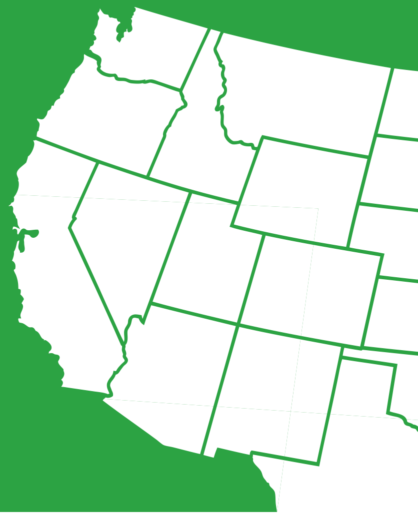
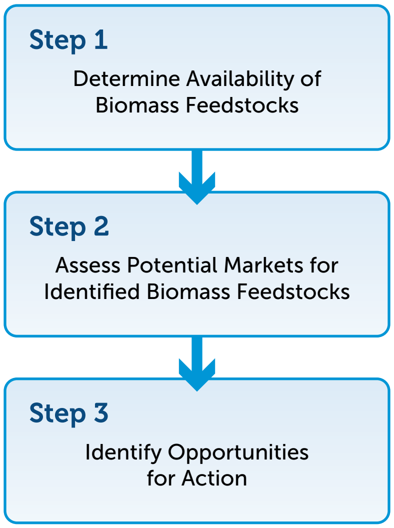
CHAPTER FOUR

How Can States Identify Bioenergy Opportunities?



After learning about the benefits and challenges of bioenergy (Chapter 3), state decision makers can consider whether they want to use bioenergy to meet state energy, environmental, and economic goals.

If states decide they want to promote bioenergy, they should consider the three steps shown below. Following these steps will help ensure that states (1) fully understand the most appropriate bioenergy activities for them, and (2) design policies and programs tailored to the market conditions and resource availability unique to each state.



Note: The order in which Steps 1 and 2 are completed is not critical as both steps are equally important to develop a rational approach.

DOCUMENT MAP

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Example

FLORIDA'S FARM TO FUEL INITIATIVE

In September 2005, inspired by the "25x'25" initiative—a group of stakeholders promoting expansion of biomass from farms, forests, and ranches to provide 25 percent of the total energy consumed in the United States by 2025—the state of Florida looked closely at its energy profile and resource base to determine how more biomass could be used sustainably in the state.

Through an assessment of market conditions Florida determined that the state was one of the nation's largest consumers of both petroleum gasoline and nonrenewable electricity in the United States. Florida also identified more than a dozen types of produce for which it is ranked first or second in production and sales value in the United States (i.e., determined potential feedstocks and markets). The Florida Department of Agriculture and Consumer Services held its first stakeholder meeting in January 2006 to develop a proposal to match the state's needs with available resources, and identified opportunities for action.

As a result, the Farm to Fuel Initiative was enacted in June 2006 as a comprehensive strategy for promoting renewable energy within the state. The main objective of the program is to enhance the market for and promote production and distribution of renewable energy from Florida-grown crops, agricultural wastes and residues, and other biomass to enhance the value of agricultural products and expand agribusiness in the state. The program offers competitive renewable energy matching grants for research and development, demonstration, and commercialization projects relating to bioenergy based on Florida-specific criteria. The program awarded $25 million to 12 projects across the state in 2008.

For more information, see: *www.floridafarmtofuel.com/*.

Source: Florida Department of Agriculture and Consumer Services, 2008 and 2007

4.1 STEP 1: DETERMINE AVAILABILITY OF BIOMASS FEEDSTOCKS

A complete inventory of its biomass feedstocks will allow a state to fully assess the range of options for bioenergy development. Biomass feedstocks are available across the United States, especially in the Midwest and Southeast (see Figure 4-1). However, each state possesses its own unique blend of bioenergy feedstocks. State-specific information is necessary to ensure pursuit of the most technically and economically viable bioenergy activities for a state.

When assessing the availability of potential biomass feedstocks, it is important for decision makers to consider all types, including waste/opportunity fuels and energy crops, as discussed in Chapter 2. States should pay particular attention to obtaining accurate estimates of biomass feedstock availability because miscalculations can greatly impact the economic viability and successful operation of bioenergy projects.

The key question each state must answer while assessing its available feedstocks and completing Step 1 is:

What is the total fuel potential of all biomass feedstocks, by location, in the state?

To develop an assessment of biomass resource availability, states should first see whether they can use existing data sources (see Section 4.1.1). If existing sources prove insufficient, states may want to consider conducting a biomass assessment (see Section 4.1.2). Nothing takes the place of a detailed, on-the-ground biomass resource assessment when considering a project.

REGIONAL BIOMASS FEEDSTOCK AVAILABILITY

Locations in all regions of the country have opportunities to take advantage of waste and opportunity fuels for biopower and bioheat generation. With respect to advanced biofuels production, regionally, cellulosic ethanol production from corn and wheat residues would probably occur most in the Midwest; dedicated crop production would most likely occur in the South/Southeast; and cellulosic ethanol production from wood and forest residues would occur in the West, Southeast, and Northeast (assuming relatively short transportation distances from feedstock to production facility) (Ugarte et al., 2006).

4.1.1 USE EXISTING RESOURCES TO DETERMINE BIOMASS FEEDSTOCK AVAILABILITY

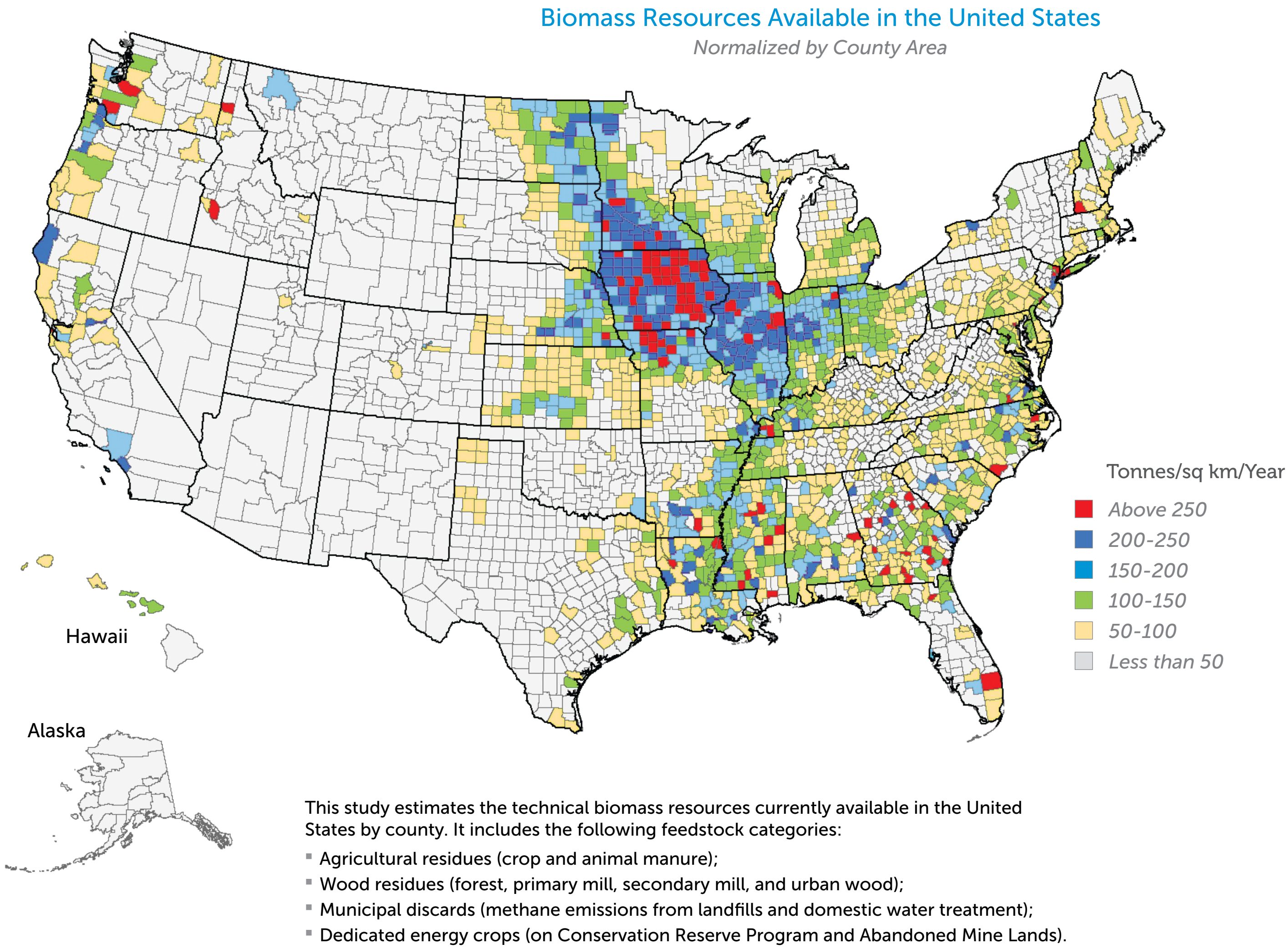
Numerous existing resources provide data on potential biomass feedstocks by state and information on how to conduct a biomass assessment (as discussed later in this chapter). For example, key state agencies (e.g., the state Department of Agriculture) are often valuable sources of information about potential biomass feedstocks. In-state expertise can also be found among local USDA rural development representatives (*www.rurdev.usda.gov/recd_map.html*), as well as local academic and business experts in agriculture, forestry, and waste.

