



U.S. DEPARTMENT OF
ENERGY



Combined Heat and Power (CHP)

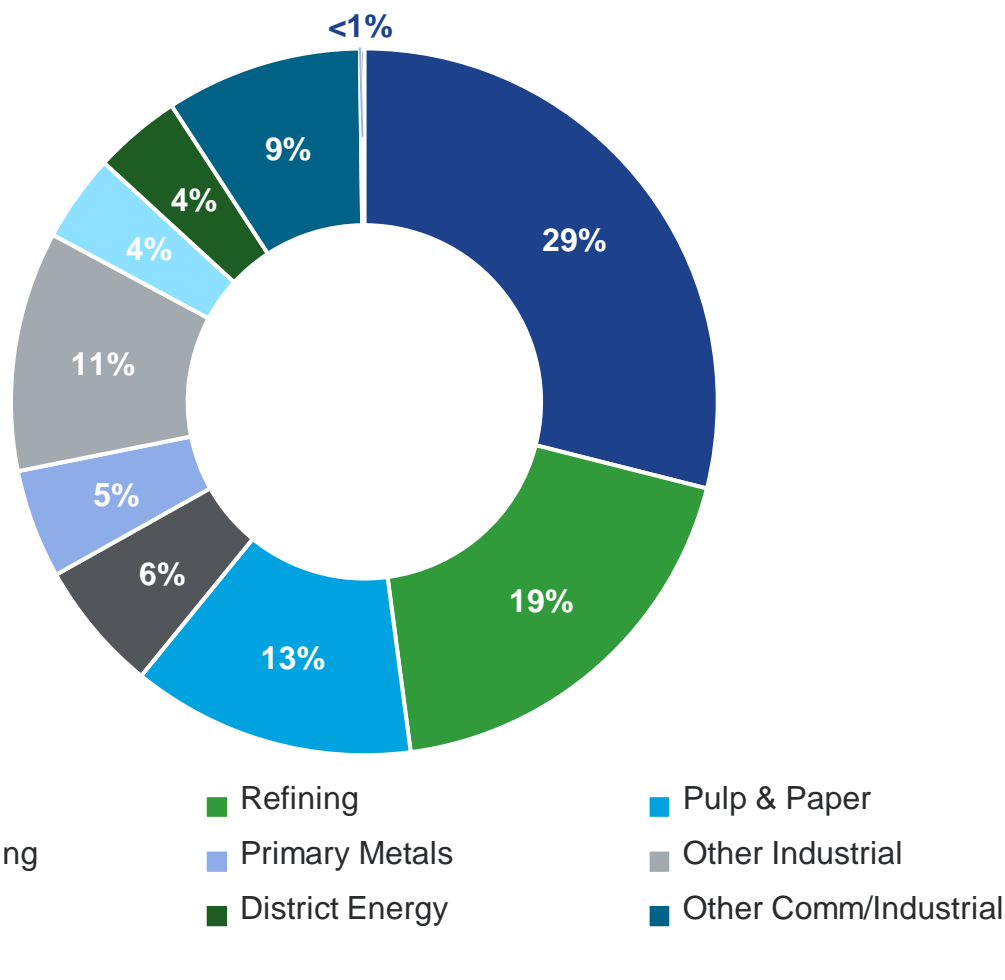
State of the Market
June 7, 2022



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ICF

Existing CHP Capacity



Avoids more than **1.3 quadrillion Btus** of fuel consumption annually.



Avoids **215 million metric tons of CO²** compared to separate production.



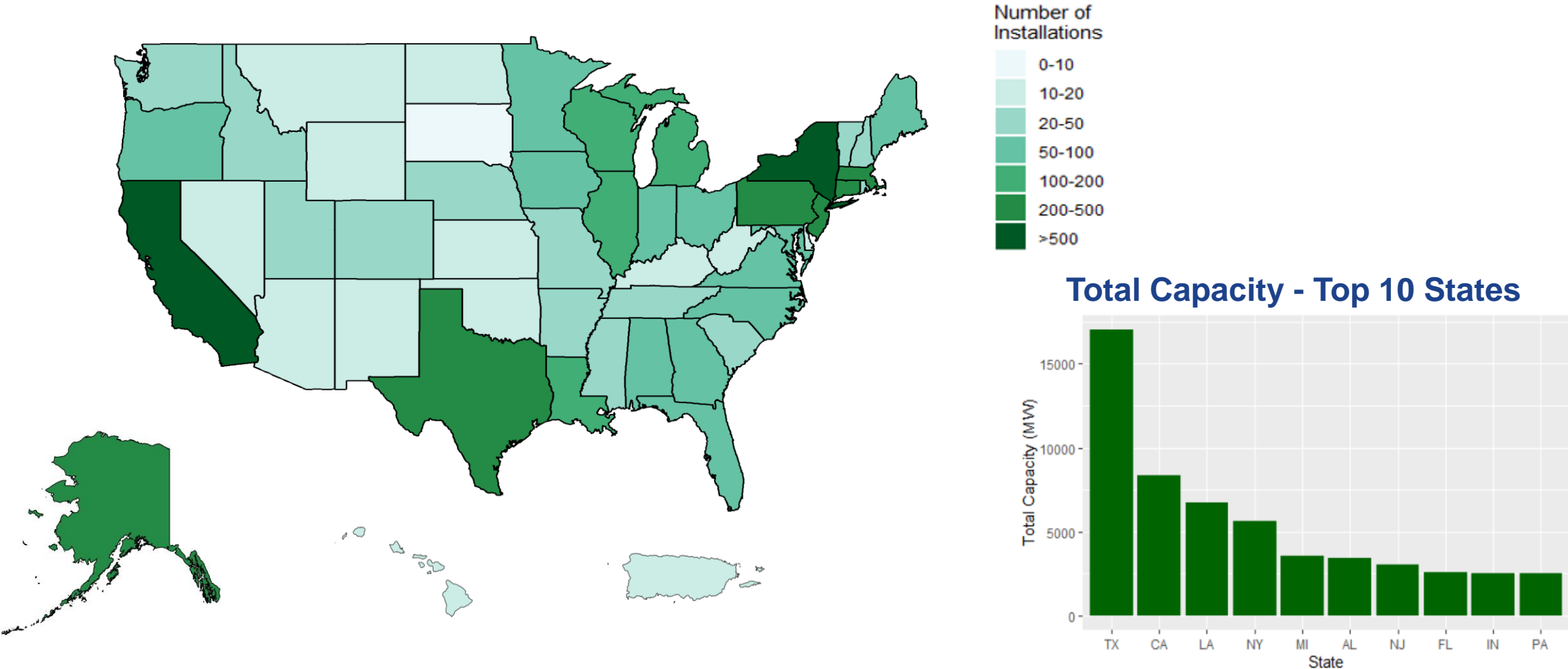
81.7 GW of installed CHP at more than **4,700** industrial and commercial facilities.



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

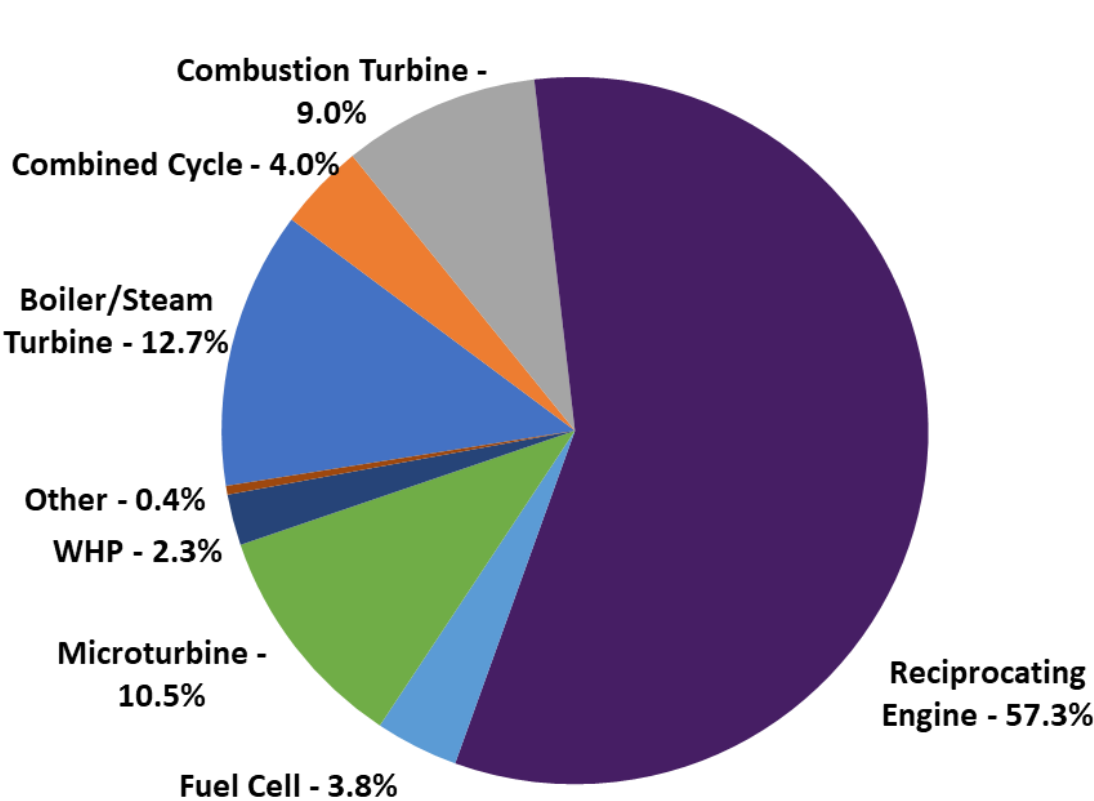
Current U.S. CHP Installations (DOE CHP Installation Database, July 2021)

