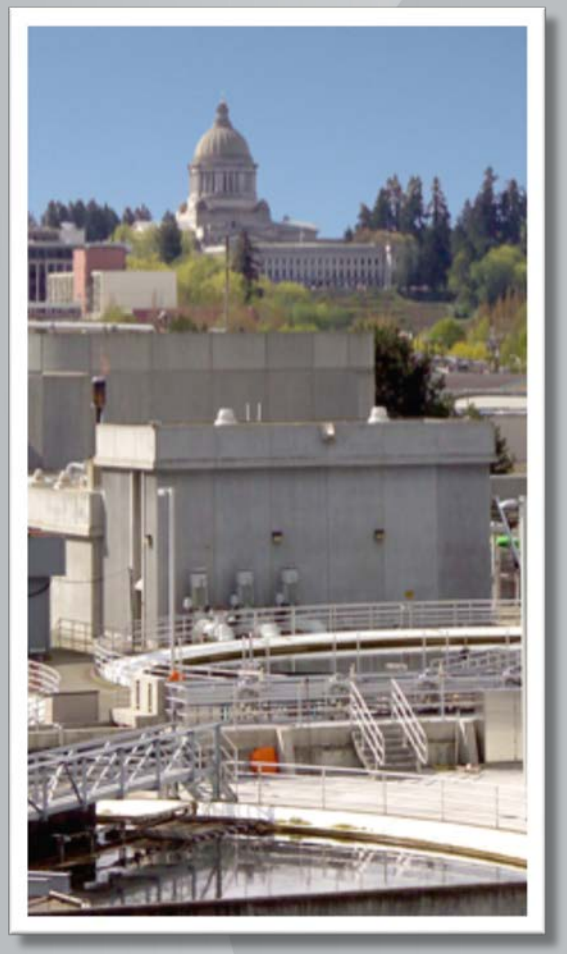


Combined Heat and Power: Status, Resources and Opportunities

For the Joint Committee on Energy Supply and Energy Conservation

Presented by Todd Currier and Dave Sjoding

October 27, 2014

Outline of Presentation

- Introduction to Combined Heat and Power (CHP)
- National Context
- State Context
- Thermal Standards
- CHP and U.S. Environmental Protection Agency (EPA) 111(d) Clean Power Plan

Combined Heat and Power

CHP is an *integrated energy system* that:

- Is located at or near a factory or building
- Generates electrical and/or mechanical power
- Recovers waste heat for
  - Heating
  - Cooling
  - Dehumidification
- Can use a variety of technologies and fuels

Typical CHP generators

The Benefits of CHP

- Fuel efficiency and reduced emissions
- Power reliability improvements
- Energy cost savings
- Energy security
- Grid congestion relief

