: Capacity differences between Table 4-4 and other tables are due to rounding.

Approximately 80% of the nonhydroelectric renewable capacity is owned by nonutilities; investor-owned utilities own only 15% of this capacity. Table 4-5 shows the ownership breakdown of nonhydroelectric renewable units in the United States.

Table 4-5. Ownership of Nonhydroelectric Renewable Units in the United States

Owner Description	Nameplate Capacity (kW)	% of Capacity	Number of Units	% of Units
Distribution Cooperatives	4,146	0.0	9	0.6
Federally Owned	357	0.0	25	1.7
Investor-Owned Utilities	1,699,322	15.2	137	9.4
Municipal	161,353	1.4	73	5.0
Nonutilities	8,992,831	80.5	1,192	81.3
Public Authorities	316,943	2.8	30	2.0
Total	11,174,953	100.0	1,466	100.0

4.4 Location Information

REPiS contains location information for virtually all plants in the database. The level of detail, however, varies by plant. The state locations of all plants have been identified in REPiS. In addition, REPiS contains city and county, as available, on some renewable units. REPiS has been designed to accommodate latitude and longitude and power pool information, although the released version of REPiS does not include this data because of its currently limited availability.

The maps included in this document were generated using a geographic information system (GIS) application, a tool that allows the spatial representation of attribute data. More specific locational information is useful for providing detailed geographical representations of renewable electric sites. This locational information can be overlaid, for example, with resource data, transmission data, and load centers using GIS.

Figure 4-6 shows total installed operating nonhydro renewable capacity in the United States, by state. Figure 4-7 reflects installed operating wind capacity in the United States, and Figure 4-8 shows planned wind capacity.

Installed operating PV capacity in the United States is reflected in Figure 4-9 with planned PV capacity shown in Figure 4-10.

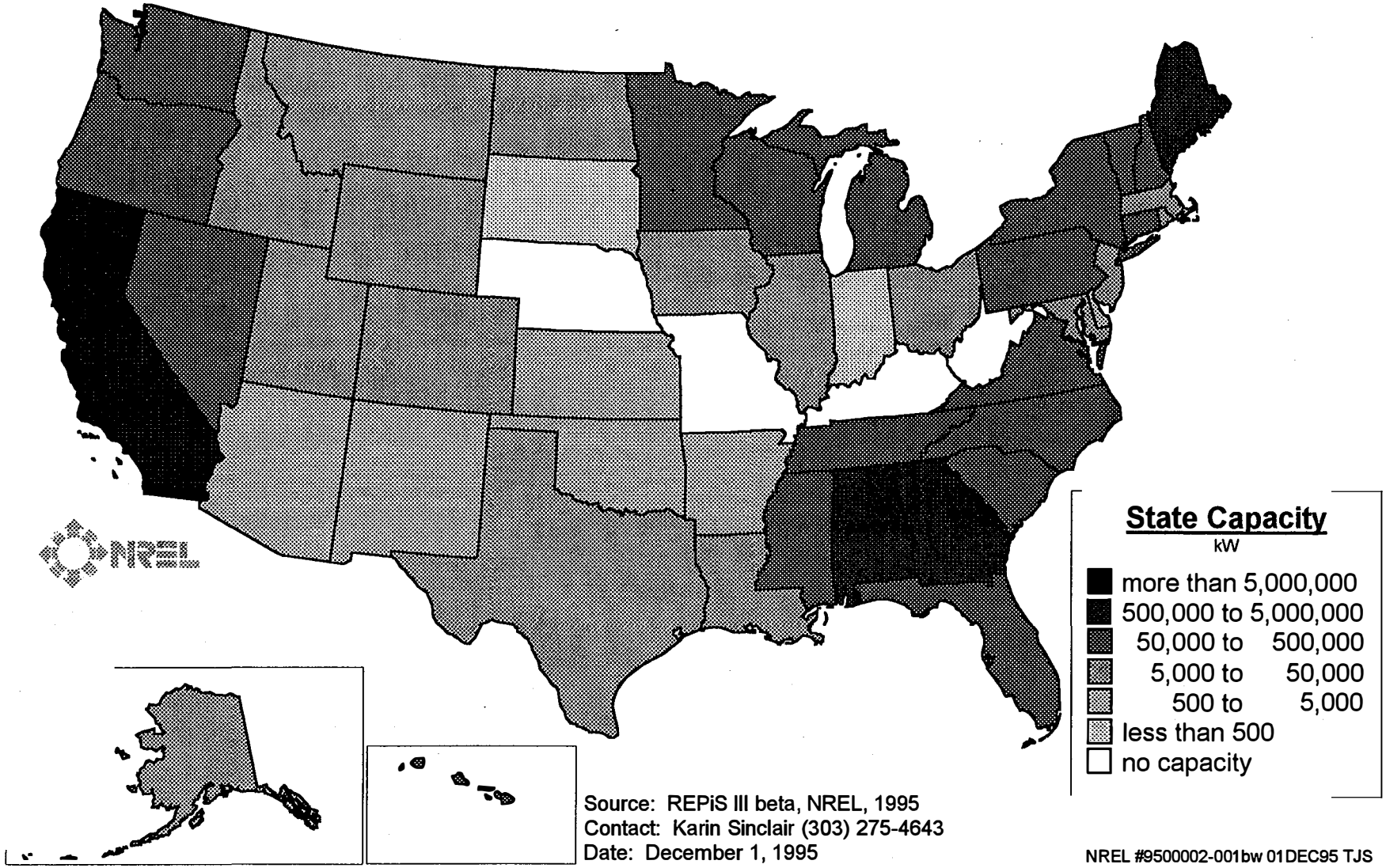


Figure 4-6. Total installed nonhydro renewable capacity (kW) in the United States

