Decarbonizing Industry with Combined Heat and Power (CHP and Waste Heat to Power Systems)

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June 14, 2023

CHP Technical Assistance Partnerships

Agenda

- Industrial Energy Consumers of America Energy Focus
- DOE CHP Deployment Program & CHP TAPS
- Decarbonization Challenge
- Topping Cycle CHP
- Waste Heat to Power and Bottoming Cycle CHP
- Inflation Reduction Act Incentive for CHP and WHP
- Questions

Industrial Energy Consumers of America Website

Since 1990, industrial energy consumption decreased by 2%, while manufacturing gross output increased by 112%.

(Sources: EIA, BEA)

Since 1990, the U.S. industrial direct and indirect CO_2 emissions fell by 12% and 41%, respectively. More than any other sector of the economy.

(Source: EIA)

Since 1990, industrial CO_2 emissions decreased 23%, while manufacturing output increased 112%. A success story.

(Sources: EIA, BEA)

The U.S. industrial sector consumes 27% and 25% of U.S. natural gas and electricity, respectively.

(Source: EIA)

U.S. DOE CHP Deployment Program Activities

DOE's CHP Deployment Program provides technical assistance and resources to end-users interested in CHP and engages with stakeholders to facilitate more widespread adoption of CHP technologies.

CHP TAPs

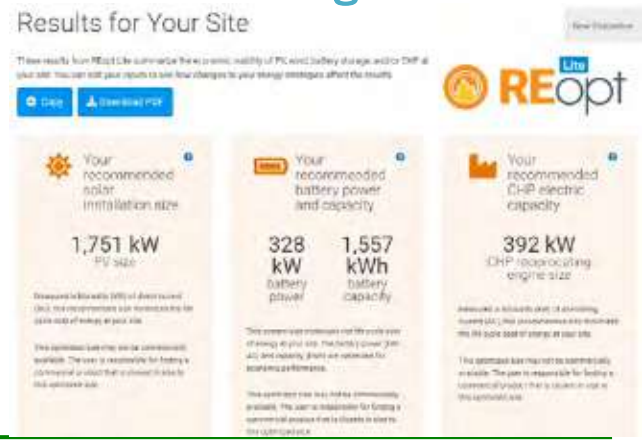
eCatalog

Packaged CHP Accelerator

Publications

CHP and Microgrid Installation Databases

Screening Tools



CHP Technical Assistance Partnerships

Combined Heat and Power Technical Assistance Partnerships

(CHP TAPs)

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End User Engagement

Stakeholder Engagement

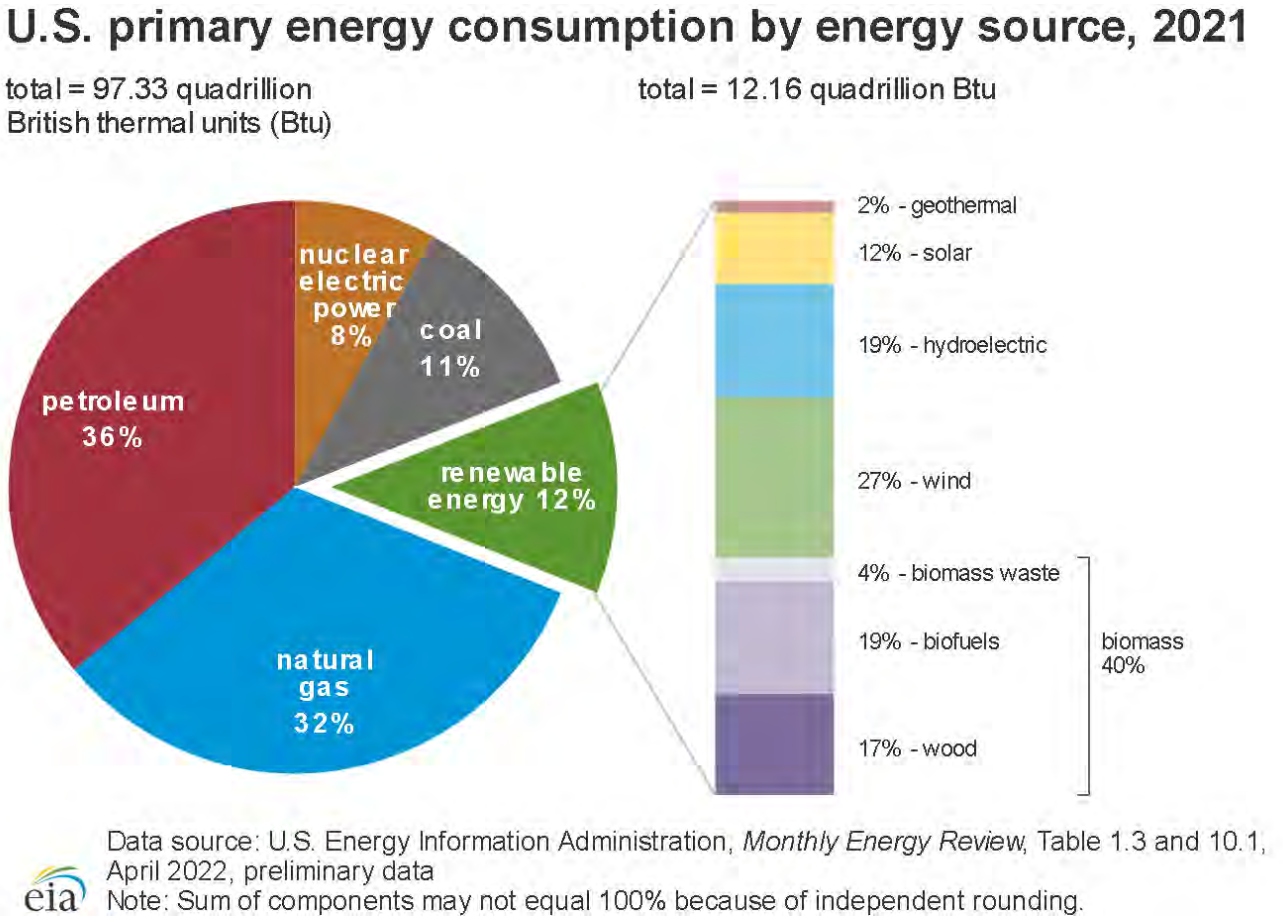
Technical Services

The Path to Decarbonization

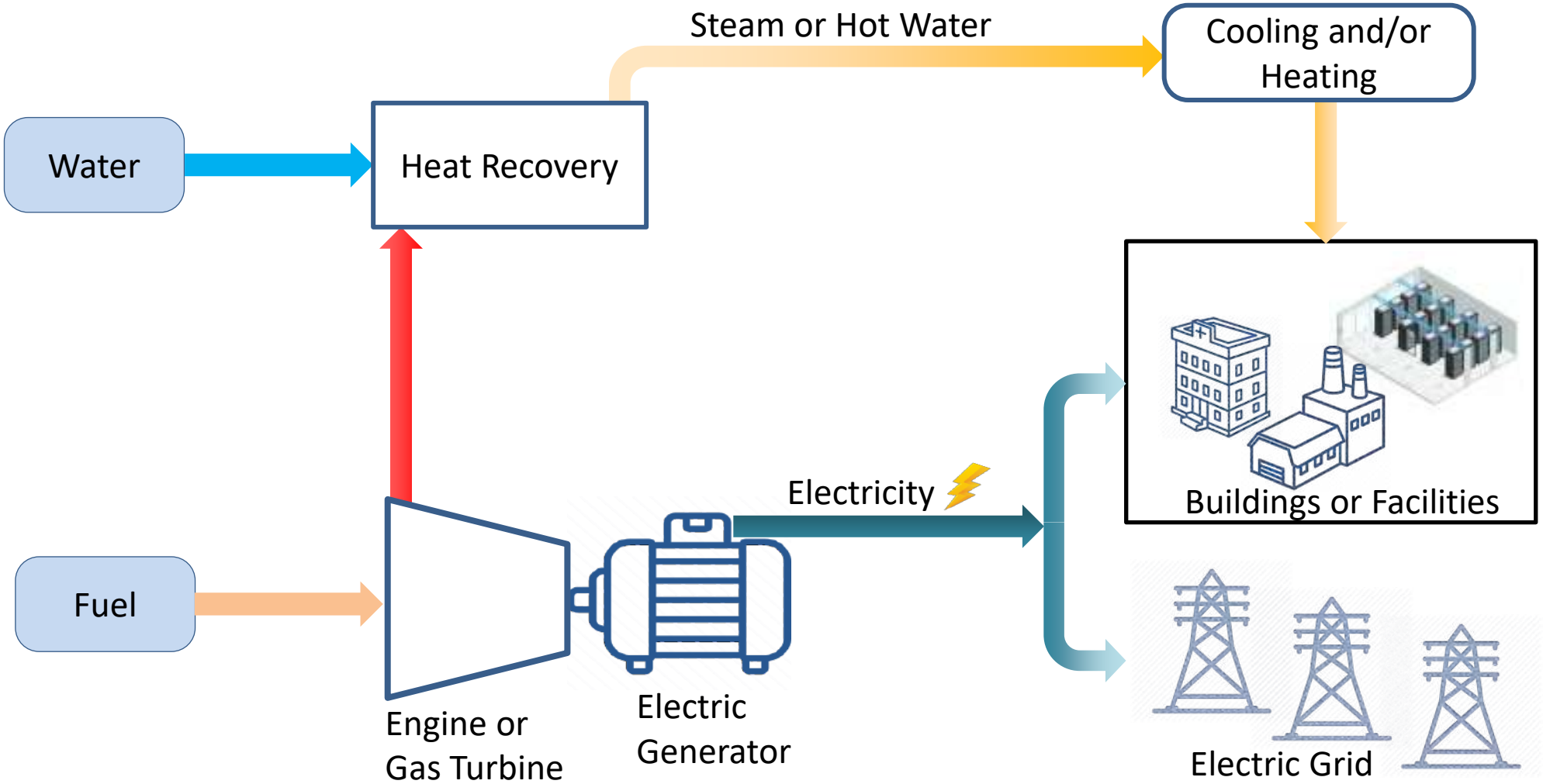
Carbon free power sector by 2035
Net-zero carbon emissions by 2050

President Biden, April 21, 2021

- Reducing carbon today is important
- Achieving a net-zero carbon future will require a historic transformation
  - Cost of new generation and T&D
  - Cost of storage
  - Some industrial processes difficult to electrify
  - Critical facilities need dispatchable on-site power for long duration resilience and reliability
  - A renewable grid will need dispatchable generation for support
- Renewable Fuels/RNG/Hydrogen increasingly looked at as part of the solution

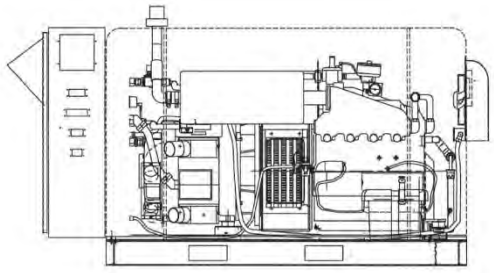


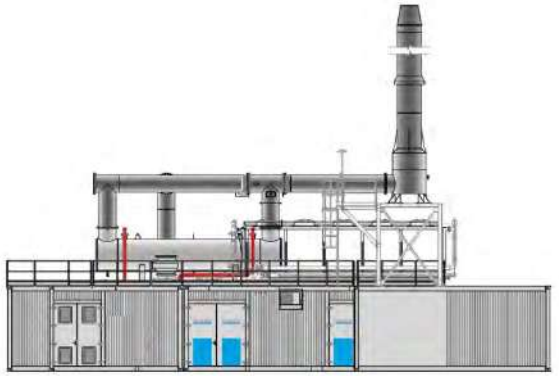
Conventional CHP or Cogen (a.k.a. Topping Cycle)

