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EERE-2010-BT-STD-0031 – "Clean Energy for New Federal Buildings and Major Renovations of Federal Buildings"

February 21, 2023

SUBMITTED ELECTRONICALLY

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Office of Energy Efficiency and Renewable Energy
Building Technologies Office, EE-5B
1000 Independence Avenue SW
Washington, DC 20585-0121

RE: Combined Heat and Power Alliance Comments on Docket EERE-2010-BT-STD-0031

Introduction

The Combined Heat and Power Alliance ("CHP Alliance") appreciates the opportunity to submit comments to the Department of Energy's ("DOE") Building Technologies Office in response to the supplemental notice of proposed rulemaking ("SNOPR"), which revises Federal building energy performance standards and requires reductions in Federal agencies' on-site use of fossil fuels for new buildings and major renovations.

We are the leading national voice for the deployment of combined heat and power ("CHP"). We are a diverse coalition of business, labor, contractor, non-profit organizations, and educational institutions with the common purpose to educate all about CHP, and how CHP and waste heat to power ("WHP") technologies can make manufacturers and other businesses more competitive, reduce energy costs, enhance grid and customer reliability, and reduce emissions.

The CHP Alliance urges DOE to consider all available technologies for compliance with the proposed rule, which would provide flexibility for Federal agencies and encourage innovative solutions to achieve the overarching goal of reducing Scope 1 greenhouse gas ("GHG") emissions associated with on-site fossil fuel energy generation to zero by FY2030. To that end, our comments discuss:

(1) How the proposed rule could be strengthened by highlighting various pathways and technologies that Federal agencies could use to meet target reduction levels;

(2) The use of zero emission fuels in combination with CHP systems and associated added benefits;
(3) How repowering existing CHP facilities to incorporate zero emission fuels is a viable compliance pathway for major renovations; and,
(4) Standards for calculating net GHG emissions for CHP systems.

Overlooked Aspects of the Proposed Rule and CHP Alliance Recommendations

As it is currently written, the SNOPR acknowledges the use of the following to be exempt from the proposed rule because of their renewable nature: biomass, solar photovoltaics, and CHP using non-fossil fuels such as geothermal as the sole source of energy. While this proposed rule is limited in scope to reducing and eventually eliminating Scope 1 fossil fuel-based emissions, it is critical for DOE to specifically recognize all alternative renewable and non-fossil zero-carbon fuels that can be used in combination with CHP systems as viable options for the design of new and majorly renovated Federal buildings to reduce on-site emissions. By omitting the mention of certain technologies that agencies could use to reduce emissions, the DOE strays from the desired holistic approach it encourages agencies to take when planning new construction and major renovation projects.

The CHP Alliance strongly recommends that the DOE include a list of all renewable and non-fossil zero-carbon fuels when used with a CHP system, to make clear that Federal buildings covered by this rule can repower existing CHP systems to incorporate renewable fuels and reduce on-site GHG emissions, and that new Federal buildings have a wide range of options for eliminating fossil fuel usage. Specifically, DOE should include the following renewable and non-fossil zero-carbon fuels, which, in concert with CHP systems, can decarbonize the onsite production of electricity, heating, and cooling of Federal buildings:

- *Biogas:* In the spirit of a "whole-of government" and holistic approach, looking at other related legislation can help agencies figure out options for reducing on-site GHG emissions. For example, the Inflation Reduction Act incentivizes the production of biogas. The carbon dioxide fixed in organic matter from which biogas is derived comes from atmospheric CO_2, so the displacement of fossil fuels with biogas lowers CO_2 emissions. Biogas also mitigates methane emissions, which would otherwise escape from sites like landfills and manure lagoons.[1]

[1] See Tim Juliani, September 24, 2020. "Is Biogas a 'Green' Energy Source. https://www.worldwildlife.org/blogs/sustainability-works/posts/is-biogas-a-green-energy-source

- *Renewable Natural Gas (RNG):* As with biogas, RNG is considered carbon neutral, because it is derived from organic sources, which previously absorbed atmospheric CO_2, and the benefits of RNG expand when derived from organic wastes that would otherwise decay—creating methane emissions. RNG sourced from landfill-diverted food and green waste can provide a 125 percent reduction in greenhouse gas emission, and RNG from dairy manure can result in a 400 percent reduction when replacing traditional fuels.[2]

