



Northwest CHP Application Center

Combined Heat and Power for the states of
Alaska, Idaho, Montana, Oregon and Washington
in cooperation with the U.S. Department of Energy



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CHP PROJECTS IN THE NORTHWEST Compiled by the Northwest CHP Application Center Dave Sjoding, Manager

Introduction

The states of Alaska, Idaho, Montana, Oregon and Washington have been steadily pushing forward to add additional Combined Heat and Power (CHP) in our region. A number of CHP projects are now in various stages of development or have recently become operational. This region also faces the risk of losing some of its forest products industry plants and their related CHP systems. It is tough to develop a replacement use for the CHP waste heat once a plant closes. A better approach is to use CHP as a tool to preserve and enhance economic development in cooperation with the forest products industry and other industries. The Northwest is increasingly adopting this approach. Reduction of energy costs is a second major driver for CHP (especially when it comes to barged in diesel in Alaska), and environmental improvements is a third. The Northwest is also facing grid congestion, but the use of wide scale CHP as a means to reduce congestion is not well established. Like other regions, the price and price volatility of natural gas has impacted development of CHP. Fortunately, this region has a wide variety of undeveloped *opportunity fuel* resources, including biogas, hog fuel from forest products, waste hydrogen, waste heat to power alternatives, and landfill gas. The following is a state-by-state listing of CHP projects including those that have recently been brought online and those in various stages of development. Additional state level context is also provided.

Summary

The following table summarizes by state the various CHP projects in a variety of stages including initial design, permitting, financing, construction, interconnection, and recent operation (2004 or later).

State	Number of CHP Projects	Known MW Increases
Alaska	31	.875
Idaho	15	60.67
Montana	22	108.161
Oregon	15	250.415
Washington	26	880.881
Totals	109	1,301.002

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Alaska

Alaska is a state with many village micro-grids, and several larger city systems. The villages barge in diesel to provide expensive power. The cost of power in communities that fuel with diesel ranges from \$.21 to \$.80 per kilowatt-hour (kWh). In response, the Alaska Energy Authority (AEA) has completed a review of each micro-grid and the opportunities to improve CHP in a district energy setting. This included a comprehensive update of the CHP database. Near term CHP efforts in Alaska are as follows:

Completed projects

- 1) Kotzebue – The Kotzebue CHP project was completed in 2005. Work was completed on a water line distribution extension to Kotzebue Electric Association's diesel power plant in the Northwest Arctic Regional Center. The line was tied into a plate heat exchanger on the diesel generators' cooling loop. This heat recovery project from the city's diesel power plant is estimated to save 60,000 gallons per year (gpy) of fuel oil with a cost savings of \$124,000 per year for heating the city's water system. Cost share of 50 percent was provided by the Alaska Energy Authority for the \$325,000 project;
- 2) Kotlik—Waste heat connected to four community buildings;
- 3) Kongiganak—Waste heat connected to water plant/washeteria;
- 4) Deering—Waste heat connected to water plant/washeteria;
- 5) Stevens Village—Waste heat connected to water plant and tribal office;
- 6) Organic Rankine Cycle (ORC) to power, Chena Hot Springs Resort – This is a 400 kWc ORC CHP system. It uses 165 degree hot water and R-134a refrigerant to power a turbine and generator. Power costs are reduced from \$.30/kWh to \$.07/kWh. The system came online in July 2006;

Completed projects with heat exchangers but waiting for heat loads to be built nearby

- 7) Hughes—Heat exchanger installed;
- 8) Tuntutuliak—Heat exchanger installed for possible fish processing plant;
- 9) Tuluksak—Heat exchanger installed for water plant (in design stage);

Projects under construction to be completed in 2006

- 10) Kwigillingok—Waste heat to new water plant;
- 11) Takotna—Waste heat to new clinic building;
- 12) Crooked Creek—Waste heat to water plant;
- 13) Koyukuk—Waste heat to school;
- 14) Artic Village—Waste heat to airport runway maintenance building;
- 15) Buckland—Waste heat to washeteria;
- 16) Manokotak—Waste heat to clinic, firewall and city vehicle maintenance shop;

Projects for construction in 2007

- 17) Angoon—Major CHP enhancement including the addition of a 475 kW diesel generator for a new total of 1,585 kW, with a new generation heat exchanger and piping to school buildings;
- 18) Chefornak—Waste heat to school;
- 19) Diomede—Waste heat to water plant and high school;

