TEXAS BIOENERGY

2010 STATUS REPORT

Prepared by Texas Department of Agriculture Staff
September 2010

Staff Contact

Jason Modglin - Policy Analyst
Contact Information at www.texasagriculture.gov/bioenergy

Funding Acknowledgment

This publication was developed by staff at the Texas Department of Agriculture to assist the Texas Bioenergy Policy Council and Research Committee program and was partially funded with oil overcharge funds from the Exxon settlement as provided by the Texas State Energy Conservation Office and the U. S. Department of Energy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Texas Bioenergy Status Report 2010

Introduction 2
Bioenergy Feedstocks 3
- Growing Regions 3
- Current Feedstock Production 5
  - Animal Fats 6
  - Barley 7
  - Corn 8
  - Cotton 9
  - Hay 11
  - Manure 12
  - Peanuts 14
  - Rapeseed 15
  - Rice 16
  - Sorghum 17
  - Soybeans 19
  - Sugarcane 20
  - Sunflowers 21
  - Wheat 22
  - Woody Biomass 23
- Potential Production 25
  - Algae 26
  - Castor 28
  - Energycane 29
  - High-tonnage Sorghum 30

Bioenergy Producers 32
- Introduction 32
- Biofuels 32
  - Current Production 33
    - Ethanol 33
    - Biodiesel 35
  - Project Capacity 37
- Biomass 38
  - Production 38
    - Biogas Generation 38
    - Combined Heat and Power or On-site Power Generation 38
    - Woody Biomass to Electricity 39
  - Project Capacity 40
- Conclusion 41

Additional Resources 42

INTRODUCTION

Texas agriculture is a powerhouse of production, ranking the Lone Star State as the second-largest agriculture producing state in the nation and contributing over $100 billion to the state economy. With a large geography and abundant and diverse natural resources, the Texas agriculture industry is in constant production, growing, harvesting, manufacturing and marketing the most reliable food and fiber supply in the world.

The agriculture industry is only one sector of a thriving Texas economy that includes energy, education/research, infrastructure development and private investment. Texans maintain the experience, knowledge and initiative to advance the renewable energy industry, specifically the production of bioenergy.

In 2009, the 81st Texas Legislature established the Texas Bioenergy Policy Council and Texas Bioenergy Research Committee to promote "the goal of making biofuels a significant part of the energy industry in this state not later than January 1, 2019."[1] The Policy Council, comprised of 18 members representing state entities and the private sector, is responsible for addressing the challenges to a bioenergy industry through a strategic plan to be reported to the 82nd Legislature. The Research Committee, comprised of 16 members, is responsible for providing technical assistance required for the strategic plan.

While the Policy Council and Research Committee are currently preparing the strategic bioenergy plan for release in Fall 2010, the purpose of the bioenergy status report is to provide a concise summary of the status of the current bioenergy industry, specifically the types and amounts of available feedstock and the level of bioenergy production, to create a foundation for future development. Data was gathered from publicly available sources and/or solicited directly from known bioenergy producers in Texas and is not intended to be an exhaustive review of the diverse bioenergy industry.

[1] Chapter 50D of the Texas Agriculture Code

BIOENERGY FEEDSTOCKS

Bioenergy is renewable energy made from any organic material from plants or animals. Sources of bioenergy are called "biomass," and include agricultural and forestry residues, municipal solid wastes, industrial wastes, and terrestrial and aquatic crops grown solely for energy purposes. – U.S. Department of Energy[2]

Before ethanol or biodiesel is purchased at the local fueling station or biomass electricity helps to heat or cool homes and offices, bioenergy production begins with a plant, tree or some other organic feedstock. The following sections are dedicated to exploring production of these feedstocks, identifying the geographic regions of the state were they are produced and their current use in the manufacture of bioenergy.

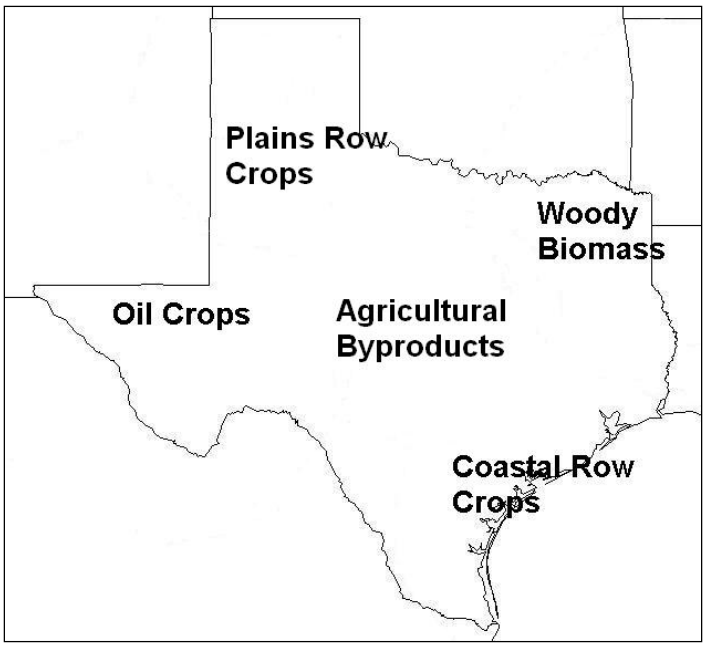
Growing Regions

Texas has many diverse growing regions that allow for a variety of bioenergy feedstocks to be produced. The State Energy Conservation Office (SECO) has emphasized Texas' diverse growing regions through recent reports on renewable energy. Most notably, the *Energy Report* published in 2008 details many sources for biomass around the state. The report breaks the state into five regions for bioenergy crop production as detailed in the chart below:

REGION	CROP TYPE
Upper East and Southeast Texas	Forest Residues and Energy Crops
Texas High Plains	Sorghum, Canola, Manure
Gulf Coast and Rio Grande Delta Lands	Sugarcane and Switchgrass
Northwest and Central Texas	Mesquite
Capital and Central Texas Corn Belt	Corn and Sorghum

[2] http://www1.eere.energy.gov/biomass/biomass_basics_faqs.html#bioenergy

For illustrative purposes, the following map shows the approximate growing regions of the state that bioenergy feedstocks are found.



Agricultural Byproducts
Animal Fats, Manure, Wood Waste, Crop Residues

Coastal Row Crops
Grasses, Energycane, Rice, Sorghum, Sugarcane

Oil Crops
Algae, Camelina, Castor, Cotton, Peanut, Rapeseed, Safflower, Sunflower

Plains Row Crops
Barley, Corn, Sorghum, Wheat

Woody Biomass
Timber, Wood Waste

Current Feedstock Production

While food, feed and fiber are the primary end uses for most crops traditionally grown in Texas, some products could be utilized as feedstocks for bioenergy production.

The following list of feedstocks is not exhaustive but reflects the most commonly documented and utilized feedstocks given current technology, availability and state agriculture production trends:

TRADITIONAL AGRICULTURAL PRODUCTS		
Animal Fats	Manure	Soybeans
Barley (Grain & Stover)	Peanuts	Sugarcane
Corn (Grain & Stover)	Rapeseed (canola)	Sunflowers
Cotton (Seed & Gin Trash)	Rice	Wheat (Grain & Straw)
Hay	Sorghum (Grain & Stover)	Woody Biomass

The *Texas Renewables Energy Resource Assessment of 2008* is the most recent comprehensive report of bioenergy in the state of Texas and includes projections for production potential.[3] These projections, along with relevant news or academic findings, are reflected in the following pages for the feedstocks listed above.

[3] http://www.seco.cpa.state.tx.us/publications/renewenergy/

Animal Fats

Description and Current Uses

Animal fat is a broad category bioenergy feedstock most often used for the production of biodiesel. The most common sources for animal fat are lard, tallow, suet and grease produced from beef, chicken and pork processing. In addition to biodiesel, animal fats are also "valuable ingredients for various soaps, paints and varnishes, cosmetics, explosives, toothpaste, pharmaceuticals, leather, textiles and lubricants."[4] [5]

Bioenergy Application

Combining oils, whether derived from plant or animal, with an alcohol and a chemical catalyst produces biodiesel through a process called transesterification. "The theoretical rate of conversion is about 100 pounds of biodiesel (B100) with about 10 pounds of unpurified glycerin produced from every 100 pounds of oil and 10 pounds of methanol."[6]

TOP TEN COUNTIES FOR LICENSED LIVESTOCK AND POULTRY SLAUGHTERING ESTABLISHMENTS, MARCH 2010

Sources: USDA Food Safety Inspection Service and Texas Department of State Health Services

County	Number of Slaughter Establishments
Harris	17
Dallas	6
Gonzales	5
McLennan	5
Parker	5
Fayette	4
Hunt	4
Titus	4
Tom Green	4
Tarrant	3

Existing Capacity

In March 2010, there were a total of 231 livestock and poultry slaughter facilities in 123 different counties in Texas. The volume of fats this number of facilities represents is unclear because production levels vary by type and use of animal processed. The chart to the left shows the top 10 counties for licensed livestock and poultry slaughtering establishments, which represents a little under 25 percent of the total state capacity at 57 establishments.

