

2007 | CENSUS OF AGRICULTURE

On-Farm Renewable Energy Production Survey (2009)

Volume 3 • Special Studies • Part 6

AC-07-SS-6

Issued February 2011

United States Department of Agriculture
Tom Vilsack, Secretary
National Agricultural Statistics Service
Cynthia Z.F. Clark, Administrator

Contents

Introduction.....	Page V
-------------------	-----------

TABLES

1. Farms Reporting Wind Turbines, Capacity, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009	1
2. Farms Reporting Methane Digesters, Number of Digesters, Methane Produced, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009.....	2
3. Farms Reporting Photovoltaic (PV) and Thermal Solar Panels by Type, Capacity, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009.....	3
4. Farms Reporting Energy Savings, Energy Audits, and/or Federal Funding: 2009	4

APPENDICES

A. Statistical Methodology	A-1
B. General Explanation and Report Form.....	B-1

Introduction

BACKGROUND

The 2009 On-Farm Renewable Energy Production Survey (OREPS) is a follow-on survey to the 2007 Census of Agriculture. It is the first on-farm renewable energy production survey conducted on the national level by the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS).

The 2009 OREPS provides additional information on energy produced by wind turbines, solar panels, and methane digesters that were in operation on farms in 2009. Wind turbines located on farm operations under a wind rights lease agreement are considered commercial and were excluded from this survey. Methane digesters not owned and operated by the farm operation were not included in the survey.

This energy survey provides an inventory of farm-generated energy practices with detailed data relating to the category or type of energy produced (wind, solar, and manure/methane digester), installation cost, percent of cost from outside funding, year installed, and total amount of utility savings from the use of on-farm renewable energy production.

USES OF SURVEY DATA

Producers, universities, legislators, utility providers, farm businesses, etc. are in need of renewable energy production and economic data in order to assess the growth and viability of new energy sources and make important marketing, business, and policy decisions. The production of on-farm renewable energy can provide cost saving alternatives for America's farmers and ranchers. The information gathered will help in the continued development of this expanding agricultural industry.

AUTHORITY

The census of agriculture is required by law under the "Census of Agriculture Act of 1997," Public Law 105-113 (Title 7, United States Code, Section 2204g). The law authorizes the Secretary of Agriculture to conduct surveys deemed necessary to furnish annual or other data on the subjects covered by the census. The 2009 On-Farm Renewable Energy Production Survey was conducted under the provisions of this section.

RENEWABLE ENERGY DEFINITION

Renewable energy is energy that comes from natural sources (sun, wind, water, biomass, and geothermal) and is renewable or naturally replenished. Renewable energy differs not only from fossil energy sources such as petroleum, gas, and coal, but also from nuclear energy.

REFERENCE PERIOD

Energy production and savings were measured for the 2009 calendar year. Installation costs and outside funding were as of time of installation.

TABLES AND APPENDICES

Tables. Tables 1 through 4 provide data from the survey at the U.S. and State level.

Appendix A. Provides information about data collection and data processing activities and discusses the statistical methodology used in conducting and evaluating the survey. Tables A and B provide statistical precision estimates for selected survey items.

Appendix B. Includes definitions of specific terms

and phrases used in this publication. It also provides facsimiles of the report form and instruction sheet used to collect data.

RESPONDENT CONFIDENTIALITY

In keeping with the provisions of Title 7 of the United States Code, no data are published that would disclose information about an individual operation. All tabulated data are subjected to an extensive disclosure review prior to publication. Any tabulated item that identifies data reported by a respondent or allows a respondent's data to be closely estimated or derived is suppressed and coded with a 'D'. The number of operations reporting an item is not considered confidential information and is provided even though other information may be withheld.

DATA PRODUCTS AND CUSTOM TABULATIONS

The 2009 On-Farm Renewable Energy Production Survey data, as well as the 2007 Census of Agriculture Volume 1 Geographic Area Series and related reports, are available on the NASS website at www.nass.usda.gov/.

Custom-designed tabulations may be developed when data are not published elsewhere. These tabulations are developed to individual user specifications on a cost-reimbursable basis and shared with the public. The census Volume 1 on a downloadable desktop query tool and the census

Quick Stats are alternative data sources that should be investigated before requesting a custom tabulation.

All custom tabulations are subject to a thorough disclosure review prior to release to prevent the disclosure of any individual respondent data. Requests for custom tabulations can be submitted via the internet from the NASS home page, by mail, or by e-mail to:

DataLab
National Agricultural Statistics Service
Room 6436A, Stop 2054
1400 Independence Ave, S.W.
Washington, D.C. 20250-2054
or
Datalab@nass.usda.gov

ABBREVIATIONS AND SYMBOLS

The following abbreviations and symbols are used throughout the tables:

- Represents zero.
- (D) Withheld to avoid disclosing data for individual farms.
- (Z) Less than half of the unit shown.
- (NA) Not available.
- (X) Not applicable.
- W Watt.
- kW Kilowatt.

Table 1. Farms Reporting Wind Turbines, Capacity, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009

State	Farms	Number of turbines	Average per turbine		Percent of installation cost funded by outside sources ¹	Year wind turbines installed ² (number of turbines)		
			Rated generating capacity ¹ (kilowatts)	Installation cost ¹ (dollars)		Prior to 2000	2000-2004	2005-2009
ALL WIND, TOTAL								
United States	1,420	1,845	(X)	(X)	(X)	(D)	535	(D)
SMALL WIND (1-100kW)								
United States	1,406	1,831	6	12,972	49	356	532	899
Alabama	3	4	(D)	(D)	-	-	-	4
Alaska	8	8	1	4,394	-	3	-	5
Arizona	63	78	1	2,768	51	15	30	30
Arkansas	7	11	2	5,800	-	5	(D)	(D)
California	134	160	3	13,955	50	38	60	52
Colorado	98	147	3	4,581	-	26	38	80
Connecticut	1	(D)	(D)	(D)	-	-	-	(D)
Delaware	-	-	-	-	-	-	-	-
Florida	5	5	1	5,250	-	-	-	5
Georgia	4	4	(D)	(D)	-	-	4	-
Hawaii	43	67	1	1,799	-	16	23	28
Idaho	39	44	4	12,778	25	9	12	23
Illinois	28	36	5	11,448	(D)	(D)	(D)	28
Indiana	49	58	2	7,870	(D)	4	9	43
Iowa	39	48	8	23,840	29	17	8	21
Kansas	18	20	6	10,084	-	5	5	10
Kentucky	1	(D)	(D)	(D)	-	-	-	(D)
Louisiana	2	(D)	(D)	(D)	-	-	-	(D)
Maine	32	34	5	17,353	(D)	8	11	15
Maryland	2	(D)	(D)	(D)	(D)	-	-	(D)
Massachusetts	22	30	7	43,218	45	5	-	25
Michigan	34	47	2	9,981	(D)	4	10	33
Minnesota	99	144	20	37,647	51	15	46	83
Mississippi	3	3	1	4,467	-	-	-	3
Missouri	21	28	3	7,779	(D)	(D)	(D)	20
Montana	63	78	3	6,293	62	9	33	36
Nebraska	7	9	1	1,563	-	-	5	4
Nevada	8	10	1	1,455	-	(D)	5	(D)
New Hampshire	11	11	3	9,850	-	6	(D)	(D)
New Jersey	3	3	8	47,518	63	-	(D)	(D)
New Mexico	28	34	1	4,807	-	10	5	17
New York	58	65	5	22,254	64	12	21	32
North Carolina	12	12	2	12,800	-	(D)	(D)	7
North Dakota	5	9	(D)	15,778	(D)	5	(D)	(D)
Ohio	44	57	2	11,257	39	15	13	29
Oklahoma	20	22	2	4,156	(D)	(D)	10	(D)
Oregon	37	63	1	3,209	(D)	19	22	22
Pennsylvania	26	27	3	7,148	(D)	4	4	15
Rhode Island	2	(D)	(D)	(D)	(D)	(D)	-	-
South Carolina	-	-	-	-	-	-	-	-
South Dakota	11	13	4	19,064	-	(D)	(D)	8
Tennessee	9	13	(D)	8,177	-	-	8	5
Texas	102	148	4	8,493	-	19	46	81
Utah	31	41	1	2,562	-	7	10	18
Vermont	43	54	3	16,847	46	3	33	18
Virginia	11	13	1	2,971	35	-	4	9
Washington	50	67	19	12,669	(D)	30	12	23
West Virginia	4	4	5	44,400	-	(D)	-	(D)
Wisconsin	46	59	8	15,329	33	22	18	17
Wyoming	20	35	2	4,648	(D)	(D)	(D)	29

See footnote(s) at end of table.

