



## CHAPTER 12

# Biomass: Overview

Biomass is any plant or animal matter used to produce energy. Many plants and plant-derived materials can be used for energy production; the most common is wood. Other sources include food crops, grasses, agricultural residues, manure and methane from landfills.<sup>1</sup>

As an agricultural state, Texas has many resources for biomass energy production. Crops used to produce biomass energy — cotton, corn and some soybeans — are all grown in Texas.<sup>2</sup> Texas has 21 landfill gas energy projects and the potential to develop more.<sup>3</sup> Forests in East Texas also provide fuel for energy production. And Texas has significant quantities of manure (feedlot biomass), especially in the High Plains area where there are numerous feedlots.

While cattle manure has the most potential for power use, other forms of agricultural waste have significant possibilities, too. These include poultry litter, rice straw, peanut shells, cotton gin trash and corn stover. In fact, a recent report from the Houston Advanced Research Center estimated that Texas agricultural wastes have the potential to produce 418.9 megawatts of electricity, or enough to power over 250,000 homes, based on average Texas electric use in 2006.<sup>4</sup>

In the U.S., the primary biomass fuels are wood, biofuels and various waste products. Biofuels include alcohols, synfuels and biodiesel, a fuel made from grain and animal fats. Waste consists of municipal solid waste, landfill gas, agricultural byproducts and other material (**Exhibit 12-1**). Most biomass energy used in the U.S. — 65 percent — comes from wood.<sup>5</sup> Another 23 percent of biomass energy used comes from biofuels while the remaining 12 percent comes from waste energy.

Energy generated from biomass is the nation's largest source of renewable energy, accounting for 48 percent of the total in 2006. The U.S. consumed

3,277 trillion British thermal units (Btu) of biomass energy in 2006 (**Exhibit 12-2**).<sup>6</sup> The next largest source of renewable energy is hydroelectric power, with 2,889 trillion Btu consumed in 2006.

In 2005, Texas consumed 73 trillion Btu of biomass energy from wood and waste, and 2.4 trillion Btu from ethanol.<sup>7</sup> Currently, biomass energy accounts for less than one percent of electrical power production in Texas.<sup>8</sup> Texas ranked 22nd in ethanol consumption (691,000 barrels), well behind California (21,864,000 barrels), which was ranked first.<sup>9</sup> Two ethanol plants opened in Texas this year and others are currently under construction and will be in production by 2008. Texas is the largest producer of biodiesel in the nation.<sup>10</sup>

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EXHIBIT 12-1

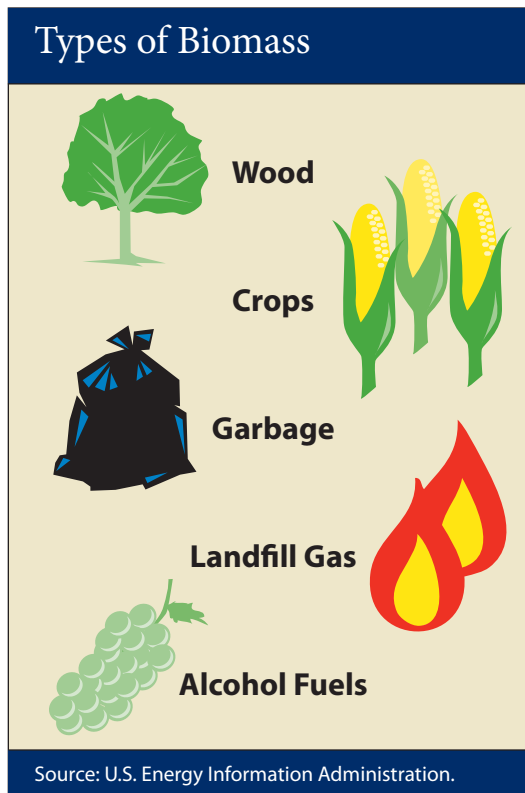
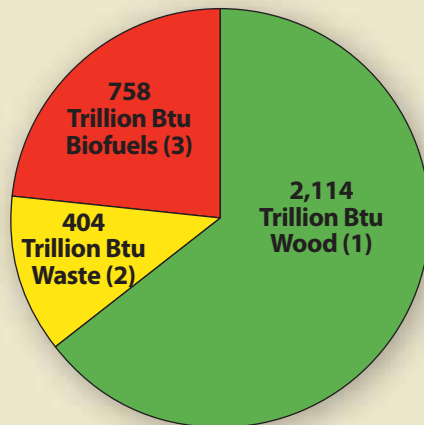




