

PRODUCTION INVESTIGATION · TIMELINE · SolisCloud data 27 Jun – 21 Oct 2026

Ban Doo Chiangrai: why solar production has not kept up with consumption

20 kWp PV · Solis 20 kW three-phase hybrid inverter, no battery · zero export (no sell-back to PEA) · small factory with a 57–62 kW machine · Ban Du, Chiang Rai

≈ 70 kWh/day the 20 kWp array should make in Chiang Rai	32–60 kWh/day actually produced, month by month	94–123 kWh/day consumed, month by month	24–29% of consumption covered by solar in every month
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Summary

Since commissioning on 27 June the panels and inverter have worked normally. Production has fallen short of consumption for three different reasons, one after the other:

- 27 Jun – 22 Sep · Three houses on one system, phases wrongly connected at the main three-phase meter by a local electrician.** The meter and CT saw the machine's load on the wrong phases, so the export control worked on false readings and output was held down.
- 23 – 30 Sep · Arc fault at the connection to house 2.** The supply from house 1 to houses 2 and 3 was double-connected at each house at the main breaker that also feeds the 1st floor to the 2nd floor. The overloaded joint overheated, wasted energy as heat, disturbed the meter readings and created a fire and shock hazard, so the connection had to be removed.
- 1 Oct – now · House 1 only, one meter.** The readings are now correct, but the base load is small and unbalanced (67% on L1), while the 57–62 kW machine runs only on Wednesdays and Saturdays, mostly outside sun hours. Zero export therefore curtails about half the available solar.

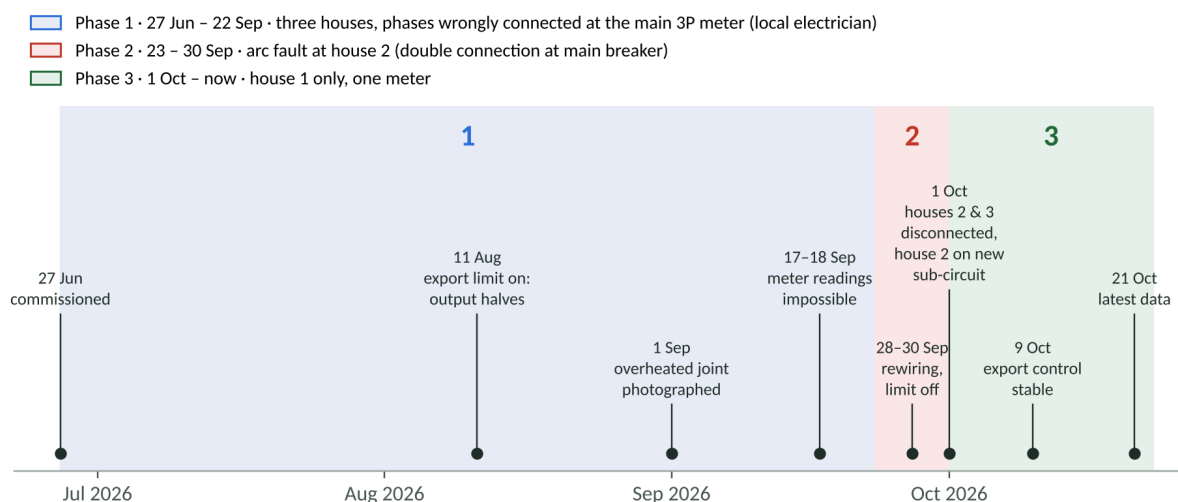


Figure 1 – Timeline of the plant from commissioning to 21 October 2026.

