CALIFORNIA
ENERGY
COMMISSION

# GUIDELINES FOR CERTIFICATION OF COMBINED HEAT AND POWER SYSTEMS PURSUANT TO THE WASTE HEAT AND CARBON EMISSIONS REDUCTION ACT, PUBLIC UTILIITES CODE, SECTION 2840 ET SEQ.


**DOCKET**
**08-WHCE-1**
DATE
RECD. OCT 06 2009


## STAFF DRAFT GUIDELINES


October 2009
CEC-200-2009-016-SD


Arnold Schwarzenegger, *Governor*

# CALIFORNIA ENERGY COMMISSION

Arthur J. Soinski, Ph.D.
***Principal Author***

Linda Kelly
***Project Manager***

Ivin Rhyne
***Manager***
**ELECTRICITY ANALYSIS OFFICE**

Sylvia Bender
***Deputy Director***
**ELECTRICITY SUPPLY ANALYSIS DIVISION**

Melissa Jones
***Executive Director***

Please use the following citation for this report:

Soinski, Ph.D., Arthur J., 2009. *Guidelines for Certification of Combined Heat and Power Systems Pursuant to the Waste Heat and Carbon Emissions Reduction Act, Public Utilities Code Section 2840 et. seq*. California Energy Commission. CEC-200-2009-016-SD.

# Table of Contents

## Abstract

Assembly Bill 1613 (Blakeslee, Chapter 713, Statutes of 2007), amended by Assembly Bill 2791 (Blakeslee, Chapter 253, Statutes of 2008), is designed to encourage the development of new combined heat and power systems in California with generating capacity not greater than 20 megawatts. The Act directs the California Energy Commission to adopt by January 1, 2010, guidelines establishing technical and legal criteria for eligibility of combined heat and power systems for programs to be developed by the California Public Utilities Commission and publicly owned utilities. The Act directs the California Public Utilities Commission to establish a standard tariff for the sale of electricity, and it requires a local publicly owned utility serving end-use customers to provide a market for the purchase of excess electricity. The Guidelines and forms establish the technical and legal criteria and the reporting requirements for the sale of excess electricity from combined heat and power systems.



**Keywords**: Assembly Bill 1613, AB 1613, bottoming cycle, combined heat and power, energy efficiency standard, environmental performance standard, export tariff, fuel savings standard, greenhouse gas emissions, marginal power plant, $NO_x$ emissions, performance monitoring, topping cycle, waste heat utilization

# California Energy Commission
# DRAFT
# Guidelines for Certification as an Eligible Customer-Generator of a Combined Heat and Power System Pursuant to the Waste Heat and Carbon Emissions Reduction Act, Public Utilities Code Section 2840 et seq.

## I. Scope

These Guidelines set forth the technical and legal requirements that combined heat and power (CHP) systems must meet to be certified as an "eligible customer-generator" of an electric corporation or as a "retail end-use customer" of a publicly owned electric utility pursuant to the Waste Heat and Carbon Emissions Reduction Act, California Public Utilities Code Sections 2840 through 2845.

## II. Definitions

For purposes of these Guidelines, the following terms shall be defined as follows:

a) The Act: The Waste Heat and Carbon Emissions Reduction Act, California Public Utilities Code Sections 2840 through 2845.

b) Applicant: The Owner/Operator of a CHP System seeking Energy Commission certification of compliance under these Guidelines of its CHP System.

c) Bottoming Cycle CHP System: A CHP system in which the input energy (for example, fuel) is used first to produce useful thermal energy for a process and some of the thermal energy is then used for electricity production.

d) Carbon dioxide equivalent: As defined in Section 95102(a)(33) of Title 17 of the California Code of Regulations.

e) Certified CHP System: An Eligible CHP system that has been certified by the Energy Commission as complying with these Guidelines.

f) Combined Heat and Power (CHP) System: A new or eligible retrofit system, with a net electrical generating capacity less than or equal to 20 megawatts, located at a residential, commercial or industrial facility owned and operated by an "Eligible Customer-Generator" or "retail end-use customer," as those terms are used in California Public Utilities Code sections 2840.2(b) and 2841.5, respectively, that produces both electricity and thermal energy and that may produce mechanical energy also.

g) Connected On-Site Thermal Load: For a Topping Cycle, the equipment at the host residential, commercial or industrial facility that uses the thermal energy from a CHP system.

h) Electrical Corporation: As defined in Public Utilities Code section 218.

i) Eligible Customer-Generator: A CHP system that has been shown to meet these Guidelines.

j) Eligible Retrofit: A CHP system that was operational prior to January 1, 2008, that did not receive funding under the Self Generation Incentive Program, that previously did not meet two or more criteria for Certification and that was modified after January 1, 2008, to meet all of the criteria for Certification.

k) Energy Commission: The State Energy Resources Conservation and Development Commission.

l) Heating Value: The amount of energy released when a specified amount of fuel is burned completely and the combustion products are returned to the state of the reactants. The heating value is dependent on the phase of water/steam in the combustion products. If $H_2O$ is in liquid form, heating value is called HHV (Higher Heating Value). When $H_2O$ is in vapor form, heating value is called LHV (Lower Heating Value).

m) Net Generating Capacity: The nameplate rating of a CHP System as designated by the manufacturer at temperature, humidity and elevation conditions specified by the International Organization for Standardization, minus parasitic electrical loads of the ancillary equipment needed to operate the CHP system.

n) Owner/operator: The individual or entity responsible for compliance and reporting requirements of a Certified CHP System.

o) Publicly Owned Utility: A "local publicly owned electric utility" as defined in Public Utilities Code Section 224.3.

p) Supplementary Firing: Combustion of fuel to add heat to an already hot gas stream 1). within a Topping Cycle CHP System in order to increase the amounts or temperature of the thermal output or 2). within a Bottoming Cycle CHP System to increase the amount of electrical energy or mechanical energy production to meet on-site demand.

q) Topping Cycle CHP System: A CHP system in which the input energy (for example, fuel) is used first for electricity production and at least some of the reject heat from electricity production is then used as useful thermal energy.

r) Useful Energy Output: Energy from a CHP System used in a productive manner for a beneficial use; may include thermal, mechanical and electrical energy.

## III. Standards for Certification of CHP Systems

A CHP System shall meet all of the criteria set forth in this section.

**a) Net Electrical Generating Capacity Standard**

The net electrical generating capacity of the CHP System shall be no more than 20 megawatts (MW).

**b) Topping Cycle Thermal Energy Output Standard**

The useful thermal energy output of a Topping Cycle CHP system, as designed, shall be no larger than the maximum one-hour thermal load served by the CHP system.

**c) Energy Conversion Efficiency Standard**

A Topping Cycle CHP System shall achieve an Energy Conversion Efficiency of no less than 60 percent, both as designed and on an annual operating basis. The Energy Conversion Efficiency shall be calculated by dividing the Useful Energy Output of the CHP System by the fuel energy input on a HHV basis.

A Bottoming Cycle CHP System that uses supplementary firing shall achieve an Energy Conversion Efficiency of no less than 60 percent both as designed and on an annual operating basis. The Energy Conversion Efficiency shall be calculated as (the sum of the useful electrical energy output plus useful mechanical energy output) divided by the fuel energy input, on a HHV basis, for supplementary firing.

A Bottoming Cycle CHP System that does not use supplementary firing is exempt from the Energy Conversion Efficiency Standard.

**d) Greenhouse Gas Emission Standard**

A CHP System shall meet a Greenhouse Gas (GHG) Emission Standard of 1,100 pounds of carbon dioxide equivalent emissions per megawatt-hour (1,100 lb $CO_2$ equivalent/MWh), crediting 1 MWh per 1,341 hp-hr of useful mechanical energy output, and 1 MWh for each 3.4121 MMBtu of useful thermal energy output. Carbon dioxide equivalent emissions shall be calculated according to Title 17, California Code of Regulations, Section 95125.

A Bottoming Cycle CHP System that does not use supplementary firing is exempt from the Greenhouse Gas Emission Standard.

**e) Thermal Energy Utilization Standard**

(1) The useful thermal energy output of a Topping Cycle CHP System, during the 12-month period beginning with the date the CHP system first produces electrical energy, and any calendar year subsequent to that year, shall be no less than 15 percent of the total fuel energy input, measured on a HHV basis.

(2) The waste heat from process(es) (which is the thermal energy input to the electricity generator) of a Bottoming Cycle CHP system must have little or no commercial value for the process(es) at the residential, commercial or industrial facility, the fuel(s) and thermal energy must be used to maximize process efficiency in the facility, and the waste heat must exist in the absence of an electricity generating system.

**f) Date of operation**

The CHP must be placed in operation, either as new construction or eligible retrofit, after January 1, 2008.