EXHIBIT 12-2

### U.S. Energy Consumption from Biomass, 2006 (in Trillions of Btu)



## Notes:

- 1) Wood includes wood and all derived fuels.
- 2) Waste includes municipal solid waste, landfill gas, sludge waste and agricultural byproducts.
- 3) Biofuels include ethanol and biodiesel.

Sources: Texas Comptroller of Public Accounts and U.S. Energy Information Administration.

The Texas Agricultural Experiment Station expects the use of biofuels to grow more rapidly than other forms of biomass energy.

In the U.S., most renewable energy is used primarily to generate electricity, but biomass energy is an exception. In 2005, about 63 percent of biomass energy was used for heating, 26 percent for electricity generation and 11 percent as transportation fuel.<sup>11</sup>

Biomass energy consumption varies by sector of the economy and by state. Industry uses most of the biomass energy available in the U.S., accounting for 55 percent of total biomass energy consumption in 2006 (**Exhibit 12-3**).<sup>12</sup> In Texas, this pattern is more pronounced with industry accounting for 72 percent of total biomass energy consumption in 2005, the most recent data available (**Exhibit 12-4**).<sup>13</sup> The industrial sector, particularly the paper, chemical and food processing industries, often uses the biomass it produces in its operations to generate electricity, heat and steam that it uses on site.<sup>14</sup>

At the national level, the transportation sector is the second-largest user, accounting for another 15 percent of the nation's biomass energy consump-

tion. In comparison, Texas' transportation sector only accounts for 3 percent of biomass energy consumption in the state. The second-largest user of biomass energy in Texas is the residential sector, which accounts for 18 percent of consumption.

The electric power sector — electric utilities — accounts for about 14 percent of the nation's biomass energy consumption, compared to just 4 percent in Texas. The commercial sector accounts for 3 percent of biomass energy consumed in the U.S and Texas.<sup>15</sup>

While biomass energy accounts for the majority of renewable energy production and consumption in the U.S., it is growing at a slow rate. Between 2001 and 2006, total biomass energy production and consumption both rose by an average of about 4 percent annually. Within the biomass energy category, biofuels experienced the fastest average annual growth in consumption — 24 percent — while wood and waste energy consumption expanded by an average of 1 percent and 2 percent, respectively.<sup>16</sup>

Federal subsidies of \$0.51 per gallon of ethanol and \$1.00 per gallon of biodiesel have contributed to their recent dramatic production growth. For a complete discussion of subsidies, see Chapter 28.

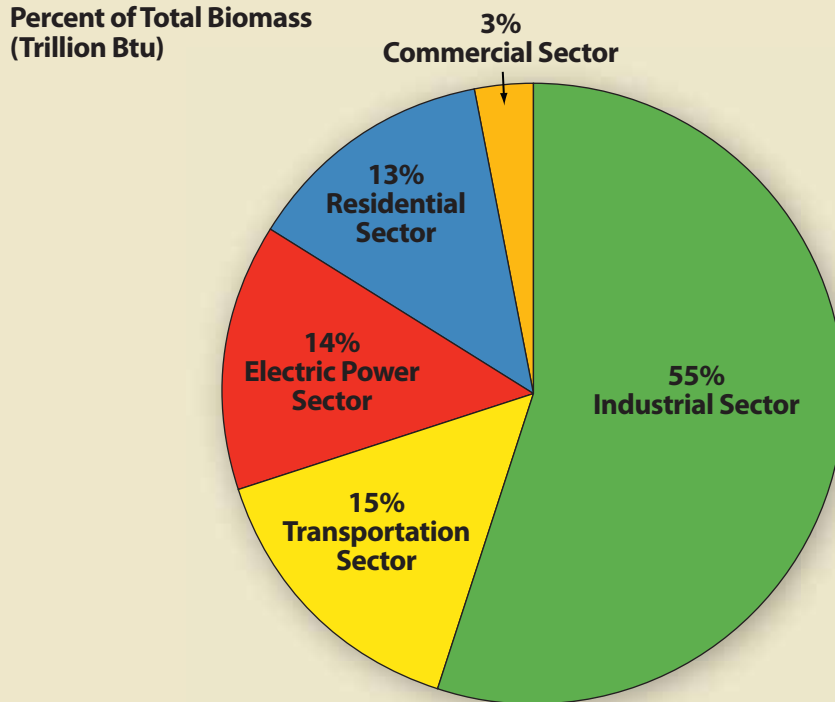
This growth trend in consumption may continue. The Texas Agricultural Experiment Station expects the use of biofuels to grow more rapidly than other forms of biomass energy.<sup>17</sup> In the U.S., ethanol made from corn currently accounts for the majority of biofuel consumption in the transportation sector. In the future, however, "lignocellulosic" biofuels made from crop residue, grasses, wood products, sorghum, "energy cane" and agricultural waste are expected to supplement corn ethanol. These are commonly referred to by the shorthand term "cellulosic." Public and private funding for new research in cellulosic biofuels is increasing. Corn ethanol requires significant amounts of fertilizers, pesticides, energy and water to grow; cellulosic biofuel production promises to be much more efficient.

