Erinjiyan Mini-Grid Load Assessment & LDC Simulation Using Odyssey

Executive Overview

This technical summary provides a comprehensive analysis of the validated electricity demand data for the Erinjiyan Community Mini-Grid project. The assessment covers 1,772 customer connections with an average daily energy demand of 8,098.90 kWh and a peak demand of 545.43 kW.

The report presents detailed customer segmentation, load profile characteristics, and demand distribution analysis. The findings support strategic decision-making for infrastructure planning, capacity sizing, and operational optimization of the mini-grid system.

System Overview and Key Metrics

The Erinjiyan mini-grid serves 1,772 customer connections with an average daily energy demand of 8,098.90 kWh (monthly: 246,530.5 kWh). Peak demand reaches 545.43 kW at hour 18 (evening), with a system load factor of approximately 62%.

The system demonstrates mature mini-grid characteristics, anchored by a set of complementary productive and commercial facilities; the Erinjiyan Waterworks, PKT Hotel & Chalets, and a Telecom installation, layered on top of established residential, commercial, and public-use patterns. The ~62% load factor indicates efficient utilization throughout the day, aided by anchor loads that deliberately balance daytime solar consumption against nighttime battery draw.

Metric	*Value*
Average Daily Load	*8,098.90 kWh*
Average Monthly Load	*246,530.5 kWh*
Total Customer Connections	*1,772*

Peak Demand	*545.43 kW (at hour 18)*
System Load Factor	*~62%*

Load Profile and Peak Demand

The Erinjiyan mini-grid system exhibits a distinctive load profile characterized by a peak demand of 545.43 kW occurring at hour 18, corresponding to the evening period when energy consumption reaches its maximum intensity across all customer segments. This evening peak represents the convergence of multiple consumption patterns: residential households transitioning into evening activities such as cooking, lighting, and entertainment; commercial establishments completing their daily operations; and the PKT Hotel & Chalets ramping up its hospitality load. The magnitude of this peak establishes critical design parameters for the mini-grid, particularly regarding generation capacity, energy storage requirements, and network infrastructure dimensioning.

The temporal evolution of the load profile reveals a progressive rise from low early-morning demand levels, representing minimal base load from essential services and the continuous Telecom baseload. As the day advances, consumption increases steadily through the morning and afternoon hours, driven primarily by the Erinjiyan Waterworks anchor (which maintains a high daytime utilization factor), commercial operations, productive users, and public institutions such as schools and health facilities. This daytime load component provides important revenue-generating consumption during periods when solar generation would be at its peak, creating favorable supply–demand dynamics for a hybrid renewable mini-grid.

The evening peak at hour 18 carries significant implications for system design and operational planning. First, generation capacity must be sized to reliably meet this peak with appropriate reserve margins to ensure service quality and accommodate demand growth. Second, the timing of the peak suggests that energy storage can play a valuable role in load shifting and peak shaving, particularly given the concentrated nighttime hotel load. Third, the demand pattern indicates opportunities for demand-side management interventions, such as time-of-use tariffs or load-control programs, to moderate peak demand and improve overall system economics. The load profile subsequently declines following the evening peak as commercial activities cease and residential consumption tapers through the late evening and night hours, returning to baseline levels sustained primarily by essential lighting, security systems, refrigeration, and the constant Telecom load.