- *Renewable Propane (rLPG):* Renewable propane is made by converting plant and vegetable oils, waste greases and animal fat into fuel, which has a far superior environmental result than disposal.[3]

- *Green Hydrogen:* As the CHP Alliance outlined in our Clean Hydrogen and CHP Roadmap,[4] the efficient use of clean hydrogen fuels enables greater carbon dioxide emission reductions and lowers costs for end users. The Inflation Reduction Act incentivizes the clean production of hydrogen fuels, which addresses a major barrier the CHP Alliance has identified in advancing the use of hydrogen in CHP systems. Additional research suggests that the Federal government has a considerable role to play in further developing the demand for green hydrogen, including providing additional funding for hydrogen hubs, allowing the Federal Energy Regulatory Commission ("FERC") to regulate the blending of hydrogen in pipelines, accelerating the permitting process for hydrogen hubs, and more.[5] Now that Congress has incentivized the creation of this fuel, recognizing CHP systems using clean hydrogen (along with the other previously mentioned fuels) as net-zero emission for the purposes of this proposed rule would support an efficient means of using these fuels to produce thermal and electric energy, helping federal buildings triggered under this rule reduce their Scope 1 emissions to zero by 2030.

The CHP Alliance would also like to recognize Waste Heat to Power ("WHP") technologies as zero emissions. WHP systems do not use fuel, they generate electricity from wasted heat, and pressure drop. Only excess waste energy captured by the WHP system is used to operate the technologies that generate electricity. Congress currently recognizes waste heat as a renewable

[2] SoCalGas. "What is Renewable Natural Gas." https://www.socalgas.com/sustainability/renewable-gas/what-is-renewable-natural-gas#:~:text=RNG%20is%20considered%20a%20carbon,decay%20and%20create%20methane%20emissions
[3] Jon Leonard (2017, Aug. 22) "Renewable Propane as a Sustainable Fuel Solution in California." https://www.act-news.com/news/renewable-propane-sustainable-fuel-solution-california/
[4] Combined Heat and Power Alliance (2019). "Clean Hydrogen and Combined Heat and Power: A Roadmap for Industrial and Commercial Decarbonization." https://chpalliance.org/wp-content/uploads/2019/08/CHP-Hydrogen-Roadmap-2.pdf
[5] Energy Futures Initiative. February 2023. "The U.S. Hydrogen Demand Action Plan." https://subscriber.politicopro.com/eenews/f/eenews/?id=00000186-32b2-d681-ab8f-f3b6569b0001

resource in the 2021 Consolidated Appropriations Act under 26 U.S.C. §48(c)(5). While WHP might be limited in the context of Federal buildings, the Alliance encourages the DOE to recognize WHP technologies as zero emissions and therefore exempt from the rule.

In addition to omitting potential pathways to achieve GHG emission reduction targets, the SNOPR allows Federal agencies to exempt emissions from backup generators when used in emergency situations. Not only does this exemption encourage the use of fossil fuels during inevitable power outages with potential adverse local health effects from criteria air pollutants,[6] but it also runs counter to the entire intent of the proposed rule, reducing onsite GHG emissions for newly constructed and majorly renovated federal buildings.

Because they are connected to a supply of clean gases and not to the electric grid, CHP systems can deliver reliable power and thermal energy to Federal buildings and obviate the need for diesel backup generators. In the private sector, CHP systems are often the preferred choice of institutions with critical infrastructure, such as hospitals, data centers, and universities, which require reliable and clean power. DOE's rule should encourage the use of CHP systems with these clean fuels as a better option than fossil-powered generators.[7]

DOE can and should make more Federal agencies aware of how they could use CHP systems in combination with clean fuels. By doing so, DOE would be adopting a more holistic approach, creating more choices for Federal buildings, leading to fewer Departments and agencies seeking exemptions and accelerating GHG emission reductions from Federal buildings, and decreasing or eliminating harmful emissions from backup generators. In summary, by highlighting CHP in combination with renewable and non-fossil zero-carbon fuels as additional pathways beyond solar, geothermal, and biomass, DOE can strengthen the rule by encouraging more holistic thought-processes when it comes to planning for new construction and major renovations.

