STATE OF CALIFORNIA
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COMMENTS OF
THE COGENERATION ASSOCIATION OF CALIFORNIA
AND
THE ENERGY PRODUCERS AND USERS COALITION
ON
PROPOSED NEAR-TERM METHOD FOR ESTIMATING GENERATION FUEL DISPLACED BY AVOIDED USE OF GRID ELECTRICITY

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On June 8, 2015, Staff issued a report entitled "*Proposed Near-Term Method for Estimating Generation Fuel Displaced by Avoided Use of Grid Electricity.*" The Cogeneration Association of California[1] and the Energy Producers and Users Coalition[2] (the CHP Parties) provide these comments with three key objectives.

1. To refine the Staff's draft proxy methodology in order to reflect marginal, rather than average resource heat rates in establishing displacement values.

2. To establish a regression methodology that demonstrates its validity by reflecting historical 2014 heat rate data as a product of the methodology calculations; for example, Southern California Edison Company's (SCE) 2014 Default Load Aggregation Point (DLAP) equivalent heat rate is 8,648 Btu/kWh.[3]

3. To acknowledge the constraints, recognized by Staff, on the limitations of the Staff's electric-only displacement methodology for California policy development for combined heat and power (CHP) due to that resource's combination of electric and thermal output.

The CHP Parties recognize the value in measuring the displacement of grid electricity and GHG emissions by substituting alternative energy strategies. Such

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[1] CAC represents the combined heat and power and cogeneration operation interests of the following entities: Coalinga Cogeneration Company, Mid-Set Cogeneration Company, Kern River Cogeneration Company, Sycamore Cogeneration Company, Sargent Canyon Cogeneration Company, Salinas River Cogeneration Company, Midway Sunset Cogeneration Company and Watson Cogeneration Company.

[2] EPUC is an ad hoc group representing the electric end use and customer generation interests of the following companies: Aera Energy LLC, Chevron U.S.A. Inc., Phillips 66 Company, Shell Oil Products US, Tesoro Refining & Marketing Company LLC, and California Resources Corp.

[3] For 2014, Staff's regression methodology provides a calculated system heat rate of 7,314 Btu/kWh; CHP Parties' marginal heat rate calculation for the same year is 8,652 Btu/kWh. *See* Appendix, table entitled "Comparison of QFER and Regression Annual Heat Rates."

displacement by industrial/manufacturing CHP reflects its increased efficiency and is directly translatable into reductions in total GHG emissions. The CHP Parties appreciate the obvious effort devoted by CEC Staff to develop a proxy methodology to value these features of the future grid relative to CHP. However, Staff's proposal suffers from some apparent shortcomings that can and should be remedied.

The CHP Parties identify refinements to Staff's proposal to focus on marginal, as opposed to average, generation. As a matter of principle, alternative energy will, at a minimum, displace the marginal generation on the grid. In other words, the last increment of generation dispatched to satisfy load, including existing, operational CHP resources, does not reflect the higher heat rate resources that would have been operating "but for" the CHP operation. Further, even with a marginal heat rate approach, as the Staff report recognizes, the methodology does not fully reflect the total energy (*i.e.*, electric and thermal) displaced by CHP.[4] A comprehensive CHP evaluation must: a) capture both the electric and thermal energy stream inherent to CHP resources; and, b) account for the total efficiencies provided by CHP resources. Accordingly, the use of this modified methodology is limited solely to quantifying the CHP electric energy displacement associated exclusively with the CHP's electric generation.

I. The Methodology Should Identify Marginal Generation and the Corresponding Heat Rates

The methodology proposed by Staff assumes that a class of generating resources will be displaced for a time period based on a capacity factor determination and then calculates the ***<u>average</u>*** heat rate for that entire class. This methodology

[4] *See* Staff Paper, p. 35.

results in the assumption that peaking units are on the margin 2.8% of the time. The heat rate for those marginal hours is determined by averaging the heat rates of all generation assets classified as peaking.

Concerns regarding these methodological factors relied upon by Staff are evident. A "class" of resources is comprised of multiple units with wide ranging heat rate values. For example, the unit heat rates for natural gas-fueled combined-cycle resources calculated from the CEC Quarterly Fuel and Energy Report (QFER) data for 2014 range from a low of about 6,850 Btu/kWh to over 12,000 Btu/kWh. A "class" average heat rate cannot accurately reflect the displaced heat rate occurring at the margin for such wide ranging values. The accurate method is to determine the heat rate associated with the individual generation displaced by alternate energy at the margin. The marginal generation is the generation whose fuel and GHG emissions would be displaced by an alternative energy source, not the entire class of peaking or load-following generators.