**g) Fuel Savings Standard**

A Topping Cycle CHP System must use less fuel than would have been used by the separate generation of electricity delivered by the utility grid and an onsite boiler. The power plant supplying the utility grid shall be assumed to have an efficiency of 44.0 percent or a heat rate of 7,750 Btu/kWh on a HHV basis after transmission and distribution losses have been subtracted. The displaced boiler shall be assumed to have a fuel-to-steam efficiency of 80 percent.

A Bottoming Cycle CHP System is exempt from the Fuel Savings Standard.

**h) $NO_x$ Emission Standard**

A CHP System shall meet an oxides of nitrogen ($NO_x$) emission standard of 0.07 pounds of $NO_x$ per megawatt hour (0.07 lb $NO_x$/MWh) of electrical energy produced, crediting mechanical energy produced at the rate of 1 MWh per 1,341 horsepower-hour (hp-hr). If the CHP system efficiency is greater than or equal to 60 percent, the useful thermal energy produced may be credited toward meeting the standard at the rate of 1 MWh per 3.412 million Btu.

## IV. Initial Qualification of a CHP System

**a) Submission of Application Forms**

To demonstrate compliance with Section III of these Guidelines, each applicant seeking certification of an Eligible CHP Facility shall submit to the Executive Director of the Energy Commission a Form CEC-2843. The Form CEC-2843 shall be completed in accordance with the accompanying instructions, shall include all required schedules and attachments, and shall include a signed declaration, executed under penalty of perjury by an authorized agent of Applicant, attesting to the veracity of all information contained therein.

**b) Determination of Completeness of Application**

Within 14 days of the receipt of the Form CEC-2843, the Executive Director may inform Applicant that its submission is incomplete, and specify the additional information

required. Applicant may submit the additional information required in an addendum to the Form CEC-2843, which shall be deemed a part of Applicant's Form CEC-2843.

The application shall be deemed complete on the 15th day after receipt by the Energy Commission of the Form CEC-2843 or any addendum thereto if no additional information is requested by the Executive Director.

**c) Determination of Compliance**

The Executive Director shall review the Form CEC-2843, including all attachments, schedules, and addenda thereto. If the Form CEC-2843 demonstrates that the CHP System complies with the requirements of Section III of these Guidelines, the Executive Director shall issue a Certificate of Initial Compliance certifying that Applicant's proposed CHP system is a Certified CHP System.

If the Executive Director determines that the CHP System does not comply, he/she shall issue a written Statement of Denial, identifying all deficiencies in the Application Forms. The Applicant may submit revised Form CEC-2843 for review.

The Executive Director shall issue the Certificate of Initial Compliance or Statement of Denial within 30 days of the date the Form CEC-2843 is deemed complete.

**d) Appeal of Executive Director's Determination**

Either the Applicant or the Electrical Corporation or Publicly Owned Utility to which Applicant seeks to sell electricity may appeal the Executive Director's determination to the Energy Commission, by submitting a written appeal to the Chairman of the Electricity and Natural Gas Committee within 30 days of the Executive Director's determination. The appeal shall explain why the issuance of the Certificate of Initial Compliance or Statement of Denial was in error.

The appeal will be heard by the Energy Commission at a duly noticed business meeting within 60 days of the receipt, at which time the Energy Commission shall review the matter de novo, and issue either a Certificate of Compliance or a Statement of Denial for the proposed project, or continue the matter pending the receipt of additional information.

## V. Ongoing Compliance, Performance Monitoring and Annual Reporting

**a) Submittal of Annual Reporting Form**

(1) The Owner/Operator of a Certified CHP System is responsible for maintaining ongoing compliance of the system with the requirements in Section III of these guidelines. To demonstrate ongoing compliance, the Owner/Operator shall file a completed Form CEC-2843A with the Executive Director of the Energy Commission annually within 30 days of the anniversary of the date the CHP System was certified.

(2) Each Form CEC-2843 Annual shall be completed in accordance with its accompanying instructions, shall include all required attachments, and shall bear the original signature of an authorized agent of the Applicant, executed under penalty of perjury, attesting to the veracity of all information contained therein.

(3) Exception for small CHP systems and/or those with limited export: The Owner/Operators of a CHP System that has a net generating capacity of 1 MW or less and/or that sells fewer than 5,000 MWh/year of electricity is exempt from Annual Reporting, unless the Owner/Operator has been cited for being in violation of any operating permit.

**b) Review of the Annual Reporting Form**

The declaration of compliance of the Owner/Operator shall be assumed to be true. The Executive Director shall review the Annual Reporting Form, attachments and supporting data to determine whether a Certified CHP System continues to meet all technical performance requirements only if the CHP System Owner/Operator declares that the CHP System was not in compliance or if the declaration of compliance is challenged by the CPUC, the Electrical Corporation or Publicly Owned Utility purchasing electricity from the Certified CHP System. The Executive Director may direct Energy Commission staff to perform an audit of the CHP System and thermal host facility. If the review and/or audit determine that the CHP System is not in compliance, the Executive Director shall issue a Notice of Non-Compliance.

**c) Correction of Non-Compliance**

If the Executive Director issues a Notice of Non-Compliance, the Applicant shall file a Compliance Plan with the Energy Commission and the CPUC within three months and shall execute the Compliance Plan. The Executive Director may decertify the CHP System if correction is not demonstrated within the next full year Annual Report.

# APPENDIX A:
# California Energy Commission
# Application Forms and Instructions for Certification of a Combined Heat and Power System Pursuant to the Waste Heat and Carbon Emissions Reduction Act, Public Utilities Code Section 2840 et seq.

# Form CEC-2843 Application for Certification as a Qualifying Combined Heat and Power (CHP) System

| *Line* | *Field Description* | |
|---|---|---|
| 1 | **CHP System Name** | |
| 2 | **CEC Plant ID** | |
| 3 | **EIA Plant ID** | |
| 4 | **Qualifying Facility ID** (if applicable) | |
| 5 | **Thermal Host/Thermal Facility** | |
| a | Business Name | |
| b | Street Address | |
| c | City | |
| d | County | |
| e | Zip Code | |
| f | Contact Person Name | |
| g | Phone | |
| h | email | |
| 6 | **CHP System Owner/Operator** | |
| a | Full Legal Name | |
| b | PO Box | |
| c | Street Address | |
| d | City | |
| e | State | |
| f | Zip Code | |
| g | Contact Person Name | |
| h | Phone | |
| i | email | |
| 7 | **Applicant for CHP System Certification** | |
| a | Full Legal Name | |
| b | PO Box | |
| c | Street Address | |
| d | City | |
| e | State | |
| f | Zip Code | |
| g | Contact Person Name | |
| h | Phone | |
| i | email | |
| 8 | **NAICS Code of Thermal Host** | |
| 9 | **NAICS Code of Direct Onsite User of Electricity** | |
| 10 | **Prinicipal Products of Thermal Host** | |
| 11 | **Thermal End Use(1)** | |
| 12 | **CHP System Type (2)** | |

| | | |
|---|---|---|
| **13** | **Generator Specific Information:** | |
| **a** | Generator (Unit) ID | |
| **b** | Generator Nameplate Capacity (MW) | |
| **c** | Prime Mover Type(s) | |
| **d** | Prime Mover Manufacturer(s)/Supplier(s) | |
| **e** | Prime Mover Model Number | |
| **f** | ISO Power Rating (MW) @ 100% Output | |
| **g** | Primary Fuel Type | |
| **h** | Secondary Fuel Type | |
| **i** | Ancillary Equipment Description | |
| **j** | Ancillary Equipment Load @100% Output (MW) | |
| **k** | Net Electrical Generating Capacity: (Prime Mover ISO Power Rating) - (Ancillary Equipment Load) =_____(MW)) | |
| **l** | Net Electrical Generating Capacity > 20 MW? If yes, do not submit Form CEC-2843. | |
| ***Notes*** | (1) For example: Space heating, space cooling, drying, distillation, calcining, other (please specify) _____ | |
| | (2) Topping cyde, without supplementary firing. Topping Cyde with supplementary firing. Bottoming cyde without supplementary firing. Bottoming cyde with supplementary firing. Other: (please specify) _____ | |

**14 Declaration**

I certify under the penalty of perjury of the laws of the State of California that I am authorized by

**(type in Applicant's Full Legal Name here)**

to submit the enclosed Form 2840 with Schedules and Required Attachments. This Form fulfills the requirement of California Public Utilities Code Section 2840 et seq. The matters contained in this report are, to the best of my knowledge and belief and based on diligent investigation, true, accurate, complete and in compliance with these regulations.