California and New York have most installations; Texas has highest capacity

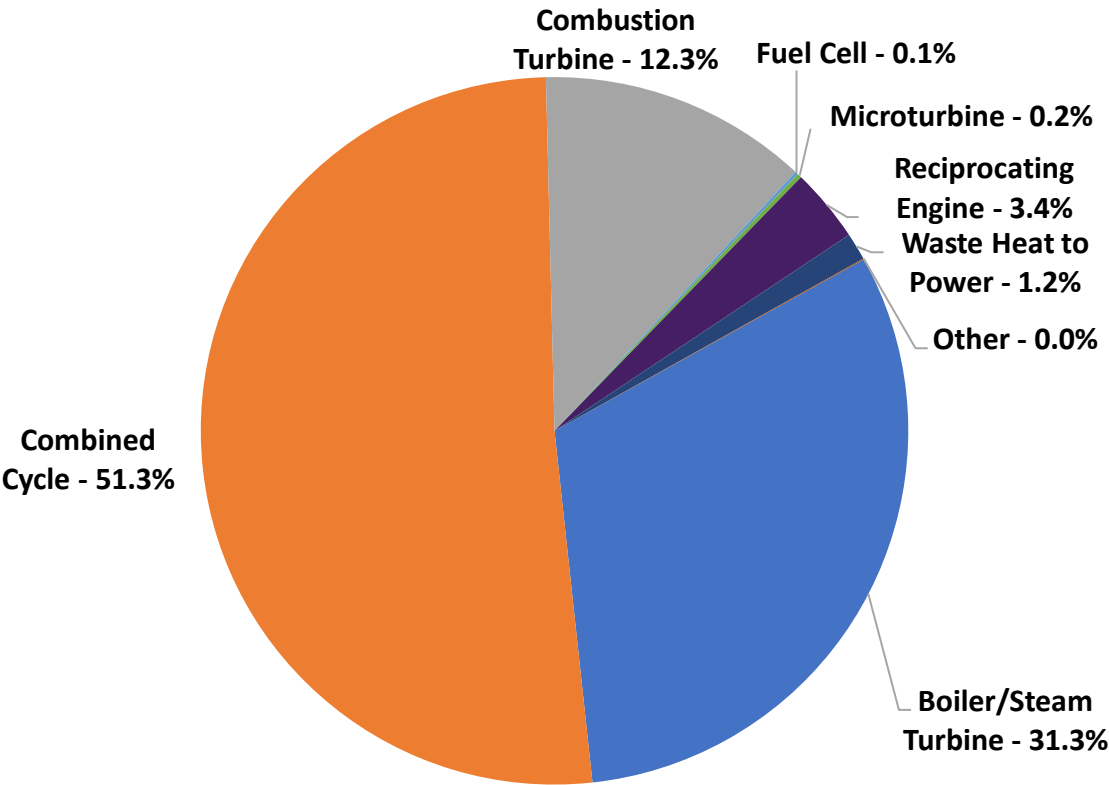


Current CHP Installations by Technology (DOE CHP Installation Database, July 2021)

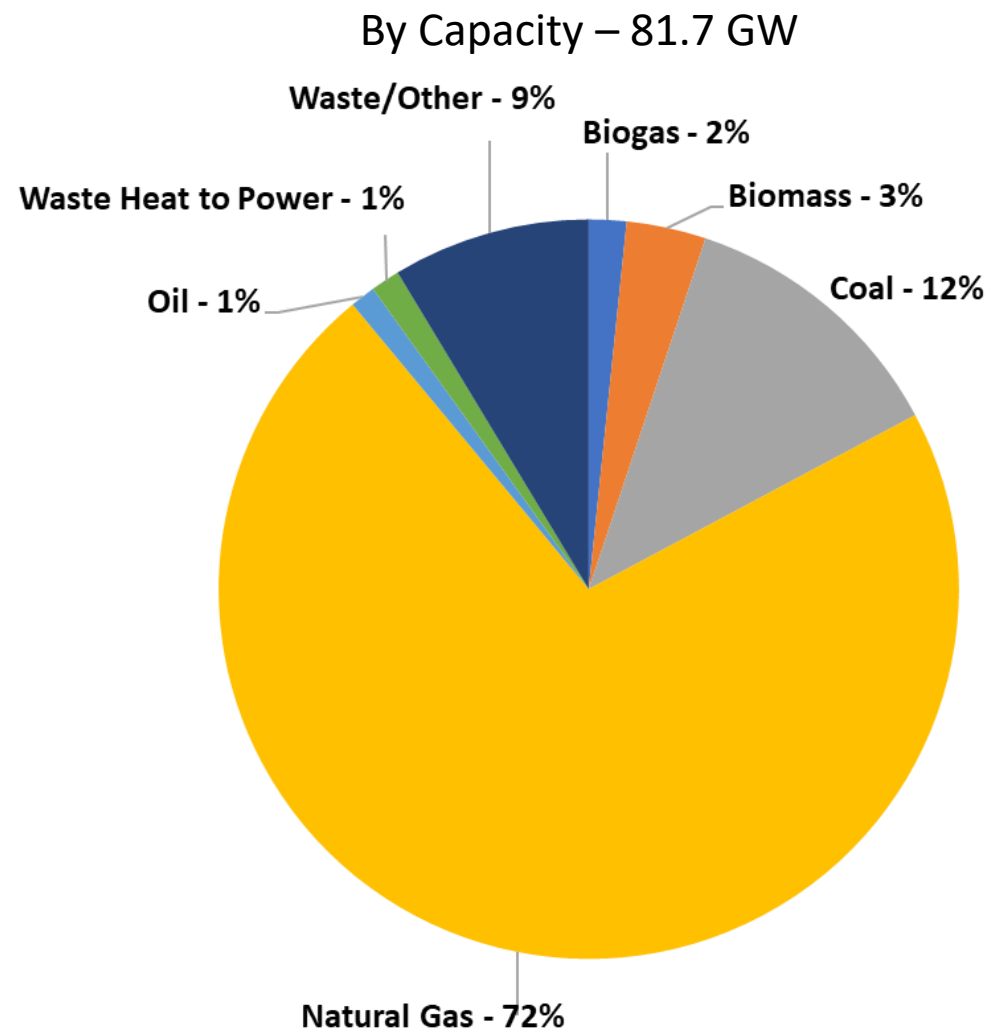
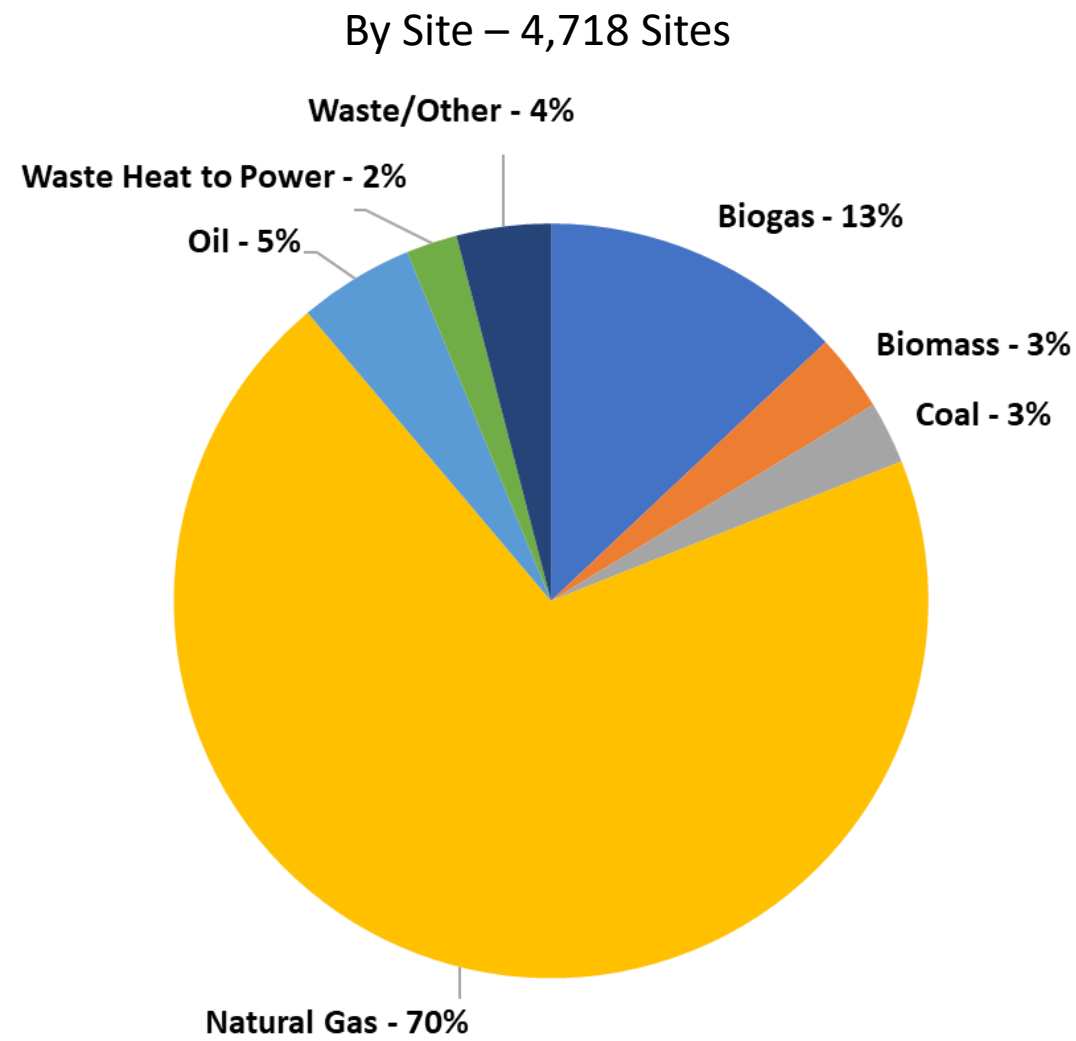
By Site – 4,718 Sites



