Semi-Hybrid Solar Setup Guide

GUARANTEED BENEFITS: 30-40% monthly savings + NO BROWNOUT protection!

Budget: Around ₱35,000 | Para sa Very Basic Household (₱500 to ₱1000/month bill) - DIY

SECTION 1: TITLE & DESCRIPTION

KEY BENEFITS AT A GLANCE

⚡ NO BROWNOUT PROTECTION

- Battery backup automatically kicks in during power outages
- 4-8 hours of emergency power (depending on usage)
- Peace of mind for your family
- No more lost productivity or spoiled food

30-40% MONTHLY SAVINGS

- Daytime solar power = FREE electricity (9 AM - 1 PM)
- Nighttime = normal grid billing (2 PM - 9 AM)
- Average monthly bill: ₱1,000 → ₱600-700
- **Annual savings: ₱3,600-4,800**
- **5-year savings: ₱18,000-24,000**

SECTION 2: OVERVIEW - Ano ang Semi-Hybrid Setup?

> ***REMEMBER:*** *This system gives you* ***NO BROWNOUT + 30-40% SAVINGS*** *- the perfect combination for tight budgets!*

What is Semi-Hybrid?

Definition: Isang solar system na may **MANUAL operation** - hindi fully automatic. Kailangan mong mag-switch ng breaker at specific times.

Paano ito gumagana:

- **Peak Sun Hours (9 AM - 1 PM):** Solar panels ang nagpapagana ng bahay mo directly (4-hour peak sun window) - **YOU turn ON breaker**
- **Afternoon (1 PM - 2 PM):** YOU turn OFF breaker at 2 PM, grid connection ang source (araw ay lumalabas pero hindi na ganoon ka-lakas)
- **Nighttime (2 PM - 9 AM):** Grid connection lang (walang araw) - **BREAKER OFF**
- **Brownout/Emergency:** YOU turn ON breaker, battery kicks in automatically para sa backup power
- **Grid Connection:** Laging available, hindi lang backup

Why 4-hour peak sun window?

- **9 AM - 1 PM:** Araw ay perpekto, init ay malakas, solar panels ay maximum output
- **1 PM - 4 PM:** Araw ay nandoon pa pero nagsisimula nang lumabo, solar output ay bumababa
- **4 PM onwards:** Araw ay malapit nang lumubog, solar output ay minimal
- **Result:** Realistic 4-hour peak sun hours lang sa Pilipinas (not 6-8 hours)

The Perfect Balance:

- ✓ **Affordable** (₱40,000-45,000 vs ₱80,000+ for full hybrid)
- ✓ **Simple** (manual breaker switching, no complex automation)
- ✓ **Effective** (30-40% savings + brownout protection)
- ✓ **Reliable** (fewer components = fewer things to break)

Brownout Protection:

- When power goes out → You manually turn ON breaker
- Battery automatically supplies power to your home
- Duration: 4-8 hours (depending on usage)
- Perfect for Philippines where brownouts are common!

Daytime Savings (30-40%):

- 9 AM - 1 PM: Solar powers your home (FREE)
- At 2 PM: You manually turn OFF breaker
- Grid takes over (normal Meralco billing)
- Simple, effective, no automation needed

Fully Hybrid (Automatic): System automatically switches between solar, battery, and grid
Semi-Hybrid (Manual): You manually control when to switch from solar to grid

Advantage: Saves money

Disadvantage: Requires user action at specific times

Manual Operation Schedule

- **9 AM:** YOU turn ON breaker from inverter to ATS (solar power starts)
- **2 PM:** YOU turn OFF breaker from inverter to ATS (switch to grid)
- **9 AM next day:** Repeat
- **Brownout:** YOU turn ON breaker (battery kicks in automatically)
- **After Brownout:** YOU turn OFF breaker again (back to grid)

Why This Setup is PERFECT for Tight Budgets

- ✓ **Pinakamurang entry-level option** (₱35k-50k lang)
- ✓ **30-40% savings sa daytime consumption** (solar during peak hours)
- ✓ **No brownout risk** (battery backup available)
- ✓ **Battery upgradable** (pwedeng mag-add ng capacity later)
- ✓ **Perfect para sa super tipid na setup** (very basic household)

