

## 1.0 INTRODUCTION

The U.S. Department of Energy (DOE) is proposing to provide partial funding for (1) the design and construction of a biomass (switchgrass [*Panicum virgatum*]) storage, handling, and conveying system into the boiler at the Ottumwa Generating Station (OGS) near Chillicothe, Iowa; (2) operational testing of switchgrass as a biomass co-fire feedstock at OGS; and (3) ancillary activities related to growing, harvesting, storing, and transporting switchgrass in areas of the Rathbun Lake watershed (Figure 1). Chillicothe is in Wapello County on the south side of the Des Moines River, approximately 16 kilometers (10 miles) northwest of Ottumwa, Iowa, and 130 kilometers (80 miles) southeast of Des Moines.

### SWITCHGRASS

Switchgrass is a warm-weather, native Iowa grass that grows well on marginal land. It has been identified and extensively studied for its potential as a biomass energy crop, especially its potential for use as co-fire feedstock in coal-burning plants. In this environmental assessment (EA), the term “co-fire” refers to the burning of switchgrass in the OGS boiler in conjunction with coal, with the goal of reducing the amount of coal used and reducing emissions of some objectionable air pollutants associated with coal combustion.

The OGS is a 725-megawatt (MW) maximum output, low-sulfur, pulverized coal-burning plant jointly owned by several Iowa utilities and operated by Alliant Energy. The plant is located about 1.6 kilometers (1 mile) northwest of Chillicothe, Iowa, on the Des Moines River (Figure 2).