[6] Climate Central. September 14, 2022. "Surging Power Outages and Climate Change." https://assets.ctfassets.net/cxgxgstp8r5d/73igUswSfOhdo7DUDVLwK7/bb0a4e95e1d04457e56106355a1f74b9/2022PowerOutages.pdf

[7] Better Buildings Initiative U.S. Department of Energy. January 2019. "Distributed Generation (DG) for Resilience Planning Guide." https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/DG%20for%20Resilience%20Planning%20Guide%20-%20report%20format.pdf

CHP Efficiency, Reliability, and Resiliency

The CHP Alliance believes the United States should continue to benefit from the overall energy efficiency of generating heat and power simultaneously as federal facilities transition to decarbonizing on-site energy generation. CHP systems operate with an overall efficiency of 65 to 85 percent, with some systems approaching 90 percent efficiency, compared to the 45 to 55 percent efficiency achieved when generating thermal and electric energy separately. Historically, CHP systems have run primarily on natural gas, but CHP systems can be fueled with renewable and zero-carbon fuels like biogas, renewable natural gas (RNG) or biomethane, renewable propane (rLPG), and clean hydrogen[8] as mentioned previously.

Highlighting these zero emissions fuels to be used in very efficient CHP systems within the rule would help agencies in their planning and provide opportunities to maximize the emission reductions these fuels can achieve and extend the resource base of these fuels by using them most efficiently. CHP systems are efficient because they capture heat which is otherwise wasted in the combustion process and use it productively by generating more power or creating heating or cooling. They enable additional emissions reductions by using zero-carbon fuels efficiently, allowing for more facilities to use those fuels.

DOE's rule should prioritize using non-fossil zero emission fuels with CHP units, as they provide reliable power and thermal energy, ensuring continued operations by Federal Departments and agencies in the face of increased grid disruptions brought on by an increasing number of extreme weather events, which climate change worsens. The reliability of CHP systems avoids the need to use diesel backup generators during power outages, thus furthering the intent of this proposed rule to eliminate emissions from onsite energy generation. Encouraging the option for agencies to use CHP in combination with clean fuels could also avoid the need for exclusions and for agencies to petition for downward adjustments. Additionally, the Federal government can provide leadership for private industry, colleges and universities, multifamily buildings, healthcare, and others by encouraging the use of CHP with clean fuels for its very own buildings.

[8] Over 600 of the existing 4,700 existing CHP systems in the U.S. are fueled by digester gas and landfill gas – DOE CHP Installations Database, https://betterbuildingssolutioncenter.energy.gov/chp/solutions-at-a-glance/us-doe-chp-installation-database

Repowering Existing Federal CHP Systems to Incorporate Zero Emission Fuels

Federal facilities that have existing CHP units can be easily retrofit to use biomass, biogas, RNG, renewable propane, and clean hydrogen at a reasonable cost with minimal disruption.[9] The CHP Alliance's *Clean Hydrogen and Combined Heat and Power: A Roadmap for Industrial and Commercial Decarbonization* outlines the potential for achieving significant emission reductions through combining clean hydrogen fuels with the efficiency of CHP systems. In addition, similar opportunities exist to further emissions reductions using numerous bio-based renewable fuels. Many of these opportunities can be realized by retrofitting CHP systems, where they are presently hosted and replacing them with equipment capable of utilizing these clean alternative fuels.

Thus, the CHP Alliances strongly encourages the DOE to mention repowering CHP systems with these clean fuels as an avenue for agencies to reduce their Scope 1 GHG emissions within the rule. DOE's rule should specifically mention the ability to retrofit existing CHP units with clean fuels, which will provide agencies doing major renovations an avenue to avoid emissions associated with completely rebuilding separate onsite power generating facilities and HVAC systems.

A fundamental flaw of the SNOPR is its requirement that "System-level renovations follow renovation requirements in the new building baseline energy efficiency standard in 10 CFR Part 433 (i.e., ASHRAE 90.1-2019), where appropriate and cost effective, and replace all equipment that is included in the renovation with EnergyStar or FEMP designated products which do NOT use fossil fuels." This requirement, however, excludes CHP systems from being both an onsite power and heating/cooling source option for major renovations, as neither the EnergyStar nor FEMP have products designated for CHP Systems. DOE should either eliminate this requirement or FEMP should immediately designate CHP systems using the renewable and non-fossil zero-carbon cited above as designated products which Federal agencies can use.