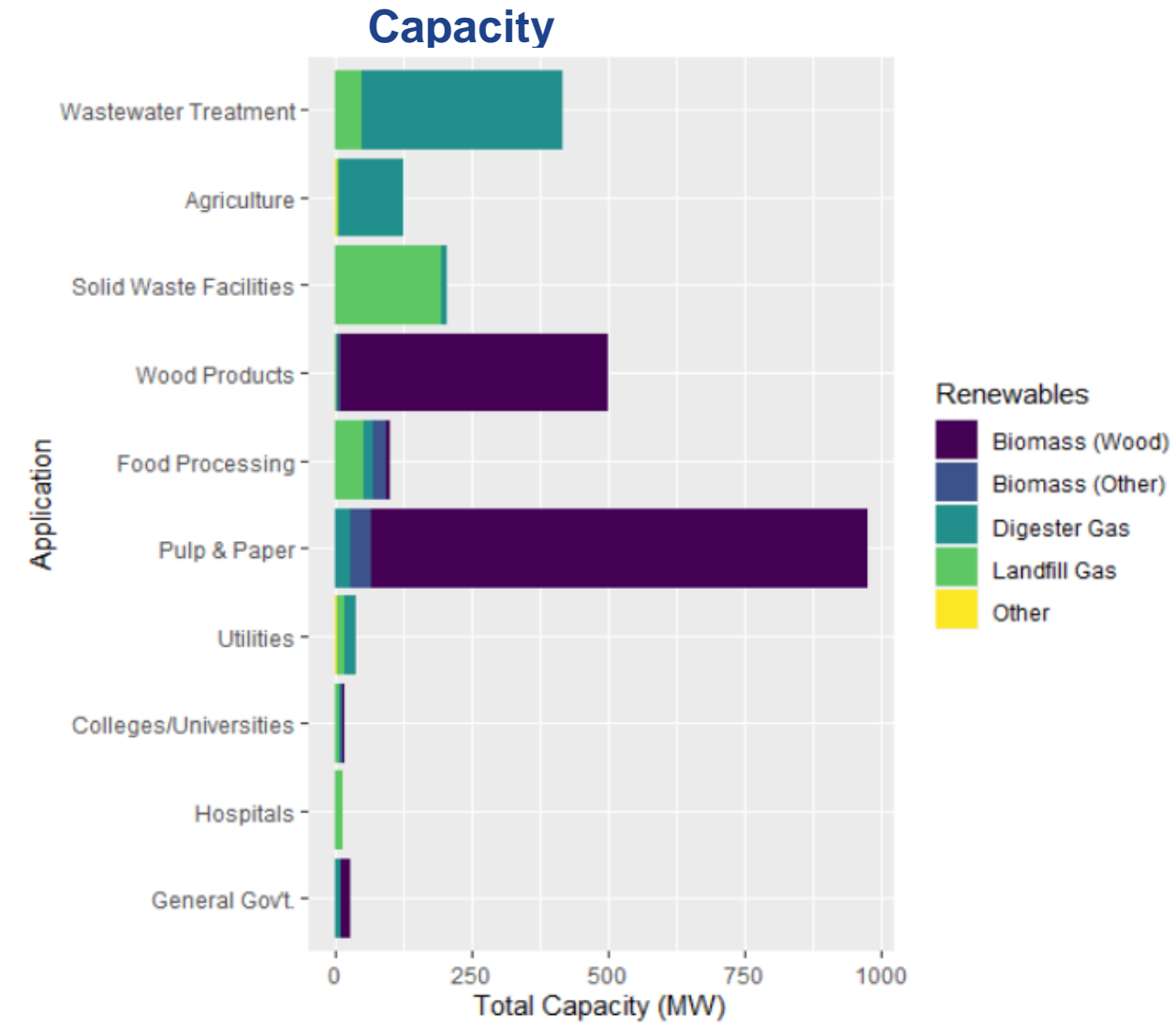
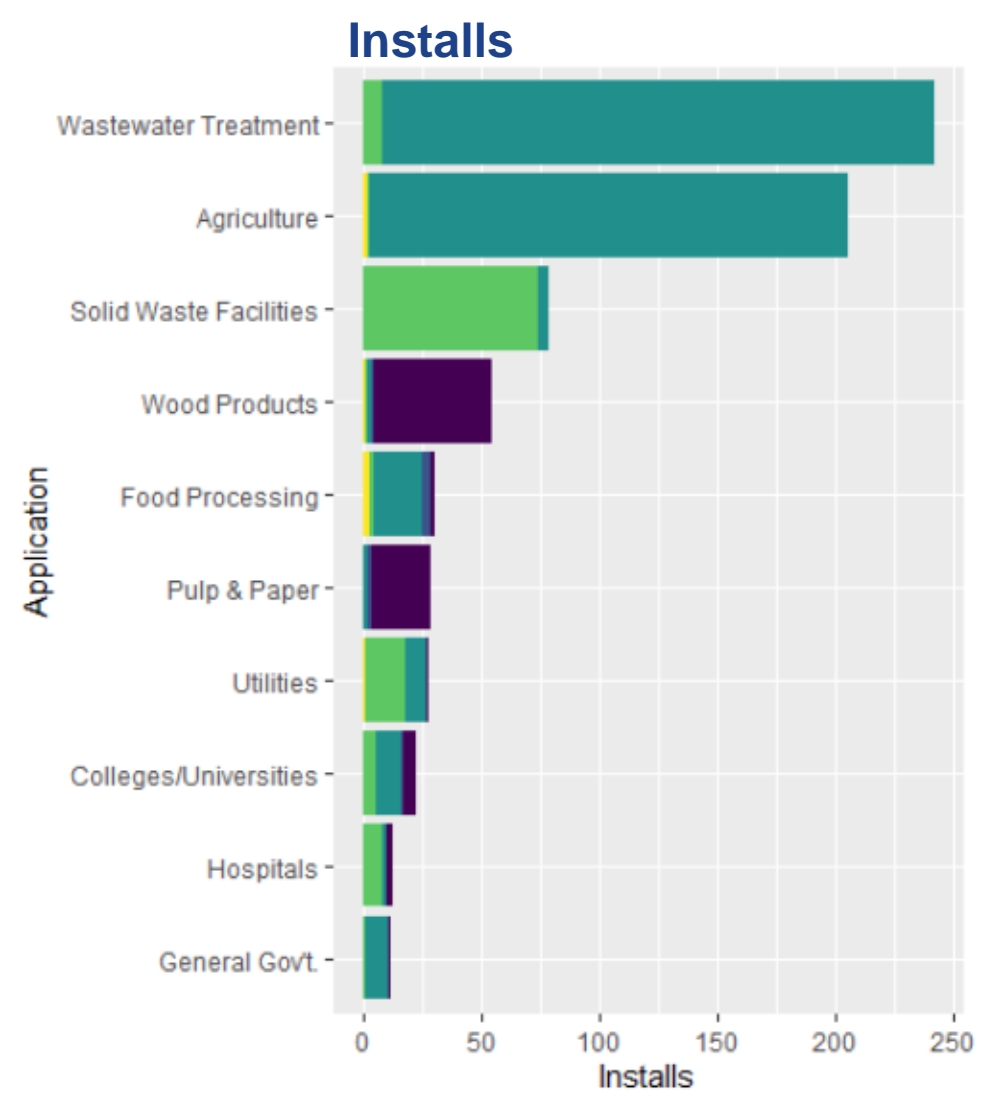
By Capacity – 81.7 GW