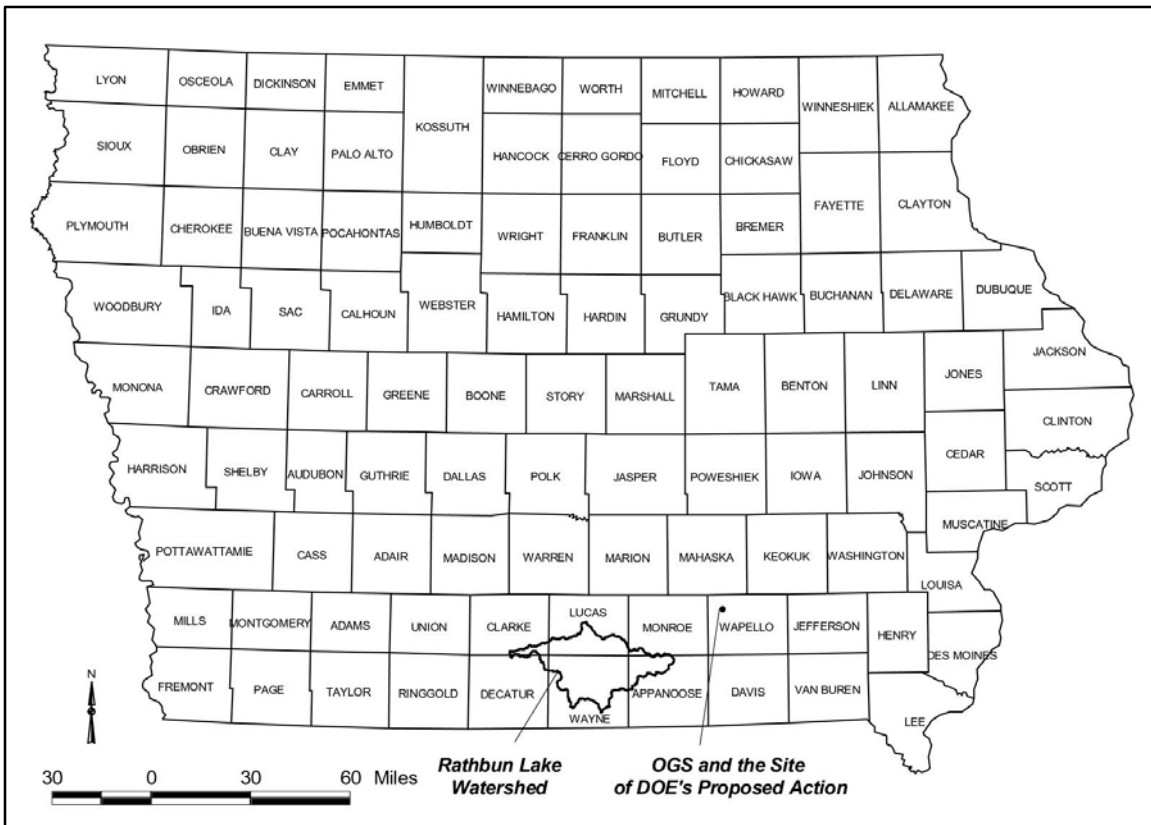
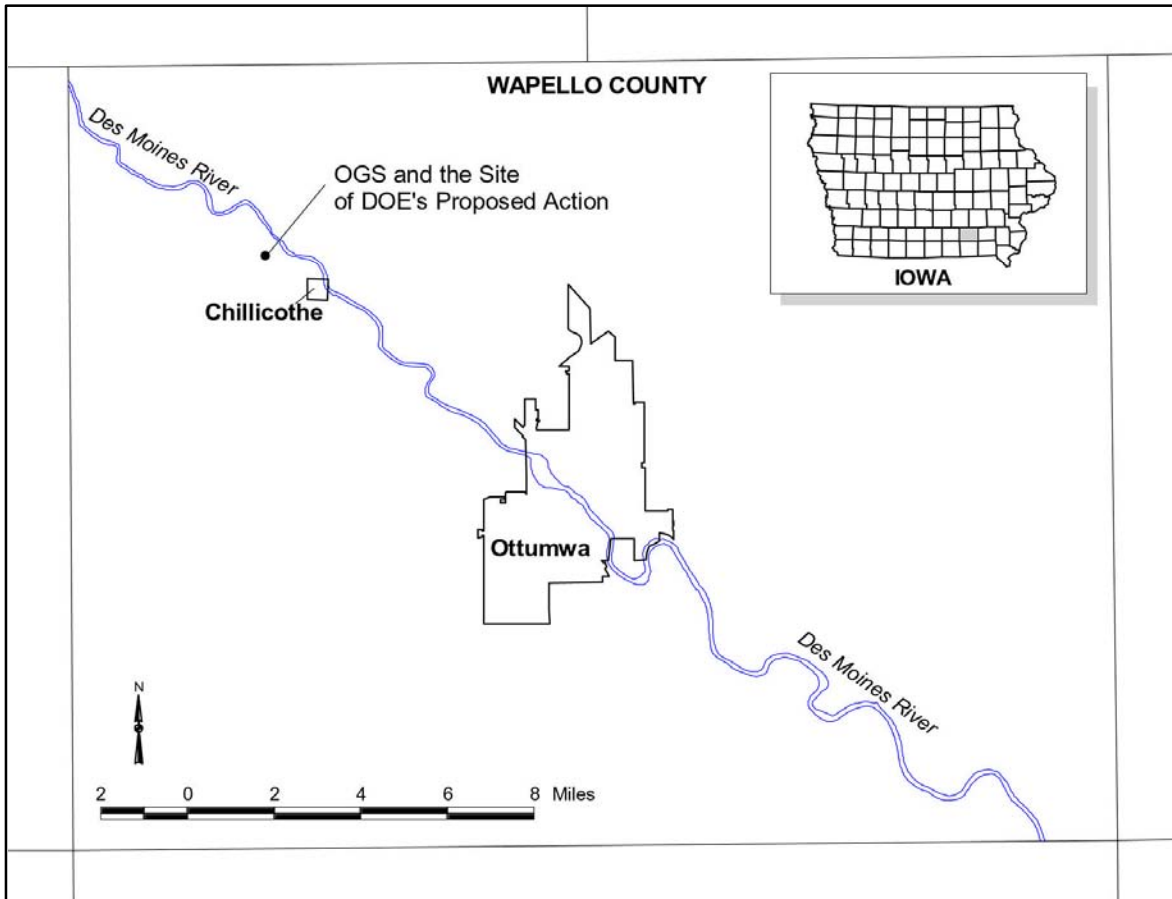


Figure 1. Location of the Rathbun Lake Watershed and the OGS



**Figure 2. Location of the OGS and the Proposed DOE Action**

The following three-phase switchgrass co-fire test campaign has been planned and partially implemented at OGS:

- During Phase 1, which occurred from November 2000 through January 2001, Alliant Energy conducted Co-fire Test 1 at OGS.
- Phase 2 testing, the Proposed Action, would consist of two additional co-fire tests. Co-fire Test 2, which would utilize some residual equipment from Co-fire Test 1 and also test some new equipment, is currently planned for September/October 2003. It would be designed to test and demonstrate the engineering and environmental feasibility of co-firing up to 11.3 tonnes (12.5 tons) of switchgrass per hour and would burn a maximum of 5,440 tonnes (6,000 tons) of switchgrass. Co-fire Test 3, which is tentatively planned for winter 2004/2005, would test the long-term (approximately 2,000 hours) sustainability of processing 11.3 tonnes (12.5 tons) per hour. Co-fire Test 3 would be conducted using a proposed new process building and storage barn that would be constructed at the OGS as part of the Proposed Action.
- Phase 3, commercial operations, may occur if Phase 2 indicated that commercial operations were technically, environmentally, and economically feasible. Continuous, full-scale commercial operations could process up to 23 tonnes (25 tons) of switchgrass per hour, generate 35 MW per year of OGS's annual output, and replace 5 percent of the coal burned at

OGS with switchgrass. Chariton Valley Resource Conservation and Development Inc. (Chariton Valley RC&D), a rural-development-oriented, non-profit corporation (Chariton Valley RC&D 2003a) and Alliant Energy would implement Phase 3 at their discretion after the completion of the Phase 2 co-fire tests.

