

CONF-970856--1

ORECCL - SUMMARY OF A NATIONAL DATABASE ON ENERGY CROP LANDBASE, YIELDS, AND COSTS

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JUN 17 1997

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ABSTRACT

The Biofuels Feedstock Development Program at Oak Ridge National Laboratory has developed a county-level database on energy crops- the Oak Ridge Energy Crop County-Level database (ORECCL). This database encompasses all U.S. counties and provides easy access to energy crop information specific to a state or county. The database contains predictions of energy crop yields and farmgate prices along with county-level data on the acreage of land suitable for energy crop production. This paper describes the database and presents state-level summary statistics on land suitable for energy crop production and average predicted yields and farmgate prices.

*Managed by Lockheed Martin Energy Research Corp., under contract AC05-96OR22646 with U.S. Department of Energy.

KEYWORDS

Energy crops; switchgrass; poplar; willow; resource assessment; ORECCL.

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OVERVIEW OF DATABASE

The Biofuels Feedstock Development Program at Oak Ridge National Laboratory has developed a county-level database on energy crops. This database, which encompasses all U.S. counties, provides easy access to energy crop information specific to a state or county.

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The county-level database is a compilation of current information on land availability and rents, energy crop yields, and production costs. It includes probable farmgate prices for energy crops as calculated from information within the database. The database includes data on switchgrass (*Panicum virgatum*), hybrid poplar (*Populus sp.*), and willow (*Salix sp.*), and is searchable by either state and county name or Federal Information Processing Standards (FIPS) numeric codes for states and counties.

There are three versions of the database available via the Internet at the address <http://www.esd.ornl.gov/bfdp/oreccl/database.html>.

1. Microsoft® Excel 5.0 Spreadsheet - ORECCL.xls
2. Comma Delimited ASCII text file - ORECCL.csv
3. SAS® transportable Binary File for use with Proc Cimport - ORECCL.cpt

Each file contains 3103 observations (counties) and 43 variables.

THE 43 VARIABLES IN THE ORECCL DATABASE

The database can be divided into six groups of variables. The first group comprises six variables which define location and include state name, county name, the FIPS code for state, the FIPS code for county, the Land Resource Region in which county is found, and the United States Department of Agriculture (USDA) Major Land Resource Area to which the county was assigned.

The second group defines the expected yield and associated variation of switchgrass, and the expected type (poplar or willow) of short rotation woody crop (SRWC) and its expected yield and associated variation. The yield estimates are based on expert opinion and field trial data. The yields presume establishment of the crop in the year 2000 and the use of best management practices and best genetic stock.

The third group describes landbases which could be used to support energy crop production. These include USDA values for cropland and pasture acreages and Conservation Reserve Program (CRP) acreage as of the 12th sign-up.

The fourth group defines variable and total production costs for the range of energy crop yields depicted in the second group. The variables are all in the form of the net present value (NPV) of the production costs associated with a complete energy crop rotation (10 years for switchgrass, 22 years for willow

and 7 years for poplar). The NPV values reflect a discount rate of 6.5%. The production costs include the chipping costs associated with SRWC and baling costs associated with switchgrass. The production cost variables were estimated using a modification of the BIOCOST model (Walsh and Becker 1996).

The fifth group describes the value of the land for current uses and includes state-level observed cash-rent values for unirrigated cropland and pasture, and county-level average CRP payments. A derived county-level cropland cash-rent value is also given. This value is the observed state-level cash-rent value (\$/acre/yr) multiplied by the ratio of the county to the state value for farmland (\$/acre).

The sixth group represents the estimated farmgate prices of switchgrass and short rotation woody crops associated with the range of yields defined in the second group of variables. The farmgate prices are the breakeven prices that assure the farmer that the net present value of the returns from the energy crop over its rotation equal the net present value of the cash rent the farmer could have received over the same time interval.

STATE-LEVEL SUMMARY STATISTICS

Table 1 is a state summary of short rotation woody crop yields, acreage, and prices. Only current cropland is considered. The lowest cost feedstocks are produced in those states where willow can be grown (CT, MA, ME, northern MI, northern MN, NH, NJ, NY, PA, RI, VT, WI). These twelve states had at least one county where the estimated farmgate SRWC price fell under \$40. Seventeen more states had at least one county where the estimated price cost was under \$50. The maximum SRWC prices are always associated with counties undergoing urban encroachment and therefore having high farmland values. Although yields for SRWC are high in Oregon and Washington, the high value of farmland west of the Cascades mountain range (where poplar can be grown without irrigation) caused the farmgate prices to be high there.