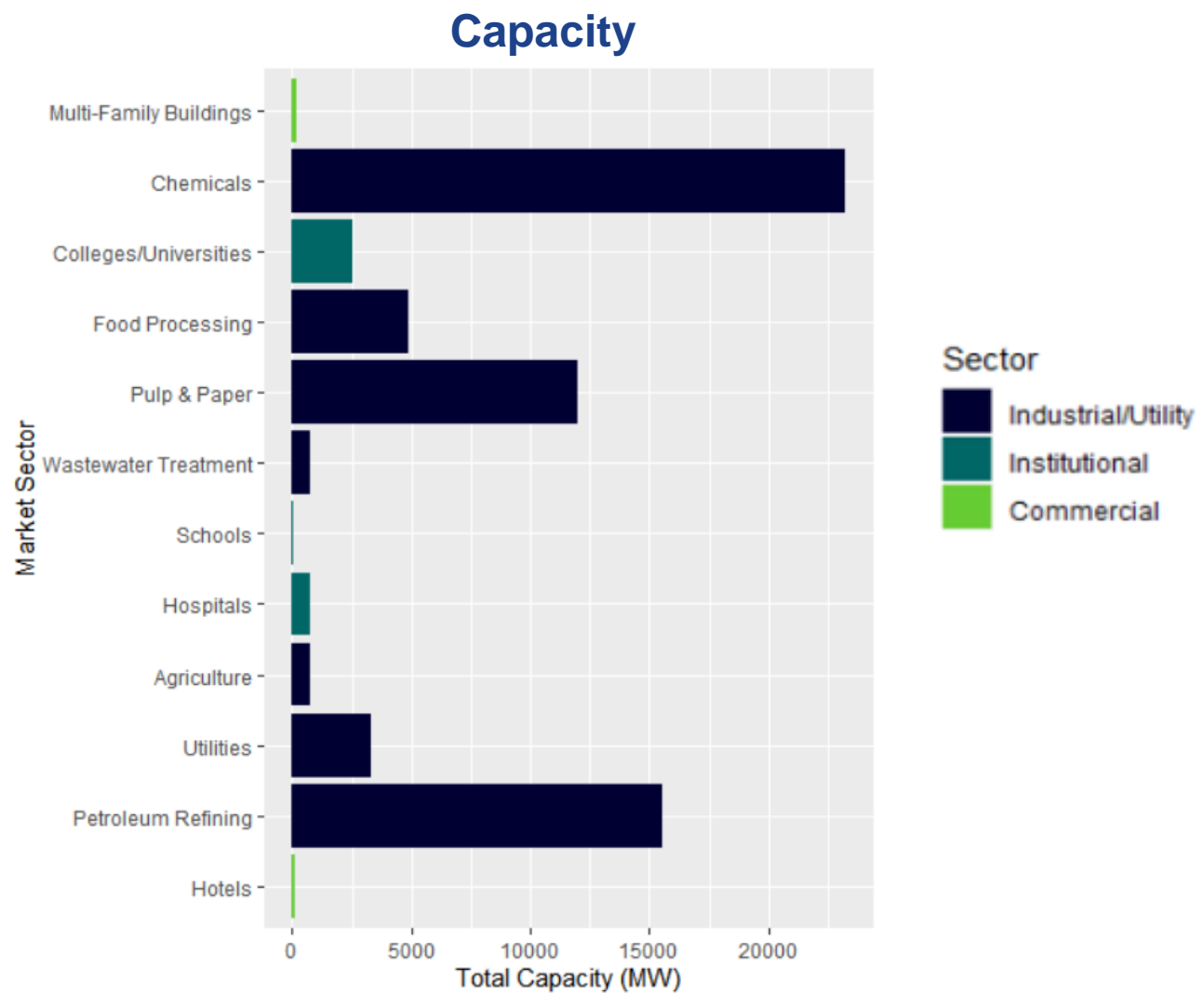
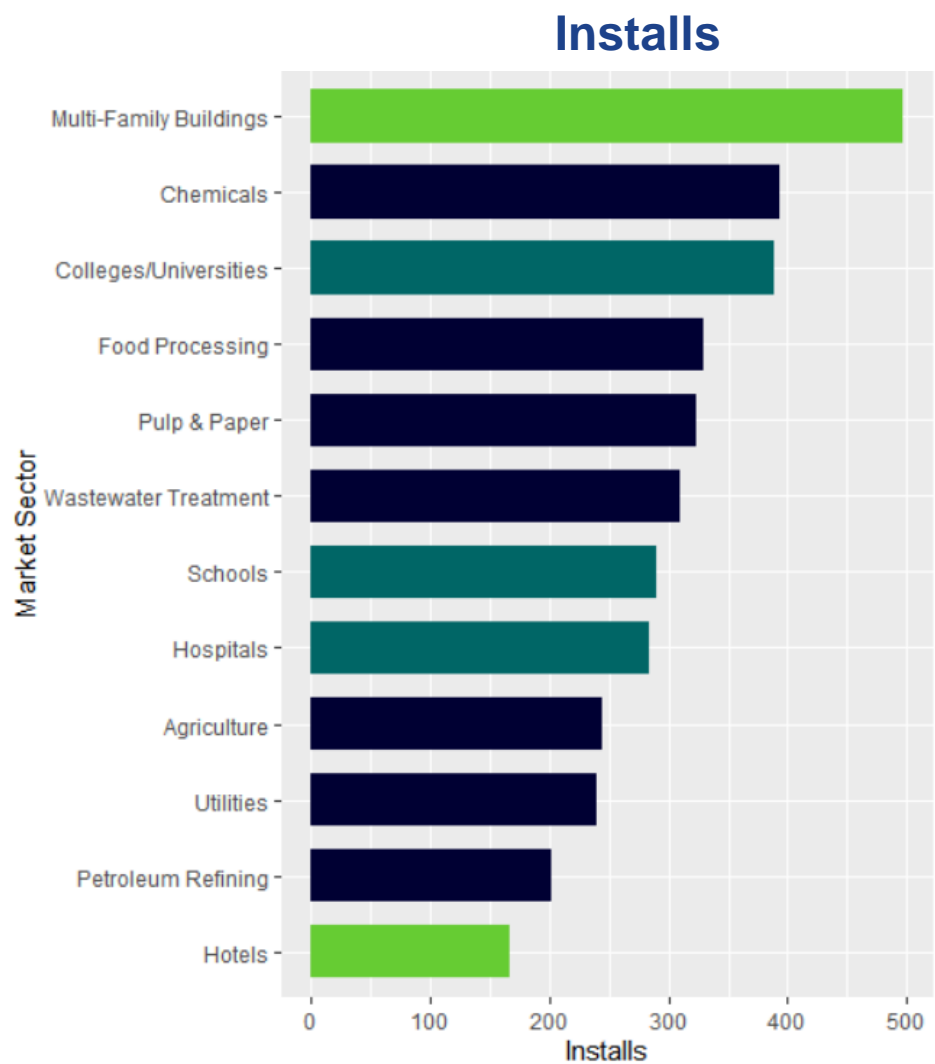
Current CHP Installations by Fuel Type (DOE CHP Installation Database, July 2021)