Utilizing the public data set – the Quarterly Fuel and Energy Report – relied upon by Staff, the CHP Parties made limited, but critical, modifications to the Staff methodology in order to approximate marginal generation resources. These modifications provide a reasonable proxy to calculate the marginal resources and relevant heat rates, and provide a material enhancement of Staff's proposal. The QFER provides basic data to determine the number of hours that each natural gas-fueled unit operates during a calendar year. The first step is simply dividing the annual "Net MWh" by the "Capacity" as these values are recorded in the QFER to determine hours of operation for each unit. Starting with the unit operated the fewest hours, it can be assumed its hourly contribution to the marginal generation is only for those hours. The next least-used unit's hourly contribution to the marginal generation is the difference between its operation hours and the operation hours of the previous unit. An individual generating unit only contributes to the marginal generation for the hours of operation in excess of the hours the prior unit is determined to operate.[5]

The next step is to convert the hours of contribution from each generator into a percentage of hours on the margin (POH). Multiplying the POH by the unit's QFER calculated heat rate yields each unit's weighted contribution to the marginal generation heat rate (MHR). The individual unit POH and MRH data can be used to calculate "peaking" (as defined by the percent of hours designated as "peaking"), "load following" (the balance of the percent of hours not designated as "peaking") and annual marginal heat rates. This modification to Staff's methodology produces heat rates that are more specific to the marginal generation displaced by alternative energy resources.

A comparison of Staff's "CEC Average Method" with the results of the "Marginal Heat Rate Method" is presented in the table below. For the Staff method, the peaking average heat rate is applicable 2.8% of the time and load following applicable the remaining period of time. The marginal method, consistent with the CPUC obligations for Resource Adequacy or Flexible resources,[6] designated four hours per day as peaking (about 16.7% of the time). The remaining percentage of time generation resources are designated as load following.

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5 *See* Appendix, Figure 1, entitled "Illustrative Development of Unit Marginal Hours."

6 *See* CPUC D.11-06-022, OP 12, "…*To qualify for [Resource Adequacy Requirements], a resource must (1) be able to operate for a minimum of four hours per day for three consecutive days*…" *Citing* D.05-10-042, OP 16.

	CEC Average Method				Marginal Heat Rate Method		
Year	Export Load Following	Export Peaking	Annual		Export Load Following	Export Peaking	Annual
2014	7,221	10,554	7,314		8,543	10,954	8,683
2015	7,214	10,534	7,307		8,420	10,872	8,570
2016	7,207	10,515	7,300		8,297	10,790	8,457
2017	7,200	10,496	7,292		8,175	10,708	8,345
2018	7,193	10,477	7,285		8,052	10,627	8,232

This marginal heat rate method produces results for the annual heat rate that are more realistic and comport with the operating realities of the existing system and dispatch of marginal generating resources. Information in the attached Appendix demonstrates that the results of the marginal heat rate method are consistent with recent equivalent heat rates for the SCE DLAP. Further details and comparisons relevant to the evaluation of the Staff's annual average and the CHP Parties marginal resource methodologies are provided in the attached Appendix.

II. The Report Does Not Provide a Comprehensive Measure of the Impact of CHP on GHG Emissions

Even if the methodology is refined to approximate the heat rate of the marginal generation, the methodology does not produce a comprehensive measure of the total fuel savings or average carbon intensity provided by CHP resources. CHP resources produce both electrical and thermal energy from a single fuel source. This inherent feature of CHP substitutes for separate thermal production boilers and electric generation resources by producing the total energy stream from a single operation. CHP produces the total energy stream more efficiently and with fewer GHG emissions. In order to properly evaluate total CHP displacement on the electric system, a more complex and comprehensive evaluation is required. Staff's report acknowledges that the proposed average methodology does not capture these efficiencies in calculating energy displacement:

> *This calculation accounts for only the generation fuel displaced by avoided use of grid electricity from this hypothetical CHP generator. Since the operating efficiency of CHP systems and boilers is out of the scope of this paper, this calculation does not take into account how much fuel the CHP unit used or the avoided boiler fuel. Real-world calculations should take these variables into account*.[7]

