CHP Savings and Avoided Emissions in Portfolio Standards

R. Neal Elliott, Anna Chittum, Daniel Trombley, and Suzanne Watson,
American Council for an Energy-Efficient Economy

ABSTRACT

Combined heat and power systems and power recovered from waste energy can represent important contributions to meeting an Energy Efficiency Resource Standard and complying with carbon reduction policies. In order for these resources to be credited towards such targets, a consistent methodology to approximate associated energy savings and emissions reductions is needed. This is a complex task for CHP systems because they produce both thermal and power outputs. Net savings need to be properly attributed to either the displaced thermal or power system (or both) without attributing the same savings twice. This is further complicated because the thermal output typically displaces an onsite thermal-only system and the power typically displaces power generated remotely and purchased from the local electric power pool. As a result, the savings are represented by the net reduction in fuel, compared to the combined fuel from the displaced local thermal system and the displaced generation in the electric pool. This paper provides a context for developing a methodology to address these issues, and proposes an approach that can fairly credit CHP systems for their energy savings and reductions in greenhouse gases.

Introduction

Combined heat and power (CHP) systems and power recovered from waste energy[1] can represent important contributions to meeting an Energy Efficiency Resource Standard (EERS) and complying with carbon reduction policies. The International Energy Agency (IEA 2008) defines CHP as "the simultaneous utilization of heat and power from a single fuel or energy source, at or close to the point of use. An optimal CHP system will be designed to meet the heat demand of the energy user—whether at building, industry, or city-wide levels—since it costs less to transport surplus electricity than surplus heat from a CHP plant. For this reason, CHP can be viewed primarily as a source of heat, with electricity as a by-product." As a result, a CHP system can both avoid the combustion of fuel at power plants—thereby reducing utility sector fuel needs and preventing the emissions associated with the fuel saved—and replace the need for a local thermal system such as a boiler or chiller.

In the context of an EERS, it is important to develop an approach that consistently captures the fuel savings and emissions reductions that result from the operation of a CHP system, compared to the operation of separate heat and power systems. The net benefit is the difference between the fuel required by the grid-supplied power and the local system. This paper proposes an approach to quantify the savings creditable to an EERS from a CHP system, and extends the approach to calculate the avoided greenhouse gas emissions that are creditable to the operation of a CHP system.

[1] Since power recovered from waste energy (also referred to as recycled energy) can be viewed as a special case of CHP in which no incremental fuel is required by the distributed energy system to produce the power output, we will generalize our discussion to CHP systems and discuss the implications for recovered waste energy later in the paper.

Energy Efficiency Resource Standards

An EERS sets targets for utilities to achieve more efficiency in the use of electricity and natural gas (Nadel 2006), so an EERS requires a clear understanding of the actual efficiency savings resulting from installed projects. Nineteen states currently have an EERS in place and three others have policies under consideration (ACEEE 2009). A federal EERS, as has been introduced in both the U.S. House of Representatives (Markey 2009) and Senate (Schumer 2009), would set a national goal for energy savings for retail electricity and natural gas distributors to meet by a given future date. Both bills have included CHP among the eligible measures subject to a U.S. Department of Energy rulemaking to determine the details.

Savings that count towards EERS energy efficiency goals are generally non-generation energy savings that can come from a variety of sources, such as weatherizing homes, installing energy-efficient equipment and appliances, and improving transmission and distribution systems. To be creditable to an EERS, actual realized savings from CHP installations needed to be able to be quantified.

An EERS or similar approach could also factor into policies put in place at the regional or national level to reduce future emissions of greenhouse gasses (GHG), specifically carbon dioxide emitted as a result of the combustion of fossil fuels. This approach has been included in recent climate legislation in the U.S. House in the form of a combined renewable electricity and energy efficiency standard (Waxman 2009).

Precisely estimating the appropriate energy savings credit for many energy efficiency improvements is fairly straightforward. For example, when replacing an incandescent light bulb with a compact fluorescent light bulb, the difference between the energy used by the new light bulb and the energy used by the old light bulb represents the “saved” energy due to the increased efficiency of the new light bulb. This calculated “saved” energy can then be directly credited within an EERS scheme or converted to avoided GHG emissions, considering the fuel mix of the power pool supplying the consumer.