[4] http://nationalrenderers.org/about/process/

[5] Picture Source: Wedliny Domowe Meat Classification Chart http://www.wedlinydomowe.com/meat-selection/meat-classification.htm

[6] http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#utilization

Barley

Description and Current Uses

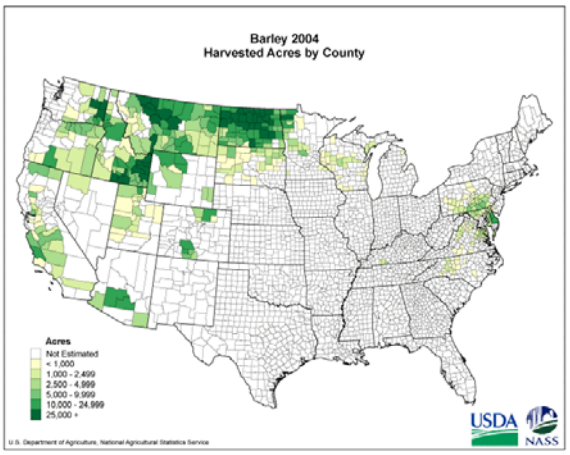
Barley is a cereal grain used for forage and food production. Multiple seasonal varietals allow for it to be grown complementary to other crops' growing seasons, giving farmers year-round production without displacing primary crops for food or fiber.[7]

Bioenergy Application

Barley grain can be fermented for the production of ethanol, and its stover can be used for the production of cellulosic ethanol. A February 2010 article in *Agricultural Research* magazine described efforts by the U.S. Department of Agriculture's Agricultural Research Service to encourage barley production grown on seasonally fallow land along the East coast.[8]

Existing Capacity

Production of barley is relatively limited in Texas. In fact, the 2007 Census of Agriculture only cited specific production numbers for three counties (Castro, Parmer and Young) and the ratio of bushels to harvest acres varied widely across the samplings. The crop is predominantly grown in the Northwest region of the country, as seen in USDA's map of the United States.[9]



BARLEY, 2007 ACRES HARVESTED AND PRODUCTION		
Source: USDA-NASS, Census of Agriculture		
County	Harvested Acres	Production (bushels)
Castro	276	31,644
Parmer	270	26,254
Young	127	3,179
Other Counties	1,417	80,922
State Total	2,090	141,999

[7] Picture Source: USDA, National Agricultural Statistics Service
[8] http://www.ars.usda.gov/is/AR/archive/feb10/barley0210.htm
[9] Map Source: USDA, National Agricultural Statistics Service

Corn

Description and Current Uses

Corn production exceeds all other feed grains in the United States, making up over 86% of planted acres nationwide in USDA's 2009-10 annual estimates.[10] Uses include feed and food but also include production for ethanol, sweeteners and starches.

Bioenergy Application

Corn grain is the predominant feedstock for traditional ethanol, which can be used as a fuel or fuel additive as oxygenate for gasoline. Corn stover is the stalk, leaves and cob, or any other part of the corn plant remaining after harvesting the grain. Cellulosic ethanol is fuel made without grain as a feedstock. Mandates for cellulosic ethanol under the federal Renewable Fuels Standard have made corn stover an attractable feedstock option.

Existing Capacity

Texas ranked #12 in planted acres of corn for the 2010 season with 2,200,000 acres planted.[11] The state's high needs for feed and food make Texas a net-importer of corn. The top ten counties for corn production and planted acres in 2009 are reproduced below from USDA's National Agricultural Statistics Service.

TOP TEN COUNTIES FOR 2009 IN CORN ACRES PLANTED AND PRODUCTION			
Source: USDA-NASS			
Planted		Production	
County	Acres	County	Bushels
Dallam	133,500	Hartley	27,740,000
Castro	129,500	Dallam	26,750,000
Hartley	122,000	Castro	23,901,000
Williamson	100,000	Sherman	18,310,000
Parmer	93,300	Parmer	17,218,000
Jackson	89,000	Lamb	13,830,000
Sherman	85,100	Moore	12,803,000
Lamb	77,300	Hale	10,009,000
Falls	72,700	Deaf Smith	6,766,000
Hill	71,000	Ochiltree	4,964,000
State Total	2,350,000	State Total	254,800,000

[10] USDA – World Agricultural Supply and Demand Estimates, http://www.usda.gov/oce/commodity/wasde/latest.txt

[11] USDA NASS U.S. & All States Data - Corn field 2010

Cotton

Description and Current Uses

Texas is a leading producer of cotton. Traditionally used in the production of fiber for textiles and fabrics, many other parts of the plant have important uses. Cottonseed can be processed into high-value oil that is used for many applications ranging from cooking to cosmetics and may be used as a component of livestock feed.

Bioenergy Application

While cotton oil can be processed directly into fuel, it is most often recycled after its initial use along with other oils and greases to become biodiesel. There are also other parts of the cotton plant that are proving to be excellent sources for bioenergy and bioproducts. A 2009 research report from USDA's Agricultural Research Service Gin Lab in Lubbock Texas demonstrated that briquetting of cotton gin trash can be a cost effective fuel source. "Densifying gin trash into briquettes delivers a BTU output comparable to wood and/or corn-based pellets. The BTU's can be increased to 9,000 per pound by adding a small amount of crude cottonseed oil or crude glycerin (a by-product of biodiesel production)."[12]

Existing Capacity

Texas leads the U.S. in cotton production and it is our leading cash crop, ranking only behind the beef and nursery industries in total cash receipts. Texas annually produces about 25% of the entire U.S. crop and plants over 6 million acres! That's over 9,000 square miles of cotton fields. – Texas A&M Cotton Program[13]

The top ten counties in Texas for cotton production and planted acres in 2008 are reproduced below from USDA's National Agricultural Statistics Service.

TOP TEN COUNTIES FOR 2008 IN COTTON ACRES PLANTED AND PRODUCTION			
Source: USDA-NASS			
Planted		Production	
County	Acres	County	Bushels
Hale	312,200	Lynn	375,900
Lubbock	297,500	Dawson	346,700
Hockley	249,000	Gaines	280,000
Floyd	246,500	Lubbock	258,800
Crosby	244,500	Hockley	227,200
Lynn	239,900	Terry	197,400
Gaines	203,200	Crosby	167,500
Lamb	201,800	Hale	163,000
Terry	163,500	Martin	161,300
Dawson	154,500	Floyd	144,500
State Total	5,000,000	State Total	4,450,000

[12] http://southeastfarmpress.com/mag/farming_cotton_gin_trash/

[13] http://cotton.tamu.edu/

A 2008 joint study between Texas Tech University and the Texas Agricultural Experiment Station, found that 30 Panhandle counties "produce an annual average of 994,736 short tons of cotton gin trash with a minimum of 606,156 short tons and a maximum of 1,485,929 short tons for the period from 2001 to 2006."[14] The density of production is illustrated in the graph below:

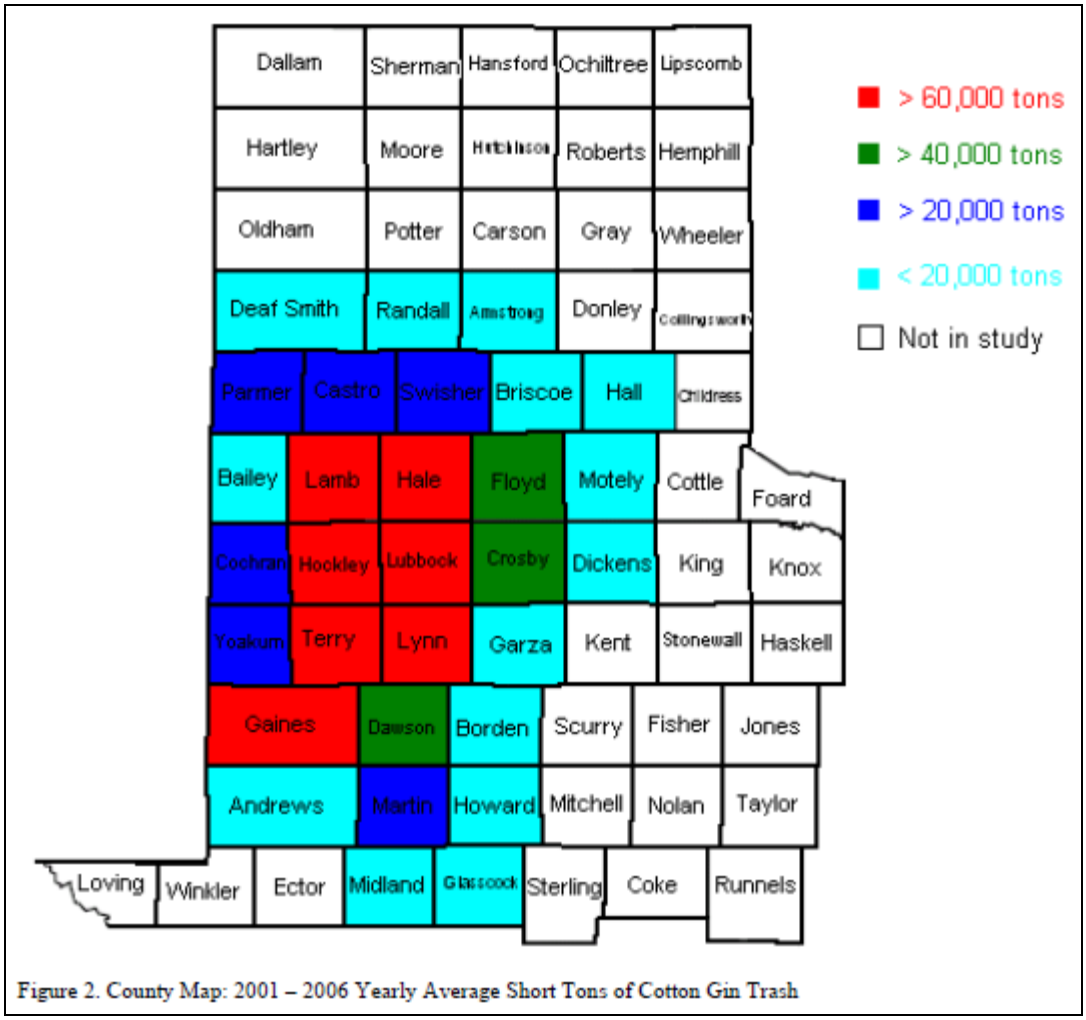


Figure 2. County Map: 2001 – 2006 Yearly Average Short Tons of Cotton Gin Trash

Figure 1- Source: http://www.aaec.ttu.edu/publications/beltwide%202008/7545.pdf

[14] Wilde, Curtis. Jeff Johnson. Michael Farmer. "Cotton Gin Trash Availability on the Texas High Plains for Bioenergy Production". 2008 Beltwide Cotton Conferences, Nashville, Tennessee, 2008. Online. Source: http://www.aaec.ttu.edu/publications/beltwide%202008/7545.pdf

Hay

Description and Current Uses

Hay is primarily used for animal feed and fodder, but silage can be used for the production of biogas when degraded inside an anaerobic digester. Hay and pasture acres are shown here to illustrate the land potential for other perennial grass feedstocks that may be used for the production of cellulosic ethanol.[15] The typically low-value of the crop is in contrast to its critical importance as a feedstock for livestock and other ruminants in times of drought or inclement weather.[16] Given this demand, careful consideration will be needed to balance the needs of foraging animals versus mandates for bioenergy production.

