# GreenPeaks: Employing renewables to cut load in electric grids

In this project we investigate how renewable energy integration in electric grids can cut electricity demand---especially peak demands---on the grids. We devised GreenPeaks, an online algorithm for integrating renewable energy sources (such as solar panels) along with energy storage devices at homes to cut their electricity bills, cut their power draw (especially peak draw) from the grid, and make their electricity consumption profile grid friendly. GreenPeaks builds upon PeakCharge, our previous work on scaling distributed energy storage, published in ACM eEnergy-2013.

Summary of Findings (from initial experiments):

Although electric utility companies are incentivizing customers to cut peak demand, and deploy onsite renewable generation equipment (solar panels), in our experiments we found that naïve renewable integration methods (such as the common Net Metering approach) don't effectively cut peaks; this is mainly because solar energy harvest peaks earlier in the day, but residential peak demands typically occur around dinner times. To address these limitations of the Net Metering approach, we propose GreenPeaks, a system that intelligently integrates renewables & onsite energy storage. Initial experiments show that GreenPeaks can reduce an individual home's electricity bills up to 20%; further, it can cut aggregate peaks by 18%, and (on average) save generation costs up to 21%, showing more than 61% improvement over Net Metering and 66% improvement over PeakCharge (the previous approach). Below we include our results highlighting some of the findings.

