United States House of Representatives
Select Committee on the Climate Crisis

Hearing on September 26, 2019
"Solving the Climate Crisis: Reducing Industrial Emissions Through U.S. Innovation"

Questions for the Record

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The Honorable Kathy Castor
Chair
Select Committee on the Climate Crisis
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Dear Chair Castor,

Thank you for inviting me to testify before the Select Committee on the Climate Crisis in September. I appreciated the opportunity to provide information to the Select Committee on combined heat and power (CHP) and waste heat to power (WHP). Thank you as well for your thoughtful follow-up questions and those of the Honorable Sean Casten. Please find attached my responses to your questions.

Sincerely,
David Gardiner
President
David Gardiner and Associates

<u>**The Honorable Kathy Castor**</u>

1. **How can existing Federal procurement policies be updated to prioritize decarbonization in the industrial sector?**

The federal government is the nation's largest energy consumer and, as a result, can and should be a leader in decarbonizing its own energy use, especially throughout the Department of Defense, the largest energy user within the federal government. The military has recognized the importance of combined heat and power (CHP) to ensure resilience of its installations. For example, Army Directive 2017-07 says "The Army will reduce risk to critical missions by being capable of providing necessary energy and water for a minimum of 14 days."[1] CHP can provide heat and electricity when the grid is down, so the Army is seeking to build microgrids and CHP projects. Among other CHP projects, the Army broke ground in November 2017 on a 2 MW CHP project at Picatinny Arsenal, a military research and manufacturing facility located in New Jersey. The CHP system will provide steam for heating and numerous ammunition manufacturing processes as well as 2 MW of electricity, which will be able to operate even when the grid is down.[2] Congress should do all it can to support these efforts and those at other government installations.

In addition, Federal procurement policies could establish a goal to reduce emissions from its suppliers, as Walmart has done by adopting its Project Gigaton goal. Under such an approach, procurement policies could give preference in awarding contracts to product manufacturers who have decarbonized their industrial processes. In 2017, California adopted AB 262 under which suppliers' emissions performance will be taken into account when an agency is contracting to buy steel, flat glass, and mineral wool (insulation) for infrastructure projects.[3] Such an approach could be adopted at the federal level for a variety of products with significant carbon emissions. This would also encourage manufacturers to reduce their emissions further while ensuring a large federal market.

Many in manufacturing are already prepared for such a move as the private sector has given increased attention to reducing its emissions and increasing energy efficiency: a 2018 study of 160 of the largest manufacturing companies with U.S. facilities found that 79% of these companies had greenhouse gas (GHG) targets, while 43% had energy efficiency (EE) targets.[4] Signatories to the Renewable Thermal Energy Buyers' Statement have also demonstrated their interest in reducing their GHG emissions and are actively seeking ways to expand and accelerate the renewable thermal energy market.[5] Renewable thermal technologies will benefit from the same policies that have helped to advance other renewable energy sources such as wind and solar.

Utilization of CHP and waste heat to power (WHP) can help both the federal government and manufacturers to decarbonize. Conventional electric generation is very inefficient, with roughly two-thirds of fuel inputs lost as wasted heat from the process. Additional energy is lost during transmission from the central power plant to the end user. By generating both heat and electricity from a single fuel source at the point of use, CHP lowers emissions and increases overall fuel efficiency—allowing utilities and companies to effectively "get more with less." CHP can make effective use of more than 70% of fuel inputs. As a consequence, natural gas-fired CHP can produce electricity with about one-quarter of the GHG emissions of an existing coal power plant. WHP, which uses waste heat from industrial processes to generate electricity with no additional fuel and no incremental emissions, reduces emissions and offsets costs associated with purchased power.

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[1] Secretary of the Army, "Army Directive 2017-07 (Installation Energy and Water Security Policy)," Feb. 23, 2017. https://www.asaie.army.mil/Public/ES/doc/Army_Directive_2017-07.pdf.

[2] J.E. "Jack" Surash, PE, Acting Deputy Assistant Secretary of the Army for Energy & Sustainability, "The U.S. Army's pivot to energy and water resilience," October 22, 2018. https://www.army.mil/article/212756/the_us_armys_pivot_to_energy_and_water_resilience

[3] California. Legislature. Assembly. Public contracts: bid specifications: Buy Clean California Act. A.B, 262. 2017-2018. California State Assembly: October 16, 2017. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB262.

[4] Alliance for Industrial Efficiency, "Committed to Savings: Major U.S. Manufacturers Set Public Goals for Energy Efficiency," June 26, 2018. https://chpalliance.org/resources/alliance-report-finds-majority-u-s-manufacturers-make-commitments-save-energy-reduce-emissions/.