(Signature)

(Printed Name)

(Company Name)

(Federal Tax Indentification Number)

(Date)

Submit Form CEC-2843 to:

**CHP Guru**
**California Energy Commission**
**1516 Ninth Street, MS-20**
**Sacramento, CA 95814**

# Instructions for Form CEC-2843
# Application for Certification as a Qualifying Combined Heat and Power (CHP) System

**Purpose:** Form CEC-2843, Associated Schedules, and Required Attachments provide forecasts of fuel use, electric generation, thermal energy usage, and emissions information related to combined heat and power (CHP) system power plant operations. This information is used by Energy Commission to certify a CHP System as qualifying under AB 1613, Statutes of 2007, as a Certified CHP System.

**Authority:** California Public Utilities Code Section 2840 et seq.
.
**Who must file:** Each Owner/Operator of a CHP system located within California who seeks to be an "Eligible customer-generator" of an electric corporation or a "retail end-use customer" of a publicly owned electric utility.

**When to file:** Prior to signing a contract for the sale of electricity. An associated Form CEC-2843 Annual is to be filed annually after the CHP system becomes operational.

**How to file:** Reports in paper or electronic file format may be submitted by email or U.S. mail. Each submittal must be accompanied with a declaration.

**Where to file:**

CHP Guru
California Energy Commission
1516 Ninth Street, MS-20
Sacramento, CA 95814
or
CHPGuru@energy.state.ca.us

**Instructions**

1. **CHP System Name**. Name of the combined heat and power system.
2. **CEC Plant ID**. The California Energy Commission will assign this code of identification when the power plant is first reported on Form CEC-2843. The respondent should use the Commission assigned code in subsequent filings.
3. **EIA Plant ID**. Code of identification used by the Energy Information Administration. Also known as EIA Facility Code.
4. **Qualifying Facility ID**. Identification code used by the purchasing utility for PURPA qualifying facilities. Also known as QFID.
5. **Thermal Host Facility/Thermal Facility**: Name and location of the thermal host for a Topping Cycle System or the name and location of the source of waste heat for a Bottoming Cycle System, including contact information.
6. **CHP System Owner/Operator**. The full legal name of the CHP system Owner/ Operator and principal business address, including contact information.

7. **Applicant for CHP** System Certification. The full legal name of the entity that will enter into a contract for the sale of electricity.
8. **NAICS Code of Thermal Host or Thermal Facility.** For a topping cycle provide the NAICS (North American Industry Classification System) code of the entity that consumes the useful thermal output (steam or waste heat) of the CHP system. For bottoming cycle, provide the NAICS code of the entity that delivers waste heat to the CHP system. For information about the NAICS, go to http://www.census.gov/epcd/www/naics.html
9. **NAICS Code of Direct Onsite User of Electricity**. If all or part of electricity produced by the CHP system is consumed by an entity onsite, other than consumption by the auxiliary equipment of the power plant, provide the NAICS codes of that entity. For information about NAICS codes, go to http://www.census.gov/epcd/www/naics.html
10. **Principal Products**. The major products or processes associated with the use of thermal energy.
11. **Thermal End Use**. See notes on Form CEC-2843.
12. **CHP System Type**. See notes on Form CEC-2843.
13. **Generator Specific Information**.

    a. Provide the commonly used name for the CHP System
    b. The sum of the nameplate capacity in MW of all generators in the CHP system
    c.–f. Provide the specifics about each of the prime movers composing the generating system

    g.–h. Provide the commonly used fuel and all other fuels that will be fired.

    i.–j. Auxiliary Equipment is all equipment required to operate the CHP system other than the equipment that is packaged with the CHP system and that is not included in the power output capacity designated by the prime mover or CHP system supplier. The auxiliary equipment load estimate is critical if the prime mover output is close to the 20 MW size limit in AB 1613.

    Note: Additional information is required in the required attachments describing and showing the CHP system and thermal facility schematics.

# Form CEC-2843
# Application for Certification as a Qualifying Combined Heat and Power (CHP) System

## Schedule A:
## Predicted Annual Energy Inputs, Outputs and Thermal Energy Usage

*Required Attachment to Form CEC-2843*

Applicant Name _____ CEC Plant ID: _____

Table 1. Predicted Annual Fuel Input and Energy Outputs.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Standard Hours per Month (hours)** | **Generator Equivalent Full Load Hours per Month (hours)** | **Fuel Energy Input (MMBtu)** | **Net Electricity Generation (MWh)** | **On-Site Electricity Use from CHP System (MWh)** | **Electricity Export from CHP System to Utility (MWh)** | **Useful Mechanical Energy Output from CHP System (hp-hr)** | **CHP System Thermal Energy Output (MMBtu)** | **CHP System Thermal Energy Return (MMBtu)** | **Waste Heat to Thermal Host Facility (MMBtu)** | **Host Site Thermal Energy Process Demand (MMBtu) (1)** | **Useful Thermal Energy Output (MMBtu) (2)** |
| Jan. | 744 | | | | | | | | | | | |
| Feb. | 696 | | | | | | | | | | | |
| March | 744 | | | | | | | | | | | |
| April | 720 | | | | | | | | | | | |
| May | 744 | | | | | | | | | | | |
| June | 720 | | | | | | | | | | | |
| July | 744 | | | | | | | | | | | |
| Aug. | 744 | | | | | | | | | | | |
| Sept. | 720 | | | | | | | | | | | |
| Oct. | 744 | | | | | | | | | | | |
| Nov. | 720 | | | | | | | | | | | |
| Dec. | 744 | | | | | | | | | | | |
| **Annual Total (2)** | 8,760 | | | | | | | | | | | |
| **Average Annual Hourly Value (3)** | | | F ave. | P ave. | | | M ave. | | | | | Q. Ave. |

(1) Excludes dumped thermal energy and stack exhaust energy with Host Facility.

(2) The lesser of Waste Heat to Thermal Host Facility and Host site Thermal Energy Connected Load

(3) The Average Hourly Value for Energy Inputs and outputs is the Annual Total divided by the Annual Generator Equivalent Full Load Hours

**Compliance with Energy Conversion Efficiency Standard**

1. **A. Topping Cycle. Predicted Annual Output Efficiency** _____ X 100 = _____%
   (Sum of Columns 5, 8 and 13) Divided by Column 4. (Use consistent units)

1. **B. Bottoming Cycle, Predicted Electrical Efficiency** _____ X 100 = _____%
   **(**Sum of Columns 5 and 8) Divided by Column 4. (Use consistent units)

*If Line 1 is less than 60%, the CHP System will not qualify. Do not file Form CEC-2843.*

**Greenhouse Gas Emission Standard, Topping Cycle only**

2. **Carbon Dioxide Emission Factor** _____ lb/MMBtu
   (A default value for natural gas of 53.42 kg $CO_2$/MMBtu or 117.77 lb $CO_2$/MMBtu may be used)

3. **Other Greenhouse Gases, Emission Factor** _____ lb/MMBtu
   (A default value of 0.0009 kg/MMBtu x 21 for methane + 0.0001 kg/MMBtu x 310 for nitrous oxide may be used. This will add 0.05 lb/MWh to the carbon dioxide factor)

4. Carbon Dioxide Equivalent Emission Factor _____ lb/MMBtu
   (Add Lines 2 plus Line 3)

**Compliance with Greenhouse Gas Emission Rate**

5. Emission Rate = Carbon Dioxide Equivalent Emission Factor X $F_{ave}$ ÷
   Useful Energy Output = _____ lb/MWh

   (Useful Energy Output = $P_{Ave} + M_{Ave}/1{,}341 + Q_{Ave}/3.4121$)

*If Line 5 is more than 1,100 lb/MWh, the CHP System will not qualify. Do not file Form CEC-2843.*

**Topping Cycle Compliance with Thermal Energy Utilization Standard**

6. Percent Thermal Output = Useful Thermal Energy Output / Fuel Energy Input
   = _____ X 100 = _____ %

   (Divide Annual Average Hourly Value in Column 13 by the Annual Average Hourly Value in Column 4)

*If Line 6 is less than 15%, the CHP System will not qualify. Do not file Form CEC-2843.*

**Compliance with Fuel Savings Standard**

7. Fuel Savings = $1 - \{F_{ave} / [P_{ave}/Eff_P + M_{ave}/Eff_M + Q_{ave}/Eff_Q]\}$ = _____

   Where:

   $F_{ave}$ is the fuel energy input to the CHP system

   $P_{ave}$ is the useful net electrical energy output

   $M_{ave}$ is the useful mechanical energy output

$Q_{ave}$ is the useful thermal energy output

$Eff_P$ is the efficiency of the displaced grid electricity system, taken here to be 44.3%.