As it currently stands, there are only EnergyStar and FEMP designated product categories for certain commercial heating and cooling technologies like boilers, water heaters, and ground source heat pumps.[10] This limited set of options violates the holistic approach DOE says it wishes to take and will hamper efforts to eliminate fossil fuels in Federal buildings and reduce emission from these buildings. Moreover, such a limited approach is inconsistent with the

[9] Combined Heat and Power Alliance (2019). "Clean Hydrogen and Combined Heat and Power: A Roadmap for Industrial and Commercial Decarbonization." https://chpalliance.org/wp-content/uploads/2019/08/CHP-Hydrogen-Roadmap-2.pdf

[10] Department of Energy. Accessed January 26, 2023. "Produce Categories Covered by Efficiency Programs." https://www.energy.gov/eere/femp/articles/product-categories-covered-efficiency-programs.

bipartisan support in Congress to further develop renewable and zero carbon fuels. For example, the Bipartisan Infrastructure Law ("BIL") allocates $8 billion for regional hydrogen hubs, and the Inflation Reduction Act ("IRA") includes a Production Tax Credit ("PTC") for clean hydrogen. The Department must consider related legislation and provide a pathway within this rule to encourage the use of CHP with the aforementioned renewable fuels.

Standards for Calculating Net GHG Emissions for CHP Systems

As DOE considers the CHP Alliance's recommendation to summarize potential technologies and pathways that Federal agencies can use to reduce their on-site emissions, we encourage the Building Technologies Office to refer to the appendix attached to this letter. The appendix addresses methodologies used to determine CO_2 emissions savings resulting from a CHP system with the following three calculations:

(1) CO_2 emissions of the CHP system;
(2) CO_2 emissions from displaced thermal energy at the site; and,
(3) CO_2 emissions from displaced electric generation, based on marginal grid emissions.

The referenced appendix is rooted in methodologies developed by the Environmental Protection Agency (EPA), United Nations, World Resources Institute, and World Business Council for Sustainable Development.

Additionally, while there might not currently be a singular approach for a Life Cycle Analysis ("LCA") across fuel types, the Department might also consider using the Greenhouse Gasses, Regulated Emissions, and Energy Use in Transportation ("GREET") model for certain renewable fuels.

Conclusion

The CHP Alliance appreciates the opportunity to provide comments on Docket EERE-2010-BT-STD-0031 – "Clean Energy for New Federal Buildings and Major Renovations of Federal Buildings." The proposed rule raises many complex and interrelated questions, and given the intricacy of decarbonizing the built environment, the CHP Alliance urges DOE to consider:

(1) Specifically acknowledging the use of CHP with clean fuels as zero emission (like it does for solar PV, biomass, and geothermal);
(2) Incorporating the efficiency, reliability, and resiliency benefits that CHP systems provide through the efficient use of generating both power and heating/cooling into the rule;

(3) How repowering existing CHP systems to combust clean fuels can drastically reduce Scope 1 GHG emissions for Federal buildings that currently use CHP; and,
(4) Having an exemption for system-level renovations where EnergyStar or FEMP designated equipment is currently required, to allow for retrofitting existing CHP systems.

Our organization would appreciate the opportunity to continue to engage with the Department of Energy's Building Technologies Office on this proposed rule through additional comment opportunities, meetings, and other means. Please feel free to contact me with any questions you have.

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APPENDIX

CALCULATING NET GREENHOUSE GAS (GHG) EMISSIONS SAVINGS FROM CHP

The energy and emissions savings benefit of a CHP system is found in the aggregate reduction in overall energy consumption. A CHP system replaces both a separate on-site thermal system (furnace or boiler) and purchased power (typically electricity from a central station power plant) with a single, integrated system efficiently producing both thermal energy and power concurrently. To accurately calculate the energy and subsequent GHG emissions savings from a CHP system, both outputs of the CHP system must be considered. The CHP system's thermal output displaces the fuel normally consumed in and emissions from on-site thermal generation in a boiler or other equipment, and the CHP power output displaces the fuel consumed and emissions from grid-connected generation. Emissions impacts of CHP projects are a function of both the amount and type of fuel consumed by CHP system and displaced thermal equipment at the site, and the marginal emissions of the servicing power grid.