Projects in conceptual design phase

- 20) Nikolai—Waste heat to school;
- 21) Chitina—Waste heat to clinic building;
- 22) Chignik Bay—Waste heat to community multi-use building;

- 23) Port Heiden Heating Load Assessment—Alaska Energy Authority (AEA) project manager Mia Devine modeled Port Heiden facility heating load as part of a conceptual design study comparing diesel versus hybrid wind-diesel CHP in this Bering Sea community. Design options are now being considered. High penetration wind-diesel requires a secondary "dump" thermal load as part of the control system. Due to long payback, wind energy will be deferred to a later date. Power system construction is tentatively scheduled for summer 2008;
- 24) Yakutat—Waste heat system upgrade to school; and,
- 25) Akiachak—Waste heat to water plant.

Hybrid Wind/Diesel CHP Projects with AEA, USDA Rural Utility Service and Department of Interior support

- 26) False Pass;
- 27) King Cove;
- 28) Nikolski;
- 29) Sand Point;
- 30) St. George, Pribilof Island; and
- 31) St. Paul, Pribilof Island

Idaho

Idaho is predominantly an investor-owned utility state (Idaho Power) with some rural cooperatives and municipal power systems. Its CHP base is mainly forest products and food processing (potato processing and sugar). The Idaho Office of Energy Resources is the state energy office. They are using industrial assessments as a vehicle to gain access to plants. CHP opportunities are then explored. Active CHP projects in Idaho are:

Projects completed

- 1) Dry Creek Dairy—This is a 2.25 MWc digester CHP system for a 10,000 head dairy. The project started producing power in August 2008. The system is owned and operated by Cargill Environmental Finance. The dairy is owned by Bettencourt Dairies. Project cost was \$8.5 million. System could be sized to 3.2 MWc due to increased herd size..

Projects under construction

- 1) Big Sky Dairy, Gooding – This is a 1.5 MWc project. A powerpurchase agreement has been approved by the Idaho Public Utilities Commission in July 2008 between Idaho Power and DE-AP #1 LLC. Target date of operation is February 2009.
- 2) Double A Dairy, Wendell—This is a 4.5 MWc digester CHP project at a 15,000 cow dairy. The facility is under construction. Project developer is Andgar;

Projects in various stages of study, planning, permitting, or financing

- 1) Amalgamated Sugar, Nampa and Twin Falls—As part of the Pump System Assessments project, Amalgamated sugar facilities in Nampa and Twin Falls were preliminarily evaluated for their CHP potential. Both facilities already have on-site generation. However, by increasing the efficiency of the pump systems, the generated power is more efficiently utilized. In particular, a very old, leaky and inefficient steam turbine pump in the Twin Falls plant will be replaced with an electric motor and variable speed drive, and the displaced steam will be diverted to greater

electricity production. This plant has four boiler/steam turbines with 9 MW capacity. CHP is underutilized at this facility with significant opportunity for improvement;

- 2) Amalgamated Sugar, Paul—This plant was evaluated in the fall of 2006, when the sugar beet processing begins;
- 3) Jerome Cheese Factory—This estimated 2 MW CHP project is in the planning stage. An anaerobic digester would use whey as the feedstock. Its methane production would run a gen-set with the waste heat used for the pasteurization processes;
- 4) J.R. Simplot CHP—J.R. Simplot is a major food processing firm headquartered in Boise. A CHP assessment at Simplot's Caldwell plant has been completed in April 2008. Other Simplot CHP opportunities are to be explored in the future (WA and ND). Idaho Office of Energy Resources staff conducted Pump System Assessments at seven Simplot facilities in the summer of 2006. Simplot has a very strong energy program;
- 5) Yellowstone Power, Emmett—Yellowstone Power is building a 20 MW CHP system powered by wood chips. Rocky Mountain Forest Products is building a small-diameter log mill at the site that will use the steam. Staff offered technical assistance on wood chip sources, CHP technology and wood-to-ethanol conversion;
- 6) Bennett Lumber, Princeton—Investigation of a wood waste CHP system for this sawmill has begun;
- 7) Renewable Energy of Idaho, Emmett—This is a restart of a Boise Cascade mill with a larger CHP system of 17.5 MW (up from 11.3 MW) located with a sawmill and planner mill. The system is under construction. Wood waste and Healthy Forest Initiative thinnings are available. An air quality permit application was submitted in July, 2005. The company has a negotiated power contract with Idaho Power;
- 8) CKTV1 Energy, Lake Lowell – This is a 3.2 MW dairy digester system. An agreement with Idaho Power and the developer has been approved by the Idaho Public Utility Commission (IPC-E-06-05) in June 2006. A Canyon County conditional use permit has been issued;
- 9) Stimson Lumber, Plummer – This is a 6.5 MWc – A power purchase has been signed with Avista. It has been approved by the IPUC as a QF under PURPA;
- 10) Bettencourt Dairy, Murtaugh – This is a 2.4 MWc dairy digester system being developed by Cargill. Sale of power and carbon credits are planned. Project is scheduled for completion in 2008;
- 11) Cargill Environmental Finance, Filer - This is a dairy CHP system in the permitting stage; and
- 12) West Boise Wastewater Treatment Plant – This is an upgrade to 1.0 MWc being planned by the City of Boise (net increase is 820 kWc).