DOE's Proposed Action would support only Phase 2 testing; that is, Co-fire Tests 2 and 3. DOE has no plans to provide financial support for the commercial operations that would be performed during Phase 3. The new construction that DOE proposes to partially fund would include a new switchgrass processing facility and equipment and a new storage barn that would be used for Co-fire Test 3.

This environmental assessment (EA) evaluates the environmental impacts that could result from the Proposed Action. It also evaluates the impacts that could occur if DOE decided not to partially fund the Proposed Action (the No Action Alternative). No other action alternatives are analyzed because (1) no generating plants other than OGS have the installed infrastructure and operating experience necessary to conduct Phase 2 co-fire testing, and (2) the Rathbun Lake watershed is the only viable source of the supply of switchgrass necessary to conduct the testing at OGS.

This EA has been prepared under DOE's regulations and guidelines for compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C §§ 4321 *et seq.*). A draft version of this EA was distributed to interested members of the public and to Federal, state, and local agencies for review and comment prior to any final decisions by DOE on the Proposed Action.

### **1.1 The National Environmental Policy Act (NEPA) and Related Procedures**

NEPA, the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (40 CFR Parts 1500-1508), and DOE's implementing procedures for compliance with NEPA (10 CFR Part 1021) require that DOE, as a Federal agency:

- Assess the environmental impacts of its proposed actions
- Identify any adverse environmental effects that cannot be avoided should a proposed action be implemented
- Evaluate alternatives to the proposed action, including a no action alternative
- Describe the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity
- Characterize any irreversible and irretrievable commitments of resources that would be involved should the proposed action be implemented

These provisions must be addressed before a final decision is made to proceed with any proposed Federal action that could cause significant impacts to human health or the environment. This EA evaluates the potential individual and cumulative effects of the Proposed Action and the No Action Alternative on the physical, human, and natural environment. The EA is intended to (1) meet DOE's regulatory requirements under NEPA, and (2) provide DOE, the U.S. Department of Agriculture (USDA), the State of Iowa, and other agency decision-makers with the information they need to make informed decisions in connection with the proposed project.

### **1.2 Background**

**Biomass Energy.** In 1992, DOE determined that developing a sustainable biomass energy program in the United States was desirable for a number of reasons. Dedicated energy crops were cited as potential long-

term sources of renewable fuel that could contribute to domestic energy independence, assist in alleviating global climate warming by reducing greenhouse gas emissions, relieve overproduction in certain agricultural sectors, reduce water pollution from agricultural runoff, and increase rural income (DOE 1992). The Midwest, especially Iowa, has a high potential for biomass energy crop production. Switchgrass, a native Iowa grass, is particularly attractive as a biomass crop. Its cultivation results in less soil, pesticide, and fertilizer runoff than row crops such as corn or soybeans; it grows well on marginal land; and it sequesters significant amounts of carbon dioxide, a greenhouse gas, into the soil (Downing et al. 1993).

**Chariton Valley Biomass Project.** In 1995, formal efforts by DOE and the USDA to encourage the use of biomass as an energy source converged with the Biomass Power for Rural Development (BPRD) initiative. Under this initiative, the two agencies issued requests for proposals which sought to demonstrate and deploy integrated biomass systems that were both economically and environmentally viable and sustainable. This solicitation resulted in the funding of three projects, each of which included a utility partner and a coalition of local agricultural interests. One of these projects, the Chariton Valley Biomass Project (CVBP), emerged as promising in terms of (1) the level of public-private commitment to the effort, (2) the viability of the technical approach, and (3) the overall potential for success. The goal of the CVBP is to eventually use switchgrass as a fuel to replace a portion of the coal burned at OGS.

