Residential Microgrid

A Private Project

John Westerman
Site Overview

- Residence: San Diego, CA
- Built in 1989
- 2,202 ft²
- Four bedrooms
- Two Occupants
- Swimming Pool
- No Air Conditioning
- Tile Roof
- 100 Amp Electric Service
- Typical Electric Bill = $260/month

<table>
<thead>
<tr>
<th>Month</th>
<th>Consumption (kWh)</th>
<th>Teir 1 ($)</th>
<th>Teir 2 ($)</th>
<th>Total ($)</th>
</tr>
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<tbody>
<tr>
<td>Jul-16</td>
<td>801</td>
<td>$77.22</td>
<td>$179.60</td>
<td>$256.82</td>
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<tr>
<td>Aug-16</td>
<td>763</td>
<td>$77.22</td>
<td>$164.40</td>
<td>$241.62</td>
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<td>Sep-16</td>
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<td>$142.00</td>
<td>$219.22</td>
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<td>Oct-16</td>
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<td>$199.20</td>
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<td>$183.20</td>
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<tr>
<td>Mar-17</td>
<td>804</td>
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<td>$180.80</td>
<td>$258.02</td>
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<tr>
<td>Apr-17</td>
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<td>$156.80</td>
<td>$234.02</td>
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<td>May-17</td>
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<td>$190.40</td>
<td>$267.62</td>
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<tr>
<td>Jun-17</td>
<td>800</td>
<td>$77.22</td>
<td>$179.20</td>
<td>$256.42</td>
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<td>Total</td>
<td>9,764</td>
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<td>$3,142.64</td>
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</table>

Avg $/kWh $0.322
Project Scope

- Re-roof Entire Roof with New Tiles
- New Solar PV
- Replace Pool Thermal Heating Panels
- New Battery Energy Storage System
- Keep All Electric On-site (no export)
- Backup Power for Critical Loads:
  1. Cable Box, Router & VoIP Phone
  2. TV, Radio & Speakers
  3. Refrigerator/Freezer (qty=2)
  4. Garage Door Opener
- Electric Sub-Meter: Same Point as SDG&E Meter
Modeled Operation

- Accessed interval data from SDG&E online account
- Modeled PV generation with PVWatts
- Developed model to size energy storage based on PV sizing against load profile

- PV and Storage sized for no export to the grid
- Storage Charges from excess PV generation
Operation – Self Consumption Mode

Home Energy Gate...
Discharging

- 78%

Home Usage: 29.2 kWh

From Grid: 1.3 kWh

Microgrid 2019 Conference Series
Operation – Island Mode

- Average Load on Critical Circuits ~ 0.5 kW
- Critical Circuits:
  - Kitchen
  - Family Room
  - Master Bedroom
  - Garage
- PV isolated and able to operate when the grid is down
- PV meets load and excess generation used to charge storage
- Energy storage able to meet critical loads throughout the night

Forced Outages to observe system operation
Economics

- Year 0 Costs = $28,900
- Year 1 Savings = $15,610 (ITC, SGIP, and electric savings)
- Assumes a 2% escalation for utility electric costs

Utility Electric Costs
Annual Bill Before $3,100
Annual Bill After $360
Annual Savings $2,740

PV & Battery Cost
Installed PV System $15,900
Installed Battery $10,000
Total Cost $28,900

Incentives
ITC $8,670
SGIP $3,480
Total Incentives $12,150

Net Cost $13,750
Simple Payback 5.0
IRR 15%