The amount of energy needed to produce corn ethanol is a subject of ongoing debate. Improved corn production practices and better ethanol plants, however, have led to a more efficient process. The production of cellulosic ethanol and other biofuels is expected to be significantly more energy-efficient than producing corn ethanol. At present, cellulosic



EXHIBIT 12-3

## U.S. Biomass Energy Consumption by Sector, 2006\*



\*The industrial sector does not include ethanol heat on co-products from the production of fuel ethanol and biodiesel.

Source: U.S. Energy Information Administration.

ethanol is cost-prohibitive, but at least eight companies are working on technologies that may make it competitive with other fuels within five years.<sup>18</sup>

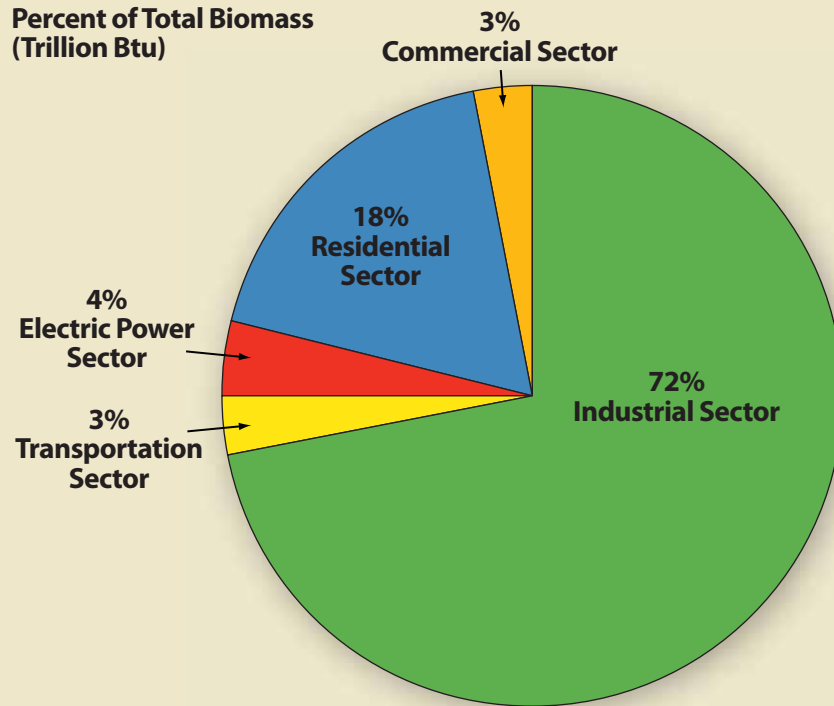
The rapid expansion of ethanol has resulted directly in increased corn production and higher prices. In 2006, 20.1 percent of the U.S. corn crop went to ethanol production, rising to 23.7 percent in 2007. The effect of using food crops for fuel has resulted in economic effects beyond corn, however. According to the U.S. Department of Agriculture, other field crops, livestock production costs, and food prices have been affected by corn ethanol as well. For example, higher corn prices led some soybean producers to plant more corn, reducing the amount of soybeans available. At the same time demand for soybean oil increased to make biodiesel, thereby increasing soybean prices. Also, cotton plantings were reduced by 4 million acres in 2007.

