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Note to the Coalitions

NEW ENERGY FOR OLDER CITIES: DISTRICT ENERGY AND COMBINED HEAT AND POWER

This Note to the Coalitions focuses on an approach to energy generation and distribution that could help move forward revitalization of the Northeast-Midwest region's many older industrial cities. Specifically, district energy and combined heat and power (DE/CHP) systems offer a potential source of competitive advantage to older cities in the form of cost-savings, energy reliability, and a reduced carbon footprint. However, those wishing to develop DE/CHP face often inadvertent utility-related, financial, and policy obstacles. This Note explains the opportunities that DE/CHP can afford older cities and describes the policy context surrounding DE/CHP development; a case example of the Medical Center Company of Cleveland, OH, provides a real-world illustration. The Note concludes with a policy agenda for faster realization of DE/CHP, and its benefits, in the region's older industrial cities.[1]

District Energy, Combined Heat and Power, and Older Industrial Cities

The industrial city of the NEMW region was the birthplace of DE and CHP in the United States. Around the turn of the 20th century, utility companies in cities like Philadelphia and New York sold steam, a by-product of their electric generation at CHP stations, in order to be competitive and profitable.[1] After World War II, government leaders and others largely overlooked the opportunities afforded by DE/CHP as urban development grew outward from the city and expanded to more spacious suburbs.[2] Now, in the early 21st century, the desire for economic development in the urban core, rising energy costs and insecurity, and the need to reduce emissions amidst growing concern over climate change have city leaders looking to craft cost-effective strategies toward a more environmentally-friendly future.[3] DE/CHP systems can deliver cost-savings, a reliable energy supply, and environmental benefits to cities and their major institutions.

> **What are DE and CHP?**
>
> DE is a method of generating and distributing energy (steam, hot water, chilled water, and/or electricity) to a network of proximate buildings from a central plant. CHP, also known as cogeneration, simultaneously produces electricity and heat from a single fuel source and can achieve twice the fuel efficiency of traditional power generation plants. DE and CHP are often used in combination in order to maximize efficiencies and minimize costs.

How could DE/CHP systems help revitalize older industrial cities?

The NEMW region's older industrial cities would benefit from wider use of DE/CHP. Those anchor institutions, government complexes, manufacturers, and other local providers of goods and services that are appropriately situated for DE/CHP would enjoy stable and lower fuel and operating

[1] See NEMWI's "New Energy for Older Cities: District Energy, Combined Heat and Power, and the NEMW Region's Older Industrial Cities" for a more in-depth discussion.

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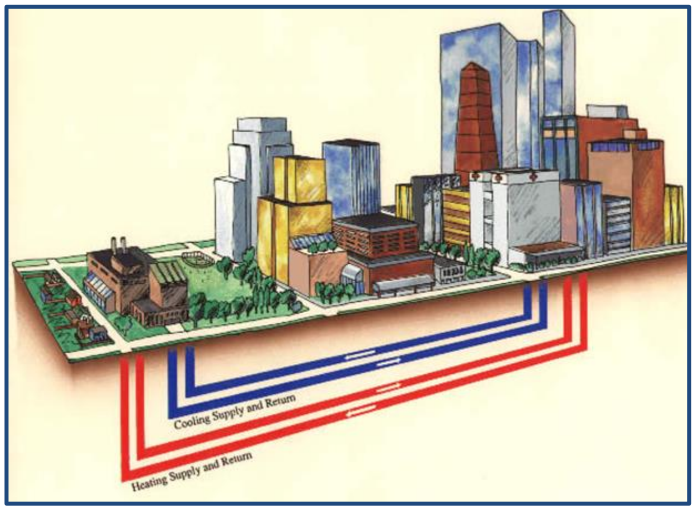
costs, leading to savings that could result in job creation and retention, lower costs to customers, and the ability to further missions and services. As a result of DE/CHP systems' heightened reliability and capacity to adopt alternative fuel sources, these entities could offer new amenities to residents and businesses: consistent power availability and security and a smaller carbon footprint. Specifically, DE and CHP systems are a good match for the following characteristics and needs of older cities.