[5] Renewable Thermal Collaborative, "The Renewable Thermal Energy Buyers' Statement," https://www.renewablethermal.org/buyers-statement/.

As I noted in my written testimony, according to the Department of Energy, the chemicals, petroleum refining, food, paper, and primary metals industrial sectors have the greatest potential for CHP installation, creating a significant opportunity to cut industrial emissions while increasing competitiveness.[6]

Fueling CHP and WHP systems with renewable natural gas can help to further reduce emissions. CHP systems can run on renewable fuels, such as biomass – forest and crop residues, wood waste, or food-processing residue – or biogas – manure biogas, wastewater treatment biogas, or landfill gas. Renewable natural gas (RNG), or biomethane, is a pipeline- quality gas that is fully interchangeable with natural gas and compatible with U.S. pipeline infrastructure and can be used to fuel CHP systems. Over time, CHP systems can evolve and use different types of fuel. A system using natural gas today may run on RNG in the future.

2. **Are there environmental, health, safety, or other risks and tradeoffs to pursuing industrial efficiency and renewable thermal? How can they be mitigated?**

In addition to the land-use considerations addressed in question 7, pursuing additional CHP deployment at industrial sites could raise concerns about air quality as onsite emissions can increase, however this can be addressed through existing Clean Air Act regulations. WHP uses waste heat from industrial processes to generate electricity with no additional fuel and no incremental emissions.

The use of any type of combustible gas carries inherent risks, though the nation's natural gas delivery system has historically had excellent performance and natural gas utilities remain vigilant and committed to continually upgrading this crucial infrastructure based on enhanced risk-based integrity management programs.[7] There are additional challenges presented when injecting RNG into the natural gas pipeline network including variability in composition and supply of gas, the potential impact on end use applications, and odorization and leak detection. RNG quality standards can help to ensure that RNG will not harm the distribution company's infrastructure or customer end-use equipment and will also prevent harm to human health and safety.[8] Several utilities in the United States have already developed gas quality standards that specifically address RNG, demonstrating that such challenges should not be a barrier to RNG deployment.[9] Interconnection guidelines can also provide clarity when connecting RNG projects to gas pipeline systems and uniform standards can offer consistency for projects across jurisdictions. The Northeast Gas Association released an Interconnect Guide for RNG in New York earlier this year, and while the report is specific to one state, the framework it presents could be adopted by other states.[10] Though adding RNG to the gas distribution system requires careful planning, this need not be an impediment to additional deployment.

3. **You mentioned in your testimony that CHP and WHP also have the benefits of being distributed energy resources and advancing the use of microgrids. Could you expand upon how these benefits help facilities obtain more reliable power and become more resilient?**

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[6] United States Department of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States," March 2016. https://www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf.
[7] American Gas Association, "An Increase in Safety Leads to a Decrease in Emissions," 2019. https://www.aga.org/globalassets/2019-increase-in-safety-leads-to-a-decrease-in-emissions-v.3.pdf
[8] M.J. Bradley & Associates, "Natural Gas Utility Business Models for Facilitating Renewable Natural Gas Development and Use," July 2019, p. 2. https://www.mjbradley.com/sites/default/files/RNGLDCOptions07152019.pdf
[9] *Id.*
[10] Northeast Gas Association, "Interconnect Guide for Renewable Natural Gas (RNG) in New York State," August 2019. https://www.northeastgas.org/pdf/nga_gti_interconnect_0919.pdf

Distributed energy resources allow energy to be created close to where it is consumed, reducing the use of electric transmission and distribution systems, reducing line loss of electricity and thereby saving money. Distributed energy resources can also provide increased reliability and resiliency, not only for facilities that host such resources, but also for a host facility's surrounding community. Facilities that are critical infrastructure – assets, systems, and networks that, if incapacitated, would have a substantial negative impact on national security, economic security, or public health and safety[11] – are particularly well suited to utilize distributed energy resources as access to energy is a high priority for ensuring that critical facilities can continue to deliver services and assist in recovery.[12] In addition to the general benefits of distributed energy resources, CHP and WHP systems provide further benefits in that they typically run and are maintained continuously, providing a consistent source of heat and power unlike intermittent resources such as wind and solar, and have lower emissions than diesel or oil generators. These systems may also be connected to a microgrid, allowing several buildings or facilities to keep the lights on during a grid power outage.