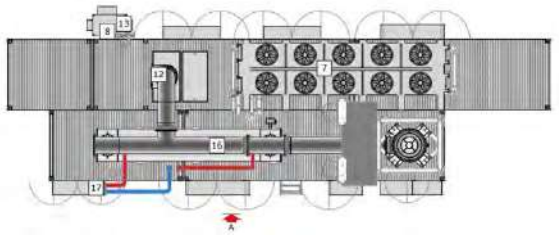


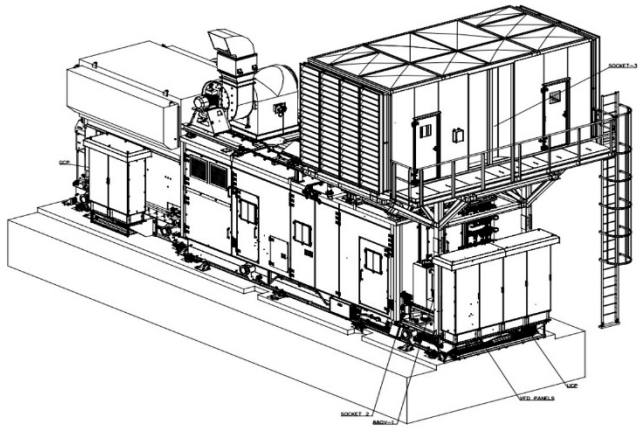
Packaged CHP Systems: Standard Repeatable Designs

- Self Contained Units or Modules
  - Prime Mover
  - Heat Recovery
  - Controls
  - Ancillary Equipment
- Standardized yet customizable
- Factory assembled
- Moveable



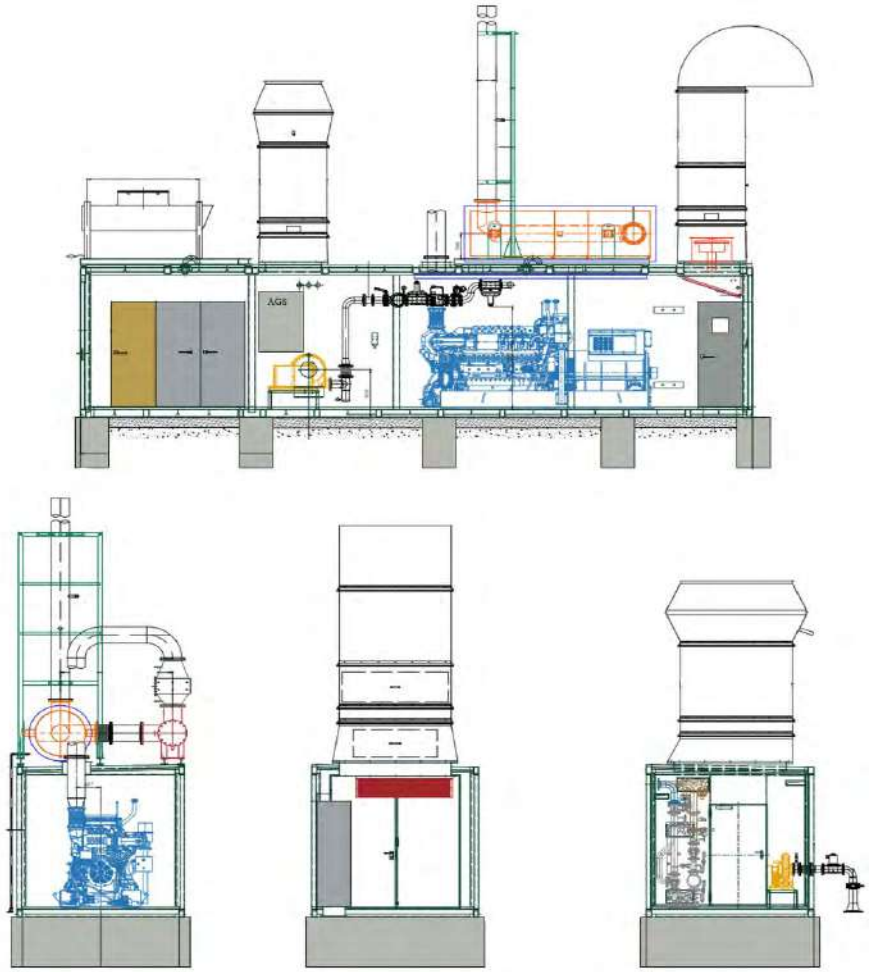






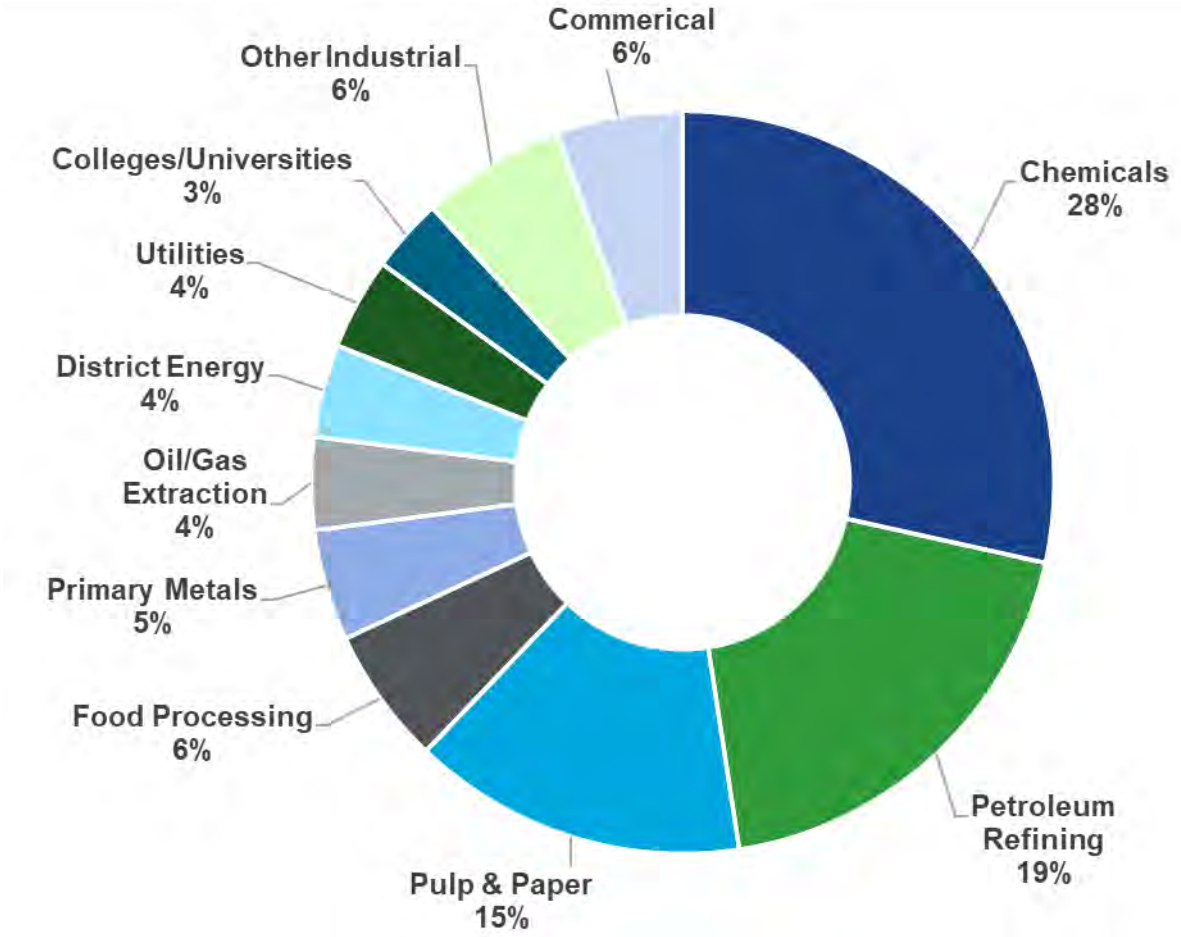
Packaged CHP Systems:

- 100% pre-wired
- 100% pre-piped with customer ready connections
- Properly ventilated
- Sound insulated
- Fire rated
- Gas detection and smoke alarm system
- Fluid containment system
- Auxiliaries sized appropriately and shipped complete with connecting piping and wiring
- Packagers have bulk purchasing power that local contractors do not have



CHP Today in the United States

Existing CHP Capacity (81.5 GW)



Avoids **1.3 Quadrillion Btus** of fuel consumption annually.

Avoids **218 million tons of CO^2** compared to separate production.

81.5 GW of installed CHP at more than **4,700** industrial and commercial facilities.

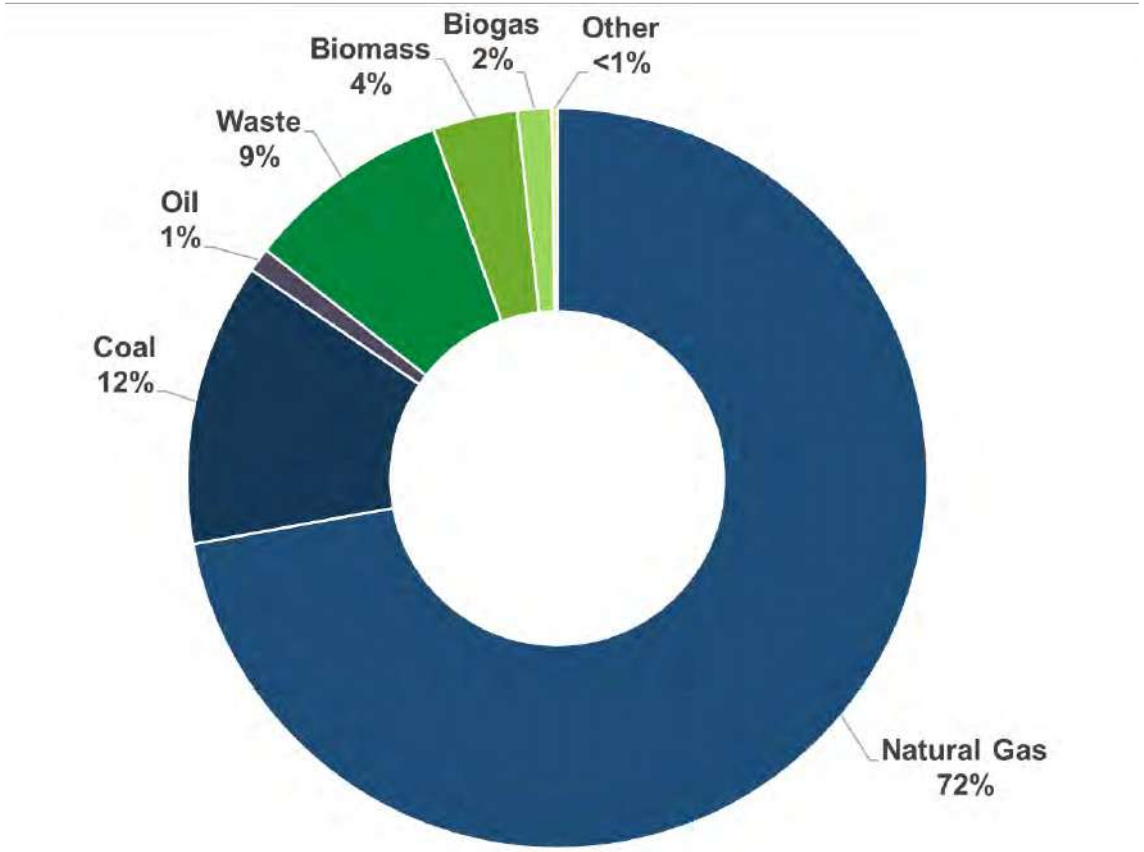
7% of U.S. electric generating capacity; 13% of generation.