Montana

About 68 percent of Montana's de-regulated electric sales are provided by investor- owned utilities (NorthWestern Energy (NWE), Montana-Dakota Utilities (MDU) and another) now fully emerged and re-positioned from several years of bankruptcy. Most of Montana's rural power transmission and distribution is provided by public utilities (the Bonneville Power Administration, the Western Area Power Administration, rural electric cooperatives and one municipal power system). The public utility sector is not bound by the same regulated transmission requirements as investor-owned utilities. This results in two distinct approaches to CHP projects. Montana focuses its CHP center activities on biomass in forest products, wastewater treatment facilities, and government/university facilities. The majority of

the current 112 MW of CHP power capacity is generated by refinery waste (64 MW), natural gas (compressor stations), wood waste, and coal.

The U.S. Forest Service and Montana Department of Natural Resources and Conservation Fuels for Schools and Beyond program is active in Montana and may yield some wood-fired CHP projects, but overcoming the increased boiler operator costs has not been able to justify the electrical savings. These projects may receive state financing from the Montana Board of Investments INTERCAP loan program for schools, or the State Energy Building Program for state/university facilities.

DEQ staff visited the Rocky Mountain Test Facility in Casper, Wyoming in December 2008 to review an oil well Waste Heat demonstration. They viewed a 225 kW Ormat system that was capable of 300-1200 MWHrs annually, depending on flow. They have also tested several 50 kW systems that would be suitable for net metering in Montana. Several developers are investigating projects in Montana

A key barrier in Montana stems from rural electric cooperatives that have signed 20 to 30 year exclusive supply contracts. This effectively blocks CHP that goes beyond net metering arrangements. CHP wheeling would be an alternative to larger systems beyond power needs.

Active CHP projects in Montana are:

Projects completed

- 1) Eagle Mill Manufacturing, Hall—This is an off-grid CHP project started in September 2004 at Eagle Mill Manufacturing. The project uses two pre-owned reciprocating steam engines, with a third in reserve, to produce 750 kW from condensing low-pressure steam used to dry wood. A grand opening was held in late 2004. The project reduces wood waste for disposal and power costs at the mill. It received System Benefit Charge funds (\$70,000);
- 2) Thompson River Co-Gen—This 16.5 MW CHP system had a somewhat troubled startup in August 2005, and has been shut down since September 2005. The facility plans to re-submit its air quality permit application. Air quality issues surfaced when their installed used boiler (not described in the permit) could not be stepped down to the maximum permitted emissions and burn rate. In addition, the facility wanted to sell its power to Avista at the higher “qualifying facilities contract rate” allowed for facilities that produce less than 10 MW under Idaho Public Utilities Commission rules. Thompson River Co-Gen filed a complaint (No. AVU-E-05-07) and a negotiated settlement has been reached;
- 3) Great Falls Wastewater Treatment Facility – This is a 500 kWc spark-ignition diesel engine-generator biogas system that began operation in 2007. The spark-ignition diesel engine-generator removes engine heat for their digesters and powers select pumps.
- 4) Huls Dairy, Bitterroot – This is an upright tank digester CHP system for a 360 head dairy with funding support from USDA and the State of Montana. This is a net metered 50 kW capacity engine fired by biogas that came into operation in 2008. The CHP program helped re-configure the electrical interface so a second coil on the generator could island the coolers and select pumps at the dairy when the grid goes down. Heat is recovered from the engine. Two biogas boilers are also used for heating either the floor system or other dairy needs. They have sufficient gas for expansion, but are limited with funding and the Ravalli Electric Co-op capacity to take additional power. This is a mesophilic IBR technology digester system with a 5