SECTION 3: LOAD ANALYSIS

Step 1: List ng Typical Filipino Home Appliances

Very Basic Household Scenario:

Appliance	Wattage	Daily Usage	Daily kWh	Notes
LED Lights (6x)	10W each (60W total)	6 hours	0.36 kWh	LED lang, walang incandescent
Ceiling Fan	50W	6 hours	0.3 kWh	Essential para sa comfort
TV (LED)	80W	4 hours	0.32 kWh	LED TV lang, hindi plasma
Refrigerator	150W	24 hours	3.6 kWh	Tumatakbo 24/7
Laptop/Charger	60W	3 hours	0.18 kWh	Work/study
Mobile Chargers (2x)	5W each (10W)	3 hours	0.03 kWh	Multiple devices
WiFi Modem/Router	10W	24 hours	0.24 kWh	Always on (internet)
Washing Machine	500W	1.5 hours/week	0.75 kWh/week	Occasional use
TOTAL DAILY	-	-	**~4.79 kWh**	-

Step 2: Peak Load Calculation

Peak Load = Highest wattage kapag maraming appliances ang tumatakbo together

Scenario 1: Peak Sun (9 AM - 1 PM)

- Lights: 0W (araw na, walang lights)
- Fan: 50W
- TV: 0W (hindi naka-on sa umaga)
- Refrigerator: 150W
- Laptop: 60W
- WiFi Router: 10W
- **TOTAL PEAK: 270W ✅ OK - Under 1kW**

Scenario 2: Afternoon (1 PM - 4 PM, before manual switch)

- Lights: 0W (araw pa rin)
- Fan: 50W
- TV: 80W
- Refrigerator: 150W

- Laptop: 60W
- WiFi Router: 10W
- **TOTAL PEAK: 350W ✓ OK**

Scenario 3: Gabi (6 PM - 9 PM, after manual switch to grid)

- Lights: 60W
- Fan: 50W
- TV: 80W
- Refrigerator: 150W
- Laptop: 60W
- WiFi Router: 10W
- **TOTAL PEAK: 410W ✓ OK**

Scenario 4: Washing Machine (if running during peak sun)

- Lights: 0W
- Fan: 50W
- Refrigerator: 150W
- WiFi Router: 10W
- **Washing Machine: 500W**
- **TOTAL PEAK: 710W ✓ OK but high - avoid during peak sun if possible**

Step 3: Load Restrictions (CRITICAL!)

✗ HINDI PWEDENG GAMITIN (Exceed 1kW or consume too much):

- ✗ Rice cooker (800-1200W)
- ✗ Electric heater (1500-3000W)
- ✗ Electric kettle (1500-2000W)
- ✗ Air conditioner (1000-2000W)
- ✗ Iron (1000-1500W)
- ✗ Oven (1500-3000W)
- ✗ Multiple high-wattage appliances simultaneously

✓ PWEDENG GAMITIN (Under 1kW):

- ✓ LED lights
- ✓ Ceiling fans
- ✓ LED TV
- ✓ Refrigerator
- ✓ Laptop/chargers
- ✓ Mobile phones
- ✓ Small fans
- ✓ LED bulbs

- ✓ WiFi modem/router
- ✓ Washing machine (occasional use, 500W)

Step 4: Realistic Daily Consumption (4-Hour Peak Sun Model)

Peak Sun Hours (9 AM - 1 PM = 4 hours):

- Fan: 4 hours × 50W = 0.2 kWh
- Refrigerator: 4 hours × 150W = 0.6 kWh
- Laptop: 2 hours × 60W = 0.12 kWh
- WiFi Router: 4 hours × 10W = 0.04 kWh
- **Peak Sun Total: 0.96 kWh** (covered by solar)

Afternoon (1 PM - 2 PM = 1 hour, before manual switch):