The following resources provide information about potential biomass feedstocks and/or data on feedstock availability by geographic location. Each specializes in particular types of data, as described below:

- **Biomass Resource Assessment Tool**. This online biomass mapping tool, developed by NREL for the U.S.

FIGURE 4-1. TOTAL BIOMASS RESOURCES AVAILABLE IN THE UNITED STATES PER SQUARE KILOMETER BY COUNTY

Source: Milbrandt, 2005



EPA Blue Skyways program, allows users to select a location on the map, quantify the biomass resources available within a user-defined radius, and then estimate the total thermal energy or power that could be generated by recovering a portion of that biomass. The tool acts as a preliminary source of biomass feedstock information; however, it will not take the place of an on-the-ground feedstock assessment. The tool also contains numerous layers including landfills, waste water treatment plants, anaerobic digesters on animal feeding operations, EPA brownfields, biopower plants, fossil power plants, ethanol manufacturing facilities, and alternative fuel filling stations. The tool can be found at *http://rpm.nrel.gov/biopower/biopower/launch*.

- **Biomass Feedstocks**. The U.S. DOE Biomass Program works with industry, academia, and national laboratory partners on a balanced portfolio of research in biomass feedstocks and conversion technologies. The Web site provides a gateway to a wealth of biomass information, including feedstock availability. In particular, the program's site lists several U.S. DOE reports on the potential of different feedstocks, including corn stover, woody biomass, and switchgrass, which states across the nation may find useful.

» To locate these publications, visit *www1.eere.energy.gov/biomass/publications.html#feed*. The U.S. DOE Biomass Program homepage can be accessed at *www1.eere.energy.gov/biomass/biomass_feedstocks.html*.

- **State Assessment for Biomass Resources**. Produced by the U.S. DOE Office of Energy Efficiency and Renewable Energy (EERE) Alternative Fuels and Advanced Vehicles Data Center, this tool provides detailed information on biomass resources and utilization throughout the United States. It features state-specific information on conventional fuel and biofuel use, ethanol and biodiesel stations and production plants, and biofuel production capacities. In addition, it offers state-by-state snapshots of available feedstocks, data on potential production capacities, and projections on the future use of biofuels. The site is particularly useful for states interested in evaluating biomass resource potential for producing biofuels.

  This resource can be found at ***www.afdc.energy.gov/afdc/sabre/index.php***.

- **Dynamic Maps, GIS Data, and Analysis Tools**. This NREL Web site provides county-level biomass resource maps, which are useful for states interested in their feedstock potential in the following categories: crop residues, forest residues, primary mill residues, secondary mill residues, urban wood waste, methane emissions from landfills, methane emissions from manure management, methane emissions from wastewater treatment plants, and dedicated energy crops. The maps are derived from data contained in a report, *Geographic Perspective on the Current Biomass Resource Availability in the United States* (described below).

  The NREL Biomass Web site is ***www.nrel.gov/gis/biomass.html***. *Note that these maps present technical biomass resource data. The economic biomass resource availability will most likely be somewhat less than what is presented here.*

- **Geographic Perspective on the Current Biomass Resource Availability in the United States**. This NREL report provides the basis for the maps and data presented in NREL's *Dynamic Maps, GIS Data, and Analysis Tools* Web site described above. The report provides a geographic analysis of biomass resource potential at the county level, and can give officials a sense of the major biomass resources available within their state and their technical potential relative to other states.

  The report is available at ***www.nrel.gov/docs/fy06osti/39181.pdf***.

- **USFS Forest Inventory Data Online (FIDO)**. This online tool provides access to the National Forest Inventory and Analysis databases. It can be used to generate tables and maps of forest statistics (including tree biomass) by running standard reports for a specific state or county and survey year, or customized reports based on criteria selected by the user.

  This tool can be accessed at ***http://199.128.173.26/fido/index.html***.

- **Market Opportunities for Biogas Recovery Systems**. This report published by U.S. EPA's AgStar program assesses the market potential for biogas energy projects at swine and dairy farms in the United States. For the top ten swine and dairy states, the guide characterizes the sizes and types of operations where biogas projects are technically feasible, along with estimates of potential methane production, electricity generation, and greenhouse gas emission reductions.

  The report is available at ***www.epa.gov/agstar/pdf/biogas%20recovery%20systems_screenres.pdf***.

- **U.S. EPA's Landfill Methane Outreach Program (LMOP) Landfill Database**. This online database provides a nationwide listing of operational and under construction LFG energy projects; candidate municipal solid waste landfills having LFG energy potential; and information on additional landfills that could represent LFG energy opportunities. The database can be accessed as a series of downloadable Excel spreadsheets, which are updated and posted to the Web site each month. The information contained in the LMOP database is compiled from a variety of sources, including annual voluntary submissions by LMOP Partners and industry publications.

  The database can be accessed at ***www.epa.gov/lmop/proj/index.htm***.

- **Coordinated Resource Offering Protocol (CROP) Evaluations**. This U.S. Forest Service and Bureau of Land Management Web page provides the results of ten CROP evaluations that have been conducted for more than 30 million acres of public forestlands potentially vulnerable to wildfires. The evaluations contain detailed resource-offering maps that illustrate the growing fuel load problem within major forest systems and quantify the biomass available for removal within five years.

  The evaluations can be accessed at ***www.forestsandrangelands.gov/Woody_Biomass/supply/CROP/index.shtml***.

- **State Assessment for Biomass Resources (SABRE)**. This comprehensive U.S. DOE tool provides detailed information on biomass resources and utilization throughout the United States. It features state-specific information on conventional fuel and biofuel use, ethanol and biodiesel stations and production plants, and biofuel production capacities. In addition, it offers state-by-state snapshots of available feedstocks, data on potential production capacities, and projections on the future use of biofuels.

This tool can be accessed at *www.afdc.energy.gov/afdc/sabre/index.php*.

4.1.2 CONDUCT A BIOMASS ASSESSMENT IF MORE INFORMATION IS NEEDED

If more information is needed about biomass feedstock availability after tapping into the resources discussed above, a state can consider conducting its own biomass feedstock assessment. The advantages of a state conducting its own assessment include the ability to tailor the study to meet specific state goals for bioenergy use (i.e., focus on resources that the state knows it wants to tap) and determine the level of data specificity (i.e., state level, county level, within 50 miles of existing energy and industrial infrastructure, etc.). Disadvantages of a state conducting its own assessment are the time and cost of doing so.