This same view holds true even if the methodological changes presented by the CHP Parties are adopted. Neither methodology provides a comprehensive assessment of the energy use and benefits of CHP resources. This fact renders the proxy methodologies from Staff or as modified by the CHP Parties applicable solely to the electric energy displaced by CHP resources. The final Staff proposal, if modified as proposed by the CHP Parties, may serve for gross comparisons of displacement of energy from generic natural-gas fueled generation, but it fails to accord to CHP a full accounting of all of its benefits and efficiencies. The methodology does not consider any of the fuel efficiencies related to the thermal production of a CHP resource, and it cannot be used as the sole basis for CHP procurement decisions.

III. Response to Staff Questions

In addition to the foundational issues addressed above regarding needed revisions to Staff's methodology, the CHP Parties provide the following additional comments in response to Staff's questions:

Is a uniform statewide method appropriate for evaluating emissions displacement factors over a long-term (10-15 year) planning horizon? If not, please explain.

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[7] *Staff Paper*, p. 35.

CHP Parties Response: The CHP Parties have two separate concerns regarding this issue.

First, the level of precision underlying the displacement methodology reasonably supports a "statewide" approach in its implementation. Doing so would promote consistency in the evaluation of the benefit of CHP resources on a statewide basis. Given the displacement results calculated from the methodology, there is no material distinction between the service territories of the investor owned utilities that requires a piecemeal (IOU-by-IOU) evaluative approach.

Second, the viability of the methodology over a time horizon of more than five years is, as Staff notes, problematic. Reliance on the Staff's regression-based methodology for a longer period is likely to distort realistic displacement assessments and is opposed by the CHP Parties. Staff relies on a regression analysis that assumes over time the continued slope of efficiency improvements as experienced over a historical period. This form of analysis creates a trend line that over time leads to zero; undeniably a false conclusion. Accordingly, the time horizon for the use of a regression analysis warrants limited and careful application. As Staff suggests, the methodology should be limited in terms of time to not longer than a five year period (*"…[R]apid changes in the electric grid makes estimates beyond five years problematic*.").[8]

Are the assumptions used to calculate the avoided generation for energy efficiency, demand response, renewables, and combined heat and power (and other distributed generation) correct? If not, what changes need to be made?

CHP Parties Response: No. The several modifications to the Staff's proposed methodology as presented in these comments, and detailed in the Appendix, are

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[8] *Id.*, p. 4.

necessary to have a reasonable and viable displacement assessment for CHP energy. Changes include, but are not limited to, modifications to reflect marginal as opposed to average heat rates, and the assumptions relative to the peaking resources should be revised from the unreasonably low 2.8% capacity factor to a more realistic peaking facility operation.[9]

Is the treatment of onsite generation and associated electric grid displacement appropriate? Please explain.

CHP Parties Response: The CHP Parties agree with Staff's position to distinguish between export and onsite displacement. Staff's treatment of CHP relative to renewable generation and the application of an avoided loss factor to the onsite generation are appropriate and should be retained.

How might this method be applied in program planning and comparison or program impacts? In what circumstances do you see the State using a method like this?

CHP Parties Response: The CHP Parties agree with Staff's comments concerning the limited use of the displacement methodology. As indicated above, this issue raises serious concerns for the CHP Parties. Neither the Staff proposed methodology nor the marginal heat rate methodology accurately captures the entire energy displaced or GHG emissions reduced by CHP. This method cannot be used as a viable tool in any CHP procurement evaluation or in setting targets for CHP versus various alternative energy sources.

What programs and/or situations would this method be inappropriate to apply? (For example, would it be inappropriate to use this method to estimate emissions avoided by geothermal plants that operate as base load?)

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[9] *See* Appendix, noting the four hours daily standard set by the CPUC for Resource Adequacy, or in this instance, peaking resources producing a 16.7% result of time on the margin rather than Staff's 2.8%.

CHP Parties Response: See above with regard to CHP facilities; the CHP Parties do not have a position on the applicability of the methodology relative to other resources, like geothermal, to estimate emissions. However, it seems apparent that Staff's methodology relying on annual average, rather than marginal heat rates, would understate benefits for such resources, just as the Staff methodology understates CHP benefits relative to displacement.

