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Commercial cogeneration benefits depend on market rules, rates, and policies

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Keen and Apt (2016) ask if high penetrations of cogeneration are good for society? For industrial combined heat and power systems, the answer is affirmative. For commercial cogeneration, on the other hand, the costs and benefits depend on market rules, rates, and policies.

Combined heat and power (CHP) has long been viewed as beneficial along a variety of dimensions including grid reliability, energy efficiency, water conservation, and pollution reduction. As a result, countries around the world have increased subsidies for CHP and are expecting rapid growth—from 33 GW in 2015 to 74 GW by 2024 worldwide according to Navigant Research (2015). With the 2012 US Executive Order establishing national goals for CHP by 2020, CHP is expected to grow in the U.S., as well. Keen and Apt (2016) ask if such growth would be good for society.

CHP systems are mature technologies that can be used in individual buildings, district heating networks, manufacturing plants, and electricity generation systems. Prior research has documented the cost and pollution benefits of district, industrial, and power generation CHP systems, and Keen and Apt's assessment is confirmatory. However, their results for CHP systems in commercial buildings are provisional; in particular, commercial cogeneration may not always reduce emissions if large amounts of wasted heat are produced. An example of a CHP configuration is the use of air-cooled microturbines with absorption chillers. The microturbines use natural gas as their fuel to produce heat and electricity, while the absorption chiller converts waste heat from the microturbines to cool the building. Alternatively, the waste heat could be used to pre-heat the building's hot water or for other purposes.

To evaluate pollution from commercial and industrial CHP, Keen and Apt construct an integrated planning and operations model that maximizes owner profit through sizing and operation of CHP on a simulated distribution feeder in New York. In one case, the CHP system is owned and operated by a customer, subject to a flat tariff; in a second case, the CHP system is owned and operated by a utility subject to time varying locational marginal prices. The modeling concludes that small CHP systems with electrical efficiencies as low as 25%, operating in buildings with low heat loads could produce higher greenhouse gas emissions than the bulk power grid.

These findings are dependent on the rate structure that is modeled. Keen and Apt assume that customer-owners are subject to a flat rate tariff (prices do not vary by hour or season) and a demand charge. As a result, the customer owner operates the CHP system more than the utility owner does during the night when heat loads are low and excess heat is wasted. This finding might not hold under alternative rate designs.

Since CHP could reduce a utility's wholesale power purchase costs, there would appear to be the possibility of a DRIPE (demand response-induced price effect), where utility rates could decrease, with the likelihood of cost savings to all ratepayers, but also the possibility of a rebound effect (Baer *et al* 2015). The fact that commercial cogeneration reduces system costs means that the DRIPE effect might apply if the utility owns the CHP. But if the building owners own the CHP, other commercial customers may end up subsidizing these CHP owners because their volumetric expenses cover fixed costs, which will have to be absorbed into higher rates for all ratepayers. These complex effects are best identified by engaging macroeconomic economy-wide models.

The policy implications of this research are fascinating and complex. As noted by Keen and Apt, the New York Reforming Energy Vision (REV) process currently prohibits utility ownership of DER, yet in the case of commercial cogeneration, utility ownership might produce greater environmental benefits. At the same time, because customers benefit from reduced demand charges under both ownership models while utilities must share revenue through a PPA, customer ownership results in more CHP installations. Whether or not this finding would generalize to other regions of the country is unclear, since utility business models are variable, for example with public power providers and vertically integrated utilities. The research merits further elaboration under different circumstances.

The fact that CHP systems can defer capital investments needed for the distribution network and transmission infrastructure also merits more analysis, given Federal Energy Regulatory Commission's Order 1000, which recognizes that 'in appropriate circumstances, alternative technologies may be eligible for treatment as transmission for ratemaking purposes.' Non-transmission alternatives (NTAs) would appear to be particularly appropriate where transmission infrastructure is particularly expensive (Southworth, 2016). State Public Utilities Commissions (PUCs) are required to follow Order 1000's requirement of 'comparable consideration' for transmission and non-transmission alternatives. As a result, for example, the Maine PUC recently approved the Smart Grid Reliability Pilot Project in the Boothbay Sub-Region of Central Maine Power Company's electric grid. At a cost of $6 million, the NTA project avoided an $18 million rebuild of a transmission line, saving consumers $12 million. The Pilot Project includes five categories of NTAs—efficiency, photovoltaic solar, demand response and peak shifting, back up generation and battery storage (GridSolar, LLC 2015). CHP systems could also qualify as NTA assets.

To reduce greenhouse gas emissions, Keen and Apt recommend policies such as time varying rates to encourage commercial CHP operation only during times of high heat loads. With this goal in mind, we can compare and contrast the impacts of production tax credits (PTCs) and investment tax credits (ITCs) for cogeneration—although again a cautionary approach to generalization is needed because impacts will depend upon the context. A PTC would likely cause most commercial CHP to produce higher relative emissions by encouraging overall power generation. An ITC, on the other hand, would simply reduce capital costs and neither encourage nor discourage CHP dispatch during high heat load periods.

This deep dive into the environmental economics of commercial cogeneration is a fruitful field of research. The analytic approach used by Keen and Apt could also enrich the national debate over distributed energy resources writ large. At the same time, conclusions must take into account their dependence on market rules, rates, and policies, as Keen and Apt clearly demonstrate in their analysis of utility tariffs, PTCs, and other policies.

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