High Demand for Reliable Energy

Urban areas use large amounts of energy due to relatively high population levels and density.[4] Residents, businesses, hospitals, universities, and data centers are concentrated in cities and in need of the continuous, reliable energy supply that DE/CHP can provide. The increased reliability of DE and CHP compared to conventional energy generation is well-documented.[5] Such systems have even maintained operations during major environmental disasters, such as the Tokyo earthquake of 2011 and Hurricane Katrina in 2005.[6-7]

Density of Energy Consumers

Buildings in older cities tend to be close together, mixed-use, and relatively small. This lay-out is an ideal context for DE, which is most cost-effective when providing energy that has to travel only a short distance from the central plant to consumers and when an energy load is balanced.[8] Urban areas and their major institutions also tend to have a high enough energy demand to offset DE's initial capital costs, leading to long-term energy savings.[9] Moreover, in the urban core, space is often at a premium and small building size can create physical and financial obstacles to individual energy improvements. DE is a ready retrofit; it requires little space for updated heating and cooling in individual buildings because it consolidates that equipment in a central plant and energy resources are shared among a network of energy consumers.[10]



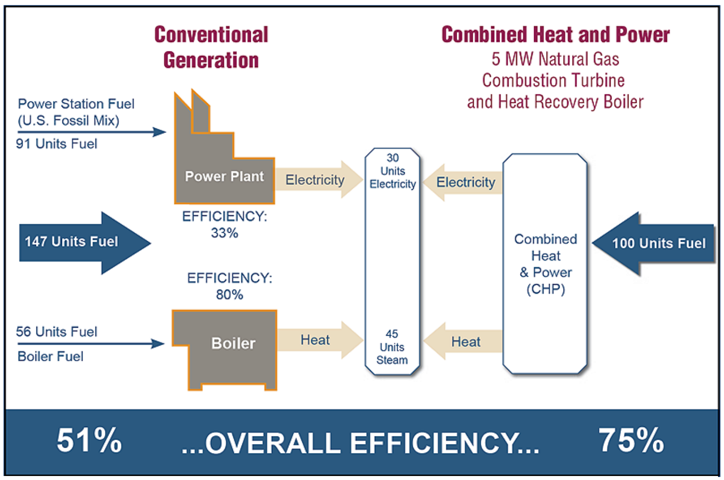
Underground piping through a DE system (www.districtenergy.org)

Need for Economic Efficiencies

DE/CHP systems can be part of a larger strategy toward achieving fiscal health in older industrial cities. The development of DE can significantly lower energy expenditures. DE systems require less fuel to operate than traditional systems and they offer "economies of scale"; using a large, central system to provide energy for multiple buildings with complementary load characteristics allows for flexibility in the purchasing of fuel and optimal operation of equipment.[11-12] As a result, DE operators can mitigate price fluctuations by switching to a different fuel source either temporarily or permanently.[13] Fuel flexibility can also lead to local economic development opportunities; systems in St. Paul, Detroit, and Baltimore, for example, are powered by locally-produced renewable energy.[14-15] Moreover, building owners connected to a DE system see a reduction in costs because they do not have to own and operate their individual building's heating and cooling equipment.[16] When DE incorporates CHP, the amount of primary fuel used is even further reduced.[17] CHP uses only one fuel source to produce heat and electricity, whereas conventional separate heat and power requires burning one fuel for the boiler to make heat and another to generate electricity. CHP can also stabilize electricity and fuel costs over the long run and lower costs for customers.[18]