Table 2 is a summary of switchgrass yields, acreage and prices. Again only current cropland is considered. On the whole, average switchgrass farmgate prices are lower than average SRWC prices by about \$15/ton except in those states where willow is the only SRWC type, in which case switchgrass and willow prices are fairly comparable. The average switchgrass price is under \$40/dry ton in most states and most states have countries with switchgrass prices below \$30/dry ton. As in the case of SRWC, the counties with high switchgrass prices are those with urban encroachment.

Table 3 is a summary of the energy crop yields and farmgate prices that might be expected if CRP lands were used to produce energy crops. The yields have not been adjusted for any difference in land quality between CRP land and cropland within a county. Differences in the average state yield on CRP land and the average state yield on cropland (Table 2) are due solely to differences in the geographic distribution of CRP land and cropland within the state. The farmgate prices in Table 3 were calculated based on providing return equivalent to the average CRP payment in the county. As in the database itself, and Table 2, a NPV approach was taken in calculating the farmgate price. Across the board, switchgrass prices on CRP land were in the mid 30s to low 40s while SRWC prices were generally in the \$50/ton price range.

Some caveats to these results are as follows. While the database contains yield estimates for switchgrass in the northeast and willow in the northern midwest, these values are not based on field data, but simply the presumption that the crops should be able to grow in these regions given their climate and soil requirements. The production costs of poplar are based on a seven year rotation and a single spacing of 48 ft² per stem (6 ft by 8 ft or 900 trees/acre). In regions with lower productivity, a wider spacing (i.e., fewer trees) and a longer rotation (e.g., 10 yrs) might be more profitable as per acre harvest costs are closely linked to stem density. The switchgrass yields are those expected years 3-10 in the rotation and are based on a single harvest each year. The switchgrass farmgate price accounts for assumed storage losses (on average 6%) and reduced yields the first two years of the rotation. The high poplar farmgate prices in the Pacific Northwest are the result of high land rent estimates (in excess of \$100/acre/yr). If land rents comparable to those presented by Withrow-Robison et al. (1995) for the Willamette Valley in Oregon (~\$65/acre/year) are assumed, the farmgate prices drop from ~ \$80/dry ton to ~ \$49/dry ton.

By linking the database variable values to county locations using a GIS or SAS/GRAFH® the information can easily be displayed in a map format. Figure 1 shows counties with more than 10,000 acres of cropland and potential switchgrass prices below \$35/dry ton. Most of these counties occur in the southeast.

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Table 1. Predicted farmgate prices and cropland acreage suitable for short rotation woody crop (SRWC) production.