Do you think the approach (as a whole or specific elements of the method) will result in an accurate estimate, or will it overestimate/underestimate grid displacement? Please explain.

CHP Parties Response: As explained herein, the methodology as proposed does not reasonably reflect a heat rate for marginal generation that may be displaced. It underestimates the grid displacement from CHP resources. It should be modified as provided in these comments to approximate the marginal generation heat rates, and eliminate reliance on average annual heat rates. Further, even the modified methodology outlined by the CHP Parties only captures the electric energy displaced by CHP and does not reflect a comprehensive total displacement for CHP resources.

What do you think are the appropriate levels of granularity necessary in order to provide a reasonable estimate of electric grid fuel displacement? Please use the discussion of Method Parameters section in Chapter 5 as a starting place for discussion.

CHP Parties Response: As applied to the displacement methodology, the CHP Parties support Staff's approach with respect to the treatment of a) renewable resources (including the issue of over-generation); b) a single heat rate projection; c) imported electricity; and d) a line loss factor adjustment. As outlined in these comments, the CHP Parties urge adoption of refinements in order to reflect marginal, rather than average resource heat rates. Concerning heat rate categories, the use of two categories (*i.e.,* peaking and load following) is acceptable, provided that the assumptions related to the peaking category are modified from the unreasonably low 2.8% capacity factor-based value. The CHP Parties established a percentage of time on the margin value consistent with CPUC resource adequacy requirements that more realistically reflect the marginal operation of peaking generation resources.

IV. Conclusion

EPUC and CAC appreciate this opportunity to respond to CEC Staff's proposed methodology. The features of the marginal heat rate methodology identified by the CHP Parties should be adopted. The revised methodology more accurately reflects the capabilities of the existing fleet, and identifies the marginal units that would be displaced by any alternative energy source. Although this methodology may produce gross approximations of the order of magnitude in energy displacement, it should not be used for any specific policy development until a comparable, comprehensive evaluation of CHP resources is provided.

Respectfully submitted,

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APPENDIX

CHP PARTIES COMMENTS ON THE CEC STAFF'S *PROPOSED NEAR-TERM METHOD FOR ESTIMATING GENERATION FUEL DISPLACED BY AVOIDED USE OF GRID ELECTRICITY*

The primary purpose of this Appendix is to detail the analysis, step-by-step calculations and comparisons of the CEC Staff annual average methodology with the CHP Parties modifications to establish a marginal heat rate methodology.

As noted in the CHP Parties' comments, Staff's proposal is premised on an assumption that there are two classes of natural gas fueled resources that will be displaced by alternative energy – "peaking" and "load following." For each of these classes, the Staff methodology calculates the ***average*** heat rate for that entire class. A linear regression is applied to historical class average heat rates for calendar years 2002 through 2013 to project the displaced heat rates for future years. Staff's methodology further assumes that alternative energy can only displace the "peaking" class average heat rate for 2.8% of the time; a number based on the class historical capacity factor. As a result, the Staff's proposal constrains the presumed operation of peaking resources to be the marginal and displaced resource for a maximum of 2.8% of the time. The flaw in this assumption is compounded by assuming that the heat rate for these peaking resources reflects the average heat rate for all generating resources comprising the "peaking" class.

The CHP Parties' assessment modifies the methodology to better approximate some recognized realities relative to the grid and displacement issues:

- California's natural gas-fueled resources are comprised of multiple units with wide ranging heat rate values. For example, the unit heat rates for California natural gas-fueled resources calculated from the CEC Quarterly Fuel and Energy Report (QFER) data for 2014 range from a low of about 6,850 Btu/kWh to over 20,000 Btu/kWh. Accordingly, the two "class" average heat rate aspect of the Staff methodology cannot accurately reflect the alternative energy displaced heat rate occurring at the margin for such a wide ranging set of values.

- The generation whose fuel and GHG emissions are displaced by alternative energy is marginal generation whose heat rate is not accurately reflected by the average heat rate for the entire class of peaking or load-following resources. A modification to Staff's methodology to approximate the marginal heat rate for "peaking" and "load following" generation displaced by alternative energy is required. Additionally, the use of historical capacity factors to develop the maximum time that alternative energy can displace "peaking" generation is too restrictive and does not reflect the California peak load realities.