Commitment to Reduce Emissions in Cities and Major Institutions

Many older industrial cities, and major institutions within them, are joining sector-wide efforts to improve their environmental sustainability. In some cases, DE and/or CHP systems are already part of these entities' energy infrastructure or plans; about 12% of existing U.S. CHP capacity is found in the commercial and institutional sectors.[19] This is because, in addition to the economic benefits described above, DE/CHP systems are more environmentally-friendly than conventional methods of energy production. The environmental benefits of DE stem from greater efficiency and the ability to adopt new technology and alternative fuel sources.[20] Added environmental benefits of CHP include reductions in thermal energy consumption, as well as decreased demand—and thus congestion—on the electrical grid when compared with separate heat and power facilities.[21] CHP efficiency is up to double that of traditional utility power plants, allowing for reductions in overall greenhouse gas emissions.[22]



Overall Efficiency of Conventional Generation vs. CHP (U.S. EPA)

Desire to Reduce Emissions in the Industrial Sector

The majority (88%) of existing U.S. CHP capacity is found in the manufacturing sector, in such industries as petroleum refinery, paper, chemical, and food processing.[23] Despite great losses in manufacturing jobs, the sector continues to play a significant role in some NEMW cities' and metropolitan areas' economies, especially in the Midwest.[24] Many manufacturers use large amounts of both heat and power throughout the year, making them a prime target for CHP technology. Further, faced with Clean Air Act and Environmental Protection Agency rules that require industry to meet specific emissions limits,[25] CHP is a particularly good fit. This is evidenced, for example, by the targeted work of DOE's Clean Energy Application Centers to provide technical assistance to facilities that will be affected by upcoming boiler regulations.[26]

Need for Brownfield Reuse

One legacy of industry in NEMW cities is the burden of brownfields. CHP may be a form of adaptive, productive reuse for these spaces (land or buildings) and developers might benefit from a combination of energy *and* brownfield redevelopment incentives. Alternatively, a number of cities are contemplating the transformation of industrial parks into eco-industrial parks, where shared resources such as CHP can lead to a new era of more sustainable manufacturing.[27]

What incentives are currently in place to support a transition to DE/CHP?

State, municipal, utility, and federal policy objectives are beginning to align around economic and environmental opportunities provided by DE/CHP. Rising U.S. energy costs and demands and concerns about climate change are helping drive this alignment. This section describes the common incentives and tools currently available.

State and Local Government Level

NEMW states make up a large proportion of those leading the way in the development of efficient energy generation, including DE and/or CHP; Massachusetts, New York, Vermont, Connecticut, Minnesota, and Rhode Island rank in the top ten for energy efficient policy program implementation across all economic sectors.[28] The primary approaches by which states and some local governments support DE/CHP include portfolio standards or energy plans, loans, grants, rebates, bonds, and tax incentives.

- ***Portfolio Standards/ Energy Plans***

Renewable portfolio standards, energy efficiency resource standards, or similar state energy plans set long-term goals for energy savings, alternative energy production, and/or use of renewable fuel sources. Sometimes these standards or plans are voluntary; other times they are paired with incentives for meeting goals and/or penalties for failing to meet them.

Example: Ohio's Energy Efficiency Resource Standard

A recent amendment to Ohio's Energy Efficiency Resource Standard allows CHP systems to qualify toward the standard if they achieve 60% thermal efficiency and were placed in service or retrofitted after the law went into effect. The efficiency standard requires investor-owned utilities to increase their efficiency by 22% by 2025.

- ***Tax Incentives***

Tax incentives come in a variety of forms. Renewable energy or energy efficiency tax credits or exemptions can be provided for electricity produced or for equipment purchased;[29] they are often taken against business or real estate taxes.[30]

- ***Loans***

Many states offer low-interest—or even no-interest—loans to help finance energy efficiency projects. Each program has its own rates and terms, but ten-year (maximum) loans are common.[31]

Example: NYC Energy Efficiency Corporation

The New York City Energy Efficiency Corporation offers direct loans ($500,000 to $5 million) to finance energy efficiency retrofits, clean heat conversions, and installations of distributed, on-site generation equipment and related activities. It also facilitates a loan alternative called Energy Service Agreements, which allow energy efficiency to be packaged as a service that building owners pay for through savings. The Corporation is an independent, non-profit financial corporation established by New York City and funded in part through the American Recovery and Reinvestment Act.