--continued

Table 1. Farms Reporting Wind Turbines, Capacity, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009 - (continued)

State	Farms	Number of turbines	Average per turbine		Percent of installation cost funded by outside sources ¹	Year wind turbines installed ² (number of turbines)		
			Rated generating capacity ¹ (kilowatts)	Installation cost ¹ (dollars)		Prior to 2000	2000-2004	2005-2009
LARGE WIND (>100kW)								
United States	14	14	1,035	1,339,143	39	(D)	3	(D)
Iowa	9	9	1,359	1,784,889	(D)	-	3	6
Other States ³	5	5	453	536,800	(D)	(D)	-	(D)

¹ Only includes positive reported data. Operations that reported zero or failed to report are not included.

² Numbers may not add to total number of turbines. Only includes operations reporting year installed.

³ Other States include Kansas, Minnesota, and Montana.

Table 2. Farms Reporting Methane Digesters, Number of Digesters, Methane Produced, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009

State	Farms	Number of methane digesters	Average per methane digester		Percent of installation cost funded by outside sources ¹	Year methane digesters installed ² (number of digesters)		
			Methane produced ¹ (cubic feet)	Installation cost ¹ (dollars)		Prior to 2000	2000-2004	2005-2009
United States	121	140	30,515,800	1,718,562	48	11	22	86
California	14	14	29,194,314	1,794,444	47	(D)	-	(D)
Michigan	5	10	36,923,333	1,322,222	(D)	-	-	9
Minnesota	5	6	69,105,120	3,123,333	(D)	(D)	(D)	(D)
New York	16	16	18,611,675	1,611,206	36	-	3	10
Pennsylvania	13	16	18,951,843	642,188	58	(D)	(D)	9
Vermont	8	8	(D)	1,718,750	31	(D)	-	(D)
Wisconsin	21	25	(D)	1,608,924	19	-	6	18
Other States ³	39	45	26,034,140	2,181,189	76	4	8	23

¹ Only includes positive reported data. Operations that reported zero or failed to report are not included.

² Numbers may not add to total number of digesters. Only includes operations reporting year installed.

³ Other States include Colorado, Connecticut, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Maryland, Mississippi, Missouri, Montana, Nebraska, North Carolina, Ohio, Oklahoma, Oregon, South Dakota, Tennessee, Texas, Washington, and Wyoming.

Table 3. Farms Reporting Photovoltaic (PV) and Thermal Solar Panels by Type, Capacity, Installation Cost, Percent Funded by Outside Sources, and Year of Installation: 2009

State	Farms	Farms reporting ¹		Average per farm		Percent of installation cost funded by outside sources ¹	Year solar panels installed ² (number of solar panels)		
		PV solar panels	Thermal solar panels	PV rated generating capacity ¹ (watts)	Installation cost ¹ (dollars)		Prior to 2000	2000-2004	2005-2009
United States	7,968	7,236	1,835	4,449	31,947	44	18,881	45,028	108,532
Alabama	33	24	13	865	6,948	47	25	9	96
Alaska	16	15	1	865	9,134	42	66	(D)	79
Arizona	255	242	41	2,002	19,992	50	1,200	1,271	1,795
Arkansas	41	37	5	833	7,502	(D)	238	47	132
California	1,906	1,825	385	11,229	78,910	41	4,242	27,544	64,328
Colorado	504	445	117	1,654	16,879	47	1,843	1,462	2,520
Connecticut	26	23	10	4,173	29,571	52	(D)	54	428
Delaware	4	4	-	15,500	101,250	54	-	-	(D)
Florida	88	69	39	2,162	12,223	40	148	54	488
Georgia	32	30	4	3,625	28,545	66	22	76	378
Hawaii	520	469	213	1,790	16,665	28	1,498	1,790	4,189
Idaho	131	121	21	916	12,524	55	442	220	396
Illinois	58	45	18	4,575	39,018	44	344	803	384
Indiana	127	112	27	543	5,262	-	132	131	323
Iowa	40	34	19	1,988	17,791	47	42	142	380
Kansas	116	93	36	408	4,607	55	186	81	172
Kentucky	67	56	21	776	6,305	29	62	36	387
Louisiana	13	13	2	876	10,970	(D)	(D)	(D)	74
Maine	97	87	27	1,680	13,892	26	330	216	1,161
Maryland	21	19	11	2,665	24,201	26	115	(D)	298
Massachusetts	63	50	22	3,678	27,624	53	154	173	959
Michigan	75	53	27	841	7,416	30	198	64	278
Minnesota	73	51	34	1,409	11,178	45	193	133	240
Mississippi	23	23	1	706	11,593	(D)	14	58	48
Missouri	93	84	22	1,022	9,429	54	114	63	360
Montana	238	226	35	988	9,180	48	562	565	882
Nebraska	65	65	7	742	5,632	57	149	232	317
Nevada	51	51	6	1,832	21,971	33	152	166	542
New Hampshire	49	35	26	1,641	16,173	(D)	413	-	416
New Jersey	138	138	24	14,081	112,855	64	216	2,204	9,631
New Mexico	258	241	38	1,261	12,888	39	675	690	1,000
New York	156	140	29	2,501	21,661	59	315	459	1,867
North Carolina	104	67	55	1,015	10,198	47	159	163	388
North Dakota	29	28	2	429	5,048	47	17	40	68
Ohio	130	115	23	1,614	12,122	53	185	781	454
Oklahoma	187	167	37	428	4,612	45	164	210	351
Oregon	332	294	97	3,002	22,147	44	793	1,046	3,284
Pennsylvania	173	160	37	1,750	20,699	44	122	290	2,048
Rhode Island	12	10	6	(D)	30,960	(D)	18	(D)	236
South Carolina	20	18	5	(D)	5,047	54	42	28	53
South Dakota	55	45	12	696	7,470	49	44	109	148
Tennessee	66	59	9	1,065	8,657	29	199	114	396
Texas	573	541	67	783	7,692	42	511	806	1,850
Utah	133	125	20	1,211	14,573	51	183	580	504
Vermont	110	103	28	1,304	15,510	34	444	272	582
Virginia	83	70	16	869	12,868	22	104	186	360
Washington	205	188	39	1,547	10,377	16	588	740	872
West Virginia	27	24	5	521	8,166	(D)	52	56	(D)
Wisconsin	176	134	78	2,484	17,607	27	866	424	1,333
Wyoming	176	168	18	1,275	10,362	42	287	411	793

¹ Only includes positive reported data. Operations that reported zero or failed to report are not included.

² Only includes operations reporting year installed.

Table 4. Farms Reporting Energy Savings, Energy Audits, and/or Federal Funding: 2009

[Only operations that reported wind turbines, methane digesters, and/or solar panels]

State	Total farms reporting wind turbines, digesters, and/or solar panels	Average dollars saved on 2009 utility bills per farm ¹	Performed energy audit (farms)	Received federal funding (farms)
United States	8,569	2,406	613	1,101
Alabama	33	1,006	1	6
Alaska	17	1,393	2	3
Arizona	259	2,461	8	46
Arkansas	42	1,070	2	2
California	1,956	4,395	237	282
Colorado	518	1,415	14	48
Connecticut	28	2,061	8	3
Delaware	4	2,375	2	3
Florida	91	1,013	8	5
Georgia	32	872	2	10
Hawaii	522	2,125	10	19
Idaho	147	1,487	5	8
Illinois	76	1,688	3	14
Indiana	152	518	2	7
Iowa	74	1,573	7	22
Kansas	125	689	-	11
Kentucky	68	831	3	3
Louisiana	13	(D)	1	-
Maine	108	1,221	13	9
Maryland	24	1,125	3	4
Massachusetts	78	917	37	19
Michigan	94	529	13	8
Minnesota	157	1,364	18	29
Mississippi	25	490	1	1
Missouri	102	547	3	12
Montana	253	1,737	25	47
Nebraska	68	1,117	1	7
Nevada	51	2,084	-	1
New Hampshire	49	1,162	8	2
New Jersey	139	2,641	30	26
New Mexico	260	2,080	1	35
New York	202	5,067	23	40
North Carolina	107	1,083	6	7
North Dakota	32	803	-	13
Ohio	148	2,000	7	9
Oklahoma	200	1,037	2	28
Oregon	342	1,251	21	46
Pennsylvania	196	4,534	10	52
Rhode Island	13	3,138	1	2
South Carolina	20	(D)	-	2
South Dakota	63	555	1	11
Tennessee	71	921	2	4
Texas	624	1,198	14	32
Utah	133	2,188	4	5
Vermont	128	2,948	11	27
Virginia	85	920	1	8
Washington	217	1,181	2	14
West Virginia	31	606	7	9
Wisconsin	214	1,506	30	49
Wyoming	178	1,330	3	51

¹ Only includes positive reported data. Operations that reported zero or failed to report are not included.