Freres Boiler, Lyons, OR

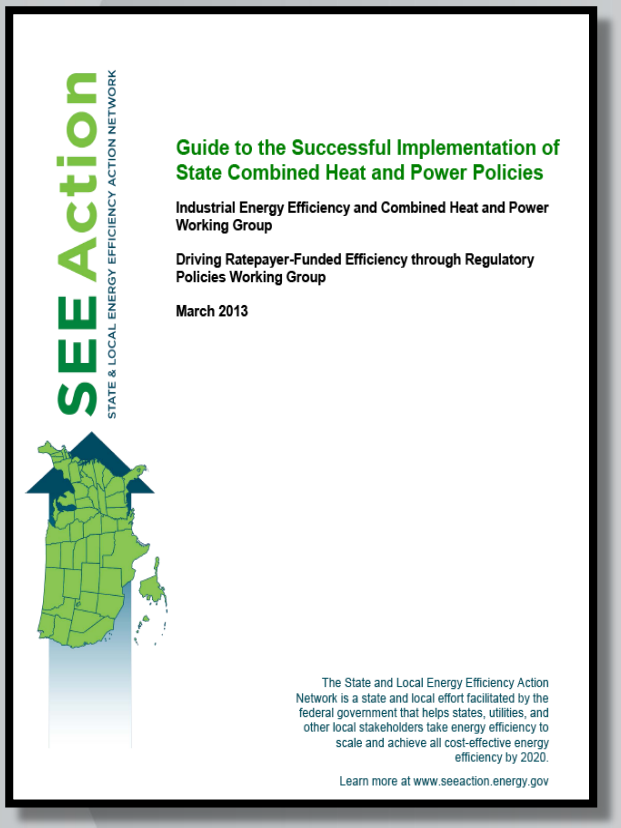
National Context

- Currently over 80,000 megawatts (MW) of CHP
- Presidential Executive Order 13624 calls for 40,000 MW of new CHP by 2020
- State and Local Energy Efficiency Action Network (SEE Action) supports same target
- Federal government supports CHP through:
  - EPA Combined Heat and Power Partnership
  - U.S. Department of Energy (DOE) CHP Technical Assistance Partnership (TAP)

SEE Action Guide

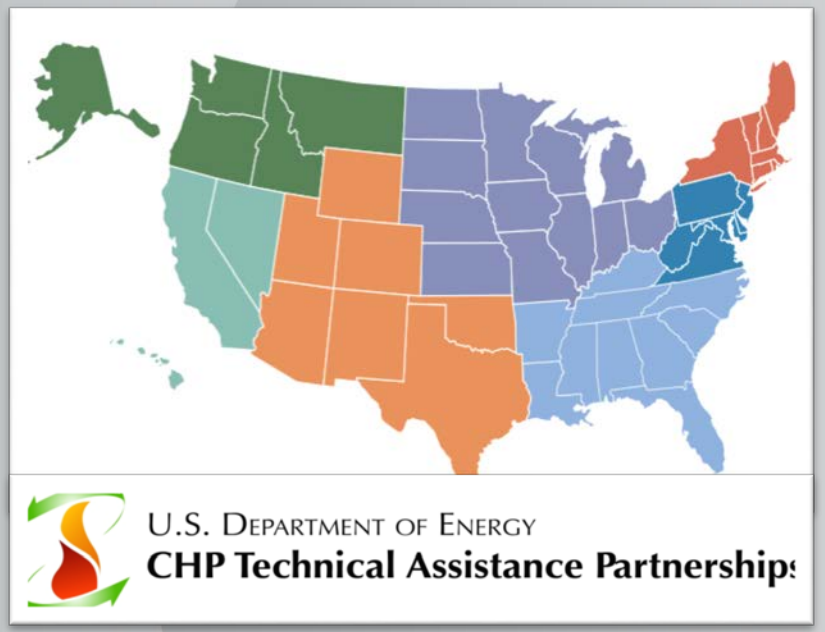
The Guide provides state policy makers with actionable information regarding:

- Design of standby rates
- Interconnection standards for CHP with no electricity export
- Excess power sales
- Clean energy portfolio standards
- Emerging market opportunities: CHP in critical infrastructure and utility participation in CHP markets



CHP Technical Assistance Partnerships

- TAP is critical to advancing CHP:
  - Regional CHP experts
  - Provide fact-based, un-biased information on CHP
    - Technologies
    - Project development
    - Project financing
    - Local electric and natural gas interfaces
    - State best practice policies
  - Vendor, fuel and technology neutral



CHP in the State of Washington

- 33 systems – Size ranges vary:
  - 265 kW – Spokane Waste Water Treatment Facility
  - 270 MW – Phillips 66 Refinery, Ferndale
- 1,307 MW

Phillips 66 Refinery, Ferndale, WA

CHP in the State of Washington
(Continued)

- Key industries/facilities that have CHP
  - Refineries
  - Pulp and Paper
  - Forest Products
  - Dairies
  - Waste Water Treatment Facilities