However, estimating the energy saved from a distributed energy system such as CHP can be much more complicated to measure, as these systems typically require the combustion of some additional onsite fuel, compared to what would have otherwise been combusted to meet the onsite thermal load without a CHP system. In these cases, the savings in energy occur not at the points of use, but rather at the centralized point of generation of the electricity that is displaced by the local power resource (in this case, the CHP system). The net benefit is the difference between the fuel required by the grid-supplied power and the local system.

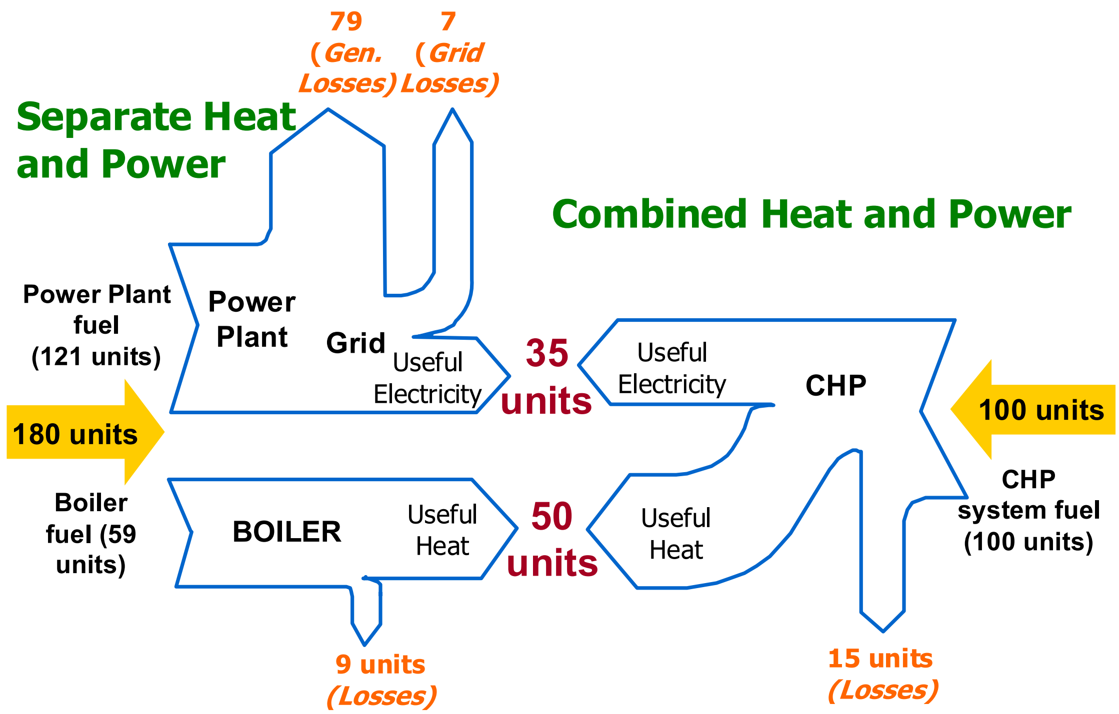
Representation of CHP

As noted in the IEA definition, CHP resources represent a suite of technologies and systems that generate electrical and/or mechanical energy concurrently with usable thermal energy. Though CHP can take many forms depending on local energy needs, an archetypal CHP system takes a single fuel input and produces both power—in the form of electricity or mechanical energy—and a useful thermal energy flow such as steam or chilled water. Both types of energy are typically used near the point of generation.

It is important to note, as IEA (2008) has, that CHP should be viewed primarily as a source of thermal energy, with electricity as a valuable by-product. The thermal energy would in almost all cases have otherwise been produced by an onsite system, such as a boiler. The electricity would have otherwise been purchased from the local electric utility. With CHP, those two systems are combined, and the input fuel is used much more efficiently.

As can be seen in *Figure 1*, there is a net decrease in the total fuel input consumed by a CHP system, and that fuel is used to produce the same amount of useful energy as the combination of local thermal and remote centralized power generation systems (Elliott and Hedman 2001). For this reason, CHP can represent an important efficiency resource. Since a CHP system primarily satisfies demand for power at or near the facility, transmission and distribution system losses that would have occurred had the electricity been purchased from a remote, centralized generator are also avoided (Shipley et al. 2001).