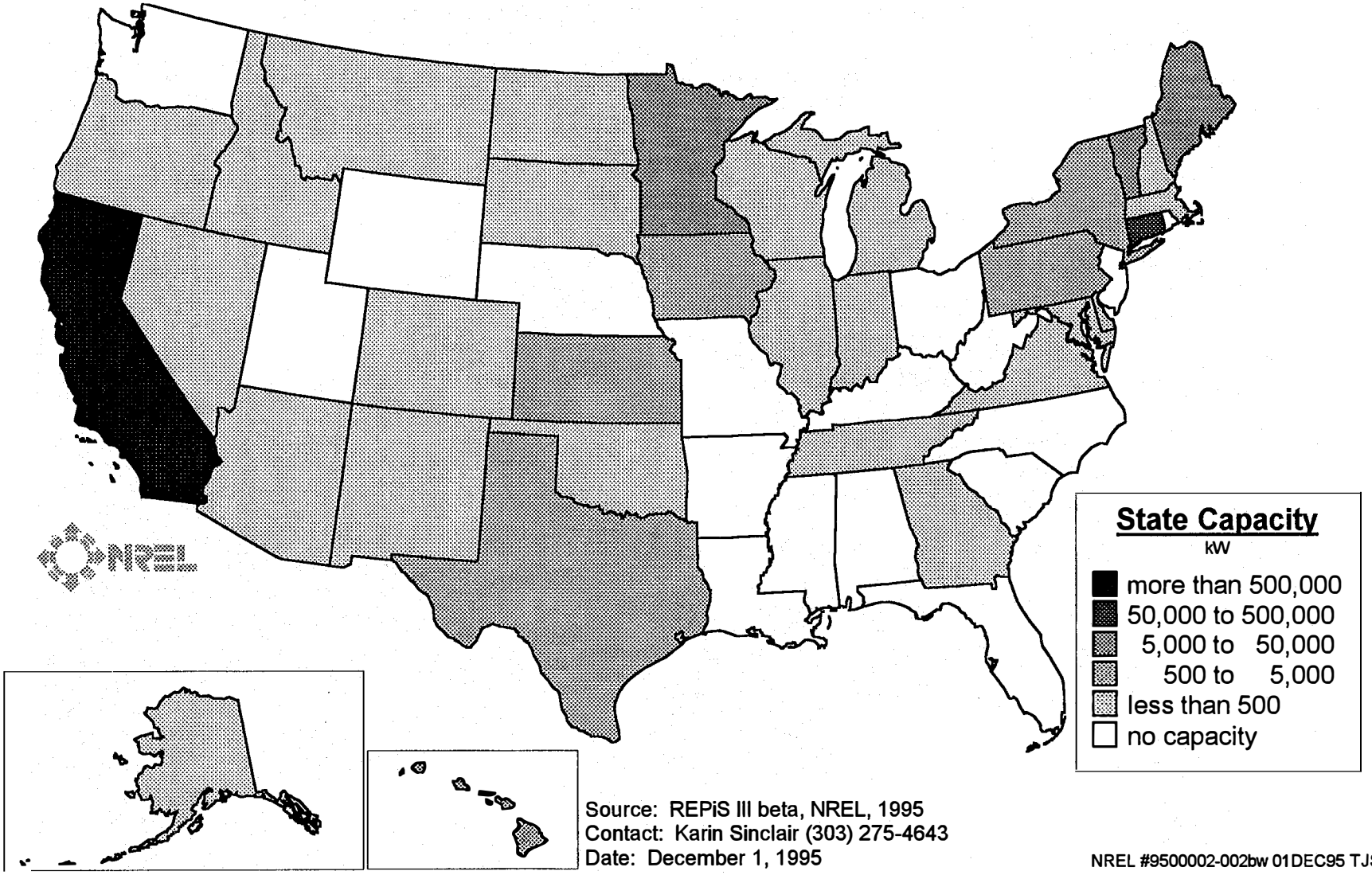


Figure 4-7. Total installed wind capacity (kW) in the United States

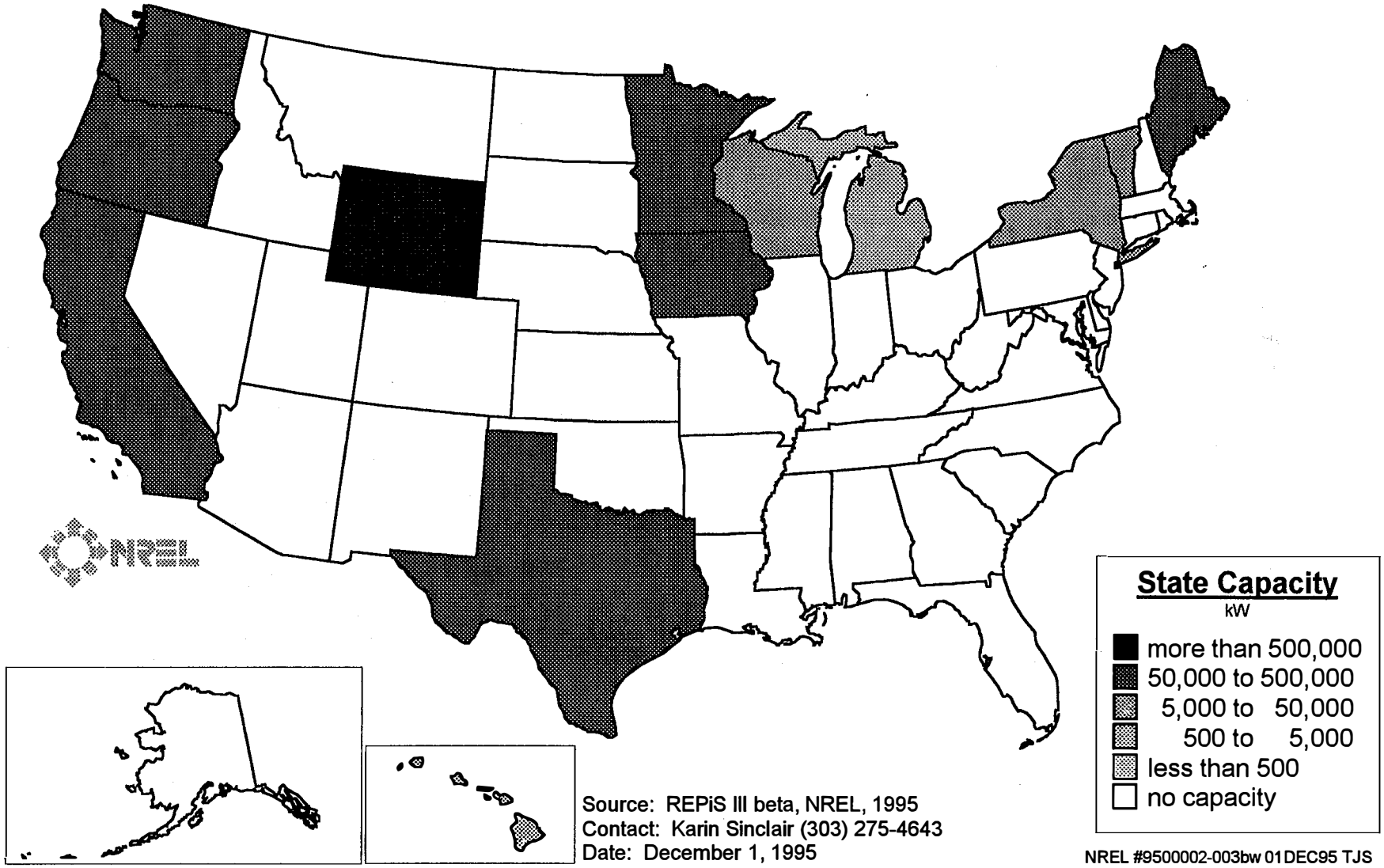


Figure 4-8. Planned wind capacity (kW) in the United States

