# Application of DER-CAM for Microgrid Design

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# Objectives

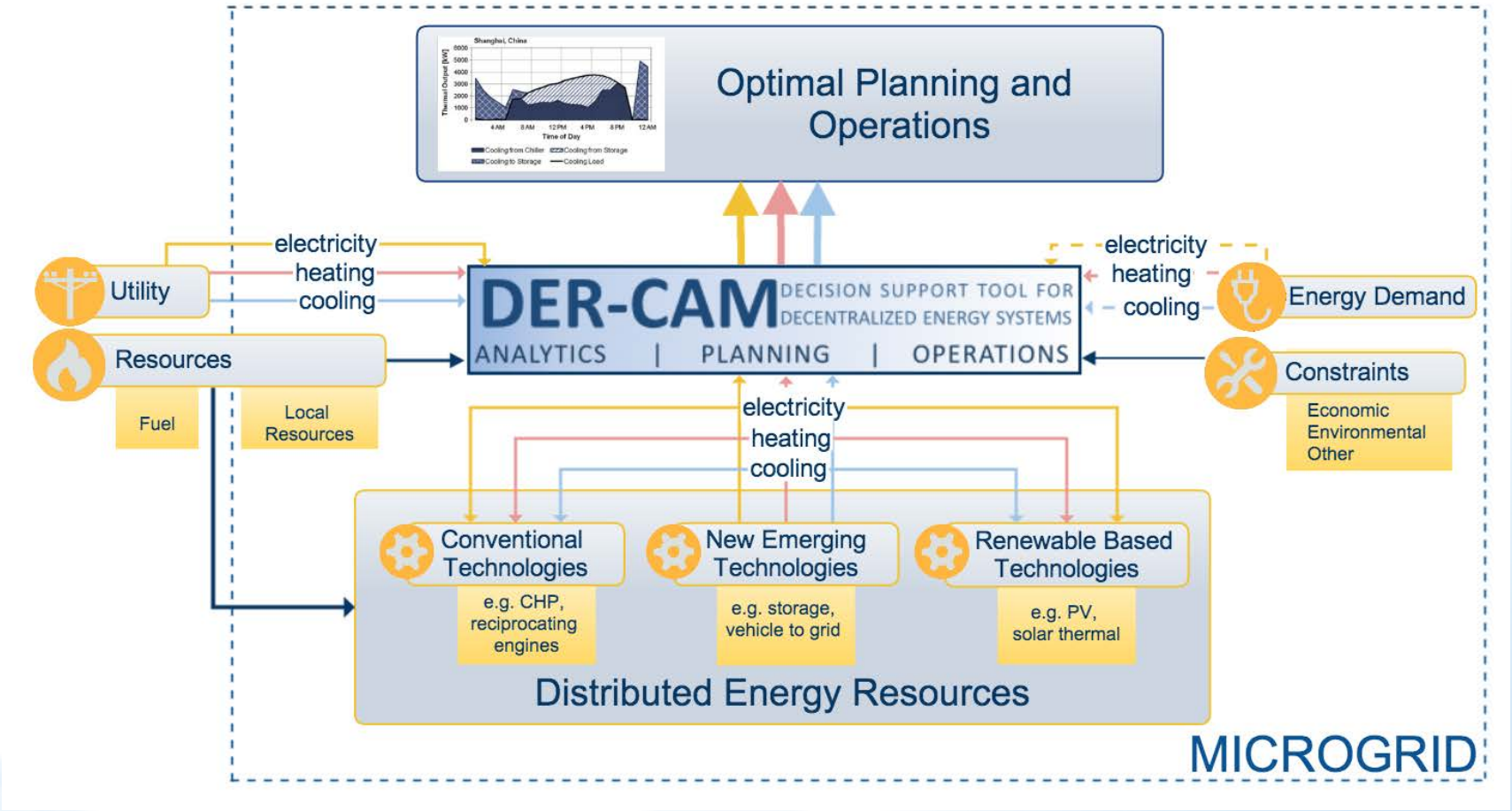
- Demonstrate how DER-CAM can be utilized to determine the energy mix for the BNL campus under two different operating modes:
  - Non-microgrid case - most economical and environmental solution to operate with a supply of utility power and without being a microgrid
  - Microgrid case - most economical and environmental solution to operate as a microgrid, including island mode

