

Biomass Energy Data Book

Edition 4



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

 **OAK
RIDGE**
National Laboratory

USEFUL WEB SITES

GOVERNMENT LINKS

U.S. DEPARTMENT OF AGRICULTURE

Agricultural Research Service

Forest Service

National Agricultural Library

National Agricultural Statistics Service

U.S. DEPARTMENT OF ENERGY

Energy Efficiency and Renewable Energy

Biomass Program

Bioenergy Knowledge Discovery Framework

Alternative Fuels Data Center

Clean Cities

Fuel Economy

Biomass Energy Data Book

Buildings Energy Data Book

Power Technologies Data Book

Transportation Energy Data Book

Energy Information Administration

IDAHO NATIONAL LABORATORY

NATIONAL RENEWABLE ENERGY LABORATORY

OAK RIDGE NATIONAL LABORATORY

Bioenergy Feedstock Information

Center for Transportation Analysis

PACIFIC NORTHWEST NATIONAL LABORATORY

USA.GOV

FEDERAL GOVERNMENT – FEDSTATS

U.S. BUREAU OF LABOR STATISTICS

U.S. CENSUS BUREAU

U.S. DEPARTMENT OF COMMERCE

Bureau of Economic Analysis

U.S. ENVIRONMENTAL PROTECTION AGENCY

www.usda.gov

www.ars.usda.gov

www.fs.fed.us

www.nal.usda.gov

www.nass.usda.gov

www.energy.gov

www.eere.energy.gov

www.eere.energy.gov/biomass

bioenergykdf.net

www.eere.energy.gov/afdc

www.eere.energy.gov/cleancities

www.fueleconomy.gov

cta.ornl.gov/bedb

www.btscoredatabook.net

www.nrel.gov/analysis/power_databook

cta.ornl.gov/data

www.eia.doe.gov

www.inl.gov

www.nrel.gov

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bioenergy.ornl.gov

cta.ornl.gov

www.pnl.gov

www.usa.gov

www.fedstats.gov

www.bls.gov

www.census.gov

www.commerce.gov

www.bea.gov

www.epa.gov

NON GOVERNMENT LINKS

American Corn Growers Association

American Soybean Association

National Biodiesel Board

National Oilseed Processors Association

National Ethanol Vehicle Coalition

Pellet Fuels Institute

Short Rotation Woody Crops Operations Working Group

www.acga.org

www.soygrowers.com

www.biodiesel.org

www.nopa.org

www.e85fuel.com

pelletheat.org

www.woodycrops.org

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**BIOMASS ENERGY DATA BOOK:
EDITION 4**

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Users of the *Biomass Energy Data Book* are encouraged to send comments on errors, omissions, emphases, and organization of this report to Ms. Stacy Davis, Oak Ridge National Laboratory. The DOE sponsor for this project is also listed below.

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The *Biomass Energy Data Book*
can be found on the Web at:
cta.ornl.gov/bedb

ACRONYMS

AEO	Annual Energy Outlook
ARS	Agricultural Research Service, USDA
ASABE	American Society of Agricultural and Biological Engineers
ASTM	American Society for Testing and Materials
Btu	British thermal unit
CES	Cooperative Extension Service
CO₂	Carbon dioxide
CRP	Conservation Reserve Program
d.b.h.	Diameter at breast height
DOE	Department of Energy
EERE	Office of Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EPAct	Energy Policy Act
ERS	Economic Research Service
EtoH	Ethanol
FTE	Fuel Treatment Evaluator
FY	Fiscal Year
GAO	United States Government Accountability Office
GHG	Greenhouse Gas
GPRA	Government Performance Results Act
GW	Gigawatt
IEA	International Energy Agency
LFG	Landfill Gas
MJ	Megajoule
MMBtu	One Million British thermal units
MW	Megawatt
MSW	Municipal Solid Waste
NASS	National Agricultural Statistics Service
NEMS	National Energy Modeling System
NOAA	National Oceanic & Atmospheric Administration
NREL	National Renewable Energy Laboratory
NRCS	Natural Resources Conservation Service
ORNL	Oak Ridge National Laboratory
PNNL	Pacific Northwest National Laboratory
PPA	Power Purchase Agreement
RPS	Renewable Portfolio Standard
SEO	State Energy Office
SRIC	Short Rotation Intensive Culture
SRWC	Short Rotation Woody Crops
SSEB	Southern States Energy Board
TBD	To Be Determined
TVA	Tennessee Valley Authority
USDA	United States Department of Agriculture
USFS	United States Forest Service

