

Bioenergy + Combined Heat & Power Benefits for Municipalities

17 June 2020

DOE Southeast CHP TAP;
NC Clean Energy Technology Center
NC State University



CHP Technical Assistance Partnerships

Today's Agenda

1:00-1:15pm	Welcome, Housekeeping and Introduction to DOE CHP TAP Resources	Kimberly Conley, DOE Southeast CHP TAP Isaac Panzarella, DOE Southeast CHP TAP
1:15-1:30pm	End User CHP Project – Three Rivers Landfill	Jon McDonald, Project Manager, Three Rivers Regional Solid Waste Management Authority
1:30-1:55pm	End User CHP Project – McAlpine Creek Wastewater Management Facility	Sarah Hazel, Manager, Office of Sustainability, Charlotte Will Rice, Project Manager, Charlotte Water
1:55-2:05pm	Facilitated Question & Answer	Kimberly Conley, DOE Southeast CHP TAP
2:05-2:10pm	Close-out and thank you	Kimberly Conley, DOE Southeast CHP TAP



Using GoToWebinar

The screenshot shows the GoToWebinar Control Panel. At the top, it says "GoToWebinar Control Panel" with window control buttons. Below that, there's a "Start Webinar" button and a "In Practice Mode" indicator. A vertical sidebar on the left contains icons for various features: Sharing, Dashboard, Attendees (1 of 501 max), Audio, Webcam, Questions, Polls, Handouts (1 of 5), and Chat. The main area contains a green message box that says "Thank you for joining us today! We'll get started in a few moments." Below this is a text input field with the placeholder "Type message here." At the bottom, there's a "To:" dropdown menu set to "Organizer(s) Only" and a "Send" button. The footer of the control panel displays the webinar title "Bioenergy + Combined Heat & Power Benefits for Municipalities", the ID "Webinar ID# 590-478-299", and the GoToWebinar logo.

The screenshot shows a "QUICKPOLL" window. The question is "Which of these organizations best represent your affiliation?". Below the question, it says "Select one of the following:" followed by five radio button options: "Wastewater Treatment Facility", "Solid Waste Facility", "Electric Utility", "City Sustainability Office", and "Federal or Environmental Agency". At the bottom right, there is a red text prompt "Poll in progress for attendees only." and a "Submit" button.



Introduction to DOE Southeast CHP TAP Resources

17 June 2020

Isaac Panzarella, Director,
DOE Southeast CHP TAP;
NC Clean Energy Technology Center
NC State University



CHP Technical Assistance Partnerships

DOE CHP Technical Assistance Partnerships (CHP TAPs)

- **End User Engagement**

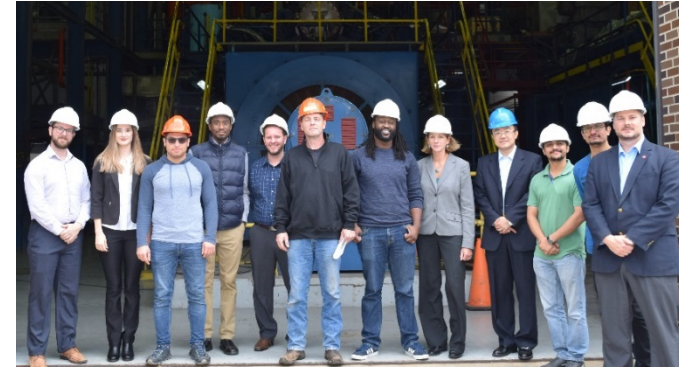
Partner with strategic End Users to advance technical solutions using CHP as a cost effective and resilient way to ensure American competitiveness, utilize local fuels, and enhance energy security. CHP TAPs offer fact-based, non-biased engineering support to manufacturing, commercial, institutional and federal facilities and campuses.

- **Stakeholder Engagement**

Engage with strategic Stakeholders, including regulators, utilities, and policy makers, to identify and reduce the barriers to using CHP to advance regional efficiency, promote energy independence, and enhance the nation's resilient grid. CHP TAPs provide fact-based, non-biased education to advance sound CHP programs and policies.