- BNL is partnering with LBNL to make this capability available to interested stakeholders in the northeast

# DER-CAM

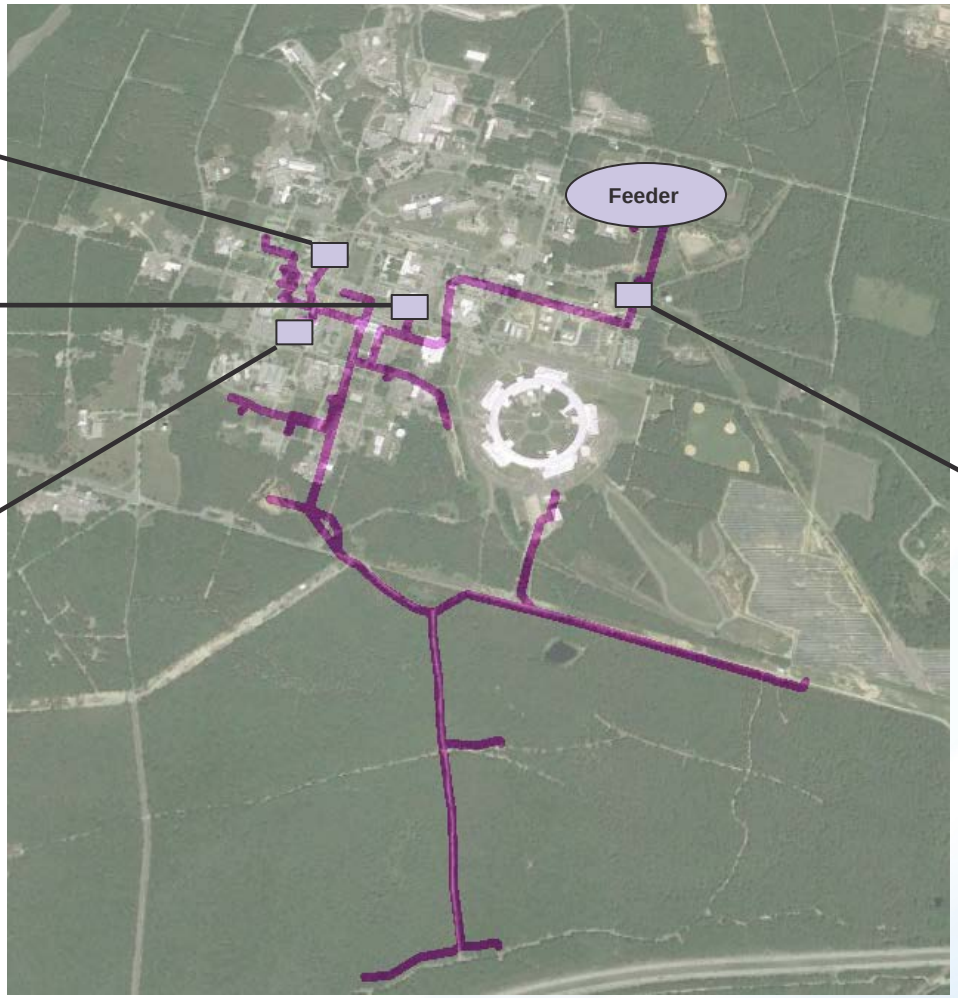
- Distributed Energy Resources Customer Adoption Model (DER-CAM) developed by Lawrence Berkeley National Laboratory (LBNL)
- Provide an analytical method of selecting the optimal combination of DER for individual customers, or for microgrid applications by addressing the following issues
  - Which is the cost-optimal configuration of distributed generation technologies that a specific customer can install?
  - What is the appropriate level of installed capacity of these technologies that minimizes cost?
  - How should the installed capacity be operated so as to minimize the total customer energy bill?
- The main objective of DER-CAM is to minimize either the annual costs or the $CO_2$ emissions of providing energy services or both