RockTenn Kraft Mill, Tacoma, WA

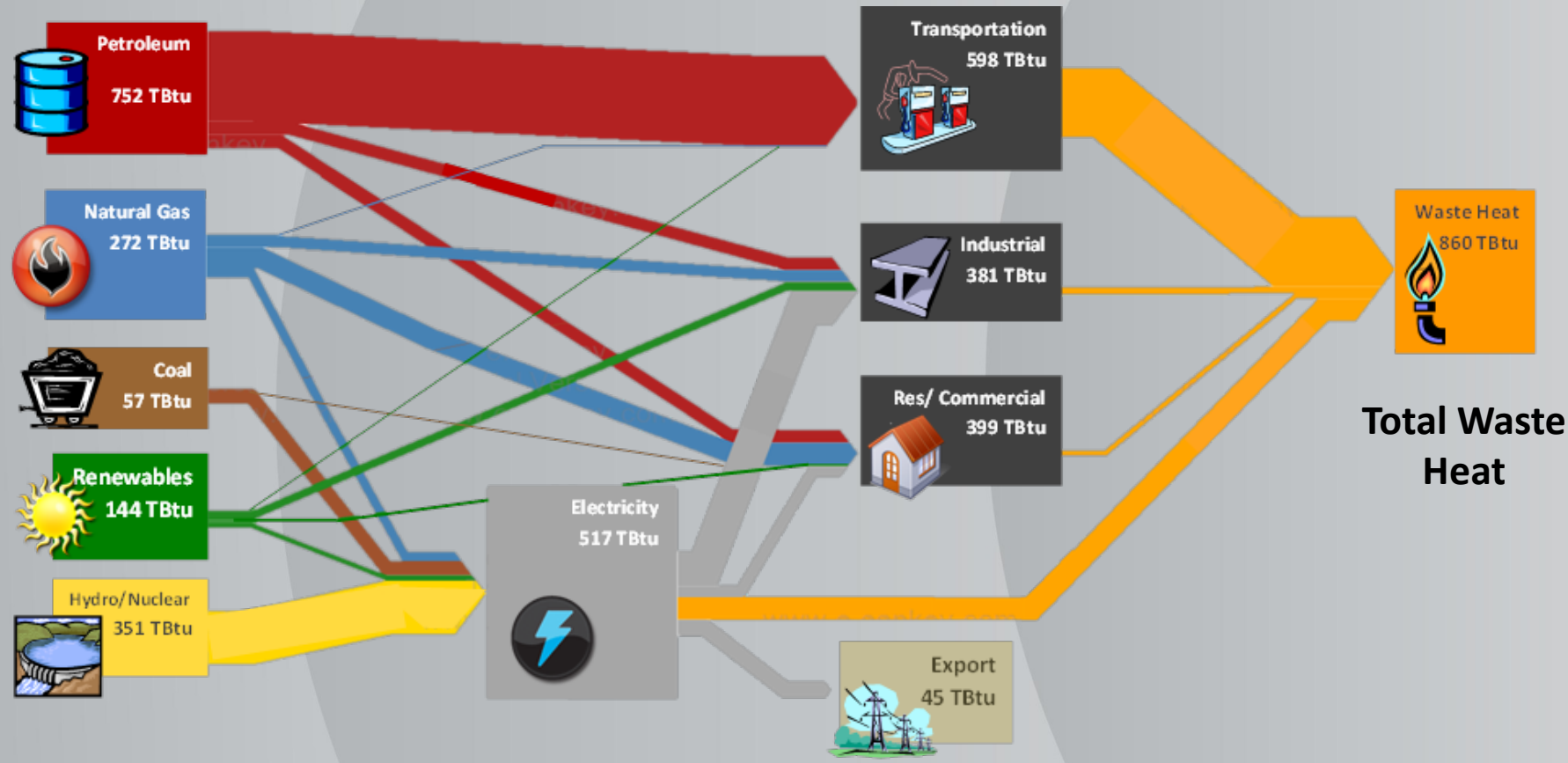
CHP in the State of Washington
(Continued)

Columbia Blvd waste water treatment facility pipes sending biogas to generator, Portland, OR