- Based upon CPUC decisions cited herein, there is a minimum four hour requirement for resource adequacy resources, and the typically retail-tariff peak load time-of-use period for California utilities is six hours. This feature of peaking resources warrants reflection of a much larger percentage of marginal operation – approximately 16.7% of the time (*i.e.*, four hours daily) rather than the 2.8% assumed by Staff.

- Significantly, the proposed revisions to Staff's proposal reflected in these comments and detailed in this Appendix rely on the data in the Quarterly Fuel and Energy Report. This is the same database underlying Staff's methodology.

The following revisions and calculation procedure developed by the CHP Parties a) approximates the contribution to the marginal generation heat rate made by California natural gas-fueled resource; b) calculates the marginal heat rate for the annual, "load following" and "peaking" time periods; and, c) applies Staff's regression analysis to calculate the heat rates associated with future marginal generation that is displaced by alternative energy.

The marginal heat rate approximation method, and the modifications to the Staff's average analysis, is outlined below:

Step 1

For each of the calendar years 2002 through 2013 (same years per CEC Report), the hours of operation are calculated per the following formula:

Operational Hours $(OH)_i = MWh_i \div MW_i$

Where: OH is the calculated operational hours for unit "i"

MWh is the "Net MWh" for unit "i" in the CEC QFER database for the subject calendar year

MW is the "Capacity" for unit "i" in the CEC QFER database for the subject calendar year

Step 2

For each year 2002 through 2013, the year's CEC QFER unit data is rank ordered smallest OH to largest OH based on the unit's OH.

Step 3

For each unit for each calendar year 2002 through 2013, a proxy number of hours on the margin are calculated per the following:

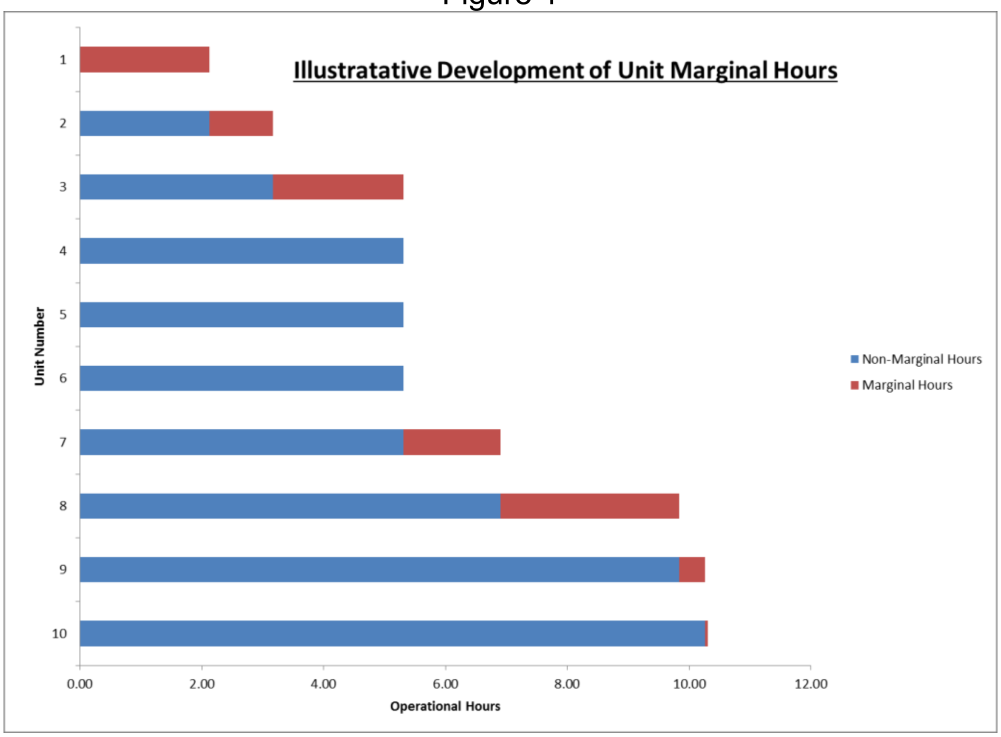
The first unit in the rank ordered data (per Step 2) has its Marginal Hours (MH) set equal to its OH. For each subsequent unit in the rank ordered data, the proxy marginal hours are per the following formula:

$$MH_i = OH_i - OH_{i-1}$$

Where: "i" is the unit designation for unit 2 through the last unit in the analysis data

The process is illustrated in the following Figure 1 for the first 10 units analyzed in the 2014 database.