Some considerations for determining whether to conduct a state-specific biomass assessment include:

- **Identify priorities**. First, consider using existing information to decide generally what priorities are of greatest interest, for example feedstock types (e.g., forest residues, energy crops), geography (e.g., economic development in southeast portion of the state), or output (e.g., biopower, biofuels) based on the state's resources and goals.

- **Look closely to analyze data gaps in existing information**. Based on the scope of interest, a state can decide whether existing data meet its needs or information gaps need to be addressed by completing its own assessment. In addition to general data availability, some considerations will include how recent the information is (i.e., to determine whether it is out of date), and the degree of data specificity (e.g., an estimate for the whole state, or detailed county-level data).

- **Determine resource availability**. Once a state knows its data needs, it will need to determine whether it has the resources to perform any needed assessment itself (i.e., using state staff) or whether it needs to hire a contractor or tap into the expertise at state universities. Costs to do so will need to be considered, as they will impact the extent of the analysis that can be completed.

Some states have already conducted assessments or related studies of renewable energy (including biomass) potential and can provide examples and guidance. Examples include:

- **Guide to Estimates of State Renewable Energy Potential**. This guidebook lists existing studies of renewable energy potential and describes how to conduct these studies.

- **State Biomass Resource Assessments**

  - ***California:*** *An Assessment of Biomass Resources in California, 2007*

    Provides an updated biomass inventory for the state along with an assessment of potential growth in biomass resources and power generation that could help to satisfy the state renewable portfolio standard (RPS). *http://biomass.ucdavis.edu/materials/reports%20and%20publications/2008/CBC_Biomass_Resources_2007.pdf*

  - ***Georgia:*** *Biomass Wood Resource Assessment on a County-by-County Basis for the State of Georgia, 2005*

    Provides a biomass wood resource assessment at the county level for Georgia. *www.gfc.state.ga.us/ForestMarketing/documents/BiomassWRACounty-byCountyGA05.pdf*

  - ***Hawaii:*** *Biomass and Bioenergy Resource Assessment: State of Hawaii, 2002*

    Provides an assessment of current and potential biomass and bioenergy resources for Hawaii. Includes animal wastes, forest product residues, agricultural residues, and urban wastes. *www.hawaii.gov/dbedt/info/energy/publications/biomass-assessment.pdf*

  - ***Mississippi:*** *Mississippi Institute for Forest Inventory Dynamic Report Generator*

    Provides a continuous, statewide forest resource inventory necessary for the sustainable forest-based economy. The inventory information is derived from sampling estimation techniques with a presumed precision of +/- 15 percent sampling error with 95 percent confidence. *www.mifi.ms.gov/*

  - ***South Carolina:*** *Biomass Energy Potential in South Carolina: A Conspectus of Relevant Information, 2007*

SUMMARY OF BIOMASS RESOURCES AND THEIR DEGREE OF UTILIZATION IN THE STATE OF HAWAII BY COUNTY

Hawaii's 2002 Biomass and Bioenergy Resource Assessment was developed through five tasks:

1. Collecting and reviewing relevant prior studies.
2. Collecting current bioenergy data from public and private sector sources.
3. Compiling, reducing, and analyzing data and information collected in Task 2.
4. Summarizing economic and other considerations related to development and operation of bioenergy facilities.
5. Inventorying public and private sector bioenergy facilities in the state.

The results of these activities are summarized below; the full report is available at *www.hawaii.gov/dbedt/info/energy/publications/biomass-assessment.pdf.*

	tons yr[1]	Hawaii	Maui	Kauai	Honolulu
Swine Manure	dry	410	540	180	1,560
Dairy Manure	dry				8,300
Poultry	dry	1,520[1]			4,830
Bagasse Fiber	dry		275,000 (275,000)[2]	74,000 (56,000)[2]	
Molasses	as-received		80,000	15,000	
Cane Trash	dry		137,000	37,000	
Pineapple Processing Water	dry		7,500 (7500)[2]		
Macademia Nut Shells	dry	19,000 (18,000)[2]			
Municipal Solid Waste	as-received	110,000	96,000	56,000	668,000 (6000,000)[2,3]
Food Waste[4,5]	as-received	24,000	15,000	5,800	90,000
Sewage Sludge[5]	dry	183	3,352 (3,352)[2,3]	246	16,576 (891)[2,3]
Fats/Oil/Grease[6]	dry	1,850	1,850	800	10,000

[1] *combined poultry waste estimate for Hawaii, Maui, and Kauai*
[2] *amount currently used*
[3] *tipping fee associated with utilization*
[4] *amount entering landfills*
[5] *included in municipal solid waste value*
[6] *processed grease, contains minimal moisture*

Summarizes studies conducted on various actual and potential feedstock resources in South Carolina and the Southeast, as well as relevant nonregional studies and other information. The report describes the existing information base, as well as information gaps. *www.energy.sc.gov/publications/Biomass%20 Conspectus%204-10-07.pdf*

- **Oregon:** *Biomass Energy and Biofuels from Oregon's Forests, 2006*

  Assesses the statewide potential for production of electricity and biofuels from woody biomass, including the available wood supply and the environmental, energy, forest health, and economic effects. Reviews and summarizes efforts underway to promote electric energy and biofuels from woody biomass, and identifies gaps in existing efforts. Assesses constraints and challenges to the development of biomass energy and biofuels from Oregon forests, including economic, environmental, legal, policy, infrastructure, and other barriers and develops recommendations on how to overcome these barriers. *www.oregonforests.org/assets/uploads//Biomass_Full_Report.pdf*

- **Regional Biomass Resource Assessments**
  - ***Northeastern states (CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT)***: *Securing a Place for Biomass in the Northeast United States: A Review of Renewable Energy and Related Policies, 2003*

    Provides a biomass feedstock assessment for northeastern states. *www.nrbp.org/pdfs/nrbp_final_report.pdf*

  - ***Western states (AK, AZ, CA, CO, HI, ID, KS, MT, NE, NV, NM, ND, OR, SD, TX, UT, WA, WY)***: *Biomass Task Force Report, 2006*

    Focuses on use of biomass resources for production of electricity as part of an overall effort of the Western Governors' Association (WGA) to increase the contribution of clean and renewable energy in the region. *www.westgov.org/wga/initiatives/cdeac/Biomass-full.pdf*

  - ***Western states (WA, OR, ID, MT, WY, CO, NM, AZ, UT, NV, CA, TX, OK, ND, SD, NE, KS, AK and HI)***: *Western Bioenergy Assessment, 2008*

    Includes a series of technical reports produced for the Western Governors' Association. These reports extensively evaluate biomass resources in the western states, biofuel conversion technologies, spatial analysis and supply curve development, and deployment scenarios and potential policy interactions. *www.westgov.org/wga/initiatives/transfuels/index.html*

  - ***Western states (WA, OR, ID, MT, WY, CO, NM, AZ, UT, NV, CA, TX, OK, ND, SD, NE, KS, AK and HI)***: *Transportation Fuels for the Future Initiative Working Group Reports and Final Report, 2008*

    Analyzes the potential for the development of alternative fuels and vehicle fuel efficiency member states of the Western Governors' Association. *www.westgov.org/wga/initiatives/transfuels/index.html*

Example

WESTERN RENEWABLE ENERGY ZONES

WGA and U.S. DOE launched the Western Renewable Energy Zones Project (WREZ) in May 2008. The central goal of the WREZ project is to utilize areas of the West with vast renewable resources to expedite development and delivery of clean and renewable energy, including wind, solar, and biomass resources. The project will generate:

Reliable information for use by decision makers that supports cost-effective and environmentally sensitive development of renewable energy in specified zones.

Conceptual transmission plans for delivering that energy to load centers within the Western Interconnection.

The project also will evaluate all feasible renewable resource technologies that are likely to contribute to the realization of WGA's goal for development of 30,000 MW of clean and diversified energy by 2015. For the latest information and geographic information system (GIS) maps of the proposed WREZ, see *www.westgov.org/wga/initiatives/wrez/index.htm*.