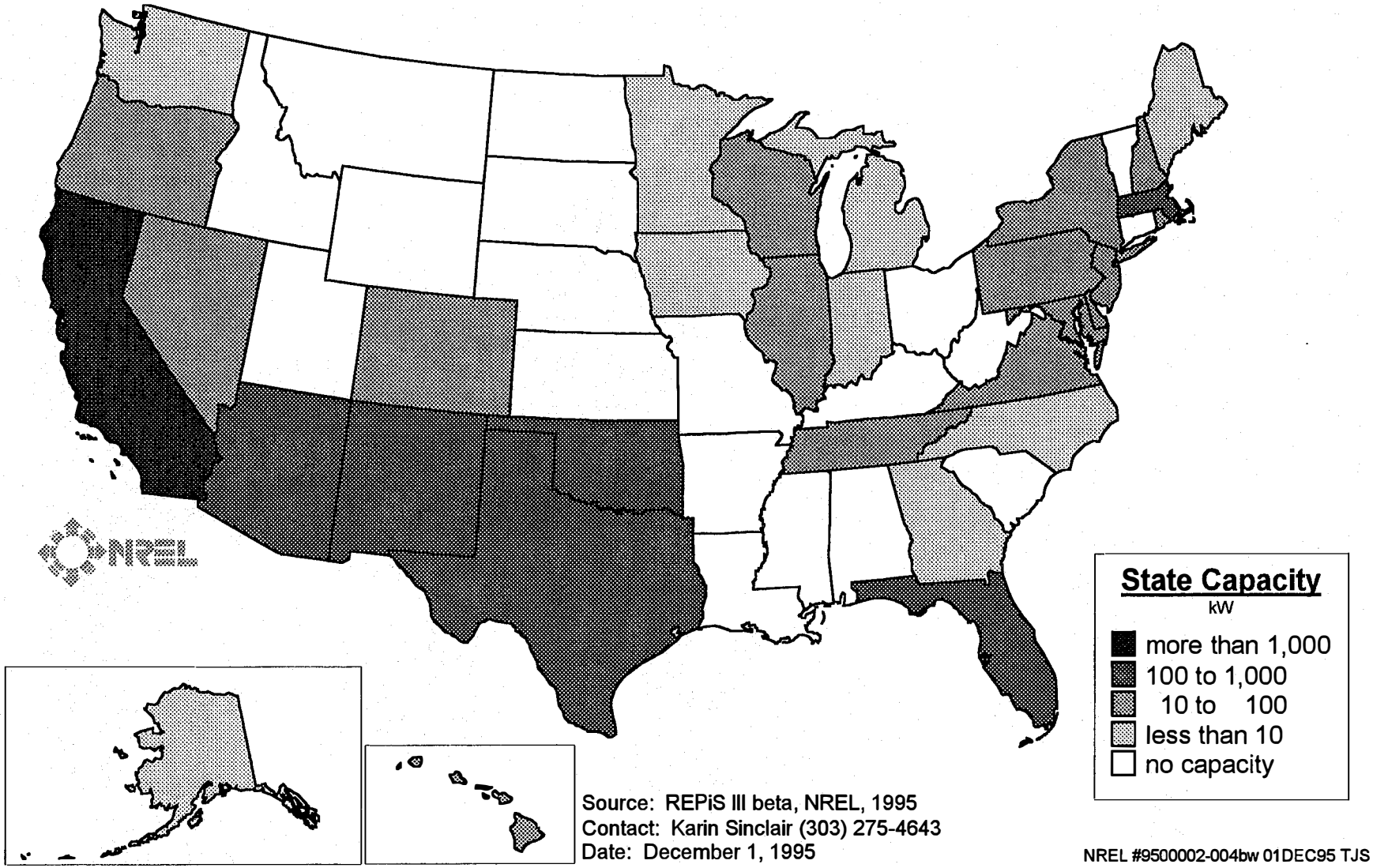


Figure 4-9. Total installed photovoltaic capacity (kW) in the United States

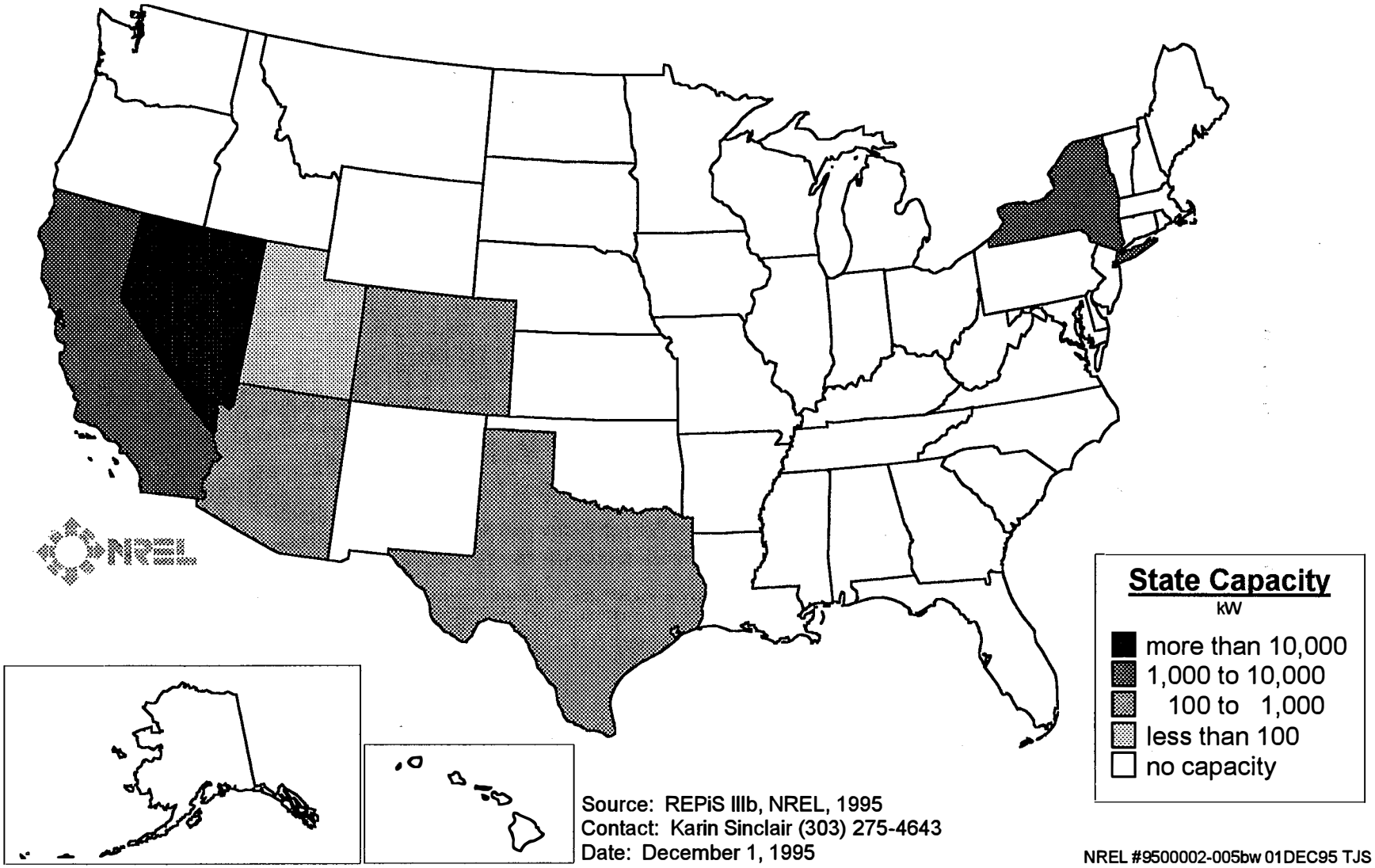


Figure 4-10. Planned photovoltaic capacity (kW) in the United States

4.5 Planned Renewable Units

According to data collected for REPiS, there is a significant amount of renewables development planned during the next 10 years. As shown in Table 4-6, there are 257 planned plants or units representing almost 8,000 MW of capacity.