Appendix A.

Statistical Methodology

THE SURVEY POPULATION

The target population for the 2009 On-Farm Renewable Energy Production Survey (OREPS) was all farms and ranches that selected yes to the question “At any time during 2007, did this operation generate energy or electricity on the farm using wind or solar technology, methane digester, etc?” on the 2007 Census of Agriculture.

Operations that were listed on the U.S. Environmental Protection Agency’s AgStar site (<http://www.epa.gov/agstar/projects/index.html>) as having a methane digester project that was operable in 2009 and earlier were also included in the sample population.

DATA COLLECTION

Method of Enumeration

The 2009 OREPS was conducted primarily by mail. It was supplemented with electronic data reporting via the internet and data collected by telephone and personal enumeration.

Report Form

A four page report form was designed to capture data for number of on-farm renewable energy production devices, installation costs, sales to the grid, and utility savings. The main focus of the 2009 OREPS was to provide detailed information on wind turbines, solar panels and methane digesters. The “other forms of energy produced” question in Section 5 of the OREPS report form was primarily for clarification and was not summarized or published. The “other solar powered devices (fence chargers)” question in Section 3 was included to prevent misreporting of solar panels versus small solar powered devices. These devices were included

in the 2007 Census of Agriculture published count of farms having renewable energy producing devices but were not included in the published OREPS solar panel section. The questions pertaining to energy sales were not summarized or published in this first energy release due to reporting errors. There was confusion between actual sales and net metering. On future energy surveys, sales questions will be clarified and additional net metering questions will be asked.

Report Form Mailings and Respondent Follow-up

The 2009 On-Farm Renewable Energy Production Survey report form mail packet was mailed from the Census Bureau’s National Processing Center (NPC) at Jeffersonville, IN on May 3, 2010. The mail packet included a labeled report form, an instruction sheet, a letter requesting prompt response with electronic data reporting instructions, and a return envelope to NPC for data capture. The report form carried a return due date of May 24, 2010. A second mailing to nonrespondents took place from NPC on June 4, 2010.

Telephone follow-up interviews to nonrespondents took place from June 20 to July 9, 2010 from NASS Data Collection Centers. A process was used to exclude operations from receiving a follow-up telephone call if their report form was received in the mail.

Data collection for the 2009 OREPS was coordinated with other NASS agricultural surveys. In some cases, if an operation was selected for multiple surveys, NPC mailed the materials to NASS field offices. Field office personnel then were responsible for collecting the data and completing other survey report forms in an effort to reduce the number of contacts and respondent burden.

REPORT FORM PROCESSING

Data Capture

All report forms returned to NPC were immediately checked in using bar codes printed on the mail label and were removed from follow-up mailings. All forms were reviewed prior to data keying to identify inconsistencies and ensure the data could be keyed. Major inconsistencies, respondent remarks, and blank forms were reviewed by analysts and adjusted prior to keying. In some cases, report forms were mailed to field offices for further editing. All forms with any data were scanned and an image was created for each page of the report form. After images were created, the data were keyed directly from the report form.

Data Editing and Analysis

Data from each report form were processed through a computer edit which flagged inconsistent entries. Each report form with a flagged entry was reviewed by an analyst. Action was required for any record with reported data that were obviously incorrect. In some cases, respondents may have failed to provide all of the information requested, only indicating the presence of an item but not the amount. Only number of wind turbines and methane digesters were coded for machine imputation. Percents and averages of positive reported data were used for all other items.

After the initial edit, an automated imputation program supplied missing wind turbine and digester numbers based on State or national averages. A post-imputation computer edit was performed to ensure imputation actions provided acceptable results. Instances where imputed data failed edit checks were referred to analysts for corrective action.

The computer edit ensured the data on a report form were internally consistent. An analysis tool was provided to examine the data across records to check for distributional irregularities and data outliers. Analysts corrected suspect data when necessary and re-edited the record.

ESTIMATION

Nonresponse Weighting

While effort was expended to obtain a response from each farm, a complete set of responses was not achieved. Nonresponse can lead to biases in published estimates because the information concerning on-farm energy production of the nonresponding farms could not be factored into the estimates. Estimates of totals, for example, will be biased low. It is necessary to reduce this bias through the use of a procedure called nonresponse weight adjustment. Nonresponse weight adjustment gives more weight to the data reported by responding farms in an effort to account for the data that would have been reported by the nonresponding farms. This will increase the estimates of totals obtained by the respondents and reduce this bias.

Most of the estimates published from the 2009 OREPS are ratios of estimated totals. The potential for bias exists for these estimated ratios, although it is difficult to predict whether the bias is upward or downward. Nevertheless, nonresponse adjustments were calculated and factored into the ratio estimates as well.

Conceptually, each farm on the mail list begins the survey with a weight of one. In other words, if each farm on the list would provide the requested data, the data could be simply added up to estimate the total. In the presence of nonresponse, adjustments are computed and applied to the initial weights of the responding farms resulting in a nonresponse adjusted weight greater than 1 for these farms. The initial weight of each nonresponding farm is adjusted to zero. The adjustments are computed in a manner that requires the sum of the nonresponse-adjusted weights across the *responding* farms on the mail list to equal the sum of the initial weights across all farms on the mail list.

If the total number of farms on the mail list is N , the sum of the initial weights across all farms on the mail list equals N , because the initial weight for each farm on the list is 1. The sum of the nonresponse-

adjusted weights across all *responding* farms on the mail list must equal N. In fact, the sum of the nonresponse-adjusted weights across all farms on the list would sum to N as well because the nonresponse adjusted weight of nonresponding farms is set to 0.

Weight-Adjustment Groups

To compute nonresponse adjustments, each record on the mail list is first placed in a weight-adjustment group. The groups are defined in such a way that all farms that reside in the same group appear to share similarities with respect to the characteristics used to define the group. It is necessary that the characteristics by which the weight-adjustment groups are defined be available for responding and nonresponding farms alike. Therefore, it was not possible to define weight-adjustment groups using data collected via the survey. Information used to define the groups was obtained from historical information maintained on the mail list and available for each farm.

The information used to create the weight-adjustment groups was a measure of general farm sales (GFS), expressed in total dollars. This measure is available for all farms on the mail list. The basic definition of the weight-adjustment groups is given below:

Definition	Weight Adjustment Group ID
GFS ≤ \$50,000	10
\$50,000 < GFS ≤ \$250,000	20
\$250,000 < GFS ≤ \$500,000	30
\$500,000 < GFS ≤ \$1,000,000	40
\$1,000,000 < GFS ≤ \$5,000,000	50
\$5,000,000 < GFS	60
Methane Digester Farms	900

Farms on the mail list were placed in mutually exclusive groups based on the farm's GFS. One additional weight-adjustment group was composed of farms believed to possess a methane digester. These farms are generally economically large but were placed in the group 900 without regard to the GFS. Weight-adjustment groups were created and

weight adjustments were carried out separately for each state.

To ensure there were sufficient numbers of responding farms in each group, some collapsing of weighting groups occurred, resulting in some States having more weight adjustment groups than others.

Nonresponse-Adjustment Computation

A separate nonresponse adjustment is calculated within each weight-adjustment group. All responding records within each group will receive the same nonresponse adjusted weight. The nonresponse-adjustment is obtained by dividing the total number of farms contained in a group by the number of responding farms in the group. If the total number of farms in the group is 50 and the number of responding farms in the group is 40, the nonresponse-adjustment for the responding farms is $50/40$ or 1.25. The nonresponse-adjusted weight for all responding farms in the group is the product of the survey weight and the nonresponse adjustment of 1.25. This is simply (1×1.25) or 1.25. Note that $1.25 \times 40 = 50$, the total number of farms in the group.