Though rising energy prices have also been a factor, the result of these trends is that animal feed prices for cattle, hogs, and poultry have risen and ultimately consumer food costs have risen, too. About 55 percent of the U.S. corn crop is used for animal feed. The effects of higher grain prices on animal feeders vary somewhat depending on the ability of some species to use a byproduct of ethanol production – distiller's grains. Beef and dairy cattle can digest this product better than hogs or poultry, for example. Ultimately, USDA projects higher farm income and retail food prices as a result of these trends and reduced profitability for livestock producers. In fact, Pilgrim's Pride, Inc., based in Pittsburg, Texas, announced that it would close a chicken processing plant in Siler City, North Carolina, and 6 of its 13 distribution centers. The company said record high prices for corn and soybean meal combined with an oversupply of chicken made it necessary to cut costs, resulting in elimination of 1,100 jobs.<sup>19</sup>



EXHIBIT 12-4

## Texas Biomass Energy Consumption by Sector, 2005\*



\*Most recent data available.

Source: U.S. Energy Information Administration.

Higher food prices have been moderated somewhat by price competition by grocery retailers and the fact that for some food products the value of the agricultural commodity is low compared to packaging, advertising, processing, transportation and other costs.<sup>20</sup>

An upcoming study of the potential of all renewable resources, including biomass, mandated by the Texas Legislature, is expected to be released by the State Energy Conservation Office by early 2009.

### ENDNOTES

- <sup>1</sup> National Renewable Energy Laboratory, "Biomass Energy Basics," [http://www.nrel.gov/learning/re\\_biomass.html](http://www.nrel.gov/learning/re_biomass.html). (Last visited April 21, 2008.)
- <sup>2</sup> U.S. Department of Agriculture, Texas Fact Sheet, [www.nass.usda.gov/Statistics\\_by\\_State/Texas/index.asp](http://www.nass.usda.gov/Statistics_by_State/Texas/index.asp). (Last visited April 21, 2008.)

- <sup>3</sup> U.S. Environmental Protection Agency, Landfill Methane Outreach Program, "Energy Projects and Candidate Landfills," <http://epa.gov/lmop/proj/index.htm>. (Last visited April 21, 2008.)
- <sup>4</sup> Houston Advanced Research Center "Combined Heat and Power Potential using Agricultural Wastes, January 2008, p.ix-x, prepared for State Energy Conservation Office, [http://www.seco.cpa.state.tx.us/zzz\\_re/re\\_biomass\\_chp-report2008.pdf](http://www.seco.cpa.state.tx.us/zzz_re/re_biomass_chp-report2008.pdf). (Last visited April 21, 2008.)
- <sup>5</sup> U.S. Department of Energy, Energy Information Administration, Annual Energy Review 2006 (Washington, D.C., June 2007), pg. 279, <http://www.eia.doe.gov/aer/pdf/aer.pdf>. (Last visited April 21, 2008.)
- <sup>6</sup> U.S. Department of Energy, Energy Information Administration, Annual Energy Review 2006 (Washington, D.C., June 2007), [http://www.eia.doe.gov/emeu/aer/pdf/pages/sec10\\_3.pdf](http://www.eia.doe.gov/emeu/aer/pdf/pages/sec10_3.pdf). (Last visited April 21, 2008.)
- <sup>7</sup> Energy Information Administration, State Energy Data System, "Table F13a: Wood, Waste, and