Data as of January 2023

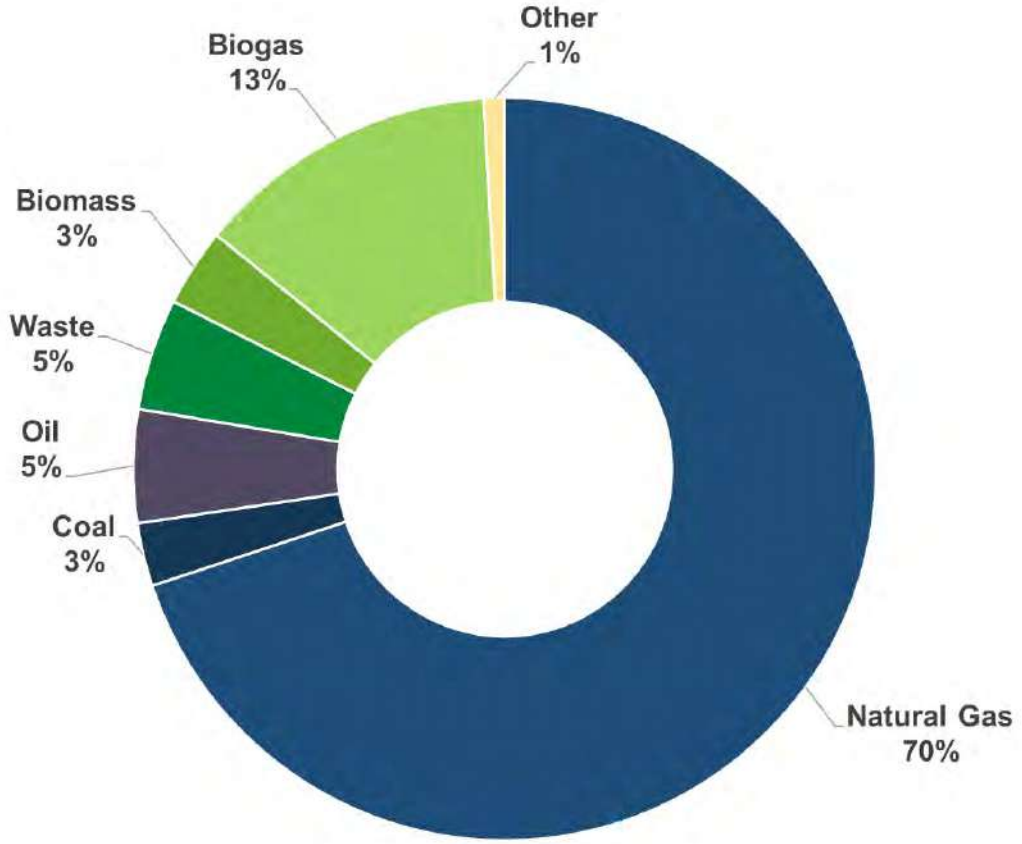
CHP Technical Assistance Partnerships

CHP Is Fuel Flexible

By Capacity – 81.5 GW



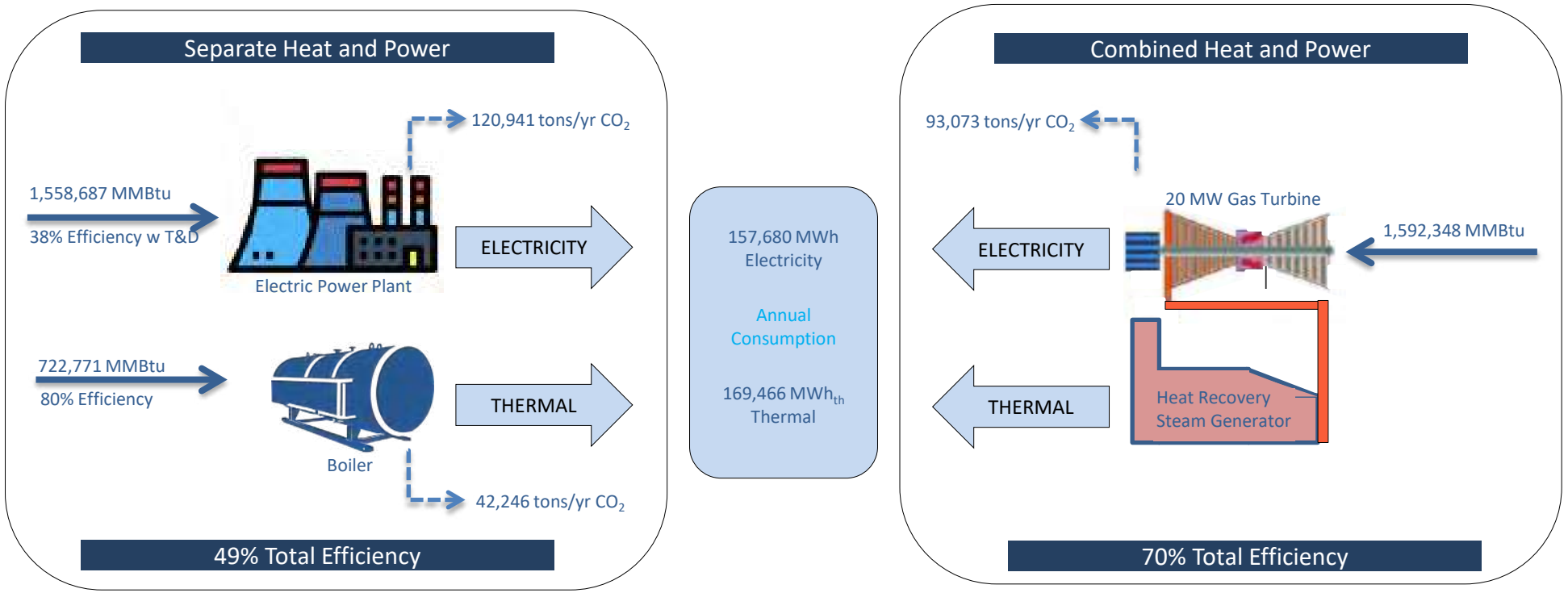
By Site – 4,743 Sites



Data as of January 2023

CHP Technical Assistance Partnerships

CHP Provides both Energy and CO_2 Emissions Savings



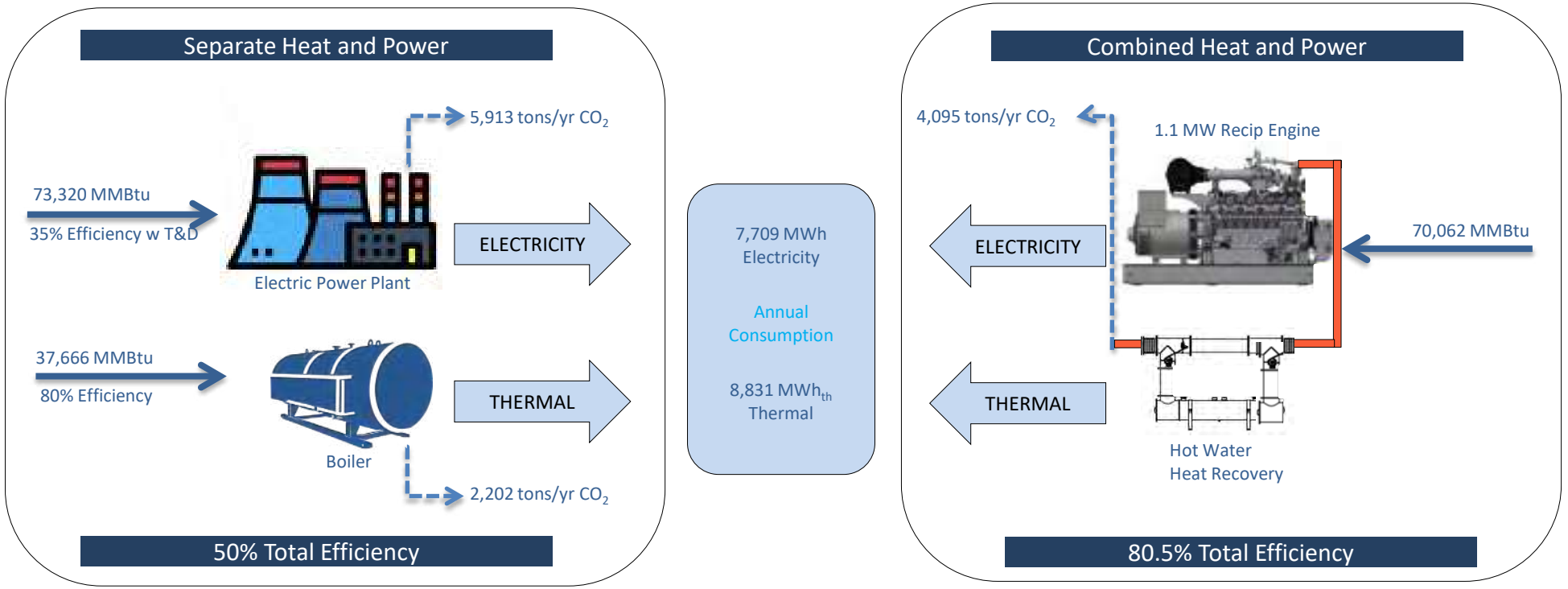
30% Energy savings: 689,110 MMBtu/yr (727,049 GJ/yr) 43% CO_2 Savings: 70,114 tons/yr (63,606 MT/yr)

20 MW Gas Turbine CHP System

- Natural gas fuel
- 90% load factor (7,884 hours)
- 33.8% electric efficiency
- 75.7 MMBtu/hr steam output
- 100% thermal utilization
- Displaces 80% efficient natural gas boiler
- CO_2 savings based on displacing EPA AVERT Uniform EE grid emissions factor (1,534 lbs CO_2/MWh)

Prepared by Entropy Research, LLC, 11/1/2022

CHP Provides both Energy and CO_2 Emissions Savings



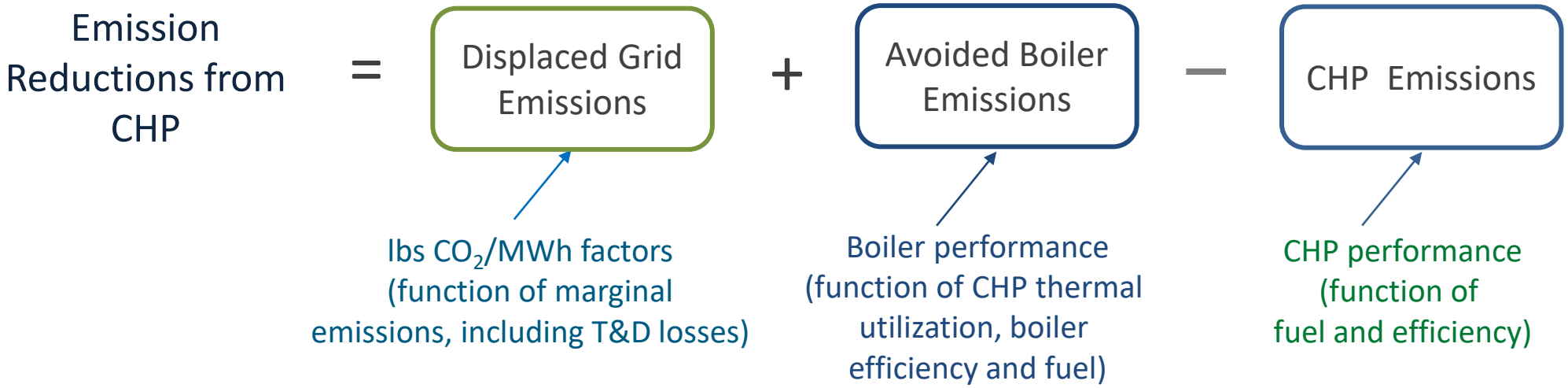
43% Energy savings: 40,834 MMBtu/yr 50% CO_2 Savings: 4,020 tons/yr

1.1 MW Recip Engine CHP System
- Natural gas fuel
- 80% load factor (7,008 hours)
- 37.5% electric efficiency
- 4.3 MMBtu/hr hot water output
- 100% thermal utilization
- Displaces 80% efficient natural gas boiler
- CO_2 savings based on displacing EPA AVERT Uniform EE grid emissions factor (1,534 lbs CO2/MWh)