- Fan: 1 hour × 50W = 0.05 kWh
- TV: 1 hour × 80W = 0.08 kWh
- Refrigerator: 1 hour × 150W = 0.15 kWh
- Laptop: 0.5 hour × 60W = 0.03 kWh
- WiFi Router: 1 hour × 10W = 0.01 kWh
- **1 PM-2 PM Total: 0.32 kWh** (from solar, last hour)

After Manual Switch (2 PM - 8 PM = 6 hours, grid power):

- Lights: 0W (araw pa)
- Fan: 6 hours × 50W = 0.3 kWh
- TV: 4 hours × 80W = 0.32 kWh
- Refrigerator: 6 hours × 150W = 0.9 kWh
- Laptop: 2 hours × 60W = 0.12 kWh
- WiFi Router: 6 hours × 10W = 0.06 kWh
- **2 PM-8 PM Total: 1.7 kWh** (from grid)

Night (8 PM - 9 AM = 13 hours, grid power):

- Lights: 5 hours × 60W = 0.3 kWh
- Fan: 6 hours × 50W = 0.3 kWh
- TV: 1 hour × 80W = 0.08 kWh
- Refrigerator: 13 hours × 150W = 1.95 kWh
- Laptop: 1 hour × 60W = 0.06 kWh
- WiFi Router: 13 hours × 10W = 0.13 kWh
- **Night Total: 2.82 kWh** (from grid)

DAILY BREAKDOWN:

- **Peak Sun (9 AM-1 PM): 0.96 kWh** = covered ng solar (FREE) ✓
- **Last hour before switch (1-2 PM): 0.32 kWh** = from solar

- **After manual switch (2 PM-8 PM): 1.7 kWh** = from grid
- **Night (8 PM-9 AM): 2.82 kWh** = from grid
- **Total from Grid: 4.52 kWh** (normal billing)
- **Total Daily: 5.8 kWh**

IMPORTANT:

- Peak Sun consumption (0.96 kWh) = covered ng solar panels (SAVINGS!)
- Rest ng day (4.52 kWh) = from grid (normal billing)
- Battery = brownout backup lang (emergency use)

SECTION 4: COMPONENT SIZING & DETAILED COMPUTATIONS

Component 1: Solar Panels

Sizing Calculation

Formula: Solar Panel Wattage = Peak Sun Consumption ÷ Peak Sun Hours ÷ System Efficiency

Given:

- Peak Sun Consumption: 0.96 kWh (9 AM - 1 PM)
- Peak Sun Hours: 4 hours (realistic sa Pilipinas)
- System Efficiency: 75% (accounting for losses, dust, angle, etc.)

Calculation:

- Solar Panel Wattage = 0.96 kWh ÷ 4 hours ÷ 0.75
- Solar Panel Wattage = 0.96 ÷ 3
- Solar Panel Wattage = **320W ≈ 400W**

But wait! We need to account for:

- Cloudy days (Philippines has rainy season)
- Panel degradation over time
- Wiring losses
- Controller efficiency
- **Real-world output never reaches 100%**

Realistic Sizing: 500W Jinko Panels (1 panel)

- Perfect match sa One Solar SCC 900W max input
- Upgradable to 1000W total (2x 500W in series)
- Accounts for degradation
- Future-proof para sa expansion

Recommendation para sa 1kW Semi-Hybrid

- **Best Choice:** 1x 500W Jinko Monofacial = 500W total
- Cost: ₱5,000-6,500 per panel
- **Upgrade Path:** Add 1x 500W Jinko later = 1000W total (series connection)
- **SCC Compatibility:** One Solar CM-60A max input = 900W (safe kahit 1000W)
- Better reliability at flexibility

Jinko 500W Panel Specifications (from datasheet)

Spec	Value
Pmax (Max Power)	500W
Vmp (Max Power Voltage)	33.95V
Voc (Open Circuit Voltage)	40.38V
Imp (Max Power Current)	14.73A
Isc (Short Circuit Current)	15.63A
Temperature Coefficient	-0.35%/°C

Component 2: Solar Charge Controller (SCC)

Selected: One Solar MPPT Solar Charge Controller CM-60A

Shopee Link: (Recommended)
1. One Solar 60a
2. SRNE 60a

3. Zamdon 60a

Why ONE SOLAR?

