April 9, 2012

Permit by Rule (PBR) for Combined Heat and Power Units
No. 2012-008-106-AI
Docket No. 2011-1486-RUL

Comments of the U.S. Clean Heat & Power Association

The U.S. Clean Heat & Power Association (USCHPA) is the voice of combined heat and power in the USA. The organization is a 501(c)(6) trade association whose membership includes manufacturers, suppliers, and developers of combined heat and power (CHP) systems, many of whom have existing facilities and/or projects in development in the State of Texas. Currently supplying twelve percent (12%) of U.S. energy capacity, CHP systems can reach efficiencies above eighty percent (80%). There is approximately 82 GW of CHP installed in the U.S. and industry estimates indicate the technical potential for additional CHP at existing sites in the U.S. is approximately 130 GW (plus an additional 10 GW of waste heat recovery CHP). A well-crafted permitting rule is crucial to ensuring CHP fulfills its potential in Texas. Thus we appreciate the opportunity to comment on the proposed permit by rule (PBR) from the Texas Commission on Environmental Quality (TCEQ) for Combined Heat and Power Units (No. 2012-008-106-AI, Docket No.: 2011-1486-RUL).

USCHPA believes the proposed PBR will streamline permitting and lower implementation costs for industries, institutions and businesses seeking to employ CHP and waste heat recovery systems. However, USCHPA supports the recommendations of the Texas Combined Heat and Power Initiative (TXCHPI) which advise that changes to the PBR language are needed to recognize common system engineering practices and to ensure that the streamlined permitting process can be used by a wider number of potential system adopters. USCHPA reiterates those recommendations below.

CHP is a form of distributed energy whereby the heat dispensed during electric generation is captured and efficiently used for heating and cooling or an industrial process. The potential for CHP in Texas is strong, and USCHPA believes that CHP and related waste heat recovery technologies will help Texas industries stay competitive in the global market by lowering energy costs. More CHP will also generate jobs as these capital investments can be designed and engineered by existing Texas companies and assembled by skilled Texas welders, pipefitters and other construction experts very familiar with the equipment used for this reliable energy resource.

In recognition of CHP's economic and environmental benefits the state legislature in 2007 directed the Public Utility Commission of Texas (PUCT) to study the installation and use of CHP technology in the state and to submit a report of its findings. The report titled COMBINED HEAT AND POWER IN TEXAS: STATUS, POTENTIAL, AND POLICIES TO FOSTER INVESTMENT (PUC Report) was submitted to the Public Utility Commission of Texas on December 10, 2008.

The PUC Report revealed that there are 17,333 MW of CHP already in operation and that roughly an additional 13,400 MW of economical CHP opportunities are available. These figures imply that existing CHP installations in Texas represent about 56% of the economic potential. Existing installations in the industrial sector represent 57% of the estimated potential, while the commercial sector has achieved penetration of approximately 38% of the estimated potential.

Of the 13,400 MW of economic CHP opportunities identified in the PUC report, 44% will come from installed systems ranging from 1 – 10 MW, and 50% will be from installed systems larger than 10MW. It is anticipated that the systems will be installed by a wide variety of industries and institutions including the chemical industry, metal manufacturing, food processing, hospitals, nursing homes, colleges and universities.

In order for Texas to reach its CHP potential the PUC Report identified more than a dozen policy options, and "modify air permitting rules to encourage greater CHP development" was included in the list of options. In general, the proposed PBR for CHP facilities fulfills this recommendation because it levels the playing field for CHP by effectively regulating NOx emissions based on the total energy output rather than solely on the electricity output thereby removing a disadvantage for CHP relative to facilities that only generate electricity.

However, in order to help refine the air modeling assumptions used by the TCEQ and develop a PBR that more fully encompasses the type, size and location of CHP installations that can use the PBR, USCHPA offers the following comments in keeping with the recommendations of the TXCHPI:

Dual Fuel Use

- USCHPA agrees that the PBR should be limited to those units using natural gas, but suggests that the Commission leave some leeway to accommodate those systems which may operate for a limited number of hours on an alternate fuel. Many engine and combustion turbine prime movers used in CHP systems can be purchased with the capability to operate on both natural gas and liquid fuels. This capability is critical for a number of facilities such as hospitals, data centers, and other applications, where energy security is paramount. In fact, the energy security value of CHP, including the ability to operate on two fuels, may be a primary selling point for such adopters. Because the use of a secondary fuel is envisioned only in emergency situations where the supply of natural gas is interrupted, emissions resulting from operation on this secondary fuel are expected to be very limited if any. However, the Commission should leave some room in the PBR to allow some limited number of run hours of such dual fuel capable CHP systems on their secondary fuel. USCHPA recommends a limit of no more than 300 hours of operation on the secondary fuel, consistent with similar time limits established in the standard permit for distributed electrical generation units.