$Eff_M$ is the efficiency of a mechanical drive, taken here to be the same as efficiency of the displaced grid electricity system (44.3%)

$Eff_Q$ is the efficiency of "displaced" thermal generation, taken here to be a fuel-to-steam efficiency of 82%.

Note that the energy values must be in the same unit.

If all energy units are converted to MMBtu,

$P_{ave}$ = 3.412 X Average Hourly Value in Column 5 = _____ MMBtu

$M_{Ave}$ = Average Hourly Value in Column 8 ÷ 393.01 = _____ MMBtu

*If Line 7 is a negative number, the CHP System will not qualify. Do not file Form CEC-2843.*

**Required Attachment to Schedule A**

**Attachment A1.**

Discussion and Mass and Heat Balance (Cycle) Diagram for the CHP System and the Connected Thermal Load under Average Hourly Operating Conditions. Include the assumptions and calculations to support all mass and energy flows between CHP system components and the thermal utilization and thermal dissipation equipment.

**Attachment A2**.

Summarize the key results of an engineering feasibility study that 1). Evaluates the suitability of CHP based on the coincidence of electrical and thermal loads, fuel and electricity tariffs, considers options to CHP, such as end use energy efficiency improvements and adoption of Best Practices, 2). shows the technical feasibility, cost effectiveness and environmental benefits of the CHP system and 3). Describes CHP configuration options and the rationale for the configuration chosen.

September 23 2009

# Instructions for Form CEC-2843
# Application for Certification as a Qualifying Combined Heat and Power (CHP) System

## Schedule A: Predicted Annual Energy Inputs, Outputs and Thermal Energy Usage

### Purpose of Schedule:

1. Compile the energy input and energy output estimates that provide the basis for determining if the CHP system, as designed and as predicted to operate over a 12 month period of time, will meet the technical performance requirements in the Guidelines.
2. Convert the reported energy input and energy output estimates to Annual Average Hourly Values.
3. Present the equations that compare the Predicted CHP System performance, as represented by Annual Average Hourly Values, to the Guideline's Performance Standards.

### Instructions

1. **Reporting Monthly Values.** Monthly summations of energy flows were chosen as a way to recognize the seasonal difference in the cost of electricity generation. Diurnal and weekly variations and load profiles may be submitted as additional attachments.
2. **Generator Equivalent Full Load Hours per Month.** This is the same as a monthly Capacity Factor times the Standard Hours per Month.
3. **Fuel Energy Input.** Report Fuel Energy on a Higher Heating Value basis. Higher Heating Value should be used throughout.
4. **Net Electricity Generation.** Report gross electricity generation minus parasitic losses in operating the CHP system or auxiliary system loads.
5. **On-site electricity use and electricity export (Optional reporting).** These values are not used in determining conformance with the Guidelines.
6. **Useful Mechanical Energy Output.** The direct use of mechanical energy for applications such as pumping, without the conversion of mechanical energy to electrical energy and back to mechanical energy, can be credited toward useful energy output.
7. **CHP Thermal Energy Output and Return**. The maximum available thermal energy is the difference between the enthalpy of the thermal fluid output from the CHP system and the enthalpy of the thermal fluid return. These values must be consistent with the Attachment showing the CHP System Schematic and the energy balance. If the CHP system includes a Dump Radiator or a Cooling Tower for managing thermal energy

delivery to the host facility, those components should be included within the CHP System Boundary.

8. **Host Site Thermal Energy Process Demand.** The process demand is limited to thermal energy used in a productive manner for a beneficial use. The process demand must exist even in the absence of a CHP system.
9. **Compliance with the Technical Requirements.** Compliance with the Guidelines is determined by a spreadsheet using data from Table 1. The equations are given in Schedule A.

# Form CEC-2843
# Application for Certification as a Qualifying Combined Heat and Power (CHP) System

**Schedule PF. Predicted Full Load Operation**

**Required Attachment to Form CEC-2843**

Applicant Name _____ CEC Plant ID: _____

**Fuel Input and Energy Outputs for One Hour of CHP System Operation at Full Load Output of the Prime Mover(s) at ISO Conditions.**

**1.** Fuel Energy Input, HHV ($F_{Peak}$) _____ MMBtu ÷ 3.412 =_____ MWh

**2.** Net Electricity Generation ($E_{net}$) _____ MWh

**3.** Useful Mechanical Energy Output ($M_{net}$) _____ hp-hr ÷ 1,341 = _____ MWh

**4.** CHP System Thermal Energy Output _____ MMBtu

**5.** CHP System Thermal Energy Return _____ MMBtu

**6.** Thermal Energy to Host Facility (Line 4 minus Line 5) _____ MMBtu

**7.** Host Site Thermal Energy Process Demand _____ MMBtu

**8.** Useful Thermal Energy Output ($Q_{peak}$)
(Enter the lesser of Line 6 or Line 7) _____ MMBtu ÷ 3.412 = _____ MWh

**9.** **A. Predicted Efficiency at Full Load, Topping Cycle** _____ X 100 = _____%
(Sum of Line 2 + Line 3 + Line 9) Divided by Line 1. (Use consistent units)

**9.** **B. Predicted Efficiency at Full Load, Bottoming Cycle** _____ X 100 = _____%
(Sum of Line 2 + Line 3) Divided by Line 1. (Use consistent units)

**Thermal Output Sizing of Topping Cycle CHP System**

**10.** Maximum sustained one hour thermal demand of host site _____ MMBtu

**11.** **Compliance with Thermal Sizing Limit** _____
(Divide Line 6 by Line 10)

*If Line 9 is less than 60 percent, the CHP System will not qualify. Do not file Form CEC-2843.*

*If Line 11 is greater than 1, the CHP may not qualify. The Description of the CHP System and connected thermal load and the Schematics **must** explain and justify why the CHP system was oversized for the thermal load.*

## Required Attachments to Schedule PF

**Attachment PF1**.

Description and Schematic of the CHP System and its components (e.g., prime mover, waste heat recovery system, fuel compressor, air compressor, water pump, cooling tower, blowers) with the CHP System Boundary shown.

**Attachment PF2.A.**

For a Topping Cycle, a Description and Schematic of the Connected Thermal Load at the Host Facility with Facility Boundary shown.

**Attachment PF2.B**

For a Bottoming Cycle, a Description and Schematic of the Thermal Process whose exhaust waste heat becomes an energy input for electricity generation.

**Attachment PF3.A**.

For a Topping Cycle, Mass and Heat Balance (Cycle) Diagram for CHP System and the Connected Thermal Load with the prime mover/generator operating at 100% output.

**Attachment PF3.B**.

For a Bottoming Cycle, Mass and Heat Balance (Cycle) Diagram for the Thermal Process and the CHP System with full supplemental burner firing.

September 24, 2009

# Instructions for Form CEC-2843
# Application for Certification as a Qualifying Combined Heat and Power (CHP) System

**Schedule PF. Predicted Full Load Operation**

**Required Attachment to Form CEC-2843**

**Purpose of Schedule**:

1. For the Applicant to demonstrate that the CHP System as designed and when operating at full load under ISO conditions will meet the 60% Minimum Energy Output Efficiency Standard. This is a specific requirement in AB 1613.
2. For the Applicant to demonstrate that the Thermal Energy Output of the CHP System as designed and operating at full load under ISO conditions will not exceed the thermal demand of the host site.

**Instructions**

**Lines 1 to 5.** Enter the CHP System Specifications, as provided by the vendor, for operation under ISO conditions.

**Line 7**. Enter a one hour thermal energy demand that corresponds to full load operation of the prime mover.

**Line 10**. Enter the host site's maximum one hour thermal energy demand. This value should be equal to or greater than the value on Line 7.

