18 Remove Barriers to Cogeneration

I. Summary

Issue:
Onsite cogeneration can be an efficient and cost effective source of heat and power to buildings, but technical and regulatory barriers inhibit its use.

Recommendation:
Con Edison should help facilitate the installation of larger systems by preparing guidelines similar to those for smaller systems, and implement a plan for significant expansion of cogeneration. Cogeneration should be properly sized to maximize economic benefit and energy efficiency.

II. Proposed Legislation, Rule or Study

This proposal on larger cogeneration or Combined Heat and Power (CHP) systems consists of four distinct parts:

Item 1: Facilitate Large CHP Systems
Con Edison should facilitate the implementation CHP systems by providing a clear set of design and installation procedures, comparable to those now available for smaller systems at (www.coned.com/dg/process_guide/processGuide.asp).

Item 2: Permit Less Expensive Controls of Large CHP Systems
To improve the cost-effectiveness of larger CHP systems, Con Edison should permit the use of substantially less costly communication systems that will still allow them to monitor operating distributed generators and shut them down rapidly if necessary.

Item 3: Prepare for Greatly Increased Distributed Generation
Over the next decade, Con Edison should modify its distribution system to prepare for substantially greater use of CHP and other forms of distributed generation than are now possible.

Item 4: Design CHP Capacity to Meet Thermal Loads and Minimize Power Exports to the Grid
As best practice for new construction and existing buildings, Combined Heat and Power systems (CHP) should be designed with systems sized to the thermal load of the facility, so that power to sell back to the utility will not normally be available. Less common cases of systems capable of or requiring sellback should be worked out individually.

III. Supporting Information

Item 1: Facilitate Large CHP Systems

Expanded Issue and Benefits:
Con Edison must ensure that power produced by an independent generator (like a large CHP system) does not induce instability or exceed the capacity of the local network, and that the generator can be safely disconnected in the event of a grid failure. In many cases, existing network technology that is not designed to accept power flows associated with distributed generation (DG) limits the capacity of the generators. These constraints require Con Edison engineers to perform an evaluation of each application for new CHP facilities to determine compatibility with the existing network.

For CHP systems under 100 kW, which will be connected to the lower voltage secondary network, this is no longer an issue since Con Edison has prepared a clear set of guidelines[i]. In general, these smaller systems cannot feed power back onto the grid, since Con Edison does not regard the lower voltage secondary system as capable of accepting CHP power.

Larger CHP systems of 2 MW or more connect directly to the primary (high voltage) grid and that grid is capable of accepting CHP power. However, the application and connection process remains difficult for larger systems due to more complex rules, and the cost of delays is greater in proportion to the size of the system.

Con Edison should prepare and present a clear set of procedures for large CHP systems, comparable to those now available for smaller systems. The timesaving in design and review for both applicants and Con Edison will be significant and more than warrant Con Edison deploying the necessary resources.

Cost:
Turner Construction Company did not perform cost estimation for this proposal. The following analysis was provided by the authors of this proposal:

No cost to practitioners, cost to Con Edison may be repaid in reduced time reviewing applications.

Implementation:
There are no barriers to implementation.

Sources:
Interviews with practitioners and conversations with Con Edison staff.

i. www.coned.com/dg/process_guide/processGuide.asp

Item 2: Permit Less Expensive Controls of Large CHP Systems

Expanded Issue and Benefits:
Con Edison must be able to ensure that CHP systems are safely and rapidly disconnected in the event of a grid failure. For larger cogeneration systems (around 2 MW or more) that may be selling power back onto the grid "Transfer/Trip telemetry" facilitates direct communication between the cogeneration system and the utility. Con Edison's current requirement, that this system be capable of shutting down in a fraction of a second, can currently only be satisfied by telemetry systems that are extremely expensive. This expensive requirement seems excessive and hinders the cost-effectiveness of larger CHP systems.

Con Edison should work with CHP manufacturers to develop appropriate technical solutions so it can monitor and shut down distributed generation with adequate speed at a significantly lower price.

Cost:
Turner Construction Company did not perform cost estimation for this proposal. The following analysis was provided by the authors of this proposal:

Appropriate development should lower costs for all parties.

Implementation:
Developers are convinced acceptable systems are available; clearly dialog is necessary.

Sources:
Conversations with leading CHP engineers.