Production and consumption month by month

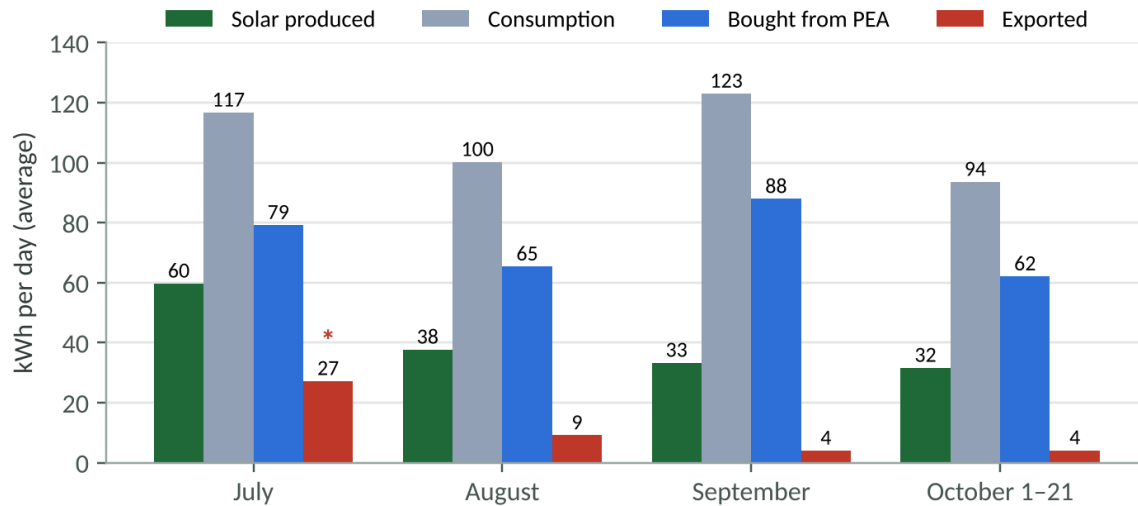


Figure 2 – Daily averages per month. * July export is overstated: with the phases swapped, part of the machine load was recorded as export. September purchases exclude the impossible readings of 17–18 September.

Month	Produced kWh/day	Used kWh/day	Bought kWh/day	Exported kWh/day	Machine days	Solar share
July	59.7	116.7	79.2	27.2*	1	28%
August	37.7	100.2	65.4	9.1	6	28%
September	33.3	123.0	87.9	4.0	10	24%
October 1–21	31.6	93.6	62.1	4.1	6	29%

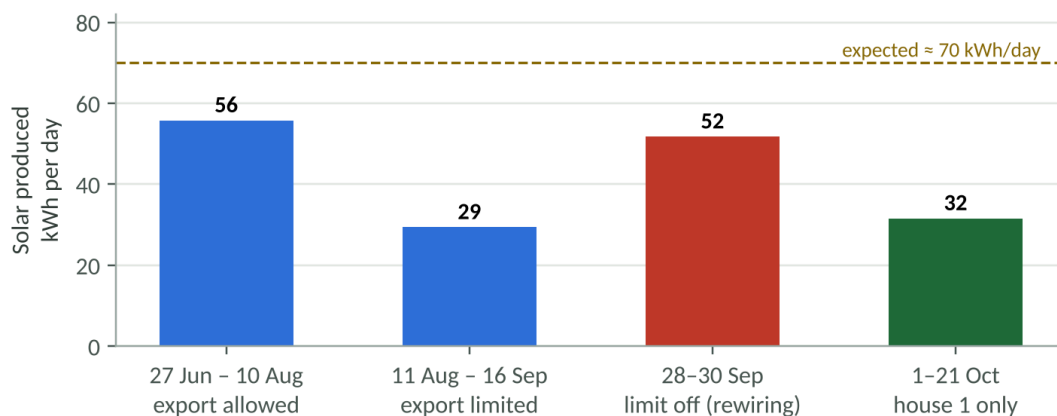


Figure 3 – Average solar production in each period against the ≈ 70 kWh/day the array can make. Only the days with no export limit (before 11 Aug, and 28–30 Sep during rewiring) came close.

Phase 1 • 27 Jun – 22 Sep: three houses, phases wrongly connected at the main meter

What happened. The plant in house 1 also supplied houses 2 and 3 through the same lines, and a local electrician had connected the phases wrongly at the main three-phase meter. The CT that tells the inverter how much the site is using therefore measured some loads on the wrong phase.