- 7 day retention time. The liquid effluent is land applied with a center pivot offsetting prior practice of tank truck application;
- 5) Billings Deaconess Hospital—This is a 250 kW high temperature fuel cell with micro-turbine and boiler CHP project. The 1,150°F exhaust heat is used to power a micro-turbine (no combustion) to help fire the boiler. It received an electric producers' permit from the Montana Public Service Commission in November, 2005. The heat and power are to be used in the hospital as parallel generation, and no power will be sold to the grid. The system became operational in 2006;
 - 6) Basin Electric Cooperative, Culbertson – This is a 5.5 MW organic rankine cycle/waste heat to power system operating at a MDU pipeline compressor station. It came on line in 2008; and
 - 7) University of Montana-College of Technology, Missoula - This is a Community Power Corporation BioMax 25 gasifier engine generator CHP system using wood chips as the fuel source. It produces 25 kW of power and approximately 250,000 Btu/hr of heat recovery. The system is portable and has a DEQ Air Quality letter saying it needs no operating permit in most of Montana

Projects in various stages of study, planning, permitting, or financing

- 1) Montana State University-Eastern, Billings—The Montana Department of Environmental Quality evaluated CHP options at Montana State University-Eastern. CHP funds for the analyses were matched by the \$900,000 in state funds for the boiler upgrades and the district heating system analysis. CHP depended upon the district heating system going in, but the network was not cost feasible at the time. The project is currently tabled pending funding opportunities;
- 2) University of Montana-Western, Dillon—This campus was evaluated by the CHP program and matched by over \$110,000 in Montana Department of Administration Architect & Engineering Construction funds. The UM-Western underwent a study, and has begun construction of a wood-fired boiler for its district-heated campus. The conversion to wood is funded by a \$400,000 USFS Fuels for Schools program grant and a \$1.122 million DEQ State Energy Program bond. Although CHP was initially found to be positive, but marginal economically, the study was unable to convince the UM-Western administration to provide the required increase in staffing and/or increase in staffing costs for a licensed higher pressure boiler operator, in light of fluctuating and deregulated utility costs;
- 3) Wastewater Treatment Facility, Helena—This project is using two direct-biogas fired Stirling engines for a combined heat and power output of 86 kW and 1,000,000 Btu heat for the digesters. The project uses gas from the City of Helena's wastewater treatment facility. The Helena Public Works Director is proceeding to obtain final interface financing. The updated costs and potential savings, based on the new contracted price of natural gas (\$11.86 per decatherm (dkt) A decatherm is equivalent to 1,000,000 Btu. There appears to be sufficient biogas for a third or fourth engine, but funds would be needed.
- 4) Montana State Prison, Deer Lodge—This CHP project has expanded from the original dairy digester system. The prison received a \$250,000 forest service grant for a new biomass boiler to serve their dairy and dorm. The State A&E office has requested that we look at enlarging that project to include several other high loads such as the laundry and industries in a central system. If that happens we will certainly look at CHP as the economics are very good as we have both the prison forestland and inmates with chainsaws, so our fuel cost will be low for quite awhile. Deer Lodge has a large progressive saw mill that is involved in long term forest maintenance agreements with at least one near by national forest. So long term fuel is very

- close by. This project is very viable has both Long Range Building Program and State Building Energy Bill support.
- 5) Ethanol Plant, Great Falls – This is a 125 million gallon ethanol plant with CHP in the planning phase;
 - 6) Ethanol/Biodiesel Plant, Glasgow – This is a 50 MGY ethanol plant with 15 MWc of CHP in the planning stage. MSW will be used as the feedstock;
 - 7) Plum Creek Timber Company, Columbia Falls – This is a 3 to 20 MW CHP system. It will use wood waste as a fuel. Recently, the plan was dropped by their corporate headquarters. They are not able to make this investment at this time.
 - 8) Boseman Hot Springs – Facility is being rebuilt and bank is encouraging CHP;
 - 9) F.H. Stoltze Land and Lumber, Columbia Falls – This is a 15 to 18 MWc CHP system in the permitting stage. The utility is Flathead Electric. It is a Fuels for Schools and Beyond project;
 - 10) Sun Mountain Lumber, Deer Lodge – This is a 12 to 25 MWc CHP system. It is in the option develop stage with 4 options being considered. NorthWestern Energy is the utility;
 - 11) Pyramid Lumber, Seeley Lake – This is a 4 to 5 MWc CHP system. It is a Clearwater Blackfoot Forest Stewardship Project being developed with Missoula Electric Co-op. Initial contacts have been made with the air quality staff. The area has recently violated PM-2.5 standards;
 - 12) Smurfit-Stone Container, Frenchtown – This is an 18 MW CHP expansion project. It would like to double its electric production. The plant uses 80-MW of power, and enough steam (flow, pounds per hour) for 130 MW of power. The facility is showing signs of economic hardships as they recently laid off a shift of workers. Information also indicates the national company may be forced into bankruptcy;
 - 13) Eagle Mill Manufacturing, Hall – This mill is investigating an additional 500 kW expansion as of January 2009 as they have the fuel and need;
 - 14) City of Troy – A CHP study is underway funded by the City of Troy; and
 - 15) University of Montana, Missoula – This CHP project replaces pressure relief valves with mini steam turbines. Montana Department of Environmental Quality is doing the study.