Item 3: Prepare for Greatly Increased Distributed Generation

Expanded Issue and Benefits:
Both CHP and solar electric power constitute what is called "distributed generation" (DG) because they produce electric power at many distributed points, rather than at large central stations. The Con Edison power grid was designed with central generation in mind, characterized by one-way flows out of the generation stations, through the network, and out to the customer. Today, Con Edison must ensure that power flows associated with DG do not exceed the capacity of the local distribution network. In many cases, existing network technology that is not designed to accept power flows associated with distributed generation (DG) prevent those systems from selling power back to the utility. Accordingly, integration of CHP or DG with the capacity to supply large amounts of power to the primary grid will require improvement or reconstruction of portions of that grid.

Network improvements are taking place, but this will take several years. Even with local network improvements, the capacity of DG that can be safely integrated into the network while preserving stability is limited and may prove to be a bottleneck in the future.

In the short term, Con Ed should give network improvement priority, and components should be selected that are capable of operating under conditions of two-way power flows that would permit sales into the secondary network as distributed generation grows in importance. On a longer time scale, Con Ed should develop a plan to modify its systems to make practical the installation of large DG systems into the primary grid without compromising system stability.

Cost:
Turner Construction Company did not perform cost estimation for this proposal. The following analysis was provided by the authors of this proposal:

The cost of grid improvements can be passed on to the ratepayers, but careful accounting must be used to ensure that the savings resulting from increased DG are also passed back to the ratepayers.

Implementation
The technical issues can be overcome, but they are not trivial, which is why planning should start now, if it is not already underway. Con Edison asserts that increased DG capacity is already part of their planning process, in which case this proposal should be read as encouragement to expand the effort.

Sources:
Conversations with DG professionals and review of Con Edison tariffs and literature.

Item 4: Design CHP Capacity to Meet Thermal Loads and Minimize Power Exports to the Grid

Expanded Issue and Benefits:
To be financially and environmentally successful, CHP must be sized so that all available thermal energy is used to produce domestic hot water or otherwise displace an alternative fuel. This limits the useful size of CHP systems in residential applications to electric capacities well below peak or even average electrical load, and ensures that the machine will run at capacity most of the time, especially if thermal storage tanks are available to level the demand for hot water over the course of a day. This is the ideal situation, since the price Con Edison pays for exported power is much lower than the price customers pay when they are purchasing electricity, making the economic value of these sales uncertain, and as a general matter, Con Edison does not accept power exported from CHP systems on the low-voltage grid to which most residential buildings are connected.

There are two circumstances where an owner or developer might wish to build a system large enough to require the sale of power to the utility. First, a system involving emergency or standby power and second, in the case of direct metering.

First, consider **emergency power**. It is tempting to consider use of CHP systems to meet the requirements for emergency power in new residential buildings over 125 feet high and most other buildings over 75 feet high, as specified in Sections BC 403.11 and BC 2702 of the NYC Building Code. These requirements have been in effect for new construction for about 5 years, and the equipment must provide adequate power for exit signs, egress illumination, fire alarms, at least one elevator, fire pumps and other listed loads. This power is designed to permit evacuation of buildings during fires or other emergencies, and buildings are only required to have a 6-hour fuel supply, normally diesel oil, on hand. Multifamily (R-2) buildings are permitted to use natural gas for these generators, and in such cases are well situated to handle extended blackouts. Buildings without natural gas and only a 6-hour supply of diesel fuel will shortly find themselves without sufficient power because the number of deliveries required for 24-hour operation will prove impractical.

The use of CHP generators to meet these emergency power requirements would seem attractive, and would lower barriers to the use of CHP. However, analysis by staff at a major developer of large residential building (390 units) revealed that a CHP unit sized to run at its most effective efficiency (and therefore sized by the amount of thermal load it can shed) would be too small to meet the demands of code-mandated emergency power. A problem exacerbated when the loads required in an extended outage are included. Their solution was to install a dedicated gas-fired emergency/standby generator to provide power during an outage, with a non-islanding CHP for use only during normal conditions. In another, somewhat smaller building (225 units), a pair of island-capable microturbines would have been able to meet the emergency loads, but could not meet the total load when the “convenience” loads needed for long-term habitability were added. For this building, they retained the microturbines and added a small gas-fired emergency generator to run in parallel and provide adequate total capacity during emergencies.