Prepared by Entropy Research, LLC, 11/1/2022

Methodology for Calculating Emission Reductions from CHP

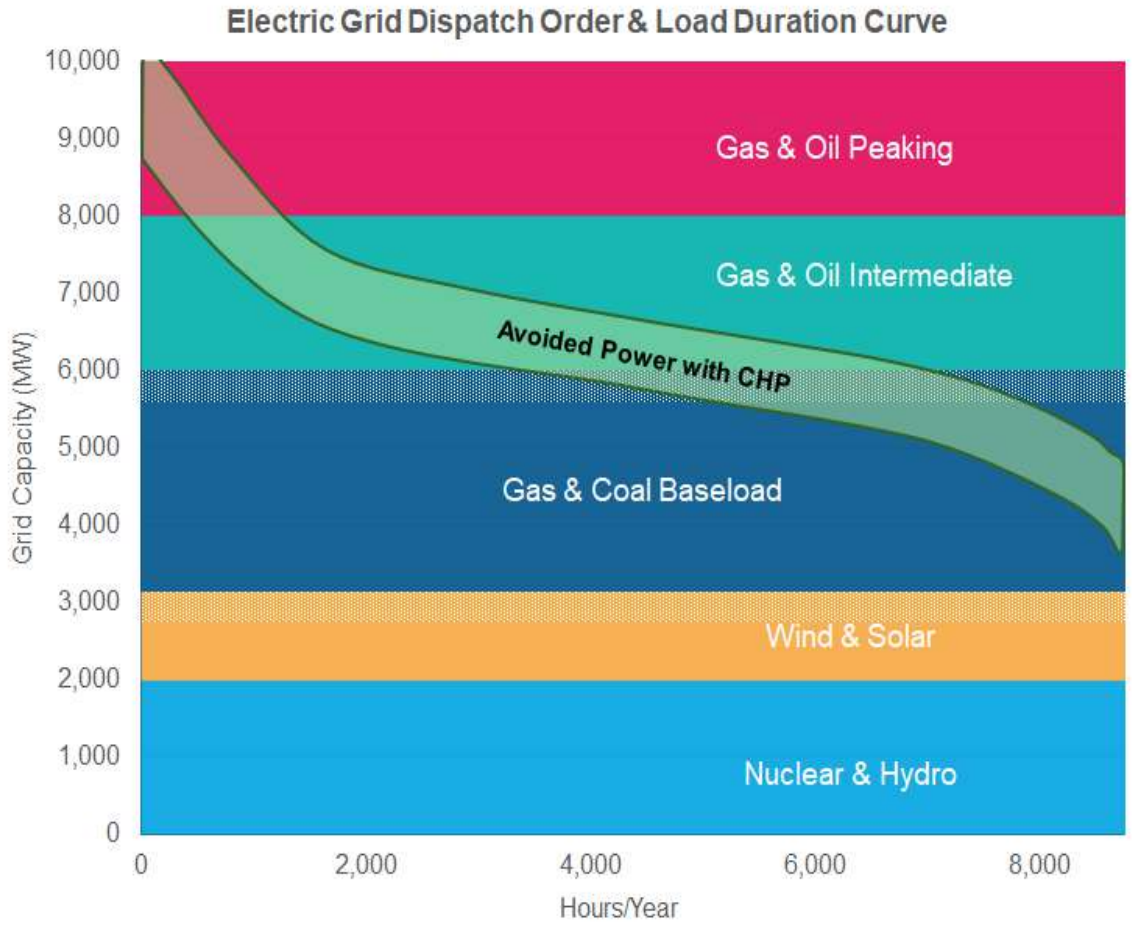
- CHP's energy and emissions savings benefits are found in the aggregate reduction in overall energy consumption - both electric and thermal outputs of CHP must be considered
- The effect of CHP on the grid is equivalent to load reductions from energy efficiency or renewable energy projects



What are Marginal Grid Emissions?

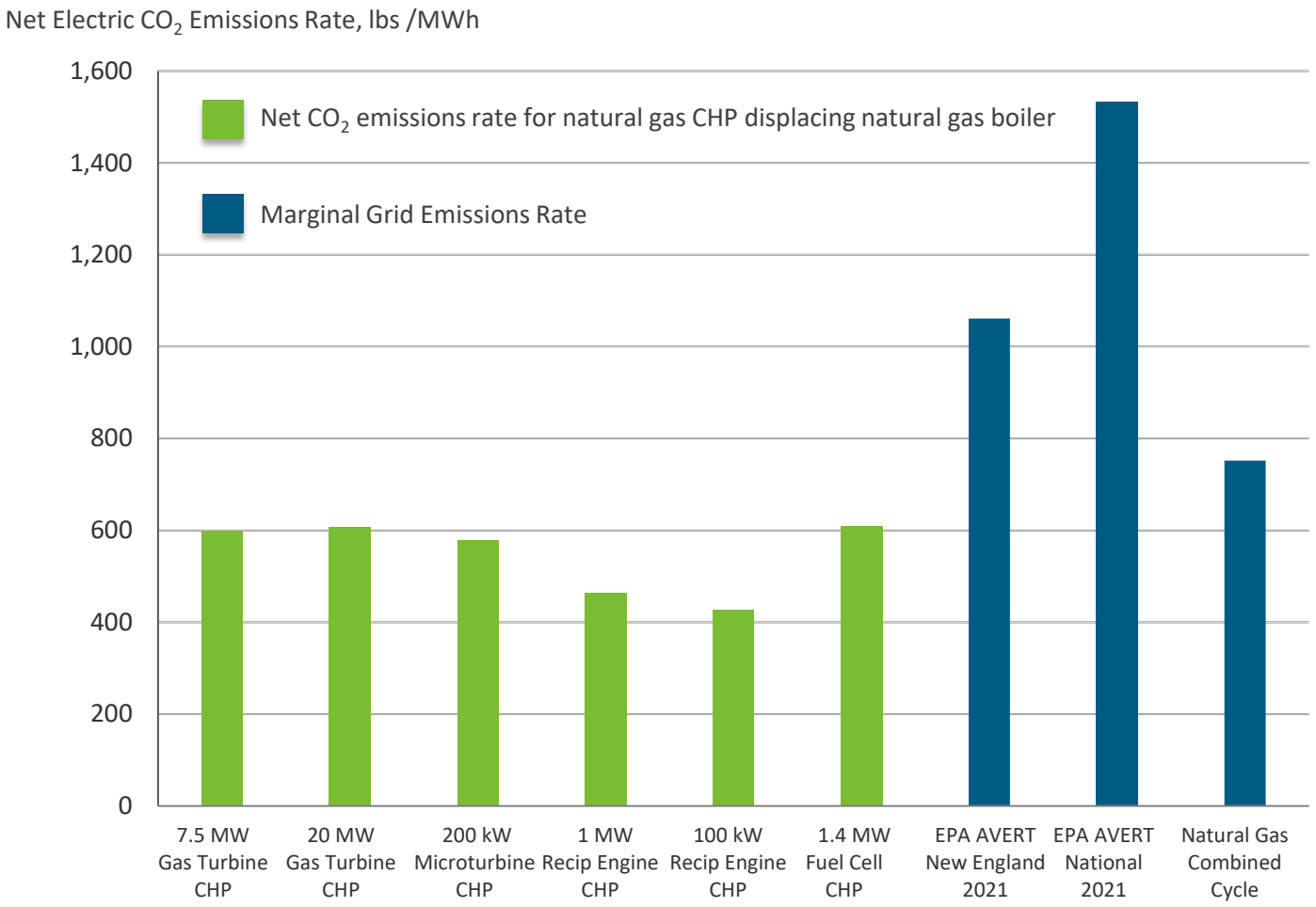
Displaced grid emissions for CHP are based on *marginal grid generation*

- Marginal units are those at the "top of the stack" that set the electricity price in real-time or day-ahead pricing
- Currently, marginal generation tends to be provided by units fueled by gas, oil, and in some cases coal



Natural Gas CHP Emissions vs Marginal Grid Emissions

- Natural Gas CHP systems have lower net GHG emissions in terms of lbs CO_2/MWh than current marginal grid generation
- Natural gas CHP displacing natural gas boilers provides emissions savings as long as the marginal grid emissions rate is greater than 430 to 615 lbs CO_2/MWh
- Current marginal grid emissions factors range from 1,071 lbs CO_2/MWh in New England to 1,925 lbs CO_2/MWh in the Rocky Mountain region based on 2021 EPA AVERT data (1,534 national average)
- Emissions factor for state of the art natural gas combined cycle power generation is 750 lbs CO_2/MWh (including T&D losses)



Based on 100% CHP Thermal Utilization

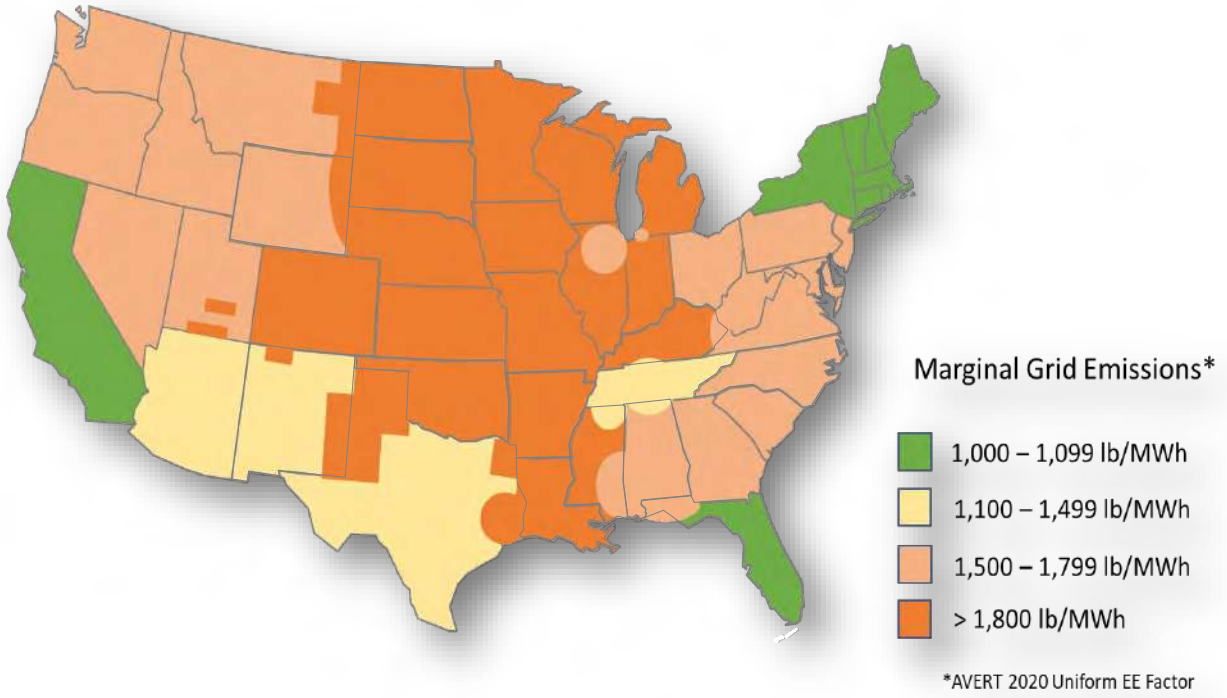
Prepared by: Entropy Research, LLC, 11/1/22

CHP Reduces CO_2 Emissions in all Regions Today

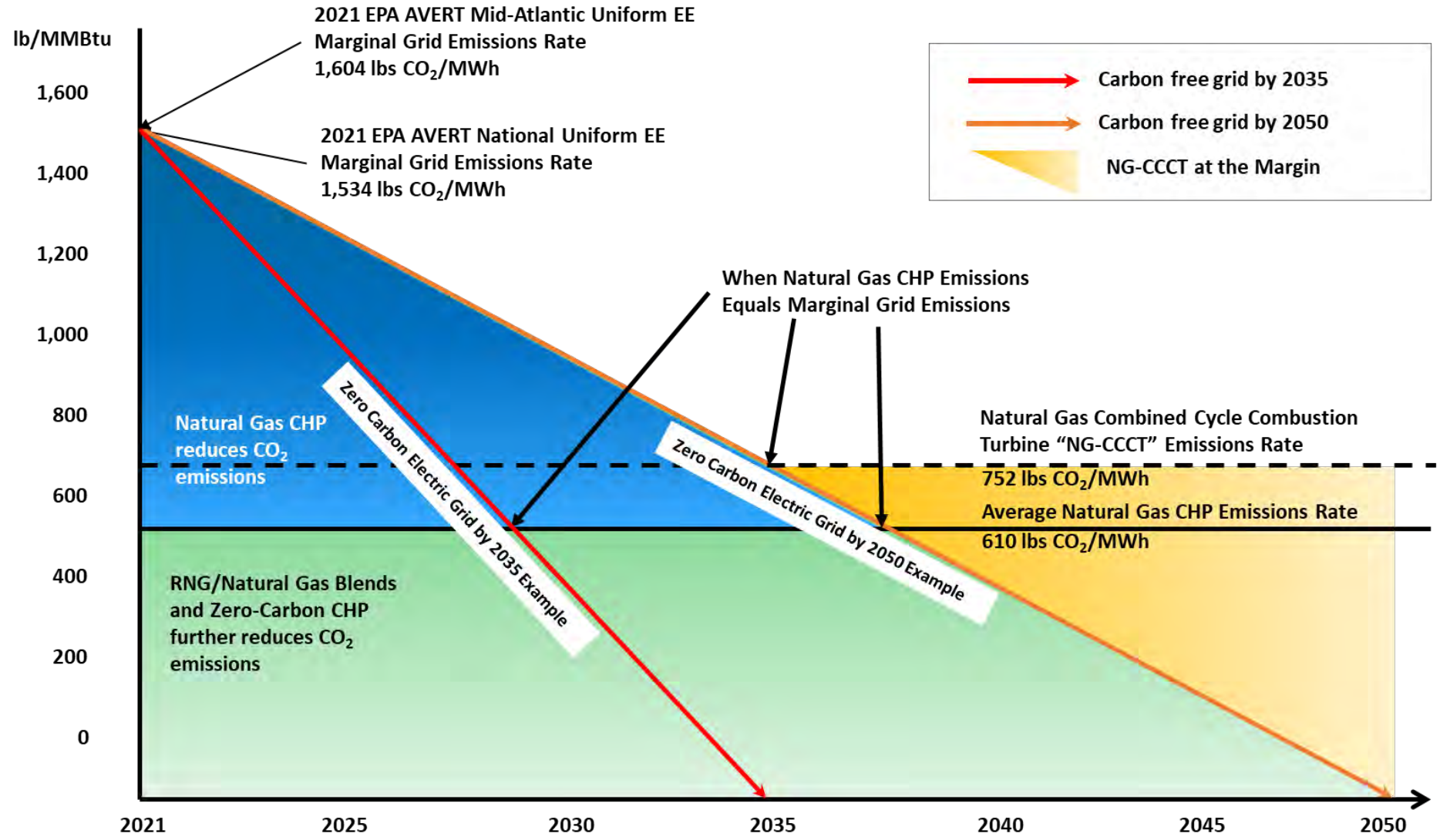
- CHP and renewables displace marginal grid generation (including T&D losses)
- Marginal generation is currently a mix of coal and natural gas in most regions of the US
- CHP's high efficiency and high annual capacity factor currently results in significant annual energy and emissions savings
- *"Because emissions are cumulative and because we have a limited amount of time to reduce them, carbon reductions now have more value than carbon reductions in the future. The next couple of decades are critical."*

