Refined Project Proposal

Objective Function

$$Min\ C(T) = \sum_{i=1}^{24} P(t)g(t) + \alpha * (b_{ch}(t) + b_{dis}(t)) + gen_{on} * (C_{gen} * G_{rate})$$

$$where\ T = \{1, 2, ..., 24\}$$

Constraints

Constraint	Equation/Description
Energy Balance	$s(t) + b_{dis}(t) + G(t) + (gen_{on} * G_{rate}) = L(t) + b_{ch}(t) \quad \forall t \in T$
Solar Usage	$0 \leq s(t) \leq A(t) \quad \forall t \in T$
Battery Charge Limits	$B_{min} \leq SoC(t) \leq B_{max} \quad \forall t \in T$
State Of Charge Update	$SoC(t) = SoC(t-1) + (\eta_{char} \cdot b_{ch}(t)) - (\frac{1}{\eta_{dis}} b_{dis}(t)) \quad \forall t \in T$
State Of Charge Initial	$SoC(0) = SoC_{initial}$
Battery Draw Rate	$0 \leq b_{dis}(t) \leq R_{max} \quad \forall t \in T$
Battery Charge Rate	$0 \leq b_{ch}(t) \leq R_{max} \quad \forall t \in T$
Battery Binary	$u_{ch}(t) + u_{dis}(t) \leq 1 \quad \forall t \in T$
Non-negativity	$g(t) \geq 0 \quad \forall t \in T$
Reusability Constraint	$SoC(24) \geq SoC_{initial}$

Decision Variables

- g(t): Power drawn from the grid (kW). (Continuous, g(t)≥0)
- s(t): Power used from solar (kW). (Continuous, s(t)≥0)
- $b_{ch}(t)$: Power charged *to* the battery (kW). (Continuous, bch(t)≥0)
- $b_{dis}(t)$: Power discharged *from* the battery (kW). (Continuous, bdis(t)≥0)
- $u_{ch}(t)$: If the battery is charging. Binary.
- $u_{dis}(t)$: If the battery is discharging. Binary.

- $gen_{on}(t)$: If the generator is on or off. Binary.

State Variables

- SoC(t): The State of Charge (energy) in the battery at the *end* of hour t (kWh).

Solving Process:

We will implement this MILP using Pyomo, an open-source Python library. This will allow us to define our decision variables, objective function, and constraints. After building the model, Pyomo should have optimizer functions that we can tune to find the optimal solution.