- **Technical Services**

As leading experts in CHP (as well as microgrids, waste heat to power, and district energy) the CHP TAPs work with sites to screen for CHP opportunities as well as provide advanced services to maximize the economic impact and reduce the risk of CHP from initial CHP screening to installation.



National Manufacturing Day 2019 at the University of Illinois at Chicago

www.energy.gov/chp



DOE CHP Technical Assistance Partnerships (CHP TAPs)

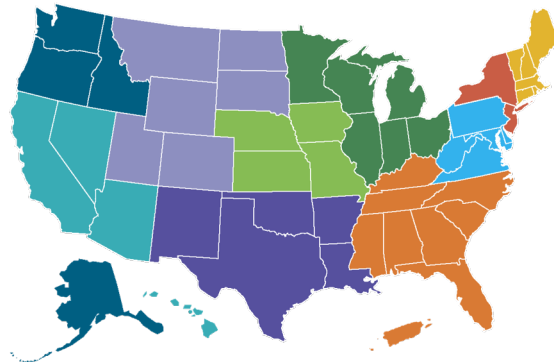
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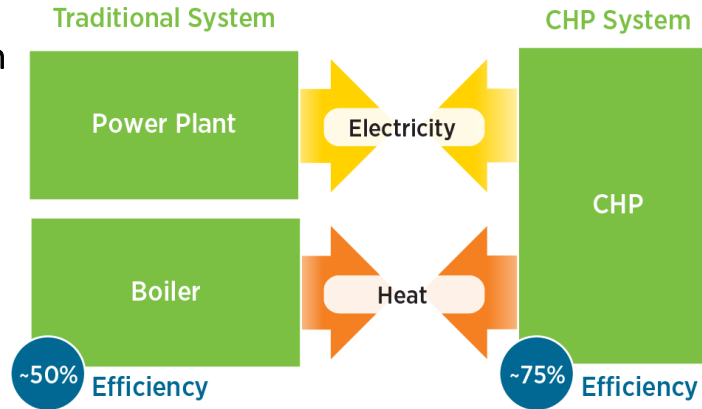
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CHP: A Key Part of Our Energy Future

- Form of Distributed Generation (DG)
- An integrated system
- Located at or near a building / facility
- Provides at least a portion of the electrical load and
- Uses thermal energy for:
 - Space Heating / Cooling
 - Process Heating / Cooling
 - Dehumidification



CHP provides efficient, clean, reliable, affordable energy – today and for the future.

Source: www.energy.gov/chp



What are the Benefits of CHP?

- CHP is **more efficient** than separate generation of electricity and heating/cooling
- Higher efficiency translates to **lower operating costs** (but requires capital investment)
- Higher efficiency **reduces emissions** of pollutants
- CHP can also increase **energy reliability and resiliency** and enhance power quality
- On-site electric generation can **reduce grid congestion** and avoid distribution costs.