Source: "Time Value of Carbon", Larry Strain, Carbon Leadership Forum, April 2020

Regional Marginal Grid Emissions Factors based on EPA AVERT 2021



Renewable and Net-Zero Carbon Fuels Maintain CHP's Advantage



Renewable and Net-Zero Fueled CHP

- Existing CHP systems can utilize biogas and biofuels.
- All natural gas-fueled CHP is compatible with renewable gas.
- Most existing turbines and engines can operate on hydrogen mixtures up to 10-40%.
- All major engine and gas turbine manufacturers are working on the capability to operate at high levels of hydrogen, targeting 2030 for 100% hydrogen prime movers.
- CHP systems can be changed out or modified in the field to 100% hydrogen-fuel blends

The ultimate scale of renewable and hydrogen-fueled CHP deployment will depend on resource availability.

Source: Atlas of Carbon and Hydrogen Hubs, Great Plains Institute, February 2022

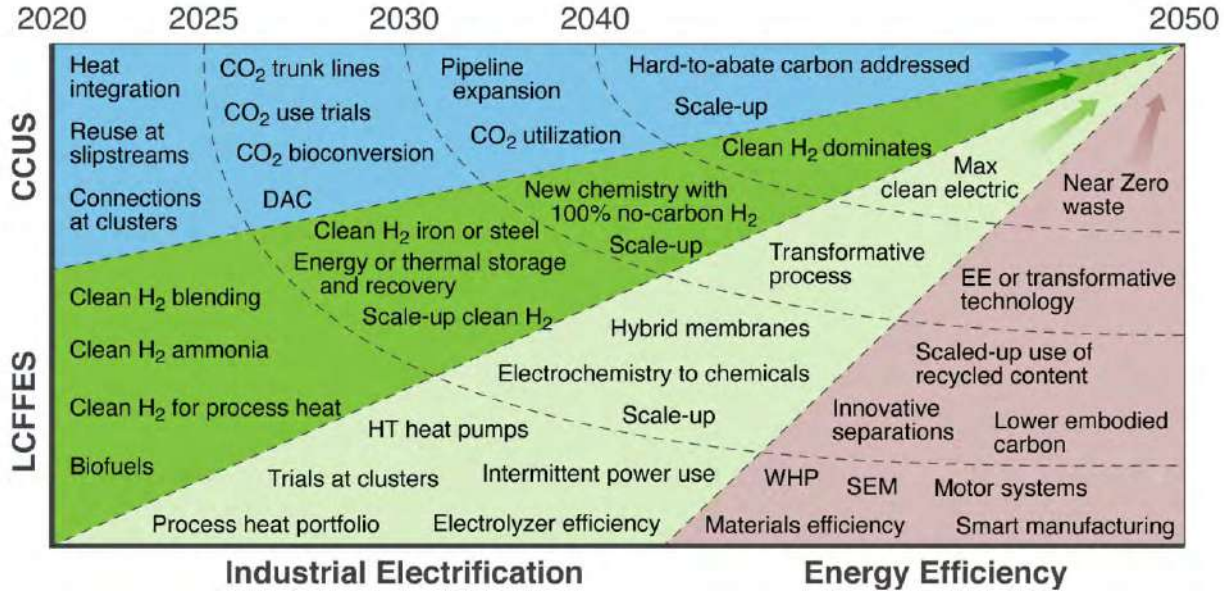
CHP for Difficult to Decarbonize Industries

- CHP is well suited to address steam and process heating needs, 95% of which is currently fossil fueled.
- CHP enables three of the four pathways for industrial decarbonization (energy efficiency; low-carbon fuels; electrification) while mitigating the need for CCUS.
- Renewable and net-zero fueled CHP can decarbonize industrial thermal processes that are difficult or prohibitively expensive to electrify.

Industrial facilities across the U.S. with challenging decarbonization pathways

CHP supports decarbonization of the industrial sector while additional technologies reach maturity.

Technology Pathways: Industrial Decarbonization

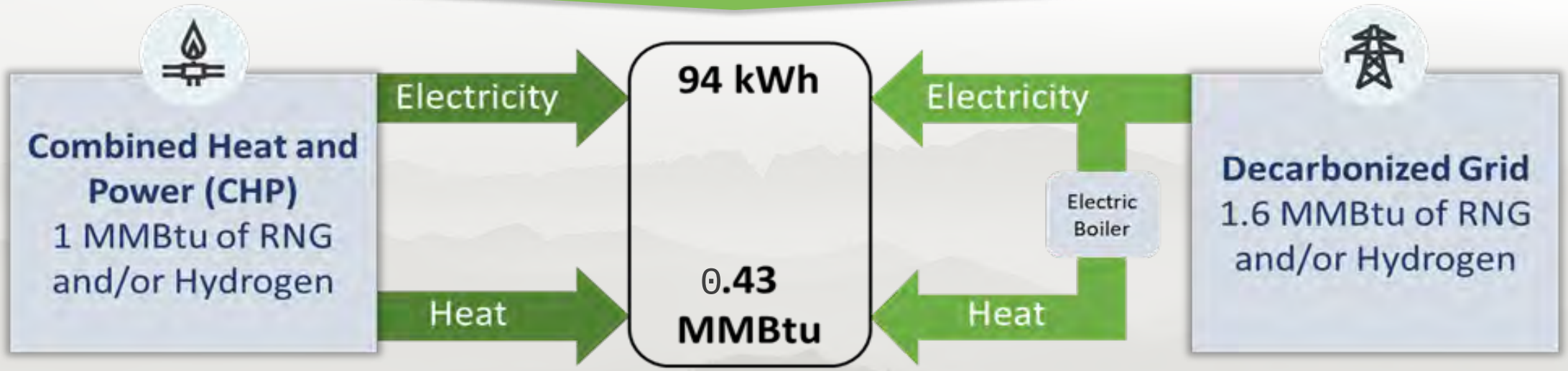


Source: Industrial Decarbonization Roadmap, DOE, May 2022 Draft

CHP: Uniquely Suited for Decarbonizing the Industrial Sector

CHP is uniquely positioned to accelerate the industrial decarbonization by addressing the need for high pressure steam and high temperature direct heat.

The industrial sector is slated to require fuel well into the future.
CHP will remain the most efficient way to use net-zero fuels.



60% more RNG or hydrogen would be required to produce the same amount of electricity and heat with grid power and an electric boiler compared to CHP.

Source: Beneficial CHP – Is that a Thing? Considering CHP in the Context of Beneficial Electrification, ACEEE Summer Study, 2021

Pairing CHP with Renewables and Storage for Resilience

- CHP can be a resilient base load anchor for multi-technology microgrids, particularly those incorporating renewable generation sources like solar PV or wind.
- CHP paired with renewable DERs optimizes overall emissions reductions and resilience.
- Net-zero fueled CHP can decarbonize critical facilities that need dispatchable on-site power for long duration resilience and operational reliability

critical infrastructure, cities, and communities

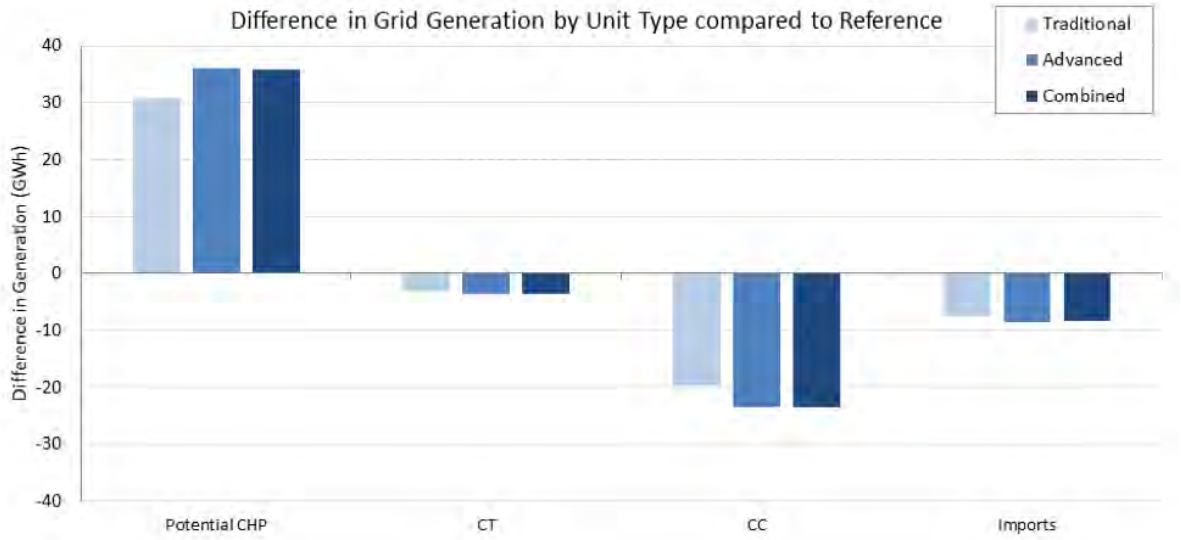
United States Marine Corps Recruit Depot (MCRD) Parris Island, SC, installed a hybrid microgrid including a 3.5 MW natural gas-fired CHP system plus 5.5 MW solar photovoltaic arrays to provide secure and resilient energy. The site also incorporated an 8 MWh battery-based energy storage system, all of which are controlled by a microgrid control system capable of fast load shedding.

CHP Can Provide Flexible, Efficient Grid Support

- Net-zero fueled CHP can accelerate independence from less efficient combustion resources as additional renewables come online.
- CHP can provide dispatchable net-zero generation and regulation support to support long-run resource adequacy
- To the extent that net-zero fuels are part of a decarbonized grid, CHP can be the most efficient way to use them.

independent system operators (ISOs) | *Utilities*

Modeling shows advanced CHP in California offsets combined cycle, combustion turbines, and imports, deepening emissions savings from renewables.



Potential Impact of Flexible CHP on the Future Electric Grid in California, ORNL, Sept. 2021.