Why production could not cover consumption

- **False readings.** Every 3–4 days (3, 7, 10, 14, 17, 21, 24, 28, 31 Jul and 4 Aug) the data shows zero solar self-use but 40–85 kWh "export" and 100–185 kWh bought on the same day. A building cannot export and import that much at once without using any solar: it was machine load measured on the wrong phase.
- **Export control on false data.** From 11 August the export limit was switched on. Daily export dropped from about 28 kWh to about 3 kWh, but production fell with it, from 56 to 29 kWh/day. On Sundays the inverter produced almost nothing (0–1 kWh).
- **Unstable control and heavy loads.** With three houses behind one CT, the CT control worked erratically, one phase carried nearly 90% of the load, and consumption stayed at 100–123 kWh/day.
- **Early warning.** On 17 and 18 September the meter recorded 1,393 / 835 kWh bought and 2,087 / 700 kWh sold – impossible for this site, a sign the meter or CT was being disturbed.

Result: solar covered only 24–28% of consumption, and the monitoring could not be trusted while the phases were wrong.

Phase 2 • 23 – 30 Sep: arc fault at the connection to house 2

What happened. Houses 2 and 3 took their supply from house 1. At both houses the local electrician connected that supply as a double connection at the main breaker – a second set of cables, including a twisted bundle, clamped under the same RCBO terminal that feeds the 1st floor to the 2nd floor. The joint at house 2 overheated: insulation melted and the copper corroded, and at the end of September it arced and nearly burnt. Solar ESS's photograph of house 3 shows the same fault: the local electrician double-connected the supply at the main breaker that feeds the 1st and 2nd floors, exactly as in house 2.

What Solar ESS did. The connection from house 1 to houses 2 and 3 was removed, and the site was rewired between 28 and 30 September with the phasing corrected. At house 2, Solar ESS relocated the connection to a new sub-circuit with its own breaker. For house 3, Solar ESS advised the local electrician how to connect it correctly. Since 1 October each of houses 2 and 3 runs on its own PEA supply, and the solar system supplies house 1 only.

House 3 – photographed, correction not yet confirmed. Solar ESS holds a photograph showing the double connection at the main breaker of house 3, the same as in house 2. Solar ESS has no record yet that the local electrician has corrected it as advised, or of how the board inside house 3 is now arranged, so it should be treated as still faulty until it is inspected.

Why production could not cover consumption

- **Energy turned into heat.** A hot joint draws paid-for energy that does no work. With the machine drawing about 82–97 A per phase, a badly corroded joint can waste around 400 W.
- **Higher load.** In the three days before the repair the site used 157 kWh/day and bought 118 kWh/day. In the three days after, it used 95 kWh/day and bought 57 kWh/day. Part of that drop is the machine running less, so the saving is indicative, not proven.
- **Disturbed measurement.** The meter and CT readings were disrupted around the fault, so the export control could not follow the real load.
- **Danger.** The damage was on the line side of the RCBO, so no breaker could detect it. Exposed live copper was a shock risk and the joint was at stage 3 of 5 on the path to fire.

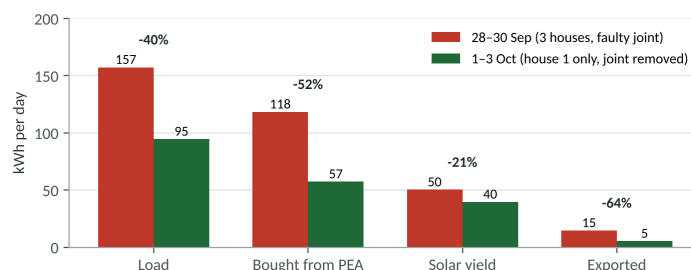


Figure 4 – Three days before and three days after the faulty connection was removed (from the attached Research Report, section 7).

Full report attached (Appendix A): *Overheated electrical joints: fire, danger to life and the cost of heat* – photographs of the joint, how a loose terminal becomes a fire, before-and-after energy data, and the repair and test steps required.

Phase 3 • 1 Oct – now: house 1 only, one meter

What changed. With houses 2 and 3 disconnected, the CT and meter now read correctly and export control is stable (from 9 October, 1–2 kWh/day leak on normal days). Production, however, is still only about 32 kWh/day.