105 N. Virginia Ave., Suite 204
Falls Church, VA 22046
703.436.2257
www.uschpa.org

Permit Exemption for Small Units

- USCHPA agrees that the PBR should contain an exemption for small-scale CHP systems, and we further agree that a threshold of less than 20 kW in electrical capacity is appropriate. However, USCHPA takes exception to the language in the draft PBR that appears to limit the exemption to only those units that are deployed at residential locations. USCHPA suggests the PBR language should be changed to eliminate any restrictions on deployment location, thereby allowing small-scale CHP less than 20 kW to be eligible for the exemption allowed in the PBR to all such systems, even if they are deployed in commercial or industrial applications. Furthermore, this approach is consistent with the language of HB3268, which indicates that the Commission should adopt a rule that is independent of end use/application bias.

Supplemental Firing

- Economical design of cogeneration-type CHP systems often dictates sizing the system to the minimum thermal load or the average monthly minimum thermal load. Consequently, the CHP system will not be able to supply 100% of the facility's thermal load at all points during the year. To augment steam production, CHP systems often employ supplemental natural gas firing capability. This capability allows additional natural gas to be injected downstream of the prime mover, but upstream of the heat recovery steam generating (HRSG) unit. The efficiency of such supplemental firing is very high, typically in the range of 92-95%, which substantially exceeds the use of a stand-alone boiler. Thus, supplemental firing is an economical and environmentally smart way to meet facility steam deficiencies. USCHPA suggests the Commission allow the use of pipeline grade natural gas in supplemental firing applications, provided the emissions resulting from the use of such gases meets the emissions limits required within the PBR. USCHPA believes the use of output-based emissions, whereby thermal energy capture and use can be credited to the overall energy produced by the system, should alleviate any concerns about increased emissions form supplemental firing.
- In addition to pipeline grade natural gas, some locations may have access to and be able to employ industrial by-product gases, waste gases, off-spec gases, and flare gases in supplemental firing applications. These gases can be used to augment steam production for thermal applications and/or electrical production, if a steam turbine generator is integrated in the project. USCHPA suggests the Commission allow the use of waste industrial gases in supplemental firing applications, provided that the emissions resulting from the use of such gases meets the emissions limits required within the PBR.

Exhaust Stack Parameters

- CHP systems that create a new emission point and are larger than 5 MW typically include a combustion turbine with a heat recovery system. The heat recovered is typically in the form of steam, but it can also be another heat transfer or process fluid. Often the combustion turbine exhaust temperature is increased using supplemental fuel fired in a duct burner to increase the thermal energy output through heat recovery. This increases the system efficiency because the duct burner uses excess oxygen in the turbine exhaust instead of combustion air and provides a way to balance the thermal energy requirement independent of the power output. It should be noted that occasionally combustion turbine exhaust is used directly for heating or drying in a process or as combustion air for a process furnace. In that case, no new emission point is created.

- Exhaust stacks are designed to impose no backpressure on the heat recovery system. The stack velocity creates a friction loss about equal to the draft created by the stack temperature. The typical stack velocity is 50 to 75 feet per second.

- The stack height is usually a minimum of 50 feet above grade. Most heat recovery systems have a high profile, so the outlet breeching to the stack is at least 20 to 30 feet above grade. Larger units will be taller. This is because it is less expensive to fabricate and ship heat recovery boilers that are limited in width, but are tall. Stack height is added above the breeching to allow a fully developed parallel flow profile for emission testing.