- Ethanol Consumption Estimates by Sector, 2005. [http://www.eia.doe.gov/emeu/states/sep\\_fuel/html/pdf/fuel\\_use\\_ww\\_en.pdf](http://www.eia.doe.gov/emeu/states/sep_fuel/html/pdf/fuel_use_ww_en.pdf).
- <sup>8</sup> E-mail communication from Linda Shirey, senior planning analyst, Electric Reliability Council of Texas, June 12, 2007.
- <sup>9</sup> Energy Information Administration, State Energy Data System, "Table F13a: Wood, Waste, and Ethanol Consumption Estimates by Sector, 2005." [http://www.eia.doe.gov/emeu/states/sep\\_fuel/html/pdf/fuel\\_use\\_ww\\_en.pdf](http://www.eia.doe.gov/emeu/states/sep_fuel/html/pdf/fuel_use_ww_en.pdf).
- <sup>10</sup> Texas State Energy Conservation Office, "Biodiesel Fuel," [http://www.seco.cpa.state.tx.us/re\\_biodiesel.htm](http://www.seco.cpa.state.tx.us/re_biodiesel.htm) (last visited August 2007); and EIA, Distillate Fuel Consumption Estimates by Sector, 2005, (Washington, D.C., August 2007) [www.eia.doe.gov/emeu/states/sep\\_fuel/html/fuel\\_use\\_df.html](http://www.eia.doe.gov/emeu/states/sep_fuel/html/fuel_use_df.html) (Last visited April 21, 2008.)
- <sup>11</sup> Email communication from Paul Hesse, U.S. Energy Information Administration, Washington, D.C., October 17, 2007.
- <sup>12</sup> U.S. Energy Information Administration, Annual Energy Review 2006 (Washington, D.C., June 2007), p. 279, [http://www.eia.doe.gov/emeu/aer/pdf/pages/sec10\\_3.pdf](http://www.eia.doe.gov/emeu/aer/pdf/pages/sec10_3.pdf). (Last visited April 21, 2008.)
- <sup>13</sup> Energy Information Administration, State Energy Data System, "Table F13a: Wood, Waste, and Ethanol Consumption Estimates by Sector, 2005." [http://www.eia.doe.gov/emeu/states/sep\\_fuel/html/pdf/fuel\\_use\\_ww\\_en.pdf](http://www.eia.doe.gov/emeu/states/sep_fuel/html/pdf/fuel_use_ww_en.pdf). (Last visited April 21, 2008.)
- <sup>14</sup> U.S. Department of Energy, Energy Information Administration, "Biomass Program: Industrial Process Heat and Steam," [http://www1.eere.energy.gov/biomass/industrial\\_process.html](http://www1.eere.energy.gov/biomass/industrial_process.html). (Last visited April 21, 2008.)
- <sup>15</sup> U.S. Energy Information Administration, Annual Energy Review 2006 (Washington, D.C., June 2007), p. 279. and Energy Information Administration, State Energy Data System, "Table F13a: Wood, Waste, and Ethanol Consumption Estimates by Sector, 2005."
- <sup>16</sup> U.S. Energy Information Administration, Annual Energy Review 2006 (Washington, D.C., June 2007), p. 279.
- <sup>17</sup> Interview with Bob Avant, program manager, Texas Agricultural Experiment Station, Texas A&M University System, College Station, Texas, October 26, 2007.
- <sup>18</sup> Interview with Bob Avant.
- <sup>19</sup> "Pilgrim's Pride Corporation to Close Chicken Processing Complex and Six Distribution Centers," (Pittsburg, Texas: March 12, 2008) News Release, [www.pilgrimspride.com/](http://www.pilgrimspride.com/) (last visited April 21, 2008.) <http://phx.corporate-ir.net/phoenix.2html?c=68228&p=irol-newsarticle&id=1117942>. (Last visited April 21, 2008.)
- <sup>20</sup> Westcott, Paul, Amber Waves, U.S. Department of Agriculture, Economic Research Service, "U.S. Ethanol Expansion Driving Changes Throughout the Agricultural Sector." (Washington D.C., September 2007) Pages.1-7 <http://www.ers.usda.gov/AmberWaves/September07/Features/Ethanol.htm> (last visited March 3, 2008) and Leibtag, Ephraim, Amber Waves, U.S. Department of Agriculture, Economic Research Service, "Corn Prices Near Record High, But What About Food Prices?" (Washington D.C., February 2008) Pages 1-5. <http://www.ers.usda.gov/AmberWaves/november07/features/biofuels.htm> (Last visited April 21, 2008).