Investments in microgrids have been encouraged by some policymakers at the state and federal level. When a traditional electric grid has an outage or needs to be repaired, all users of the grid are impacted. A microgrid is a local energy grid that can disconnect from the traditional grid and operate on its own during a traditional grid outage.[13] To function independently, a microgrid requires either battery storage or a form of distributed generation such as CHP or WHP. CHP systems provide 39% of the energy in existing microgrids.[14] Microgrids are used by universities, military installations, municipalities, and public institutions, helping to maintain their reliability of electric and thermal energy supply and to improve their resiliency against extreme weather and power outages.[15] In some locations, a number of critical facilities such as hospitals, fire and police stations, emergency shelters, and gas stations can be connected and configured to operate in isolation from the larger utility grid, even during extended outages.[16]

Whether used to power a single building or as part of a microgrid, CHP systems have additional benefits over other types of backup power, such as onsite diesel generators. CHP systems generally run and are maintained continuously, avoiding the need to call a generator into operation that may not have been used recently. In addition, CHP systems frequently run on natural gas delivered directly via pipelines, avoiding the need for a fuel delivery as well as resulting increased emissions from diesel or oil.[17] Many critical infrastructure customers such as hospitals, universities, municipalities, and data centers have successfully deployed CHP and WHP systems, increasing their resiliency against natural disasters, emergencies, or other events that may impact the electric grid. Power outage protection can be designed into a CHP system that efficiently provides electric and thermal energy on a continuous basis.

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[11] Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT ACT) Act of 2001. Pub. L. 107-56 at Sec. 1016(e). 26 Oct. 2001. https://www.congress.gov/bill/107th-congress/house-bill/3162/text.

[12] United States Department of Energy Better Buildings, "Distributed Generation (DG) for Resilience Planning Guide," January 2019, p. 4. https://betterbuildingsinitiative.energy.gov/sites/default/files/attachments/DG%20for%20Resilience%20Planning%20Guide%20-%20report%20format.pdf.

[13] United States Department of Energy, "How Microgrids Work," Jun. 17, 2014. https://www.energy.gov/articles/how-microgrids-work.

[14] Greentech Media, "US Microgrid Growth Beats Estimates: 2020 Capacity Forecast Now Exceeds 3.7 Gigawatts," Jun. 1, 2016. https://www.greentechmedia.com/articles/read/u-s-microgrid-growth-beats-analyst-estimates-revised-2020-capacity-project#gs.fmnot7GL.

[15] *Id.*

[16] United States Department of Energy, "CHP for Resiliency in Critical Infrastructure," May 2018, p. 3. https://betterbuildingsinitiative.energy.gov/sites/default/files/attachments/CHP_Resiliency.pdf.

[17] United States Environmental Protection Agency, "Valuing the Reliability of Combined Heat and Power," January 2007, p. 2. https://www.epa.gov/sites/production/files/2015-07/documents/valuing_the_reliability_of_combined_heat_and_power.pdf.

CHP systems can improve the resiliency of critical infrastructure. If the electric grid is impaired, CHP systems can continue to operate, providing electric and thermal service without interruption. This can mitigate the impacts of an emergency by keeping critical facilities operational until power is restored. In addition to providing power and heat to a host facility to keep the facility operational, such host facility may also be able to provide services to their local community to aid in the recovery effort.

Case studies have demonstrated the benefits of CHP systems during severe weather events that result in electric grid service disruption. During and after Superstorm Sandy in the northeast United States, numerous facilities with CHP systems were able to remain operational. For example, South Oaks Hospital in New York was able to provide critical services for two weeks relying solely on its CHP system and admitted displaced patients, offered refrigeration of vital medicines to those who had lost power, and welcomed the local community to recharge phones and electronic devices at its facility.[18] In New Jersey, The College of New Jersey was able to disconnect from the electric grid for a week and the campus continued to operate despite the grid disruption. In addition, the College's equipment was used to assist the state's largest utility in reestablishing service after the grid outage: the utility was able to use the College's equipment to back-feed one of their power lines to bring it back in service.[19] Louisiana State University has also benefitted from a CHP system, the university never lost power during Hurricane Katrina, allowing the school to continue to operate and allow administrative offices of other institutions to relocate to the main campus.[20]

4. **You mentioned that most of the policies for renewable heat occur within the European Union. Could you elaborate on some of these policies and how they could be applied in the United States?**

Unlike the United States where policies have focused almost exclusively on renewable electricity and transport, the European Union Renewable Energy Directive (RED) takes a more comprehensive approach by requiring 20% of European Union final energy consumption to be met by renewables in 2020, with contributions from electricity, transport, *and* heating and cooling. Individual countries have also seen success in increasing renewable heat by setting ambitious targets, utilizing existing infrastructure to achieve economies of scale, and providing financial incentives.