DOE's Evolving CHP Program

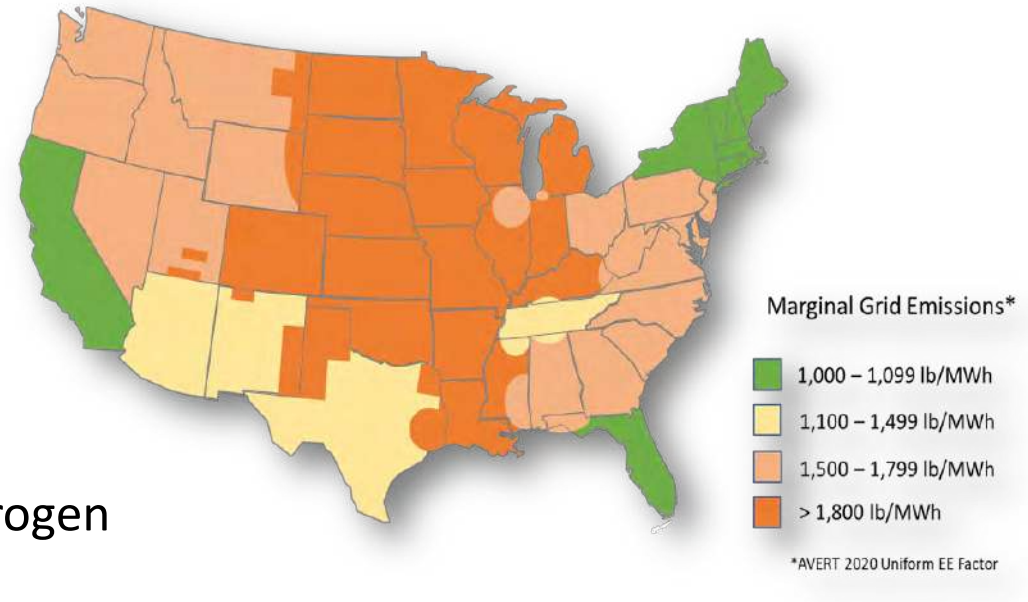
- Focus future program activities on renewably fueled CHP

  biofuels | waste heat | green hydrogen

- Natural gas-fired CHP for:
  - Heavily fossil geographies
  - Hard-to-decarbonize industries
  - Long-term resilience
  - Sites with fuel flexible outlooks

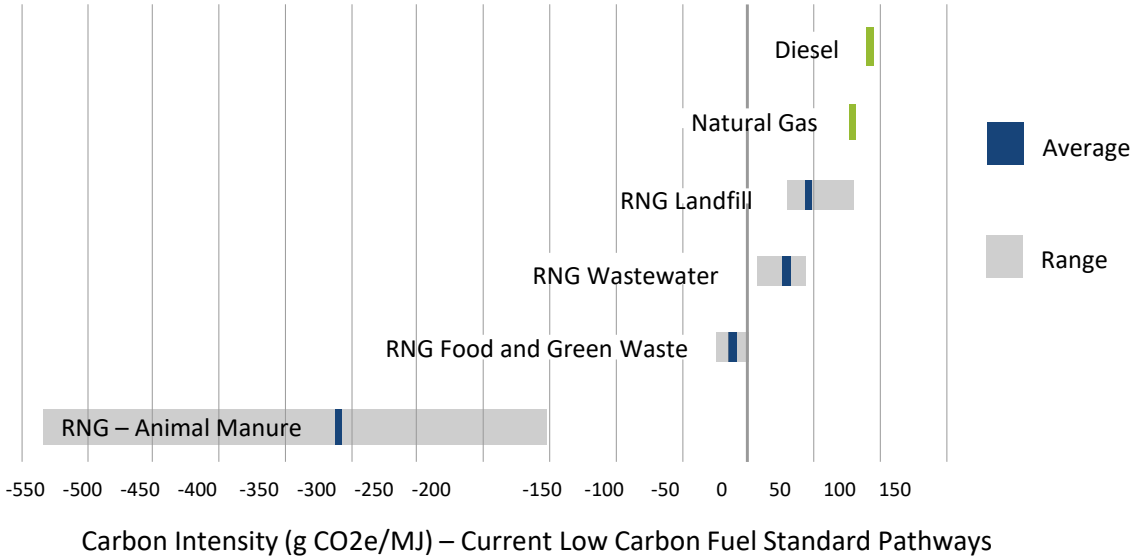
- R&D investments pair with deployment priorities to prepare for the future by:
  - Addressing challenges with renewable fuels, such as hydrogen
  - Developing technologies for flexible grid connections

Regional Marginal Grid Emissions Factors based on EPA AVERT 2021



Renewable Natural Gas

- Displaces fossil fuels
- Contributes to sustainable waste management
- Reduces methane from organic wastes



Source: WRI, Renewable Natural Gas As A Climate Strategy: Guidance For State Policymakers, 2021

Low/Zero Carbon Fuel Feedstocks

- *Food Waste*
- *Animal manure*
- *Wastewater Treatment (WWTP)*
- *Landfill gas (LFG)*

- *Agricultural residue*
- *Forestry and forest product residue*
- *Energy crops*
- *Municipal solid waste (MSW)*

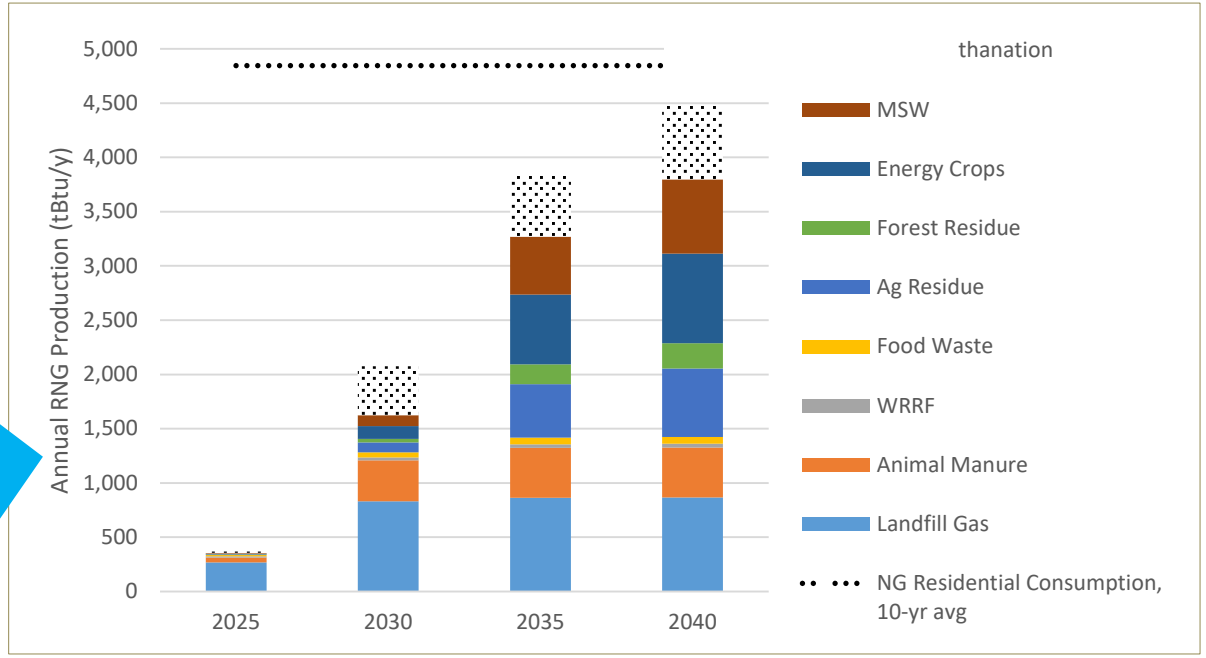
- *Green Hydrogen from renewable electricity*
- *Blue Hydrogen from natural gas with carbon capture*

Source: AGA Foundation, Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment, 2019

Renewable Natural Gas Resource Potential

- High resource case: 4.5 Tcf of RNG by 2040
- Represents 60% of current industrial natural gas use
- Cost competitive with other emission reduction strategies, $55-300/ton of GHG emission reductions

Estimated Annual Production



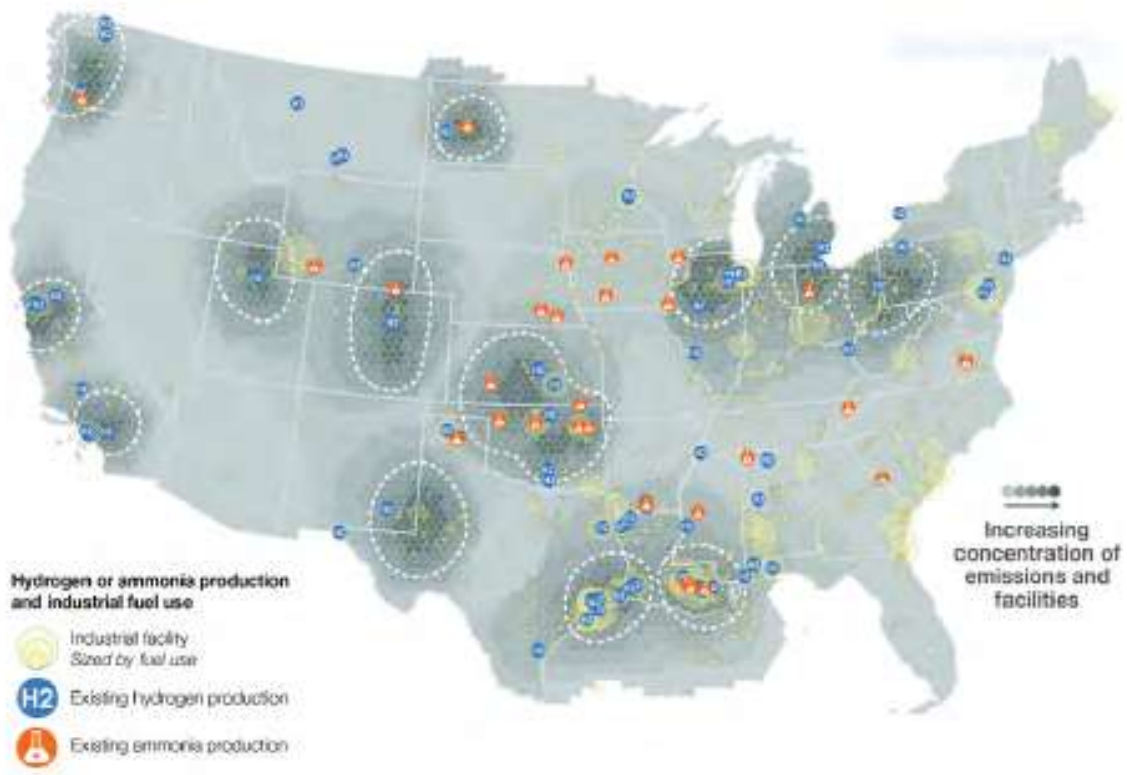
Source: AGA Foundation, Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment, 2019

What About the Availability of Hydrogen?

Hydrogen as a Decarbonization Solution

An increase in low-and zero-carbon hydrogen production and related technologies is needed to reach net-zero GHG emissions by 2050. Hydrogen is a versatile fuel source that can be stored for long periods of time and can reduce carbon intensity of power systems, heating systems, and industrial production. Hydrogen can also act as an energy carrier, be combusted for energy without emitting GHGs, and enable energy storage that can cover intermittent or seasonal periods of low energy production from renewable electricity generation.

When produced with zero- or low-carbon energy, hydrogen is a powerful decarbonization solution for multiple sectors and numerous end uses that are difficult to electrify, such as industrial process heat, heavy trucking, iron and steel production, and marine shipping. Hydrogen use can displace fossil-based medium- and high-grade heat in industrial applications that may be hard to electrify.[35] In the IEA's net-zero scenario, hydrogen-based fuels account for 13 percent of global energy demand in 2050.[37]

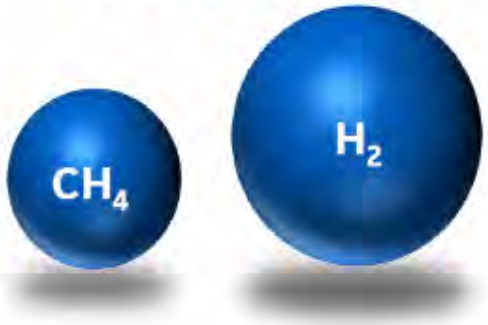


Source: "An Atlas of Carbon and Hydrogen Hubs for U.S. Decarbonization", Great Plains Institute, February 2022

Use of Hydrogen will Require System Changes

Fuel System

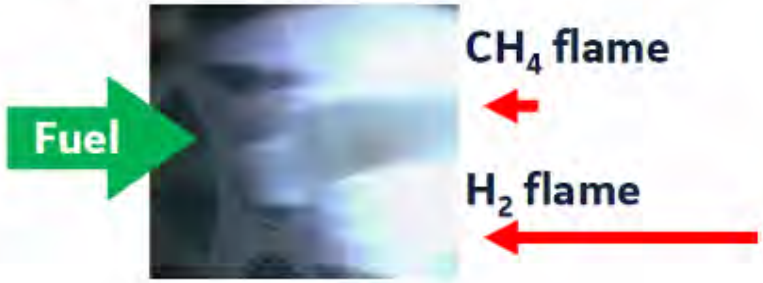
Methane (CH_4): 912 lb/ft^3
Hydrogen (H_2): 275 lb/ft^3



To deliver the same energy content, hydrogen requires 3X more volume flow

Combustion System

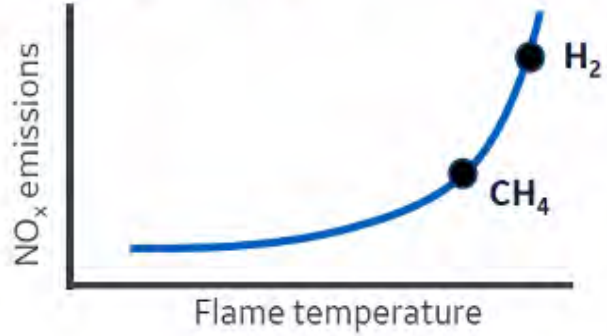
Methane (CH_4): ~30–40 cm/sec
Hydrogen (H_2): ~200–300 cm/sec



Hydrogen flames may increase risk of damage to combustion hardware

Emissions Aftertreatment

Methane (CH_4): ~3,565 °F
Hydrogen (H_2): ~4,000 °F



Operating on hydrogen may increase NO_x emissions

What About the Cost of Hydrogen?