Figure 1. Schematic Comparison of Combined Heat & Power and Separate Heat & Power Systems



Source: Elliott and Hedman (2001)

The efficiency of CHP's conversion of fuel to useful output may vary significantly from system to system, and the type of input fuel displaced at the corresponding electric generators will vary depending on the power pool in which the CHP system operates. Simply using the absolute power output of a CHP system as the applicable metric for credit within an EERS or GHG context does not accurately reflect the benefits of a CHP system. Doing so would distort the true impact, in most cases unfairly benefiting the CHP system.

In addition, it may not be appropriate for all CHP systems to be eligible for credit under an end-use program. Current EERS legislation (Markey 2009; Schumer 2009) is targeted at savings in the transmission, distribution, and consumption of energy resources, but explicitly excludes efficiency in generation. Thus, CHP systems that are primarily intended to satisfy demand at or near their location on a net annual basis would qualify for inclusion in an EERS program. However, to the extent that a CHP system is primarily operated as a wholesale power generator, crediting savings from the CHP system would not be appropriate. These systems should be viewed as power generation facilities, and would be more appropriately covered by policy and market mechanisms that address generation efficiency.

Purpose of this Paper

To address the need for a clear, comprehensive, and accurate methodology for calculating the efficiency impact of a CHP system, ACEEE proposes the following factors be considered: 1) the "true" efficiency of the locally generated electricity, and 2) the market environment within which the individual CHP system operates, adjusting the credited benefits of using that particular CHP system accordingly. ACEEE suggests that the methodology described below presents a fair way to treat a CHP system, crediting it neither too little nor too much for its actual energy impacts. Further, it is proposed that the net fuel savings be used to calculate the GHG benefits that would result from a CHP system for use in a cap-and-trade or other GHG portfolio program.

Necessity for a New Methodology

In most previous energy policies that have encouraged CHP deployment or provided incentives (Elliott 2001), a threshold criterion has been used to qualify projects, and the relative energy resource impact of CHP systems has not been estimated. Most incentive and financing programs have established a basic efficiency threshold level—typically the percent of fuel input that ends up as useful energy—and allow any CHP systems that exceed the threshold to participate in the program. This approach was used with the CHP investment tax credit (ITC) in the *Emergency Economic Stabilization Act of 2008* (Kennedy 2008).

In contrast to an incentive program, an EERS or GHG portfolio program does more than just encourage the deployment of efficiency resources. These portfolio programs actually give specific credit for the amount of overall electricity consumption an efficiency measure avoids. Such a program either confers benefit to measures that save electricity or gives credit for the net carbon dioxide emissions avoided by the operation of a CHP system. Therefore, saved electricity has value, and must be credited and calculated accurately. This approach is necessary in order to treat all efficiency measures as comparable, and to allow for the trading of efficiency credits, if such a system is allowed by regulations.

As noted above, not all CHP systems are created equal. A mandated efficiency requirement ensures that qualifying CHP systems are producing electricity at or above the efficiency level of the new utility generation resource—usually 60 percent, or one level above a combined cycle gas turbine system, which is assumed to be the most efficient commercially available, electric-only generation technology. This 60 percent threshold was used in the federal ITC (Kennedy 2008) and in some state provisions. Policymakers can be fairly confident that electricity produced by qualifying systems, then, is being produced using less fuel than would have been used had the electricity been produced by the power pool. However, simply meeting a one-size-fits-all efficiency level offers no indication as to exactly *how much less* fuel is being used due to the replacement of centralized generation with CHP-generated electricity.

Like CHP systems, each power pool's efficiency is unique. To accurately calculate the true energy savings accrued by using CHP to generate electricity instead of buying it from the grid, one must know how much fuel a given local power pool needs to generate its electricity.

Saving a certain amount of fuel in California, for example, does not have an equivalent impact on California's corresponding power pool as does saving the same amount in Ohio on its power pool.

Further complicating the issue is the particular fuel input and relative efficiency of the generation that is actually being displaced by the output from the CHP system. The displaced generation can change depending on where and when the load reductions are occurring and what generating units are consequently being affected. The U.S. Environmental Protection Agency maintains a database—*eGRID*[2]—which uses plant capacity factors to estimate emissions from non-base load generation plants by assuming that they are indicative of the dispatch order of the plants within a given region (EPA 2007). How a power system reacts to energy efficiency in the long term is complicated because several parameters must be taken into account, such as the political and economic landscapes, which are inherently difficult to predict. Extending an analysis to include impacts decades into the future significantly increases uncertainty, rendering estimates of displaced generation from models of limited value (EPA 2008).