- Energy sources:
  - Natural Gas
  - Wood Waste
  - Biogas
  - Oil
- Equipment:
  - Boiler/Steam Turbines
  - Reciprocating Engines
  - Combustion Turbines
  - Combined Cycle

Waste Heat In Washington

Washington State Energy Map



Total Input Energy

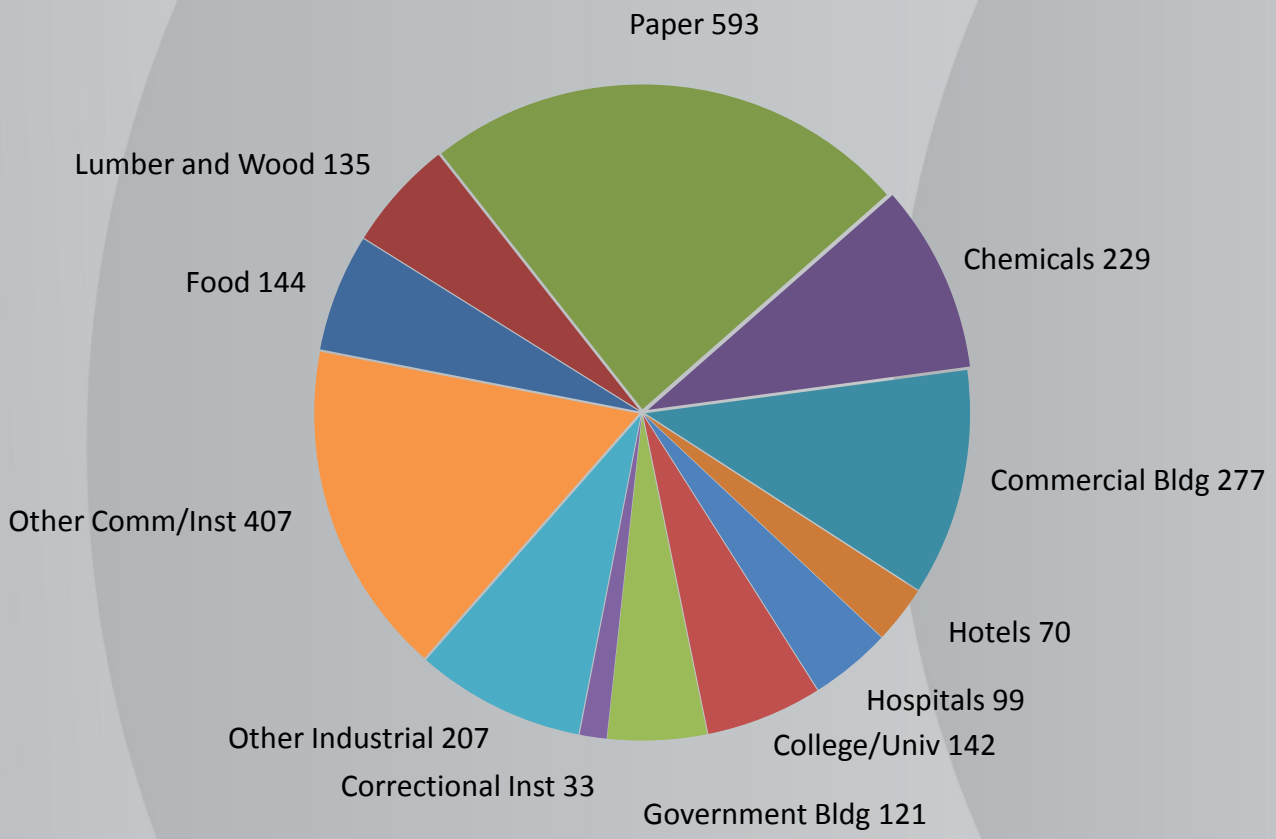
Total Use By Sector

Total Waste Heat

2011 U.S. Dept. of Energy EIA data

Washington CHP Technical Potential

2,457 Megawatts



Data Source: ICF International November 2013

Washington CHP Economic Potential

- Study has not been performed. Overall assessment should reflect:
  - The value of the electric power and the useful thermal energy
  - The cost impacts of opportunity fuels (wood waste, biogas)
  - The relative prices of natural gas and electricity