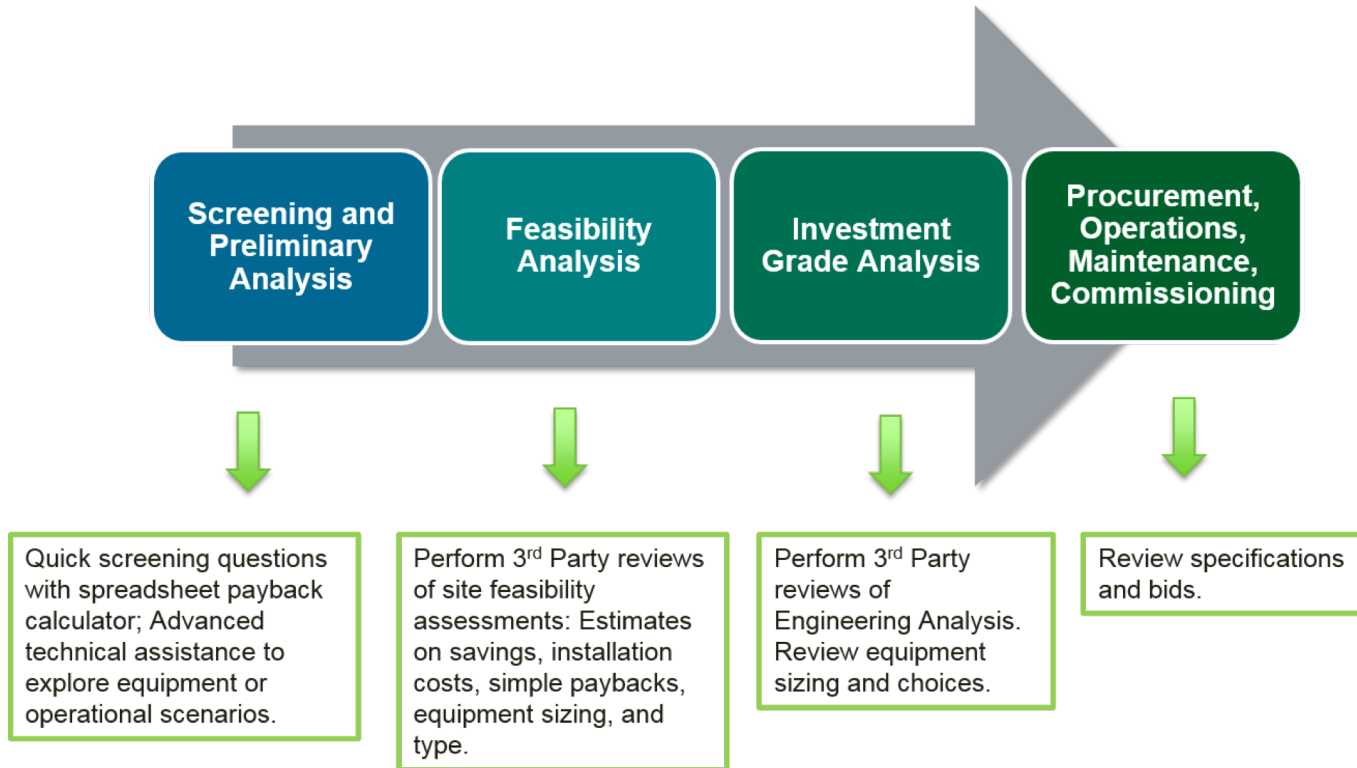


Finding the Best Candidates: Some or All of These Characteristics

- High and constant thermal load
- Favorable spark spread
- Need for high reliability
- Concern over future electricity prices
- Interest in reducing environmental impact
- Existing central plant
- Planned facility expansion or new construction; or equipment replacement within the next 3-5 years