Table 4-6. Planned Renewable Units

Planned Year	Number of Planned Units	Total Planned Capacity (kW)
Year Unknown	61	1,028,138
1994	29	261,250
1995	45	598,619
1996	46	1,169,149
1997	20	222,272
1998	15	456,200
1999	7	254,900
2000	22	2,466,354
2001	7	1,051,000
2002	3	350,000
2003	1	50,000
2004	1	50,000
Total	257	7,957,852

However, the probability of success varies among planned units. Many planned units contained in REPiS have a probability of success code associated with them. These codes range from conceptual to project under construction. A project is considered to have a high probability of success if it meets any of the following criteria: permitting approved, financing obtained, firm power purchase contract, construction equipment has been ordered, or plant under construction. The first four criteria are consistent with EIA Form 867 reporting requirements.

Table 4-7 illustrates the total number of planned units and those with a high probability of success, by technology. At least 31 planned units have a high likelihood of being completed between 1995 and 2004, although this count may be artificially low due to lack of information. These units represent 839 MW of renewable capacity and 11% of total planned capacity. Although the success rate of 11% seems low, based on the available data it may be reasonable because so many of the planned renewable units are still in the conceptual stage. However, since renewable technologies typically require relatively short lead times to go from the conceptual stage to installation, the likelihood of success may be understated.

A majority of the planned units (16 out of 31) with a high probability of success code are wind. Bioenergy units make up the second largest component of planned additions most likely to be completed (16%).

Table 4-7. Planned Renewable Units, by Technology

Technology	Total Planned		High Probability of Success		% of Total Capacity Planned
	# of Units	Capacity (kW)	# of Units	Capacity (kW)	
Bioenergy	86	1,142,650	7	135,600	12
Geothermal	21	710,000	4	76,000	11
Hydro	87	4,147,412	2	125,000	3
Photovoltaic	11	105,500	1	5	0
Solar Thermal	3	10,015	1	10,000	100
Wind	49	1,842,305	16	492,655	27
Total	257	7,957,882	31	839,260	11

As shown in Table 4-8, planned renewables capacity with a high probability of success can be found in 16 states. Two western states, Wyoming and Oregon, each have firm plans to add more than 100 MW of wind.

Table 4-8. Planned Capacity, with High Probability of Success, by State

State	Technology						Total Capacity (kW)
	Bioenergy Capacity (kW)	Geothermal Capacity (kW)	Hydro Capacity (kW)	Photovoltaic Capacity (kW)	Solar Thermal Capacity (kW)	Wind Capacity (kW)	
Alaska		12,000					12,000
Arizona				5			5
California		12,000			10,000	45,500	67,500
Colorado			25,000				25,000
Florida	73,000						73,000
Iowa						60,000	60,000
Maine						43,500	43,500
Michigan	58,600					600	59,200
Nevada		19,000					19,000
New York	4,000						4,000
Ohio			100,000				100,000
Oregon		33,000				100,000	133,000
Texas						65,160	65,160
Washington						56,645	56,645
Wisconsin						900	900
Wyoming						120,350	120,350
Total	135,600	76,000	125,000	5	10,000	492,655	839,260

Planned renewable units are dispersed around the country. The data in REPiS indicates that 36 states reported expected resource additions from renewables. Table 4-9 shows the location, by state, of all reported planned units.

Table 4-9. Planned Capacity (kW) in the United States, by State and FERC Region

State/FERC Region	Bioenergy	Geothermal	Photo-voltaic	Solar Thermal	Wind	Total Nonhydro	Hydro	Total Including Hydro
Region 1								
Connecticut	2,000					2,000	3,100	5,100
Maine					63,500	63,500	45,200	108,700
Massachusetts	19,000					19,000	13	19,013
New Hampshire	1,600					1,600		1,600
Rhode Island	5,000					5,000		5,000
Vermont	20,000				6,050	26,050	2,500	28,550
Region 1 Total	**47,600**	**0**	**0**	**0**	**69,550**	**117,150**	**50,813**	**167,963**
Region 2								
New Jersey	18,000					18,000		18,000
New York	173,500		2,000		36,000	211,500	179,854	391,354
Region 2 Total	**191,500**	**0**	**2,000**	**0**	**36,000**	**229,500**	**179,854**	**409,354**
Region 3								
Delaware						0		0
District of Columbia						0		0
Maryland						0		0
Pennsylvania	150,000					150,000		150,000
Virginia	86,200					86,200		86,200
West Virginia						0	42,000	42,000
Region 3 Total	**236,200**	**0**	**0**	**0**	**0**	**236,200**	**42,000**	**278,200**
Region 4								
Alabama						0		0
Florida	251,800					251,800		251,800
Georgia	1,600					1,600		1,600
Kentucky						0		0
Mississippi						0		0
North Carolina						0		0
South Carolina	250					250		250
Tennessee						0		0
Region 4 Total	**253,650**	**0**	**0**	**0**	**0**	**253,650**	**0**	**253,650**
Region 5								
Illinois	52,100					52,100		52,100
Indiana	4,800					4,800	1,400	6,200
Michigan	105,700				600	106,300	1,370	107,670
Minnesota	4,800				402,500	407,300		407,300
Ohio						0	203,000	203,000
Wisconsin	20,200				12,900	33,100	7,100	40,200
Region 5 Total	**187,600**	**0**	**0**	**0**	**416,000**	**603,600**	**212,870**	**816,470**