Existing Capacity

The top ten Texas counties for hay and pasture acres in 2007 are reproduced below from USDA's National Agricultural Statistics Service Census of Agriculture.

TOP TEN COUNTIES FOR HAY AND PASTURE ACRES, 2007			
Source: USDA-NASS, Census of Agriculture			
Hay Acres Harvested		Permanent Pasture & Rangeland	
County	Acres	County	Acres
Lamar	92,037	Polk	2,778,691
Hopkins	91,230	Hudspeth	2,121,704
Van Zandt	84,716	Wharton	1,757,143
Fannin	82,472	Brewster	1,662,005
Hunt	75,040	Crockett	1,573,739
Cooke	68,840	Rains	1,510,541
Grayson	67,999	Van Zandt	1,458,986
Erath	67,575	Jeff Davis	1,344,486
Wise	66,891	Terry	1,274,517
Fayette	63,970	Edwards	947,211
State Total	5,145,606	State Total	87,217,416

[15] See Perennial Grasses section.

[16] Picture Source: http://seguindailyphoto.blogspot.com/2008/05/sky-watch-over-hay-field.html

Manure

Description and Current Uses

Manure can be a source of significant concern for cattle, swine, or poultry operations. Though fertilizer applications are an acceptable and beneficial disposal process, producers must closely manage these activities; therefore new and more advanced disposal systems and techniques are a priority. Utilizing manure as a feedstock for bioenergy is proving an option for livestock operations across Texas.

Bioenergy Application

Manure and other animal waste can be dried and burned with traditional fuel sources like coal to produce electricity, or it can be processed in an anaerobic digester to produce methane, a natural gas alternative traditionally used in electricity production. In addition to bioenergy, contents from the anaerobic digester, after all of the methane has been captured, can be used as a nutrient rich compost and fertilizer. Manure is one of the lowest cost feedstocks given its current classification as a waste product, but bioenergy production requires transportation infrastructure and a conversion facility to harness its bioenergy potential.

Existing Capacity

Total capacity to determine availability of manure resources cannot easily be measured; instead the top counties for cattle in feedlots, dairies, and poultry facilities have been identified using the 2007 Census of Agriculture.

INTENSIVE LIVESTOCK OPERATIONS WITH POTENTIAL FOR HARVESTABLE MANURE STOCKPILES			
Source: USDA, Census of Agriculture			
County	Cattle Reported on Feedlot	County	Dairy Head
Deaf Smith	467,459	Erath	55,937
Castro	341,694	Parmer	33,842
Parmer	299,584	Deaf Smith	33,265
Hartley	203,049	Hopkins	32,936
Hansford	194,843	Castro	28,702
Swisher	157,450	Comanche	26,605
Randall	143,176	Hartley	22,001
Moore	139,948	Lamb	20,860
Dallam	118,405	Bailey	17,015
Sherman	112,548	Hale	14,715
Ochiltree	76,413	Archer	8,783
Gonzales	20,814	Wood	8,205
Palo Pinto	1,740	Hamilton	7,188
Archer	1,547	Van Zandt	6,490
Roberts	1,536	Dallam	5,500
State Total	3,056,260	State Total	404,399

INTENSIVE CHICKEN OPERATIONS WITH POTENTIAL FOR HARVESTABLE MANURE STOCKPILES			
Source: USDA, Census of Agriculture			
County	Broiler	County	Layers
Shelby	24,186,885	Gonzales	4,909,610
Nacogdoches	19,372,881	Wharton	3,500,000
Gonzales	11,251,154	Brazos	1,500,000
Camp	6,616,470	Caldwell	1,500,000
Cass	6,001,390	Camp	1,500,000
Titus	5,802,158	Shelby	1,371,757
San Augustine	5,710,598	Denton	1,000,000
Franklin	4,953,655	Nacogdoches	513,918
Hopkins	3,662,643	Lavaca	495,007
Wood	3,634,744	La Salle	300,000
Morris	3,569,369	Hopkins	224,351
Leon	3,337,412	San Augustine	217,840
Panola	3,138,624	Fayette	213,451
Robertson	2,394,913	Robertson	161,811
Cherokee	1,657,888	Guadalupe	140,828
State Total	118,612,254	State Total	19,116,712

Peanuts

Description and Current Uses

Peanuts are a high value crop for food and oil production. Texas is second in peanut production nationally. "The Texas peanut industry is worth more than $1 billion to the state's economy. Peanut farmers, shellers, equipment dealers, manufacturers and labor make up a portion of the industry that has become so valuable to Texas."[17]

Bioenergy Application

Peanut oil was rumored to have powered Rudolf Diesel's first diesel engine at the 1900 Paris Exhibition.[18] The food quality peanut market demands production inputs at a level that make the oil production less economical than other crops. For this reason, current research is focused on developing a high–oil, non-food peanut and alternative production techniques that would maximize oil yields.[19] Other parts of the peanut, like shell and root system could provide a source of woody biomass, see picture right.[20]

Existing Capacity

For 2008, the top counties in Texas for peanut acres planted and production are shown in the chart at right. The Texas Peanut Board reports that in 2009 "state peanut farmers planted 165,000 acres and produced nearly 550 million pounds of peanuts. In 2008, Texas peanut farmers produced 860 million pounds of peanuts on 257,000 acres, making it the largest crop in the state's history." Very little peanut oil is produced directly for bioenergy, though it may ultimately be used for biofuel made from recycled cooking oils.

PEANUTS, 2008 ACRES PLANTED AND PRODUCTION

Source: USDA-NASS

County	Planted Acres	Production (pounds)
Andrews	4,600	15,400,000
Atascosa	4,700	15,760,000
Bailey	2,500	5,320,000
Cochran	14,400	44,630,000
Collingsworth	19,900	50,070,000
Comanche	1,700	4,070,000
Dawson	10,100	35,650,000
Donley	5,400	19,300,000
Frio	15,200	55,660,000
Gaines	69,700	263,780,000
Hall	2,100	7,030,000
Hockley	5,000	16,400,000
Lamb	4,400	11,700,000
Terry	30,000	99,420,000
Wheeler	2,700	7,490,000
Wilbarger	2,500	7,940,000
Yoakum	37,400	130,260,000
Other Counties	24,700	70,320,000
State Total	257,000	860,200,000

[17] http://www.texaspeanutboard.com/about.html

[18] http://www.biodiesel.org/resources/reportsdatabase/reports/gen/20011101_gen-346.pdf

[19] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#cropproduction

[20] Picture Source: http://today.ttu.edu/2009/12/new-technology-may-boost-peanut-crops/

Rapeseed

Description and Current Uses

Rapeseed is an oilseed crop.[21] Canola, its main varietal, is grown for the production of food-grade oil. Domestic production is largely confined to the northern plains region of the United States, but rapeseed's low water needs make the plant a potential feedstock for Texas bioenergy production.

Bioenergy Application

Like other oilseeds, biodiesel can be produced from rapeseed oil by combining it with alcohol in a process called transesterification. To date, rapeseed has become recognized as a biofuel crop in Europe and Canada, and farmers in Texas, Oklahoma and Kansas are evaluating incorporating canola into wheat, sorghum and cotton rotations.[22]

Existing Capacity

For 2007, the USDA Census of Agriculture captured a total of seven farms in Texas that disclosed production of rapeseed but only totals for the entire state were published. In 2007, rapeseed was produced on 486 harvested acres, which yielded approximately 438,400 bushels.

RAPESEED, 2007 HARVESTED ACRES			
Source: USDA-NASS, Census of Agriculture			
(D) Data not published to avoid disclosure of confidential information			
County	Number of Farms	Harvested Acres	Production (bushels)
Bailey	1	(D)	(D)
Castro	1	(D)	(D)
Hidalgo	1	(D)	(D)
Midland	1	(D)	(D)
San Patricio	2	(D)	(D)
Yoakum	1	(D)	(D)
State Total	7	486	438,400

[21] Picture Source: http://agnewsarchive.tamu.edu/dailynews/stories/AGEC/photos/Apr1106a.htm

[22] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#cropproduction

Rice

Description and Current Uses

Rice grain is one of the world's most prolific food sources and a valuable grain export for growing regions in southeast Texas.[23] While the value of the crop is in the grain, much of the crop waste could be used for the production of bioenergy.

Bioenergy Application

Rice crop waste, including straw and hulls, can be used as feedstocks for bioenergy either as cellulosic ethanol or burned to create heat and steam for the production of electricity.[24]

Existing Capacity

For 2008, USDA reported Texas planted a total of 175,000 acres of rice for an approximate production weight of 1.1 billion pounds of rice.