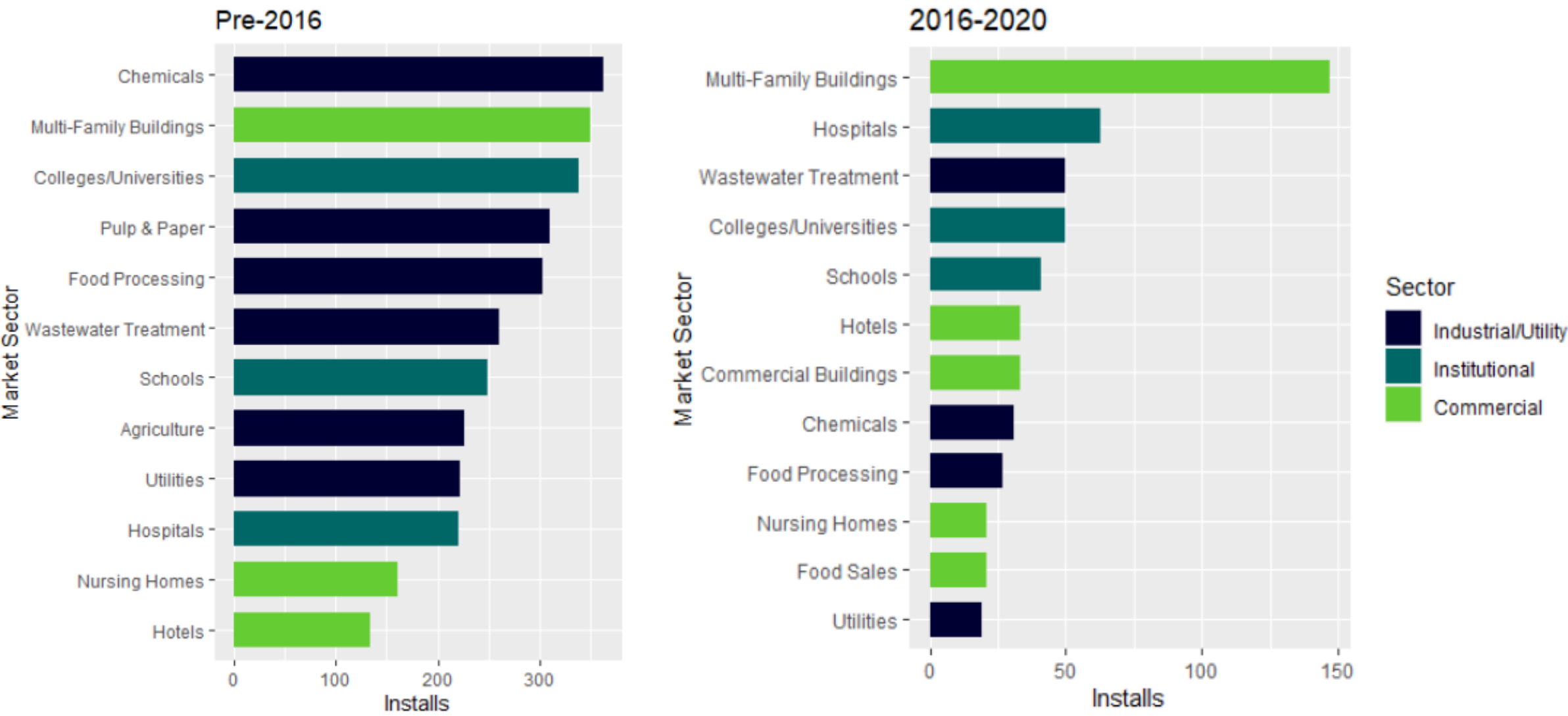
Top Market Sectors for Renewable Fuel Use



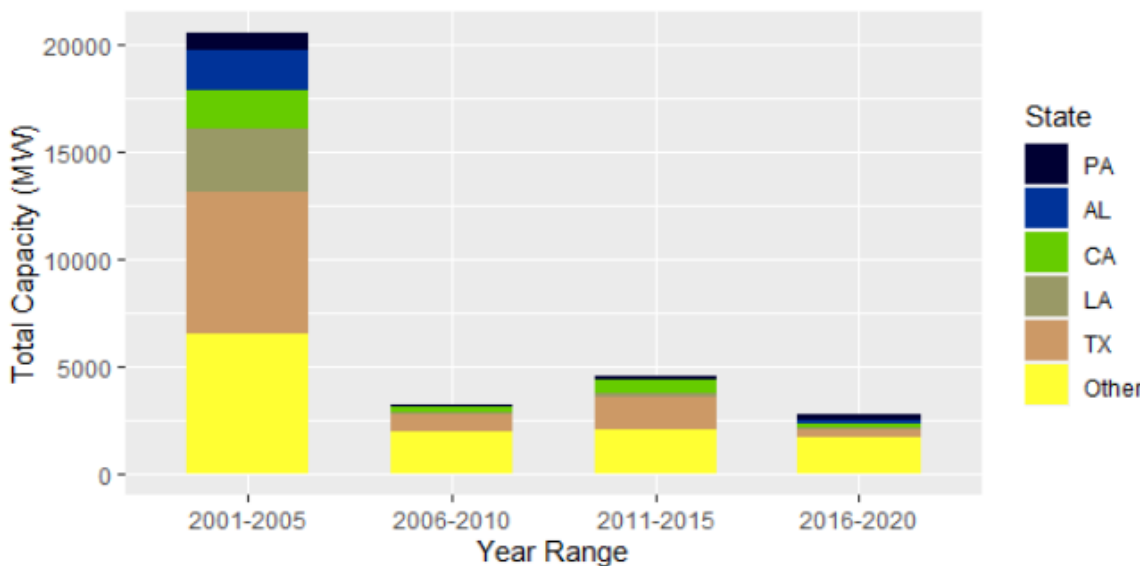
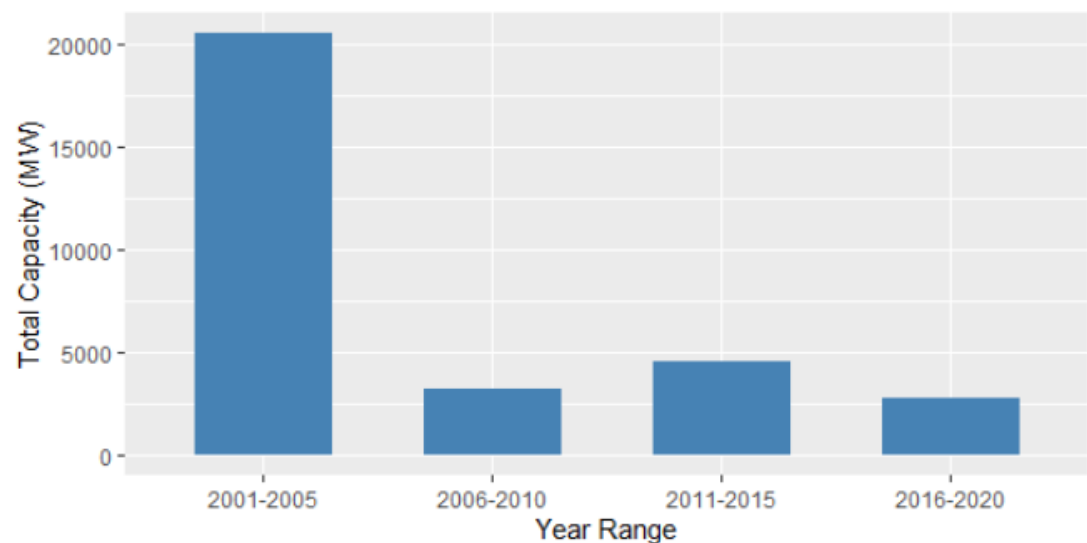
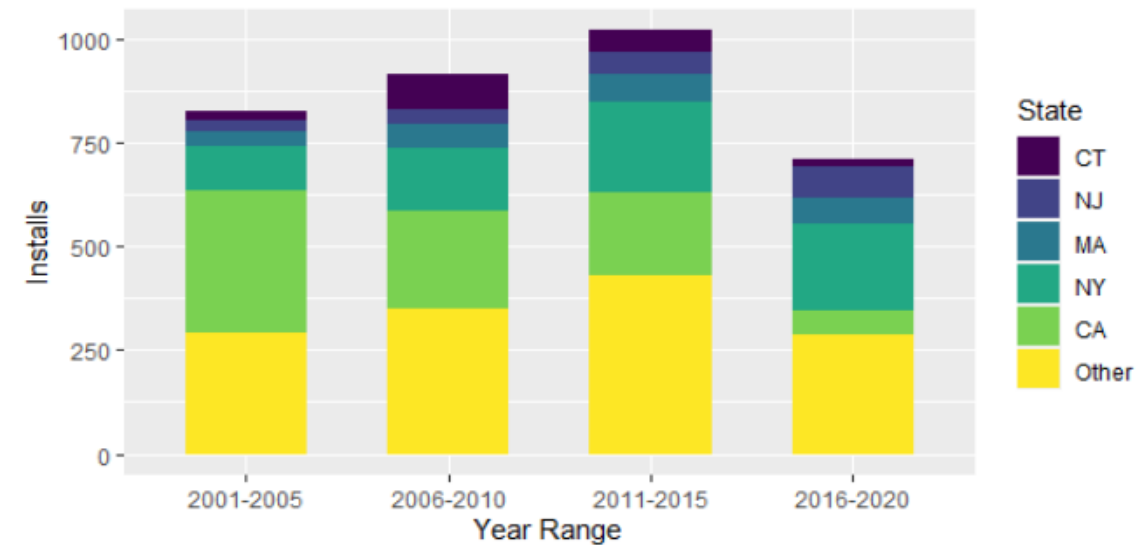
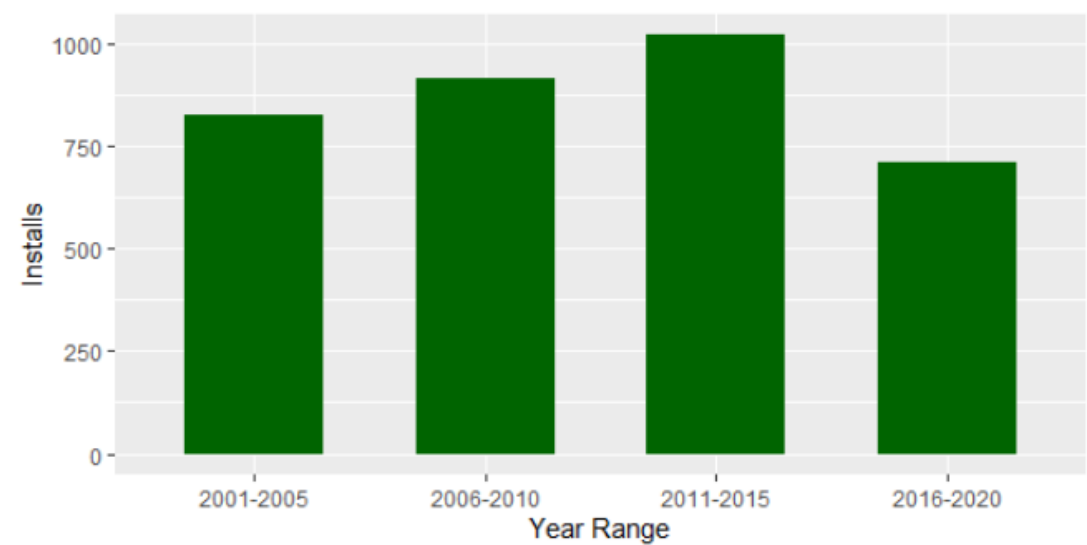
Top Market Sectors for Current CHP Installations