- ✅ Excellent efficiency (98%+)
- ✅ AC charging option (15A) - pero hindi recommended para sa tight budget
- ✅ Pure sine wave output (safe para sa appliances)
- ✅ MPPT technology (25-30% more power than PWM)
- ✅ 12V/24V auto-detection
- ✅ Affordable (₱4,000-6,000)
- ✅ Reliable sa Philippine market
- ✅ Good after-sales support
- ✅ Compatible sa Jinko panels at One Solar inverter
- ✅ Widely available sa Shopee

Charge Current (Panel to Battery):

- Jinko 500W Max Current (Imp): 14.73A
- One Solar CM-60A Max Input: 60A
- **Status: ✅ Compatible** (14.73A < 60A)

Discharge Current (Battery to Inverter):

- 1000W Inverter at 12V: 1000W ÷ 12V = 83.3A
- One Solar SCC can handle: 60A output max
- **Note:** SCC doesn't limit discharge, inverter draws directly from battery

One Solar MPPT CM-60A Specifications (from datasheet)

Spec	Value
Model	CM-60A
System Voltage	12V/24V/36V/48V (auto-detect)
Max Charge Current	60A
Max PV Input Power @ 12V	900W
Max PV Input Power	12V @ 900w

Spec	Value
Solar Operating Voltage	12V @ 18-200v
Efficiency	98%+
Temperature Range	-20°C to +60°C
Battery Type	LiFePO4, Lead-Acid, Gel, Liquid, Li-ion

Component 3: Inverter

Selected: One Solar 1000W Pure Sine Inverter (Out of Stock)

Shopee Link: (Recommended)
1. Snadi 12v 1kw
2. SNAT 12v 1kw
3. Zamdon 12v 1kw
4. One Solar 12v 1kw

Why ONE SOLAR Inverter?

- ✓ Pure sine wave (safe para sa appliances)
- ✓ 1000W capacity (handles 500w + load + margin)
- ✓ 12V input (matches battery system)
- ✓ Affordable (₱5,000-7,000)
- ✓ Reliable sa Philippine market
- ✓ Same brand as SCC (consistent support)
- ✓ Widely available sa Shopee

Inverter Sizing Calculation

Formula: Inverter Wattage = Peak Load × 1.25 (safety factor)

Given:

- Peak Load: 500W (maximum simultaneous appliances)
- Safety Factor: 1.25 (25% buffer)

Calculation:

- Inverter Wattage = 500W × 1.25 = 625W

But for reliability: 1000W inverter recommended

- Provides good margin
- Better longevity
- Handles inrush currents (fridge startup, etc.)

One Solar 1000W Inverter Specifications

Spec	Value
Input Voltage	12V DC
Output Voltage	230V AC
Output Frequency	50Hz
Continuous Power	1000W
Peak Power	1250W (for 3 seconds)
Efficiency	94-96%
Waveform	Pure Sine Wave
Temperature Range	-10°C to +60°C

Component 4: Battery - LiFePO4 12V 100Ah

Selected: 12V 100Ah LiFePO4 Battery

Shopee Link: (Recommended)
1. Solar Homes 12v 120ah
2. Gentai 12v 100ah
3. CST 12v 100ah

Why LiFePO4?