Source: Western Governors' Association and U.S. DOE, 2009

4.2 STEP 2: ASSESS POTENTIAL MARKETS FOR IDENTIFIED BIOMASS FEEDSTOCKS AND BIOENERGY

Once a state understands the availability of potential biomass feedstocks, the next step is to evaluate how the feedstocks can be employed by the market. In this step, analysis is conducted to determine the viability of using a state's feedstocks, as identified in Step 1, to produce bioenergy. To develop an evaluation that can withstand the scrutiny required to justify state policy, it is important to examine potential markets quantitatively and under a number of scenarios given different economic or market activities. The following sets of questions can be useful in assessing potential markets for biomass feedstocks:

1. **At what cost can the feedstocks reasonably be used?**
   - Are crop and waste feedstocks available at competitive prices?
   - What is the relative proximity of feedstocks, processing facilities, and markets?
   - How cost-competitive is the bioenergy with fossil-based resources?
   - What are the economics of using bioenergy?
2. **Who might use biomass feedstocks?**
   - What industries can use the available feedstocks?
   - What is the current and potential competition for feedstocks in the region?
   - Does the state have policies in place that could create a market for bioenergy?
3. **What does the state's energy and environmental profile look like?**
   - What are the state's anticipated energy demands?
   - What environmental issues should be considered?

4.2.1 AT WHAT COST CAN THE FEEDSTOCKS REASONABLY BE USED?

Are Crop and Waste Feedstocks Available at Competitive Prices?

The economics of bioenergy production are highly dependent on feedstock prices, and it is important that state officials considering actions to promote bioenergy explore whether a sufficient supply of competitively priced feedstocks exists to support a profitable bioenergy industry. This undertaking is typically challenging, in part because the prices of biomass feedstocks are subject to considerable uncertainty.

Many of the factors that influence the availability of feedstocks over time, such as weather, plant disease, feedstock demand, and transportation costs, will also affect feedstock prices (see Chapter 3, Benefits and Challenges of Bioenergy, for a more in-depth discussion of these factors). Other factors, such as fossil fuel prices, can also significantly impact the price of feedstocks if their harvest requires the use of fertilizer and other chemicals (the prices of which are highly dependent on the cost of fossil fuels), if they need to be transported any significant distance, and if higher fossil fuel prices are passed through and impact the biofuels supply chain. Financial speculation by commodities traders will also affect the price of energy crop feedstocks.

When evaluating the cost-effectiveness of a given feedstock supply, it is important to consider how changes in these factors could affect feedstock prices; volatility, uncertainty, and or/changes in any of these factors will be reflected in the price of feedstocks. With all these factors in mind, some of the questions that should be considered when evaluating the cost effectiveness of a given biomass feedstock supply over the long term include:

- Will bioenergy producers likely have to compete with other industries for access to the resource?
- What are projected fossil fuel prices?
- How might financial speculators influence prices, if at all?
- Could a feedstock supply that is currently ample become easily exhausted?
- How much will feedstock prices change as the bioenergy industry grows?

What Is the Proximity of Feedstocks, Processing Facilities, and Markets?

In addition to understanding the industries or potential industries that can utilize a state's biomass feedstocks, it is important to know the limitations that might impede cost-effective bioenergy use. Foremost among these is whether biomass feedstocks, processing facilities, and markets exist in close enough proximity to deliver a competitive product. Proximity considerations are discussed below.

How far can each biomass feedstock be transported cost effectively? One critical factor that affects the financial viability of using a biomass feedstock is the proximity of the feedstock to where it would be used. The most cost-effective bioenergy applications often site the conversion facility as close as possible to the feedstock source (and to the end user). For wood feedstocks, a general rule of thumb is that 50 to 100 miles is the maximum distance that feedstocks can be transported at competitive cost; however, this depends on the cost of competing sources (e.g., of power/heat) and on the specific type of bioenergy feedstock. EIA (2006) uses the following assumptions in its National Energy Modeling System (NEMS):

- Urban wood waste and mill residues transportation cost: $0.24/ton-mile, maximum supply distance 100-mile radius.
- Forest residues, agricultural residues, energy crops transportation cost: $10 to $12/ton-mile, within a maximum supply distance of 50 miles.

Another question that needs to be answered is who, specifically, will collect and transport the biomass to the end-use facility? There are different answers to this question depending upon whether one is using urban wood waste, forest residues, or crop residues. What contractual requirements for feedstock delivery need to be developed? What is the quality and quantity of feedstock to be supplied?

Are sufficient biomass resources available within the distance identified to support a processing facility? Sufficient feedstocks must be close enough to the potential processing facility to support its long-term operation. For example, it would not make financial sense to invest substantial capital for a plant that relies on feedstock that will be exhausted within a few years. Proposed projects may need long-term contracts for feedstock supplies. Because bioenergy costs are frequently highly dependent on feedstock transportation costs, detailed scenario building and certainty analyses will be needed to answer this question with confidence.

As an example, one analysis of biomass-fueled boiler power generation systems and CHP configurations showed that 100 tons/day of dry biomass fuel (assuming 8,500 Btu of energy per pound) could be used to generate 500 kW to 4 MW of electricity depending on the conversion technology used, plus thermal energy for process steam. (A 100 tons/day system would require about four to five standard semi-trailer trucks for feedstock delivery each day.) A system receiving 900 tons/day of dry biomass fuel could produce roughly 8 MW to 24 MW of electricity depending on the conversion technology and how much thermal energy was desired (U.S. EPA, 2007d – Chapter 7).

Are markets for fuel, heat, and/or power readily accessible? Available markets require critical infrastructure to be in place and may require contractual arrangements. For example, biofuels require access to populations of consumers who need fuel. Bioenergy for heat and power, especially if not used primarily or exclusively for on-site demand, may require long-term contracts with the electric utility (as discussed with interconnection standards in Section 4.3.2). Markets for renewable energy, such as green power or renewable energy credits (RECs), may or may not be open to biopower.

How Cost-Competitive Is Bioenergy with Fossil-Based Resources?

The most promising markets for bioenergy will typically share several characteristics. Perhaps most importantly, the cost of bioenergy will be competitive (in some cases without government support; in other cases with direct or indirect support) with energy that is generated from other sources, including fossil fuels. High or volatile energy prices will generally help to improve the cost effectiveness of bioenergy.

The increase in gasoline prices over the last several years, for example, has helped to make ethanol a more attractive alternative motor fuel economically. Similarly, volatility in electricity prices over this same period has generally increased the appeal of biomass power as facilities look for ways to stabilize energy prices or hedge fuel costs. It is important, therefore, that any assessment of the market for bioenergy take prevailing and forecasted energy prices into account.

» **Data on gasoline and electricity prices are available on EIA's Web site at *www.eia.doe.gov*.**

» **For information on prevailing energy prices by state, see *http://tonto.eia.doe.gov/state/SEP_MorePrices.cfm*.**

» **Forecasts of projected energy prices through 2030 are available in EIA's Annual Energy Outlook reports. The 2008 version of the report is accessible on the Web site at *www.eia.doe.gov/oiaf/aeo/index.html*.**

Energy prices and forecasts are also important to consider in later evaluations if a state decides to develop incentives or policy measures to support bioenergy. A state will want to understand the level of support necessary to achieve its objectives given prevailing and projected cost effectiveness—to decrease the likelihood that states offer too many or too few incentives for

PRICE VOLATILITY

Noteworthy, of course, is that petroleum prices spiked and crashed in 2008—from a high of more than $100/barrel to a low of less than $40/barrel—making biofuels in many parts of the country uneconomical after a period of cost competitiveness. This extreme type of volatility is difficult to predict; having flexible policies that are robust to different price trajectories can buffer the effects of volatile prices.

bioenergy development and are therefore inefficient or ineffective in the long run.

Using biomass to produce heat is currently one of the most cost effective applications for biomass energy. This is especially true if one is replacing propane or fuel oil, which are typically more expensive than biomass on a $/Million Btu basis. Depending on the price, it may also be possible to compete with natural gas.