The assumption being made is that within each weight-adjustment group, the data the nonrespondents would have provided had they responded is similar to the data provided by the respondents. This assumption is made somewhat more plausible by the fact that farms in the same group share similar characteristics with respect to the information used to define the group- the GFS.

Coverage Weighting Adjustments

The target population for the 2009 OREPS was the set of all farms in the United States producing at least \$1,000 worth of raw agricultural commodities and producing on-farm renewable energy in 2009. Realistically, it is a nearly impossible task to compose a list of farms that is complete. Due to this incompleteness of the 2009 OREPS mail list, estimates produced from it, even if perfectly corrected to account for nonresponse, will still be downward biased because farms not on the list

would not have any representation. This bias due to list incompleteness is called coverage bias, or more specifically, bias due to under coverage of the list.

To reduce the amount of this bias, an additional adjustment was calculated and applied to the nonresponse-adjusted weight for each responding farm. This is called the coverage adjustment. The coverage adjustment was calculated within the same weight-adjustment groups defined above.

Coverage Adjustment Computation

Each farm on the 2009 OREPS mail list was a respondent to the 2007 Census of Agriculture. The weights of all 2007 census respondents were fully adjusted for nonresponse and coverage error. Coverage adjustment for the 2007 census was made possible through the use of survey data that was based on a list (or frame) of geographic land segments. In theory, every acre of land in the U.S. is contained in one of these segments. This implies that a survey based on such a frame will have complete coverage and represent all farms in the U.S. This survey was used to derive estimates of the magnitude of the coverage error associated with the census mail list. The nonresponse-adjusted weight for each 2007 agricultural census respondent received a coverage adjustment based on the estimated coverage error obtained from the area frame survey. This resulted in a fully coverage-adjusted weight for each census respondent.

These weights were pulled forward for every farm on the 2009 OREPS mail list. Summing these weights across every farm on the list produces an estimate of the total number of farms producing on-farm energy in 2007. These estimates account for both 2007 census nonresponse and coverage bias. Information contained in the census weights is used to create a coverage adjustment for the 2009 OREPS. This information is somewhat dated (2007 vs. 2009), but still useful for accounting for the 2009 OREPS list coverage bias

The coverage-adjustment for responding farms to the 2009 OREPS was calculated by first summing the 2007 census fully adjusted weight across all farms residing in the weight-adjustment group. This gives an estimate of the total number of energy producing

farms in a state that would fall into that group, whether they are contained on the 2009 OREPS mail list or not. This number is divided by the sum of the nonresponse-adjusted weights for all responding farms in the group. This results in the 2009 OREPS coverage adjustment for that group. If the sum of the fully adjusted census weights in a group for all farms in the group is 60 and the sum of the nonresponse-adjusted weight across all responding farms in the group is 50, the 2009 OREPS coverage-adjustment is $60/50$ or 1.2. Multiplying the coverage adjustment by the nonresponse adjusted weight results in the fully-adjusted 2009 OREPS weight. In the given example with 40 responding farms, this would be $1.25 \times 1.2 = 1.5$. Note that $1.5 \times 40 = 60$. This represents the estimated total number of energy-producing farms that would fall into that group, whether on the list or not. All responding farms in a group will have the same fully-adjusted 2009 OREPS weight.

Summary Weights

Many of the fully adjusted weights for the 2009 OREPS are not whole numbers (integers). Using these weights to create the estimates published in the tables would result in the tables having lots of fractional values. These would be difficult to read or could cause consistency problems between different tables. To avoid some of these problems, *summary weights* were created by moving the fully adjusted weights randomly up or down to the nearest integer in an unbiased manner by retaining the weighting cell total. This process is called *weight integerization*. The resulting integer summary weights are used to actually produce the numbers published in the tables.

Explanation of Published Ratios

Table 1. Wind Turbines – Calculations for columns 3, 4, and 5 in Table 1 include only those surveyed farms reporting positive data values for both the numerator and the denominator.

Column 3. Average Rated Generating Capacity Per Turbine - This is computed as the estimated total kilowatts of rated generating capacity, divided by the estimated number of actively generating turbines.

Column 4. Average Installation Cost Per Turbine - This is computed as the estimated total system installation cost (includes outside funding) for all turbines, divided by the estimated number of turbines owned and used.

Column 5. Percent of Installation Cost Provided by Outside Funding - This is computed as the estimated installation cost received from outside funding, divided by the estimated total installation cost.

Table 2. Methane Digesters – Calculations for columns 3, 4, and 5 in Table 2 include only those surveyed farms reporting positive data values for both the numerator and denominator.

Column 3. Average Methane Volume Production Per Digester - This is computed as the estimated total amount of methane produced, divided by the estimated total number of methane digesters.

Column 4. Average Installation Cost Per Digester - This is computed as the estimated total installation cost of methane digesters, divided by the estimated total number of digesters on farms with positive installation costs.

Column 5. Percent of Installation Cost Provided by Outside Funding - This is computed as the estimated installation cost provided by outside funding, divided by the estimated total installation cost.

Table 3. Solar Panels – Calculations for columns 4, 5, and 6 in Table 3 include only surveyed farms reporting positive data values for both the numerator and denominator.

Column 4. Average Photovoltaic Solar Panel Generating Capacity Per Farm - This is computed as the estimated total generating capacity of all photovoltaic solar panels, divided by the estimated total number of farms utilizing photovoltaic solar panels.

Column 5. Average Installation Cost Per Farm - This is computed as the estimated total solar panel system installation cost, divided by the estimated

number of farms having positive solar panel installation cost.

Column 6. Percent of Installation Cost Provided by Outside Funding - This is computed as the estimated installation cost received from outside funding, divided by the estimated total installation cost.

Table 4. Energy Cost Savings -

Column 2. Average Dollars Saved on Utility Bills Per Farm - This is computed as the estimated total amount saved on utility bills for farms having wind turbines, solar panels, and/or methane digesters, divided by the estimated total number of farms having positive utility bill savings.

MEASURES OF PRECISION AND ACCURACY OF THE ESTIMATES

All numbers published in the tables are merely estimates of particular characteristics of the entire population of energy-producing farms. The true values of these characteristics are unknown and unknowable. Even though an attempt was made to contact every farm on the mail list, the estimates produced by the survey will not exactly attain the true values. This is due to a number of factors, such as survey nonresponse, mail list incompleteness, and the weight integerization process. Hypothetically, if the entire survey process was repeated over and over again, each replication of the survey would almost certainly produce a different estimate for the same population value every time. This is because each time the survey is carried out, a different set of respondents would be obtained, response rates would fluctuate, and the estimated coverage rates of the mail list could change.

It is possible to obtain an idea of how much this variation would be on average by calculating the estimate's *variance*. The variance of an estimate gives a measure of the average squared random fluctuation that would be seen in an estimate if the survey was carried out multiple times. This is referred to as the *precision* of the estimate. Because the variance measures random fluctuation in squared units, the square root of the variance is computed to

obtain a random fluctuation measure that is in the same units as the original estimate. This is called the *standard error* (se) of the estimate. The standard error can then be divided by the estimate itself to show the relative size of the standard error to the estimate. If this ratio is small, the estimate is quite precise. If this ratio is large, the estimate is imprecise. An estimate of 100 with a standard error of 2 would result in a relative standard error of .02 or 2 percent. This would be a very precise estimate. An estimate of 100 with a standard error of 20 would result in a relative standard error of 20 percent. This might be considered to be an imprecise estimate. The idea of precision can be made a little more clear by stating that if the estimate is 100 with a standard error of 2, you could be quite confident that the true population value would be in the interval 96 to 104 (within two standard deviations of the estimate).

Unbiased estimates are generally accurate. This is to say that if the survey is hypothetically repeated over and over, the *average* of the estimates obtained would be very close to the true value being estimated. This does not mean that any particular realization of the estimate will be “close” to the true value. An accurate estimate that is not precise has a good chance of missing the true value of the characteristic being estimated by a significant amount.

If the estimate contains some *bias*, both precision and accuracy are measured by computing the *mean squared error* (mse) of the estimate. *Bias* is systematic error that would be about the same for every hypothetical replication of the survey. Bias is not random fluctuation and affects the *accuracy* of

the estimate. The weight adjustments described earlier are used to decrease biases in the estimates. However, the weight integerization process introduces some bias. Ideally, the amount of bias contained in an estimate should be small or non-existent, but in conducting actual surveys, some biases may be hard to avoid. Biased estimates can be precise, but in hypothetical replications of the survey, will tend to be systematically lower or higher than the true population value being estimated. Highly biased estimates are generally quite inaccurate and are not desirable.