State	Average short rotation woody crop yield (tons/acre/yr)	Land suitable for SRWC (acres)	Average farmgate price (\$/dry ton)	Minimum farmgate price (\$/dry ton)	Maximum farmgate price (\$/dry ton)
Alabama	4.51	2,643,369	\$51.35	\$47.02	\$65.67
Alaska	-	0	-	-	-
Arizona	-	0	-	-	-
Arkansas	4.79	7,973,137	\$53.19	\$48.49	\$73.82
California	-	0	-	-	-
Colorado	-	0	-	-	-
Connecticut	6.09	145,017	\$36.77	\$34.52	\$55.14
Delaware	4.50	446,024	\$58.81	\$57.28	\$65.04
Florida	4.50	582,501	\$56.91	\$49.95	\$72.92
Georgia	4.44	4,043,178	\$50.39	\$46.67	\$99.52
Hawaii	-	0	-	-	-
Idaho	-	0	-	-	-
Illinois	5.00	23,154,466	\$65.46	\$49.93	\$139.24
Indiana	5.00	12,623,620	\$61.65	\$52.81	\$80.46
Iowa	4.99	24,984,913	\$67.13	\$50.31	\$81.02
Kansas	4.52	4,587,036	\$54.64	\$50.26	\$81.09
Kentucky	4.94	5,417,270	\$53.79	\$46.06	\$82.22
Louisiana	4.81	4,656,679	\$52.17	\$45.81	\$442.44
Maine	4.13	469,741	\$49.69	\$39.40	\$58.15
Maryland	4.49	1,453,526	\$58.11	\$47.31	\$70.53
Massachusetts	5.43	164,393	\$39.29	\$30.58	\$51.37
Michigan	5.03	7,339,680	\$49.80	\$32.60	\$80.25
Minnesota	4.74	20,115,912	\$58.01	\$37.35	\$144.42
Mississippi	4.86	5,163,948	\$50.35	\$45.76	\$71.92
Missouri	4.78	13,796,574	\$58.56	\$47.92	\$83.23
Montana	-	0	-	-	-
Nebraska	4.52	6,424,623	\$67.15	\$55.18	\$88.51
Nevada	-	0	-	-	-
New Hampshire	5.37	101,867	\$39.51	\$35.29	\$48.70
New Jersey	4.76	477,295	\$53.84	\$34.71	\$102.07
New Mexico	-	0	-	-	-
New York	6.03	3,916,278	\$34.81	\$30.57	\$288.49
North Carolina	4.34	4,668,279	\$54.77	\$47.76	\$90.71
North Dakota	3.76	15,676,374	\$62.21	\$57.86	\$66.60
Ohio	4.87	10,569,329	\$58.33	\$40.32	\$184.45
Oklahoma	4.26	1,510,587	\$52.42	\$47.63	\$62.55
Oregon	6.03	991,030	\$79.68	\$55.70	\$163.60
Pennsylvania	4.73	4,180,191	\$52.73	\$31.44	\$125.75
Rhode Island	6.00	18,727	\$37.91	\$35.69	\$45.85
South Carolina	4.39	2,000,262	\$48.99	\$46.21	\$62.31
South Dakota	4.32	7,371,267	\$61.58	\$52.52	\$75.77
Tennessee	4.85	4,458,730	\$52.99	\$45.91	\$82.51
Texas	4.01	991,571	\$56.29	\$50.53	\$63.58
Utah	-	0	-	-	-
Vermont	5.05	493,465	\$42.23	\$34.00	\$61.36
Virginia	4.34	2,727,835	\$53.76	\$47.03	\$69.65
Washington	5.90	283,121	\$86.13	\$61.21	\$126.13
West Virginia	4.21	616,480	\$54.31	\$49.07	\$70.82
Wisconsin	4.96	9,509,929	\$52.54	\$35.88	\$71.16
Wyoming	-	0	-	-	-

Table 2. Predicted farmgate prices and cropland acreage suitable for switchgrass (SWG) production.

State	Average switchgrass yield (tons/acre/yr)	Land suitable for SWG (acres)	Average farmgate price (\$/dry ton)	Minimum farmgate price (\$/dry ton)	Maximum farmgate price (\$/dry ton)
Alabama	6.19	2,643,369	\$31.44	\$28.34	\$41.13
Alaska	-	0	-	-	-
Arizona	-	0	-	-	-
Arkansas	6.09	7,973,137	\$35.24	\$29.56	\$47.37
California	-	0	-	-	-
Colorado	-	0	-	-	-
Connecticut	5.00	145,017	\$40.30	\$36.47	\$65.89
Delaware	3.39	446,024	\$55.54	\$45.44	\$57.79
Florida	4.78	761,720	\$49.24	\$32.93	\$92.48
Georgia	5.82	4,043,178	\$31.52	\$27.67	\$63.60
Hawaii	-	0	-	-	-
Idaho	-	0	-	-	-
Illinois	5.96	23,154,466	\$48.20	\$34.24	\$112.63
Indiana	5.91	12,623,620	\$45.11	\$35.35	\$61.04
Iowa	6.00	24,984,913	\$49.27	\$34.57	\$61.52
Kansas	5.04	18,595,069	\$35.24	\$29.10	\$56.75
Kentucky	6.44	5,417,270	\$35.91	\$29.37	\$59.14
Louisiana	5.37	4,656,679	\$37.95	\$30.64	\$572.43
Maine	-	0	-	-	-
Maryland	4.30	1,453,526	\$47.37	\$30.05	\$58.49
Massachusetts	5.00	120,154	\$38.18	\$33.71	\$51.92
Michigan	5.04	7,339,680	\$39.18	\$32.59	\$70.13
Minnesota	5.41	20,115,912	\$42.41	\$34.41	\$135.25
Mississippi	5.99	5,163,948	\$33.56	\$30.04	\$66.71
Missouri	6.09	13,796,574	\$39.72	\$32.47	\$63.47
Montana	-	0	-	-	-
Nebraska	5.41	13,709,869	\$45.42	\$34.18	\$62.63
Nevada	-	0	-	-	-
New Hampshire	5.00	27,159	\$44.41	\$39.57	\$48.06
New Jersey	5.41	477,295	\$38.93	\$31.92	\$132.85
New Mexico	-	0	-	-	-
New York	5.00	3,646,878	\$36.48	\$31.74	\$398.85
North Carolina	5.11	4,668,279	\$38.30	\$29.67	\$99.35
North Dakota	4.39	19,970,542	\$38.57	\$32.54	\$49.18
Ohio	5.77	10,569,329	\$41.83	\$30.24	\$160.76
Oklahoma	5.50	5,360,154	\$35.71	\$30.66	\$43.29
Oregon	-	0	-	-	-
Pennsylvania	5.60	4,180,191	\$37.58	\$27.96	\$97.75
Rhode Island	5.00	18,727	\$41.30	\$38.14	\$52.64
South Carolina	5.32	2,000,262	\$32.54	\$27.70	\$54.95
South Dakota	5.09	12,642,868	\$38.42	\$32.08	\$50.44
Tennessee	6.25	4,458,730	\$34.89	\$29.73	\$49.04
Texas	5.35	8,500,408	\$38.40	\$31.41	\$63.70
Utah	-	0	-	-	-
Vermont	5.00	191,483	\$37.25	\$35.72	\$42.39
Virginia	5.63	2,727,835	\$35.18	\$27.54	\$57.88
Washington	-	0	-	-	-
West Virginia	6.23	616,480	\$32.57	\$27.37	\$49.83
Wisconsin	5.11	9,509,929	\$41.26	\$32.42	\$60.56
Wyoming	-	0	-	-	-