District heating can facilitate the deployment of renewable heat because of economies of scale and siting of facilities, though government policies facilitating use of additional renewables are still necessary. Denmark, Finland, and Sweden are three countries with extensive district heating systems that also have ambitious long-term targets to switch to renewables. This combination of infrastructure and policy has made these countries leaders in the deployment of renewable heat: in 2015, the share of renewables in heat consumption was 39.6% in Denmark, 52.8% in Finland, and 68.6% in Sweden, with biomass comprising the main source of renewable heat in each country.[21]

France and Germany also have ambitious targets for heat's role in their transitions to the greater use of renewable energy. France has distinct measures for different sectors: its commercial and industrial program includes subsidies for both project support and project execution and supported 3,600 projects from 2009-2015.[22] In the residential sector, tax credits of 30% of capital costs are the main incentive for

[18] ICF International, "Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities," March 2013, 13.
[19] *Id.* at 18.
[20] *Id.* at 24.
[21] International Energy Agency, "Renewable heat policies: Delivering clean heat solutions for the energy transition," 2018, p. 21. https://www.iea.org/publications/insights/insightpublications/Renewable_Heat_Policies.pdf.
[22] *Id.* at 29.

renewable heat development along with a reduced value added tax (VAT) rate.[23] In Germany, the focus has been on buildings rather than industrial process heat: building code obligations for renewable heat in new construction and a subsidy program with extra incentives when linked to energy efficiency improvements have driven additional deployment of renewable heat.[24]

The United States does not have specific targets, nor a clear policy, for renewable heat at the federal level. However, some states have adopted renewable heating and cooling plans or have provided incentives, demonstrating that programs in the U.S. are possible. For example, Vermont established a goal to increase the share of renewable heat from 20% to 30% by 2025, New York offers a range of incentives for biomass heating systems, air and ground source heat pumps, and biodiesel blended with conventional heating oil, New Hampshire requires a specific portion of its renewable portfolio standard (RPS) come from heat,[25] and 14 other states offer a credit for renewable thermal energy as part of their state renewable electricity standards.[26] Other state-level incentives include sales tax exemptions and rebates.[27] While some states have taken the lead in increasing renewable thermal, not all states choose to participate, creating a patchwork of policies and a dearth of incentives to promote renewable heat in some areas. A further challenge is that many of the state programs are only focused on buildings and there is less support for accelerating the use of renewable thermal technologies in the manufacturing sector.

Setting ambitious targets for renewable heat deployment and providing financial support for projects has been successful in European countries and has begun at the state level in the U.S.. Additional support at the federal level could help to further increase the use of renewable heat in the country.

5. **You mentioned that the high upfront capital costs of CHP and WHP systems make it difficult to compete for limited investment capital. How can the Federal government incentivize companies to make these investments? What types of financial instruments would be most effective?**

A 2015 United States Department of Energy study found that some of the key economic and financial barriers to the accelerated adoption of CHP included internal competition for capital, the “split-incentive” between capital improvement and operation and management budgets, securing low-cost financing due to financial risks, and lack of financing instruments such as Master Limited Partnerships.[28] Regulatory barriers such as utility business models that result in rate designs that unfairly charge partial requirements customers and do not appropriately recognize the value of the services the CHP systems provide to the grid were also acknowledged by the Department.[29]

Installation of CHP systems typically requires a significant upfront investment which can eclipse long-term benefits. Insufficient capital and internal competition for capital prevent many facilities from installing CHP systems, even when such a system has an attractive financial return.[30] A company may also be hesitant to make investments outside of its core business and may require an even higher rate of

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[23] *Id.*
[24] *Id.* at 31.
[25] *Id.* at 40
[26] Clean Energy States Alliance, “Renewable Thermal in State Renewable Portfolio Standards,” July 2018. https://www.cesa.org/assets/Uploads/Renewable-Thermal-in-State-RPS-April-2015.pdf.
[27] International Energy Agency, “Renewable heat policies: Delivering clean heat solutions for the energy transition,” at 40.
[28] United States Department of Energy, “Barriers to Industrial Energy Efficiency,” June 2015, p. 95. https://www.energy.gov/sites/prod/files/2015/06/f23/EXEC-2014-005846_5%20Study__0.pdf. *See also* United States Department of Energy, “Barriers to Industrial Energy Efficiency: Report to Congress,” June 2015, p. 9-10. https://www.energy.gov/sites/prod/files/2015/06/f23/EXEC-2014-005846_6%20Report_signed_0.pdf.
[29] *Id.* at 103-104.
[30] *Id.* at 95.