# DER-CAM




Schematic of information flow in DER-CAM

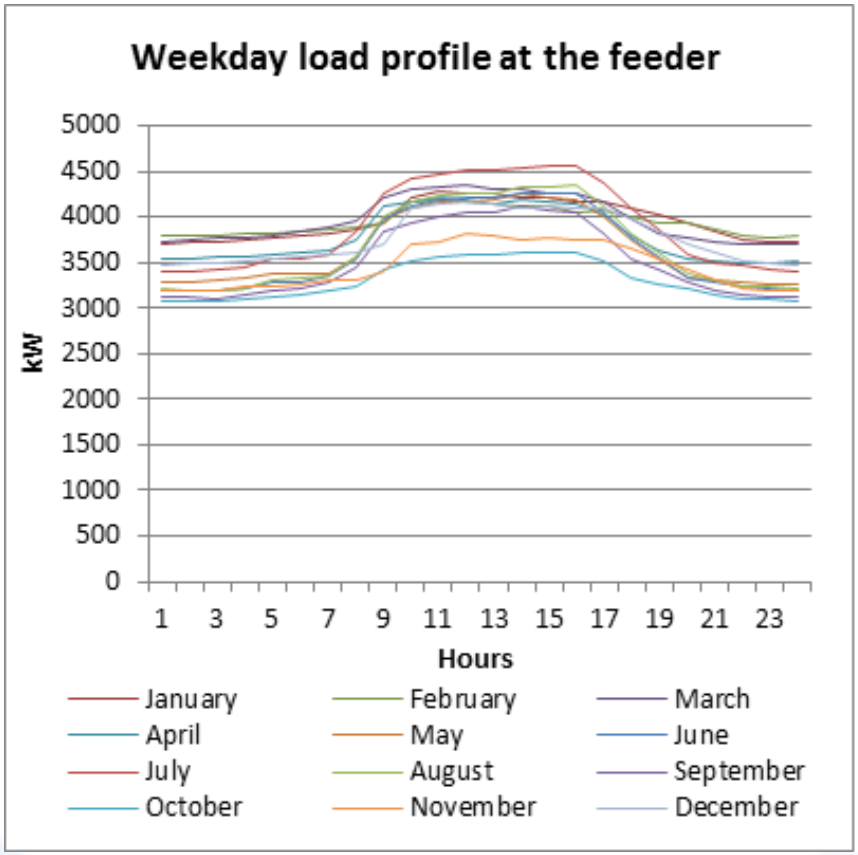
# BNL Electrical Network

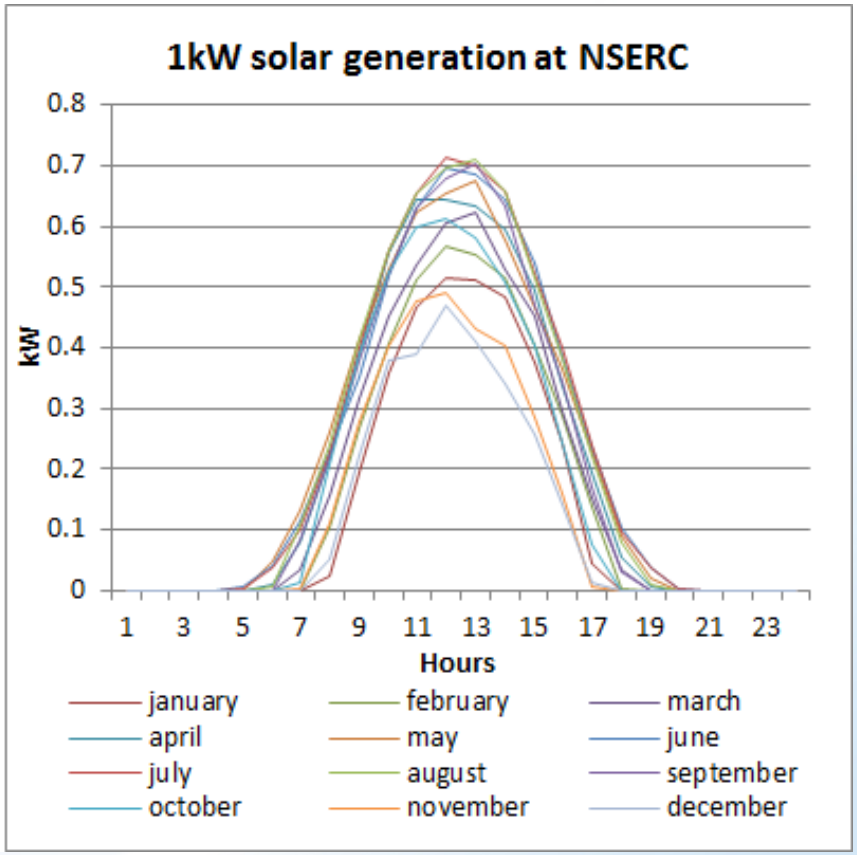


Northeast Solar Energy Research Center (NSERC)

The selected BNL electrical network for DER-CAM study

# BNL Circuit Data




key input data into DER-CAM

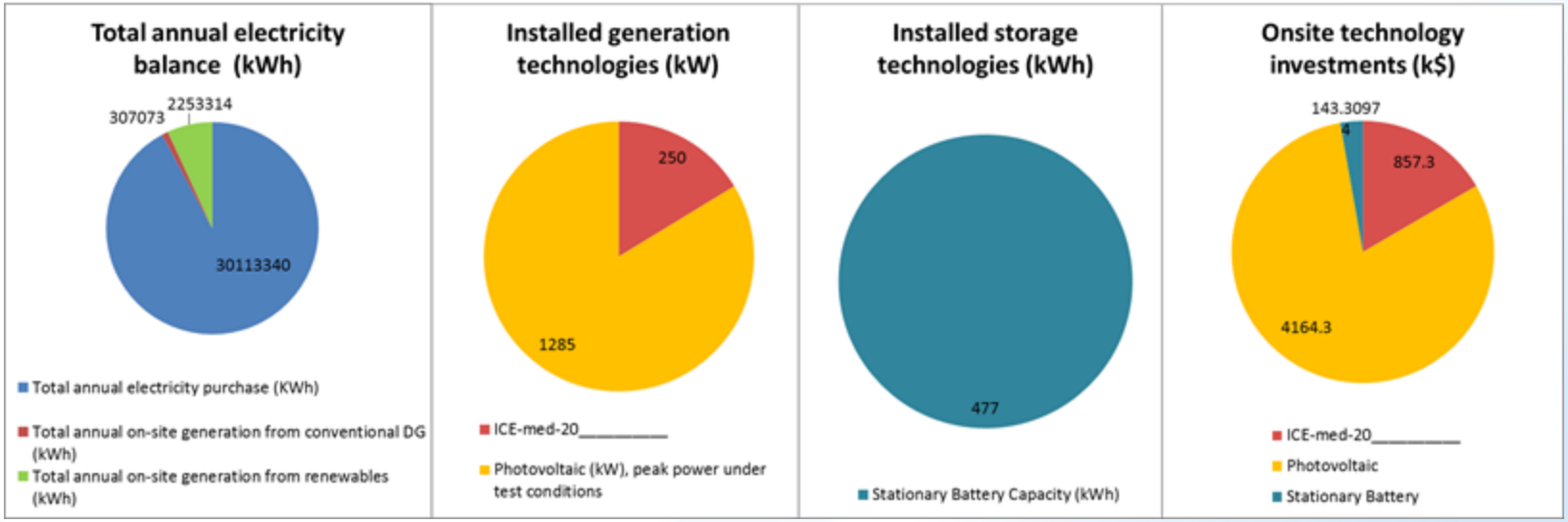
# Approach

- The load profile at the feeder and a normalized 1kW solar generation profile at NSERC are used as inputs for DER-CAM
- The standard commercial PSEG-LI electric rate is used for the local energy tariff structure
- The reference data provided by DER-CAM are used for the fuel and equipment investment prices.
- A multi-objective approach is used by considering the minimization of both the annual costs and $CO_2$ emissions. 75% weight is given to minimizing annual cost and 25% weight is given to minimizing $CO_2$ emissions