Top Market Sectors – Pre-2016 vs. 2016-2020 (Installs)

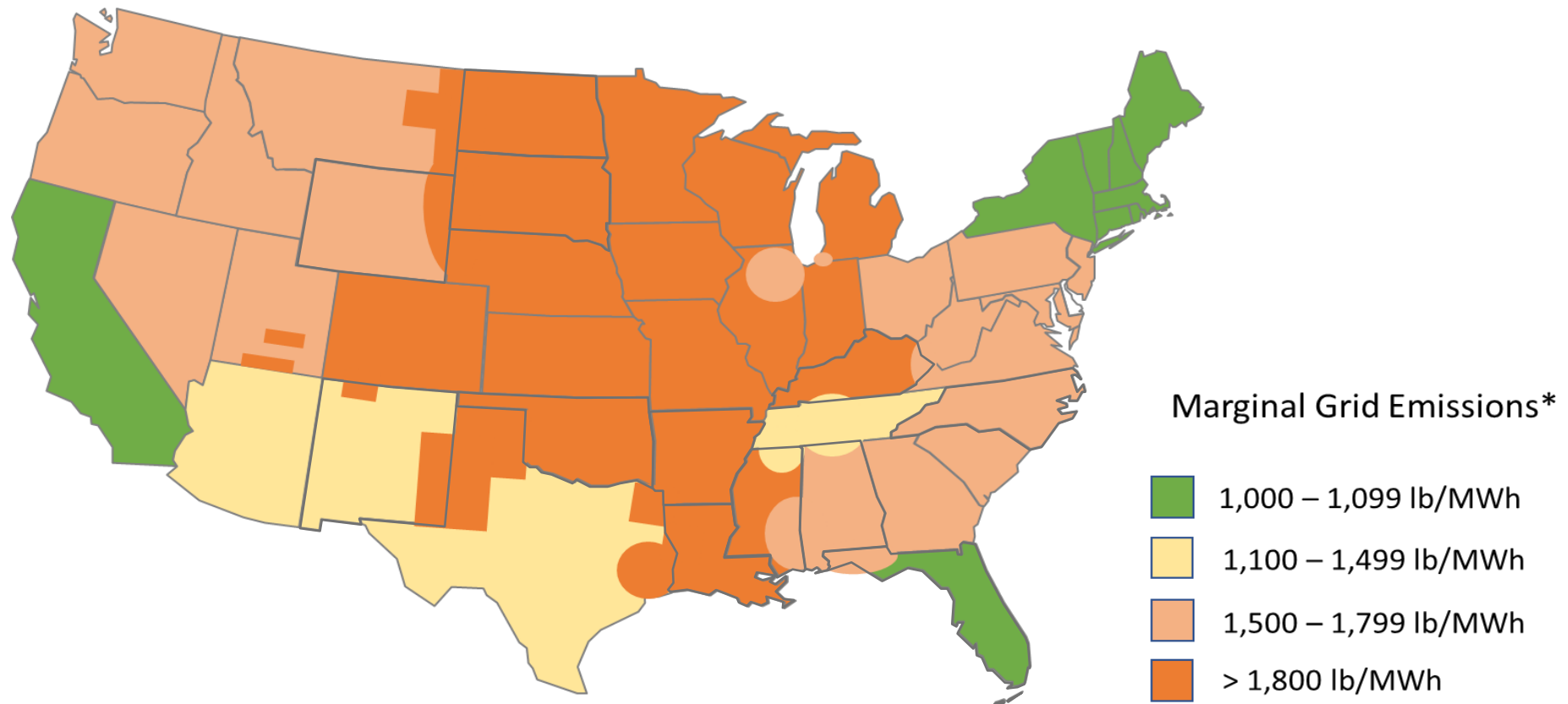


Installations and Capacity Additions over Time (Five largest states)



Natural Gas CHP can Reduce Carbon Emissions in Most U.S. Locations

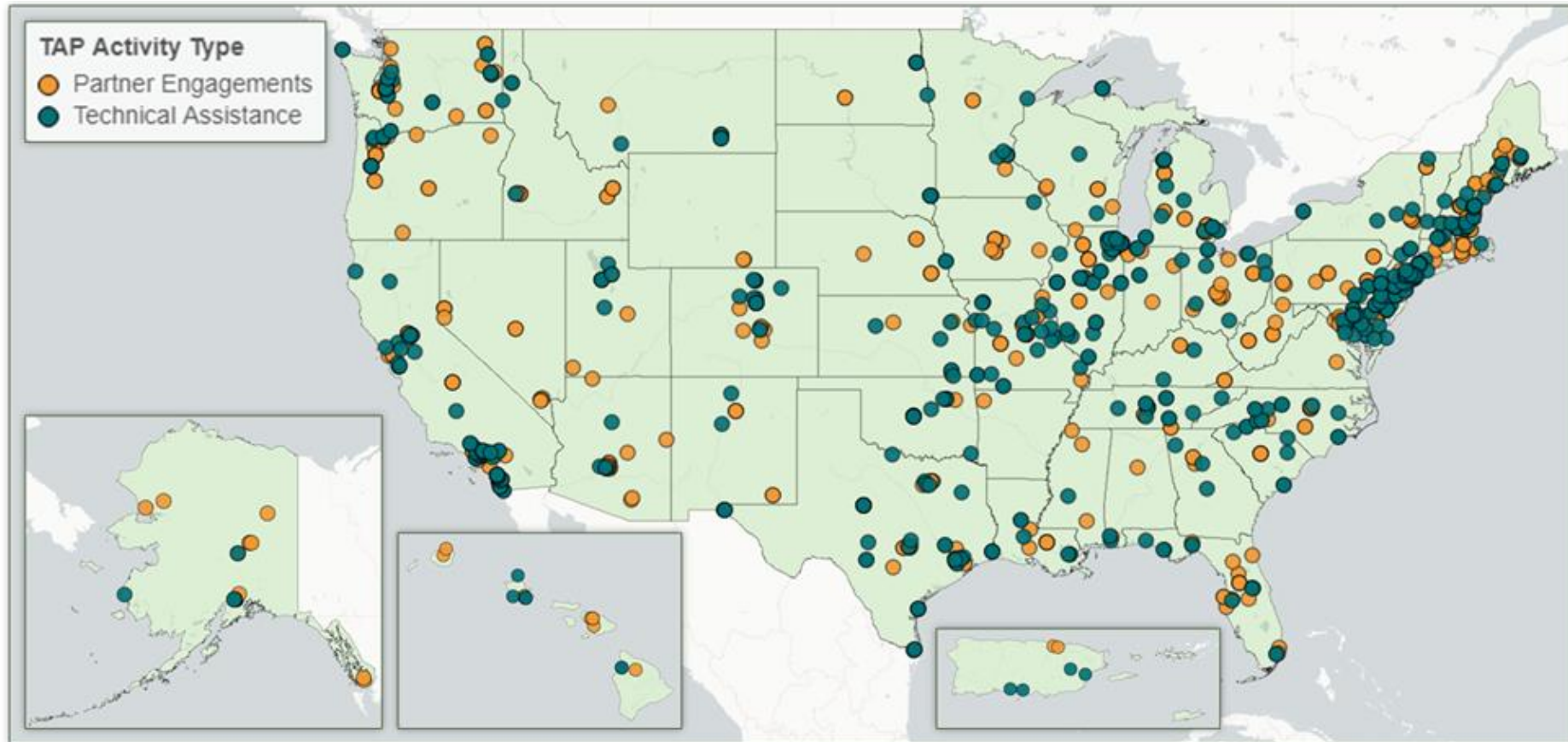
- Net on-site CHP emissions (including displacing thermal output from gas boilers) are typically in the range of 500-750 lbs per MWh of electricity produced
- Marginal grid emissions are higher throughout the U.S. (EPA / AVERT)