- ***Bonds***

Through the issuance of tax exempt or taxable bonds offered in capital markets, borrowers (or issuers) can often more cost-efficiently finance a long-term investment by borrowing funds for a stated period of time at a fixed interest rate.

- ***Grants and Rebates***

Most state energy grant programs aim to help offset the upfront costs of eligible projects by distributing funds toward installment or operation. Energy rebates provide a cash refund or reduction on the costs of energy efficiency measures already taken.[32]

Example: Massachusetts Green Communities

Through Massachusetts' Green Communities Designation and Grant Program, funded by the Regional Greenhouse Gas Initiative, municipalities that meet certain criteria can become designated "Green Communities" and access grant funds to pursue energy efficiency and renewable energy projects.

Utilities

A state's public utilities commission typically develops and administers interconnection standards. These standards establish state-wide processes and technical requirements for connecting distributed generation systems, like DE and CHP, to the electric utility grid.[33] Connecting to the grid allows distributed generation systems the ability to purchase power *from* the grid if necessary and sell excess power *to* the grid. A related utility practice is net metering. Net metering allows those using distributed generation to measure the energy they produce on-site against the energy they purchase at retail rates or sell back to the grid. Customers are then billed for their net electricity consumption or credited for excess generation.[34]

Example: Interconnection in Maine

Maine's interconnection standard, in place since 2010, is often considered the best standard in place right now, allowing all distributed generation and with multiple fee tiers that take into account a unit's generating capacity and whether or not it exports power off-site.

Federal Government Level

In his 2012 State of the Union address, President Obama expressed his commitment to clean energy, local energy use, and strong infrastructure.[35] Some congressional offices have specifically encouraged the use of CHP by introducing legislation.[36] Further, at a recent hearing, Steven Chu, Secretary of the Department of Energy (DOE), stated that the Department is "bullish" about CHP, a proven technology that he said offers "low-hanging fruit."[37] DOE's eight Clean Energy Application Centers provide local technical assistance and educational support related to CHP. EPA's CHP Partnership, too, promotes the use of CHP.[38] A 2012 EPA standard also will generate interest in DE/CHP systems for their emissions-reduction capabilities; the Industrial Boiler Maximum Achievable Control Technology (Boiler MACT) standard will require industrial, commercial, and institutional boilers to meet new emission limits by 2015.[39] Federal programs relevant to DE/CHP development typically reside within DOE, EPA, and the Department of Treasury.

Current Federal Policy Tools Available for DE/CHP Development

Loans/Loan Guarantees:	*U.S. Dept. of Energy - Loan Guarantee Program*
Bonds:	*Qualified Energy Conservation Bonds* *Clean Renewable Energy Bonds*
Tax Credits/Exemptions:	*Business Energy Investment Tax Credit* *CHP Investment Tax Credit* *Renewable Electricity Production Tax Credit* *Modified Accelerated Cost-Recovery System* *Energy-Efficient Commercial Buildings Tax Deduction*
Grants:	*U.S. Dept. of Agriculture - High Energy Cost Grant Program* *U.S. Dept. of Treasury - Renewable Energy Grants*
Other:	*Renewable Energy Production Incentive*

What obstacles currently hinder adoption of DE/CHP?

Despite an improving policy context, those wishing to develop district energy and combined heat and power systems (DE/CHP) still face utility-related, financial, and policy obstacles.