# Non-microgrid case results

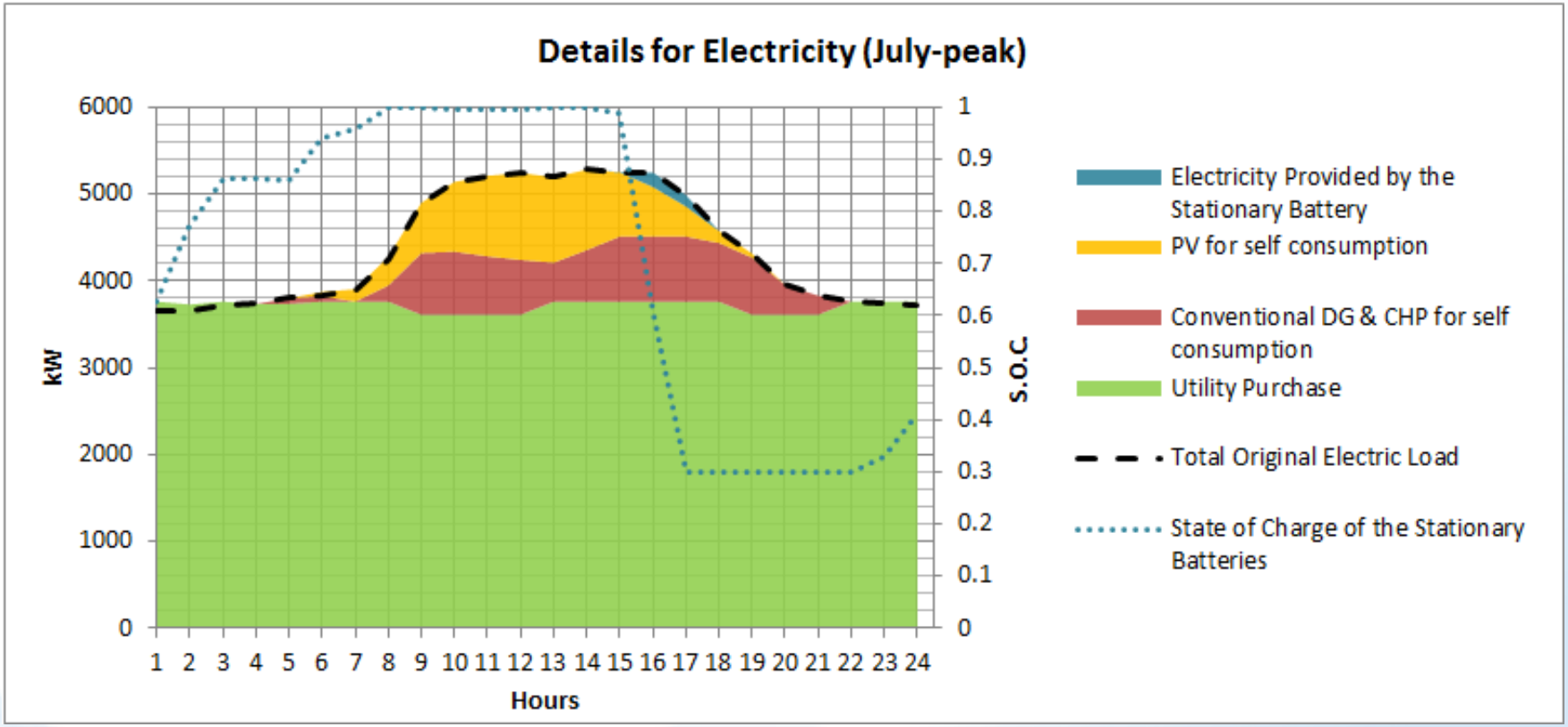
The annual operating costs and CO2 emissions savings by the investment for the non-microgrid case (does not include investment costs)

| | Reference Case (no investment) | Non-microgrid Case (investment) | Change | % Reduction |
|---|---|---|---|---|
| **Annual Energy Operating Costs ($)** | $4,073,282 | $3,556,799 | *- $516,483* | *12.68 %* |
| **Total Annual $CO_2$ emissions (kg)** | 16,656,949 kg | 15,547,613 kg | *- 1,109,336 kg* | *6.66 %* |