Example

COST-COMPETITIVE WOOD CHIP BOILER

In the winter of 2009, the National Renewable Energy Laboratory (NREL) installed a central, wood chip fired boiler to provide thermal energy for its main campus. NREL estimates that wood can be obtained for less than $3/million Btu, compared to natural gas costs of $6-$10/million Btu. The system is expected to meet up to 80% of NREL's heating load with biomass energy.

Source: NREL, 2008

What are the Economics of Using Bioenergy?

Once information on availability, proximity, and cost competitiveness of feedstocks and other considerations has been gathered, it is important to conduct an economic analysis of the various options for sourcing and using biomass to produce bioenergy. At the minimum, a 20-year pro-forma analysis should be developed to evaluate various options. Bioenergy options should be compared with other options such as fossil fuels (e.g., if looking at using biomass to offset natural gas in a school, what are the life-cycle costs of the biomass technology vs. the natural gas technology?)

4.2.2 WHO MIGHT USE BIOMASS FEEDSTOCKS?

What Industries Can Use the Available Feedstocks?

An understanding of the key market factors that will allow potential feedstocks to become actual bioenergy projects is essential. Foremost among these factors is knowing what drives demand for biomass resources in the state, that is, which industries can use the available feedstocks.

Industries in a state can make greater use of bioenergy in several ways:

- Existing industries can expand their facilities or construct new facilities.
- Industries can use their waste streams as biomass feedstock.
- Existing energy production facilities can initiate or increase their use of biomass.
- New industries that use biomass feedstocks can be encouraged to locate in the state.

Understanding the relationships between feedstocks, conversion technologies, products, and markets, and their implications for industry, commerce, and end users within a state's borders, is essential.

Figure 2-2 in Chapter 2 illustrates the conversion pathways of different biomass feedstocks into various final forms of bioenergy. As the diagram shows, states with abundant waste or opportunity fuels may have an advantage if they focus support toward industries that can generate on-site heat or power or utilities that can provide heat and power. However, states with abundant energy crops are in a better position to support biofuel development using current technologies.

Although a wide variety of industrial, commercial, and institutional facilities could potentially benefit from the use of biomass as an energy source, there are several types of facilities for which biomass could be a particularly attractive and economical source of energy. Some examples of these facilities include (DOE, 2004):

- **Schools, prisons, hospitals, and municipal WWTPs**. Facilities with large, fairly constant electricity and heating requirements are good candidates for on-site biopower/bioheat production. In 2008, four prisons and one high school in the United States were using biomass CHP systems to produce energy (ICF, 2008). For facilities with potentially sensitive populations (i.e., schools and hospitals) it is especially important to utilize best available pollution control technologies to reduce the risk of exposure to air emissions.

FUELS FOR SCHOOLS

The Fuels for Schools program is an innovative venture between public schools and state and regional foresters of the northern and intermountain regions of the U.S. Forest Service. This program helps public schools retrofit their current fuel or gas heating systems to biomass-based systems through knowledge sharing, information dissemination, identifying potential financing opportunities, supply assessment, and overall support and assistance as needed. As of 2008, Fuels for Schools had initiated projects in Idaho, Montana, Nevada, and North Dakota.

For more information on Fuels for Schools, see: *www.fuelsforschools.info/*.

There are dozens of schools in the United States that are heating their buildings with automated wood chip boilers. These facilities may also be capable of generating anaerobic digester gas for use as a fuel by treating wastewater in on-site treatment plants (DOE, 2004).

- **Landfills**. Landfills can capture the gas that is produced as a byproduct of the decomposition of solid waste for use as an energy source. This LFG can be used to generate electricity and/or heat for the landfill itself or other nearby facilities.

» **For more information, tools, and links to landfill and LFG databases, visit EPA's LMOP Web site, *www.epa.gov/lmop*.**

- **Lumber yards and pulp and paper mills**. Both the lumber processing and pulp and paper industries produce wood residues and black liquor that can be used as a source of energy to generate electricity and/or heat, typically for on-site use. Pulp and paper mills also produce large quantities of wastewater that can be treated with anaerobic digesters to create biogas.

- **Food and beverage processing facilities**. Food and beverage processing facilities can use the food processing waste (FPW) they generate as a fuel source. A 2004 study found that even though FPW could significantly reduce fuel costs for these facilities, its use as a fuel is minimal. The facilities are also good candidates for anaerobic digestion of wastewater to produce biogas for on-site use (DOE, 2004).

- **Petroleum refineries**. There are opportunities to integrate biomass feedstocks into existing fossil fuels industries. For example, petroleum refineries can take bio-oil and process it within existing refineries, blending the renewable diesel product into petroleum diesel and using existing pipeline infrastructure for distribution. This alternative to biodiesel (sometimes called "green diesel") overcomes the distribution infrastructure challenge described in Chapter 3. The same approach can apply to bio-produced gasoline—"green gasoline."

- **Power plants and other large energy users**. Power plants, typically coal fired, can substitute biomass for a portion of the fossil fuel used in the combustion process, in most cases with only minor equipment modifications. As of 2006, 52 coal-burning power plants in the United States were utilizing cofiring technology (EIA 2008). Other large energy users, such as cement plants, may also be good candidates for biomass cofiring.

» **One source of information to help states identify industries that are in a position to initiate or increase their use of biomass is the U.S. Bureau of Economic Analysis. The bureau provides information on state-by-state output (gross domestic product) of industries, such as those described above, that might be poised to incorporate bioenergy feedstocks into their operations. This information is accessible online at *www.bea.gov/regional/gdpmap/*.**

The presence of related industries, including oil and gas refining, blending, terminals, transportation corridors, and distribution networks, can create more demand for bioenergy. Transportation infrastructure limitations (discussed below) may place constraints on building centralized conversion facilities while creating opportunities for distributed ones.

Example

BREWERY BIOENERGY PRODUCTION

Anheuser-Busch, a member of EPA's Climate Leaders partnership program, utilizes Bio-Energy Recovery Systems (BERS) at nine of its 12 breweries. These systems feature anaerobic digesters that break down nutrients in the wastewater from the brewing process, creating biogas. The biogas is captured and used by CHP systems to fuel boilers that provide heat and power for the breweries. Where they are in use, BERS meet 15 percent of Anheuser-Busch facilities' on-site fuel needs. In 2007, the nine systems generated enough energy to heat more than 25,000 homes.

For more information, see: *www.abenvironment.com/Environment/BioEnergyRecovery.html* and *www.epa.gov/stateply/partners/partners/anheuserbuschcompaniesinc.html*.

What is the current and potential competition for feedstocks in the region?

When doing a market assessment, it is very important to consider whether there are any current users of biomass and what the future competition for feedstocks will be in the region. For example, a 50 MW biomass power plant or ethanol plant could be sourcing feedstocks from within a 100-mile radius. Other plants located within this radius will likely compete with it for feedstocks, and competition will increase as the distance between plants decreases. So when planning new bioenergy facilities, it is crucial to examine how siting plants will create and/or affect competition. Additionally, there are other competitors for feedstocks that need to be taken into consideration, such as composters, wood recyclers, and landscape mulch companies. All current and potential users of biomass need to be assessed.

Does the State Have Policies that Could Create a Market for Bioenergy?

States with promising markets for bioenergy may also have enacted policies and incentives to encourage and/or require use of renewable energy, including biomass. Renewable portfolio standards (RPS), RFS, production and tax incentives, low-interest loans, rebates, environmental revenue streams, grants, and standardized utility interconnection standards are examples of the measures states have enacted to improve bioenergy markets.

In addition, policies that are not specifically intended to promote renewable energy can also enable a market for industrial or commercial entities that might become users of bioenergy, such as rural economic development policies, designations of industrial development zones with environmental restrictions, waste reduction or processing requirements, etc. Chapter 5 provides information about evaluating state policies and incentives.