Table 4-9. Planned Capacity (kW) in the United States, by State and FERC Region

State/FERC Region	Bioenergy	Geothermal	Photo-voltaic	Solar Thermal	Wind	Total Nonhydro	Hydro	Total Including Hydro
Region 6								
Arkansas						0	660,000	660,000
Louisiana						0		0
New Mexico						0		0
Oklahoma						0		0
Texas	3,000		100	8	71,160	74,268		74,268
Region 6 Total	**3,000**	**0**	**100**	**8**	**71,160**	**74,268**	**660,000**	**734,268**
Region 7								
Iowa	700				403,100	403,800		403,800
Kansas						0		0
Missouri	800					800	50,000	50,800
Nebraska						0		0
Region 7 Total	**1,500**	**0**	**0**	**0**	**403,100**	**404,600**	**50,000**	**454,600**
Region 8								
Colorado			179			179	27,600	27,779
Montana						0	90,000	90,000
North Dakota						0		0
South Dakota						0		0
Utah		30,000	2			30,002		30,002
Wyoming					520,350	520,350		520,350
Region 8 Total	**0**	**30,000**	**181**	**0**	**520,350**	**550,531**	**117,600**	**668,131**
Region 9								
Arizona	3,000		831	8		3,839		3,839
California	102,700	249,000	2,388	10,000	109,500	473,588	785,400	1,258,988
Hawaii		10,000			10,000	20,000		20,000
Nevada		345,000	100,000			445,000	100,000	545,000
Region 9 Total	**105,700**	**604,000**	**103,219**	**10,008**	**119,500**	**942,427**	**885,400**	**1,827,827**
Region 10								
Alaska		12,000				12,000	4,900	16,900
Idaho		9,900				9,900	167,975	177,875
Oregon	16,300	54,100			150,000	220,400	1,016,000	1,236,400
Washington	99,600				56,645	156,245	760,000	916,245
Region 10 Total	**115,900**	**76,000**	**0**	**0**	**206,645**	**398,545**	**1,948,875**	**2,347,420**
United States Total	**1,142,650**	**710,000**	**105,500**	**10,016**	**1,842,305**	**3,810,470**	**4,147,412**	**7,957,882**

5.0 Database Design

The current version of the REPiS database was completely redesigned, allowing for a more detailed and comprehensive summary of plant-related information. There are two primary tables in REPiS with the tables linked by a plant identification number. Appendices B and C provide descriptions of the fields contained in each table. As a result of the new database design, updates can now be handled more efficiently and expeditiously and changes can be easily accommodated.

5.1 Data Fields

The primary data fields included in REPiS include plant and unit name, unit owner, location, capacity, technology, system type, and purchasing utility (Appendix A). Other fields include the relationship between plant and utility, fuel code, unit status, and company type.

5.2 Co-fired Units

There is a potential for units to co-fire a mix of fuels; the database structure has been designed to accommodate these cases. Co-firing can include burning a mix of fossil and biomass at the same time, for example. Other instances may involve switching between fossil and biomass fuels. The percentage contribution from the renewable fuel source is used to calculate the contribution of a unit to the renewable capacity count. REPiS can easily accommodate any changes to the fuel mix percentages. This feature will be particularly useful if more coal plants switch to mixed fuels in an effort to comply with emission restrictions under the Clean Air Act.

5.3 Plant Status

The database contains units operating as of 1994 and has been designed to accommodate a variety of statuses. Operating units may include demonstration, field trial, out-of-service, pilot, standby, and test units. In addition, retired, cancelled, and planned renewable units are contained in the database.

As discussed in Section 4.5, each planned renewable unit has an associated criteria for success code, which was current as of 1995. Most hydroelectric units have a PL-only designation, which means the project is not under construction but its exact status is unknown (see Table C-2 for a description of status codes). The requirement for planned units to be included in REPiS is less stringent than the reporting requirement on planned units to the EIA, using EIA Form 867. REPiS contains all known planned renewable units, irrespective of how far along the development is. Therefore, REPiS captures more planned renewable units than EIA.

The criteria for success status codes range from PL1 (initial planning stage) through PL11 (equipment has been ordered). When construction work is in progress, a CO code is assigned to the planned unit. Codes PL8 through PL11 are consistent with the EIA Form 867 criteria for planned additions.

5.4 Hardware/Software Requirements

The basic hardware/software requirements to operate the REPiS database are a PC capable of running Windows in a 386 mode and a copy of Paradox for Windows. For optimal performance, a 486DX PC with a minimum of 8 megabytes of RAM and 35 megabytes of available disk space should be considered. Designed in Paradox for Windows, the database can be made compatible with other standard database software, including FoxPro and Dbase.

5.5 Comparison to 1989

There has been a change in the mix of renewable units between 1989 and 1994. Table 5-1 compares REPiS II aggregated findings with REPiS III. Based on this comparison, there has been a 4.2% overall increase in operating renewable capacity. During the past 5 years, with the exception of photovoltaics, all technologies experienced an increase in capacity additions. These increases ranged from almost 29% for wind to 2% for geothermal.