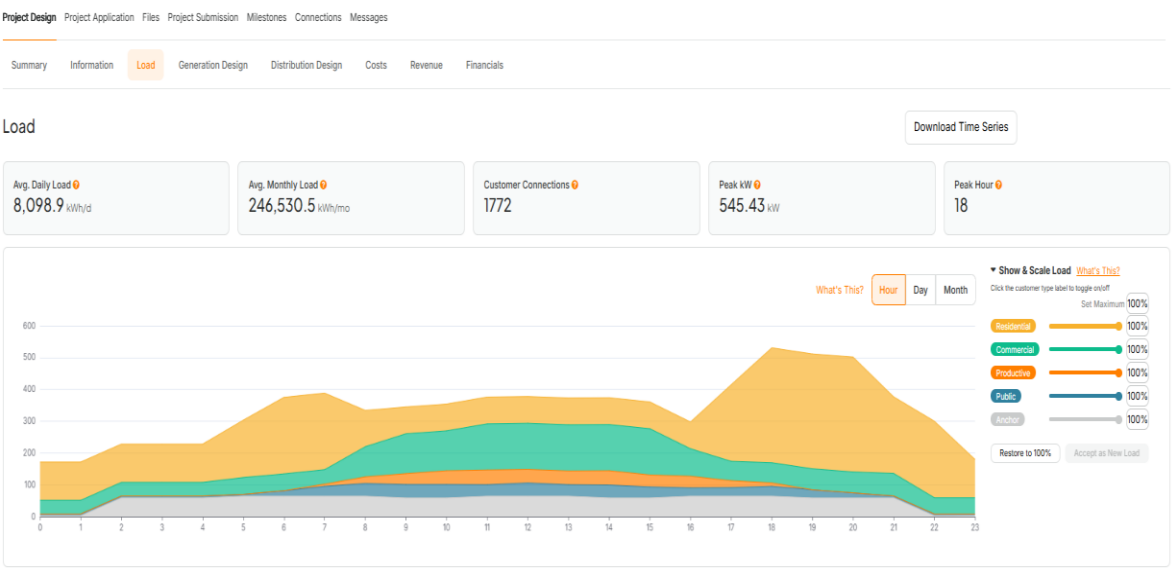

Figure 1: Erinjiyan Community Validated Load Duration Curve using Odyssey

Customer Segmentation Overview

The 1,772 connections are distributed across five categories: residential (89.4%), commercial (6.4%), public (3.2%), productive (0.9%), and anchor (0.2%). As is typical for community mini-grids, residential dominance by count contrasts with the demand distribution, where the commercial, productive, public, and anchor segments together contribute ~51% of consumption despite only ~11% of connections.

Segment	Customers	Percentage
R1 (Residential Tier 1)	*824*	*46.5%*
R2 (Residential Tier 2)	*600*	*33.9%*
R3 (Residential Tier 3)	*160*	*9.0%*
Commercial (C1)	*112*	*6.3%*
Commercial (C2)	*1*	*0.1%*
Public Institutions (Pub/Insti)	*56*	*3.2%*

Productive Use (P1)	*16*	*0.9%*
Anchor (A1)	*2*	*0.1%*
Anchor (A2)	*1*	*0.1%*
Total	**1772**	**100.0%**