4.2.3 WHAT IS THE STATE'S ENERGY AND ENVIRONMENTAL PROFILE?

What Are the State's Anticipated Energy Demands?

Besides evaluating existing markets in a state that can utilize available biomass feedstocks, state officials can assess anticipated rates of increase in electricity demand, renewable electricity demand, and biofuels demand. Rapid increases in these demands could create a promising market environment for biomass feedstocks and bioenergy. EIA, the state public utilities commission, state energy plan, or regional economic modeling results are likely sources of energy demand forecasts.

Voluntary markets for renewable electricity and green power can also spur demand.

» **For more information about green power, states can refer to the Green Power Network at *www.eere.energy.gov/greenpower/*. This online resource created by U.S. DOE provides information about utility green pricing, green power marketing, and renewable energy credits.**

Interested states can also join U.S. EPA's Green Power Partnership, a voluntary program that supports organizational procurement of green power by offering expert advice, technical support, tools, and resources.

» **For more information about the Green Power Partnership, see *www.epa.gov/greenpower/*.**

GREEN POWER MARKETING

The Green Power Network publishes a report series, *Green Power Marketing in the United States: A Status Report*, which identifies market trends. The report covering 2007 notes that in that year, total retail sales of renewable energy in voluntary purchase markets exceeded 18 billion kWh, a capacity equivalent of 5,100 MW of renewable energy, including 4,300 MW from new renewable energy sources. Biomass energy sources (including LFG) provided 28 percent of total green power sales.

For more information, see *www.nrel.gov/docs/fy09osti/44094.pdf*.

What Environmental Issues Should Be Considered?

Due to the complexity of the interaction between bioenergy and the environment, some types of bioenergy production can be more beneficial to the environment than others. In addition, some types of biomass are more appropriate for certain climates or areas with particular resources. For example, ethanol production typically requires access to significant and reliable water resources and is therefore less likely to have positive environmental effects in a drought-prone area. In contrast, some evidence suggests that biomass CHP requires less water than traditional natural gas-fired electricity generation, making it a regionally appropriate bioenergy option in a drier climate.

It is important for decision makers to understand the net environmental effects of growing, collecting, and processing biomass feedstocks into bioenergy in the context of their state's environmental features and challenges.

Examples of some environmental considerations that could be important to a state when considering bioenergy opportunities include:

- Lower GHG emissions from biofuels and biopower compared to fossil fuels can contribute to achieving goals of state and local climate action plans.
- Reduced air emissions (e.g., lower SO_2, NO_x, and PM emissions) from cofiring biomass with coal can make bioenergy more attractive to regulated facilities in a nonattainment area by lowering emissions-related operating costs. However, if gas or oil fueled operations are converted to woody biomass, PM emissions will increase.
- When large areas of undeveloped land are converted to agricultural uses to produce biofuel feedstocks, the po-

tential exists for damage to local ecosystems (e.g., from pesticide and fertilizer use) and displacement of species.

- Unregulated biomass boilers and furnaces can increase PM emissions, contributing to air quality problems.

As discussed in Chapter 3, Benefits and Challenges of Bioenergy, LCAs can help identify strategies to maximize the environmental benefits of biomass because they reveal the environmental effects of alternative approaches to biomass production, transportation, and conversion. Because of the level of detail involved, LCAs are not often tailored to specific geographic regions; however, state-specific analysis of policy options can draw on LCA results. This type of analysis can support major state decisions about policies and incentives.

Section 4.4.2 — Bioenergy and State Planning, describes the inclusion of bioenergy in comprehensive state environmental planning. Additional resources for evaluating environmental effects of bioenergy, including LCAs, are presented in Chapter 3.

4.3 STEP 3: IDENTIFY OPPORTUNITIES FOR ACTION

Working through Steps 1 and 2 should provide a state with a solid foundation for understanding the basics about biomass feedstock availability and potential markets for expanded bioenergy production. Before identifying specific actions to promote bioenergy, a state should have also considered the economic and environmental benefits and challenges outlined in Chapter 3. Once these considerations are weighed, a state can decide whether to move ahead with policies and initiatives that will promote bioenergy.

One final step before developing a bioenergy promotion plan is to identify some key opportunities for action. States have found success by examining their policy and regulatory situations for typical barriers (see Section 4.3.1); considering including bioenergy issues in the content of state planning processes to enable cohesive approaches with all stakeholders (see Section 4.3.2); and reviewing policy, regulatory, and financial opportunities for further action.

4.3.1 TYPICAL BARRIERS TO BIOENERGY DEVELOPMENT

After developing an understanding of the processes, products, and markets that are relevant to a state, the next step is to assess current policies that present barriers to bioenergy development and those that can remove barriers.

Because states have primary jurisdiction over many areas related to bioenergy, including electricity generation, agricultural development, and land use, state policies are particularly important in advancing or impeding bioenergy. The key to successful advancement is a policy environment that is flexible enough to support diverse and changing utilization of different biomass resources and conversion technologies, and that can adapt as the industry grows, markets change, and technology advances.

Policy areas that can impact the use of bioenergy include regulatory requirements and market-based incentives. Policies that remove barriers to bioenergy development can include favorable utility rate structures, interconnection standards, state RPS, public benefits funds, and financial incentives.

Policy Barriers to Biopower/Bioheat

Some policies create barriers to biopower development, such as unfavorable utility rate structures, lack of interconnection standards, and difficulties securing environmental permits. Listed below are some key policy barriers to biopower development and ways that states have overcome them to enable a healthy market for biopower:

- **Utility Rate Structures**. Unfavorable utility rate structures have perennially been a barrier to increased deployment of renewable energy technologies, including those that use bioenergy. Unless carefully monitored to encourage development of distributed generation (DG) bioenergy resources, rate structures can increase the cost of DG (with biomass or other fuels) or completely disallow connection to the electrical grid.

  - ***Decoupling or Lost Revenue Adjustment Mechanisms***. Traditional electric and gas utility ratemaking mechanisms unintentionally include financial disincentives for utilities to support energy efficiency and DG. This misalignment can be remedied through “lost revenue” adjustment mechanisms (LRAMs) or mechanisms that “decouple” utility revenues from sales.

    LRAMs allow a utility to directly recoup the lost revenue associated with not selling additional units of energy because of the success of energy efficiency or DG programs in reducing electricity consumption.

The amount of lost revenue is typically estimated by multiplying the fixed portion of the utility's prices by the energy savings from energy efficiency programs or the energy generated from DG. The lost revenue is then directly returned to the utility.

- ***Revised Standby Rate Structures***. Facilities that use bioenergy usually need to contract with the utility for standby power when the biopower system is unavailable due to equipment failure, during maintenance, or in other planned outages. Electric utilities often assess standby charges on on-site generation to cover the additional costs they incur as they continue to provide adequate generating, transmission, or distribution capacity (depending on the structure of the utility) to supply on-site generators when requested (sometimes on short notice). The utility's concern is that the facility will require power when electricity is scarce or at a premium cost, and that it must be prepared to serve load during such extreme conditions.

  The probability that any one generator will require standby service at the exact peak demand period is low, and the probability that all interconnected small-scale DG will need it at the same time is even lower. Consequently, some states are exploring alternatives to standby rates that may more accurately reflect these conditions. These states are looking for ways to account for the normal diversity within a load class and consider the probability that the demand for standby service will coincide with peak (high-cost) hours versus the benefits that renewables provide to the system.

- ***Exit Fee Exemptions.*** When facilities reduce or end their use of electricity from the grid, they reduce the utility's revenues that cover fixed costs on the system. The remaining customers may eventually bear these costs. This can be a problem if a large customer leaves a small electric system. Exit (or stranded asset recovery) fees are typically used only in states that have restructured their electric utilities.

  To avoid potential rate increases due to load loss, utilities sometimes assess exit fees on departing load to keep the utility whole without shifting the responsibility for those costs to the remaining customers. States can exempt renewable projects from these exit fees to recognize the economic value of the projects, including their grid congestion relief and reliability enhancement benefits.