The mean squared error is computed by adding a term to the variance called the estimated *squared bias*. The mean squared error can be used to measure the combined effects of random variation and bias contained in an estimate. Like the variance, the mean squared error is measured in squared units, so the square root of the mean squared error is often taken. This results in what is called the *root mean squared error* (rmse). Like the standard error, the ratio of the root mean squared error to the estimated value can be created. It is often multiplied by 100 and expressed as a percent. This ratio gives a measure of the *relative root mean squared error* (relative rmse) of the estimate. When this ratio is small (close to 0 percent), the estimate is both very precise and very accurate. A large ratio (20 percent or more) might indicate that the estimate is precise but not very accurate. Another possibility is that the estimate might be accurate but not very precise. A third possibility is that the estimate might reflect only a moderate level of both accuracy and precision.

Table A. Reliability Estimates of Operations Reporting Small and Large Wind Turbines: 2009

State	Small wind turbines						Large wind turbines					
	Farms		Average per turbine				Farms		Average per turbine			
			Rated generating capacity		Installation cost				Rated generating capacity		Installation cost	
	Number	Relative RMSE	kW	Relative RMSE	Dollars	Relative RMSE	Number	Relative RMSE	kW	Relative RMSE	Dollars	Relative RMSE
United States	1,406	1.4	6	3.4	12,972	1.7	14	8.4	1,035	9.7	1,339,143	8.9
Alabama	3	48.1	(D)	(D)	(D)	(D)	-	-	-	-	-	-
Alaska	8	11.9	1	11.0	4,394	24.9	-	-	-	-	-	-
Arizona	63	6.9	1	11.0	2,768	16.0	-	-	-	-	-	-
Arkansas	7	8.5	2	57.3	5,800	56.9	-	-	-	-	-	-
California	134	5.5	3	4.3	13,955	4.1	-	-	-	-	-	-
Colorado	98	6.9	3	12.5	4,581	4.6	-	-	-	-	-	-
Connecticut	1	16.0	(D)	(D)	(D)	(D)	-	-	-	-	-	-
Delaware	-	-	-	-	-	-	-	-	-	-	-	-
Florida	5	12.3	1	13.6	5,250	8.4	-	-	-	-	-	-
Georgia	4	12.1	(D)	(D)	(D)	(D)	-	-	-	-	-	-
Hawaii	43	8.7	1	2.8	1,799	5.5	-	-	-	-	-	-
Idaho	39	7.8	4	8.0	12,778	14.1	-	-	-	-	-	-
Illinois	28	9.3	5	11.7	11,448	9.3	-	-	-	-	-	-
Indiana	49	7.4	2	10.2	7,870	9.3	-	-	-	-	-	-
Iowa	39	5.7	8	7.9	23,840	9.3	9	6.0	1,359	5.8	1,784,889	5.6
Kansas	18	16.5	6	11.3	10,084	7.0	-	-	-	-	-	-
Kentucky	1	60.1	(D)	(D)	(D)	(D)	-	-	-	-	-	-
Louisiana	2	27.9	(D)	(D)	(D)	(D)	-	-	-	-	-	-
Maine	32	7.2	5	9.0	17,353	6.9	-	-	-	-	-	-
Maryland	2	29.5	(D)	(D)	(D)	(D)	-	-	-	-	-	-
Massachusetts	22	6.4	7	7.2	43,218	7.9	-	-	-	-	-	-
Michigan	34	10.7	2	11.8	9,981	19.3	-	-	-	-	-	-
Minnesota	99	4.8	20	6.1	37,647	4.5	-	-	-	-	-	-
Mississippi	3	23.6	1	4.2	4,467	6.6	-	-	-	-	-	-
Missouri	21	11.9	3	38.4	7,779	23.9	-	-	-	-	-	-
Montana	63	6.2	3	13.4	6,293	5.9	-	-	-	-	-	-
Nebraska	7	8.0	1	6.7	1,563	15.4	-	-	-	-	-	-
Nevada	8	34.3	1	7.9	1,455	12.4	-	-	-	-	-	-
New Hampshire	11	16.0	3	18.5	9,850	14.1	-	-	-	-	-	-
New Jersey	3	46.7	8	7.2	47,518	11.9	-	-	-	-	-	-
New Mexico	28	14.4	1	5.7	4,807	10.9	-	-	-	-	-	-
New York	58	7.6	5	7.4	22,254	9.9	-	-	-	-	-	-
North Carolina	12	10.9	2	5.2	12,800	6.8	-	-	-	-	-	-
North Dakota	5	35.7	(D)	(D)	15,778	10.8	-	-	-	-	-	-
Ohio	44	10.6	2	8.4	11,257	11.8	-	-	-	-	-	-
Oklahoma	20	14.7	2	13.5	4,156	9.9	-	-	-	-	-	-
Oregon	37	7.9	1	4.5	3,209	10.2	-	-	-	-	-	-
Pennsylvania	26	7.0	3	7.7	7,148	20.9	-	-	-	-	-	-
Rhode Island	2	30.6	(D)	(D)	(D)	(D)	-	-	-	-	-	-
South Carolina	-	-	-	-	-	-	-	-	-	-	-	-
South Dakota	11	7.6	4	35.8	19,064	13.1	-	-	-	-	-	-
Tennessee	9	23.7	(D)	(D)	8,177	13.0	-	-	-	-	-	-
Texas	102	6.9	4	9.4	8,493	4.2	-	-	-	-	-	-
Utah	31	9.0	1	4.7	2,562	9.8	-	-	-	-	-	-
Vermont	43	4.9	3	2.2	16,847	5.5	-	-	-	-	-	-
Virginia	11	11.0	1	25.5	2,971	34.0	-	-	-	-	-	-
Washington	50	7.6	19	16.7	12,669	7.9	-	-	-	-	-	-
West Virginia	4	19.9	5	14.8	44,400	16.0	-	-	-	-	-	-
Wisconsin	46	5.4	8	1.2	15,329	1.9	-	-	-	-	-	-
Wyoming	20	12.8	2	8.2	4,648	10.4	-	-	-	-	-	-
Other States ¹	-	-	-	-	-	-	5	20.0	453	54.0	536,800	55.7

¹ Other States include Kansas, Minnesota, and Montana.

Table B. Reliability Estimates of Operations Reporting Methane Digesters and Solar Panels: 2009