Oregon

Oregon is developing a very positive CHP policy and financing framework. There is a strong focus on forest products economic development, renewable energy, energy independence and reduction of greenhouse gases. The Oregon Department of Energy (ODOE) provides Business Energy Tax Credits. The Energy Trust of Oregon (ETO) provides project funding through a competitive process. Information about the Trust's Biomass Program is at www.energytrust.org/RR/bio/index.html. The Trust approved \$5.3 million in 2005 funding, and \$2.11 million in 2006. Twenty-five proposals (91 potential MW) were received in 2005 and five finalists were chosen. The Climate Trust has also provided funding. Active CHP projects in Oregon are:

Projects completed

- 1) Douglas County Forest Products, Winchester—This 8 MWc project began operating in January, 2006. They converted its four natural gas-boiler heated dimensional lumber dry kilns to highly efficient kilns that will use steam from a new hog fuel boiler. The boiler will principally drive the turbine, and low pressure steam will serve the dry kilns. The kiln loads were reduced so that the new load match met the amount of hog fuel produced by their on-site barking and saw operations

and the 8 MW of electric generation. Power purchase contracts are in place. The Oregon Department of Energy (ODOE) provided 35 percent tax credits for this \$12 million project, and the company earned Energy Trust of Oregon incentives;

- 2) Gresham Wastewater Treatment Plant – This is a 395 kWc CHP system rebuild and upgrade project completed in 2005 with funding from the ETO. The prior CHP system was sized at 250 kWc;
- 3) Sun Studs (Swanson Lumber), Roseburg—Swanson Lumber’s 6 MWc CHP biomass facility was completed in 2006. This facility runs on hog fuel produced at the site and purchased from nearby facilities with saw and barking residue. The project will serve dry-kilns and power production. ODOE staff worked with Swanson to integrate the tax credit with their financing scheme and informed financiers of the strategy and timing of tax incentives;
- 4) Rough & Ready Lumber, Cave Junction – This is a 1.28 MWc CHP project using mill waste. This project has funding support from: 1) ETO - \$1,700,000); 2) USDA - \$500,000 grant and \$2,350,000 loan; and 3) ODOE - \$1,250,000 business energy tax credit. The likely start date will be in the fall of 2007;
- 5) Freres Lumber, Lyons—This is a 10 MWc CHP project using mill waste. It is a 2005 ETO finalist. The project is under construction with a fourth quarter 2007 start date. PacificCorp will buy the power through a power purchase agreement signed in February 2007. The project is being developed by Evergreen BioPower;

Projects under construction

- 6) Columbia Boulevard Wastewater Treatment Plant, Portland—This is a 1.73 MWc CHP project using digested sewage treatment gas. It is a 2005 ETO finalist with a March 2008 likely start date. The facility is under construction;

Projects in various stages of study, planning, permitting, or financing

- 7) Collins Pine, Lakeview—This is a 15 MW CHP project in the development stage. Project developer is Marubeni/DG Energy Solutions. It is located next to the Collins Pine Fremont Sawmill. On January 16, 2006, the director of the Oregon Department of Energy attended the signing ceremony for the memorandum of understanding (MOU) that includes private, county, city, state and federal partners that are collaborating on the project. Under that MOU, the ODOE confirmed it will provide a 35 percent Business Energy Tax Credit worth some \$3.5 million, and technical assistance. ODOE will co-fund with the Energy Trust of Oregon the final feasibility study;
- 8) Hampton Lumber, Tillamook—This is a 10 to 11 megawatt capacity (MWc) CHP system. Hampton Lumber is in the process of designing its biomass plant to replace a gas boiler at its Tillamook dimensional lumber plant. It is expected to have co-generation on-site and a power sales agreement with the local public utility district. The mill has applied for a Business Energy Tax Credit;
- 9) Confederated Tribes of Warm Springs/Warm Springs Forest Products Industries—This is a 15.8 MWc CHP project using mill waste. It is a 2005 ETO finalist with an early 2009 likely start date;
- 10) Bradwood Landing Liquid Natural Gas Terminal – This is a 130 MWc CHP system. A Draft EIS has been prepared by FERC and questions raised are being answered. County Planning Commission has recommended LNG project approval.
- 11) Jordan Cove Liquid Natural Gas Terminal—This is a 37 MWc CHP project, and part of a 1,000 million cubic feet per day (MMcfd) LNG project (Jordan cove Energy Projects LP). A Federal Energy Regulatory Commission (FERC) filing has been submitted AND Notice of Intent to prepare an EIS has been issued;