- **Lack of Interconnection Standards for Clean Distributed Generation**. The absence of standard interconnection rules, or uniform procedures and technical requirements for connecting DG systems to the electric utility's grid, can make it difficult, if not impossible, for DG systems to connect to the grid. This barrier can hinder biomass CHP in particular.

  - ***Standardized Interconnection Rules and Net Metering***. A lack of interconnection standards can make it difficult, if not impossible, for renewable energy DG systems, including those using biopower, to connect to the electric grid. Once established, however, these statewide standards reduce uncertainty and delays that bioenergy systems can encounter when connecting to the grid.

    Standard interconnection rules establish uniform processes and technical requirements that apply to utilities within a state; in some states, municipally owned systems or electric cooperatives may be exempt from rules approved by state regulators. Standard interconnection rules typically address the application process and technical interconnection requirements for small DG projects of a specified type and size.

    Net metering provisions are a subset of interconnection standards for small-scale projects. When DG output exceeds the site's electrical needs, the utility can pay the customer for excess power supplied to the grid or have the net surplus carry over to the next month's bill. Some states allow the surplus account to be reset periodically, meaning that customers might provide some generation to the utility for free. Net metering provisions streamline interconnection standards but are often limited to specified sizes and types of technologies, as well as fuel types.

    Several groups are actively working to provide information about and/or follow and facilitate development of improved net metering standards. These include:

    - *Database of State Incentives for Renewable Energy*, which includes a summary table and summary database on interconnection standards. ***www.dsireusa.org/*** (click on Summary Tables, and then Rules, Regulations, and Policies [Renewable Energy]).
    - The Interstate Renewable Energy Council, which publishes a newsletter, "Connecting to the Grid." ***www.irecusa.org/index.php***
    - EPA's *Clean Energy-Environment Guide to Action* provides information about interconnection and

net metering benefits, design elements, interaction with state and federal programs, implementation and evaluation, and case studies. *www.epa.gov/cleanenergy/energy-programs/state-and-local/state-best-practices.html*

- **Environmental Permitting**. Major new industrial facilities that produce and/or use bioenergy must obtain a number of different permits from state agencies including construction permits from state environmental officials to ensure that plans meet environmental standards; operating permits for air emissions during operation; and stormwater and/or wastewater discharge permits. New bioenergy facilities and projects are subject to federal and state emission standards for combustion sources and to air permitting requirements for new sources.

The federal standards that could apply to biomass combustion units are the New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants for boilers, gas turbines, and internal combustion engines. The process of obtaining multiple permits from different entities within state agencies—particularly for newer technologies/processes—can add significant uncertainty to construction timing and the cost of emission controls that will be required.

4.3.2 BIOENERGY AND STATE PLANNING

One way to facilitate creation of a policy environment conducive to bioenergy is to include bioenergy considerations during comprehensive state energy, environmental, or climate change planning.

Energy Plans

Energy planning involves a strategic effort to develop energy-related goals and objectives and formulate related policies and programs. As the nexus for a variety of state concerns, energy planning can serve as an umbrella mechanism for simultaneously addressing energy, environmental, economic, and other issues. Energy planning can be undertaken at both state and regional levels.

Many states have used their energy plans to support development and use of cost-effective clean energy, including bioenergy, and to help address multiple challenges, including energy supply and reliability (e.g., concerns with availability, independence, and security), energy prices, air quality and public health, and job development. States can also develop strategies completely devoted to bioenergy. For example, in 2006 California released the *Bioenergy Action Plan for California*, which provides specific actions and timelines to advance bioenergy in the state (Bioenergy Interagency Working Group, 2006).

Environmental Plans

Opportunities also exist to consider biomass in environmental planning. States facing nonattainment under NAAQS are required to develop and submit SIPs. EPA provides guidance to state and local governments on quantifying and including emission reductions from energy efficiency and renewable energy measures in SIPs. (A guidance document is available at *www.epa.gov/ttn/oarpg/t1/memoranda/ereseerem_gd.pdf*.)

Climate Change Plans

In addition, many states have completed climate action plans to encourage clean energy as a way to decrease carbon emissions. Given that biomass is "carbon-neutral," it does and can play an important role in state climate plans.

Example

BIOMASS AND THE MASSACHUSETTS CLIMATE PROTECTION PLAN

In 2004, Massachusetts published the Massachusetts Climate Protection Plan as an initial step in a coordinated effort to reduce GHG emissions and improve energy efficiency throughout the state. The plan entails a set of near-term actions, including development of a comprehensive state biomass policy to ensure:

- Biomass material is grown and harvested in an environmentally sound manner.
- Strong air quality standards are maintained.
- Low emissions and advanced biomass conversion technologies, as defined by the Massachusetts RPS, are utilized for both heat and electricity.
- State agencies provide incentives and work together to implement pilot biomass projects in various sectors (public and private applications) in rural regions.

For more information, see *masstech.org/renewableenergy/public_policy/DG/resources/2004_MA_Climate_Protection_Plan.pdf*.

4.3.3 REVIEW POLICY OPTIONS

Whether a state explores bioenergy through a comprehensive energy strategy, a SIP, or a climate change action plan, several policies should be developed simultaneously to enhance the likelihood that biomass usage increases, as discussed in Chapter 5.

4.4 RESOURCES FOR DETAILED INFORMATION

Resource	Description	URL
Bioenergy		
Biomass Resource Assessment Tool, U.S. EPA and NREL.	Online mapping tool that takes various biomass resource datasets and maps them, allowing user queries and analysis. For example, users can select a point on the map and determine the quantity of feedstock within a certain radius, and the quantity of energy that could potentially be produced from that biomass.	*http://rpm.nrel.gov/biopower/biopower/launch*
Coordinated Resource Offering Protocol (CROP) Evaluations, U.S. Forest Service and Bureau of Land Management.	Provides the results of ten CROP evaluations that have been conducted for over 30 million acres of public forestlands potentially vulnerable to wildfires. The evaluations contain detailed resource-offering maps that illustrate the growing fuel load problem within major forest systems and quantify the biomass available for removal within five years.	*www.forestsandrangelands.gov/Woody_Biomass/supply/CROP/index.shtml*
USFS Forest Inventory Data Online (FIDO).	Provides access to the National Forest Inventory and Analysis databases. It can be used to generate tables and maps of forest statistics (including tree biomass) by running standard reports for specific states or counties and survey year, or customized reports based on criteria selected by the user.	*http://fiatools.fs.fed.us/fido/index.html*
Biomass Feedstocks, U.S. DOE.	U.S. DOE Biomass Program Web site	*www1.eere.energy.gov/biomass/biomass_feedstocks.html*
Dynamic Maps, GIS Data, and Analysis Tools, NREL.	Provides county-level biomass resource maps. The feedstock categories include crop residues, forest residues, primary mill residues, secondary mill residues, urban wood waste, methane emissions from landfills, methane emissions from manure management, methane emissions from wastewater treatment plants, and dedicated energy crops. The maps are derived from data contained in a report, Geographic Perspective on the Current Biomass Resource Availability in the United States (described below). Note that these maps present technical biomass resource data. The economic biomass resource availability will most likely be somewhat less than what is presented in the maps.	*www.nrel.gov/gis/biomass.html*
Geographic Perspective on the Current Biomass Resource Availability in the United States, NREL, 2006.	Provides the basis for the maps and data presented in NREL's Dynamic Maps, GIS Data, and Analysis Tools Web site described above. The report provides a geographic analysis of biomass resource potential at the county level, and can give state officials a sense of the major biomass resources available within their state and their technical potential relative to other states.	*www.nrel.gov/docs/fy06osti/39181.pdf*
State Assessment for Biomass Resources (SABRE), U.S. DOE.	Provides detailed information on biomass resources and utilization throughout the United States. It features state-specific information on conventional fuel and biofuel use, ethanol and biodiesel stations and production plants, and biofuel production capacities. In addition, it offers state-by-state snapshots of available feedstocks, data on potential production capacities, and projections on the future use of biofuels.	*www.afdc.energy.gov/afdc/sabre/index.php*