CHP systems produce both power and thermal energy from the same fuel source, so both the power and thermal output need to be accounted for. A number of approaches can be used to accomplish this, either converting all the output into equivalent thermal output or using an approach such as has been proposed in Massachusetts, where the thermal output is converted into an equivalent electric output (Mass DEP 2008). This approach draws upon the model rule proposed by the Regulatory Assistance Project (RAP 2002) and is appropriate for capturing the full beneficial output from a CHP system.

In the case of savings within an EERS context, however, we are not interested in the full output from the CHP system, but the net savings relative to separate heat and power systems. If savings were allowed to be allocated to a combination of thermal energy and power, this process would introduce significant complexity into the process with the proliferation of implementation options creating potential opportunities for manipulation or abuse.

Therefore, for the purpose of a portfolio, ACEEE recommends that credit for the energy savings from a CHP system be allowed to apply to only one market—either electric or thermal. ACEEE further recommends that the credit apply to the electric market, because onsite thermal demands will almost always need to be met with onsite thermal systems (e.g., a boiler to produce steam), whereas electricity can generally be purchased from a local electricity provider—a fact reflected in the IEA definition of CHP (IEA 2008).

Proposed Calculation for CHP Fuel Savings

CHP systems produce power, which can be easily measured as kWh output. It might seem, then, that determining the actual impact of a CHP system as an efficiency resource is as straightforward as crediting the displaced purchased electricity. However, the appropriate treatment of CHP is more complex. With CHP, additional fuel is required locally to operate the system, over and above the fuel that would have otherwise been combusted to satisfy the onsite thermal load.[3] This amount of additional energy varies with the specific configuration and operation of a given system. In general, however, the total input energy used by the CHP system is *less* than the amount of fuel that would have been used by a centralized electricity generator *plus* the fuel that would have been used by an onsite boiler (see *Figure 1*).

[2] *eGRID* can be accessed at http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html.
[3] This does not apply in the case of recovered waste energy, which will be discussed later.

As discussed earlier, for the purposes of portfolio policy, the credited savings from a CHP system should be expressed in terms of the actual energy no longer being consumed due to the presence of the more efficient CHP system. ACEEE recommends using input fuel amounts (expressed in BTUs) to measure savings across a variety of energy resource types. This paper will later discuss the conversion of the fuel savings back to electricity savings for the purposes of an EERS and emissions savings for the purposes of a GHG portfolio program.

At its most basic, the equation describing the total fuel savings from the installation of a CHP system is:

Formula for Determining Fuel Savings from a CHP System for Purposes of Portfolio Policy		
Total fuel savings from the CHP System	Fuel that would have been combusted in the power pool to provide the electricity that is now supplied by the CHP system	Fuel used by the CHP system to produce onsite electricity

Using variables to describe the above idea yields this basic equation:

(1) $$\mathbf{S_{FUEL} = F_{GRID,POWER} - F_{CHP,POWER}}$$

Where $\mathbf{S_{FUEL}}$ is the net fuel savings due to the CHP system, which will be used to determine electricity or GHG savings creditable to the CHP system; $\mathbf{F_{GRID,POWER}}$ is the fuel that would have been combusted by the generation sources in the power pool to generate the electricity that is now displaced by the CHP system's power output; and $\mathbf{F_{CHP,POWER}}$ is the fuel used by the CHP system to produce the electric power onsite.

The fuel input to a CHP system is easily quantified. However, it is not enough to simply use the total fuel input amount to substitute for $\mathbf{F_{CHP,\ POWER}}$. Using the total amount of a CHP system's fuel input for purposes of any calculation ignores the fact that a CHP system is generally replacing some other, often less efficient thermal-only system. The system being replaced would have still used a certain amount of input fuel to produce thermal energy that would not have contributed to electricity production. In an electric EERS, the aim is to capture the benefits to the *electric* market by implementing efficiency measures. Thus, we do not count the amount of fuel that would have otherwise gone toward satisfying the onsite thermal demand when calculating the CHP system's total *electric* output for the EERS.