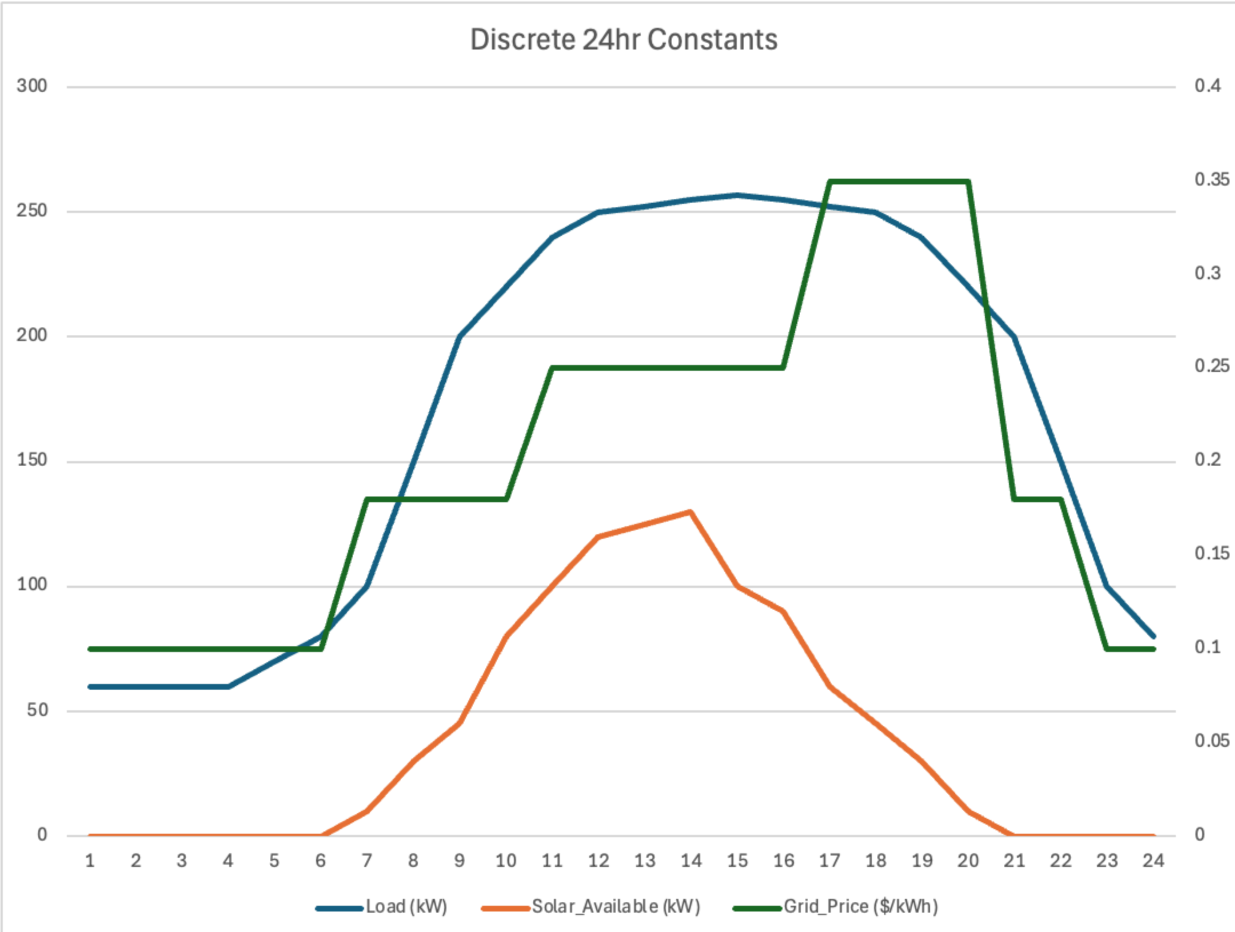
Constants:

Parameter	Symbol	Value	Unit
Load	L(t)	*See table below	kWh
Available Solar	A(t)	*See table below	kWh
Grid Price	P(t)	*See table below	$/kWh
Max Battery Capacity	B_max	500	kWh
Min Battery Capacity	B_min	100	kWh
Initial State of Charge	SoC_initial	250	kWh
Max Charge and Discharge Rate	R_max	125	kW
Charging Efficiency	eta_ch	0.95	(decimal)
Discharging Efficiency	eta_dis	0.95	(decimal)
Degradation Cost	alpha	0.025	$/kWh
Generator Capacity (must run at max capacity)	C_gen	100	kW
Generator Rate (includes fuel and startup and maintenance)	G_rate	0.32	($/kWh)

Discrete 24hr Constants:

Hour	**L(t) (kW)**	**A(t) (kW)**	**P(t) ($/kWh)**
1	60	0	0.1

2	60	0	0.1
3	60a	0	0.1
4	60	0	0.1
5	70	0	0.1
6	80	0	0.1
7	100	10	0.18
8	150	30	0.18
9	200	45	0.18
10	220	80	0.18
11	240	100	0.25
12	250	120	0.25
13	252	125	0.25
14	255	130	0.25
15	257	100	0.25
16	255	85	0.25
17	252	60	0.35
18	250	45	0.35
19	240	30	0.35
20	220	0	0.35
21	200	0	0.18
22	150	0	0.18
23	100	0	0.1
24	80	0	0.1



Discrete 24hr Constants
300
250
200
150
100
50
0
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Load (kW)
Solar_Available (kW)
Grid_Price ($/kWh)