Trouble Connecting to Utilities

Utility rate structures are rarely conducive to CHP; standby rates for supplemental power supply and/or back-up service can be very high, there is no standard for interconnection across states or regions, and rates paid to CHP energy producers for excess electricity generated and sold to the grid for other energy consumers to use are extremely low.[40] Federal policy can compound utility-related obstacles. In the late 1970s, the federal Public Utilities Regulatory Act required investor-owned utility companies to buy electricity from any qualified facilities, which included industrial and institutional facilities using cogeneration. However, this requirement was modified by the federal Energy Policy Act of 2005, which stated that certain utility companies would no longer have to buy electricity from those facilities if they (the facilities) have access to certain wholesale markets.[41] This change has had an adverse effect on the relationship between utility companies and CHP developers.[42]

Financing and Market Barriers

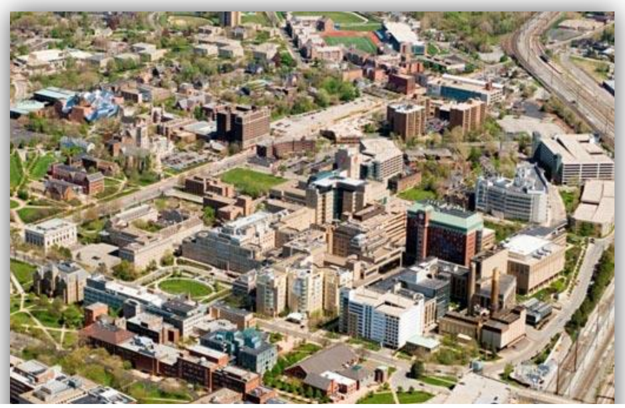
The construction of a new DE network is an expensive, major infrastructure project that requires the connection of multiple buildings to a central plant through underground pipes.[43] CHP systems, too, are large, long-term investments. CHP systems may typically take seven to ten years to pay back, but private investors tend to prefer shorter-term investments.[44] Market barriers can also make a CHP investment hard to justify. For example, selling excess power to the utility system at low wholesale rates—as opposed to nearby facilities at higher retail rates—is often the only option for CHP owners. Further, if local electricity and natural gas prices are low, it is difficult to make the short-term economic case for investing in CHP.[45] Especially in the manufacturing sector, low electricity prices can be artificially created through special arrangements and cross-subsidized by higher prices for residential and commercial energy consumers. In Ohio, for instance, residential consumers pay nearly double the rate for electricity than industrial customers do.[46]

Federal/State Policy Obstacles

Even though the federal government has promoted DE/CHP in a number of ways, there is substantial room for improvement. Some argue that the 10% federal CHP Investment Tax Credit is too low and too restrictive.[47] Also, American Recovery and Reinvestment Act (ARRA) funding, which created or extended many energy programs, is no longer available or fast running out. At the state level, DE and CHP are not always eligible for state energy and economic development programs. Moreover, regulations that set out to protect the environment and improve air quality can fail to adequately recognize DE/CHP systems' overall reductions in emissions and can be perceived as deterrents. For example, although some states have adopted output-based standards to regulate emissions, others continue to establish limits on an input basis. Input-based standards take into account heat input and exhaust concentration to determine the "amount of emissions that can be produced per unit of fuel input." Output-based standards, however, more accurately account for the efficiency and environmental benefits of DE/CHP systems, as such standards consider the amount of emissions "produced per unit of useful output."[48] Additionally, in some sectors, the Clean Air Act's New Source Review is perceived to discourage CHP installation by requiring lower onsite emissions for new or modified stationary sources of air pollution without taking into account commensurate increases in fuel-efficiency associated with the simultaneous and more fuel-efficient generation of heat and electricity.[49]

Case Example: The Medical Center Company of Cleveland, OH (MCCo)

MCCo is a non-profit energy provider that uses DE to provide coal- and natural gas-fueled steam heat generation and chilled water to its nine member organizations, all of which are educational, community benefit, or religious non-profits in Cleveland's dense University Circle neighborhood. MCCo also purchases and distributes electricity through the local municipal utility. MCCo members report many benefits to being a part of the DE system, including cost-savings, improved reliability and efficiency, the ability to power specialized environments (e.g. the Botanical Garden), and a sense of community. In 2010, MCCo made the decision to phase out its aging coal-fired boilers and become coal-free. Among other efficiency-related investments, the company seeks to generate its own electricity by developing a natural gas- fueled CHP system.