September 24 2009

# Form CEC-2843
# Application for Certification as a Qualifying Combined Heat and Power (CHP) System

**Schedule $NO_x$. Emissions of Nitrogen Oxides**

**Required Attachment to Form CEC-2843**

Applicant Name _____ CEC Plant ID: _____

**Table $NO_x$-1. Fuel Consumption, $NO_x$ Emissions, and Energy Output as a Function of Prime Mover Load**

| % Full Load | 1 Hour Fuel Input (MMBtu, HHV) | $NO_x$ Emissions (ppmvd) | $NO_x$ Emissions (lb/MMBtu) | 1 Hour Electric Output (MWh) | 1 Hour Mechanical Output (hp-hr) | 1 Hour Topping Cycle Net Thermal Output (MMBtu) |
|---|---|---|---|---|---|---|
| 100 | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Min | | | | | | |

**Predicted Annual Fuel Consumption, $NO_x$ Emissions, and Energy Outputs under Projected CHP System Operating Profile**

1. **Average Annual Hourly Fuel Energy Input** _____ MMBtu
2. **$NO_x$ Emissions** **a.**_____ ppmvd **b.** _____ lbm/MMBtu
3. **Electrical Generation** _____ MWh
4. **Mechanical Energy Output** _____ hp-hr
5. **CHP System Net Thermal Output** _____ MMBtu
6. **CHP System Useful Thermal Energy Output** _____ MMBtu
7. **Maximum Energy Output** _____ MWh
   (Sum of Lines 3, 4, and 5, in units of MWh)
8. **Useful Energy Output** _____ MWh
   (Sum of Lines 3, 4 and 6, in units of MWh)

**Compliance with $NO_x$ Emission Standard**

**9. A. Topping Cycle Emissions** _____ lb/MWh
(Divide Line 2b by Line 8)

**9. B. Bottoming Cycle Emissions** _____ lb/MWh

*If Line 9.A or 9.B is greater than 0.07 lb/MWh, the CHP System will not qualify. Do not file CEC Form-2843.*

**Required Attachments to Schedule $NO_x$**

**Attachment $NO_x$1.**

Manufacturer/Vendor/Supplier $NO_x$ Emissions Specifications

**Attachment $NO_x$2.**

Warranty or Service Agreement

**Alternative 1.**

Prime mover/generator manufacturer or CHP system supplier guarantee or warranty that $NO_x$ emissions will not exceed specifications for a minimum of three years.

**Alternative 2.** Service Agreement for servicing and maintaining CHP system to remain within manufacturer specified $NO_x$ emission limits for a minimum of three years.

**Attachment $NO_x$3.**

Copy of either the local Air Quality Management District (AQMD) permit to operate or the Application for an AQMD permit to operate.

**Attachment $NO_x$4.**

Copy of local AQMD regulations(s) governing criteria pollutant emissions from a CHP System or Supplementary fired burner.

**Attachment $NO_x$5.**

$NO_x$ monitoring protocol to be used to satisfy AQMD requirements.

September 23 2009

# Instructions for Form CEC-2843
# Application for Certification as a Qualifying Combined Heat and Power (CHP) System

**Schedule $NO_x$: Prediction of Annual $NO_x$ Emissions**

**Purpose of Schedule:**

**1.** Compile $NO_x$ emission predictions based on equipment specifications and engineering analyses

**2.** Document that the CHP System Owner/Operator has obtained or is obtaining an air quality permit to operate.

**3.** Present an Air Quality Monitoring Protocol to demonstrate that the CHP System emissions will be measured and reported.

**Background**

AB 1613 requires that Qualifying CHP Systems have $NO_x$ emissions of no more than 0.07 lb/MWh. This limit is the same as that given in ARB Distributed Generation Standards required by the ARB Certification Program. Local Air Quality Management Districts (AQMDs) may have different and perhaps lower emission limits.

**Instructions**

1. **Table $NO_x$-1**. Provide prime mover, CHP system vendor, or supplementary burner vendor specifications for $NO_x$ emissions at five load points, ranging from full load to minimum load or firing level.
2. **Energy Inputs and Outputs.** These estimates will be transferred from Schedule A, Table 1.
3. **$NO_x$ Emissions, Line 2.** Select a value from Table $NO_x$-1 that represents the annual average operating conditions.
4. **For Bottoming Cycles with supplementary firing,** Useful Energy Output is the hourly electrical energy output with the industrial or commercial process operating under annual average hourly operating conditions and the supplementary burner operating at full rated output: _____MWh.

September 24, 2009

# APPENDIX B:
# California Energy Commission
# Annual Performance Reporting Forms for a Combined Heat and Power System that has been Certified Pursuant to the Waste Heat and Carbon Emissions Reduction Act, Public Utilities Code Section 2840 et seq.

# Form CEC-2843 Annual
# Report of Operation as a Qualifying Combined Heat and Power (CHP) System

For the Period _____ to _____

Owner/Operator Name _____ CEC Plant ID: _____

| *Line* | *Field Description* | |
|---|---|---|
| 1 | **CHP System Name** | |
| 2 | **CEC Plant ID** | |
| 3 | **EIA Plant ID** | |
| 4 | **Qualifying Facility ID** (if applicable) | |
| 5 | **Thermal Host/Thermal Facility** | |
| a | Business Name | |
| b | Street Address | |
| c | City | |
| d | County | |
| e | Zip Code | |
| f | Contact Person Name | |
| g | Phone | |
| h | email | |
| 6 | **CHP System Owner/Operator** | |
| a | Full Legal Name | |
| b | PO Box | |
| c | Street Address | |
| d | City | |
| e | State | |
| f | Zip Code | |
| g | Contact Person Name | |
| h | Phone | |
| i | email | |

**Statements of Compliance with the Performance Guidelines**

7. The Energy Conversion Efficiency was greater than or equal to 60% _____ *Initial*
8. If a Topping Cycle, the Carbon Dioxide Equivalent Emission Rate was no greater than 1,100 lb/MWh. _____ *Initial*
9. If a Topping Cycle, the Thermal Energy Utilization was greater than or equal to 15% _____ *Initial* or N/A
10. The Fuel Savings Calculation yielded a positive value _____ *Initial*
11. The $NO_x$ Emission Rate was less than 0.07 lb/MWh _____ *Initial*

## Required Attachments to Form CEC-2843 Annual

Form CEC-2843 Annual Schedule A

Form CEC-2843 Annual Schedule $NO_x$

**Attachment 1.**
Identify any change in the ownership or operator of the CHP system and/or the thermal facility. If none, enter N/A here _____

**Attachment 2**.
Describe any change in the CHP system, the thermal facility, or the operations that could affect continued status as a Qualifying CHP System. If none, enter N/A here; _____

**Attachment 3**.
Copy of Reports submitted to the California Environmental Protection Agency, Air Resources Board, pursuant to the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions, Subchapter 10, Article 2, Sections 95100 to 95133, Title 17, California Code of Regulations. If none, enter N/A here; _____

**Attachment 4**
Required if and only if the CHP System failed to meet any of the annual compliance standards). A). Explanation of why the CHP system failed to comply. B). Schedule for actions to bring the CHP system into compliance.

| | | |
|---|---|---|
| **14** | **Declaration** | |
| I certify under the penalty of perjury of the laws of the State of California that I am authorized by | | |
| **(type in Company Name here)** | | |
| to submit the enclosed Form 2840 with Schedules and Required Attachments. This Form fulfills the requirement of California Public Utilities Code Section 2840 et seq. The matters contained in this report are, to the best of my knowledge and belief and based on diligent investigation, true, accurate, complete and in compliance with these regulations. | | |
| (Signature) | | |
| | | |
| (Printed Name) | | |
| | | |
| (Company Name) | | |
| | | |
| (Federal Tax Identification Number) | | |
| | | |
| (Date) | | |
| | | |
| Submit Form CEC-2843 to: | | |
| **CHP Guru** | | |
| **California Energy Commission** | | |
| **1516 Ninth Street, MS-20** | | |
| **Sacramento, CA 95814** | | |
| | | 0 |

September 24 2009

# Form CEC-2843 Annual
# Report of Operation as a Qualifying Combined Heat and Power (CHP) System

For the Period _____ to _____

**Annual Schedule A:**
**Annual Energy Inputs, Outputs and Thermal Energy Usage**

***Required Attachment to Form CEC-2843 Annual***

Owner/Operator Name _____ CEC Plant ID: _____

**Table 1. Measured Annual Fuel Input and Energy Outputs.**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specify Month And Year | Standard Hours per Month (hours) | Generator Equivalent Full Load Hours per Month (hours) | Fuel Energy Input (MMBtu) | Net Electricity Generation (MWh) | On-Site Electricity Use from CHP System (MWh) | Electricity Export from CHP System to Utility (MWh) | Useful Mechanical Energy Output from CHP System (hp-hr) | CHP System Thermal Energy Output (MMBtu) | CHP System Thermal Energy Return (MMBtu) | Waste Heat to Thermal Host Facility (MMBtu) | Host Site Thermal Energy Process Demand (MMBtu) (1) | Useful Thermal Energy Output (MMBtu) (2) |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| **Annual Total (2)** | | | | | | | | | | | | |
| **Average Annual Hourly Value (3)** | | | F ave. | P ave. | | | M ave. | | | | | Q. Ave. |

(1) Excludes dumped thermal energy and stack exhaust energy from the Host Facility.

(2) The lesser of Waste Heat to the Thermal Host Facility and Host Site Connected Thermal Load

(3) The Average Hourly Value for Energy Inputs and outputs is the Annual Total divided by the Annual Generator Equivalent Full Load Hours.