Figure 1



Note that because units 3 through 6 have the exact same operational hours only one of the three is calculated as contributing to the marginal generation. Each unit is assumed to have been dispatched during the same period and only one of the three units could have been on the margin.

Step 4

For each unit for each calendar year 2002 through 2013, the percent of the time the unit contributes to the margin generation is calculated per the following formula:

$$\text{Percent of time unit on the margin (POM)}_i = \sum_{i=1}^{k} H_i \div MH_i$$

Where: k is the total number of units for the subject calendar year

Step 5

For each unit for each calendar year 2002 through 2013, the unit weighted contribution to the marginal generation heat rate is calculated per the following formula:

$$\text{Weighted contribution to marginal heat rate (MHR)}_i = \text{Unit Heat Rate (HR)}_i \times POM_i$$

Where: Each unit heat rate (HR) is calculated by dividing the unit total fuel use (MMBtu) recorded in the CEC QFER database by the unit “Net MWh”

Step 6

The annual approximate marginal heat rate (AMHR) for each year is equal to the sum of all unit MHR for the subject year.

The peaking proxy marginal heat rate (PMHR) for each year is equal to the sum of MHR for those units whose cumulative sum of OH are equal to or less than the number of hour during the year attributable to the peak period (for purposes of this analysis 4 hours per day are peak hours or about 16.7% of the hours) divided by the sum of the those same unit’s POM.

The load following proxy marginal heat rate (LFMHR) for each year is the calculated as the sum of the remaining MHR divided by the remaining POM.

With the modifications described in Steps 1 through 6 above applied, Staff’s regression analysis is implemented using the marginal heat rates in place of the average heat rates proposed in the Staff methodology (*see* Figure 2 and Figure 3). The result is the “export” displacement heat rates (*i.e.*, non-loss adjusted displacement heat rates) for calendar years 2014 through 2018.

A sanity check on the marginal generation heat rate approximation was performed comparing the historical-based annual marginal generation heat rates for calendar years 2012, 2013 and 2014 with the SCE DLAP annual average equivalent heat rate for the same years. Additionally, the 2014 regression derived annual marginal generation heat rate was also compared to SCE DLAP annual average equivalent heat rate for 2014. The result of the comparison is presented in the following table.

Comparison of QFER and Regression Annual Heat Rates With SCE Day-Ahead Market DLAP Equivalent Heat Rate				
Line	Description	2012	2013	2014
1	QFER Annual Marginal Heat Rate (Btu/kWh)	9,501	8,816	8,652
2	SCE DLAP Equivalent Heat Rate (Btu/kWh)	9,307	9,238	8,648
3	Regression QFER Annual Heat Rate (Btu/kWh)			8,683
4	Percent QFER Exceed DLAP	2.1%	-4.6%	0.1%
5	Percent Regression Exceed DLAP			0.4%
6	Staff Regression QFER Avg Annual (Btu/kWh)			7,314
7	Percent Staff Regression Exceed DLAP			-15.4%

Note that the annual marginal heat rate calculated pursuant to the recommended marginal heat rate modification to the Staff methodology (Line1) is within $\pm$ 5% (Line 4) of the historical DLAP equivalent annual Locational Marginal Prices (LMP) heat rate (Line 2) calculated from CAISO Day-Ahead Market (DAM) Locational Marginal Prices.

Importantly, the 2014 regression derived 2014 annual marginal heat rate (Line 3) is within 0.4% (Line 5) of the DLAP equivalent heat rate (Line 2 at column “2014”). These comparisons show that the results of the CHP Parties’ recommended modification to Staff’s methodology produce reasonable results. In contrast, the Staff 2014 average annual heat rate derived from Staff’s regression is 7,314 Btu/kWh (Line 6) or more than 15% (Line 7) less than the DLAP equivalent annual heat of 8,648 Btu/KWh (Line 2 at column “2014”).