RICE, 2008 PLANTED ACRES AND PRODUCTION		
Source: USDA-NASS		
County	Planted Acres	Production (hundredweight)
Austin	1,000	74,000
Brazoria	15,200	840,000
Calhoun	2,800	160,000
Chambers	13,100	540,000
Colorado	31,800	2,390,000
Fort Bend	5,700	500,000
Jackson	9,900	740,000
Jefferson	17,500	910,000
Lavaca	1,700	111,000
Liberty	7,600	570,000
Matagorda	19,700	1,400,000
Victoria	1,100	74,000
Waller	6,300	580,000
Wharton	38,000	2,740,000
Other Counties	3,600	239,000
State Total	175,000	11,868,000

[23] Picture Source: http://newagnews.tamu.edu/dailynews/stories/DRGHT/photos/Mar0106a.htm

[24] http://southwestfarmpress.com/energy/032607-bioenergy-rice/

Sorghum

Description and Current Uses
Sorghum or milo grain is primarily used as feed for animals ranging from livestock to pets.[25] Today, approximately 30% of the Texas milo crop is used for ethanol production.[26]

Bioenergy Application
Currently, sorghum is often processed into ethanol using techniques similar to corn grain ethanol production. Sorghum stover has many of the same properties as corn stover and can be used in the production of cellulosic ethanol.

Texas A&M University has initiated efforts to create varietals of sorghum, including sweet and high-tonnage sorghum (discussed in a later section) for ethanol feedstocks.[27] Sweet sorghum is processed for its syrup. The high sugar content makes it similar to sugarcane and therefore a source for ethanol production. Work continues to identify efficient ways to extract and ferment sugar from the plant stalks through the same methods employed by sugarcane processors.[28]

Existing Capacity
Beyond traditional biofuel processes, researchers are exploring the use of sorghum to produce "green gasoline." Green fuels are distinct because they can be used in engines or systems currently in the market. Many companies are pursuing this fuel type with other feedstocks and technologies.[29]

[25] Picture Source: http://www.depts.ttu.edu/aged/Sorghum
[26] TDA Bioenergy Listening Session – Lubbock. July 8, 2010. Wayne Cleveland – Texas Sorghum Producers Board.
[27] http://southwestfarmpress.com/energy/bioenergy-crops-1204/
[28] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#cropproduction
[29] http://www.biomassmagazine.com/article.jsp?article_id=1731

A 2005 map from USDA shows sorghum production is prevalent throughout the United States but concentrated in Kansas and Texas.

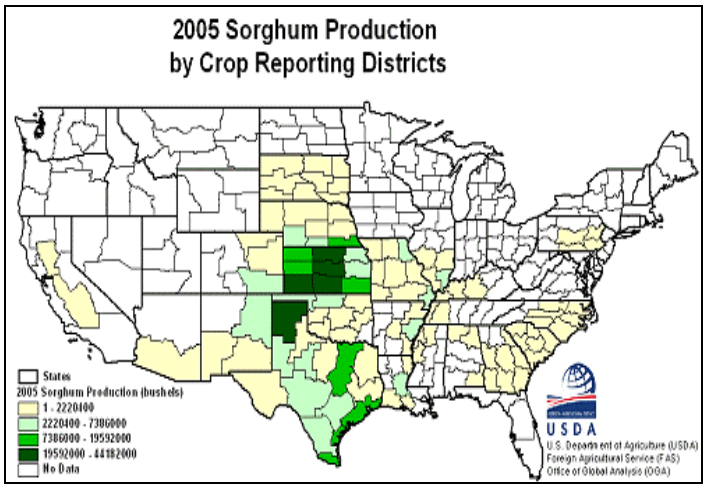
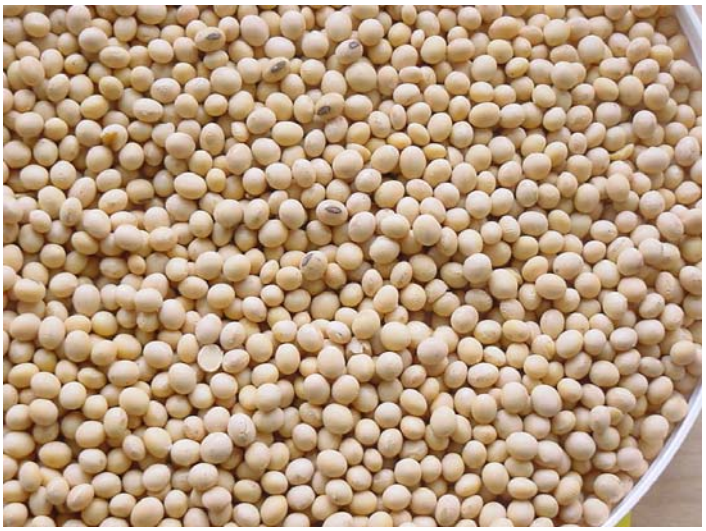


Figure 2-Source: http://www.pecad.fas.usda.gov/cropexplorer/al/usa_crop_prod.htm

The top ten counties for grain sorghum planted acres and production in 2009 are reproduced below from USDA's National Agricultural Statistics.

TOP TEN COUNTIES FOR GRAIN SORGHUM, 2009 PLANTED ACRES AND PRODUCTION			
Source: USDA-NASS			
County	Planted Acres	County	Production (bushels)
Nueces	168,000	Willacy	6,565,000
Willacy	151,000	Hidalgo	5,747,000
Hidalgo	137,000	Cameron	5,255,000
Cameron	115,000	Matagorda	3,810,000
Lynn	78,100	Ochiltree	3,110,000
Terry	70,800	Lamb	3,050,000
Lamb	60,000	Wharton	2,955,000
Deaf Smith	58,000	Swisher	2,920,000
Swisher	55,500	Moore	2,600,000
Hockley	55,000	Hale	2,530,000
State Total	2,700,000	State Total	98,400,000

Soybeans



Description and Current Uses
In addition to a food and protein source, soybean oil is the primary feedstock for biodiesel production in the United States.[30]

Bioenergy Application
Like other oilseeds, biodiesel can be produced from soybean oil by combining it with alcohol in a process called transesterification.[31] Soy based biodiesel is the most common type of bioenergy for this feedstock.

Existing Capacity
According to USDA's National Agricultural Statistics Service, Texas planted 215,000 acres of soybeans in 2009 and harvested 4,750,000 bushels. The top ten counties for soybean planted acres and production in 2009 are reproduced below.

SOYBEANS, 2009 ACRES PLANTED AND PRODUCTION			
Source: USDA-NASS			
County	Planted Acres	County	Production (bushels)
Fannin	17,200	Fannin	325,000
Wharton	16,100	Lamar	320,000
Lamar	14,500	Wharton	295,000
Delta	14,100	Delta	275,000
Calhoun	11,100	Ochiltree	220,000
Victoria	11,000	Matagorda	185,000
Hunt	9,800	Kaufman	172,000
Kaufman	8,900	Victoria	166,200
Matagorda	7,300	Hunt	162,000
Red River	6,700	Calhoun	125,100
State Total	215,000	State Total	4,750,000

[30] http://www.soyatech.com/soy_oilseed_facts.htm
[31] Picture Source: http://www.alibaba.com/buyofferdetail/102546249/Urgently_find_yellow_soybean_suppliers_.html

Sugarcane

Description and Current Uses
Sugarcane is pressed for molasses syrup, which after a short refining process becomes sugar.[32] While most of Texas' sugarcane crop is confined to the Lower Rio Grande Valley, due to climate and rainfall requirements of the crop, Texas is the fourth largest sugarcane growing state in the nation.

Bioenergy Application
Tropical countries, like Brazil, have large-scale production of ethanol from sugarcane. Sugarcane's use in bioenergy production in the United States is primarily limited to processing sugarcane bagasse, the pressed stalked after the syrup has been wrung, which can be used for cellulosic ethanol production or burned to make steam to power electric generators. According to USDA, one acre of sugarcane would yield 665 gallons of ethanol in Texas. Sugarcane processors often employ cogeneration technology; after the cane is processed into sugar or ethanol, the fibrous material that is left over (bagasse) is as fuel to generate electricity on-site. [33]

Existing Capacity
Domestic sugarcane production in the United States is limited to states along the Gulf Coast and Hawaii due to heat and humidity demands. According to USDA's National Agricultural Statistics Service, Texas planted 37,200 acres of sugarcane in 2008 and harvested 1,321,000 tons. A county breakdown is reproduced below.

SUGARCANE, 2008 HARVESTED ACRES AND PRODUCTION		
Source: USDA-NASS		
County	Harvested Acres	Production (tons)
Cameron	12,400	435,500
Hidalgo	19,400	686,000
Willacy	5,400	199,500
State Total	37,200	1,321,000

[32] Picture Source: http://www.seco.cpa.state.tx.us/energy-sources/biomass/agriculture.php
[33] http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#utilization

Sunflowers

Description and Current Uses

Sunflowers are produced for many uses, including floral and landscape aesthetics, human consumption and feed. Sunflower oil is a high-value product used to fry foods, namely potato chips.[34]

Bioenergy Application

Sunflower oil, combined with alcohol in a process called transesterification, creates biodiesel. According to research by the State Energy Conservation Office, sunflower acreage has increased over the past few years, but bioenergy production from this sunflower oil directly competes with the food oil market, where sunflower oil is a premium. [35]

Existing Capacity

Sunflower production in the United States is primarily located in the Great Plains stretching from the Canadian Border to the Rio Grande River.[36] According to USDA's National Agricultural Statistics Service, Texas planted 59,000 acres of oil-type sunflowers in 2009 and harvested 53,100,000 pounds of seed. A county breakdown of all sunflower production is reproduced to the right.