return compared to other, more familiar capital investments.[31] Internal accounting practices that separate plant operation and maintenance budgets from capital improvements, resulting in costs and savings accruing to different budgets, can also make it difficult to demonstrate the financial benefits of a system.[32] Facilities may also have a hard time finding favorable financing for a long-term investment in the facility upgrade.[33]

First signed into law in 2005 as part of the Energy Policy Act, the federal Investment Tax Credit (ITC) has played, and continues to play, a critical role in driving energy innovation and technological leadership in the United States. The federal ITC has helped to create thousands of jobs, lower electricity prices for families and businesses, reduce carbon emissions, and maintain the country's competitive edge in emerging energy technologies. Section 48 and Section 25D of the ITC provide tax credits that cover renewable energy technologies such as CHP, micro-turbines, solar energy, geothermal, fuel cells, and distributed wind energy. Increasing, or at the very least maintaining, this tax credit will continue to allow American businesses to realize energy and cost savings, support clean energy jobs, and reduce carbon and other GHG emissions.

While the ITC has helped to support the deployment of CHP systems, WHP systems have not been able to benefit from this policy. Despite the fact that WHP is a zero-emission energy resource, these systems currently do not currently qualify for the Section 48 ITC. There are key differences between CHP and WHP systems that prevent WHP from accessing the ITC as written: while CHP systems capture waste heat generated in the production of electricity for thermal uses, WHP systems capture waste heat and energy from thermal processes and operations and convert that energy into electricity. The exclusion of WHP systems from the federal ITC puts such projects at a competitive disadvantage. The proposed Waste Heat to Power Investment Tax Credit Act would rectify this problem by allowing an energy tax credit for investments in WHP property.[34]

Loan programs can also be an effective policy to support additional CHP deployment. For example, the LIFT America Act creates a loan program to support the deployment of distributed energy systems for states, institutions of higher education, and electric utilities as well as a technical assistance and grant program to disseminate information and provide technical assistance to nonprofit and for-profit entities for identifying, evaluating, planning, and designing distributed energy systems.[35] As discussed in question 3 above, distributed energy systems have significant reliability and resiliency benefits, especially for facilities that are critical infrastructure.

Federal grants could also help to increase CHP deployment in the United States and such legislation has previously been proposed. The Job Creation through Energy Efficient Manufacturing Act would require the Department of Energy to establish a Financing Energy Efficient Manufacturing Program that provides grants for energy efficiency improvement projects in the manufacturing sector.[36] Entities eligible for grants would include state energy offices, nonprofit organizations, electric cooperative groups, or

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[31] *Id.* at 96.
[32] *Id.* at 97.
[33] *Id.*
[34] United States. Cong. Senate. Waste Heat to Power Investment Tax Credit Act. 116th Cong. 1st sess. S. 2283. Washington: 2019. https://www.congress.gov/bill/116th-congress/senate-bill/2283?r=2&s=1.
[35] United States. Cong. House of Representatives. Leading Infrastructure for Tomorrow's America Act. 116th Congress. 1st sess. H.R. 2741, Secs. 33303-33304. Washington: 2019. https://www.congress.gov/bill/116th-congress/house-bill/2741/text#toc-H364FAC1BA8D742599CF5C10984A7AF57.
[36] United States. Cong. Senate. Job Creation through Energy Efficient Manufacturing Act. 115th Cong. 1st sess. S. 1687. Washington: 2017. https://www.congress.gov/bill/115th-congress/senate-bill/1687. A similar bill was also introduced in 2018, *see* United States. Cong. House of Representatives. Job Creation through Energy Efficient Manufacturing Act. 115th Cong. 2d sess. H.R. 5042. Washington: 2018. https://www.congress.gov/bill/115th-congress/house-bill/5042/text.

certain entities with a public-private partnership.[37] The grant recipients would then distribute subgrants to nongovernmental, small or medium sized manufacturers located in the state in which the recipient is located to carry out projects that improve the energy efficiency of the manufacturers and develop technologies that reduce electricity or natural gas use by the manufacturers.[38] By improving the efficiency of industrial plants, policies such as this Act will reduce carbon and other GHG emissions, reduce energy costs for manufacturers making them more competitive, and create jobs.

Historically, tax policies have been able to stimulate investments in both conventional and clean energy projects. However, conventional energy technologies have access to low-cost capital through types of financing mechanisms that are not available to CHP projects. A Master Limited Partnership (MLP) is a business structure that provides tax advantages to the partners in the business, permitting investors to trade shares and thereby allowing energy projects that qualify as MLPs to have lower cost of capital.[39] Congress should adopt bipartisan legislation to allow clean energy projects to qualify as MLPs, as they do not qualify under current law.