- 12) Three Mile Canyon Dairy, Boardman—This is a 8 MW CHP project at the largest dairy in the Northwest. It is in the design and financing stage;
- 13) Oregon State University, Corvallis – This is a 5.5 MW CHP system in the design stage. It has received funding from the Climate Trust. It is a \$39 million facility replacement. Natural gas will be used. The project is scheduled to be operational in the fall of 2008;
- 14) Rickreall Dairy, Rickreall – This is a 850 kW CHP system in the development phase with scheduled completion in the summer of 2008. Funding from the Oregon State Energy Loan Program was approved in September 2006 for a loan of \$2.86 million with a total cost of approximately \$6,000,000. The is a RealEnergy digester;
- 15) Nike, Beaverton – This is a 360 kW CHP system with simultaneous chilled and hot water in the feasibility engineering stage. A UTC Power PureComfort system is to be used.

Washington

Washington has a number of CHP projects online, clustered around forest products, wastewater treatment facilities and university campuses. The focus is on taking advantage of opportunity fuels. These include forest products, wastewater facilities, anaerobic digesters with the dairy/feedlot industry and waste heat to power projects.

Projects completed

- 1) Sierra Pacific Industries, Burlington – This is a 28 MWc CHP system at a forest products mill. Excess power needs are sold to Sacramento Municipal Utility via Seattle City Light. System came on-line in 2007.
- 2) Hampton Timber Mill, Darrington—This is a 7.5 MWc—4.5 megawatt average (MWA)—CHP system (downsized from an original 20 MW wood waste proposal). Air quality issues raised by the U.S. Forest Service have been resolved. The Puget Sound Clean Air Agency issued a construction permit in June, 2005. This system went on-line in October 2006. Mill needs are approximately 4.5 MW/hr with additional power sold to Snohomish PUD under an early 2007 contract. In addition, 7 MW of green tags are sold to the PUD;
- 3) Wastewater Treatment Facility, Renton—The 1.5 MWc molten carbonate fuel cell is located at the South Treatment Plant in Renton, WA. It is now past the initial period of occasional minor upgrades and adjustments and the demonstration period will end in September 2006. The Center has a case study on this CHP system at <http://www.chpcenternw.org/Default.aspx?tabid=34&Section=#CaseStudies>. Molten carbonate fuel cells operate at very high temperature providing a strong thermal energy capability. Dr. Gordon Bloomquist of the Center serves on the advisory committee for this demonstration fuel cell. In addition, an 8 MWc CHP system has been completed at the same facility bringing total production to 9.5 MWc. The 8 MWc system is composed of three turbines (two 3½ MW turbines and a 1 MW steam turbine). The entire system became operational December 12, 2005, operating on approximately a 5 MW average with a 9 MW capacity. The facility has enough biogas beyond the fuel cell's needs for 3½ MW of power. Facility operators plan to use supplemental natural gas to avoid ratcheted demand charges;
- 4) Vander Haak Dairy, Lynden—This is the first dairy digester CHP project completed in this state. This project was rebuilt and upgraded in 2007 to 450 kWc. It was originally sized at 300 kWc and began operation in November 2004. It has been the site of many presentations and tours, including a visit by the governor. Washington State University also is using the dairy as a research site to improve the economics/products for this type of system. The Center has a case

study on this CHP system at

www.chpcenternw.org/NwChpDocs/VanderHaakDairyCaseStudy.pdf . This is a cold climate GHD/Andgar digester with a design size for 1500 cows;