The equivalent annual DLAP LMP heat rate is calculated per to the following formula:

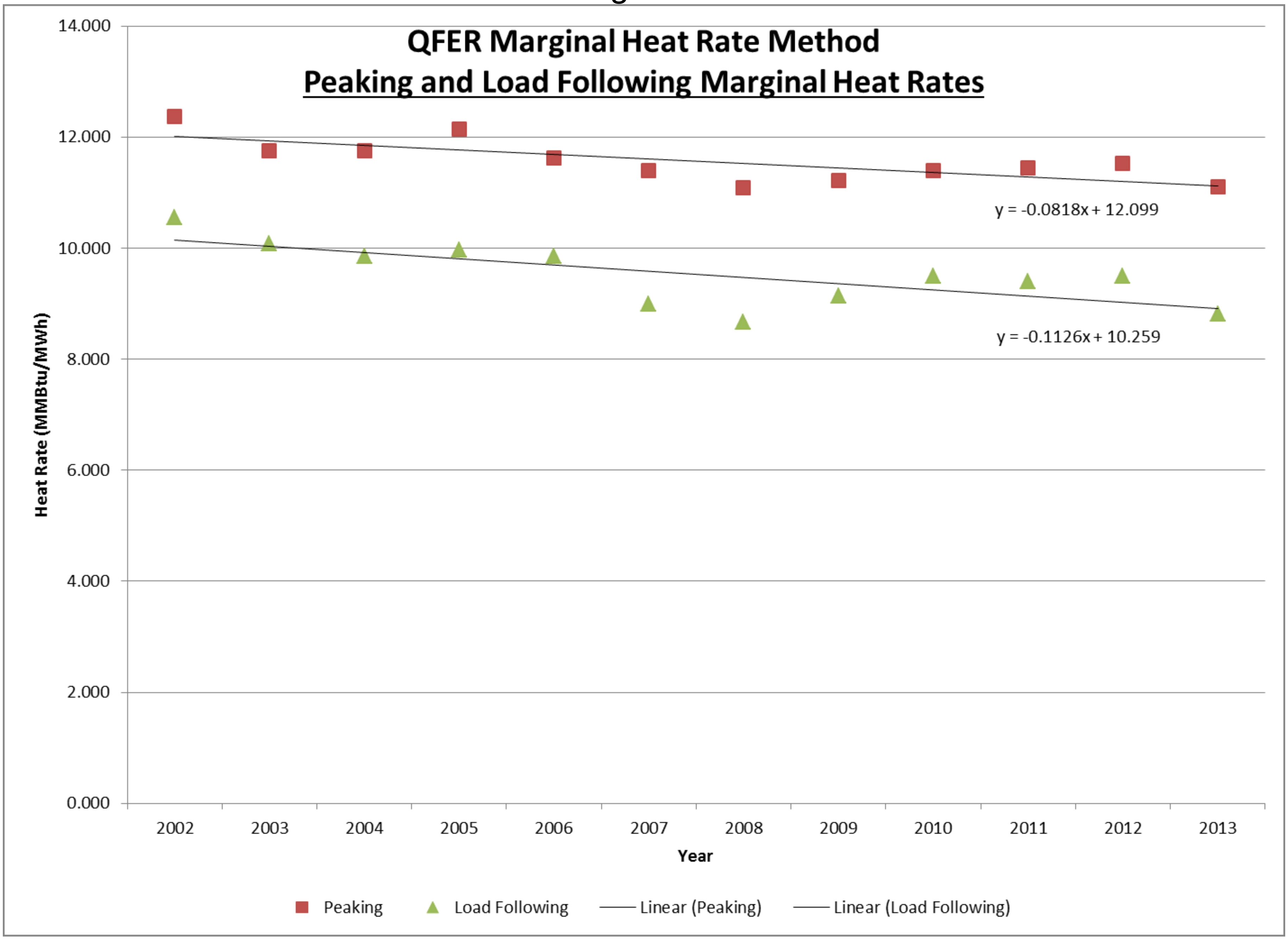
Annual DLAP Heat Rate =

{(Annual Average DLAP Prices – VOM)/Gas Price} x 10^3

Where: VOM = variable operation and maintenance cost from publicly available tolling PPA