One could install a CHP system large enough to meet the required emergency loads, but then it would be discarding thermal energy. Sale of electric power to Con Edison would only be possible if the system was large enough to be connected to the high-voltage network, and would only garner the relatively low LBMP rates[ii] for power. Since the excess thermal energy would be wasted, it is very unlikely that this configuration would be cost-effective.

The optimal approach to buildings with both CHP and emergency power is a hybrid configuration: include CHP capacity in new construction whenever possible, capable of operating in island mode with transfer switches and other equipment as needed for safe operation as emergency generation. Size the CHP system to meet but not exceed thermal loads and to operate full time. Then add gas-fired emergency generator capacity, capable of running in parallel with the CHP system, sized to meet code-mandated emergency loads and desired standby loads. This will result in minimum cost systems, without any legal or regulatory barriers.

Voluntary standby generation is another case to consider. Existing buildings are not required to add emergency generation, but may wish to install CHP for economic reasons. Many CHP systems can operate in island mode without a grid connection, are gas-fired, and could provide power to a building during an emergency electrical outage. Use of CHP in this function would increase the financial viability of the CHP system by lowering the costs associated with pure emergency generation capacity. However, the modest CHP system size will limit the number of loads that can be carried. Any CHP system could easily provide power for common area lighting and fire alarm systems. Many could also power water and sewage pumps, making it possible to maintain sanitation. However, powering elevators or large pumps may exceed the capacity of smaller CHP systems, especially when inrush current is accounted for. The issue of which loads must be met by CHP systems during long electric service interruptions is dealt with in Building

[ii] The “low” energy prices paid for cogenerated electric energy represent the wholesale price of generation (Location-Based Marginal Pricing or LBMP), established by competition among all available generators.

Resiliency Task Force Proposal “Remove Barriers to Backup & Natural Gas Generators,” and if that proposal is successful, CHP systems sized to thermal loads will be able to meet many essential building loads during blackouts.

There is one circumstance, **direct metering**, where a building owner could reasonably approach Con Edison with a request for net metering, in which the building owner is paid the same rate for energy as he pays when purchasing it. (These are the rates paid for solar electric power, due to its low carbon footprint and lack of air pollution). The ideal case for residential CHP is one where the CHP system is sized to the thermal loads, and generates power at all times. However, this will normally work only in a building with a single, “master” electric meter, since the CHP’s electric output will exceed the small nighttime demands of the building’s common areas. Only if the CHP can also meet the resident’s nighttime needs, such as refrigerator operation, can the electric power be put to good use. With a single master meter for the entire building’s single Con Edison account, this is the case.

However, many buildings utilize direct metering, where each apartment has its own Con Edison account. In this case, since Con Edison will not accept sell-back, the CHP system must be downsized to follow the nighttime electric loads of the common area, at a considerable loss in efficiency. The building could qualify for a thermally sized CHP system by converting to master metering, but many owners are reluctant to do this, for a variety of reasons. Physically, if Con Edison were to offer net metering to such a directly metered building, the power fed back would in fact stay within the building and the resulting physical and economic impacts on the Con Edison system would be the same as if the building had converted to master metering. Because of the complexity of determining the “right-sized” CHP system, the impact of a building’s transformer configuration, and many other details, it is unlikely that a simple tariff can be developed around this situation. However, it may be well worth a developer’s time to bring a particular case like this to Con Edison’s attention and see if any negotiations are possible.

Since CHP allows greater fuel utilization efficiency than standard utility generation, buy-back should be encouraged from installations where high thermal loads allow production of unneeded electric energy, but high connection charges and low LBMP-based buy-back energy prices discourage sales to the utility, which are only allowed at the high-tension level. For larger CHP, for instance one meeting a large thermal load, sellback may be attractive even at LBMP rates. For these cases it may be worth examining the associated demand and customer charges, which accrue for both purchases from the utility (SC-5, 8, 9, & 12) and sales to the utility (SC-11). (Duplicate customer charges are waived). However, these tariffs are the result of many cases and arguments before the New York State Public Service Commission (PSC) and will not be easy to modify, even if modification is justified. Owners and developers of larger, high-voltage systems should examine their demand tariffs to assess the value of requesting negotiated changes.

Cost:
Turner Construction Company did not perform cost estimation for this proposal. The following analysis was provided by the authors of this proposal:

These best practice suggestions do not involve costs, but may produce substantial life cycle savings.

Implementation:
All technologies are available off the shelf.

Sources:
Con Edison tariffs and regulations, discussions with developers and engineers.