ACEEE therefore recommends that, in order to determine the amount of fuel attributable to a CHP system's electric production (and thus applicable to any EERS calculation), the amount of fuel *equivalent to that which would be required to produce the same thermal energy in an onsite thermal-only system* be subtracted from the total fuel input of the CHP system. The amount of fuel attributable to a hypothetical onsite thermal-only system can be derived from the known boiler efficiency rate of either the existing boiler that will be replaced by the CHP system or an available technology that could provide the same amount of thermal energy as the new CHP system.[4] The remaining CHP system fuel would be the appropriate metric for calculating the CHP system's electric and emissions output that is attributable to an EERS and GHG portfolio program, respectively. This reflects the fact that $\mathbf{F_{CHP,POWER}}$ represents only the fuel attributable to the electric output of the CHP system.

[4] The reference quantity could be estimated in a number of ways. The authors suggest that actual methodology be deferred to a public rulemaking process that fully considers the complexities inherent in this issue.

Incorporating this definition of $\mathbf{F_{CHP,\,POWER}}$ into equation (1) yields:

$$\textbf{(2)}\ \mathbf{S_{FUEL}} = \mathbf{F_{GRID,POWER}} - \left(\mathbf{F_{CHP,TOTAL}} - \mathbf{F_{CHP,THERMAL}}\right)$$

Where $\mathbf{F_{CHP,TOTAL}}$ is the total absolute fuel input of the CHP system and $\mathbf{F_{CHP,THERMAL}}$ is the CHP fuel input that would have been required to produce the same thermal energy in an onsite system, as discussed above.

At this point, equation (2) contains a defensible measure of the applicable fuel input attributable to power generation in the CHP system in the calculation $\mathbf{F_{CHP,TOTAL}} - \mathbf{F_{CHP,THERMAL}}$. However, $\mathbf{F_{GRID,POWER}}$, the amount of fuel that would have been consumed by the power pool to create the electricity now offset by the CHP system, can only be determined by factoring how efficiently the corresponding power pool uses fuel to generate and deliver electricity. This level of power pool efficiency varies significantly across the country, as some power pools use a collection of much more efficient generating resources than others. It is imperative that applicable electricity savings be scaled to account for the fact that an efficiency measure that saves one kWh in a given region may reduce more or less source fuel than a similar measure elsewhere. We choose to use the average efficiency of the fossil generation in the power pool since the data is readily available from *eGrid* (EPA 2007); both other values could also be chosen based on more detailed modeling.

The "average heat rate" of a power pool is the rate that describes how much fuel is required, on an average annual basis, by the generating resources in the power pool to produce and deliver a given amount of electricity. This rate, when incorporated into the equation, will adjust for differences in efficiency levels of power pools across the country. The average heat rate should include the average avoided transmission and distribution losses for the power pool as well.[5]

Once the power pool's average heat rate is determined, $\mathbf{F_{GRID,POWER}}$—the fuel that would have been used by the power pool to provide the electricity saved by the CHP system—can be calculated by multiplying the average heat rate by the CHP system's total electric output.

Incorporating this definition of $\mathbf{F_{GRID,\,POWER}}$ into equation (2) yields:

$$\textbf{(3)}\ \mathbf{S_{FUEL}} = \mathbf{E_{CHP}} * \mathbf{H_{GRID}} - \left(\mathbf{F_{CHP,TOTAL}} - \mathbf{F_{CHP,THERMAL}}\right)$$

Where $\mathbf{E_{CHP}}$ is the average annual output of the CHP system in kWh, and $\mathbf{H_{GRID}}$ is the average heat rate of the corresponding power pool expressed in BTU/kWh.

Proposed Calculation for CHP Electric Savings for an Electric EERS

The savings described in the above equation are the net fuel savings that occur at the point of generation as a result of the deployment of the CHP system. As mentioned above, an EERS credits savings in terms of kWh saved onsite, so there remains a need to use the net fuel savings derived above—$\mathbf{S_{FUEL}}$—to determine the fraction of the total CHP system electric output that counts as creditable kWh savings. This savings amount can then be compared to other onsite efficiency measures within an EERS. To do this, the rate at which BTUs of fuel saved by the

[5] While quantifying these losses is important to ensure the accurate total average heat rate—a discussion of the methodology for quantifying these numbers is beyond the scope of this paper.

installation of the CHP system would have been used as fuel input to the power pool to make electricity must be considered.