- 5) George DeRuyter & Sons Dairy, Outlook—Project start-up was completed November, 2006. It was funded in part with a \$499,219 Renewable Energy Grant from the U.S. Department of Agriculture (USDA). A 1.2 MWc system was installed. This project was awarded a \$1,972,715 loan at 1 percent interest from the Washington Energy Freedom Program. It is a cold climate GHD/Andgar digester designed for 4300 cows. A third gen-set could be added;
- 6) Grays Harbor Paper, Hoquiam—Grays Harbor Paper has completed two upgrades of its CHP capacity (2006 and December 2007) using hog fuel. Total mill capacity is now 18.5 MWc with a combined increase of 8.0 MWc. Their original goal was to be electrical energy self sufficient (11-12 MW). They can now sell power to Puget Sound Energy in addition to their own needs. In 2001 company purchased a turbine but lacked the funding to install it. A complex package—involving the pre-purchase of power, Grays Harbor PUD ownership of the turbine and boiler with a lease back, state financing of a \$6 million grant, and two loan packages—has enabled this project to move forward. The pending closure at the nearby Cosmopolis, Washington, Weyerhaeuser mill spurred this economic development project as part of the new Energy Freedom Program established by the state Legislature;

Projects under construction

- 7) Simpson Tacoma Kraft Mill— This project is permitted for a 60 MWc CHP system. This system has a power purchase agreement with Iberdrola Renewables. Construction began in January 2008 and is scheduled for power production in August 2009. It will use both sawmill and paper mill wood waste and black liquor as the fuels. Tacoma Power will provide transmission services.
- 8) Snohomish County dairy digester, Monroe—This is a 450 kW CHP digester project for 3 dairies with 1,600 cows. Digester size can handle up to 2,200 cows allowing herd size to grow. The project is run by Qualco Energy Corporation, a non-profit. Construction began in July 2008 with completion scheduled for late October 2008 and power generation in January 2009. A feasibility study with the Tulalip Tribe and local dairy farmers was funded by a DOE 2003 Tribal Energy Program grant of \$256,476. The study was done by the Clark Group and RCM Digesters. It included an inventory assessment of flushed and scraped manure volumes as well as non-dairy waste. Alternative digester technologies were reviewed. The Legislature has provided the land for the project as part of the capital budget. The USDA has provided a \$500,000 grant for construction (total cost estimate is \$2 million). Power purchase agreement and interconnection negotiations with Snohomish PUD continue.
- 9) Organic Rankine Cycle, Sumas—Puget Sound Energy and ORMAT signed a 20-year power purchase agreement on January 25, 2006, to install the first organic rankine cycle (ORC) system in the Northwest. This heat recovery project located at a natural gas compressor station is sized at 4.95 net MW. Recovered waste heat comes from three existing gas turbines driving the compressor station. This project is in suspended status;

Projects in various stages of study, planning, permitting, or financing

- 10) BP Cherry Point Refinery—. This is a 720 MWc CHP system proposed at the BP Refinery at Cherry Point. It will be built in two phases. The first phase is 520 MWc with an efficiency of 63% LHV. On October 10, 2006 a revised Site Certificate Agreement was approved by Washington's Energy Facility Site Evaluation Council (EFSEC). WSU recalculated the greenhouse gas emissions for the project. This action revised the Governor's approval given on

December 21, 2004. The final site certificate agreement was signed at a ceremony in the Governor's Office. This CHP system was the first high impact technical assistance system selected by the Northwest CHP Application Center. There was no appeal of the governor's decision. The loss of investment partners and failure to find a buyer for power sales delayed scheduled completion of this \$400 million project by about two years, to 2009. BP West Coast Products has now decided to develop the project, and it is moving forward with development of a staged implementation. On October 10, 2006, an amended site certificate was approved by the state's Energy Facility Site Evaluation Council. The first phase (approximately 520-570 MWc) would consist of two combustion turbines, two heat recovery steam generators and one steam turbine. Construction is now on hold pending a major refinery upgrade. The second phase would complete the project for a new total of 738 MWc. Transmission issues on the north side of the Canadian border are now being resolved. The ability to wheel power to AB, Canada will help this project;