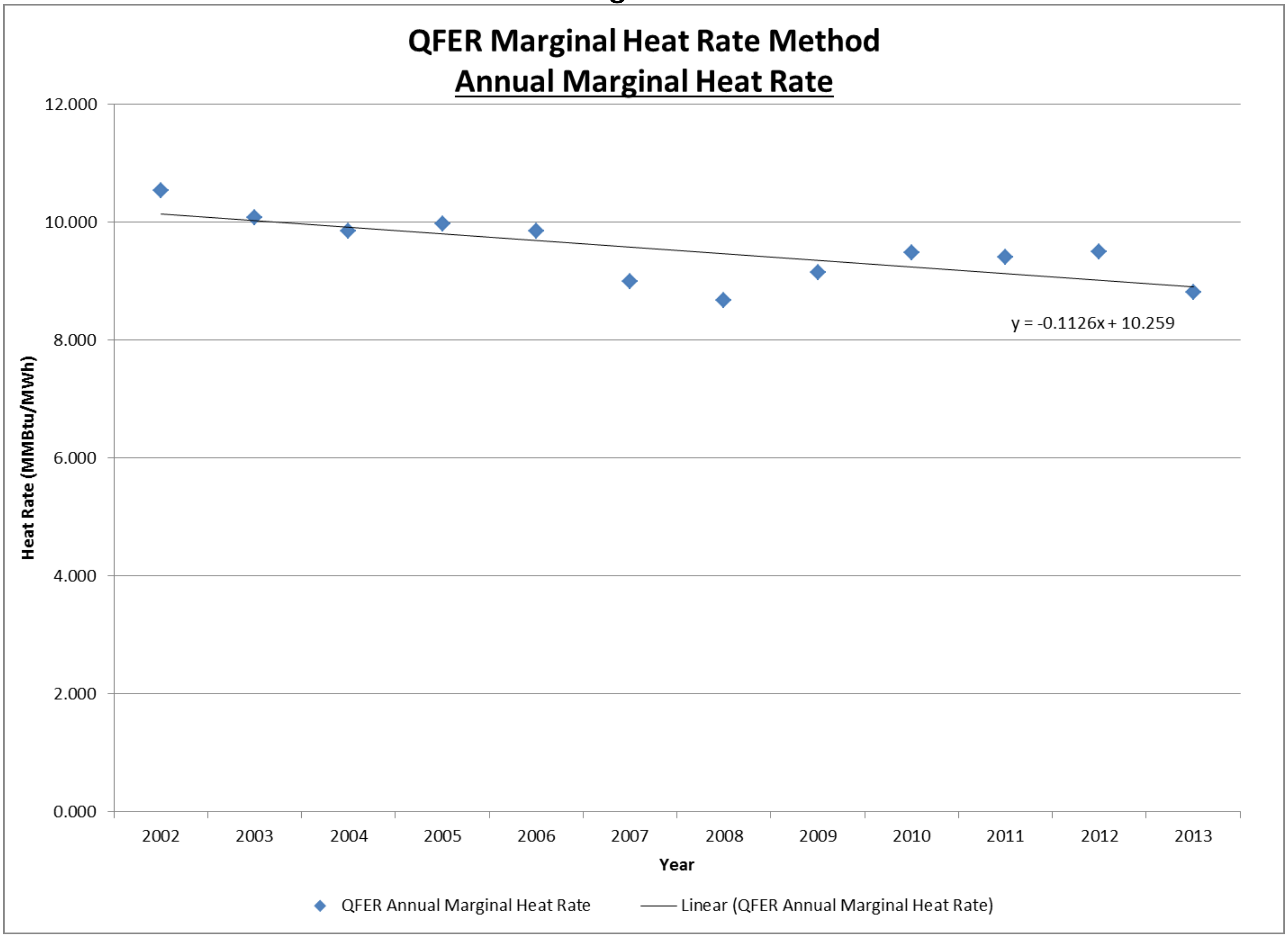
Gas Price = Annual Average SCE SRAC Burner Tip Natural Gas Price + GHG Allowance Cost (expressed in $/MMBtu)

Figure 2



QFER Marginal Heat Rate Method
Peaking and Load Following Marginal Heat Rates
Heat Rate (MMBtu/MWh)
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0.000
y = -0.0818x + 12.099
y = -0.1126x + 10.259
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year
Peaking
Load Following
Linear (Peaking)
Linear (Load Following)

Figure 3


QFER Marginal Heat Rate Method
Annual Marginal Heat Rate
12.000
10.000
8.000
6.000
4.000
2.000
0.000
Heat Rate (MMBtu/MWh)
y = -0.1126x + 10.259
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year
QFER Annual Marginal Heat Rate
Linear (QFER Annual Marginal Heat Rate)