State	Methane digesters						Solar panels					
	Farms		Average per methane digester				Farms		Average per farm			
			Methane produced		Installation cost				PV rated generating capacity		Installation cost	
	Number	Relative RMSE	Cubic feet	Relative RMSE	Dollars	Relative RMSE	Number	Relative RMSE	Watts	Relative RMSE	Dollars	Relative RMSE
United States	121	1.5	30,515,800	2.0	1,718,562	1.3	7,968	1.5	4,449	3.8	31,947	2.8
Alabama	-	-	-	-	-	-	33	7.7	865	23.3	6,948	12.3
Alaska	-	-	-	-	-	-	16	8.0	865	7.9	9,134	9.0
Arizona	-	-	-	-	-	-	255	4.9	2,002	4.9	19,992	2.7
Arkansas	-	-	-	-	-	-	41	6.6	833	14.6	7,502	8.0
California	14	8.9	29,194,314	20.5	1,794,444	23.3	1,906	5.4	11,229	5.6	78,910	4.5
Colorado	-	-	-	-	-	-	504	5.1	1,654	4.5	16,879	2.7
Connecticut	-	-	-	-	-	-	26	12.1	4,173	16.4	29,571	17.6
Delaware	-	-	-	-	-	-	4	17.1	15,500	19.3	101,250	18.7
Florida	-	-	-	-	-	-	88	6.3	2,162	6.6	12,223	4.0
Georgia	-	-	-	-	-	-	32	6.8	3,625	9.3	28,545	8.3
Hawaii	-	-	-	-	-	-	520	6.0	1,790	3.5	16,665	3.2
Idaho	-	-	-	-	-	-	131	6.1	916	3.5	12,524	6.9
Illinois	-	-	-	-	-	-	58	8.2	4,575	19.1	39,018	16.6
Indiana	-	-	-	-	-	-	127	6.3	543	5.7	5,262	6.4
Iowa	-	-	-	-	-	-	40	6.7	1,988	13.8	17,791	18.6
Kansas	-	-	-	-	-	-	116	4.1	408	11.4	4,607	5.4
Kentucky	-	-	-	-	-	-	67	9.6	776	5.9	6,305	7.5
Louisiana	-	-	-	-	-	-	13	10.3	876	11.7	10,970	10.1
Maine	-	-	-	-	-	-	97	5.9	1,680	6.0	13,892	7.2
Maryland	-	-	-	-	-	-	21	11.2	2,665	26.8	24,201	15.0
Massachusetts	-	-	-	-	-	-	63	5.9	3,678	6.5	27,624	2.4
Michigan	5	1.0	36,923,333	(Z)	1,322,222	(Z)	75	6.5	841	9.2	7,416	6.7
Minnesota	5	1.0	69,105,120	(Z)	3,123,333	(Z)	73	6.6	1,409	7.4	11,178	5.2
Mississippi	-	-	-	-	-	-	23	13.3	706	13.4	11,593	11.2
Missouri	-	-	-	-	-	-	93	6.1	1,022	12.7	9,429	13.2
Montana	-	-	-	-	-	-	238	4.3	988	3.0	9,180	3.2
Nebraska	-	-	-	-	-	-	65	4.3	742	6.6	5,632	4.8
Nevada	-	-	-	-	-	-	51	12.6	1,832	13.7	21,971	8.2
New Hampshire	-	-	-	-	-	-	49	8.4	1,641	5.6	16,173	4.7
New Jersey	-	-	-	-	-	-	138	5.5	14,081	4.4	112,855	4.4
New Mexico	-	-	-	-	-	-	258	4.2	1,261	4.2	12,888	4.6
New York	16	1.5	18,611,675	(Z)	1,611,206	(Z)	156	6.2	2,501	4.8	21,661	4.3
North Carolina	-	-	-	-	-	-	104	8.1	1,015	8.1	10,198	3.5
North Dakota	-	-	-	-	-	-	29	9.9	429	6.1	5,048	10.6
Ohio	-	-	-	-	-	-	130	6.5	1,614	10.7	12,122	16.2
Oklahoma	-	-	-	-	-	-	187	5.2	428	22.9	4,612	9.7
Oregon	-	-	-	-	-	-	332	5.3	3,002	8.0	22,147	6.9
Pennsylvania	13	1.0	18,951,843	(Z)	642,188	(Z)	173	5.6	1,750	4.8	20,699	2.8
Rhode Island	-	-	-	-	-	-	12	7.9	(D)	(D)	30,960	28.3
South Carolina	-	-	-	-	-	-	20	10.4	(D)	(D)	5,047	6.9
South Dakota	-	-	-	-	-	-	55	3.3	696	3.9	7,470	2.7
Tennessee	-	-	-	-	-	-	66	6.5	1,065	8.7	8,657	13.4
Texas	-	-	-	-	-	-	573	4.3	783	2.4	7,692	1.9
Utah	-	-	-	-	-	-	133	5.3	1,211	4.2	14,573	5.7
Vermont	8	1.0	(D)	(D)	1,718,750	(Z)	110	6.2	1,304	1.2	15,510	1.7
Virginia	-	-	-	-	-	-	83	5.7	869	10.1	12,868	5.4
Washington	-	-	-	-	-	-	205	5.6	1,547	2.7	10,377	2.6
West Virginia	-	-	-	-	-	-	27	9.9	521	9.2	8,166	7.4
Wisconsin	21	2.1	(D)	(D)	1,608,924	1.8	176	6.0	2,484	13.8	17,607	8.2
Wyoming	-	-	-	-	-	-	176	5.6	1,275	5.1	10,362	2.7
Other States ¹	39	4.9	26,034,140	6.0	2,181,189	5.6	-	-	-	-	-	-

¹ Other States include Colorado, Connecticut, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Maryland, Mississippi, Missouri, Montana, Nebraska, North Carolina, Ohio, Oklahoma, Oregon, South Dakota, Tennessee, Texas, Washington, and Wyoming.

Appendix B.

General Explanation and Report Form

DEVELOPMENT OF THE REPORT FORM

The 2009 On-Farm Renewable Energy Production Survey report form was developed through input from other government agencies, special interest groups and each of NASS's field offices. Report form testing was conducted in several States and included various types of producers. Producers were asked to evaluate the report form through cognitive interviews.

TERMS AND DEFINITIONS

The following definitions and explanations provide a detailed description of specific items and terms used in this publication and on the report form. Copies of the 2009 On-Farm Renewable Energy Production Survey report form and instruction sheet are included in this appendix.

Biodiesel. A non-petroleum based diesel fuel consisting of long-chain alkyl esters. Biodiesel is typically made by chemically-reacting lipids (e.g., vegetable oil) and alcohol. It can be used (alone or blended with conventional petrodiesel) in unmodified diesel-engine vehicles.

Energy Audit. An audit conducted by a certified energy manager or professional engineer that focuses on potential capital-intensive projects and involves detailed gathering of field data and engineering analysis. The audit will provide detailed project costs and savings information with a high level of confidence sufficient for major capital investment decisions.

Ethanol. A fuel produced by converting crops such as corn, sugarcane, or wood into alcohol sugar ($\text{CH}_3\text{CH}_2\text{OH}$). This may then be blended with gasoline to enhance octane, reduce exhaust pollution, and reduce reliance on petroleum fuels.

Generating Capacity. The ability to generate electricity is measured in watts. Wind turbines currently manufactured have power ratings ranging from 250 watts to 5 megawatts (MW). A 10-kW wind turbine can generate about 10,000 kWh annually at a site with wind speeds averaging 12 miles per hour, or about enough to power a typical household. A 5-MW turbine can produce more than 15 million kWh in a year - enough to power more than 1,400 households. The average U.S. household consumes about 10,000 kWh of electricity each year.

Geothermal Energy. Energy, in the form of heat, stored in the earth, which originates from the original formation of the planet, from radioactive decay of minerals, and from solar energy absorbed at the surface.

The "Grid". The grid consists of two infrastructures: the high-voltage transmission systems, which carry electricity from the power plants and transmit it hundreds of miles away, and the lower-voltage distribution systems, which draw electricity from the transmission lines and distribute it to individual customers.

Hydroelectric Energy. Power produced through use of the gravitational force of falling or flowing water

Kilowatt. kW = 1,000 watts, megawatt (MW) = 1 million watts, and gigawatt (GW) = 1 billion watts.

Kilowatt Hour. One kilowatt (1,000 watts) of electricity produced or consumed for one hour. For example, one 50-watt light bulb left on for 20 hours consumes one kilowatt-hour of electricity (50 watts x 20 hours = 1,000 watt-hours = 1 kilowatt-hour).

Manure/Methane Digester. Anaerobic digestion involves the decomposition of manure and processing of by-products and other materials into effluent and biogas. Microorganisms perform the decomposition process in an anaerobic digester, which can be designed in several ways. Once biogas is harvested from the processed manure, it can be run through an engine to generate electricity, used in place of natural gas, or flared.

Methane. A chemical compound with the molecular formula CH_4 . It is the simplest alkane, and the principal component of natural gas.

Outside Funding Sources. Federal, state, and local governments, universities, and private industries provide funds for renewable energy installation costs.

Solar Energy. Energy, in the form of heat, generated by the sun.

Solar Panel, Photovoltaic. Solar photovoltaic modules use solar cells to convert light from the sun into electricity.

Solar Panel, Thermal. Flat plate and evacuated tube solar collectors are typically used to collect heat for space heating or domestic hot water.

Wind Power. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when "harvested" by modern wind turbines, can be used to generate electricity. The terms "wind energy" or "wind power" describe the process by which the wind is used to generate mechanical power or electricity.

The power available in the wind is proportional to the cube of its speed, which means that doubling the wind speed increases the available power by a factor of eight. A turbine operating at a site with an average wind speed of 12 mph could in theory generate about 33 percent more electricity than one at an 11-mph site, because the cube of 12 (1,768) is 33 percent larger than the cube of 11 (1,331).

Wind Powered Device. Usually wind turbines, but can also be windmills. If the energy created is used directly by machinery, such as a pump or grinding stones, the machine is a windmill. If the energy is converted to electricity, the machine is called a wind generator, wind turbine, wind power unit (WPU), wind energy converter (WEC), or aero generator. Wind turbines convert wind energy to electricity.