It should also be noted that PV experienced a 28% decrease in capacity between REPiS II and REPiS III. There are several reasons for this change. First, there were a number of PV units in the REPiS II data set that were counted as operating but were actually retired. For this one reason, the PV capacity in 1989 should have been represented as 11,329 kW. Based on this adjusted number, the change in PV capacity is more accurately characterized as a 23% decrease between 1989 and 1995.

A second reason for the differential is that a large amount of PV, more than 5,000 kW, was retired between 1989 and 1995. This capacity represented large-scale PV demonstration facilities.

Table 5-1. Comparison of Capacity (kW) between REPiS II and REPiS III, by Technology

	Bioenergy	Geothermal	Hydro	PV	Solar Thermal	Wind	Total
REPiS II	5,196,665	2,839,136	89,701,117	12,225	289,350	1,667,919	99,706,412
REPiS III	5,739,215	2,904,858	92,671,697	8,778	367,748	2,154,354	103,846,650
% Change (REPiS III to REPiS II)	10.4% increase	2.3% increase	3.3% increase	28.2% decrease	27.1% increase	29.2% increase	4.2% increase

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Appendix A

Primary Data Fields

Table A-1. Primary Data Fields

Plant Name(s)
Unit Name
Unit Owner(s)
Plant Location (where available)
Installed Nameplate Capacity
Year of Installation
Technology, System Type, and Fuel Type
Purchasing Utility

Appendix B

Plant Name, Location, and Utility Table

Table B-1. Plant Name, Location, and Utility Table Structure

Field Name	Field Type	Size (in characters)
ID Code	Alpha	6
Plant Name	Alpha	65
Utility Name	Alpha	50
Contract Factor	Numeric	
Start Year	Short integer	
Term	Short integer	
End Year	Short integer	
Relationship (Code)	Alpha	2
Landmark	Alpha	50
City	Alpha	25
County	Alpha	25
State (Code)	Alpha	2
Zip	Alpha	9
# of Units	Alpha	2

Table B-2. Relationship between Plant and Utility

Relationship Codes	Code Description
C	Plant is Contracted to Sell Power to Utility
IC	Interconnected with Utility
NA	Information is Not Available
OP	Utility Owns the Plant
PG	Parallel Generator - Contributes and Receives
PP	Plant Sells Power to Utility

Table B-3. State Code and FERC Region

State	State Name	FERC Region
AK	Alaska	10
AL	Alabama	4
AR	Arkansas	6
AZ	Arizona	9
CA	California	9
CO	Colorado	8
CT	Connecticut	1
DC	District of Columbia	3
DE	Delaware	3
FL	Florida	4
GA	Georgia	4
HI	Hawaii	9
IA	Iowa	7
ID	Idaho	10
IL	Illinois	5
IN	Indiana	5
KS	Kansas	7
KY	Kentucky	4
LA	Louisiana	6

Table B-3. State Code and FERC Region

State	State Name	FERC Region
MA	Massachusetts	1
MD	Maryland	3
ME	Maine	1
MI	Michigan	5
MN	Minnesota	5
MO	Missouri	7
MS	Mississippi	4
MT	Montana	8
NC	North Carolina	4
ND	North Dakota	8
NE	Nebraska	7
NH	New Hampshire	1
NJ	New Jersey	2
NM	New Mexico	6
NV	Nevada	9
NY	New York	2
OH	Ohio	5
OK	Oklahoma	6
OR	Oregon	10
PA	Pennsylvania	3
RI	Rhode Island	1
SC	South Carolina	4
SD	South Dakota	8
TN	Tennessee	4
TX	Texas	6
UT	Utah	8
VA	Virginia	3
VT	Vermont	1
WA	Washington	10
WI	Wisconsin	5
WV	West Virginia	3
WY	Wyoming	8

Appendix C

Unit and Owner Table

Table C-1. Unit and Owner Table Structure

Field Name	Type	Size (in characters)
ID Code	Alpha	6
Unit Code	Alpha	6
Fuel Code	Alpha	4
Owner Name	Alpha	50
Status Code	Alpha	4
Status Yr	Short Integer	
Tech Code	Alpha	3
Sys Type Code	Alpha	6
Fuel/Ownership Factored NP (kW)	Numeric	
Owner Code	Alpha	1
% of Unit Owned	Numeric	
Notes	Alpha	255

Table C-2. Status Codes

Status Code	Description	Classification
CN	Cancelled	Retired
CO	Under Construction	Planned
IP	Postponed	Planned
OP	Operating	Operating
OS	Out of Service	Operating
PL	Planned (Unit Not Under Construction)	Planned
PL1	Initial Planning Stage	Planned
PL10	Firm Contract	Planned
PL11	Equipment Has Been Ordered	Planned
PL2	Resource Monitoring Begun	Planned
PL3	Permitting in Progress (Environment and/or Reg.; Including Siting)	Planned
PL4	Financial Letter of Intent In Hand	Planned
PL5	Fuel Source Commitment Signed Contracts	Planned
PL6	Project Selected from RFP Process	Planned
PL7	Contract Under Negotiation	Planned
PL8	Permitting Approved	Planned
PL9	Financial Closure	Planned
RE	Retired	Retired
REDM	Retired and Dismantled	Retired
SB	Standby	Operating
SD	Sold to and Operated by Nonutility	Retired
TS	Testing	Operating
UNK	Unknown	Unknown