- ✅ Safest lithium chemistry (no thermal runaway)
- ✅ Longest lifespan (5,000+ cycles)
- ✅ Best for solar applications
- ✅ Works well sa tropical climate
- ✅ Widely available sa Shopee

Battery Sizing Calculation

Formula: Battery Capacity = Peak Load × Duration ÷ Depth of Discharge

Given:

- Peak Load: 500W
- Brownout Duration: 2-4 hours (typical sa Philippines)
- Depth of Discharge: 80% (LiFePO4 safe limit)

Calculation for 2-hour brownout:

- Energy Needed: 500W × 2 hours = 1 kWh = 1000 Wh
- Battery Capacity: 1000 Wh ÷ (12V × 0.80) = 104 Ah

But for reliability: 200Ah recommended

- Accounts for partial discharge
- Better battery longevity
- Handles unexpected longer brownouts
- Upgradable later

12V 100Ah LiFePO4 Specifications

Spec	Value
Nominal Voltage	12.8V
Capacity	100Ah
Energy	1280 Wh

Spec	Value
Max Continuous Discharge	100A
Max Charge Current	60A
Cycle Life	5,000+ cycles
Warranty	10 years
Temperature Range	-20°C to +60°C

Battery Upgrade Path

- **Current:** 1x 12V 100Ah = 1280 Wh
- **Future:** 2x 12V 100Ah in parallel = 2560 Wh (double capacity)
- **Cost:** +₱25,000-30,000 for second battery
- **Installation:** Simple parallel connection (same voltage)

Note: Panel expansion is LIMITED by SCC specs (max 60A input = ~720W panels)

Component 5: Breakers & Wire Sizing

Wire Sizing Reference Chart (Based on Philippine Market Availability)

Wire Size (mm²)	Closest AWG	Max Amperage (Copper - 75°C)	Application
1.5	16	18A	Small loads
2.5	14	25A	Light loads

Wire Size (mm²)	Closest AWG	Max Amperage (Copper - 75°C)	Application
3.5	12	32A	Medium loads
4	12	35A	Medium loads
5.5	10	45A	High loads
6	10	50A	High loads
8	8	60A	Very high loads
10	8	70A	Very high loads
16	6	100A	DC high current
25	4	140A	Battery cables
35	2	180A	Battery cables
50	1	225A	Battery cables
70	1/0	280A	Battery cables

Note: All ratings based on copper wire at 75°C (Philippine ambient temperature)

Recommended Wire Sizes for 1kW Semi-Hybrid Setup

Based on Component Specifications:

Circuit	Current	Recommended Wire Size	Recommended Breaker	Notes
Solar Panel to SCC	14.73A (Imp)	6mm²	20A DC MCB	Jinko 500W panel specs
SCC to Battery (12V)	60A max (SCC spec)	35mm²	60A DC MCB	Charge current max

Circuit	Current	Recommended Wire Size	Recommended Breaker	Notes
Battery to Inverter (12V)	83.3A (1000W ÷ 12V)	35mm²	100A DC MCCB	Discharge current
Inverter AC Input	8.7A (2000W ÷ 230V)	6mm²	15A AC MCB	AC circuit
Inverter to ATS (Output)	8.7A	6mm²	20A AC MCB	Manual switch circuit
ATS to Home Panel	8.7A	6mm²	20A AC MCB	Grid connection
Ground Cable	-	6mm²	-	Safety ground

Detailed Breaker Sizing Explanation

DC Side (Solar to Battery):

- **Solar Panel to SCC:** 20A DC breaker (protects panel wiring)
  - Panel max current: 14.73A (Jinko 500W specs)
  - Breaker: 125% × 14.73A = 18.4A ≈ **20A DC**
  - Wire: 6mm² (50A capacity, safe margin)
- **SCC to Battery:** 60A DC breaker (protects SCC output)
  - SCC max output: 60A (One Solar MPPT specs)
  - Breaker: **60A DC** (direct from SCC rating)
  - Wire: 35mm² (140A capacity, very safe)
- **Battery to Inverter:** 100A DC breaker (protects battery)
  - Inverter max draw: 1000W ÷ 12V = 83.3A
  - Breaker: 125% × 83.3A = 104A ≈ **100A DC**
  - Wire: 35mm² (140A capacity, safe)

AC Side (Inverter to Home):

- **Inverter AC Output/Input:** 20A AC breaker
  - Inverter max output: 2000W ÷ 230V = 8.7A
  - Breaker: 125% × 8.7A = 10.9A ≈ **15A or 20A AC**
  - Wire: 6mm² (50A capacity, safe)
- **ATS to Grid:** 15A AC breaker
  - Grid connection: 8.7A
  - Breaker: **15A or 20A AC**
  - Wire: 6mm² (50A capacity, safe)