2009 ON-FARM RENEWABLE ENERGY PRODUCTION SURVEY

Form Number: 09-A629
(04/15/10)



09-A629



National Agricultural
Statistics Service

Please return your
completed report to:

Census of Agriculture
1201 East 10th Street
Jeffersonville, IN 47132

OFFICE USE ONLY

0010	0011	0016

Please make corrections to name, address, and ZIP code if necessary.

Everyone who receives a form **must complete and return** one by mail or via the Internet at <http://agcounts.usda.gov>. Your report is due by **May 24, 2010**. To fill out the paper form, use a black or blue ballpoint pen. **Duplicate forms?** If you received extra report forms for the SAME farming operation, return all report forms in the same envelope with this completed report. Questions? Call us toll-free at **1-888-424-7828**. Thank you for your cooperation.

NOTICE: Response to this inquiry is required by law (Title 7, U.S. Code). By the same law and the Confidential Information Protection and Statistical Efficiency Act of 2002 (Public Law 107-347), YOUR REPORT IS CONFIDENTIAL and it will only be used for statistical purposes. Your report CANNOT be used for purposes of taxation, investigation, or regulation. The law also provides that copies retained in your files are immune from legal process.

SECTION 1 INTRODUCTION

1. Did this operation produce any electricity, energy or fuel using **wind, solar, methane, or any other renewable energy production devices** during 2009? **Include** any on-farm renewable energy produced on land owned, rented, or used by you, your spouse, or by the partnership, corporation, or organization named on the label above.

101 ¹ ☐ **Yes** – Continue

³ ☐ **No** – Go to SECTION 6

SECTION 2 WIND TURBINES

1. Did this operation **own** any wind turbines that generated electricity during 2009? **Exclude** turbines on this operation under a wind rights lease agreement.

201 ¹ ☐ **Yes** – Complete this section

³ ☐ **No** – Go to SECTION 3

2. How many wind turbines were owned and used on this operation in 2009?

Number
210

- a. What was the rated generating capacity of all turbines reported in question 2?

Average per Turbine (Kilowatt hr)
220

OR

Total for All Turbines (Kilowatt hr)
221

09629015



3. When were the wind turbines reported in question 2 installed? a. prior to year 2000? b. years 2000 – 2004? c. years 2005 – 2009?	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Number of Turbines</th> </tr> <tr> <td>230</td> </tr> <tr> <td>231</td> </tr> <tr> <td>232</td> </tr> </table>	Number of Turbines	230	231	232
Number of Turbines					
230					
231					
232					
4. What was the total cost (the initial or start-up investment) for all wind turbines reported in question 2? Include outside funding.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Dollars</th> </tr> <tr> <td>250 \$00</td> </tr> </table>	Dollars	250 \$00		
Dollars					
250 \$00					
a. Of this total cost, how much was received from outside funding? Include federal, state, local, and private funding. Exclude loans.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Dollars</th> </tr> <tr> <td>251 \$00</td> </tr> </table>	Dollars	251 \$00		
Dollars					
251 \$00					

SECTION 3 SOLAR PANELS

1. Did this operation own any photovoltaic or thermal solar panels in 2009? 301 ☐ Yes – Continue ☐ No – Go to question 6 below 2. Were any of these solar panels photovoltaic? Include solar panels used to generate electricity to power buildings, pump water, etc. 310 ☐ Yes – Continue ☐ No – Go to question 3	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Watts</th> <th style="text-align: center;">OR</th> <th style="text-align: left;">Kilowatts</th> </tr> <tr> <td>311</td> <td></td> <td>312</td> </tr> </table>	Watts	OR	Kilowatts	311		312
Watts	OR	Kilowatts					
311		312					
a. What was the total maximum power rating of these photovoltaic solar panels?							
3. Were any thermal solar panels used for heating buildings or water on this operation in 2009? 320 ☐ Yes ☐ No							
4. When were the photovoltaic or thermal solar panels reported in questions 2 and 3 installed? a. prior to year 2000? b. years 2000 – 2004? c. years 2005 – 2009?	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Number of Solar Panels</th> </tr> <tr> <td>341</td> </tr> <tr> <td>342</td> </tr> <tr> <td>343</td> </tr> </table>	Number of Solar Panels	341	342	343		
Number of Solar Panels							
341							
342							
343							
5. What was the total cost (the initial or start-up investment) for the photovoltaic or thermal solar panels reported in questions 2 and 3? Include outside funding.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Dollars</th> </tr> <tr> <td>350 \$00</td> </tr> </table>	Dollars	350 \$00				
Dollars							
350 \$00							
a. Of this total cost, how much was received from outside funding? Include federal, state, local, and private funding. Exclude loans.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Dollars</th> </tr> <tr> <td>351 \$00</td> </tr> </table>	Dollars	351 \$00				
Dollars							
351 \$00							
6. Did this operation own any other solar powered devices not included above in 2009? 330 ☐ Yes – Continue ☐ No – Go to SECTION 4 a. Mark all other solar powered devices on this operation in 2009. 331 ☐ fence chargers 332 ☐ solar lights 334 ☐ other – Specify 							

09629023



SECTION 4		MANURE/METHANE DIGESTERS									
1. Did this operation own any manure/methane digesters in 2009?											
401 1 ☐ Yes – Complete this section 3 ☐ No – Go to SECTION 5											
		<table border="1"> <tr><td colspan="2">Number</td></tr> <tr><td>410</td><td></td></tr> </table>		Number		410					
Number											
410											
2. How many manure/methane digesters did this operation own?											
		<table border="1"> <tr><td colspan="2">Cubic Feet</td></tr> <tr><td>411</td><td></td></tr> </table>		Cubic Feet		411					
Cubic Feet											
411											
a. How much methane was produced by these digesters in 2009?											
3. Was any of the methane produced used to generate electricity in 2009?											
420 1 ☐ Yes 3 ☐ No											
4. Were there any sales to a natural gas pipeline in 2009?											
430 1 ☐ Yes – Continue 3 ☐ No – Go to question 5											
		<table border="1"> <tr><td colspan="2">Dollars</td></tr> <tr><td>431</td><td></td></tr> </table>		Dollars		431					
Dollars											
431											
a. What was the total payment received from sales to the pipeline in 2009?											
		<table border="1"> <tr><td colspan="2">Dollars</td></tr> <tr><td>431</td><td>\$.00</td></tr> </table>		Dollars		431	\$.00				
Dollars											
431	\$.00										
5. Was the methane produced used for any other purpose in 2009? Include heat, heating water, flaring, etc.											
440 1 ☐ Yes – Specify											
3 ☐ No											
6. When were the methane digesters reported in question 2 installed?											
		<table border="1"> <tr><td colspan="2">Number of Methane Digesters</td></tr> <tr><td>451</td><td></td></tr> <tr><td>452</td><td></td></tr> <tr><td>453</td><td></td></tr> </table>		Number of Methane Digesters		451		452		453	
Number of Methane Digesters											
451											
452											
453											
a. prior to year 2000?											
b. years 2000 – 2004?											
c. years 2005 – 2009?											
		<table border="1"> <tr><td colspan="2">Dollars</td></tr> <tr><td>460</td><td></td></tr> </table>		Dollars		460					
Dollars											
460											
7. What was the total cost (the initial or start-up investment) for all digester systems reported in question 2? Include outside funding.											
		<table border="1"> <tr><td colspan="2">Dollars</td></tr> <tr><td>460</td><td>\$.00</td></tr> </table>		Dollars		460	\$.00				
Dollars											
460	\$.00										
		<table border="1"> <tr><td colspan="2">Dollars</td></tr> <tr><td>461</td><td></td></tr> </table>		Dollars		461					
Dollars											
461											
a. Of this total cost, how much was received from outside funding? Include federal, state, local, and private funding. Exclude loans.											
		<table border="1"> <tr><td colspan="2">Dollars</td></tr> <tr><td>461</td><td>\$.00</td></tr> </table>		Dollars		461	\$.00				
Dollars											
461	\$.00										