**Compliance with Energy Conversion Efficiency Standard**

1. **A. Topping Cycle. Predicted Annual Output Efficiency** _____ X 100 = _____%
   (Sum of Columns 5, 8 and 13) Divided by Column 4. (Use consistent units)

1. **B. Bottoming Cycle, Predicted Electrical Efficiency** _____ **X 100 =** _____**%**
   **(**Sum of Columns 5 and 8) Divided by Column 4. (Use consistent units)

*If Line 1 is less than 60%, the CHP System did not qualify.*

**Greenhouse Gas Emission Standard, Topping Cycle only**

2. Carbon Dioxide Emission Factor _____ lb/MMBtu
   (A default value for natural gas of 53.42 kg $CO_2$/MMBtu or 117.77 lb $CO_2$/MMBtu may be used)

3. Other Greenhouse Gases, Emission Factor _____ lb/MMBtu

   (A default value of 0.0009 kg/MMBtu x 21 for methane + 0.0001 kg/MMBtu x 310 for nitrous oxide may be used. This will add 0.05 lb/MWh to the carbon dioxide emission factor)

4. Carbon Dioxide Equivalent Emission Factor _____ lb/MMBtu
   (Add Lines 2 plus Line 3)

**Compliance with Greenhouse Gas Emission Rate**

5. Emission Rate = Carbon Dioxide Equivalent Emission Factor X $F_{ave}$ ÷

   Useful Energy Output = _____ lb/MWh

   (Useful Energy Output = $P_{Ave}$ + $M_{Ave}$/1,341 + $Q_{Ave}$/3.4121)

*If Line 5 is more than 1,100 lb/MWh, the CHP System did not qualify.*

**Topping Cycle Compliance with Thermal Energy Utilization Standard**

6. Percent Thermal Output = Useful Thermal Energy Output / Fuel Energy Input

   = _____ X 100 = _____ %

   (Divide Annual Average Hourly Value in Column 13 by the Annual Average Hourly Value in Column 4)

*If Line 6 is less than 15%, the CHP System did not qualify.*

**Compliance with Fuel Savings Standard**

**7.** Fuel Savings = 1 – {Fave / [Pave/EffP + Mave/EffM + Qave/EffQ]} = _____

Where $F_{ave}$ is the fuel energy input to the CHP system

$P_{ave}$ is the useful net electrical energy output

$M_{ave}$ is the useful mechanical energy output

$Q_{ave}$ is the useful thermal energy output

$Eff_P$ is the efficiency of the displaced grid electricity system, taken here to be 44.3%.

$Eff_M$ is the efficiency of a mechanical drive, taken here to be the same as efficiency of the displaced grid electricity system (44.3%)

$Eff_Q$ is the efficiency of "displaced" thermal generation, taken here to be a fuel-to-steam efficiency of 82%.

Note that the energy values must be in the same unit.

If all energy units are converted to MMBtu,

$P_{ave}$ = 3.412 X Average Hourly Value in Column 5 = _____ MMBtu

$M_{Ave}$ = Average Hourly Value in Column 8 ÷ 393.01 = _____ MMBtu

*If Line 7 is a negative number, the CHP System did not qualify.*

**Required Attachment to Annual Schedule A**

**Attachment Annual A1.**
Mass and Heat Balance (Cycle) Diagram for the CHP System and the Connected Thermal Load under Average Hourly Operating Conditions. Include the data, working papers, assumptions and calculations used to obtain all mass and energy flows between CHP system components and the thermal utilization and thermal dissipation equipment.

**Attachment Annual A2.**
Monitoring and Data Collection Protocol. (Required only for the first Annual Filing of Annual Form CEC-2843). The Protocol must include at least the following:

1. Instrumentation Diagram/Data Collection Point Diagram for the CHP System and the Connected Thermal Load. Identify the physical or chemical properties being measured, the instrument Manufacturer and Model Number.
2. Data Collection Plan, with data collection at least every 15 minutes, summed to daily and then monthly tabulations. Only the monthly data is reported, but the Energy Commission must have access to the more frequent data recording records.
3. Equations and data compilation methods used to convert measured data to reported values in the CEC-Forms 2843, Schedules and Attachments.

# Instructions for Form CEC-2843 Annual Report of Operation as a Qualifying Combined Heat and Power (CHP) System

**Annual Schedule A:**
**Annual Energy Inputs, Outputs and Thermal Energy Usage**

**Purpose of Schedule:**

1. Compile the energy input and energy output values that provide the basis for determining if the CHP system met the technical performance requirements in the Guidelines.
2. Convert the reported energy input and energy output values to Annual Average Hourly Values, metrics that are in units that are easy to comprehend.
3. Present the equations that compare the CHP System performance, as represented by Annual Average Hourly Values, to the Guideline's Performance Standards.

## Instructions

1. **Reporting Monthly Values.** Monthly summations of energy flows were chosen as a way to recognize the seasonal difference in the cost of electricity generation. Diurnal and weekly variations and load profiles may be submitted as additional attachments.
2. **Generator Equivalent Full Load Hours per Month**. This is the same as a monthly Capacity Factor times the Standard Hours per Month.
3. **Fuel Energy Input**. Report on a Higher Heating Value basis.
4. **Net Electricity Generation.** Report gross electricity generation minus parasitic losses in operating the CHP system or auxiliary system loads.
5. **On-site electricity use and electricity export (Optional reporting).** These values are not used in determining conformance with the Guidelines.
6. **Useful Mechanical Energy Output.** The direct use of mechanical energy for applications such as pumping, without the conversion of mechanical energy to electrical energy and back to mechanical energy, can be credited toward useful energy output.
7. **CHP Thermal Energy Output and Return.** The maximum available thermal energy is the difference between the enthalpy of the thermal fluid output from the CHP system and the enthalpy of the thermal fluid return. These values must be consistent with the Attachment showing the CHP System Schematic and the energy balance. If the CHP system includes a Dump Radiator or a Cooling Tower for managing thermal energy delivery to the host facility, those components should be included within the CHP System Boundary.
8. **Host Site Thermal Energy Process Demand.** The process demand is limited to thermal energy that was used in a productive manner for a beneficial use. The process demand must exist even in the absence of a CHP system.

9. **Compliance with the Technical Requirements.** Compliance with the Guidelines is determined by a spreadsheet using data from Table 1. The equations are given in Schedule A Annual.

September 23 2009

# Form CEC-2843 Annual
# Report of Operation as a Qualifying Combined Heat and Power (CHP) System

For the Period _____ to _____

**Annual Schedule $NO_x$. Emissions of Nitrogen Oxides**

**Required Attachment to Form CEC-2843 Annual**

Owner/Operator Name _____ CEC Plant ID: _____

**Annual Fuel Consumption, $NO_x$ Emissions, and Energy Outputs**

1. **Annual Fuel Consumption** _____ MMBtu
   (From Annual Schedule A, Table 1)
2. **$NO_x$ Emissions** _____ lbm
3. **Electrical Generation** _____ MWh
   (From Annual Schedule A, Table 1)
4. **Mechanical Energy Output** _____ hp-hr
   (From Annual Schedule A, Table 1)
5. **CHP System Net Thermal Output** _____ MMBtu
   (From Annual Schedule A, Table 1)
6. **CHP System Useful Thermal Energy Output** _____ MMBtu
   (From Annual Schedule A, Table 1)
7. **Maximum Energy Output** _____ MWh
   (Sum of Lines 3, 4, and 5, in units of MWh)
8. **Useful Energy Output** _____ MWh
   (Sum of Lines 3, 4 and 6, in units of MWh)

**Compliance with $NO_x$ Emission Standard**

9. **A. Topping Cycle Emissions** _____ lb/MWh
   (Divide Line 2b by Line 8)
9. **B. Bottoming Cycle Emissions** _____ lb/MWh

*If Line 9.A or 9.B is greater than 0.07 lb/MWh, the CHP System did not qualify.*

## Required Attachments to Annual Schedule $NO_x$

**Attachment $NO_x$1.**

**Option 1.**
Summary of Source test results as reported to the local AQMD. Calculations converting the source test results to lb $NO_x$/MMBtu and lb $NO_x$/MWh. Identification of Testing Method used and entity that performed the testing.

**Option 2.**
Summary of continuous monitoring test results as reported to the local AQMD. Calculations converting the source test results to lb $NO_x$/MMBtu and lb $NO_x$/MWh.

**Option 3.**
Copy of service agreement or warranty guaranteeing that the prime mover or supplementary burner will operate within specifications. Calculations showing that the operation within equipment specifications over the annual operating load profile will yield $NO_x$ emissions less than 0.07 lb/MWh.

**Attachment $NO_x$2.**

Cover letter and summary of criteria pollutant emissions reports submitted to the local AQMD.