**BIOMASS AND ITS USE IN THE CO-FIRING PROCESS**

Plant biomass consists primarily of three materials: cellulose (50 percent), hemicellulose (25 percent), and lignin (25 percent). Geologically, coal is formed from lignin, and typically the lignin component of plant biomass has the same energy content as medium- to high-British thermal unit (BTU)-grade coal. However, when combusted, plant biomass can produce significantly lower concentrations of many of the most objectionable air pollutants associated with coal combustion, notably sulfur and nitrogen oxides. Examples of plant biomass include wood waste, agriculture crop residues, fast-growing grasses and trees, and the paper component of municipal solid waste. Biomass can be directly converted into fuels through processes such as gasification or ethanol production, or it can be used to supplement (co-fire) coal in coal-fired generating plants. The coal industry and many utilities are increasingly interested in using biomass to co-fire existing coal burning plants in order to reduce sulfur and nitrogen oxide air pollutants.

The CVBP is sponsored by Chariton Valley RC&D. The Chariton Valley RC&D/Alliant Energy partnership is assisted by the Energy Research Corporation; the Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation; the Iowa Department of Natural Resources (DNR); the Iowa Energy Center; the Iowa Farm Bureau Federation; Iowa State University; the Iowa State University Extension; Appanoose, Lucas, Monroe, and Wayne counties; John Deere Works; the Leopold Center for Sustainable Agriculture; the National Renewable Energy Laboratory (NREL); Prairie Lands Bio-Products Inc.; R.W. Beck; the USDA Farm Service Agency; the USDA Natural Resources Conservation Service; DOE; Oak Ridge National Laboratory; Vermeer Manufacturing Company; and Foster Wheeler, Inc.

Since 1998, the CVBP has made progress on several fronts, including (1) agricultural (identification of and research on acreage in southern Iowa that is best suited for potential conversion to switchgrass production as an energy crop); (2) permitting (identification of permitting and environmental issues that will need to be identified and resolved), and (3) engineering (demonstration that the existing OGS plant design and the modifications required for commercial switchgrass co-fire operations are compatible.)

**Ottumwa Generating Station.** Construction of the OGS began in 1976, and commercial operations began in 1981. Prior to the current switchgrass co-fire tests, coal was the only fuel burned at OGS. The plant receives all its coal from Wyoming via rail. Of the approximately 3.2 million tonnes (3.5 million tons) of coal that the facility receives annually, approximately 360,000 to 450,000 tonnes (400,000 to

500,000 tons) have been resold to local industry and transported offsite via trucks (approximately 16,000 to 20,000 trucks per year). However, some of this resale activity is currently being changed from truck to rail shipments. Fly ash is the main product left after the coal is burned. It has significant commercial value as a component used in cement manufacturing and as a construction fill material. Fly ash is stored onsite in silos until it is sold, usually during the construction season—March through October. Some fly-ash is also processed onsite into C-Stone®, an artificial

#### **WHY SWITCHGRASS?**

DOE and Oak Ridge National Laboratory's Biofuels Feedstock Development Program have identified switchgrass, a warm-season grass, as a model biomass energy crop. Favorable features of switchgrass include its native origin in North America, genetic diversity, adaptation to a wide range of climates and soil types, effectiveness in carbon sequestration and soil improvement, and value for other uses such as forage for livestock and wildlife habitat. In terms of characteristics related to its quality as a biomass fuel, switchgrass has ash and alkali contents favorable for use in coal-fired combustion boilers, sulfur and nitrogen contents that could result in lower sulfur dioxide and nitrogen oxide emissions than coal, an energy content comparable to that of wood, low moisture content, and the capability of producing high biomass yields with relatively low fertilizer and herbicide inputs.

aggregate used as a paving and foundation material. Coal, fly ash, and C-Stone®, are all shipped offsite via truck. Currently, outbound coal and fly ash shipments comprise a majority of the truck traffic at OGS.

**Phase 1 Co-fire Tests.** From November 2000 through January 2001, Alliant Energy conducted Phase 1 of a planned three-phase switchgrass co-fire test campaign at OGS. During Phase 1, Alliant Energy co-fired approximately 1,151 tonnes (1,269 tons) of switchgrass at rates up to 15.2 tonnes (16.8 tons) per hour. The Phase 1 co-fire testing included facility modifications, combustion tests, and post-test analyses. Stack testing for emissions was conducted during co-firing and when burning coal only. Fuel and ash samples, boiler performance information, and emissions data were collected and analyzed. Phase 1 testing was completed without environmental incident, personnel injuries, or loss of power output from OGS. In general, the results of the Phase 1 testing were as expected; however, some of the emission test results were inconclusive. A report on the Phase 1 testing (NREL 2002) provides details on the testing process, equipment performance, and test results.