Table 3. Conservation Reserve Program (CRP) lands suitable for short rotation woody crop (SRWC) and switchgrass (SWG) production by state and average farmgate price of biomass from those lands.

State	CRP acreage suitable for switchgrass (acres)	CRP acreage suitable for SRWC (acres)	Average price of SWG on CRP land (\$/ton)	Average price of SRWC on CRP land (\$/ton)	Average yield of SWG on CRP land (tons/ac/yr)	Average yield of SRWC on CRP land (tons/ac/yr)
Alabama	573,191	573,191	\$33.84	\$54.24	6.09	4.50
Alaska	0	0	-	-	-	-
Arizona	0	0	-	-	-	-
Arkansas	260,006	260,006	\$34.84	\$55.18	6.20	4.52
California	0	0	-	-	-	-
Colorado	0	0	-	-	-	-
Connecticut	10	10	\$40.22	\$37.15	5.00	6.00
Delaware	995	995	\$53.37	\$60.96	4.06	4.50
Florida	134,860	133,838	\$36.09	\$54.05	5.59	4.50
Georgia	706,459	706,459	\$34.75	\$54.79	5.91	4.44
Hawaii	0	0	-	-	-	-
Idaho	0	0	-	-	-	-
Illinois	811,926	811,926	\$42.00	\$58.62	5.97	5.00
Indiana	462,649	462,649	\$41.33	\$57.84	5.99	5.00
Iowa	2,224,834	2,224,834	\$42.97	\$59.90	6.00	5.00
Kansas	1,691,232	359,831	\$40.78	\$59.52	4.94	4.52
Kentucky	451,317	451,317	\$37.00	\$54.27	6.33	5.00
Louisiana	146,571	146,571	\$36.71	\$51.79	5.54	4.81
Maine	0	38,490	\$0.00	\$58.92	-	3.50
Maryland	20,392	20,392	\$55.05	\$62.93	4.25	4.49
Massachusetts	11	32	\$40.22	\$50.80	5.00	4.36
Michigan	332,853	332,853	\$41.94	\$53.17	5.14	5.01
Minnesota	1,928,954	1,928,954	\$40.99	\$55.54	5.16	4.68
Mississippi	841,826	841,826	\$34.22	\$52.71	5.99	4.68
Missouri	1,726,835	1,726,835	\$38.80	\$56.58	6.04	4.86
Montana	0	0	-	-	-	-
Nebraska	797,988	558,616	\$40.01	\$61.39	5.65	4.51
Nevada	0	0	-	-	-	-
New Hampshire	0	0	-	-	-	-
New Jersey	723	723	\$39.00	\$55.86	5.46	4.62
New Mexico	0	0	-	-	-	-
New York	61,930	64,498	\$41.42	\$37.89	5.00	6.11
North Carolina	151,008	151,008	\$35.57	\$58.24	5.93	4.11
North Dakota	2,298,125	1,638,558	\$39.21	\$63.69	4.36	3.64
Ohio	377,089	377,089	\$41.11	\$58.11	5.89	4.89
Oklahoma	167,751	23,675	\$39.54	\$55.62	5.35	4.31
Oregon	0	5,373	\$0.00	\$44.51	-	6.82
Pennsylvania	101,078	101,078	\$41.08	\$55.86	5.60	4.77
Rhode Island	0	0	-	-	-	-
South Carolina	278,071	278,071	\$35.93	\$55.33	5.68	4.33
South Dakota	1,246,232	606,685	\$39.04	\$58.56	4.85	4.26
Tennessee	475,625	475,625	\$36.06	\$54.12	6.13	4.82
Texas	222,944	46,567	\$36.45	\$56.12	5.99	4.00
Utah	0	0	-	-	-	-
Vermont	88	193	\$40.22	\$44.71	5.00	5.10
Virginia	79,556	79,556	\$36.73	\$59.79	5.96	4.16
Washington	0	0	-	-	-	-
West Virginia	618	618	\$35.65	\$58.39	6.08	4.22
Wisconsin	746,530	746,530	\$43.11	\$55.48	5.33	4.99
Wyoming	0	0	-	-	-	-