The plant's smoke stacks are visible near the bottom right corner, surrounded by MCCo members Case Western Reserve University and Case Medical Center; other MCCo members would appear to the left of this picture.

The State of Ohio and the city of Cleveland have taken recent steps to show their support for a brighter energy future—such as the adoption of energy standards and sustainability initiatives—but policy and financial obstacles still impede MCCo's progress toward adopting CHP. Few federal, state, or utility-based incentives/ financing mechanisms are useful to MCCo. Most of the federal incentive options are either tax credits—neutralized in this situation by MCCo's non-profit status—or only reward renewable energy projects. At the state level, many programs similarly revolve around tax exemptions. Some utility companies, however, offer incentives to their non-profit customers; unfortunately MCCo's current electricity provider does not.

MCCo's story suggests that despite clear DE/CHP benefits and a relatively environmentally-friendly political context, the adoption of even tried and true efficient energy generation technologies will require further policy changes and greater public financing options.

What policy changes could encourage wider development of DE/CHP in older industrial cities and beyond?

In tomorrow's older cities, those wishing to develop DE/CHP—the leaders of public entities, for-profit companies, and non-profit organizations alike—would ideally have an array of financing options and incentives to make the transition from conventional energy generation approaches. Government leaders would continue to strengthen federal emissions regulations, to evaluate interconnection standards, and to urge robust state portfolio standards or energy plans. Leaders at all levels of government would consider renewable energy *and* advanced energy, as well as the importance of thermal energy, when developing energy and economic development programs. They would also lead by example when making energy decisions in public buildings.

Ideally, state efficiency standards would incorporate benchmarks and incentives and diligently measure savings and air quality changes that result from sources of efficiency like DE/CHP. CHP would be recognized for its efficiency and ability to reduce a state's overall carbon footprint. Utility companies would have greater incentive to adopt DE/CHP and public utility companies and owners of DE/CHP systems would collaborate toward mutually-beneficial agreements so that standby rates for supplemental power and/or back-up service are affordable, reasonable, and conducive to DE/CHP.

If federal decision-makers wish to move toward more widespread DE and CHP deployment in tomorrow's older industrial cities, it will be important for them to consider the following recommendations.

- **Address the dwindling number of programs available** as American Recovery and Reinvestment Act funding runs out and acknowledge the high demand for such programs by expanding the availability of targeted grants, low-cost loans, and tax incentives. Provide financial and technical assistance to state and local officials and their municipal utilities to help them take advantage of DE/CHP opportunities.
- **Evaluate the impacts of the Energy Policy Act of 2005** as it relates to interconnection requirements. As part of this evaluation, consider the establishment of efficiency thresholds.
- **Revise emissions regulations** to consider useful energy and to evaluate the production of thermal energy and electricity, especially in output-based emissions programs. As DE/CHP systems may increase site emissions when producing both electricity and thermal energy, it is important that useful heat and displaced regional greenhouse gas emissions be properly credited to the CHP facility. Investigate the role that New Source Review plays in the development of CHP and consider revisions while remaining vigilant about local air quality and residents' health.

See NEMWI's "New Energy for Older Cities: District Energy, Combined Heat and Power, and the NEMW Region's Older Industrial Cities" for a more in-depth discussion.

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[4] Environmental and Energy Study Institute, 2011a.
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[7] Shipley, et al, 2008.
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[12] Gochenour, 2001.
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[25] These include BoilerMACT and the proposed “Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units,” which will apply to new fossil fuel-fired electric utility generating units greater than 25 megawatt electric.
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[37] International District Energy Association, 2012b.
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[39] The implementation date for Boiler MACT will likely be delayed beyond 2015.
[40] Haugen, March 2012; Center for Climate and Energy Solutions, 2011; Chittum, 2011a.
[41] Stoel Rives, 2006.
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[49] Shipley, et al, 2008; More research is needed to determine whether or not this barrier is more than a perception.