To the extent any technology neutral tax credit regimes or economy-wide tax systems such as cap and trade are being considered, it is essential to ensure that the emissions for CHP systems are appropriately calculated. For example, with regard to technology neutral approaches on tax credits, the model in the Clean Energy for America Act calculates the emissions rate for CHP using both electrical and useful thermal energy.[40] If a carbon pricing regime is under consideration, allowance structures must appropriately account for the savings realized by CHP systems.

In addition to financial and tax barriers, regulatory barriers that impact project economics can also restrict capital outlays for CHP systems. Though CHP and WHP systems can operate independently from the electric grid, many facilities that install such systems still interconnect with the electric grid to provide backup power during scheduled or unscheduled outages. Public utilities implement standby rates to recover infrastructure costs related to providing this backup power service and ensure that CHP host sites have power available when it is needed. However, in many cases, these rates are burdensome, inflexible, unpredictable, or lack transparency.[41] By ensuring that standby rates better reflect the actual costs that a CHP or WHP system imposes on the electric grid, utilities can be compensated for costs while still encouraging investments in these systems.

Though standby rates are approved by state utility regulators, federal policies could help to make standby tariffs and rates simple, transparent, and consistent. For example, the HEAT Act directs the Department of Energy to establish model rules and procedures for interconnection and its associated costs and procedures for determining fees or rates for supplementary power, backup or standby power, maintenance power, and interruptible power supplied to facilities that operate CHP and WHP systems.[42] This legislation would establish a federal framework to help states develop solutions to meet growing energy demands efficiently and economically through the use of CHP and WHP, strengthening local economies and supporting national energy policy goals.

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[37] *Id.*
[38] *Id.*
[39] *Id.* at 98.
[40] United States. Cong. Senate. Clean Energy for America Act. 116th Cong. 1st sess. S. 1288. Washington: 2019. https://www.congress.gov/bill/116th-congress/senate-bill/1288/text.
[41] Alliance for Industrial Efficiency, "Standby Rates: Barriers to CHP Deployment on a National Scale," May 2018. https://chpalliance.org/wp-content/uploads/2018/05/Standby-Rates-One-Pager_5.9.19.pdf.
[42] United States. Cong. Senate. Heat Efficiency through Applied Technology Act. 116th Cong. 1st sess. S. 2706. Washington: 2019. https://www.congress.gov/bill/116th-congress/senate-bill/2706.

The ability of equitable standby tariffs to unlock the potential of CHP and WHP has been acknowledged by utility regulators at the national level. The National Association of Regulatory Utility Commissioners (NARUC) recently recognized the significance of standby rates to the viability of CHP and WHP projects as well as the potential of CHP and WHP to improve system reliability and resiliency. In a 2019 resolution, NARUC "encourages regulators to consider whether the cost of standby rates discourages further deployment of CHP and WHP, and could harm CHP and WHP facility competitiveness; and encourages Commissioners to assure that standby rates for partial requirements customers acknowledge that: (a) effectively coordinating CHP and WHP with grid system operations reduces demand and costs; and (b) CHP and WHP have the potential to improve system reliability and resiliency."[43]

6. **During the hearing, you mentioned that you have a project looking at the carbon accounting associated with combusting biomass. Could you elaborate on the sources of emissions studied? Were emissions outside of combustion, such as tree removal and transport, taken into account? Could you share the findings of this project?**

The Renewable Thermal Collaborative (RTC) serves as the leading coalition for organizations - businesses, cities and universities - that are committed to scaling up renewable heating and cooling at their facilities and dramatically cutting carbon emissions. Our partner in the RTC, World Wildlife Fund, is leading a project to help large thermal energy buyers evaluate whether biomass, considered from a lifecycle perspective, emits greater or fewer carbon emissions than other fossil fuels. There is growing recognition that automatically assuming carbon neutrality for bioenergy is inadequate to account for climate impacts, particularly for forest biomass as a fuel where the time lag between emission and uptake from regrowth can take up to a century for slow-growing trees. Nor is there yet consensus on the best way to account for this biogenic carbon. However, the World Resources Institute intends to create new accounting guidelines for land sector emissions and removals within the Greenhouse Gas Protocol[44] over the next few years. The Greenhouse Gas Protocol is a voluntary standard for accounting that is widely used and accepted globally for emissions reporting. Until we have accepted accounting practices, it will be difficult to reach agreement on these challenging issues.