PREFACE

The Department of Energy, through the Biomass Program in the Office of Energy Efficiency and Renewable Energy, has contracted with Oak Ridge National Laboratory to prepare this Biomass Energy Data Book. The purpose of this data book is to draw together, under one cover, biomass data from diverse sources to produce a comprehensive document that supports anyone with an interest or stake in the biomass industry. Given the increasing demand for energy, policymakers and analysts need to be well-informed about current biomass energy production activity and the potential contribution biomass resources and technologies can make toward meeting the nation's energy demands. This is the third edition of the Biomass Energy Data Book and it is only available online in electronic format. Because there are many diverse online sources of biomass information, the Data Book provides links to many of those valuable information sources. Biomass energy technologies used in the United States include an extremely diverse array of technologies - from wood or pellet stoves used in homes to large, sophisticated biorefineries producing multiple products. For some types of biomass energy production, there are no annual inventories or surveys on which to base statistical data. For some technology areas there are industry advocacy groups that track and publish annual statistics on energy production capacity, though not necessarily actual production or utilization. The Department of Energy's Energy Information Administration (EIA) produces annual estimates of biomass energy utilization and those estimates are included in this data book. Information from industry groups are also provided to give additional detail. An effort has been made to identify the best sources of information on capacity, production and utilization of most of the types of biomass energy currently being produced in this country. It is certain, however, that not all biomass energy contributions have been identified. With the rapid expansion in biomass technologies that is occurring, bioenergy production information may not yet be available, or may be proprietary.

It is even more difficult to track the diverse array of biomass resources being used as feedstocks for biomass energy production. Since most of the biomass resources currently being used for energy or bioproducts are residuals from industrial, agricultural or forestry activities, there is no way to systematically inventory biomass feedstock collection and use and report it in standard units. All biomass resource availability and utilization information available in the literature are estimates, not inventories of actual collection and utilization. Biomass utilization information is derived from biomass energy production data, but relies on assumptions about energy content and conversion efficiencies for each biomass type and conversion technology. Biomass availability data relies on understanding how much of a given biomass type (e.g., corn grain) is produced, alternate demands for that biomass type, economic profitability associated with each of those alternate demands, environmental impacts of collection of the biomass, and other factors such as incentives. This book presents some of the information needed for deriving those estimates, as well as providing biomass resource estimates that have been estimated by either ORNL staff or other scientists. In all cases it should be recognized that estimates are not precise and different assumptions will change the results.

ABSTRACT

The *Biomass Energy Data Book* is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Biomass Program in the Energy Efficiency and Renewable Energy (EERE) program of the Department of Energy (DOE). Designed for use as a convenient reference, the book represents an assembly and display of statistics and information that characterize the biomass industry, from the production of biomass feedstocks to their end use, including discussions on sustainability.

This is the fourth edition of the Biomass Energy Data Book which is only available online in electronic format. There are five main sections to this book. The first section is an introduction which provides an overview of biomass resources and consumption. Following the introduction to biomass, is a section on biofuels which covers ethanol, biodiesel and bio-oil. The biopower section focuses on the use of biomass for electrical power generation and heating. The fourth section is on the developing area of biorefineries, and the fifth section covers feedstocks that are produced and used in the biomass industry. The sources used represent the latest available data. There are also four appendices which include frequently needed conversion factors, a table of selected biomass feedstock characteristics, and discussions on sustainability. A glossary of terms and a list of acronyms are also included for the reader's convenience.