CHP TAP Role: Technical Assistance



CHP TAP Screening Technical Assistance

High level assessment to determine if site shows potential for a CHP project

Quantitative Analysis

Energy Consumption & Costs

Estimated Energy Savings & Payback

CHP System Sizing

Qualitative Analysis

Understanding project drivers

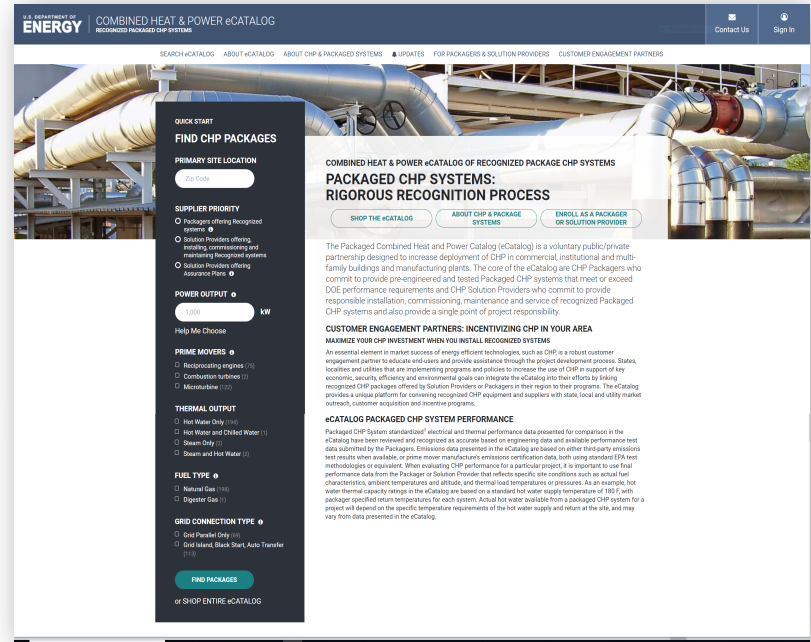
Understanding site peculiarities

Annual Energy Consumption	Base Case	CHP Case
Purchased Electricity, kWh	88,250,160	5,534,150
Generated Electricity, kWh	0	82,716,010
On-site Thermal, MMBtu	426,000	18,872
CHP Thermal, MMBtu	0	407,128
Boiler Fuel, MMBtu	532,500	23,590
CHP Fuel, MMBtu	0	969,845
Total Fuel, MMBtu	532,500	993,435
Annual Operating Costs		
Purchased Electricity, \$	\$7,060,013	\$1,104,460
Standby Power, \$	\$0	\$0
On-site Thermal Fuel, \$	\$3,195,000	\$141,539
CHP Fuel, \$	\$0	\$5,819,071
Incremental O&M, \$	\$0	\$744,444
Total Operating Costs, \$	\$10,255,013	\$7,809,514
Simple Payback		
Annual Operating Savings, \$		\$2,445,499
Total Installed Costs, \$/kW		\$1,400
Total Installed Costs, \$/k		\$12,990,000
Simple Payback, Years		5.3
Operating Costs to Generate		
Fuel Costs, \$/kWh		\$0.070
Thermal Credit, \$/kWh		(\$0.037)
Incremental O&M, \$/kWh		\$0.009
Total Operating Costs to Generate, \$/kWh		\$0.042



DOE Packaged CHP eCatalog

- A national web-based searchable catalog (*eCatalog*) of DOE-recognized packaged CHP systems and suppliers with the goal to reduce risks for end-users and vendors through partnerships with:
 - *CHP Packagers and Solution Providers* that assemble, install, commission and service packaged CHP systems
 - *CHP Engagement* partners that provide CHP market deployment programs at the state, local and utility level
- Pre-engineered and tested packaged CHP systems that meet DOE performance requirements
- End-users and design engineers search for applicable CHP system characteristics, and get connected to packagers, installers and CHP engagement programs
- Allows users to compare technology options on a common basis



<https://chp.ecatalog.lbl.gov/>



Packaged CHP eCatalog Status [April 2020]

- 30 recognized Packagers
- 19 recognized Solution Providers
- 174 Package Offerings
 - 91 recip engine
 - 82 microturbine
 - 1 gas turbine
 - 170 natural gas
 - 4 digester gas
 - 54 grid parallel only
 - 108 grid islandable/auto transfer
 - 24 kW to 7.5 MW
 - Multiple suppliers and packages in every zip code
- 10 Customer Engagement Partners

The screenshot displays the CHP eCatalog interface. On the left, a sidebar contains filters for Primary Site Location (10005), Assurance Plan Offered, Customer Engagement Partner, Power Output (1500 kW), Prime Movers, Thermal Outputs, Fuel Type, Grid Connection Type, and Outdoor Installation. The main area shows 48 packages ordered by relevance, including models like ECOMAX 15 NGS-0-6-HW, TEDOM M285 DM, SWCOGEN SWCS-340-HW-00, TEDOM M285 C, FLEXENERGY 3235M GRID PARALLEL, FLEXENERGY 3235M DUAL MODE, KRAFT ENERGY SYSTEMS KN 285, and GEAR ENERGY C600S-1CHP HPNG DM MAX EFFICIENCY. Each product card includes a photo, name, power output, fuel type, and grid connection options.

<https://chp.ecatalog.lbl.gov/>



CHP Project Resources

DOE Project Profile Database

DOE Policy/Program Profiles

SOUTHEAST

U.S. DOE PROJECT PROFILE

North Carolina State University

Project Overview

North Carolina State University's fall of 2012 is part of a major program, Inc. that delivered two of three central plant boilers, a energy efficiency upgrades on the

The CHP portion of the contract is 3.5 MW combustion turbines and at the Case Utility Plant. The two Campus' peak power demand and reducing utility cost savings. The turbines for the existing district reduce overall energy costs with security by the year 2015.