**Attachment $NO_x$3**.
Notification, if any, that the CHP system was in violation of any air quality operating permit.

## Instructions

**There are no separate instructions for Annual Schedule $NO_x$**

# APPENDIX C:
# California Energy Commission Staff Response to Comments on the July 23, 2009 Draft AB 1613 Guidelines for Certification of a Combined Heat and Power System Pursuant to the Waste Heat and Carbon Emissions Reduction Act, Public Utilities Code Section 2840 et seq.

September 2009

**Background**

Assembly Bill 1613 (Blakeslee, Chapter 713, Statutes of 2007), amended by Assembly Bill 2791 (Blakeslee, Chapter 253, Statutes of 2008), is designed to encourage the development of new combined heat and power (CHP) systems in California with generating capacity not greater than 20 megawatts. The Act directs the Energy Commission to adopt by January 1, 2010, guidelines establishing technical criteria for eligibility of CHP systems for programs to be developed by the California Public Utilities Commission (CPUC) and publicly owned utilities. The Act directs the CPUC to establish a standard tariff for the sale of electricity and it requires a local publicly owned utility serving end-use customers to provide a market for the purchase of excess electricity. The Guidelines and forms establish the technical and legal criteria and the reporting requirements for the sale of excess electricity from CHP systems.

The Electricity and Natural Gas Committee conducted a Workshop on the 2008 Rulemaking on Implementation of the Waste Heat and Carbon Emissions Reduction Act Pursuant to Assembly Bill 1613 on April 23, 2009. Staff and Workshop participants discussed the requirements in AB 1613 and the manner in which they could be implemented as regulations. On July 22, 2009, the Energy Commission staff posted Draft Guidelines to Docket Number 09-WHCE-1.

The following stakeholders submitted written comments to the Docket on the Draft Guidelines: California Air Resources Board, California Cogeneration Council (CCC), Energy Producers and Users Coalition (EPUC), Cogeneration Association of California (CAC), Pacific Gas and Electric (PG&E), Sempra Energy Utilities, and Southern California Edison (SCE). Other stakeholders made informal comments and suggestions and provided data on existing combined heat and power systems. Their interest and support is gratefully acknowledged.

Staff considered all comments and is responding to the most significant ones. Many of the comments have lead to revisions to the Guidelines. All comments will be addressed in a subsequent Statement of Reasons Report.

# Staff Response to Comments on July 22, 2009 Draft AB 1613 Guidelines

**Definition: Eligible CHP System**

Sempra notes that there is no formal definition.

> **Staff Response**—A definition has been added.

**Definition: Combined Heat and Power**

Sempra and SCE object to the inclusion of mechanical energy under "Useful Energy Output," noting that neither the Public Utilities Code nor AB 1613 include mechanical energy output in the definition of CHP.

SCE recommends that generator nameplate capacity be used instead of net electrical nameplate capacity for administrative reasons and consistency with the Power Purchase and Sale Agreement filed in the Working Group Report on May 15, 2009 in CPUC proceeding R.08-06-026.

SCE recommends a definition for "Power Rating" to be added to the Guidelines.

> **Staff Response**—With respect to mechanical energy output, both physical reality and federal law include mechanical energy output. Most electricity generating systems (engines and turbines) involve the conversion of chemical energy or thermal energy to rotational motion, a form of mechanical energy. The conversion of this mechanical energy is wasteful when the mechanical energy could be used directly.
>
> The Code of Federal Regulations, 18 CFR Section 292.205, a section cited by SCE in its written comments, includes electrical, thermal, chemical and mechanical output under criteria for new cogeneration facilities and the fundamental use test. Staff followed SCE's suggestion provided on April 13, 2009, that Energy Commission staff refer to FERC regulations that reflect federal proceedings on issues associated with CHP definitions and performance standards to facilitate its development of the AB 1613 Guidelines. Hence the inclusion of mechanical energy. Staff included chemical energy also in its April 13, 2009, workshop presentation. Chemical energy output was included so as to capture the value of endothermic fuel reforming in a high temperature fuel cell. Upon further thought, staff removed chemical energy output because the value of fuel reforming would be credited in the conversion of thermal energy to chemical energy.

**Definition: Supplementary Firing**

SCE recommends that the definition of Supplementary Firing be modified to clarify the intended purpose of Supplementary Firing: to control the thermal output in a Topping Cycle or to control the electrical output in a Bottoming Cycle.

> **Staff Response**—Staff agrees with SCE about the intended use of Supplementary Firing and will adopt SCE's recommended definition with modifications to some of the language and with two caveats. First, definitions should not be used for setting operational requirements. Second, the proposed definition may not prevent the use of Supplementary Firing to achieve AB 1613 goals.

**Marginal Generation Displaced by CHP / GHG Emission Performance Standard**

EPUC, CAC and CCC present 2008 heat rates derived from Energy Information Administration data for Mountainview, a "new" combined-cycle combustion turbine (7,460 Btu/kWh) and California's weighted fleet average (8,032 Btu/kWh). They also observe that "It is imperative that California not adopt a scaled down CHP policy driven by an assumption that reduced reliance on coal fired generation is attributed to other forms of generation and none to CHP."

SCE notes that the incremental GHG emissions from the electricity system are about 985 lb/MWh, the value in the Draft Guidelines, but that the GHG emissions will decline as out-of-state coal generation declines. SCE recommends a GHG emission rate of 842 lb/MWh, which corresponds to a heat rate of about 7,000 Btu/kWh of a modern combined-cycle gas turbine (CCGT) plant.

Sempra states that the draft Guidelines change the previously adopted 1,100 lb/MWh Emission Performance Standard without explanation.

CCC, EPUC and CAC state that the GHG EPS of 1,100 lb $CO_2$/MWh adopted for SB 1368 should be used.

> **Staff Response**—The nature and characteristics of the displaced marginal resource is a factor in determining the benefits and costs of not only CHP but also end use energy efficiency and renewable resources. For these Guidelines, the heat rate of the marginal resource displaced by a CHP system is used to calculate the Greenhouse Gas Emission reduction and the Fuel Savings of a CHP system compared to the displaced utility electricity generation and the production of steam in a boiler.
>
> Staff assumed that the displaced central station resource is a blend or mix of a new natural gas fired CCGT and a natural gas fired simple cycle power plant. Both types of power plants have been proposed for certification before the Energy Commission. Given these two choices, the following factors must also be considered: 1). The heat rate of each generating type both at standard ISO conditions and as influenced by

temperature and elevation; 2). The percentage of each generating type in the mix; and 3). Transmission and distribution system line losses.

For the July 23, 2009, version of the Guidelines, Staff calculated the heat rate of the displaced resource as being 80 percent of a CCGT (with a heat rate of 7,050 Btu/kWh) and 20 percent of a simple cycle power plant (with a heat rate of 10,487 Btu/kWh). Staff used a "blended" heat rate of 8,737 Btu/kWh because applications for power plant certification before the Energy Commission include numerous simple cycle power plants, at least one of which anticipates a 33 percent capacity factor.

ICF International, in its docketed presentation at the July 23, 2009, IEPR Workshop, used four different blended heat rates, depending on the CHP System Load Factor (see slide 63). The delivered heat rates are 7,460 Btu/kWh, 7,833 Btu/kWh, 9,403 Btu/kWh, and 11,851 Btu/kWh. The utility system heat rate would be a weighted sum of these heat rates.

The delivered heat rate, which includes transmission and distribution system losses between the central power plant and the end user, usually assumed to be about 8 percent, rather than the power plant heat rate, is the appropriate metric for the displaced generation.

The record contains recommendations for heat rates of 7,000 Btu/kWh + 8% or 7,560 Btu/kWh, 7,460 Btu/kWh, 7,460 Btu/kWh + 8% or 8,057 Btu/kWh, 7,833 Btu/kWh, 8,032 Btu/kWh + 8% or 8,674 Btu/kWh, and 8,737 Btu/kWh. Going forward in the near term for the application of these Guidelines, staff proposes a value between 7,460 Btu/kWh and ~8,000 Btu/kWh and recommends a displaced power plant heat rate of 7,700 Btu/kWh. This is significantly more efficient than the originally proposed 8,737 Btu/kWh.

AB 1613 requires that CHP Systems achieve the Environmental Performance Standard (EPS), which is 1,100 lb/MWh. The $CO_2$ emissions of a power plant can be readily calculated from the heat rate and the fuel composition using the Emission Factor tabulated by the ARB. The draft Guidelines used this procedure to calculate a GHG Emission Standard of 985 lb of carbon dioxide equivalent per megawatt hour. The $CO_2$ equivalent includes other GHG gas emissions associated with a CHP system using natural gas; namely, methane and nitrous oxide. Although these are potent greenhouse gases, their mass emissions are low.