Multiple Units

- Whether implemented in new construction or as a retrofit into an existing facility, the optimal solution for many sites may involve multiple combustion turbines or reciprocating engines. A number of technical and financial reasons driving the use of multiple prime movers include:
    - Project phases: CHP systems are best designed when they meet the thermal loads of a campus, facility, or building. In many cases, especially in new construction, the thermal loads build over time as the facility or campus is fully developed. Because CHP is a capital intensive solution, the developer may desire to augment the CHP system over time as loads develop.
    - Load Following: In many applications, especially those in the commercial buildings where large load swings occur during the day, CHP projects may be expected to closely follow on-site thermal or electrical loads. Because prime movers, especially combustion turbines, experience greater inefficiencies at part load operation, the use of multiple prime movers allows units to be brought on line or taken off line as loads change, thereby creating greater operational flexibility, better overall efficiency, and lower emissions.
    - Redundancy: Because on-site CHP systems can be designed to operate independent from the utility grid, they are a good solution for critical buildings and facilities requiring secure power. Many adopters in this category find that multiple units provide redundancy of the key prime mover equipment, which can further enhance the energy security value proposition of the system.
    - Standby Charges: Adopters of CHP systems rely on the electricity grid to provide backup electricity during times when the on-site CHP system is not working, such as during planned maintenance. Power demand during these times can "ratchet" a charge on the adopter's utility bill lasting for as much as a full year. To avoid excessive demand charges, CHP adopters may choose multiple prime movers to maintain some on-site power production under all circumstances.
- To allow adopters to implement optimal configurations, USCHPA encourages the Commission to allow multiple units within the PBR process, provided project implementation meets reasonable time constraints established by the Commission and/or the total megawatts of the combined units do not exceed any size cap included in the permit.
- USCHPA supports TXCHPI's suggestion to add the following language to the definition of CHP:

(b) Definitions.
(1) Combined heat and power (CHP) unit--A collection of facilities and

other equipment that generally consists **<u>of one or more</u>** electric generating unit (EGU) and a means of extracting energy from the exhaust of ~~that~~ **<u>the</u>** EGU for useful purposes other than electricity generation, such as heating or cooling. A CHP unit does not include facilities for generating additional electricity after the EGU. Equipment that is not a source of emissions itself but also extracts energy from the exhaust flow to create electricity is not a facility and may be used in addition to a CHP unit authorized by this section.

Net Emissions

- The low emission levels now required for many prime movers — especially gas turbines — has led to lower pollutants concentrations at the exhaust than what is found in the ambient air inducted into the engine. Although this is not found in every instance, it does occur frequently enough that its benefits should be recognized. USCHPA suggests that emission concentration should be measured at the engine's inlet and at the exhaust, and that the concentration used to calculate the environmental impact be the net difference. Measuring the impact by this differential recognizes that the prime mover can exhibit a net benefit with regard to some emissions. Since net emission benefits have not been recognized in the past, USCHPA believes this is a good opportunity to recognize the positive developments in technical innovation that have occurred in the turbine industry. We suggest that the emissions for any pollutants be determined on a "Net" basis.

Regulatory Costs

- Rule language under the subtitle "Public Benefits and Costs" (page 19) states that monitoring and testing cost for CHP units authorized by the proposed PBR are expected to be about the same as costs for a standard permit. However, combined heat and power facilities are usually base-loaded and operate continuously except for short scheduled maintenance periods. If the performance testing, as outlined on page ten of the rule, is required every 16,000 hours of operation testing would occur at least two additional times in the first five years of operation. It does not appear that the testing cost estimated by TCEQ included these additional tests in the permit's cost impact assessment.

To help TCEQ staff and the general public gain a better understanding of CHP and its environmental benefits, USCHPA offers the following comments regarding the environmental benefits of CHP:

Combined heat and power (CHP) yields several environmental benefits as an efficient form of on-site power generation. Its efficiencies stem from its ability to capture waste heat from fuel combustion and apply it toward other facility functions such as HVAC, process heating, cooling, hot water, and dehumidification.

CHP efficiencies offer significantly reduced emissions relative to the centralized power generation model, and as a form of distributed generation, CHP suffers no transmission losses. Additionally, unlike centralized power plants, CHP requires little to no water, depending on system configuration. CHP also provides robust continuous base-load power using relatively minimal physical space.

CHP's environmental benefits stand out in light of present concerns over Texas' drought conditions. Texas is projected to sustain severe droughts in the coming years while a growing population increasingly strains the state's water supply and infrastructure. If these projections hold true, centralized power plants' water consumption will draw larger percentages of the state's water supply. As a result, utility rates could due to greater reliance on desalinated or reused water. Insufficient water resources could also trigger statewide blackouts if power plants cannot access enough water to operate. For these reasons CHP stands as a reliable energy resource.

The tables and data tables below reflect conservative estimates of CHP's capacity, emission, and water use rates relative to the centralized power generation model and to a solar photovoltaic (PV) system.