Resource	Description	URL
State Woody Biomass Utilization Policies, University of Minnesota, Department of Forest Resources, Staff Paper 199. Becker, D.R., and C. Lee. 2008.	Documents information on state policies to facilitate comparison of the types of approaches used in certain areas, policy structures and incentives employed, program administration, and relationships to complementary local and federal actions.	*www.forestry.umn.edu/publications/staffpapers/Staffpaper199.pdf*
Biopower/Bioheat		
Initial Market Assessment for Small-Scale Biomass-Based CHP. National Renewable Energy Laboratory, NREL, January 2008.	Examines the energy generation market opportunities for biomass CHP applications smaller than 20 MW. Using relevant literature and expert opinion, the paper provides an overview of the benefits of and challenges for biomass CHP in terms of policy and economic drivers, and identifies primary characteristics of potential markets.	*www.nrel.gov/docs/fy08osti/42046.pdf*
Green Power Marketing in the United States: A Status Report, NREL.	Documents green power marketing activities and trends in voluntary markets in the United States.	*http://apps3.eere.energy.gov/greenpower/resources/pdfs/38994.pdf*
U.S. EPA's Landfill Methane Outreach Program (LMOP).	Promotes the use of landfill gas as a renewable, green energy source. Its Web site contains general information, tools, and links to databases containing specific landfill data.	*www.epa.gov/lmop/*
U.S. EPA's Landfill Methane Outreach Program (LMOP) Landfill Database.	Provides a nationwide listing of operational and under-construction LFG energy projects; candidate municipal solid waste landfills having LFG energy potential; and information on additional landfills that could represent LFG energy opportunities. The database can be accessed as a series of downloadable Excel spreadsheets, which are updated and posted to the Web site each month. The information contained in the LMOP database is compiled from a variety of sources, including annual voluntary submissions by LMOP partners and industry publications.	*www.epa.gov/lmop/proj/index.htm*
Landfill Gas Energy Project Development Handbook, U.S. EPA Landfill Methane Outreach Program.	Provides landfill gas energy project development guidance, with individual chapters on the basics of landfill gas energy, gas modeling, technology options, economic analysis and financing, contract and permitting considerations, and selection of project partners.	*www.epa.gov/lmop/res/handbook.htm*
Market Opportunities for Biogas Recovery Systems, U.S. EPA AgStar.	Assesses the market potential for biogas energy projects at swine and dairy farms in the United States. For the top ten swine and dairy states, the guide characterizes the sizes and types of operations where biogas projects are technically feasible, along with estimates of potential methane production, electricity generation, and greenhouse gas emission reductions.	*www.epa.gov/agstar/pdf/biogas%20recovery%20systems_screenres.pdf*
U.S. EPA's Combined Heat and Power (CHP) Partnership.	Promotes the use of biomass-fueled CHP and the use of biogas at wastewater treatment facilities.	*www.epa.gov/chp*

Resource	Description	URL
Biofuels/Bioproducts		
State Assessment for Biomass Resources, U.S. DOE.	Provides detailed information on biomass resources and utilization throughout the United States. It features state-specific information on conventional fuel and biofuel use, ethanol and biodiesel stations and production plants, and biofuel production capacities. It offers state-by-state snapshots of available feedstocks, data on potential production capacities, and projections on the future use of biofuels. The site is particularly useful for states interested in evaluating resource potential for producing biofuels.	*www.afdc.energy.gov/afdc/sabre/index.php*
Environmental Laws Applicable to Construction and Operation of Ethanol Plants, U.S. EPA.	This compliance assistance manual, issued by EPA Region 7, serves as a road map of information on federal environmental programs and federal and state agency roles applicable to the construction, modification, and operation of ethanol plants.	*www.epa.gov/region07/priorities/agriculture/ethanol_plants_manual.pdf*
Environmental Laws Applicable to Construction and Operation of Biodiesel Production Facilities, U.S. EPA.	This compliance assistance manual, issued by EPA Region 7, serves as a road map of information on federal environmental programs and federal, state, and local agency roles applicable to designing, building, and operating biodiesel manufacturing facilities.	*www.epa.gov/region07/priorities/agriculture/biodiesel_manual.pdf*
State Examples		
California	***An Assessment of Biomass Resources in California***, 2007, provides an updated biomass inventory for the state along with an assessment of potential growth in biomass resources and power generation that could help to satisfy the state renewable portfolio standard (RPS).	*http://biomass.ucdavis.edu/materials/reports%20and%20publications/2008/CBC_Biomass_Resources_2007.pdf*
Georgia	***Biomass Wood Resource Assessment on a County-by-County Basis for the State of Georgia*** provides a biomass wood resource assessment on a county-level basis for Georgia.	*www.gfc.state.ga.us/ForestMarketing/documents/BiomassWRACountybyCountyGA05.pdf*
Hawaii	***Biomass and Bioenergy Resource Assessment: State of Hawaii*** provides an assessment of current and potential biomass and bioenergy resources for the state. Includes animal wastes, forest products residues, agricultural residues, and urban wastes.	*www.hawaii.gov/dbedt/info/energy/publications/biomass-assessment.pdf*
Mississippi	***Mississippi Institute for Forest Inventory Dynamic Report Generator*** provides a continuous, statewide forest resource inventory necessary for the sustainable forest-based economy. The inventory information is derived from sampling estimation techniques with a presumed precision of +/- 15% sampling error with 95 percent confidence.	*www.mifi.ms.gov/*
South Carolina	***Potential for Biomass Energy Development in South Carolina*** quantifies the amount of forestry and agricultural biomass available for energy production on a sustainable basis in South Carolina. Also includes an analysis of the economic impacts of transferring out-of-state costs for coal to in-state family forest landowners and biomass processors.	*www.scbiomass.org/Publications/Potential%20Biomass%20Energy%20in%20SC.pdf*

Resource	Description	URL
Oregon	***Biomass Energy and Biofuels from Oregon's Forests*** assesses the statewide potential for production of electricity and biofuels from woody biomass, including the available wood supply and the environmental, energy, forest health, and economic effects. Reviews and summarizes efforts underway to promote electric energy and biofuels from woody biomass, and identifies gaps in existing efforts. Assesses constraints and challenges to the development of biomass energy and biofuels from Oregon forests, including economic, environmental, legal, policy, infrastructure, and other barriers and develops recommendations on how to overcome these barriers.	*www.oregonforests.org/assets/uploads/Biomass_Full_Report.pdf*
Northeastern states (CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT)	***Securing a Place for Biomass in the Northeast United States: A Review of Renewable Energy and Related Policies*** provides a biomass feedstock assessment for northeastern states.	*www.nrbp.org/pdfs/nrbp_final_report.pdf*
Western states (WA, OR, ID, MT, WY, CO, NM, AZ, UT, NV, CA, TX, OK, ND, SD, NE, KS, AK, HI)	The ***Western Bioenergy Assessment*** includes a series of technical reports produced for the Western Governors' Association. These reports extensively evaluate biomass resources in the western states, biofuel conversion technologies, spatial analysis and supply curve development, and deployment scenarios and potential policy interactions.	*www.westgov.org/wga/initiatives/transfuels/index.html*
Western states (WA, OR, ID, MT, WY, CO, NM, AZ, UT, NV, CA, TX, OK, ND, SD, NE, KS, AK, HI)	The ***Western Governors' Association Transportation Fuels for the Future Initiative*** provides seven working group reports and a final report analyzing the potential for the development of alternative fuels and vehicle fuel efficiency in the West.	*www.westgov.org/wga/initiatives/transfuels/index.html*
Western states (WA, OR, ID, MT, WY, CO, NM, AZ, UT, NV, CA, TX, ND, SD, NE, KS, AK, HI)	***Biomass Task Force Report*** focuses on the use of biomass resources for the production of electricity as part of an overall effort of the Western Governors' Association to increase the contribution of clean and renewable energy in the region.	*www.westgov.org/wga/initiatives/cdeac/Biomass-full.pdf*

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