According to the Energy Information Agency (IEA), "the main obstacle to the extensive use of low-carbon hydrogen is the cost of producing it."[1] Currently, hydrogen from renewable sources costs about $5 per kilogram to produce in the U.S., with the cost heavily driven by the cost required to acquire and install renewable power equipment, electrolyzers and hydrogen compressors. As noted above, the DOE has a goal to unlock new markets for hydrogen, including steel manufacturing, clean ammonia, energy storage and heavy-duty trucks, to achieve an 80 percent cost reduction to bring the cost to $1 per kilogram.[2]

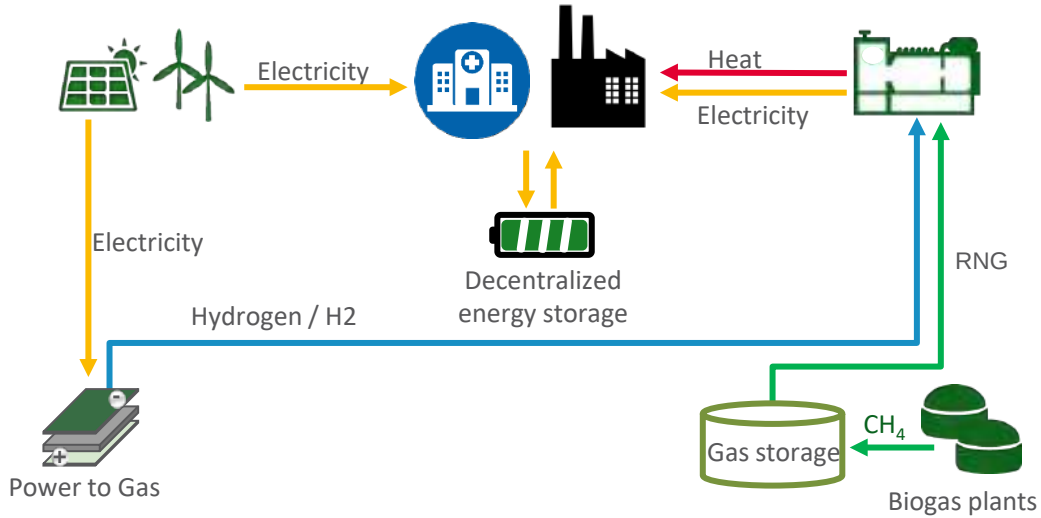
The U.S. Department of Energy takes the view that "[c]lean hydrogen is a form of renewable energy that – if made cheaper and easier to produce – can have a major role in supporting President Biden's commitment to tackling the climate crisis."[3] Accordingly, this summer DOE announced the "Hydrogen Shot," a "1-1-1" goal to cut the cost of clean hydrogen to $1 per 1 kilogram in 1 decade, an 80 percent reduction from its current estimated average cost of $5 per kilogram.[4]

1. https://www.iea.org/news/decisive-action-by-governments-is-critical-to-unlock-growth-for-low-carbon-hydrogen
2. https://www.energy.gov/eere/fuelcells/hydrogen-shot
3. https://www.energy.gov/articles/doe-announces-525-million-accelerate-progress-clean-hydrogen
4. https://www.energy.gov/eere/fuelcells/hydrogen-shot

CHP and Decarbonization

- CHP is fuel flexible
- CHP is the most efficient way to generate power and thermal energy, and reduces GHG emissions today
- CHP can decarbonize industrial and commercial facilities that are difficult to electrify
- CHP can decarbonize critical facilities that need dispatchable on-site power for long duration resilience
- CHP's high efficiency can extend the supply of renewable, low carbon and hydrogen fuels
- CHP can support the long-run resource adequacy of a highly renewable grid

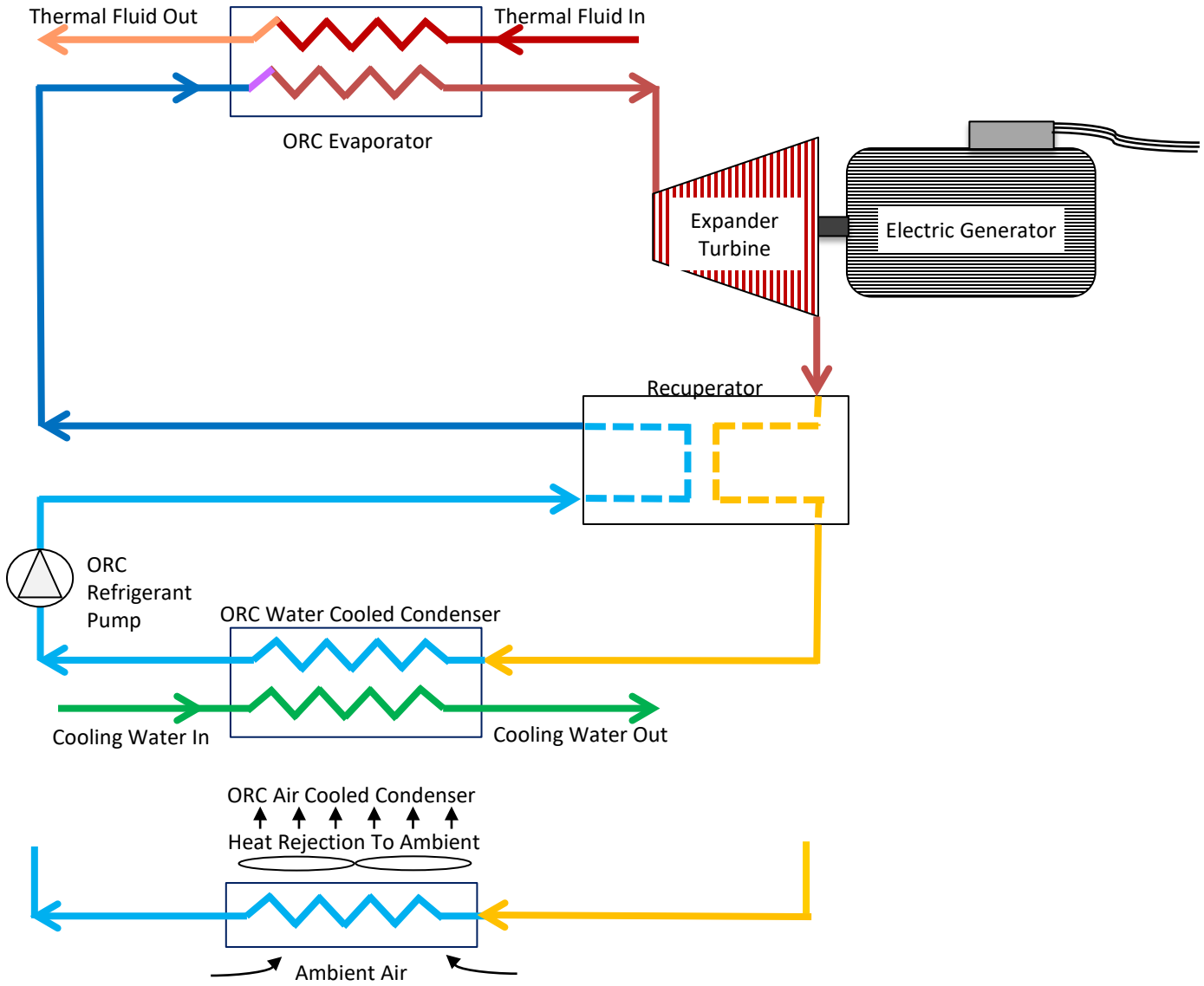
CHP in a Decarbonized Economy



Source: Based on 2G Energy

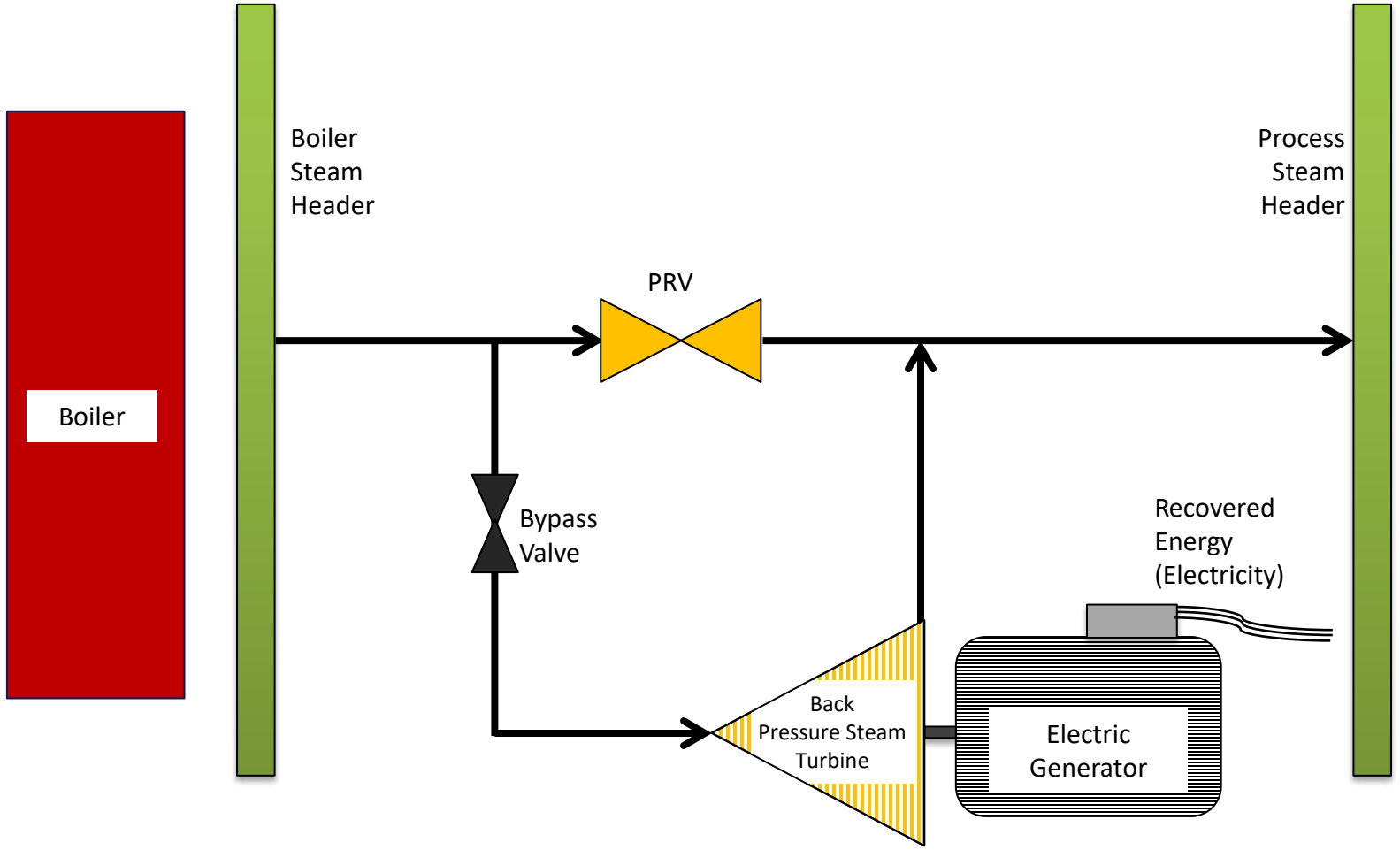
Waste Heat to Power – Organic Rankine Cycle

ORCs have long been used to generate power in geothermal power plants and a variety of packaged ORC systems are now available to generate emissions-free electricity from waste heat recovered from boilers, ovens, kilns and other types of furnaces, from gas turbine and engine exhaust, or from byproduct heat released from exothermic reactions (e.g., fertilizer production) or incinerators.