Table C-3. Technology Codes

Tech Code	Description
BIO	Bioenergy
G	Geothermal
H	Hydro
P	Photovoltaic
ST	Solar Thermal
W	Wind

Table C-4. System Type Codes

System Type Code	Description
(Blank)	Unknown System Type
AB	Atmospheric Fluidized-Bed Clean-Burning Plant (BIO)
B	Binary (GEO)
C	Concentrating (PV)
CC	Combined Cycle (BIO)
CR	Central Receiver (ST)
CS	Central Station (PV)
D	Distributed (PV)
DF	Dual Flash (GEO)
DS	Dry Steam (GEO)
DSTR	Dish Stirling (ST)
FP	Flat Plate (PV)
GT	Gas Turbine (BIO)
GE	Geothermal - Unknown System Type
GP	GeoPressure (GEO)
HTC	Hydraulic Turbine Conventional
HTP	Hydraulic Turbine Pipeline
HTR-PS	Hydraulic Turbine Reversible-Pumped Storage
HY	Hydro - Unknown System Type (HTC or HTP)
IC	Internal Combustion (BIO)
MT	Multiple Turbines (Wind Farm)
PD	Parabolic Dish (ST)
PS	Pumped Storage (H)
PT	Parabolic Trough (ST)
SF	Single Flash (GEO)
SP	Photovoltaic - Unknown System Type (CS or D)
SST	Solar Steam Turbine - Unknown System Type (CR or PD or PT)
ST<100	Single Turbine <100 kW
ST>100	Single Turbine >100 kW
STT	Steam Turbine (BIO)
TF	Triple Flash (GEO)
WT	Wind Turbine - Unknown System Type (MT or ST)

Units using bioenergy (biomass) technology will have system types that depend on the fuel type used. Possible system types for bioenergy are:

AB - Atmospheric fluidized-bed clean-burning plant (all fuel types)
IC - Internal combustion (biogas fuel type)
STT - Steam turbine (all fuel types)

Table C-5. Fuel Codes

Fuel Code	Description	Classification
AR	Agricultural Residues (Waste)	Bioenergy
BG	Biogas	Bioenergy
ER	Energy Crops	Bioenergy
GST	Geothermal Steam	Geothermal
MSW	Municipal Solid Waste (Including Industrial and Medical)	Bioenergy
SUN	Solar	Sun
TR	Timber Residues (Milling and Logging Residues)	Bioenergy
UNK	Unknown	Unknown
WAT	Water	Water
WND	Wind	Wind

Table C-6. Bioenergy (Biomass) Fuel Code Descriptions

Bioenergy Fuel Code	Description
AR	Agricultural Residues (Waste)
	Cannery Wastes
	Nut Hulls
	Fruit Pits
	Nut Shells
BG	Biogas
	Alcohol (Term Includes Butanol, Ethanol, and Methanol)
	Bagasse
	Hydrogen
	Landfill Gas (Refuse Gas) see also METHANE
	Livestock Manure
	Methane (LGAS or Sewage Gas) Includes Digester Gas
	Refuse Gas
	Municipal Sewage
	Wood Gas (from Wood Gasifier)
ER	Energy Crops
	Grains (Corn, Rice, Wheat)
MSW	Municipal Solid Waste (Including Industrial and Medical)
	Hazardous Waste
	Refuse-Derived Fuel (Combustible Portion of Refuse)
	Refuse (Garbage, Trash) (Brush, Dirt, Food Waste, Grass, Greens, Leather, Leaves, Oils, Paints, Paper, Plastics, Rags, Rubber, Wood)
	Scrap Tires (Could be Shredded)
	Wastewater Sludge

Table C-6. Bioenergy (Biomass) Fuel Code Descriptions

Bioenergy Fuel Code	Description
TR	Timber Residues (Milling Residues and Logging Residues)
	Tree Bark
	Wood Chips (from Milling/Logging)
	Hog (Hogged) Fuel
	Pulping Liquor
	Paper Mill Sludge
	Peat
	Tree Pitch
	Sander Dust (from Milling)
	Sawdust (from Milling)
	Shavings (from Milling)
	Tree Trim (from Milling)
	Wood or Wood Waste

Table C-7. Owner Codes

Owner Code	Description	Classification
A	Public Authorities	Publicly Owned
C	Generation Cooperatives	Cooperatives
D	Canadian	Canadian
F	Federally Owned	Publicly Owned
I	Oil Company	Nonutilities
P	Power Pool/Planning Areas	Power Pool
M	Municipal	Publicly Owned
N	Nonutilities	Nonutilities
P	Investor-Owned Utilities	Investor Owned
T	Distribution Cooperatives	Cooperatives
Y	Local Distribution Company	Local Distribution
Z	Unknown	Unknown

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13. ABSTRACT *(Maximum 200 words)*

This report explains the procedures used for creating the Renewable Electric Plant Information System (REPiS) database, describes the database fields, and summarizes the data. The REPiS database contains comprehensive information on grid-connected renewable electric generation plants in the United States. Originally designed in 1987 and updated in 1990, the database includes information through 1994. The report also illustrates ways of using the data for analysis and describes how researchers validated the data.

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