The DOE Southeast CHP TAP loan assistance to the NCSU Facilities planning and development process review, as well as support on requirements.

Incorporating a CHP system into energy infrastructure provides benefits, including:

- Achieve higher efficiency for heat and steam generation, a 15% increase in steam generation for a 72% overall CHP system
- Reduced operating costs for use of approximately 6.5M
- Aiding in achieving LEED certified building Council for campus
- Capacity for operation during

For many years, EMMCO has been a manager of CHP combustion engines. Turbine Company in San Diego, Calif. waste treatment digester gas. In doing a energy expertise, where excess of

The addition of the 4-6 MW gas turbine the primary electricity generation system gas available. The overall system cost 11 MW.

PACIFIC

U.S. DOE PROJECT PROFILE

East Bay

Project Overview

A new open turbine installed in 2011 at the East Bay area.

The East Bay Municipal Utility District customer in the San Francisco Bay Area for a 72% overall CHP system

For many years, EMMCO has been a manager of CHP combustion engines. Turbine Company in San Diego, Calif. waste treatment digester gas. In doing a energy expertise, where excess of

SOUTHEAST

U.S. DOE PROJECT PROFILE

McAlpine Creek Wastewater Management Facility 1MW Biogas CHP System

Project Overview

Charlotte Water (formerly Charlotte-Mecklenburg Utilities) operates seven wastewater treatment plants, including their largest, McAlpine Creek Wastewater Management Facility (WWMF). Located in Reynolds, near Charlotte, N.C., this facility has a daily treatment capacity of 66 million gallons per day. In March of 2012, McAlpine Creek became the first wastewater treatment plant in North Carolina to utilize anaerobic digester gas to power a Combined Heat and Power (CHP) system. The CHP system generates electricity while also providing process heat to the vital process of aeration/digestion. The project was supported by a 20-year zero-interest loan from North Carolina's Clean Water Financing and Investment Authority (CWFIA). The Southeast Combined Heat and Power Technical Assistance Partnership provided technical support to the utility during the planning phases of the project by conducting a CHP Qualification, Sizing, and a Feasibility Analysis. The facility is now considering the addition of a second CHP system with plans to increase CHP capacity to 2 MW.

Quick Facts

LOCATION: Pineville, NC
MARKET SECTOR: Wastewater Treatment
FUEL: Biogas / Methane
GENERATING CAPACITY: 1MW, approximately 7.9 Mwh annually
EQUIPMENT: GE Inverness 3018
USE OF ELECTRIC ENERGY: Exported to grid
USE OF THERMAL ENERGY: Digester gas to water heating
NET PROJECT COST: \$4.6 million
ANNUAL SAVINGS: \$300,000
ENVIRONMENTAL BENEFITS: Avoids flaring of up to 900 pounds per day of methane gas
EMERGENCY CONTROLS: Lean oxidation catalysts, scrubbed fuel gas
EFFICIENCY: 75%
AWARDS: The project was awarded the 2014 Henry A. Sikes Great Connector Award by The American Council of Engineering Companies of North Carolina for having the best engineering project in the state.

Reasons for Installing CHP

Charlotte Water recognized the energy potential and greenhouse gas emissions associated with the 500 pounds per day of methane gas produced and flared at the McAlpine WWMF. Additionally, the utility was interested in increasing the overall efficiency of their wastewater treatment operations. Prior to installing the CHP system, their anaerobic digesters were heated using 20-year old boilers. By installing CHP, the operational thermal methane gas system that provides heat for the digesters and generates electricity that is sold to Duke Energy under a Power Purchase Agreement, the revenue from which offsets a significant portion of the cost to operate the plant.