### **1.3 Scoping**

During February 2003, DOE sent scoping letters to the U.S Fish and Wildlife Service (FWS), the State Historic Preservation Officer (SHPO), and the Iowa DNR describing the Proposed Action and asking for their assistance in identifying potential issues that should be evaluated in this EA. DOE also sent scoping letters to various other potentially interested organizations and agencies and ran a 3-day notice in the *Ottumwa Courier* to inform the public of the Proposed Action and to solicit public comments. Appendix A contains copies of the scoping letters. Appendix B contains the responses DOE received (DOE did not receive any public comments in response to the *Ottumwa Courier* notice). Appendix C contains the full scoping letter distribution list.

### **1.4 Purpose and Need**

By testing various aspects of the technical, environmental, and economic feasibility of intermediate-scale biomass co-fire operations at OGS, the Proposed Action would support a collaborative effort by DOE, Alliant Energy, and Chariton Valley RC&D. Each of these three partners has distinct, although related, needs that would be met by the Proposed Action.

**U.S. Department of Energy.** It is a mission of DOE to assist in advancing the development and commercialization of energy efficiency and renewable energy technologies such as biomass energy (reference the Energy Policy Act of 1992). Pursuant to this mission, DOE has a need to demonstrate

renewable sources of electricity that would be commercially feasible in the United States and that would reduce fossil fuel dependence and air pollutant emissions. The Proposed Action would address this need by partially funding the construction of an intermediate-scale switchgrass processing and storage facility and related activities to test the viability of a promising biomass energy crop.

**Alliant Energy.** Before Alliant Energy would proceed with plans and investments for commercial switchgrass operations, it needs to demonstrate that full-scale operations can be achieved, sustained, and verified in a manner that allows it to remain in compliance with all existing permitted emission levels. Alliant Energy further needs to ensure that (1) sustained co-fire operations are technically feasible, (2) such operations would not result in any degradation of the plant's boiler or operating parameters, and (3) OGS fly ash would continue to be marketable. The Proposed Action would also support Alliant Energy's need to confirm whether switchgrass co-fire operations would qualify it for credits under a recently enacted Iowa law (Iowa Code Section 476.41 et seq. (2001) [House File 577]) that requires all electric utilities operating in the state, including those not regulated by the Iowa Utilities Board (IUB), to offer green power options to their customers, beginning January 1, 2004.

**Chariton Valley Resource Conservation and Development Inc.** The Proposed Action responds to Chariton Valley RC&D's need to further assess the adequacy of the existing regional infrastructure to sustain switchgrass harvesting, transportation, storage, and sales, and to assess further the overall economic and agricultural viability of switchgrass as an energy crop. Information gained through these further assessments would be used as a basis for gauging the technical and environmental feasibility, costs, and benefits of using switchgrass as a fuel to replace a portion of the coal burned at OGS. Upon approval of the Proposed Action, DOE would provide a portion of the necessary funding to the Chariton Valley RC&D, which in turn would secure the balance of the necessary funding and subsequently coordinate with Alliant Energy and engineering firms to implement the Proposed Action.

## **1.5 Organization of the EA**

This EA is structured in accordance with the standards set forth in DOE's NEPA implementing regulations and guidelines. Section 2.0 describes the Proposed Action and the No Action Alternative in sufficient detail to give the reader an understanding of the actions that would take place during construction, operation, and decommissioning of the proposed switchgrass co-fire test facilities, and the ramifications if they did not take place. Section 3.0 characterizes the existing environment at the proposed site and the area where the switchgrass feedstock would be obtained from various environmental perspectives: air quality and meteorology; soils and geology; biological, water, and cultural resources; land use; noise; infrastructure; aesthetics, socioeconomics, and environmental justice. Section 4.0 assesses the impacts that would or could occur if the Proposed Action were implemented. Section 5.0 describes the cumulative impacts that could occur from the Proposed Action when combined with other related activities. Section 6.0 addresses short-term uses of the environment and the effect on long-term productivity, and the irreversible and irretrievable commitment of resources should the Proposed Action be implemented. Section 7.0 lists the documents, websites, and other sources of information cited in this EA. Appendix A contains the text of DOE's scoping letters, Appendix B contains the responses DOE received, and Appendix C contains the scoping letter distribution list. Appendix D contains a summary and a full copy of the one comment letter DOE received regarding the Draft EA and DOE's responses to the items raised in the letter.

## **2.0 PROPOSED ACTION AND NO ACTION ALTERNATIVE**

DOE is considering providing partial funding for (1) the design and construction of a switchgrass storage, handling, and conveying system into the boiler at the OGS, (2) operational testing of switchgrass as a biomass co-fire feedstock at OGS, and (3) ancillary activities related to growing, harvesting, storing, and