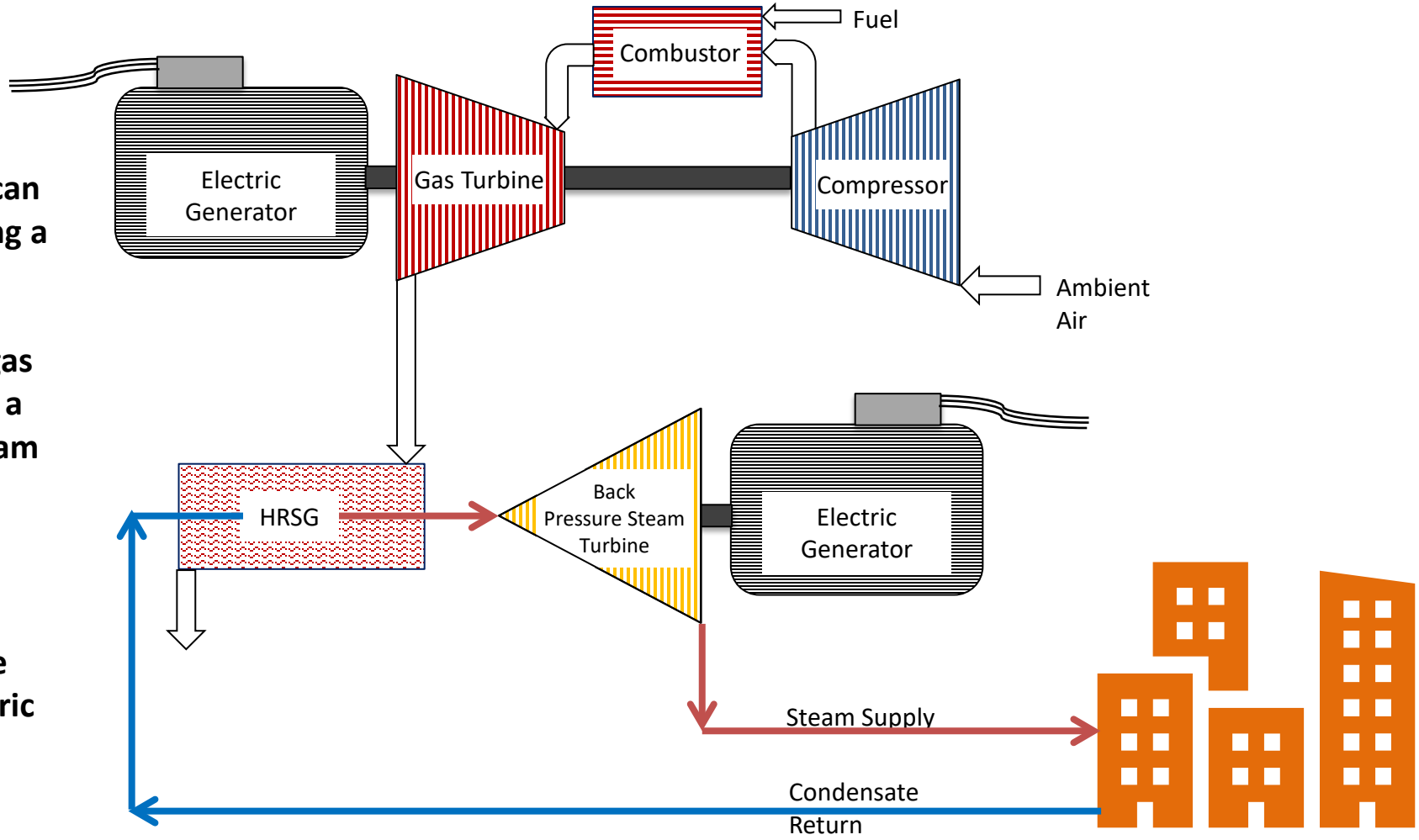
Waste Heat to Power – Back Pressure Steam Turbines

Many industrial facilities produce steam at a pressure higher than that demanded by process requirements. Steam passes through pressure-reducing valves (PRVs, also known as letdown valves) at various locations in the steam distribution system to let down or reduce its pressure. A BPST can perform the same pressure-reducing function as a PRV while converting steam energy into electrical energy.



Waste Heat to Power – BPST Bottoming Cycle to CHP Plant

Modern gas turbine-based CHP systems can increase their power output by integrating a BPST in combined cycle configuration. When recovering steam through a heat recovery steam generator (HRSG), from gas turbine exhaust in a CHP system, there is a balance between steam capacity and steam pressure (related to temperature). Often the steam pressure exiting the HRSG is higher than required by the process or heating. Instead of adding a pressure reducing station, a BPST generator can be economically added to increase the electric output of the CHP plant.



Legal Disclaimer

- The tax information presented in Slides 34-45 is provided for informational purposes by Exergy Partners Corp.

- Neither I nor Exergy Partners Corp. are tax attorneys or accountants so you should not rely on the tax information in this presentation to make investment decisions!

- Seek tax legal and accounting professionals to advise on specific investments!

- The tax information in this section was sourced from the CHP IRA Alliance Fact Sheet. https://chpalliance.org/wp-content/uploads/2019/08/CHPA-IRA-FAQ-Final-Factsheet.pdf

IRA Overview

- Under the IRA, the full Sec. 48 ITC will be available to qualifying CHP system property that begins construction before January 1, 2025 (please note there are capacity, efficiency, and other limitations that will continue to apply for CHP eligibility). The IRA defines CHP as an 'energy property' and WHP as 'waste energy recovery property' under paragraph (3)(A) and clause (v) of the Sec. 48 energy credit, respectively. For full text of the Sec. 48 as amended by the IRA, please refer here.[1]

- The Sec. 48 ITC base credit rate is 6%. Projects can increase the base rate by a 5x multiplier (30%) by meeting or being exempt from the prevailing wage and apprenticeship requirements.

- The IRA provides a bonus credit of up to 10% for meeting requirements for domestic content, and a bonus credit of up to 10% for projects located in "energy communities." These requirements cannot be used towards reaching the 30% bonus rate, which is only attained by satisfying (or being exempt from) the labor requirements (prevailing wage and apprenticeships).

- CHP projects that begin construction after December 31, 2024, can qualify for renewable energy tax credits under the new technology- neutral Sec. 45Y PTC or Sec. 48E ITC, if the project yields zero greenhouse gas emissions.

- This factsheet continues with several sections that address the above listed topics and covers Direct Pay, IRS Guidance, Hydrogen tax credits, the Advanced Manufacturing tax credit, and other areas of interest for our membership and the broader CHP industry.

Section 48 CHP ITC Extended

- Under the IRA, the full Section 48 Credit will be available to CHP system property that begin construction before January 1, 2025.
- "Safe Harbor" provision – Can extend the tax credit to 2028 by beginning physical work of a significant nature on the project or incurring 5% of the total cost of the project.
- Tax credits are transferable between certain entities. The Section 48C base rate is 6%.

30% CHP ITC

- Increases to 30% for projects that meet prevailing wages and apprenticeship Department of Labor requirements for projects beginning January 29, 2023.
- Prevailing wages: wages paid for similar work in the locality of the project site, as determined by U.S. Secretary of Labor
- Apprenticeship: percentage of labor hours be performed by qualified apprentices:
  - 12.5% for Jan. 1, 2023 – Jan. 1, 2024
  - 15% for Jan. 1, 2024 – Jan. 1, 2025

10% Bonus Credits for Energy Communities

- Bonus credits can allow taxpayers to claim an additional 10% (if labor requirements are met) for projects using sufficient "domestic content" and/or located in "energy communities."
- "Energy communities":
  - A brownfield site
  - An area with above average fossil energy employment with above average unemployment or local tax dependence on fossil energy
  - Within or adjacent to a census tract where a coal mine has closed after 1999, or a coal-fired electric generator closed after 2009

10% Bonus Credits for Domestic Content

- "Domestic content": Must use 100% domestic iron and steel and a specified percentage of domestic manufactured products.
  - 2023: 40%
  - 2024: 40%
  - 2025: 45%
  - 2026: 50%
  - 2027 and later: 55%
- The IRS guidance provisions can be found at: https://www.irs.gov/inflation-reduction-act-of-2022

Post-2024 48E ITC Credit Will Require Clean Fuels

- CHP projects that begin construction after December 31, 2024, can qualify for renewable energy tax credits under the new technology - neutral Section 45Y PTC or Section 48E ITC, if the project yields zero greenhouse gas emissions. Value of credit equals 2023-25 credit.
- Requires CHP projects to shift to zero emission fuels.
- Treasury required to publish greenhouse gas emission rates for types or categories of facilities. If they don't establish an emissions rate for a kind of facility, taxpayers may petition to establish one.
- CHP Alliance is engaging Treasury on definitions to include WHP and CHP with clean fuels.

48E ITC Credit Phases Out in 2032

- Credit will phase out as greenhouse gas emission reduction targets in the electric sector are reached (scheduled to begin in 2032 at the earliest):
- Applicable year (2032)
- First calendar year following the “applicable year”: 100% (2033) Second calendar year following the “applicable year”: 75% (2034) Third calendar year following the “applicable year”: 50% (2035)
- After the third year following the “applicable year”: 0% (2036 and later)

IRA Includes Other Tax Credits

- ITC for Clean Energy Manufacturing – Section 48C
- $10 billion for factories that reduce GHG emissions 20% with efficiency, waste reduction, carbon capture, and the introduction of low or zero carbon heat processes.
- PTC for clean hydrogen
- Expanded Section 45Q credit for Carbon Capture and Storage

IRA Other Provisions

- The total capacity limitation under Section 48 is 50 MW. However, for systems over 15 MW, the tax credit must bear "the same ratio to such credit as the applicable capacity [15 MW] bears to the capacity of such property"
- Under the zero-emission, technology neutral regime, these capacity limitations do not apply. The challenge becomes qualifying as a zero-emission technology.
- The following organizations exempt from tax are "applicable entities" eledgible for direct payments.
  - any organization exempt from the tax imposed by subtitle A,
  - any State or political subdivision thereof,
  - the Tennessee Valley Authority,
  - an Indian tribal government (as defined in section 30D(g)(9)),
  - any Alaska Native Corporation (as defined in section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. 1602(m)), or
  - any corporation operating on a cooperative basis which is engaged in furnishing electric energy to persons in rural areas.

DOE Industrial Assessment Centers Implementation Grant Program

The purpose of this program is to provide grants funded by section 40521 of the Bipartisan Infrastructure Law, 42 USC 17116, to small and medium-sized manufacturers to implement recommendations made in Industrial Assessment Centers and Combined Heat and Power Technical Assistance Partnership (CHP TAP) assessments, between 2018 and 2023 and, in future rounds, recommendations made in equivalent assessments.

- DOE expects to make awards totaling up to $80 million in this round of funding, with a maximum of $300,000 per recipient (small and medium-sized manufacturers) and a maximum 50% federal cost share.
- Detailed information on application process (deadline July 14) can be found at this site: https://go.ratio.exchange/opps/challenge.cfm?i=387AF1B5-410E-4974-BCEC-901EA565045C
- Start Date: July June 7, 2023 and End Date: July 14, 2023
- A virtual question and answer session will take place on 14 June 2023 from 2:00 PM – 3:00 PM ET. RSVP here: https://energywerx.wufoo.com/forms/z1reiv6q12uwjyo/

Qualifying Advanced Energy Project Credit (48C) Program

- Up to $4 billion in a first round of tax credits for projects that expand clean energy manufacturing and recycling and critical materials refining, processing and recycling, and for projects that reduce greenhouse gas emissions at industrial facilities. Approximately $1.6 billion of this allocation will be set aside for projects in designated energy communities. The program will provide an investment tax credit of up to 30% of qualified investments for certified projects that meet prevailing wage and apprenticeship requirements.

- CHP systems are eligible for the tax credit, which is a competitive process they have to apply for rather than a credit everyone gets who qualifies. CHP systems fueled by a biofuel or other renewable fuel could be very competitive.

- DOE and Treasury will host a virtual informational webinar for potential applicants on June 27, 2023, at 2 p.m. ET. See link below for registration information.

- Details of this program can be found at: https://www.energy.gov/infrastructure/qualifying-advanced-energy-project-credit-48c-program?utm_medium=email&utm_source=govdelivery

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THANKS FOR LISTENING