EMISSIONS

Because CHP can generate more work per Btu than grid-supplied electricity can, its emissions of CO_2, and SO_2 are greatly reduced in comparison.

Table E-1. CHP and grid emissions

Pollutant	Grid (lbs./MWh)	CHP (lbs./MWh)	Reduction
CO_2	1,162	615	47%
SO_2	2.33	.003	99%

Source: U.S. EPA

Table E-2. Carbon dioxide emissions

The CO_2 emissions rates below were calculated using the following data:

- Natural gas = heat rate (Btu/kWh) * 1000 (kWh/MWh) *117.1 (lbs/MMBtu) / 1,000,000 (Btu/MMBtu)
- Coal = heat rate (Btu/kWh) * 1000 (kWh/MWh) *210.4 (lbs/MMBtu) / 1,000,000 (Btu/MMBtu)
- Note: 210.4 lbs/MMBtu is an average rate between coal (205.3 lbs/MMBtu) and lignite (215.4 lbs/MMBtu)

CO_2 emissions were calculated by multiplying the emissions rate by the corresponding electrical energy generation by year.

Generation Source	Rate (lb./MWh)
CHP	798[1]
Nat Gas	978[2]
Coal	2867[3]
Nuclear	0
Wind	0
Other	0

Table E-3. Sulfur oxide emissions

Generation Source	Rate (lb./MWh)
CHP	0[4]
Nat Gas	0[5]
Coal	9.79[6]
Nuclear	0
Wind	0
Other	0

Table E-4. CHP and solar PV

The following data applies to a 1 MW CHP reciprocating engine with 34 percent electric efficiency and 72 percent total efficiency. Such a configuration displaces equivalent ERCOT generation, whose average fossil generation (eGRID 2007) entails 9,258 Btu/kWh; 1,532 lbs CO_2/MWh; and 6 percent transmission losses.

Category	1 MW CHP	1 MW Solar PV
Annual capacity factor	85%	15%
Annual electricity	7,446 MWh	1,577 MWh
Annual useful heat	8,273 MWh_t	None
Physical space required	1,500 sq. ft.	100,000 sq. ft.
Capital cost	$2.4 million	$4.6 million
Annual energy savings	33,633 MMBtu	15,475 MMBtu
Annual CO_2 savings	3, 739 tons	1, 280 tons

[1] Calculated from 2010 CHP heat rate of 6817 Btu/kWh.
[2] Calculated from 2010 NG unit heat rate of 8349 Btu/kWh.
[3] Calculated from 2010 coal unit heat rate of 13,626 Btu/kWh.
[4] Hadley and Van Dyke, p. 5
[5] Hadley and Van Dyke, p. 5
[6] Hadley and Van Dyke, p. 5

Source: calculations by ICF International, 2011

WATER CONSUMPTION

CHP systems tend to be air-cooled and require little water in the production of electricity and thermal energy. On the other hand, power plants fueled by coal, natural gas, and nuclear power require 157,000 million gallons of water (482,100 acre-ft.) per year for cooling—the equivalent of providing enough water for 3 million people per year using 140 gallons per person each day.[7] As of January 2010, CHP accounted for 16,485 MW—or roughly 20 percent—of the state's overall capacity.[8] This amount of CHP conserved 44,600 million gallons per year compared to equivalent centralized power generation—roughly one-quarter of total annual water usage by thermoelectric plants.

Table W-1. Water consumption rates

Generation Source	Rate (gal/MWh)	Source
CHP	74	Gulf Coast Clean Energy Center*
Natural gas	194	King, Duncan, and Webber, p. 25
Coal	390	Twomey et al – 87.5% of average (200-700 gal/MWh)
Nuclear	600	King, Duncan, and Webber, p. 25
Wind	0	King, Duncan, and Webber, p. 25
Other	0	King, Duncan, and Webber, p. 25

** This calculation involves a capacity weighted average of water consumption estimates for different CHP types.*

USCHPA believes the recommended changes above, if implemented, will further streamline the permitting process and ensure that a wide range of potential CHP adopters may take advantage of the process. We appreciate the opportunity to comment on the proposed PBR.

Sincerely,

Jessica H Bridges, CAE IOM

Executive Director

[7] Twomey et al.
[8] ICF International.

105 N. Virginia Ave., Suite 204
Falls Church, VA 22046
703.436.2257
www.uschpa.org

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