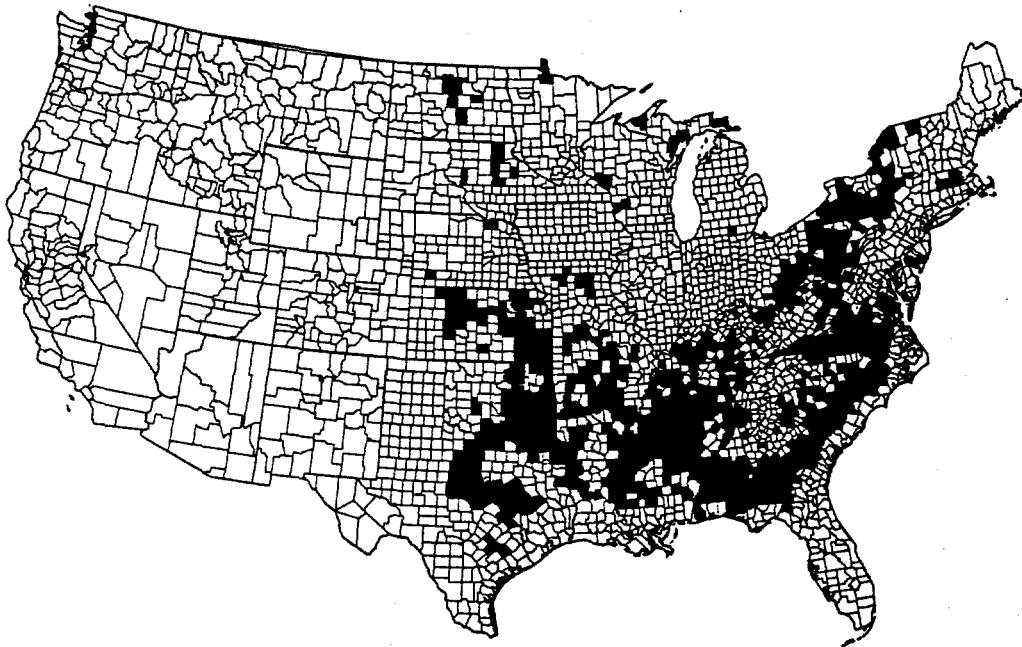


Figure 1. Counties with more than 10,000 acres of cropland and predicted switchgrass farmgate prices below \$35/dry ton.

ACKNOWLEDGEMENTS

We would like to acknowledge Dr. Shaine Tyson of the National Renewable Energy Laboratory, Golden, CO, who sponsored a significant portion of the database development and encouraged us to make the database as complete and detailed as possible. Dr. Marie Walsh of Oak Ridge National Laboratory provided invaluable review of the farmgate price calculations. Drs. Jerry Tuskan and Sandy McLaughlin (also of Oak Ridge National Laboratory) provided detailed reviews of the energy crop yield assumptions. Questions regarding the database should be directed to Robin L. Graham (GrahamRL@ORNL.GOV).

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