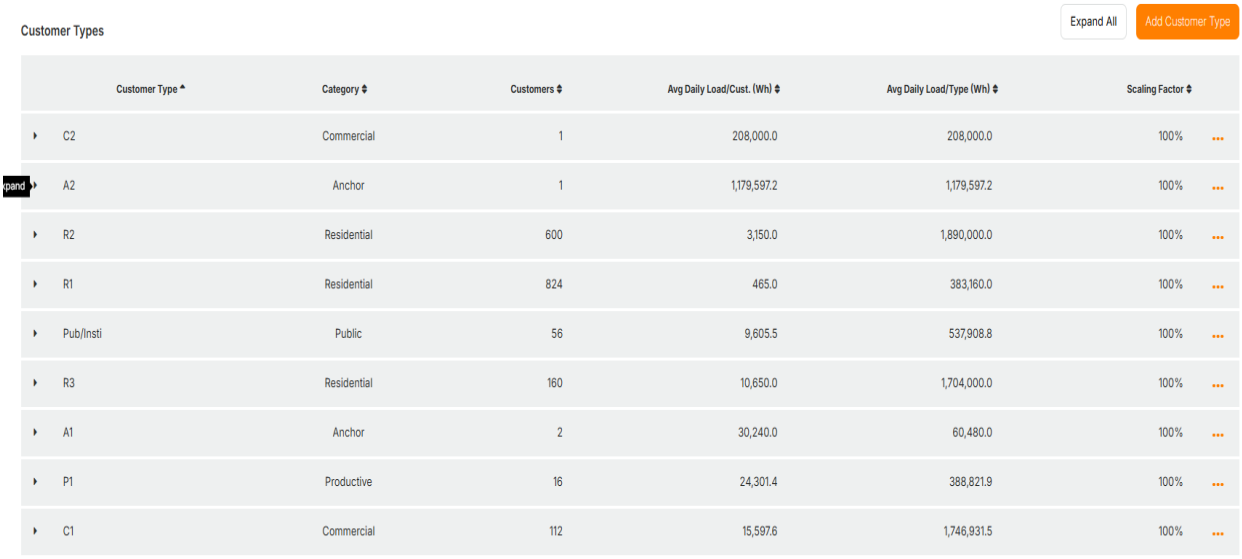

Figure 2: Erinjiyan Customer Segmentation from Odyssey Simulation.

Segment	Customers	Avg kWh/Day	Total kWh/Day	% Demand
Residential (R1)	*824*	*0.47*	*383.16*	*4.7%*
Residential (R2)	*600*	*3.15*	*1,890.00*	*23.3%*
Residential (R3)	*160*	*10.65*	*1,704.00*	*21.0%*
Commercial (C1)	*112*	*15.60*	*1,746.93*	*21.6%*
Commercial (C2)	*1*	*208.00*	*208.00*	*2.6%*
Public (Pub/Insti)	*56*	*9.61*	*537.91*	*6.6%*
Productive (P1)	*16*	*24.30*	*388.82*	*4.8%*
Anchor (A1)	*2*	*30.24*	*60.48*	*0.7%*
Anchor (A2)	*1*	*1,179.60*	*1,179.60*	*14.6%*
Total	*1,772*		*8,098.90*	*100.0%*

Segment Roles and Strategic Significance

Residential customers provide base volume and social inclusion through a three-tier structure accommodating varying affordability levels. Commercial establishments deliver consistent daytime demand with typical 08:00–20:00 operations, improving load factors. Productive users contribute high-intensity consumption via workshops and processing facilities.

Public institutions offer stable, predictable demand through schools, health centers, and administrative offices. Anchor customers provide critical baseload and concentrated revenue: despite representing under 1% of connections, the anchor segments (A1 + A2) together contribute ~15.3% of total demand, delivering financial stability and enhanced system utilization.

Community Anchor Loads

Three distinct facilities act as the primary anchor loads for the Erinjiyan microgrid. Integrating their contrasting profiles creates a highly complementary community load duration curve that maximizes system efficiency:

- **Erinjiyan Waterworks (~102.7 kWh/day):** *heavy pumping machinery operating predominantly during standard working days. It serves as the perfect daytime anchor — on weekdays it maintains a 65–70% utilization factor between 02:00 and 20:00, pushing high continuous draw directly into the solar production window to use direct solar generation and prevent heavy battery cycling. Over weekends, utilization drops to 30–35%, allowing the battery bank to fully replenish.*
- **PKT Hotel & Chalets (~50.0 kWh/day):** *hospitality services driven by evening lighting and overnight cooling. Its profile is the direct opposite of the Waterworks — utilization falls to ~3% during peak solar hours (09:00–15:00) and holds a constant ~30% from 21:00 to 05:00. This concentrated nighttime load relies on battery storage, but its daytime dip ensures it does not compete with the Waterworks for live solar power.*
- **Average Telecom Load (~1.8 kWh/day):** *a continuous, highly stable load at a flat ~70% utilization across all 24 hours, providing a reliable, non-fluctuating baseline that does not negatively impact community peak demand.*

Ultimately, these anchor loads balance each other on the load duration curve: the Waterworks consumes the bulk of the daytime solar yield while the Hotel utilizes stored energy at night, resulting in an efficient and financially viable system.