Rough and Ready Lumber Mill, Cave Junction, OR

Washington CHP Economic Potential

- Specific CHP project assessments also include:
  - The cost of avoided power interruptions
  - The impact of connecting utility rate structure and connection fees
  - The length and value of the contract for any excess electricity
  - Optimization of size of system and type of equipment to site and need

Washington CHP Economic Potential
(Continued)

Key:

CHP improves overall efficiency, but costs and other considerations matter

Edaleen dairy farm, Lynden, WA

Examples of CHP Cost per installed Kilowatt

- 3.3 MW Reciprocating IC engine…….. $1,917
- 21.7 MW Gas Turbine…… $1,518
- 3 MW Backpressure Steam Engine……. $682
- 200 kW Microturbine…… $3,150
- 1.4 MW Molten Carbonate Fuel Cell…….. $4,600

Data from EPA Catalogue of Technologies (Sept 2014) Total installed cost in 2013 $/KW

Simplot Mill, ID

Thermal Standards

- A minimum requirement of energy performance for boilers and process heaters and sometimes the systems of which they are a part
- Can be developed to support CHP directly or indirectly

Thermal Standards – Sample Approaches

- Federal efficiency standards already exist for packaged units up to 2.5 million BTU/hr.

Thermal Standards – Sample Approaches
(Continued)

- EPA Boiler Maximum Achievable Control Technology (MACT) Standards
  - Major Source (based on site pollutant volumes for boilers and process heaters)
    - One time energy audit
    - Annual tune-up unless O_2 sensor continuous monitoring
  - Area Source (smaller solid fuel and oil boilers and process heaters)
    - Annual tune-up unless O_2 sensor continuous monitoring

Thermal Standards – Sample Approaches

(Continued)

- Washington Law RCW 80.80: Greenhouse Gas Emission Performance Standard for Baseload Electric Generation
  - Was 1,100 lbs/MWh
  - Now 970 lbs/MWh (2013 WAC)
- Massachusetts was moving to create a thermal energy standard until EPA Boiler MACT

Thermal Standards – Sample Approaches

(Continued)

Enabling use of waste heat can be viewed as an economic development tool

EPA Clean Power Plan 111(d) & CHP

- EPA draft rule not clear about the role CHP can play in state plans

LOTT Waste Water Treatment Plant, Olympia, WA

EPA Clean Power Plan 111(d) and CHP

(Continued)

- EPA has a second proceeding that specifically applies to biomass CHP (a baseload renewable power option)
  - There are varying opinions in the scientific community
  - There is a major difference between using wood waste/logging slash for biomass CHP and standalone biomass power generation logging and using whole logs
  - The State of Washington has submitted comments with joint signatures from the Governor and the Commissioner of Public Lands

EPA Clean Power Plan 111(d) & CHP

(Continued)

- These rulings will impact how states can incorporate CHP within state plans for 111(d)

Nippon Paper, Port Angeles, WA

Resources

- U.S. DOE Northwest CHP Technical Assistance Partnership
  http://northwestchptap.org/
- U.S. EPA Combined Heat and Power Partnership
  http://www.epa.gov/chp/
- SEE Action Guide on CHP policies
  https://www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies

Contact Information

- **Dave Sjoding**, Renewable Energy Specialist
  Washington State University Energy Program
  sjodingd@energy.wsu.edu
  Director of the U.S. Department of Energy
  Northwest CHP Technical Assistance Partnership

- **Todd Currier**, Assistant Director
  Washington State University Energy Program
  curriert@energy.wsu.edu
  Co-Chair of the National Industrial Energy Efficiency and CHP SEE Action Workgroup

Washington State University Energy Program

Your regionally, nationally and internationally recognized
energy experts