DER-CAM investment results for the non-microgrid case

# Non-microgrid case results

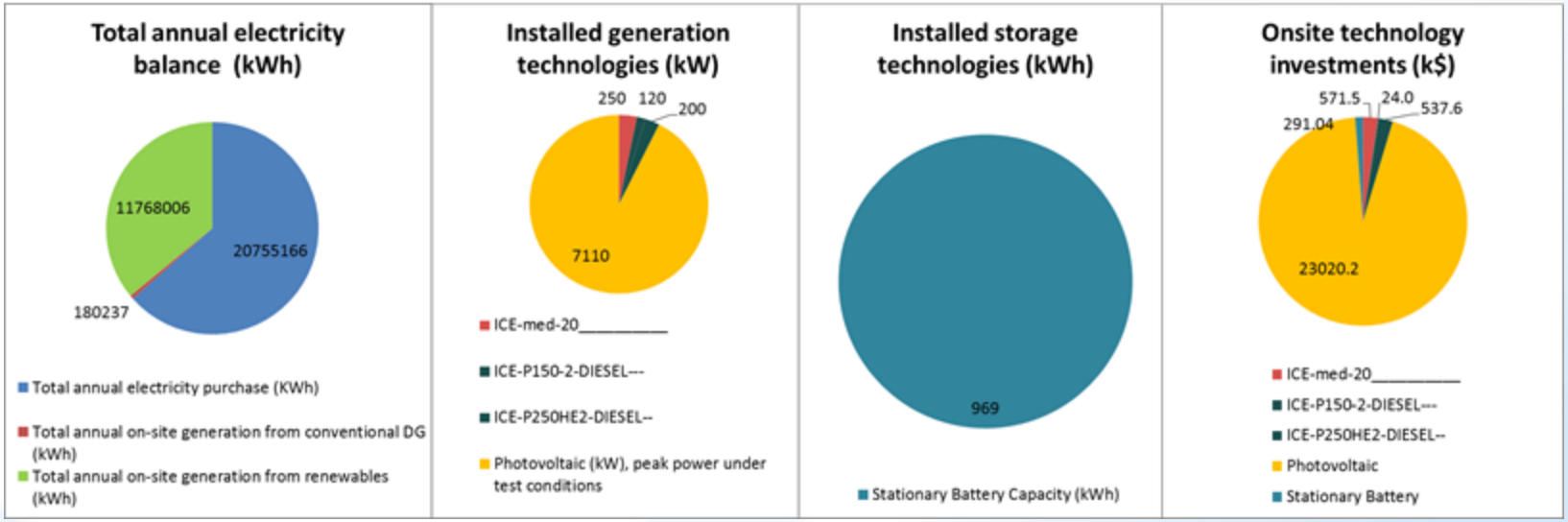



The detail electricity operation during peak day in July for the non-microgrid case