Demand Distribution Analysis

Total daily demand of 8,098.90 kWh is distributed across customer segments as follows. Residential consumption accounts for ~49.0% of total demand, subdivided into R1 (4.7%), R2 (23.3%), and R3 (21.0%). Non-residential consumption comprises ~51.0%, distributed among Commercial (24.2%, of which C1 is 21.6% and C2 is 2.6%), Public (6.6%), Productive (4.8%), and Anchor (15.3%, of which A2 is 14.6% and A1 is 0.7%).

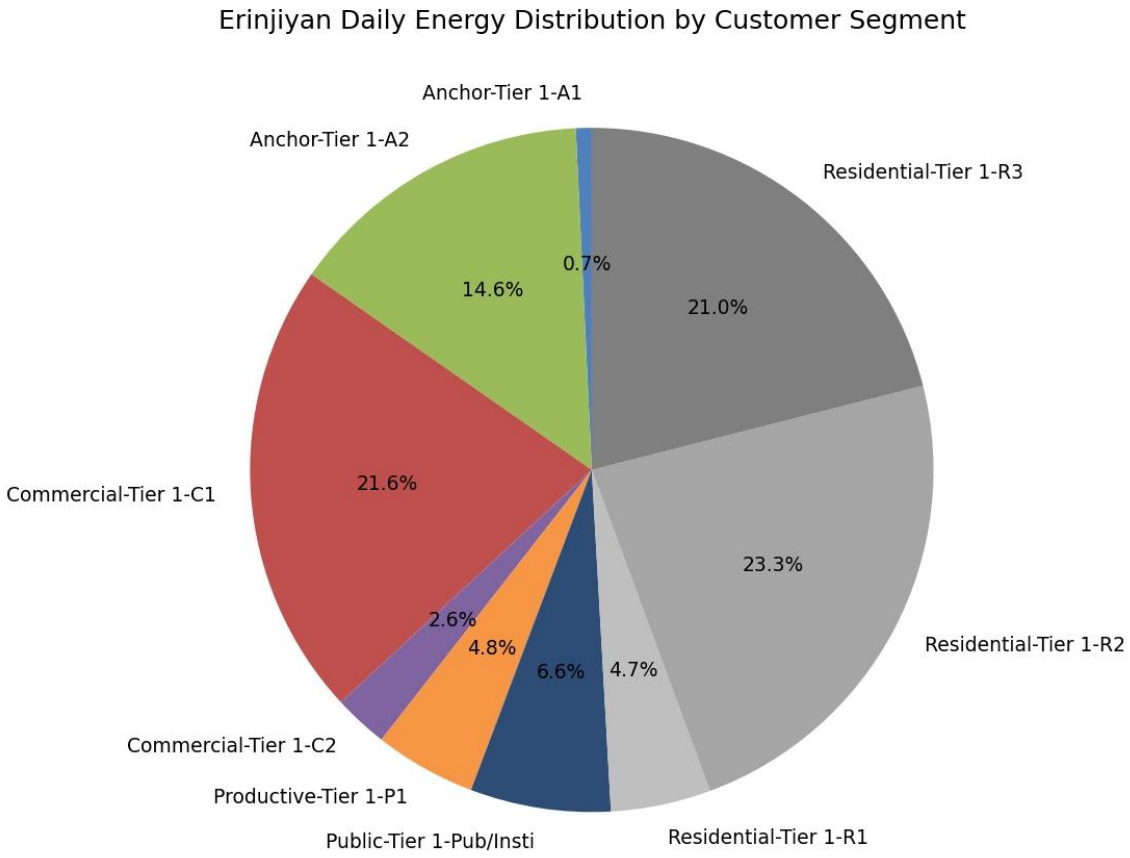

Figure 3: Daily Energy Distribution By Customer Segment.

Residential customers, representing ~89% of connections, consume ~49% of total energy. In contrast, non-residential customers account for only ~11% of connections yet consume ~51% of energy, indicating a balanced, diversified demand structure with a strong commercial and anchor base. Per-customer consumption varies dramatically across segments, spanning a wide range from R1 (0.47 kWh/day) to the A2 anchor (1,179.6 kWh/day), underscoring the central role of the anchor and commercial loads in underpinning the project's commercial viability.