New Jersey Energy Master Plan
Strategy Template
2005-2020

Capacity from shifting electric cooling demand to Off-Peak Hours

SUBMITTED BY

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Objective

- Permanently flatten the industry electric demand load shape by shifting substantial existing electric cooling load to off-peak hours
- Reduce the addition of new peak cooling electric peak demand by at least 50%

Strategy

1. Deliver Permanent Reductions in cooling peak demand by shifting cooling load to off-peak hours. This is accomplished by installing cooling equipment that makes chilling during off-peak hours and stores it in the form of ice or chilled water for use during on-peak hours. Electric capacity delivered from permanently shifting on-peak loads to off-peak hours has similar value to the grid as new peaking generation capacity necessary to satisfy peak summer cooling loads. Off-Peak chilling has additional value by avoiding additional investment in transmission and distribution, by lowering peak demand at the customer site and thereby freeing up peak demand for a new customer.

2. Until now the inability for utilities to invest in thermal storage on customer sites and earn a return has led to an ever increasing need for more peaking generation. Little thought has been given to how the electric industry load shape could be flattened. The substantial growth in air conditioning load since the 1950s has produced an increasingly steep summer daytime peak demand. Thermal storage systems that use electric chillers to charge ice or chilled water storage are in use in several thousand buildings around the world and are as reliable as conventional chilling equipment.

3. In addition to shifting load, by using variable speed pumping to deliver the chilled storage medium, additional energy savings are produced compared to conventional DX air conditioning units that operate full on or off. When ice storage is designed into a new building there is little incremental cost because distribution piping, motors and air handling equipment and be reduced in size while delivering the required cooling, from the availability of colder stored cooling from ice storage than is available from conventional chillers. The savings from the reduced sizing of cooling distribution equipment offsets most of the incremental cost of the ice storage.

4. Existing central and rooftop air conditioning can be retrofit with an off-peak cooling storage system to shift part or all of the chilling electric demand to off-peak hours.
Responsible Party

By requiring all new construction to utilize off peak storage for at least 50% of peak cooling demand, perhaps initially buildings over 50,000 sq. ft, with incremental reductions to 10,000 sq.ft,, the program will deliver significant summer peak demand avoidance from new buildings.

By also providing incentives to convert existing chilling systems to partial or full cooling load shift, over 1000 MW can be shifted from peak demand periods to off-peak hours before 2020. The incentives necessary in deliver this result in addition to new rate structures, can take the form of rebates, or possibly investments by regulated utilities with a ten year amortization life, during which the utilities earn a return on the invested capital similar to current returns. Higher incentives can be utilized to target areas of congestion to achieve more significant levels of penetration. Retrofits of off peak chilling to buildings that have central chillers and to those that have rooftop DX units are proven and not technically difficult. See: [www.calmac.com](http://www.calmac.com)

As a part of the incentive structure essential to permanently flatten the electric industry load curve, hourly electric prices should have no demand charge. Hourly prices should include all T & D charges allocated during peak demand hours with a cost weighting toward some number of system peak hours. There should be no demand charges or T & D charges for electric use during off-peak hours to encourage the maximum shift of electric load to off-peak hours. All necessary revenue presently collected in the form of demand charges and T & D charges by utilities should be allocated to system peak hours to keep utilities revenue neutral to the change. Grouping these costs into the hours with the highest system peak demands would allow for the installation of partial or full cooling to be shifted to off-peak hours, depending on the technical limitations of each site.

Timeline

These changes should be made a permanent part of future utility rate structures. Encouraging and investing in equipment located at customer facilities that minimize peak cooling load will avoid the construction of more than 1000MW of peaking generation by 2020. Shifting electric usage from peak hours to off-peak hours should also reduce pollution by shifting usage from the generations units last to be called on, which are typically the least efficient.

Outcome

Permanent flattening of the load curve. Maximum penetration of this technology along with distributed renewable generation could reduce peak demand by several thousand MW by 2020. The combination of off-peak cooling storage with PV or other renewable generation during on-peak hours could produce buildings with a negative electric demand during peak summer demand periods. This will occur if the renewable energy system is sized to supply daytime
electric loads, not including chilling, with all chilling made during off-peak hours.

### Implementation cost

The cost of transforming the air conditioning industry to a significant amount of off-peak cooling will be a function of the financial incentive created by a new rate structure, that creates a financial incentive to shift load. This difference in electric costs between on-peak and off-peak costs will need to be sufficient to amortize part or all of the cost to retrofit existing chilling equipment. The subsidy necessary to bring the capital cost decision to implement off-peak chilling to a positive result, if needed, can be in the form of a rebate from SBC funding or a rebate by electric utilities that are allowed to earn a rate of return on the subsidy. Financial modeling using proposed hourly rate structures should be done to generate what level of initial capital cost subsidies, (or investments by utilities), if any, are required to generate the necessary market response. In the early 1990s ConEdison briefly had a rebate of $600/kw shifted KW from off-peak cooling installations. The rebate did not stay in place long enough to generate significant market response.

### Source of Funding

<table>
<thead>
<tr>
<th>Funding sources</th>
<th>Yes</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>SBC funding</td>
<td></td>
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<tr>
<td>Utility investments in Off-peak chilling capacity through rebates with appropriate returns and amortization periods</td>
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<tr>
<td>Sale of capacity from load shift to assist in meeting generating margin requirements.</td>
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<tr>
<td>Private sector funds</td>
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<td></td>
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<tr>
<td>Public sector funds</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Consumer/ratepayer Funds</td>
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### Indicators

- Customer and system load profiles as compared to present the industry load profile.

### A. Current state of adoption

Little adoption due to insufficient disparity between on-peak and off peak rate structures. Demand periods that are 10-12 hours, limit customer ability to deploy partial off-peak cooling that would avoid cooling electric demand during highest peak demand hours, which are less than 10-12 hour demand charge period. Thousands of systems have been installed worldwide, typically during new construction or when additional chilling capacity is needed, due to the lower incremental cost during new construction.
B. Projection to 2020.

Appropriate hourly rate structure and rebate type incentives, which could decline over time, will have a dramatic impact on additions to peak demand through 2020. Appropriate incentives to defray part of the capital cost of retrofitting existing buildings will flatten the existing electric industry load curve. Benefits from Load shifting are:

- Reduction in amount of electricity consumption during peak demand hours
- Reduction in congestion and LMP with geographically targeted load shift programs
- Reduction in the need for new peaking and mid-peak generation