In the meantime, RTC's biomass project has been reviewing accounting options and developing a method (called GWPbio) for comparing biomass to other fuels to help large thermal energy buyers make sound investment decisions. Because the project is still underway, we do not have final results yet. However, the decision tool that is being developed adopts a lifecycle approach and considers emissions from many sources, from the traditional footprint including combustion, cutting, processing and transporting the wood product, to its biogenic impact, that considers the type of wood species, their regrowth rate (shorter is better for carbon), the amount of carbon and duration it is stored in a product (e.g., furniture vs fuel) and direct and indirect land use impacts of above and below ground carbon as well as soil carbon, among other attributes.

The decision tool is expected to be publicly available at the end of Q1 in 2020.

7. **Could you expand upon what issues need to be considered when determining whether sources of biomass are appropriate for renewable thermal to reduce greenhouse gas**

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[43] NARUC Board of Directors, "Resolution on Standby Rates for Partial Requirements Customers," February 13, 2019.
https://pubs.naruc.org/pub/758747DC-F64E-BFD7-D411-817D44D3E571.
[44] http://ghgprotocol.org/

emissions? Taking into account land-use considerations and the multiple uses of biomass, what is a reasonable scale for using biomass for renewable thermal?

Several key issues that need to be considered when determining whether sources of biomass are appropriate for renewable thermal to reduce greenhouse gases are outlined in the second paragraph of the answer to question 6. In addition to the GWPbio tool under development, the Greenhouse Gas Protocol for the land sector will be a definitive resource when completed.

In short, there is not yet a consensus on the reasonable scale for using biomass for renewable thermal energy or for other needs. The U.S. Department of Energy Oak Ridge National Laboratory completed the Updated Billion-Ton Report Study[45] in 2016 to estimate the amount of biomass available in the US. The study was a US-wide assessment of bioenergy feedstock availability. It considered issues of access, maintaining base case soil health and other factors, but did not explicitly apply sustainability criteria or standards in its analysis. The RTC has some work underway to develop criteria to filter against the results of the Updated Billion-ton Study results. However, a robust scientific study developed and carried out with stakeholder input and peer review is needed. For now, and until WRI completes the land sector Greenhouse Gas Protocol, a sound approach would use waste materials and materials that are harvested from sustainably managed forests, considering climate and forest health, including biodiversity. Forest Stewardship Council controlled wood supply would provide a sound sustainability filter.

In addition, we would note that some states have analyzed these issues extensively as part of their rulemakings to determine appropriate crediting of biomass thermal energy products in their Renewable or Alternative Portfolio Standards. Massachusetts' Alternative Portfolio Standard, for example, offers credits for biomass thermal projects under these guidelines. However, as outlined in a report from the Clean Energy States Alliance on these issues, states have taken different approaches to biomass in their standards. The RTC is only beginning to assess how the states have addressed these issues so does not endorse any particular approaches which the states may have taken.

David Gardiner and Associates is happy to share with the Committee any additional studies or reports we develop that address these issues.

[45] U.S. Department of Energy Oak Ridge National Laboratory. Updated Billion-Ton Study (2016). https://www.energy.gov/sites/prod/files/2016/12/f34/2016_billion_ton_report_12.2.16_0.pdf

The Honorable Sean Casten

1. **In terms of designing a combined heat and power plant there can be a lot of flexibility in terms of how a system can be utilized to produce various ratios of heat to power. However, these two products can be subject to very different regulatory regimes that can in turn influence how a system is designed and its ultimate efficiency as you discussed in your testimony before the Committee. How can regulation at both the state and federal level create barriers that can incentivize CHP developers to sub optimize design of a plant with regard to overall efficiency?**

Conventional electric generation is very inefficient, with roughly two-thirds of fuel inputs lost as wasted heat from the process. Additional energy is lost during transmission from the central power plant to the end user. By generating both heat and electricity from a single fuel source at the point of use, CHP lowers emissions and increases overall fuel efficiency. When electricity and thermal energy are provided separately, overall energy efficiency ranges from 45-55%, but, though efficiencies vary for individual CHP installations, a properly designed CHP system will typically operate with an overall efficiency of 65-85%.[46] Because they combust less fuel to provide the same energy services, CHP systems reduce all types of emissions, including greenhouse gases, criteria pollutants, and hazardous air pollutants. As a consequence, natural gas-fired CHP can produce electricity with about one-quarter of the GHG emissions of an existing coal power plant. WHP, which uses waste heat from industrial processes to generate electricity with no additional fuel and no incremental emissions, reduces emissions and offsets costs associated with purchased power.