Safety Devices Required

Device	Location	Rating	Purpose
DC SPD (Surge Protection)	Solar input to SCC	1000V	Protect from lightning
DC Breaker	SCC output	60A	Protect SCC and battery
DC Breaker	Battery to Inverter	100A	Protect battery and inverter
AC SPD	Inverter AC output	230V	Protect AC circuit
AC Breaker	Inverter output	15A	Protect AC wiring
AC Breaker	ATS to Grid	15A	Protect grid connection
Ground Rod	System ground	6mm² copper	Safety ground

Component Compatibility Summary (60A SCC FINAL CHECK)

Double-Checked Amps (Charge vs Discharge):

Component	Specification	Charge Current	Discharge Current	Status
Jinko 500W Panel	Imp = 14.73A @ 33.95V	14.73A input	-	✅ Compatible
One Solar MPPT CM-60A	Max input = 900W @ 12V	60A max	60A max	✅ Perfect
One Solar 1000W Inverter	12V system, 1000W	-	83.3A (1000W÷12V)	✅ Compatible
12V 100Ah LiFePO4	Nominal 12V, 100Ah	60A charge max	83.3A discharge max	✅ Compatible

All components are fully compatible! ✅

Shopee Link: (Recommended)
1. ATS
2. PV Mounting Kit

3. AC Breakers
4. DC Breakers
5. DC SPD
6. AC SPD
7. DC MCCB (Battery Breaker)
8. Ground Rod
9. Battery Cable
10. Solar Cable
11. and other accesories

Daily Operation Schedule

9 AM - Manual Breaker ON (Solar Power Starts)

- YOU manually turn ON the breaker from inverter to ATS
- Solar panels start charging battery and powering appliances
- Grid connection is disconnected
- Battery is being charged by solar (if excess power)

2 PM - Manual Breaker OFF (Switch to Grid)

- YOU manually turn OFF the breaker from inverter to ATS
- ATS automatically switches to grid connection
- Solar panels stop powering your home
- Grid power takes over (normal billing)

9 AM Next Day - Repeat

- YOU turn ON breaker again
- Cycle repeats

Brownout - Manual Breaker ON (Battery Backup)

- YOU manually turn ON the breaker from inverter to ATS
- Battery kicks in automatically (ATS switches to inverter)
- Home is powered by battery
- Lasts 2-4 hours depending on consumption

After Brownout - Manual Breaker OFF (Back to Grid)

- YOU turn OFF the breaker
- ATS switches back to grid
- Normal operation resumes

Budget Breakdown

System Components Cost (12V System)

Component	Unit Price	Quantity	Total
Jinko 500W Panel	₱5,500	1	₱5,500
One Solar MPPT 60A	₱5,500	1	₱5,500
One Solar 1000W Inverter	₱6,500	1	₱6,500
12V 100Ah LiFePO4	₱11,000	1	₱11,000
Wiring (6mm², 35mm²)	₱2,500	1	₱2,500
Breakers (DC + AC)	₱2,000	1	₱2,000
SPD (DC + AC)	₱1,500	1	₱1,500
ATS (Automatic Transfer Switch)	₱1,000	1	₱1,000
Miscellaneous	₱1,000	1	₱1,000
TOTAL	-	-	**₱36,500**

Note: Budget can be reduced to ₱32,000-35,000 with DIY installation and cheaper components

Upgrade Path - Add 2nd Panel

Component	Unit Price	Quantity	Total

Component	Unit Price	Quantity	Total
Jinko 500W Panel (2nd)	₱5,500	1	₱5,500
Additional Wiring	₱500	1	₱500
TOTAL UPGRADE COST	-	-	**₱6,000**

After Upgrade:

- Total Panel Power: 1000W (2x 500W in parallel)
- SCC Max Input: 900W (safe, real-world never reaches 100%)
- Annual Savings: ₱4,500-5,400 (vs ₱3,000-3,600 current)
- Payback Period: 12-15 years (vs 15-18 years current)

Important Notes

- Battery is for brownout backup ONLY (not daily nighttime use)
- Manual breaker switching required at 2 PM daily
- System requires discipline and routine
- Not suitable for families that cannot reduce consumption
- Payback period is long (15-18 years) due to tight budget

Maintenance Schedule

Monthly

- Check battery voltage (should be 12.8V-13.2V)
- Inspect wiring for damage or corrosion
- Clean solar panel (remove dust, bird droppings)
- Check breaker connections (tighten if loose)

Quarterly

- Full system voltage check (with multimeter)
- Inspect all connections for oxidation
- Check inverter cooling fan (if applicable)
- Test manual breaker switching

Annually

- Professional system inspection
- Battery health check (capacity test)
- Wiring insulation test
- Solar panel output verification

Upgrade Path

Current System (Year 1)

- 1x 500W Jinko Panel
- 1x 12V 100Ah LiFePO4 Battery
- Brownout protection only

Panel Upgrade (Year 2-3)

- Add 2nd 500W Jinko Panel (series connection)
- Total: 1000W panel power
- Cost: +₱6,000
- Installation: Simple (series connection)
- Increased daily savings

Battery Upgrade (Year 3-5)

- Add 2nd 12V 100Ah LiFePO4 Battery (parallel connection)
- Double brownout duration (4-8 hours)
- Cost: +₱11,000
- Installation: Simple (parallel connection)

Panel Expansion Limitation

- **Max panel power: 900W** (One Solar CM-60A max input)
- Current: 1x 500W = 500W
- Upgrade: 2x 500W = 1000W (slightly over pero safe, real-world ~900W)
- Cannot add 3rd panel (would exceed SCC specs)
- To expand beyond: Need to upgrade SCC (additional cost)

FAQ - Frequently Asked Questions

Q: Bakit semi-hybrid at hindi fully hybrid? A: Para makatipid sa automatic controller cost. Manual operation ay mas mura pero kailangan ng discipline.

Q: Gaano katagal ang brownout protection? A: 2-4 hours depending on consumption. With 100Ah battery at 500W load = 1.2-1.5 hours max.

Q: Pwede ba mag-add ng more panels? A: Yes! Start with 1x 500W, upgrade to 2x 500W = 1000W total (parallel). Max SCC input = 900W (safe kahit 1000W). Cannot add 3rd panel - need SCC upgrade.

Q: Gaano kalaki ang savings? A: ₱250-300/month (30-40% of daytime consumption). Payback: 15-18 years.

Q: Kailangan ba ng maintenance? A: Yes, monthly cleaning ng panel at quarterly checks. Simple maintenance lang.

Q: Safe ba ang LiFePO4? A: Yes, safest lithium chemistry. No thermal runaway risk.

Q: Pwede ba mag-upgrade ng battery? A: Yes, add 2nd battery in parallel (same voltage). Cost: +₱27,000.

Q: Ano ang warranty? A: Panel (10 years), Battery (10 years), Inverter (2-3 years), SCC (One Solar CM-60A = 2-3 years).

Q: Kailangan ng professional installation? A: Recommended for safety. DIY possible kung may electrical knowledge.

Q: Ano ang ROI (Return on Investment)? A: Long term (15-18 years) pero may peace of mind benefits.

Q: Pwede ba gamitin during rainy season? A: Yes, pero mas mababa ang output. System still works but savings reduced.

Final Checklist Before Installation

- ☐All wires sized correctly per chart
- ☐All breakers rated per specifications
- ☐DC SPD installed on solar input
- ☐AC SPD installed on inverter output
- ☐Ground rod properly installed
- ☐All connections tight and secure
- ☐Polarity checked (+ and -)
- ☐System tested with no load first
- ☐Manual breaker switching schedule understood

- ☐Brownout procedure understood
- ☐ATS manual switch location clear
- ☐All safety devices in place