- 11) West Point Treatment Plant, King County—This facility has operated CHP since 1985. Two of the three .8 MW systems don't operate. In addition, digester gas is used to run influent pumps (1.6 MW). This is a rebuilding and enlargement of an existing CHP project (2.4 MWc to 4.6 MWc). A natural gas line is now being run to the plant. The rebuilt system will have two reciprocating engines of 2.3 MW each, plus the 1.6 MW, for a total system capacity of 6.2 MW. Like the Renton plant above, a combination of average operations at the 3.9 MWa level with peak operation when necessary;
- 12) Cedar Hills Landfill, King County—This is a 26 MWc facility under development by private developer Energy Development Inc and King County. It is in the permitting stage. The landfill has an expected life of 15 to 20 years;
- 13) U.S. Navy, Bremerton—An analysis of steam pressure requirements has shown a major opportunity to drop pressure, increase electricity production, and improve economic payback. The system is now sized at 1,986 kWc instead of 1,371 kWc. This project was submitted for engineering review by the Navy at Port Hueneme, California. Two questions were raised regarding: 1) The impact of natural gas prices on project economics (a sensitivity analysis is needed); and 2) The impact of additional steam condensate returns necessitating a design analysis of the steam trap system. Funding for this capital budget item is being sought. Discussions with Puget Sound Energy have been held;
- 14) Brightwater Wastewater Treatment Facility, Woodinville—A new wastewater treatment facility is under construction using new membrane technology. This technology produces less biogas than typical wastewater treatment systems. Construction is scheduled to be completed in 2010. About 1 MW of gas will be produced. A feasibility study is being conducted by King County in cooperation with the Northwest Energy Technology Collaborative to use Brightwater as a test bed facility for CHP applications;
- 15) Stanwood community digester—A group of 10 dairies and one egg production facility have joined to do a digester CHP feasibility study. This study is funded with an \$85,175 Value Added Producer Grant (2005) from the USDA. The CHP system will be roughly 650 kW to 1 MW in size and handle the equivalent of approximately 5,000 head of dairy cows (200 chickens = 1 cow);
- 16) Dairy CHP, Hood Canal—Hood Canal has low levels of dissolved oxygen. One of the causes is animal waste. The Washington State Legislature appropriated \$560,000 to study the problem. A biogas fueled CHP/digester system is being considered. A feasibility study has been completed and developer selected;

- 17) Wood waste project, Forks—Located in the northwest corner of the Olympic Peninsula, Forks has recently shut down wigwam hog fuel burners and is looking for alternatives to use the waste wood. A feasibility study was completed on May 12, 2006 for Clallam networks Economic Development Council by Siemens Energy & Environmental Solutions. A 1.2 MWc CHP system co-located with a Interfor sawmill in the Forks Industrial Park is recommended. The Port of Port Angeles has hired a consultant (September 2008) to move this project forward;
- 18) Eka Chemicals, Moses Lake—This is a 4.5 MW project located at this chlor-alkali plant. It would use hydrogen as the feedstock (The hydrogen currently is flared). A proposal for funding was submitted to the U.S. Department of Energy Industrial Technologies Program. Hydrogen burns at a hot temperature. This is a technical challenge;
- 19) Enumclaw Plateau dairy farms, King County—This CHP digester system is ultimately envisioned as a community digester project but will start with a single dairy and add others if they are close enough to pipe the manure. A team led by King County, Energy Northwest and the WSU Center for Bioproducts and Bioenergy is working to resolve the economic issues. King County was recently awarded a \$93,990 USDA Rural Business Enterprise Grant to further the project; and,
- 20) Central Treatment Plant, Tacoma – This is a digester CHP system under development. It will use biogas from the digester
- 21) S’Kallam Tribe, Port Gamble – This project is in the early stages of development using biomass as the fuel. A combination of power production and heat for the casino is under consideration.
- 22) Quillayute Valley School District, Forks – This is a 120 kW microturbine project. The Hoh Indian Tribe is considering buying the power with Clallam PUD wheeling it. This project has WA Energy Freedom Program financial support.
- 23) Farm Power, REXVILLE – This is a 1.5 MWc community dairy digester CHP system. The project has a memorandum of understanding with Puget Sound Energy. Project financing includes a \$500,000 grant from the WA Energy Freedom Program, \$500,000 grant from USDA Rural development and a \$575,000 USDA loan guarantee. The project is in the permitting stage with co-digestion concerns.
- 24) Wastewater Treatment Facility, Olympia – This is a biogas CHP project at the Olympia/LOTT wastewater treatment facility. A project development team has been selected including Allied Electric.
- 25) Port of Benton, Benton County – This is a 1.5 MW gasification genset CHP project with Evergreen Fuel Technologies. This project builds on lessons learned at a gasifier system used at FruitSmart (Whitstram, WA). The project is in the fund seeking, utility power purchase and design stages.
- 26) Ocean Spray, Markham – This is a hog fuel CHP project that has completed an initial assessment. This is a 24 X 7 332 days per year craisin food processing facility with food drying needs. It is currently using diesel fuel.

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