*AVERT 2020 Uniform EE Factor

CHP TAPs are Active Across the U.S. (Engagements, Summer 2018 – 2021)

- Completed **633 technical assistance activities** with an estimated capacity of **991 MW**
- Identified **204 end-user partners** and completed **303 engagements**
- Identified **140 stakeholder partners** and completed **208 engagements**



CHP Remains an Underutilized Resource

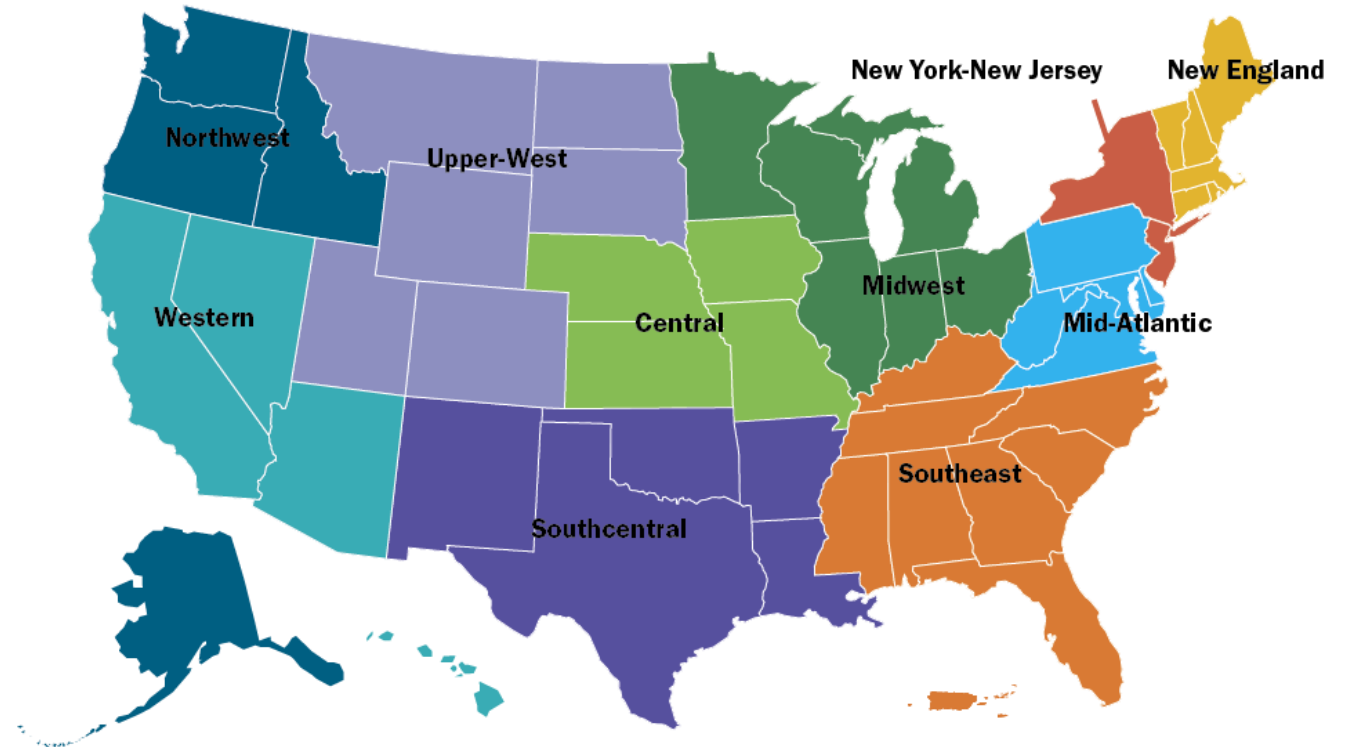
Objective

To maximize CHP exposure to potential end-users and key stakeholders, and to locally promote best practices in CHP technology policies and installation.

Opportunity:

If one quarter of CHP technical potential were met, the U.S. would save **1 quadrillion BTUs (Quad) of energy and would save energy users \$10 Billion a year** compared to current energy use.

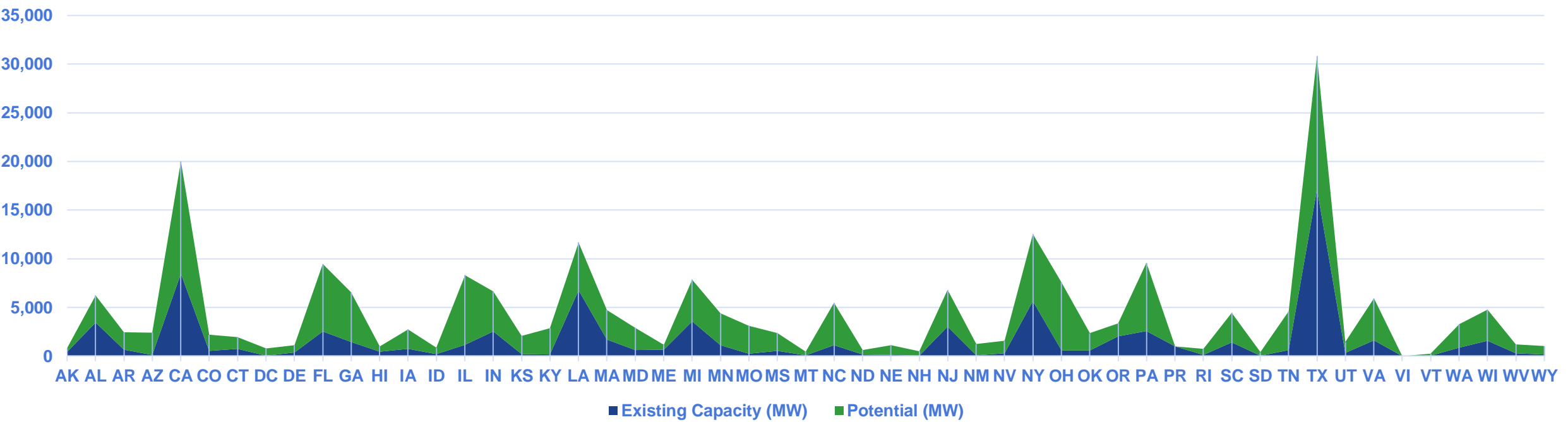
CHP supports the transition to a prosperous America powered by resilient, clean, domestic, affordable and secure energy.



Above: DOE's CHP Technical Assistance Partnerships (CHP TAPs) promote and assist in transforming the market for CHP, waste heat to power, and district energy technologies and concepts throughout the United States.

Technical Potential for Additional CHP Installations Across the U.S.

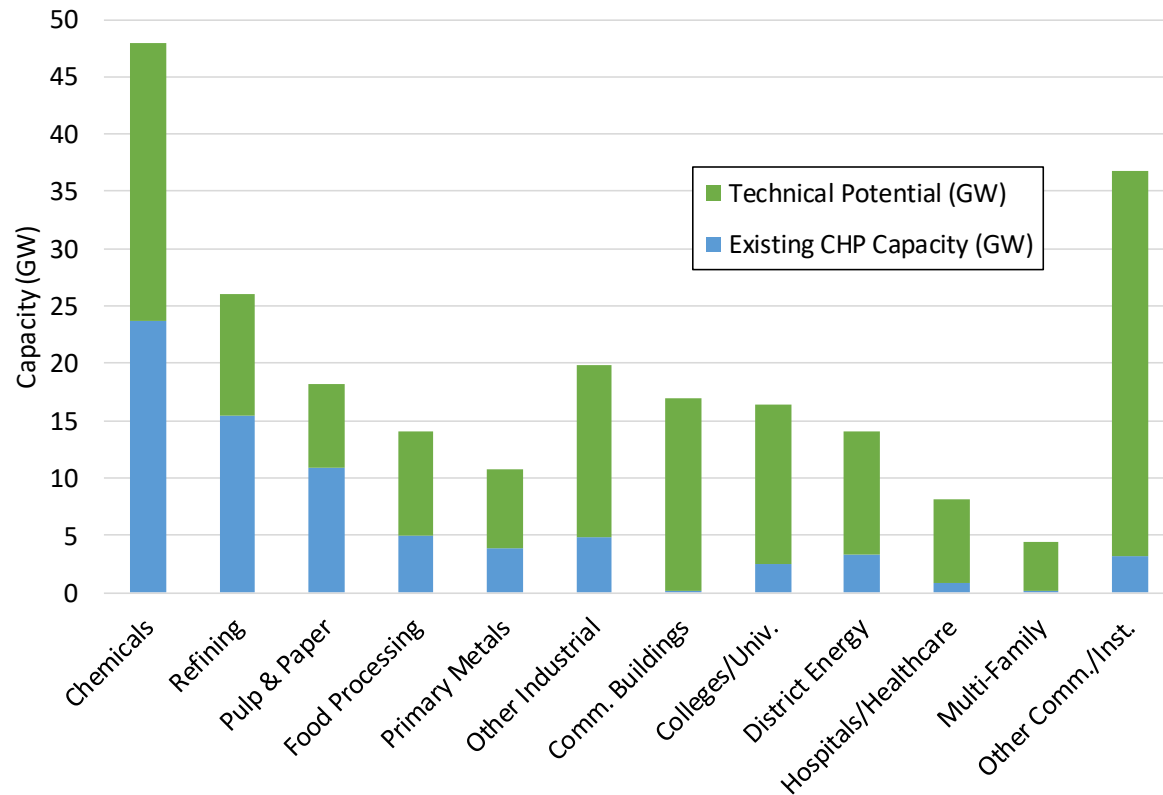
Existing CHP and Potential by State (DOE, 2016)