SUNFLOWERS (ALL TYPES) PLANTED ACRES AND PRODUCTION, 2009		
Source: USDA-NASS		
County	Planted Acres	Production (pounds)
Bailey	8,000	6,675,000
Crosby	2,100	2,420,000
Dallam	3,000	2,740,000
Dawson	5,600	3,960,000
Floyd	1,900	1,890,000
Hale	5,200	5,800,000
Hansford	1,700	3,160,000
Hidalgo	4,000	2,930,000
Jones	1,500	580,000
Lamb	10,200	13,030,000
Lubbock	2,200	1,375,000
Lynn	5,100	2,860,000
Terry	1,400	1,190,000
Other Counties	49,100	43,790,000
State Total	101,000	92,400,000

[34] Picture Source: http://epa.gov/region6/water/beyondtranslation/images/sunflower.jpg

[35] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#cropproduction

[36] Picture Source: http://www.pecad.fas.usda.gov/cropexplorer/al/usa_crop_prod.htm

Wheat

Description and Current Uses
Wheat grain is highly valued for food production, but wheat straw has the potential to be processed into cellulosic ethanol.[37]

Bioenergy Application
The process for manufacturing heat-based ethanol is similar to making corn grain ethanol. Currently, a Canadian ethanol plant uses wheat as its primary bioenergy feedstock, though some domestic ethanol producers use it in combination with corn grain.[38] Most wheat grown in the United States for bioenergy purposes is focused on wheat straw as a source for cellulosic ethanol production. This transition from grain to other parts of the plant, similar to corn and barley stover, would allow existing ethanol plants (those using the grain portion of the plant) to modify their processes to accommodate cellulosic production without dramatically changing their suppliers and surrounding economy.

Existing Capacity
The top fifteen Texas counties for wheat production and planted acres in 2009 are reproduced at right from USDA's National Agricultural Statistics Service.

WHEAT, 2009 ACRES PLANTED AND PRODUCTION

Source: USDA-NASS

County	Planted Acres	County	Production (bushels)
Deaf Smith	217,000	Hansford	5,740,000
Hansford	216,000	Ochiltree	4,360,000
Jones	183,500	Sherman	4,099,000
Parmer	183,000	Dallam	3,410,000
Knox	181,200	Castro	3,112,000
Haskell	176,400	Hartley	2,430,000
Ochiltree	168,200	Moore	2,230,000
Castro	160,000	Deaf Smith	2,050,000
Wilbarger	154,300	Hutchinson	1,650,000
Swisher	153,600	Carson	1,639,000
Sherman	142,000	Parmer	1,580,000
Dallam	139,600	Lamb	1,095,000
Runnels	126,100	Hale	1,062,000
Baylor	121,400	Childress	937,000
Moore	113,000	Haskell	860,000
State Total	6,400,000	State Total	61,250,000

[37] Picture Source: Texas Wheat News
[38] http://biofuelsdigest.com/blog2/2008/08/11/largest-wheat-ethanol-plant-in-north-america-opens-in-canada/

Woody Biomass

Description and Current Uses
Timber is primarily harvested for wood and paper resources, but burning wood has been an energy source since fire was discovered. Texas' pulp and paper mills have a long history of employing cogeneration technologies—burning mill and wood waste created in the manufacturing process to generate facility electricity needs.

Bioenergy Application
Targeting woody biomass for low-value resources like logging waste and land clearings allows owners and operators to obtain additional income from biomass that would otherwise be left to decompose or is considered invasive. Forest resources for paper products and lumber are primarily located in East Texas. Considerable woody biomass potential can be found in Central Texas where invasive species like cedar and mesquite are cleared.

Existing Capacity
A December 2008 report produced by the Texas Department of Agriculture and the Texas Forest Service estimated 5.9 million dry tons of wood biomass could be produced annually from East and Central Texas.[39] Excerpts are reproduced below:

East Texas Supply of Woody Biomass
Biomass supply potential in East Texas includes wood waste from logging and biomass thinning operations in the region. Logging residue includes tops, limbs, and unutilized cull trees. Wood waste from biomass thinning in this study includes woody biomass from pre-commercial thinning and timber stand improvement thinning. Overall, about 4.3 million dry tons of wood waste is potentially available annually for energy generation in East Texas, 35 percent from logging residue and 65 percent from biomass thinning.

Central Texas Supply of Woody Biomass
Brush control rather than timber harvest are the main sources for woody biomass in Central Texas. Mesquite, juniper (cedar), Chinese tallow, and locust are among the least desirable species in the region.

The average of the three scenarios shows that Central Texas can produce 1.6 million dry tons of woody biomass per year. Among the three sub-regions, Hill Country can produce 65 percent of the total biomass supply, Blacklands can produce 18 percent, and Post Oak can produce 17 percent. Fifteen percent of the biomass is from desirable species and 85 percent is from undesirable species.

[39] Xu, W., Yanshu Li and Burl Carraway. 2008. Estimation of Woody Biomass Availability for Energy in Texas. College Station, TX: Texas Forest Service. http://www.texasagriculture.gov/vgn/tda/files/1848/37823_TFSBiomassStudy_Dec_17_2008.pdf

Efforts to clear cedar in Central Texas to promote water conservation could provide a needed funding source to help offset the costs of harvesting Central Texas woody biomass.[40] The dual purpose of conservation and energy production makes this field a promising bioenergy feedstock.

The top fifteen counties for timber harvest in 2008, broken out by pine, hardwood and total harvest, are reproduced below from data provided by the Texas Forest Service.

2008 TEXAS TIMBER HARVEST IN CUBIC FEET					
Source: Texas Forest Service					
County	Pine	County	Hardwood	County	Total
Angelina	38,272,861	Cass	6,962,578	Angelina	43,652,019
Newton	36,863,884	Cherokee	6,244,621	Newton	38,873,041
Jasper	33,215,621	Red River	6,183,513	Polk	37,905,371
Polk	32,858,900	Angelina	5,379,158	Tyler	36,010,575
Tyler	31,443,251	Rusk	5,178,176	Jasper	35,983,641
Hardin	20,343,051	Polk	5,046,471	Cherokee	23,437,598
Nacogdoches	19,960,151	Smith	4,751,880	Hardin	23,271,874
Cherokee	17,192,977	Tyler	4,567,324	Cass	23,183,420
Panola	17,060,089	Liberty	4,214,107	Nacogdoches	21,859,783
Cass	16,220,842	Harrison	3,937,085	Panola	20,771,462
Liberty	14,609,662	Panola	3,711,373	Liberty	18,823,769
Houston	14,560,238	Marion	3,349,081	Harrison	18,466,399
Harrison	14,529,314	Hardin	2,928,823	Houston	16,279,400
Trinity	13,929,554	Jasper	2,768,020	Trinity	15,418,659
Sabine	12,634,704	Upshur	2,720,648	Rusk	14,204,466
Total Production	440,281,125	Total Production	97,684,239	Total Production	537,965,364

[40] http://www.statesman.com/news/local/ranchers-team-up-with-feds-to-clear-cedar-337004.html?srcTrk=RTR_95609

Potential Production

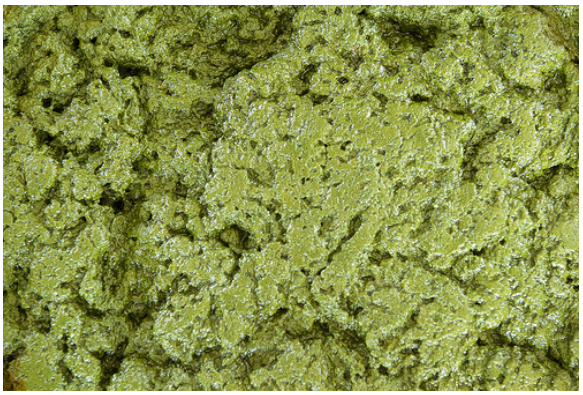
The following pages illustrate nontraditional agricultural products that could be produced entirely for bioenergy use. The term dedicated energy crops is also used to describe the intended purpose for growing these crops.

Nontraditional Agricultural Feedstocks:

Algae	Energycane	Perennial Grasses
Castor	High-tonnage Sorghum	

Algae

"Algae have great potential as a feedstock for biofuels and bioproducts. Microalgae can regenerate in 48 to 72 hours. Cyanobacteria can regenerate in 5 to 20 hours. These short generation times (compared to seed crops such as soybean, jatropha, and castor) lead to the high potential for biodiesel production from algae. Theoretically, algae could supply the entire U.S. diesel demand on only 2.7 million acres of land."[41]



Research is ongoing to address some of the obstacles to full-scale algae production, which includes genomic breeding or selection, production models, and fuel quality. Several algae research facilities exist in the state, and significant research is being done through public-private partnerships with the state's universities.[42] A sample of these projects are discussed below; however, this list is not exhaustive:

- General Atomics and the Texas AgriLife Research are collaborating on a project to transform algae into fuel by establishing a demonstration plant in Pecos, Texas.[43] The Pecos facility is striving to bridge the high-tech world of algae fuel production with practicality in the field. The facility tests multiple strands and varietals of algae, which are supplied to them by the largest collection of algae samples in the world, which is housed at the Culture Collection of Algae at The University of Texas at Austin.[44] Techniques, technologies and processes are being developed at this facility to allow for farmers and landowners to become the suppliers of algae to fuel facilities just as corn or sorghum farmers provide harvest for ethanol facilities.[45]

- January 2010, Photon8 partnered with University of Texas at Brownsville and Texas Southmost College to develop production models for Photon8's wave bioreactor. The bioreactor is essential to growing algae quicker than it normally would in nature. Faster production times can drastically reduce costs, which is