This is calculated by dividing $\mathbf{S_{FUEL}}$ by the average heat rate, $\mathbf{H_{GRID}}$. This yields the applicable electrical savings for the CHP system within an EERS, or $\mathbf{S_{CHP,ELEC}}$, expressed in kWh:

$$\textbf{(4)}\quad \mathbf{S_{CHP,ELEC}} = \frac{\mathbf{S_{FUEL}}}{\mathbf{H_{GRID}}}$$

Combining equations (3) and (4) yields:

$$\textbf{(5a)}\quad \mathbf{S_{CHP,ELEC}} = \frac{\mathbf{E_{CHP}} * \mathbf{H_{GRID}} - \left(\mathbf{F_{CHP,TOTAL}} - \mathbf{F_{CHP,THERMAL}}\right)}{\mathbf{H_{GRID}}}$$

Expressing equation (5a) in general form yields:

$$\textbf{(5b)}\quad \mathbf{S_{CHP,ELEC}} = \mathbf{E_{CHP}} * \left(1 - \frac{\mathbf{F_{CHP,TOTAL}} - \mathbf{F_{CHP,THERMAL}}}{\mathbf{E_{CHP}} * \mathbf{H_{GRID}}}\right)$$

Where:

$\mathbf{S_{CHP,ELEC}}$	CHP savings creditable to an EERS, expressed in kWh
$\mathbf{E_{CHP}}$	Annual electrical output of CHP system, expressed in kWh
$\mathbf{F_{CHP,\ TOTAL}}$	Total fuel input of the CHP system, expressed in BTUs
$\mathbf{F_{CHP,\ THERMAL}}$	Fuel that would have been required to produce the same amount of thermal energy *as the new* CHP system in an onsite thermal-only system, expressed in BTUs
$\mathbf{H_{GRID}}$	Average rate at which the local power pool generates and delivers electricity, expressed in BTU/kWh

Proposed Extension of Net Fuel Savings to GHG Reduction

To extend the energy savings from the CHP system to GHG emissions reductions, the same approach can be used, netting the emissions from the fuel used to power the CHP system—$\mathbf{F_{CHP,POWER}}$—against the emissions from the fuel required to generate what would have been the grid-supplied electricity had the CHP system not existed—$\mathbf{F_{GRID,POWER}}$. This calculation is somewhat complicated by the fact that the fuel mix for the CHP system may be significantly different from the fuel mix of the grid. Thus two new parameters are introduced, representing the effective CO_2 emissions rates in kg_{CO2}/BTU for the CHP fuel: $\mathbf{e_{CHP,POWER}}$ and $\mathbf{e_{GRID,POWER}}$. Building on the general form of equation (1) the following relationship is derived for the emissions savings—$\mathbf{S_{EMISSIONS}}$—that are attributable to the CHP system operation:

$$\text{(6)}\quad S_{EMISSIONS} = e_{GRID,POWER} * F_{GRID,POWER} - e_{CHP,POWER} * F_{CHP,POWER}$$

Applying the same substitutions as applied in equations (2) and (3), the relationship can be expressed in a more general form:

$$\text{(7)}\quad S_{EMISSIONS} = e_{GRID,POWER} * E_{CHP} * H_{GRID} - e_{CHP,POWER} * \left(F_{CHP,TOTAL} - F_{CHP,THERMAL}\right)$$

This relationship allows $e_{CHP,\,POWER}$ and $e_{GRID,\,POWER}$ to be calculated for the unique fuel mix of the CHP system and the power pool in which it operates. The emissions factors for various fuels are readily available from many sources.[6] The effective emissions rate for both the CHP system and the corresponding power pool should be calculated based on the relative fractions of fuels in the fuel mix of each.[7] This can be expressed for the power pool as:

$$\text{(8)}\quad e_{GRID,POWER} = \frac{\sum_{i=1}^{n} e_{GRID,POWER_i} * F_{GRID,POWER_i}}{F_{GRID,POWER,total}}$$

Where **i** represents each individual fuel in the fuel mix of the power pool. If the CHP system uses more than a single fuel, the same relationship in equation (8) can be used to calculate an effective emissions rate for the CHP system.

Special Cases

While the approach described above should apply in most scenarios, a number of special cases exists that warrant further consideration and discussion.