Industrial and manufacturing facilities often have large thermal loads in comparison to their electric power needs. Installing a CHP system to meet such facility's entire thermal load would create the most energy and emissions savings: the optimal way to size a CHP system for a facility is by matching the thermal output of the system to the baseload thermal demand of the facility.[47] However, when a CHP system is deployed at such a facility, the CHP system is frequently not sized to meet the entire thermal load, but instead is capped at the electric demand of the facility because it is either impossible to sell the excess electric power or difficult to sell the excess electric power at a price that reflects its value. Regulations that prohibit the sale of excess power to the grid, prohibit wheeling[48] or the sale of excess power to another facility, or that do not appropriately value such power create this sub-optimization of CHP deployment. The inability to sell excess power, or to sell excess power at a competitive price, can be a deterrent to CHP projects sized to meet facility thermal loads.[49]

Policies that allow facilities that install CHP systems to sell excess electric power would help to encourage additional deployment of CHP and would result in increased energy efficiency by creating thermal and electric energy in one system. Policy options include power purchase agreements (PPAs) with a local electric utility which typically guarantee that a CHP system owner can sell power at a predetermined rate for a certain number of years. However, state utility regulation that does not provide fair treatment to all of the benefits and costs of CHP may curtail the attractiveness of these types of

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[46] United States Department of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States," March 2016, p. 3-4. https://www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf.

[47] *Id.* at 11.

[48] "Wheeling" in the electric market is the interstate sale of electricity or the transmission of power from one system to another. *See* U.S. Department of Energy Office of Electricity Delivery and Energy Reliability, "United States Electricity Industry Primer," July 2015, p. 91. https://www.energy.gov/sites/prod/files/2015/12/f28/united-states-electricity-industry-primer.pdf.

[49] United States Department of Energy, "Barriers to Industrial Energy Efficiency," June 2015, p. 101. https://www.energy.gov/sites/prod/files/2015/06/f23/EXEC-2014-005846_5%20Study__0.pdf.

agreements.[50] Third-party PPAs are another policy option where a CHP system owner can sell excess electricity to neighboring facilities, however in many states CHP system owners are not able to deliver excess electricity to nearby plants that are under common ownership or sell excess power except to the electric utility that serves the CHP site, creating a potential barrier to CHP deployment.[51] In general, rules that prohibit or diminish the value of excess power sales leave large amounts of energy and emissions savings unrealized.

2. **Given than waste heat to power represents a zero marginal fuel use source of energy with emission equivalent to those of renewable sources, how should federal incentives treat these projects? Should they receive similar support to other zero-carbon sources of energy?**

Waste heat to power (WHP) systems capture waste heat, a byproduct of industrial processes, and use it to generate electricity with no additional fuel and no incremental emissions. WHP is a clean form of energy that uses leftover heat from industrial, commercial and institutional operations to generate electricity for use onsite or for export to the electric grid. WHP systems capture waste heat from sources such as exhaust stacks, pipes, boilers and cement kilns, which would otherwise be lost to the atmosphere, and convert the waste heat into electricity. Because WHP generates electricity with no additional fuel or combustion, WHP is effectively a "zero emission" energy resource. Like wind and solar energy, waste heat is a resource we already have, but it just needs to be captured and used. However, the resource is underutilized in the U.S.: as of 2016, the U.S. Department of Energy determined existing WHP capacity to be 469 megawatts and the WHP technical potential to be 7,624 megawatts, meaning that the U.S. was utilizing around six percent of this resource.[52]

As of 2016, of the 40 states that had some form of portfolio standard, either an RPS, alternative portfolio standard (APS), or energy efficiency resource standard (EERS), 32 states included WHP systems.[53] While this recognition at the state level is important, it also demonstrates that WHP is not fully recognized for all of the benefits it delivers.

Despite being a zero-emissions technology, WHP does not currently qualify for the federal Investment Tax Credit. CHP and WHP have some key differences that prevent WHP from accessing the ITC as written. CHP systems capture waste heat generated in the production of electricity for thermal uses, whereas WHP systems capture waste heat and energy from processes and operations and convert that energy into electricity. WHP should receive support just as other zero-carbon sources of energy do.

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[50] *Id.*
[51] *Id.* at 102.
[52] United States Department of Energy, "Combined Heat and Power (CHP) Technical Potential in the United States," March 2016, p. 18, 28-29. https://www.energy.gov/sites/prod/files/2016/04/f30/CHP%20Technical%20Potential%20Study%203-31-2016%20Final.pdf.
[53] U.S. Environmental Protection Agency Combined Heat and Power Partnership, "Portfolio Standards and the Promotion of Combined Heat and Power," March 2016, p. 16-32. https://www.epa.gov/sites/production/files/2015-07/documents/portfolio_standards_and_the_promotion_of_combined_heat_and_power.pdf