[41] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#algae
[42] http://www.nationalalgaeassociation.com/
[43] Picture Source: Texas AgriLife http://www.flickr.com/photos/agrilife/sets/72157624019146337/
[44] http://www.sbs.utexas.edu/utex/default.aspx
[45] http://agnews.tamu.edu/showstory.php?id=330

key to making algae a widespread and viable feedstock for bioenergy. Photon8 is partially funded by a grant from the Emerging Technology Fund.[46]

- The Emerging Technology Fund also awarded funding to Sunrise Ridge Algae, based in Austin, in 2008. Sunrise Ridge sponsors research for developing algae for fuel production, partnering with the University of Texas at Austin and the University of Houston. The company owns and operates a pilot production facility at the Austin Water Utility's Hornsby Bend plant in Austin, Texas.[47]

- Lone Star College has partnered with the National Algae Association to build a commercial-scale photobioreactor demonstration facility at their Montgomery campus.[48] According to a March 2010 press release, "plans are already in place to add a commercial-scale harvester and extraction system, which will make this the first completed turn-key commercial-scale demo system in the US."[49]

- There are two commercial facilities under construction or in the planning phases in Texas for algae to fuel production. Joule Biotech, a Massachusetts-based company, plans to operate a facility at the Leander wastewater treatment facility to use wastewater, sunlight, carbon dioxide and microorganisms to produce ethanol and biodiesel.[50]

- The other facility is a partnership between Dow Chemical and Algenol to construct a $50 million pilot algae biofuels plant in Freeport. Dow has expressed interest in Algenol's ability to use algae to produce ethanol, which could be used as a base for making ethylene, a feedstock for many types of chemicals.[51]

[46] http://www.victoriaadvocate.com/news/2010/jan/24/bc-tx-algae-to-biodiesel/?business
[47] http://sunrise-ridge.com/
[48] http://www.lonestar.edu/13487.htm
[49] http://www.newswiretoday.com/news/66517/
[50] http://www.jouleunlimited.com/news/2010/joule-biotechnologies-secures-pilot-site-renewable-solar-fuel
[51] http://www.algenolbiofuels.com/media-houstonchron-091207.html

Castor

Castor was once widely grown in Texas due to its drought-resistance and widespread industrial demand for its oil throughout the 20th century. However, cheaper castor imports coupled with higher value crops displaced the crop.[52]

Today, castor is considered a potential oilseed crop for bioenergy feedstocks because of its high drought, heat and salinity tolerance.[53] Castor oil is well suited for use in jet-fuel and other military applications that require reliability and consistency across a range of climates and conditions. However, concerns remain about large-scale commercial production, because castor is considered highly toxic in its natural form to both humans and livestock. Ensuring castor beans do not share tools, warehouses, silos, or transportation with grain and feed would significantly raise the cost of production though this may be viable for high-end oils. Research is ongoing to develop a low ricin variety that would be acceptable for safety concerns.[54]

This crop from Texas' past is seeing a resurgence through trait research in South Texas. On February 1, 2010, Evogene, an Israeli-based company, commenced field trials for drought resistant strains of Castor in fields outside of Uvalde, Texas.[55] Similar growing regions to Israel and an abundance of Texas land made locating the trials near Uvalde ideal for this type of research.

[52] http://www.hort.purdue.edu/newcrop/proceedings1993/V2-380.html
[53] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#cropproduction
[54] Picture Source: http://uvalde.tamu.edu/herbarium/rico.htm
[55] http://www.evogene.com/news.asp?new_id=86

Energycane

Energycane is a vegetatively-propagated perennial grass developed specifically for biomass production which has many of the same traits as sugarcane. Due to climatic requirements of Energycane, cultivation is restricted to South Texas and the state's coastal regions.[56]

Energycane has been identified as a feedstock for cellulosic ethanol. Currently, Verenium, a Massachusetts-based company, is partnering with farmers in the Beaumont area to produce Energycane. If the crop can be sustained and economically harvested in southeast Texas, Verenium may consider locating a cellulosic ethanol plant in the area. This plant would be the first of its kind in Texas.[57]

Figure 3- Source: http://www.ceres.net/Products/Products-Energycane.html

[56] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#cropproduction
[57] http://www.doguets.com/ethanol-production.htm

High-tonnage Sorghum

High-tonnage or high-biomass sorghum is a crop bred specifically for bioenergy production into biofuel, namely cellulosic ethanol. Texas AgriLife Research has an extensive Sorghum Program in partnership with Ceres Energy Crops[58] to create and commercialize high biomass sorghum, unique because of its stems, stalks and leaves, for biofuel production.[59]

According to project researchers, sorghum may prove attractive because it fits into established production systems and is harvested the year it is planted, unlike perennial grasses.[60] Varieties being developed may approach 20 feet under favorable conditions and could produce more than 2,000 gallons of ethanol per acre[61]

[58] http://agriliferesearch.tamu.edu/library/files/corporate_relations_bioenergy/Sorghum.pdf
[59] http://www.ceres.net/News/NewsReleases/2007/10-01-07-News-Rel.html
[60] Picture Source: http://agnewsarchive.tamu.edu/dailynews/stories/SOIL/photos/May0307a.htm
[61] http://southwestfarmpress.com/mag/farming_ceres_texas_am/

Perennial Grasses

Perennial grasses are considered potential feedstocks for the Texas bioenergy industry because they do not traditionally compete with food and feed, and they may be grown on marginal lands. Texas AgriLife Research is currently investigating four distinct grass types under their Perennial Grass Breeding Program, including Pearl Millet-Napiergrass, Giant Miscanthus, Maiden Grass, and Switchgrass.[62] The most common variety is Switchgrass, which is native to North America and grows readily in most parts of the state. Scientists at Texas Agrilife's Blacklands Research Center have estimated average harvest yields to be 6.25 tons per acre in Texas.[63] This variety and others, including old world bluestems, would be used to make cellulosic ethanol.[64]

In June 2010, USDA released a Regional Roadmap to Meeting the Biofuels Goals of the Renewable Fuels Standard by 2022. This roadmap relies heavily on perennial grass production for the Southeast region, which includes Texas.[65] Grasses that can grow on marginal or non-agricultural land could dramatically alter parts of West Texas, bringing agricultural production to areas that currently cannot sustain it without significant irrigation and improvements. Research is also underway to reduce the demand for nitrogen fertilizer, which is currently needed to sustain high yields for perennial grasses.

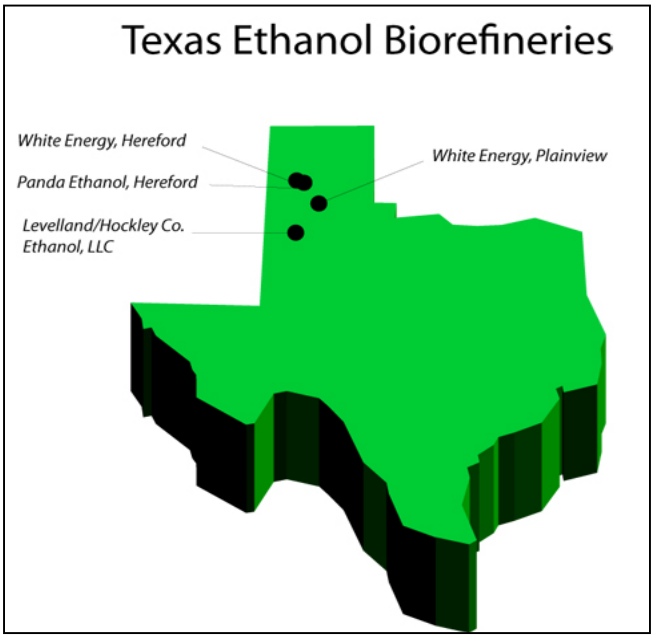
[62] http://agriliferesearch.tamu.edu/library/files/corporate_relations_bioenergy/PerennialGrassBreeding.pdf
[63] SECO Renewable Energy Report: http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#cropproduction
[64] Picture Source: http://uvalde.tamu.edu/herbarium/pavi.htm
[65] http://www.usda.gov/documents/USDA_Biofuels_Report_6232010.pdf

BIOENERGY PRODUCERS

Introduction

Today, bioenergy companies across the state are using a variety of feedstocks and converting crops and agricultural waste products into biofuels and electricity. Texas' diverse landscape leads to diversity in bioenergy feedstock production, and as new crops are developed, technology improves, and markets are opened, Texas is positioned to remain a leader in the renewable energy sector.