Aggregate Reduction in Generation Costs (%)
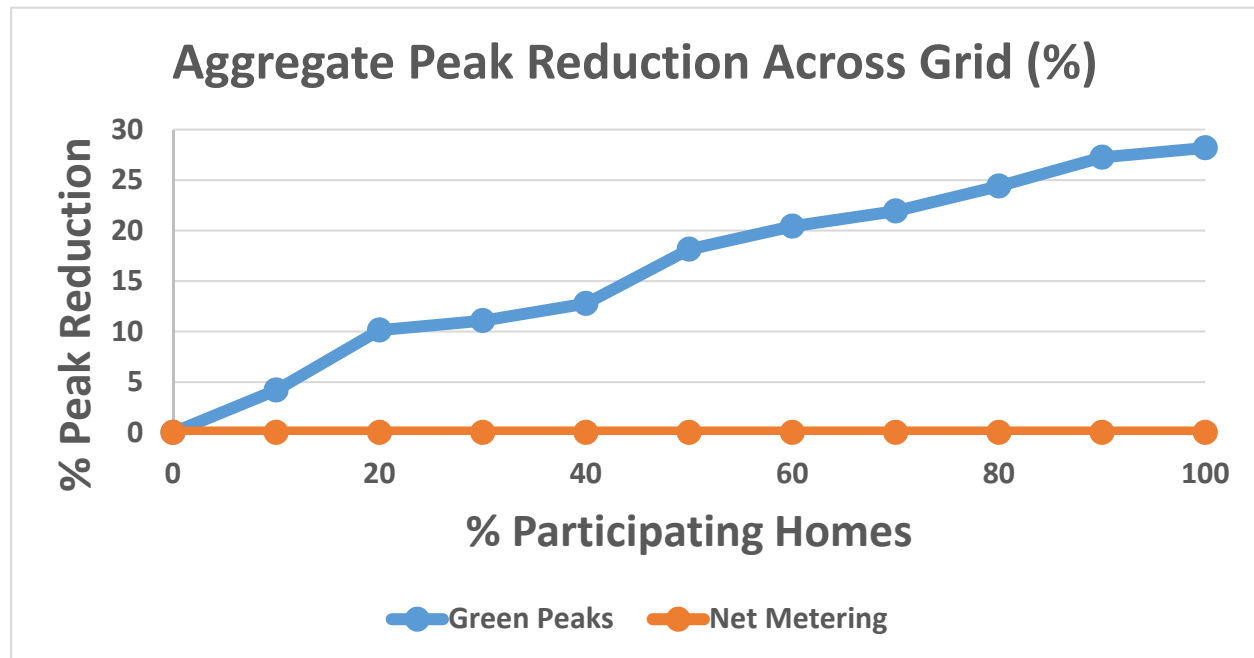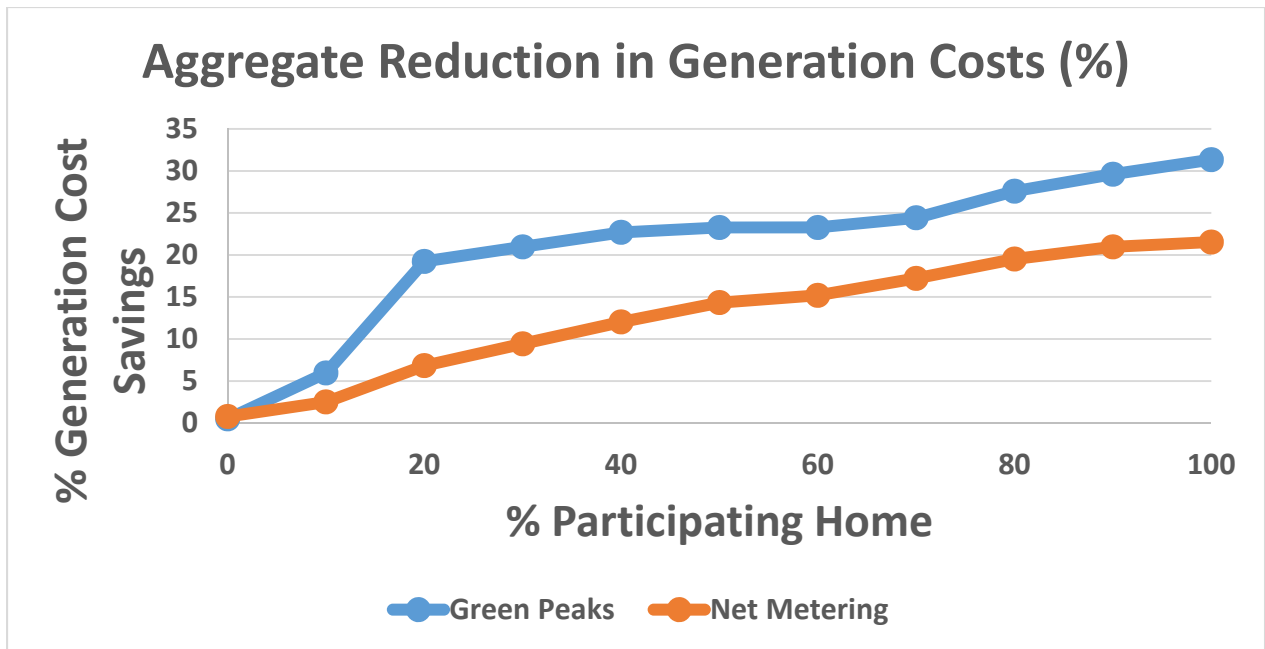
Completed Tasks:

We presented our initial algorithm, and results at CEJS brown bag presentation in fall-2016.
So far, we have completed the following tasks in the project, as outlined in the proposal:

- Literature survey for existing approaches to integrate renewable energy in grid.
- Coding for baseline renewable integration approaches to experiment and compare with GreenPeaks (to be devised as part of this work).
- Design of GreenPeaks---online battery charging-discharging algorithm to cut peaks and bills using renewables.
- Design of GreenPeaks system architecture to enable homes and buildings deploy GreenPeaks.
- Simulation code for GreenPeaks.
- Initial experiments with GreenPeaks, mostly for sanity check and bug fixes. (Some more functionality needs to be added and tested before final evaluation can be done.)
- Initial cost saving and peak reduction evaluation of GreenPeaks for individual homes.

Remaining Tasks:

Having completed the literature survey, algorithm design, GreenPeaks coding, and initial testing and experiments, most of the remaining tasks are related to preparing the work for publication:

- Extensive cost saving and peak reduction evaluation for individual homes.
- Extensive cost saving and peak reduction evaluation of GreenPeaks across the grid.
- Cost benefit analysis of GreenPeaks.
- Prepare manuscript for journal/conference publication.
- Final report for year-end submission.