Thermally Activated Cooling

A special case for CHP systems exists where thermally activated cooling technology is used to displace an electrically driven cooling system. In this case, the CHP system will be credited with the electricity output equivalent to the power required to operate a conventional electrically driven cooling system of the same capacity. In this special case, both the thermal output and the power output could be displacing grid-supplied electricity.

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[6] The U.S. Environmental Protection Agency offers an emissions calculator for CHP systems based upon the system's prime mover and prime fuel(s): http://www.epa.gov/CHP/basic/calculator.html. It also offers extensive resources for calculating emissions based upon the burning of fuels for power generation, such as its Clearinghouse for Inventories and Emissions Factors (CHIEF): http://www.epa.gov/ttn/chief/index.html.

[7] In the case where a centralized generator employs some mode of CO_2 capture and/or sequestration, the effective emissions rate would need to consider the impact of such technologies. The methodology for treating such technologies is beyond the scope of this paper.

Recovered Waste Energy

In the special case of recovered waste energy (also referred to as "recycled energy"), no additional fuel input is required to produce the usable energy. In equation (5b), the incremental fuel required, $\mathbf{F_{CHP}}$, is zero, so the CHP savings are equal to the displaced power. Therefore, for the purposes of an EERS, any avoided power can be fully credited to savings.

In reality, some recovered waste energy systems may require small additional amounts of fuel to be combusted to operate. In these cases, the incremental fuel required is not zero, so equation (5b) continues to apply.

Sometimes a recovered waste energy system recovers and uses energy that then displaces some amount of fuel from an onsite thermal system. In this case, if the fuel displaced is covered by an EERS (as in a natural gas EERS), then the creditable savings should be determined by calculating the fuel savings that occur at the onsite thermal system. In the case where the recovered waste energy system displaces both electric power and thermal energy, the savings should be credited to both electric and onsite natural gas savings. The GHG emissions savings, based on the net fuel savings, can be calculated in a manner similar to the treatment of CHP systems, as described above.

Use of Waste Fuels

Because the proposed methodology focuses on the energy value of both the fuel used for the CHP system and the electricity produced in the power pool, it is also appropriate when considering other purchased fuel sources. Special cases may result if the CHP fuel used is: 1) a renewable fuel, such as landfill gas or biomass, in which case the system might also qualify for a renewable portfolio standard or similar policy; or 2) a waste product such as a process off-gas that would otherwise not be used effectively. In these cases, special consideration may be required to account for the unique nature of the fuel. The consideration of this issue is beyond the scope of this paper, and should be considered as part of a public rulemaking process that would be required to fully administer an EERS or GHG portfolio program.

District Energy Systems

Many CHP and waste energy systems are designed principally to meet the energy needs of the facility at which they are located. However, there are also many examples where an independent system is installed to meet the needs of customers in proximity to the CHP system. These systems are generally referred to as *district energy systems* (Elliott and Spurr 1999). For purposes of a portfolio policy, it is appropriate to treat a district energy system and its customers as a single energy consumer, as the district energy system can be viewed as a thermal aggregator. In the absence of a district energy system, separate thermal and power systems would be required. Thus, ACEEE suggests that the efficiency savings from district energy systems be allowed to contribute CHP savings to an EERS program as a whole.

Conclusions

As an efficiency resource, CHP offers highly effective and efficient ways to reduce costs while also reducing other negative externalities such as overall emissions and electricity supply constraints. Though the manner in which CHP is treated in an EERS may seem unduly complex, it is merely a reflection of the fact that CHP systems are very heterogeneous in nature and site-specific in design. Their unique attributes make them versatile and quite well-suited for a number of applications, but their benefits to the local power pool vary tremendously based on a number of factors.

Because CHP systems can use fuel so efficiently across so many sectors, it is important that their deployment be encouraged through the proper application of public policy and regulatory tools. An EERS offers the ideal vehicle for creating additional support and value to CHP system owners and operators. An appropriately structured EERS that accurately gives credit for a system's efficiency will encourage the deployment of the most efficient CHP systems. ACEEE's recommendation for the treatment of CHP, laid out above, has been created with the input of many within the CHP community. As such, our recommendation reflects a common sense that future CHP deployments are best served by precisely and fairly treating a CHP system's output to best reflect its benefit to the local power pool and to society as a whole.

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