09629031



SECTION 5		OTHER INFORMATION							
1. Were other forms of energy or electricity produced or generated on this operation in 2009?									
501	1 ☐ Yes – Continue	3	1 ☐ No – Go to question 2						
a. Mark all other forms of energy or electricity produced or generated on this operation in 2009.									
511	☐ Biodiesel	514	☐ Hydroelectric						
512	☐ Ethanol	515	☐ Mechanical (windmills, water wheels, etc.)						
513	☐ Geothermal	516	☐ Other – Specify						
2. Was any electricity produced on this operation in 2009 sold onto the grid?									
520	1 ☐ Yes – Continue	3	1 ☐ No – Go to question 3						
a. How many kilowatt hours were sold onto the grid in 2009?									
		Average per Kilowatt Hour (Cents)	OR Total Dollars						
		522	523 \$						
b. What was the total payment received for electricity sold onto the grid in 2009?									
		Dollars	524 \$						
3. What is your estimate of the amount saved on your 2009 utility bills by producing and using renewable energy?									
4. Did you have an energy audit performed?									
530	1 ☐ Yes	3	1 ☐ No						
5. Did you receive any federal funding (grants, loans, etc.) for the installation of your on-farm renewable energy devices?									
531	1 ☐ Yes	3	1 ☐ No						
SECTION 6		CONCLUSION							
COMMENTS									
Name		Phone							
		Date MM DD / YYYY							
Thank you for your response									
Response	Respondent	Mode	R Unit	Enum.	Eval.	Office Use for FOID			
1-Comp 2-R 3-Inst 4-Office Hldt 5-R - Est 6-Inst - Est 7-Off Hldt - Est 8-Known Zero	9901	1-Comp 2-R 3-Inst 4-Office Hldt 5-R - Est 6-Inst - Est 7-Off Hldt - Est 8-Known Zero	9902	1-Mail 2-Tel 3-Face-to-Face 4-CAT 5-Web 6-e-mail 7-Fax 8-CAT 9-Other	9903	921	0008	0105	788
According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0535-0250. The time required to complete this information collection is estimated to average 20 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.									

09629049



Instruction Sheet
2009 On-Farm Renewable Energy Production (OREP) Survey

COMPLETING THE 2009 OREP REPORT FORM

Make all entries clear and easy to read. Use a **blue** or **black** ball point pen. Enter your answers in the proper spaces and in the units requested, i.e., number of acres, dollars, percent, etc. Mark all applicable Yes/No boxes with an "X."

Refer to the instructions below for completing your report form. The enclosed report form was mailed to agricultural producers and growers throughout the United States. Because it is meant for use in all parts of the country, it may contain items and inquiries which do not apply to your operation. In this case, mark the "No" or "None" box and go on to the next item or section.

If You Did Not Produce Any Renewable Energy On Your Operation In 2009

In Section 1, item 1, Select "No," then go to Section 6 on the back page and complete the remainder of the report form.

If You Did Not Operate Any Agricultural Land in 2009

Go to Section 6 on the back page and complete the remainder of the report form.

Partial Year Operation

If you stopped farming at any time during 2009, complete the report form for the portion of 2009 that you did farm. Write "Stopped farming in 2009" and the date you stopped farming below the address label on the report form and mail the completed report form in the return envelope.

If You Receive More Than One Report Form for the Same Operation

Return any duplicate report forms in the same envelope with the completed report form(s). In the address area of the report form(s) you complete, write the 11-digit ID number from the address label of the extra report form(s).

Partnership Operations

Complete only ONE report form for a partnership operation and include all partners' shares on the same report form. If two or more report forms were received for the partnership, see instruction on "If You Receive More Than One Report Form for the Same Operation" above.

INSTRUCTIONS BY SECTION

Section 1 RENEWABLE ENERGY PRODUCTION SCREENER

The operation must have **owned** the devices that produced the renewable energy. Operations that only leased out wind rights should respond "No" and skip to Section 6 on the back page.

Section 2 WIND TURBINES

Report for wind turbines, which are usually considered small, **owned** by this operation. The operation must have either used and/or sold the electricity generated.

Item 2 - Number of turbines owned and operated - Turbines installed under a wind rights lease agreement are not included in this survey, so do not report them here.

Item 2a - Generating capacity of wind turbines - Report either the average generating capacity per turbine or the total generating capacity of all turbines owned in kilowatts/hour. If you are reporting in a different unit, note this in the margin next to the answer cell.

Item 3 - Year(s) of installation - Items 3a, b, and c should total to the number of turbines reported in item 2. Report each turbine only once.

Item 4 - Installation cost - Report the total cost for all wind turbines installed, regardless of when they were installed. Include cost for turbines, labor, meters, wiring, batteries, new structures to protect batteries, remodeling of existing structures, concrete slabs, etc.

Item 4a - Outside funding - There are many sources of outside funding available to install renewable energy devices. Include funding received from the federal, state, or local government, utility companies, coops, etc. DO NOT include tax credits or loans.

Section 3 SOLAR PANELS

Report photovoltaic or thermal solar panels owned by this operation. These may be used to generate electricity to power a building or pump water; heat water or buildings; or electrify a fence.

Item 2 - Photovoltaic solar panels - Only report panels here if they **generated electricity** to power buildings, pump water, etc. Other types of solar powered devices should be reported in items 3 and 6.

Item 2a - Maximum power rating of photovoltaic solar panels - If you owned more than one panel, report total power rating for all panels combined. For example, if you owned 3 panels and two had power ratings of 50 watts and one was rated for 100 watts, enter 200 into answer cell 311.

Item 4 - Year(s) of installation - Items 4 a, b, and c should only include solar panels reported in items 2 and 3.

Item 5 - Installation cost - Report the total installation cost for all solar panels reported in items 2 and 3, regardless of when they were installed. Include cost for solar panels, labor, meters, wiring, batteries, new structures to protect batteries, remodeling of existing structures, etc.

Item 5a - Outside funding - There are many sources of outside funding available to install renewable energy devices. Report funding received from the federal, state, or local government, utility companies, coops, etc. DO NOT include tax credits or loans in this total.

Item 6 - All other solar powered devices - Complete this section if there were other solar powered devices on this operation not reported in items 2 and 3.

Item 6a - Stand alone solar powered devices - Check all that apply. If you had a solar powered device not listed, select the "other" option and specify what the device powered.

Section 4 MANURE/METHANE DIGESTERS

Item 2 - Number of digesters owned and operated - Report number of digesters owned and operated in 2009. All digesters reported need to be owned and operated by the operation named on the report form address label.

Item 2a - Methane produced - Record the amount of methane produced in cubic feet. If reporting in a different unit, note this in the margin of the report form next to answer cell 411.

Item 5 - Other uses of methane - If methane was flared, used for heating buildings or water, etc., specify other uses here.

Item 6 - Year(s) of installation - The number of methane digesters reported in items 6a, b, and c should total to the number of digesters reported in item 2.

Item 7 - Installation cost - Report the total cost for all digesters installed, regardless of when they were installed. Include cost for digesters, labor, meters, wiring, generators used to produce electricity, batteries, new structures to protect batteries, remodeling of existing structures, etc.

Item 7a - Outside funding - There are many sources of outside funding available to install renewable energy devices. Include funding received from the federal, state, or local government, utility companies, coops, etc. DO NOT include tax credits or loans.

Section 5 OTHER INFORMATION

Complete this section for all other types of energy producing devices, types of renewable energy produced, electricity sold onto the grid, savings, and federal funding.

Items 1 and 1a - Other forms of energy produced - If this operation produced any other forms of energy or used another type of energy producing device than those previously recorded, report those here

Mark all that apply in 1a. If you select answer cell 516 (other), specify what type of device was used. Be as detailed as possible. For example, if you used a wood-burning furnace to heat your shop, report this as "wood-burning furnace." If you are used the heat to heat your household and the household is not considered part of the operation, do not report the furnace on this report form.

Item 2 - Electricity sold onto the grid - If this operation had a net metering arrangement with the utility company, this is not considered sales to the grid and should not be reported.

Item 2a - Amount of electricity sold onto the grid - Report amount of electricity sold in kilowatt hours. If you are using a different magnitude (i.e. watts), write the amount and unit in the margin next to answer cell 521.

Item 2b - Payment received for electricity sold - If you had a contract with the utility company stating you cannot disclose amount received for electricity, please note this in the margin of the report form.

Item 3 - Utility bill savings - Dollar amount saved on utility bills may be an exact amount or a rough estimate, depending on the type and age of device. Savings is the amount the utility bill was reduced by producing and using renewable energy. If you are unsure, please give a range of how much you think was saved.

Item 4 - Energy audit - An energy audit is conducted by a certified energy manager or professional engineer and it focuses on potential capital-intensive projects and involves detailed gathering of field data and engineering analysis.

Item 5 - Federal funding - Tax credits are not considered federal funding.