Biofuels



Ethanol and biodiesel has been produced from a number of feedstocks around the state. Ethanol is produced at three operating plants in the Panhandle, which use a combination of corn and sorghum grain.[66] The forth plant, Panda Ethanol-Hereford, shown on the map at right is not currently operational.[67]

Biodiesel producers, of which there are many around the state, use animal fats and oils and greases as feedstocks. An April 2009 briefing from the Biodiesel Coalition of Texas lists 30 biodiesel plants in Texas, along with 32 distributors, and 54 fueling locations.[68]

[66] Picture Source: http://www.texascorn.org/index.cfm?show=10&mid=47

[67] http://ethanolproducer.com/article.jsp?article_id=5752

[68] http://biodieselcoalitionoftexas.org/documents/Texas%20Biodiesel%20Industry%20Fact%20Sheet%202009.doc

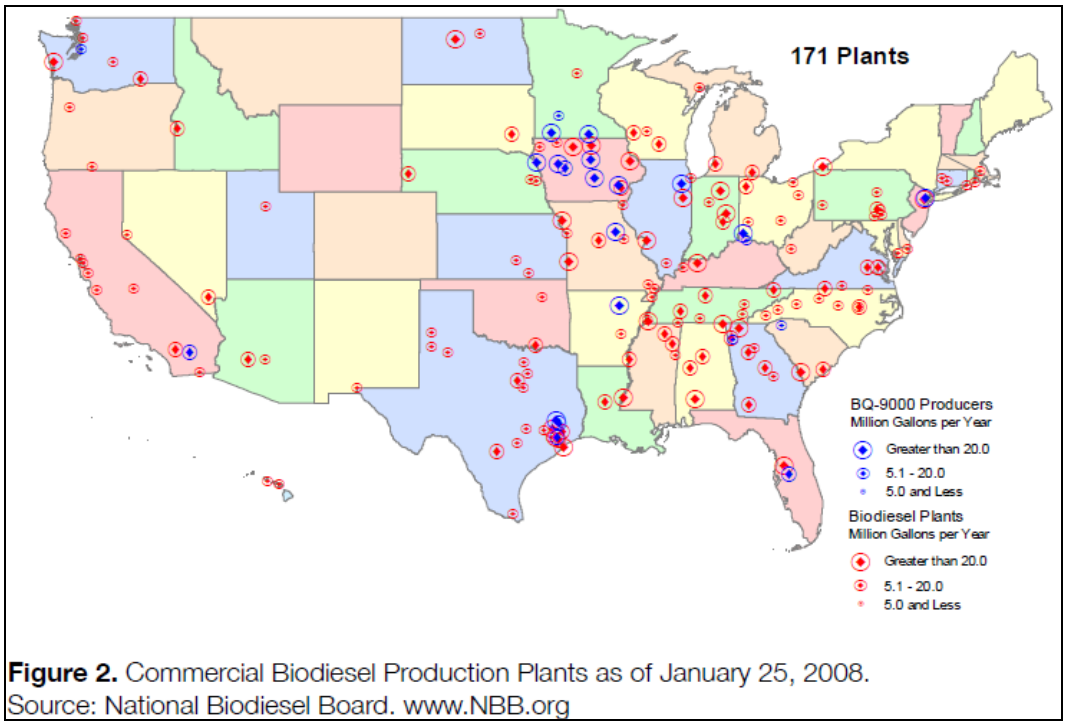


Figure 2. Commercial Biodiesel Production Plants as of January 25, 2008.
Source: National Biodiesel Board. www.NBB.org

Figure 4- Source: Biodiesel Coalition of Texas

Current Production

Ethanol

Texas has the capacity to produce 250 million gallons of ethanol a year amongst the three currently operating plants. All three of these plants are located in the Panhandle.

Company	Location	Feedstock	Nameplate Capacity (MMgy)
Levelland/Hockley County Ethanol, LLC	Levelland, TX	Milo[69]	40
White Energy	Hereford, TX	Corn/Milo	100
White Energy	Plainview, TX	Corn	110
Source: http://www.ethanolrfa.org/bio-refinery-locations/			

[69] TDA Bioenergy Production Survey of Sam Sacco, Levelland Hockley County Ethanol. 4.27.10.

Texas ethanol production numbers can be seen in this January 2010 Production Capacity Chart from the Renewable Fuels Association.[70] The 115 million gallons in unrealized production is from the fourth ethanol plant mentioned above in Hereford, Texas.

U.S. ETHANOL PRODUCTION CAPACITY BY STATE

In Millions of Gallons

	Nameplate	Operating	Under Construction/ Expansion	Total
Iowa	3,293.0	3,183.0	380	3,673.0
Nebraska	1,523.0	1,454.0	275	1,798.0
Illinois	1,350.0	1,350.0	93	1,443.0
Minnesota	1,136.6	1,112.6	0	1,136.6
South Dakota	1,016.0	1,016.0	33	1,049.0
Indiana	908.0	706.0	88	996.0
Ohio	538.0	314.0	0	538.0
Kansas	491.5	436.5	20	511.5
Wisconsin	498.0	498.0	0	498.0
Texas	250.0	250.0	115	365.0
North Dakota	353.0	343.0	0	353.0
Michigan	265.0	215.0	5	270.0
Missouri	261.0	261.0	0	261.0
California	194.5	39.5	50	244.5
Tennessee	177.0	177.0	38	215.0
Georgia	100.4	100.4	100	200.4
New York	164.0	50.0	0	164.0
Oregon	148.0	40.0	0	148.0
Colorado	125.0	125.0	0	125.0
Pennsylvania	0	0	110	110.0
Virginia	0	0	65	65.0
North Carolina	0	0	60	60.0
Arizona	55.0	55.0	0	55.0
Idaho	54.0	54.0	0	54.0
Mississippi	54.0	54.0	0	54.0
Kentucky	35.4	35.4	0	35.4
New Mexico	30.0	0	0	30.0
Wyoming	6.5	6.5	0	6.5
Louisiana	1.5	1.5	0	1.5
Total	**13,028.4**	**11,877.4**	**1,432**	**14,460.4**

Source: Renewable Fuels Association, January 2010

[70] http://www.ethanolrfa.org/page/-/objects/pdf/outlook/RFAoutlook2010_fin.pdf?nocdn=1

Biodiesel

Due to availability of feedstocks and transportation infrastructure along the Gulf Coast, Texas is an attractive location for biodiesel producers. When operating at full capacity, Texas can produce 445.1 million gallons of biodiesel annually.

Plant Name	City	State	Feedstock	Capacity (MMgy)
American Biorefining & Energy Inc.	Douglass	TX	sunflower oil/yellow grease	2
Central Texas Biofuels	Giddings	TX	yellow grease	1
Johann Haltermann Ltd.	Houston	TX	soy oil	20
Global Alternative Fuels LLC	El Paso	TX	beef tallow/soy oil	5
GeoGreen Fuels LLC	Gonzales	TX	soy oil	3
GreenHunter BioFuels LLC	Houston	TX	multi-feedstock	105
Southwest Energy & Feed Co.	Seminole	TX	cottonseed oil	1.5
Double Diamond Energy Inc.	Dimmit	TX	canola oil/soy oil	20
Momentum Biofuels Inc.	Pasadena	TX	multi-feedstock	20
Direct Fuels LLC	Euless	TX	beef tallow	10
Pacific Biodiesel Texas LLC	Carl's Corner	TX	cottonseed oil/yellow grease	2.6
The Sun Products Corp.	Pasadena	TX	animal fats/palm oil	4
Beacon Energy Corp.	Cleburne	TX	animal fats	12
REG Houston LLC	Seabrook	TX	vegetable oils	35
Green Earth Fuels of Houston LLC	Houston	TX	multi-feedstock	90
Organic Fuels Ltd.	Galena Park	TX	animal fats/palm oil	30
Biodiesel Industries of Greater Dallas	Denton	TX	multi-feedstock	3
Red River Biodiesel Ltd.	New Boston	TX	multi-feedstock	15
Valco Bio Energy	Harlingen	TX	yellow grease	3
Safe Renewables Corp.	Conroe	TX	multi-feedstock	18
National Wind Soltuions Inc.	Poteet	TX	soy oil	5
South Texas Blending	Laredo	TX	beef tallow	5
BioSelect Galveston Bay	Galveston Island	TX	multi-feedstock	30
Sun Cotton Biofuels	Roaring Springs	TX	cottonseed oil	2
Brownfield Biodiesel LLC	Ralls	TX	multi-feedstock	2
Hardin Fuels Inc.	Kountze	TX	multi-feedstock	1

Chart Source: Biodiesel Magazine Plant List - http://www.biodieselmagazine.com/plant-list.jsp

Discrepancies in the number of biodiesel plants and production capacity vary greatly by source. In May 2010, the federal Energy Information Agency reported that in March 2009 10 biodiesel plants were operating in Texas, with an annual production capacity of 359 million gallons. The chart also shows that Texas outpaces the rest of the nation in number of producers and annual production capacity.[71]

[71] http://www.eia.doe.gov/cneaf/solar.renewables/page/biodiesel/biodiesel.pdf

Table 3. Biodiesel and Glycerol Production, by State, March 2009
(Million Gallons)

State	Number of Producers	Annual Production Capacity	Monthly Production	
			B100	Glycerol
Alabama	3	35	W	W
Arizona	2	18	W	W
Arkansas	2	18	W	W
California	5	51	W	W
Connecticut	2	2	W	W
Florida	1	-	-	-
Georgia	7	27	s	s
Illinois	6	218	2	W
Indiana	3	115	W	W
Iowa	7	211	W	W
Kansas	3	2	-	-
Kentucky	3	53	W	W
Louisiana	1	12	-	-
Maryland	1	3	-	-
Michigan	3	32	W	W
Minnesota	6	107	W	W
Mississippi	2	88	-	-
Missouri	6	104	4	W
Montana	1	s	W	W
Nebraska	1	5	W	W
Nevada	1	1	W	W
New York	1	20	-	-
North Carolina	5	8	s	W
Ohio	4	66	W	-
Oklahoma	4	60	W	W
Pennsylvania	5	52	W	W
South Carolina	2	57	-	-
South Dakota	1	2	-	-
Tennessee	4	52	-	-
Texas	10	359	W	W
Virginia	2	10	W	W
Washington	2	105	-	-
West Virginia	1	3	W	W
Wisconsin	3	12	W	W
U.S. Total	**110**	**1,904**	**24**	**2**

s = Value is less than 0.5 of the table metric, but value is included in any associated total.
W = Withheld to avoid disclosure of individual company data.
- = No data reported.
Notes: Totals may not equal sum of components due to independent rounding. Number of Producers is a count of entities with operable capacity in the reporting month.
Source: U.S. Energy Information Administration, Form EIA-22M, "Monthly Biodiesel Production Survey."