To quantify the GHG emissions savings of a CHP system, the emissions released from the CHP system must be subtracted from the GHG emissions that would normally occur without the system (i.e., using conventional separate heat and power):[11]

$$C_S = (C_T + C_G) - C_{CHP}$$

Where:

C_S = Total Emissions Savings
C_T = Emissions from Displaced On-site Thermal Production
C_G = Emissions from Displaced Purchased Grid Electricity
C_{CHP} = Emissions from CHP System

Calculating CO_2 Emissions from the CHP System

The CO_2 emissions from the CHP system are a function of the amount and type of fuel consumed. The total amount of fuel consumed by the CHP system in terms of energy content (F_{CHP}) can be measured directly as the higher heating value of the fuel consumed (typically in MMBtu) or by the fuel volume or weight, which can then be converted to the energy value through fuel-specific energy factors or heating values. Fuel consumption can also be estimated

[11] The calculation methodology outlined below is based on Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems, 2020, U.S. EPA, https://www.epa.gov/sites/default/files/2015-07/documents/fuel_and_carbon_dioxide_emissions_savings_calculation_methodology_for_combined_heat_and_power_systems.pdf

based on the electric or power output of the CHP system and the net electric generation efficiency.

The CO_2 emissions associated with the CHP system can then be calculated based on total fuel consumption and fuel-specific emissions factors:

$$C_{CHP} = F_{CHP} * EF_F$$

Where:

C_{CHP} = CO_2 Emissions from CHP System (lbs)

F_{CHP} = CHP Fuel Consumption (MMBtu)

EF_F = Fuel Specific Emission Factor (CO_2 lb/MMBtu)

The table below shows energy and CO_2 emissions factors for common fossil fuels:

Selected Fossil Fuel-Specific Energy and CO_2 Emissions Factors[12]

Fuel Type	**Energy Density**	**CO_2 Emissions Factor, lb/MMBtu**
Natural Gas	1,028 Btu/scf	116.9
Propane	91,452Btu/gallon	138.6
Distillate Fuel Oil #2	138,000 Btu/gallon	163.1
Residual Fuel Oil #6	150,000 Btu/gallon	165.6
Coal (Anthracite)	12,545 Btu/lb	228.3
Coal (Bituminous)	12,465 Btu/lb	205.9
Coal (Subbituminous)	8,625 Btu/lb	213.9
Coal (Lignite)	7,105 Btu/lb	212.5
Coal (Mixed-Industrial Sector)	11,175 Btu/lb	207.1

Calculating CO_2 Emissions from Displaced Thermal Energy at the Site

The emissions from displaced thermal energy at the site are a function of the amount and type of fuel currently consumed. The thermal energy produced by a CHP system displaces combustion of some or all of the fuel that would otherwise be consumed in boilers or other thermal equipment to provide required heating or cooling services at the site. The energy and emissions associated with this displaced fuel consumption can be calculated using the thermal output of the CHP system and measured data on or reasonable assumptions about the

[12] 40 CFR Part 98, Mandatory Greenhouse Gas Reporting, Table C-1: Default CO2; Emission Factors and High Heat Values for Various Types of Fuel, https://www.govinfo.gov/content/pkg/CFR-2015-title40-vol21/xml/CFR-2015-title40-vol21-part98-subpartC-appC.xml

efficiency characteristics of the displaced thermal equipment. Displaced thermal fuel use is calculated by:

$$F_T = CHP_T / \eta_T$$

Where:

F_T = Displaced On-Site Thermal Fuel (MMBtu)

CHP_T = CHP System Useful Thermal Output (MMBtu)

η_T = Thermal Equipment Efficiency (%)

Displaced CO2 emissions are then calculated based on the amount of displaced thermal fuel and the fuel specific emissions factor:

$$C_T = F_T * EF_F$$

Where:

C_T = CO_2 Emissions from Displaced On-site Thermal Production (lbs)_

F_T = Displaced On-Site Thermal Fuel (MMBtu)

EF_F = Fuel Specific Emission Factor (CO_2 lb/MMBtu)

Calculating CO_2 Emissions from Displaced Electric Grid Generation

The emissions from displaced grid generation are a function of the amount and emissions profile of generation displaced. Displaced grid electricity associated with on-site CHP include the grid electricity no longer supplied to the site because of the CHP output and any related transmission and distribution losses - a portion of the electricity transmitted over power lines is lost due to resistance and other forms of dissipation, commonly referred to as 'transmission and distribution losses'. The amount of power delivered to users is less than the amount generated at central station power plants, usually by an average of about 6 to 9 percent. Fuel and emissions savings from displaced grid power should therefore be based on the corresponding amount of displaced grid electricity generated and not on the amount of grid electricity delivered to (and consumed at) the site. This can be calculated using the following equation:

$$E_G = CHP_E / (1-L_{T\&D})$$

Where:

E_G = Displaced Grid Generation (MWh)

CHP_E = CHP System Electricity Output (MWh)

$L_{T\&D}$ = Transmission and Distribution Losses (%)

The equation above determines the total amount of grid electricity generation displaced by the power produced by the CHP system. The CO_2 emissions related to this displaced generation are based on the marginal emissions factor for the servicing grid:

$$C_G = E_G * EF_G$$

Where:

C_G = CO_2 Emissions from Displaced Grid Generation (lbs)

E_G = Displaced Grid Generation (MWh)

EF_g = Marginal Grid Emissions Factor (CO_2 lb/MWh)

Marginal Grid Emissions

A critical component in correctly calculating the emissions impacts of implementing an energy efficiency retrofit or installing CHP is to base estimates of displaced grid emissions savings on the marginal emissions factor for the servicing grid as recommended in the GHG Protocols developed by the World Resources Institute and the World Business Council for Sustainable, by the World Bank in their Clean Development Mechanism guidance and in several of U.S. Environmental Protection Agency guidance documents[13]. Marginal resources are the first/next unit of generation that is scaled back or avoided when grid demand is reduced. Marginal emission factors are typically different from average emissions factors used in facility or company inventories, and use of marginal emissions factors recognizes the emissions savings realized across the grid due to a CHP project, much of which are beyond the facility's inventory boundary.

Estimating marginal emission factors can be a complex and data intensive task, matching a project's output to the marginal generating sources on the grid in each hour. In practice, a range of estimation methods can be used that vary in their complexity and accuracy[14]. The U.S. EPA has developed the *AVoided Emissions and geneRation Tool* (AVERT) to estimate marginal emissions rates for 14 regions across the United States which are based on one or multiple balancing authorities.[15] AVERT regions generally represent sections of the grid that have

[13] GHG Protocol Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects, World Resources Institute and the World Business Council for Sustainable Development, https://ghgprotocol.org/sites/default/files/standards_supporting/Guidelines%20for%20Grid-connected%20Electricity%20Projects.pdf
Tool to Calculate the Emission Factor for an Electricity System, United Nations' Clean Development Mechanism, https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf
Appendix I: Methods for Quantifying Energy Efficiency and Renewable Energy Emission Reductions, U.S EPA, https://www.epa.gov/sites/default/files/2016-05/documents/appendixi_0.pdf
Quantifying the Emissions and Health Benefits of Energy Efficiency and Renewable Energy, Part Two, Chapter 4, U.S.EPA, https://www.epa.gov/sites/production/files/2018-07/documents/mbg_2-4_emissionshealthbenefits.pdf
Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems, 2020, U.S. EPA, https://www.epa.gov/sites/default/files/2015-07/documents/fuel_and_carbon_dioxide_emissions_savings_calculation_methodology_for_combined_heat_and_power_systems.pdf

[14] GHG Protocol Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects, Chapter 10: Estimating the Margin Emission Factor, World Resources Institute and the World Business Council for Sustainable Development.

[15] AVERT Version 3.2, 2021 Data, U.S. EPA, https://www.epa.gov/avert/download-avert

similar resource mix and emissions. The AVERT tool can estimate specific emissions reductions based on user-supplied hourly kWh data for detailed planning and custom analysis that accounts for seasonal and time-of-day variations. However, EPA has also developed emissions factors for AVERT based on pre-defined load patterns in each of AVERT's 14 regions. EPA recommends using the Uniform Energy Efficiency factors as a close representation of avoided emissions from CHP systems[16]. Note that AVERT factors include regional T&D losses.

Emissions Savings for Waste Heat to Power Projects

Waste heat to power (WHP) projects generate electricity onsite using process waste heat. There is normally no additional fuel used in implementing WHP nor thermal energy displaced at the site. As such, the calculation for emissions savings for WHP essentially is reduced to the estimate of displaced grid emissions:

$$C_G = E_G * EF_G$$

Where:

C_G = CO_2 Emissions from Displaced Grid Generation (lbs)

E_G = Displaced Grid Generation (MWh)

EF_g = Marginal Grid Emissions Factor (CO_2 lb/MWh)

[16] Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems, 2020, U.S. EPA, https://www.epa.gov/sites/default/files/2015-07/documents/fuel_and_carbon_dioxide_emissions_savings_calculation_methodology_for_combined_heat_and_power_systems.pdf