SOUTH

U.S. DOE PROJECT PROFILE

Alternative Portfolio Standard

Massachusetts' Alternative Portfolio Standards (APS) provide incentives for installing alternative energy systems and other alternative energy systems by increasing energy efficiency, facilities must submit a required alternative energy certificate (AEC) incentivizing deployment of clean

Although the APS includes many required that at least 4.70% of power produced by APS-eligible

Year	APS Minimum Standard	APS Installed
2009	1.00%	1.50%
2010	1.50%	2.00%
2011	2.00%	2.50%
2012	2.50%	3.00%
2013	3.00%	3.50%
2014	3.50%	4.00%
2015	4.00%	4.25%
2016	4.25%	4.50%
2017	4.50%	4.75%
2018	4.75%	5.00%

Table 1. Minimum standard cumulative CHP installed

The APS-eligible CHP capacity registered CHP systems operate

SOUTH

U.S. DOE PROJECT PROFILE

CHP Roadmap

Program Description

The North Carolina Department of Environmental Quality (NCEM) offers low-interest loans and other financial tools to help fund clean water projects through its Clean Water State Revolving Fund (CWSRF). The CWSRF program was created as the result of a 1987 amendment to the federal Clean Water Act. The program, administered by the U.S. Environmental Protection Agency, provides Federal funds on an 80:20 basis (80% Fed, 20% state) to assist with financing high-priority wastewater projects. Under federal program guidelines, project applicants for funding include those that reduce energy consumption, making combined heat and power (CHP) an ideal candidate.

Two municipal wastewater treatment plants (WWTP) in North Carolina have utilized the CWSRF to finance CHP at their facilities:

- McAlpine WWTP, operated by Charlotte Water in Reynolds, installed a 1 MW biogas-fueled CHP system in 2012
- Multiple Creek WWTP, owned and by the Water and Sewer Authority of Cabarrus County in Midway-Salem, installed a 300 kW biogas-fueled CHP system in 2013

The McAlpine Creek WWTP was the first WWTP in North Carolina to use anaerobic digester gas to power a CHP system. Charlotte Water was awarded a \$3.2 million, 20-year, 0% interest loan under the CWSRF's Green Project Reserve to fund the McAlpine CHP system. This loan covered approximately 70% of the \$4.6 million total costs, resulting in a package of costs that is less than 10%.

Program Background and Development

The CWSRF program replaced its predecessor (the Construction Grant Program) in 1987 and was updated most recently in 2014 under the Water Resources Reform and Development Act. The program offers a variety of financial services to assist clean water projects, including loans at below-market interest rates (as low as 0%); grants; revolving debt guarantees; and state revolving loans. The financial tools are funded primarily (as determined by the program's terms) by payments received from the federal government, and are distributed back into the program, helping to keep it self-funded. Projects can be financed for up to 10 years or the useful life of the equipment, whichever comes first.

Federal rules identify 15 eligible project categories, including combined heat and power (CHP) systems, water conservation, efficiency, and energy efficiency in thermal energy use to CHP. The American Recovery and Reinvestment Act of 2009 (ARRA) also released a requirement that no less than 10% of these funds be allocated to a Green Project Reserve initiative that would target water efficiency improvements, energy efficiency improvements, green infrastructure, and environmentally innovative activities. This requirement has been used forward and is used in program guidelines, including CHP, which fall under the branch of energy efficiency.

[energy.gov/chp-projects](http://www.energy.gov/chp-projects)

[energy.gov/chptap](http://www.energy.gov/chptap)

http://www.chptap.org/Data/projects/McAlpineWWTP-Project_Profile.pdf

<http://www.chptap.org/Data/projects/NCCWSRF-Profile.pdf>



Our Most Important Resource: People!



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Three Rivers CHP Project



McAlpine Creek Wastewater Management Facility CHP Project



Q&A

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Tony Dawson, Project Mgr., 2G

Sarah Hazel, Manager, Office of Sustainability - City of Charlotte

Will Rice, Project Mgr., Charlotte Water



Next Steps

Contact your regional CHP TAP for assistance if:

- Interested in having a screening performed to determine if there is an opportunity for CHP at your site
- If you already have an existing CHP plant and interested in expanding it
- Need an unbiased 3rd Party Review of a CHP proposal





A program sponsored by



Thank You!

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