Chart Source: http://www.eia.doe.gov/cneaf/solar.renewables/page/biodiesel/biodiesel.pdf

Project Capacity

The *Texas Renewable Energy Resource Assessment* in December 2008 estimated that, for the feedstocks examined, total biofuel production capacity in Texas could reach 1.9 billion gallons annually.[72]

Texas Biofuels Potential				
	Input Volume/Acreage	**Units**	**Yield**	**Gallons**
Crop Residue	961,400	Dry tons	75 g/dt	72,105,000
Forest/Wood Resources	3,000,000	Dry tons	75 g/dt	45,000,000
Grain (Ethanol)	355,000,000	Gallons	Fixed production rate	355,000,000
High-tonnage Sorghum	348,300	Acres	75 g/dt at 10 dt/ac	261,225,000
Oilseed Crops	108,110	Acres	100 g/ac	10,811,000
Algae	100,000	Acres	3,000 g/ac	300,000,000
Municipal Solid Waste	2,530,279	Dry tons	75g/dt	189,770,897
Energy Cane	6,375	Dry tons	75 g/dt at 10 dt/ac	4,781,250
Sweet Sorghum	42,130	Acres	300 g/ac	12,639,000
Switchgrass	2,162,291	Acres	75 g/ac at 4 dt/ac	648,687,300
TOTAL				**1,900,019,447**

Chart Source:
http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#txbiofuelpotential

[72] http://www.seco.cpa.state.tx.us/publications/renewenergy/biomassenergy.php#txbiofuelpotential

Biomass

The production of energy from biomass can take many forms; feedstocks are commonly burned to generate heat or, using various techniques to accelerate the decomposition process, to produce gas. In either scenario, the end product for consumers is electricity or natural gas.

Biomass power has been utilized by Texas' industrial sector for years, and the technology is rapidly expanding into commercial electricity applications. Biogas, produced in an anaerobic digester and fed by manure or crop residues and wastes, can provide an on-site or local alternative for waste disposal.

Production

Biogas Generation

Manure and crop biomass are the primary feedstocks for biogas generation. In an anaerobic digester, combined with heat or other catalyst, the decomposition process is accelerated, allowing for biogas in the form of methane to be harvested. Methane can be converted into a liquid known as methanol, which is similar to ethanol, allowing for a dairy farm to produce both electricity, natural gas, and fuel to meet onsite power needs, or to sell creating an additional income stream.

The Texas Panhandle seems to be a preferred location for biogas facilities. The availability of feedstocks from dairies, the network of natural gas pipelines across the state and nation and state-level renewable energy portfolios seem to facilitate biogas production in this region of the state.

Three other projects in Texas have been able to capitalize on the Environmental Protection Agency's AgSTAR program, which provides funding for anaerobic digester technology, these include: Broumley Dairy Farm in Hico, and two digesters at Premium Standard Farms in Dalhart. From the four projects, EPA estimates total annual energy production at 55,547-megawatt hours of electricity.[73]

New feedstocks are constantly being identified as sources of biogas production. As mentioned in the previous section, hybrid crops, for example sorghum, are being considered because they may be grown in fallow or abandoned fields to supply their anaerobic digester.

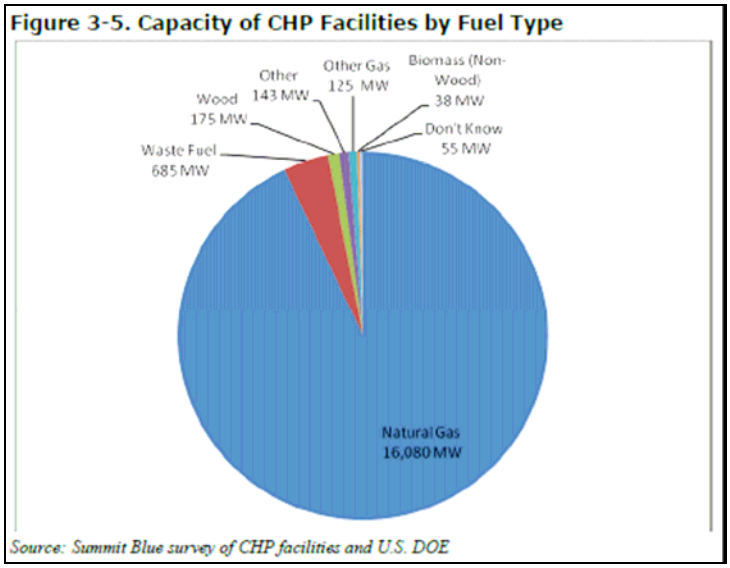
Combined Heat and Power or On-site Power Generation

Combined Heat & Power (CHP) is a process of generating heat and power for on-site use rather than generating power for the electricity grid. Proponents of CHP claim this type of production saves a tremendous amount of energy from being wasted through transport inefficiencies. As of December 2008, an estimated 135 facilities in Texas are currently operating CHP systems with a 17,333-megawatt capacity.[74] Nearly all of the

[73] http://www.epa.gov/agstar/accomplish.html#tx

[74] http://www.texaschpi.org/Assets/downloads/pucoftexas-combined-heat-and-power-report-2008dec10-p34934.pdf

power is generated via natural gas, but there is great potential for utilization of biomass, wood, or biogas for this application. Currently, eight CHP facilities are utilizing biomass to produce up to 210 megawatts of power.[75]



The Rio Grande Valley Sugar Growers Mill utilizes agricultural waste for on-site electricity generation.[76] The sugar mill uses tremendous amounts of steam and electricity to press the molasses out of the sugarcane. This process produces a mulch-like substance known as bagasse, which can be burned to produce steam and power through an on-site electric generator. After using an estimated 7 megawatts of power internally, the mill sells an average of 3.5 megawatts of power on the electric grid, enough to power roughly 4,000 homes in the area.[77]

Woody Biomass to Electricity

While the above facilities generate electricity primarily for on-site use, a number of facilities and projects in East Texas are utilizing woody biomass to generate electricity for use on the grid. Aspen Power was awarded a Texas Capital Fund grant by the Texas Department of Agriculture to assist with the construction of a 50-megawatt power plant in Lufkin, which will generate electricity from logging debris and urban wood waste.[78] Another project by Southern Power in Sacul, outside Nacogdoches, is a 100-megawatt power plant, which will sell power directly to Austin Energy starting in 2012. This facility will also be powered by woody biomass.[79]

[75] Picture Source: http://www.texaschpi.org/Assets/downloads/pucoftexas-combined-heat-and-power-report-2008dec10-p34934.pdf

[76] http://www.rgvsugar.com/news_2.asp

[77] TDA Bioenergy Production Survey of Steve Bearden, Rio Grande Valley Sugar Growers. 4.26.10.

[78] http://www.forestbioenergy.net/case-studies/CaseStudy1Aspen.pdf

[79] http://www.cleantech.com/news/5287/southern-power-starts-100-mw-texas-

Zilkha Biomass Energy is a wood pellet company that converts woody biomass into a pellet form that can be burned in home or industrial applications.[80] They also design generating systems for CHP and electricity generation. The company produces an estimated 37,500 tons of wood pellets annually in Texas.[81]

Project Capacity

A 2009 report from the Electric Reliability Council of Texas revealed an available capacity of 40.3 megawatts of biomass-generated electricity with over 73,364 megawatt hours produced throughout the year.[82]

[80] http://zilkha.com/index.html

[81] TDA Bioenergy Production Survey of George Dickinson, Zilkha Biomass Energy. 4.27.10.

[82] https://www.texasrenewables.com/staticReports/Annual%20Report/2009_Report.doc

CONCLUSION

This report provides a brief overview of current trends in feedstock utilization and development and bioenergy production in the state of Texas. The report is intended to provide a reference point from which a more comprehensive discussion about the future of the Texas bioenergy industry may proceed.

Moving forward, Texas clearly has significant resources to facilitate bioenergy production. From reliable streams of livestock and crop waste products to marginal lands and crop diversification needs, the agriculture industry has a capacity to offer a variety of feedstocks to energy generators. Additionally, Texas' universities and business community hold the research capabilities and capital to ensure the latest technologies are available to move the bioenergy industry from farms, ranches and production facilities to consumers.

For the Texas Department of Agriculture, the goal is to ensure state programs and policies facilitate the work of farmers, ranchers, researcher and energy producers in establishing Texas as a leader in bioenergy production. This goal must be pursued through equitable, sustainable and defensible policies and programs. To be equitable, we cannot favor one technology over another, nor pit existing industries against emerging ones. To be sustainable, our state should have the long-term goal of establishing a self-sufficient, market-driven, renewable energy industry where consumers do not pay hidden costs. The idea is to make us independent from foreign oil and create jobs, not develop an industry dependent on Washington or state government largesse. And, finally, accountability to taxpayers can never be discounted, so our state programs must show a measurable return on investment. A defensible bioenergy program will generate jobs, dollars and savings for taxpayers.

The Texas Department of Agriculture in conjunction with the Texas Bioenergy Policy Council and the Texas Bioenergy Research Committee will set a bold agenda for the expansion of the bioenergy industry in Texas by the winter of 2010.

ADDITIONAL RESOURCES

Texas Renewable Energy Resource Assessment:
http://www.seco.cpa.state.tx.us/publications/renewenergy/

The Energy Report 2008:
http://www.window.state.tx.us/specialrpt/energy/

Texas AgriLife Research – Bioenergy Program:
http://agriliferesearch.tamu.edu/corporaterelations/programs/bioenergy/

USDA Bioenergy Page:
http://www.ers.usda.gov/features/bioenergy/

USDA Biofuels Strategic Production Report
http://www.usda.gov/documents/USDA_Biofuels_Report_6232010.pdf

USDOE Biomass Energy Data Book:
http://cta.ornl.gov/bedb/download.shtml

USDOE State Assessment for Biomass Resources:
http://www.afdc.energy.gov/afdc/sabre/sabre.php?state=texas

Memphis BioWorks New Crop Database:
http://newcropsdatabase.com/default/index.cfm/new-crops/