States with the most remaining CHP Technical Potential (Top 15)

Rank	State	Capacity (MW)	Rank	State	Capacity (MW)	Rank	State	Capacity (MW)
1.	Texas	13,675	6.	Florida	6,917	11.	Virginia	4,308
2.	California	11,542	7.	New York	6,908	12.	Michigan	4,291
3.	Illinois	7,161	8.	Georgia	5,110	13.	Indiana	4,145
4.	Pennsylvania	7,025	9.	Louisiana	4,903	14.	Tennessee	3,981
5.	Ohio	7,005	10.	North Carolina	4,352	15.	New Jersey	3,761

CHP Applications and Market Trends

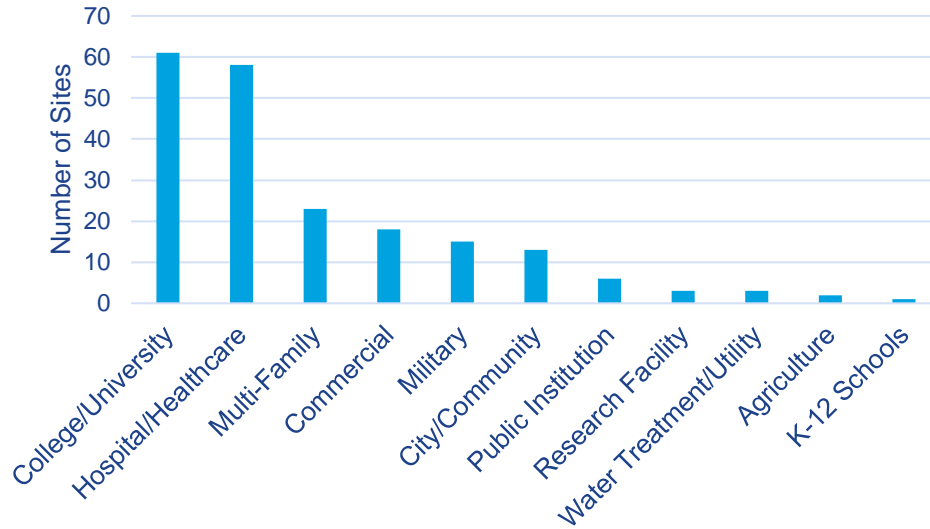


Source: DOE CHP Technical Potential report, 2016

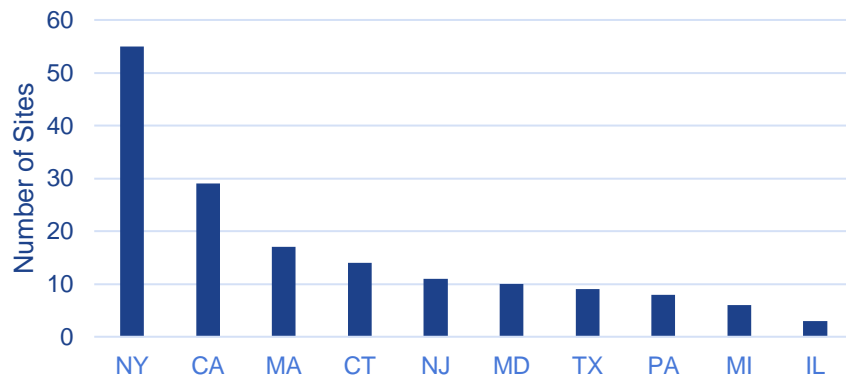
- Large amount of technical potential remains in both commercial and industrial sectors
- Recent trend of smaller installations in commercial markets
 - Packaged CHP
 - Micro CHP
- Resilience and power reliability are key drivers for new CHP installations
- Hybrid systems for microgrids (CHP+PV+storage)

CHP Provides 24/7 Resilience for Microgrids (DOE Microgrid Installation Database, July 2021)

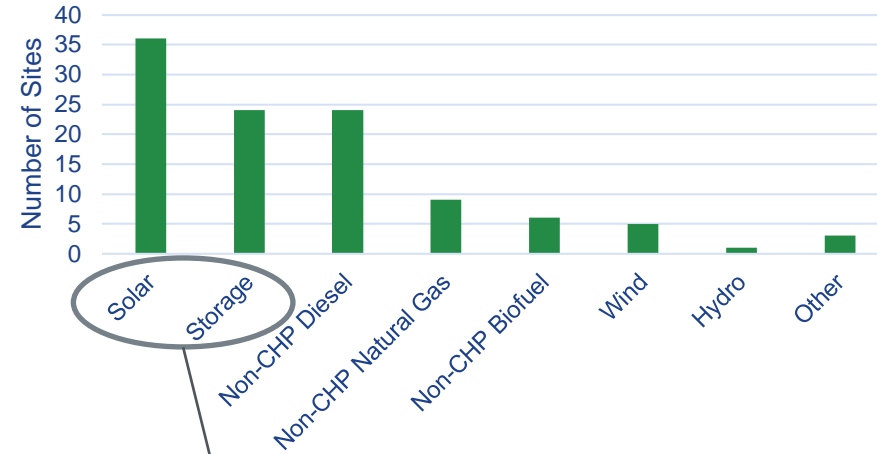
CHP Microgrids by Application



CHP Microgrids by State



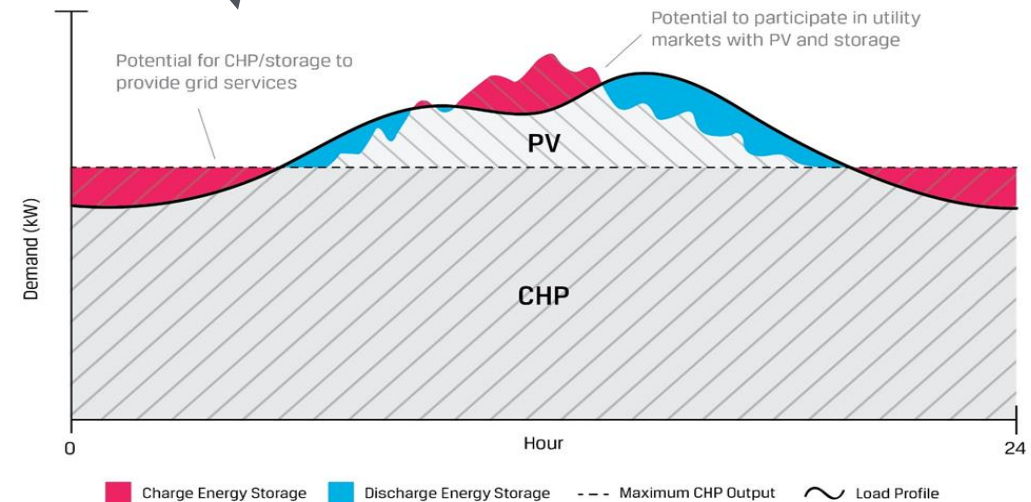
Technologies Paired with CHP at Microgrids



All data from
ICF/DOE Microgrid
Installation Database

Microgrid must use
multiple
technologies and/or
serve multiple
buildings to be
included in database

CHP + PV + Storage Microgrid



CHP for Energy Resilience and Decarbonization

- CHP offers 24/7 resilience from multi-day grid outages
 - Anchor for microgrids
 - Pair with PV and energy storage to maximize resilience while minimizing emissions
- Flexible CHP systems can support renewables on the grid
 - Need for dispatchable firm generation resources as more variable renewable electricity is incorporated in the grid
- Across the U.S. CHP systems are reducing carbon emissions compared to on-site heat and grid power
- CHP can incorporate renewable and low-carbon fuels to further reduce carbon emissions (RNG, hydrogen)