Staff recommends that the EPS of 1,100 lb/MWh be retained because a GHG emission standard derived from the displaced plant heat rate duplicates the effects of the Total Energy Efficiency and Fuel Savings Standards for the range of displaced power plant heat rates considered.

**Efficiency Standard**

SCE recommends an efficiency standard of no less than 75 percent which they describe as an attainable standard that would achieve tangible carbon reductions and meet the goals of the ARB Scoping Plan. In comments to Docket 09-IEP-1H, SCE encourages the Energy Commission to "pursue premium efficiencies and fuel standards that reduce waste heat…."

PG&E recommends an efficiency standard higher than 60 percent for larger-capacity CHP.

> **Staff Response**—Staff recognizes that well-designed and well-operated CHP systems, especially those with a high useful thermal output fraction, can have total useful energy output efficiencies higher than 60 percent. We believe that economics of operation, the fact that the AB 1613 tariff will pay for performance (electricity deliveries) not for installed capacity, and performance monitoring and reporting will force CHP system designers and operators to strive for efficiency levels above 60 percent to avoid contractual penalties developed under the CPUC's parallel proceeding.
>
> Staff agrees with PG&E's recommendation that larger CHP systems have a higher efficiency standard. This recommendation leads to a broader question of whether other performance metrics, monitoring, and reporting should be tiered. Staff requests recommendations for specific requirements as a function of CHP system size and operational characteristics. Staff notes that SCE is opposed to tiering under both the Energy Commission's and the CPUC's AB 1613 proceedings.
>
> Staff anticipates that a dynamic will develop such as developed around the Self Generation Incentive Program. The legislature, the Energy Commission, and the CPUC will modify the Guidelines and requirements based on whether CHP systems 1) are installed and 2) provide economic and environmental benefits.

**Different Standards for Topping Cycles and Bottoming Cycles**

Sempra states that the Public Utilities Code does not distinguish between Topping Cycles and Bottoming Cycles. Sempra adds that there is no provision in the Public Utilities Code to exempt Bottoming Cycles that do not use supplementary firing from the Energy Efficiency Standard.

SCE disagrees with Sempra. SCE states that "The CEC Guidelines appropriately distinguish between topping and bottoming systems, correctly stating that bottoming cycle systems that do not use supplemental firing are exempt from any efficiency standards."

For Bottoming Cycles that use supplementary firing, SCE states that the 60 percent efficiency standard in Public Utilities Code Section 2840 should be used.

**Staff Response**—Staff recommends that the exemption of Bottoming Cycles that do not use supplementary firing, which is recognized by FERC and by the CPUC in Decision 09-06-051 in Rulemaking 06-04-009, be retained in the Guidelines.

Staff agrees that the same 60 percent efficiency standard should apply both to Topping Cycles and to Bottoming Cycles that use supplementary firing.

**Thermal Energy Utilization Standard**

SCE recommends that the thermal energy utilization standard be deleted and replaced with its recommended 75 percent total energy output efficiency standard.

CCC, EPUC, and CAC note that the thermal utilization standard is modeled after the operating and efficiency standards in the Public Utilities Regulatory Policies Act (PURPA). They state that subsection (1)(A) could be eliminated and subsection (1)(B) could be revised if the intent of these standards is to address the provision in The Act to prevent the CHP system from being a de facto wholesale generator.

**Staff Response—** CCC, EPUC, and CAC are correct in their belief that the thermal utilization standards were intended to prevent de facto wholesale generation. Staff recommended a thermal energy utilization standard to assure, as in FERC regulations and in Public Utilities Code Section 218, that CHP systems supply a significant thermal load and are not primarily electricity generators.

Staff agrees with both SCE and CCC, EPUC, and CAC that the thermal utilization standard can be at least simplified, if not eliminated. Staff recommends that subsection (1)(A) be eliminated. Staff thus does not believe that the useful energy output rather than the total fuel energy input is the appropriate denominator in determining the thermal utilization minimum requirement for two reasons. First, the minimum thermal utilization requirement would vary with efficiency, rising to 25 percent of fuel energy input for a 60 percent efficient system. Second, the coupling of the two standards may constrain CHP system design and operation.

**Topping Cycle Thermal Output Standard**

SCE recommends that a Topping Cycle system be sized no larger than the minimum thermal load of the host facility or that it be capable of being varied to meet the instantaneous thermal load.

**Staff Response**—CHP systems subject to Chapter 713 shall:

- Be sized to meet the eligible customer-generator's thermal load
- Operate continuously in a manner that meets the expected thermal load
- And that optimizes the efficient use of waste heat.

CHP systems, by definition, simultaneously provide electricity and thermal energy. If CHP systems are to be viable replacements for boilers, furnaces and heaters, the Guidelines must allow CHP systems to meet the maximum one hour thermal load in a twelve month reporting period and to follow the thermal load. Staff's proposed Guideline language permits design flexibility. The Thermal Utilization Standard and the efficiency-related Standards will discourage oversized systems.

We note that the simultaneous fulfillment of all of the performance standards could result in an over constrained problem; that is, no practical CHP system would meet them. That result would be contrary to the intent of AB 1613.

**Fuel Savings Standard**

PG&E "strongly support[s] the concept of a fuel savings standard as a must-have part of these regulations, since that is how lowered GHG production can be assured."

PG&E states that "Efficiency should specifically mean that the CHP…emits less GHG than the alternative of separate production of electricity and heat."

CCC, EPUC, and CAC state that the Fuel Savings Standard that is not expressly required by The Act, that it duplicates the 60 percent efficiency standard, and that therefore it should be eliminated.

SCE recommends that more efficient systems be used in the double benchmark comparison to the separate production of electricity and thermal energy. SCE recommends that an 85 percent boiler efficiency be used.

**Staff Response**—Staff recognizes that a Fuel Savings Standard is not expressly required by The Act. Staff believes that the Fuel Savings Standard is the most meaningful and most informative of the performance metrics in the Guidelines. The Fuel Savings Standard was introduced as a short hand method for showing GHG emission reductions.

Staff has explained its electricity benchmark above. The boiler benchmark is an 80 percent efficient boiler. More efficient boilers were proposed by participants in the April 13, 2009, Workshop. An 80 percent efficient boiler qualifies for the US Environmental Protection Agency EnergySTAR designation. Boiler efficiencies improve slightly with increasing size. This is another area where different standards might be applied to different size CHP systems. At this time, staff recommends that its proposed efficiency benchmarks remain unchanged.

**Measuring CHP System Performance**

Sempra recommends that the Guidelines describe how mechanical energy will be measured.

> **Staff Response**—The Guidelines do not prescribe measurement protocols, meter locations, meter specifications, data reduction, quality control procedures, etc. so as to permit engineering judgment and established procedures and practices to be used. If the Applicant's and Owner/Operator monitoring procedures are deficient, they can be challenged both at the Application stage and at the Annual reporting stage.
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> If staff were to recommend specific methods, they would be the Testing and Reporting Protocols developed with US Department of Energy and multi-state funding by the Association of State Energy Research and Technology Transfer Institutions, Inc. (ASERTTI) that are available on the internet at www.dgdata.org. These protocols were derived from those published by organizations such as the American Society for Mechanical Engineers (ASME) and the American Society for Testing and Materials (ASTM). Another source is the US Environmental Protection Agency's Greenhouse Gas Technology Verification Center operated by the Southern Research Institute. Testing and Quality Assurance Plans and Test Reports can be found at http://www.sri-rtp.com/

**Initial Qualification as a CHP System**

SCE recommends that the Applicant provide a copy of Form CEC-2843 and attachments to the electrical corporation or utility.

> **Staff Response**—Staff recommends that the Applicant provide a copy of Form CEC-2843 and attachments to the electrical corporation or utility after certification but not contemporaneously.

**Ongoing Compliance, Performance Monitoring and Annual Reporting**

SCE states that "Monitoring and verification are the most critical elements of the implementation of AB 1613."

SCE states that "There is an inherent need for annual verification…." and that "A simple affidavit will provide no useful data."

PG&E raised a number of questions related to the specifics of these requirements, including access to data, metering requirements, and challenging performance data.

Sempra asked about penalties for noncompliance and the timing of the imposition of penalties.

**Staff Response**—Staff has gone beyond AB 1613, which requires only that "An eligible customer-generator shall adequately maintain the combined heat and power system…."

The Annual Reporting forms will require the submittal of performance data, analyses of performance, **and** an affidavit that CHP system operation was in compliance with the Guidelines.

There is an overlap between the Energy Commission's Guidelines and the Contract being developed by the CPUC. The specifics need to be coordinated; many of the issues are more appropriate for the Contract than for the Guidelines.

September 24, 2009