# Microgrid case results

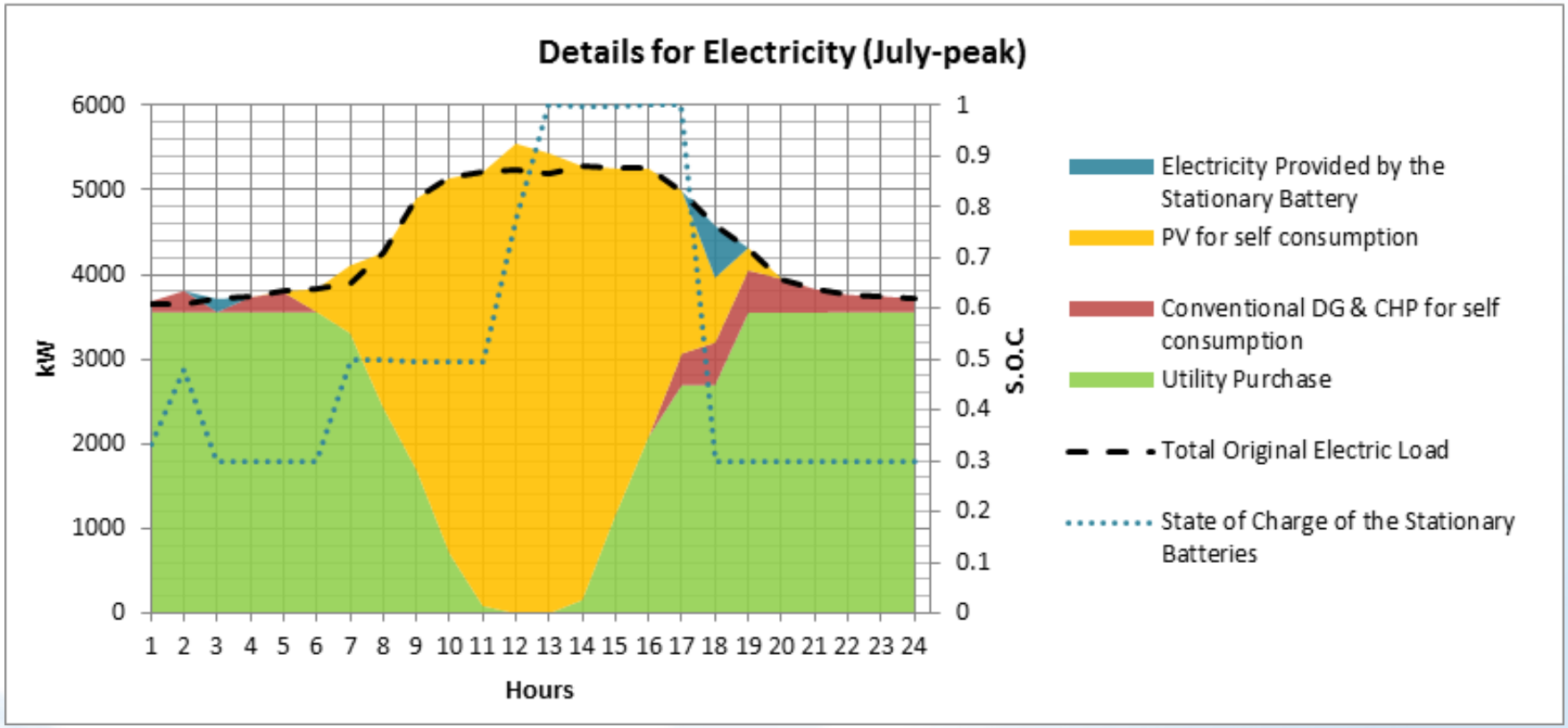
The annual operating costs and CO2 emissions savings by the investment for the microgrid case (does not include investment costs)

| | Reference Case (no investment) | Microgrid Case (investment) | Change | % Reduction |
|---|---|---|---|---|
| **Annual Energy Operating Costs ($)** | $4,073,282 | $2,577,616 | *- $1,495,666* | *36.72 %* |
| **Total Annual $CO_2$ emissions (kg)** | 16,656,949 kg | 10,731,794 kg | *- 5,925,155 kg* | *35.57 %* |




DER-CAM investment results for the microgrid case

# Microgrid case results




The detail electricity operation during peak day in July for the microgrid case

# Summary

- DER-CAM is a useful tool that can provide information on the optimal size, type and operation schedules for DER adoption based on specific site load and price information, and performance data for available equipment options
- The model also provides an estimate of the annual energy operating costs and total annual $CO_2$ emissions when the selected DERs are adopted
- In this feasibility study at BNL, we show that DER-CAM can be used for microgrid applications and to help implement net-zero buildings, campuses and communities.

# More Information

Please visit our website

http://www.bnl.gov/SET/DER-CAM.php