Why production still cannot cover consumption

- **Small daytime load.** On days without the machine the shop draws only about 6 kW (as low as 2.8 kW at lunch). Zero export holds the inverter to that, so about 30 kWh of solar is lost each normal day and about 55 kWh each Sunday.
- **The machine is too big for the array and runs at the wrong time.** The 57–62 kW machine is about five times the array's 12–13 kW peak. It now runs on every Wednesday and Saturday; 20% of its energy is used after 17:30, and the export limit takes 45–55 minutes to release after it starts.
- **Phase imbalance.** The base load sits 67% on L1, 11% on L2 and 22% on L3. The hybrid inverter can supply each phase separately, so this does not cut production, but it overloads L1 and the neutral (about 13 A) – the same path that failed in September. **Solar ESS detected this heavy imbalance and has reported it to the factory's electrician.**
- **Working hours after sunset.** The load curve for 20 October shows the pattern clearly: the site starts around 09:30, dips at lunch, then keeps drawing about 5–7 kW from 17:30 until about 21:00 – after sunset (17:53), when all of it comes from PEA, roughly 20 kWh that evening – while solar from about 07:30 to 09:30 goes unused.

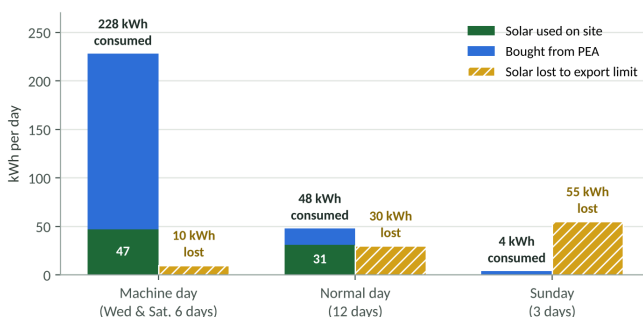


Figure 5 – Energy per day by day type, 1–21 Oct.

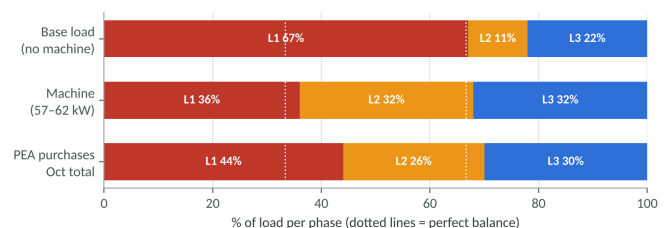


Figure 6 – Share of load per phase, October.

Per day, 1–21 Oct	Machine days (6)	Normal days (12)	Sundays (3)
Consumption	~230 kWh	~48 kWh	3–5 kWh
Solar produced	~50 kWh	~30 kWh	~0
Bought from PEA	~180 kWh	~17 kWh	~4 kWh
Solar lost to the export limit	~10 kWh	~30 kWh	~55 kWh

Result: about 850 kWh of solar a month ($\approx$ 4,000 THB at 4.7 THB/kWh) is curtailed, mostly on days without the machine, while machine days account for about 83% of what is bought from PEA.

Is the 20 kWp system the right size?

Yes. The site uses about **1,800–3,600 kWh a month**. In Chiang Rai a 20 kWp array should produce about 70 kWh a day, or roughly **2,100 kWh a month** – enough for all of the lower end of that range and well over half of the upper end. More panels are not needed.

Per month	kWh	Share of 1,800 kWh	Share of 3,600 kWh
What the 20 kWp array can produce ($\approx$ 70 kWh/day)	$\approx$ 2,100	$\approx$ 117%	$\approx$ 58%
What it produced in October (31.6 kWh/day)	$\approx$ 950	$\approx$ 53%	$\approx$ 26%
Curtailed by the export limit	$\approx$ 850		

The shortfall is not the size of the system. It comes from the wiring problems in Phases 1 and 2 and, now, from **when** the energy is used: the array makes its energy between about 09:00 and 16:00, while the machine's demand comes in short, very high bursts, partly after dark, and on other days the daytime load is too small to absorb the output. The actions below recover most of the curtailed energy without adding panels.

Observation – wireway of the main cables. During our visit we noticed that the wireway carrying the main cables is quite narrow. The cables sit tightly together, with little room for heat to escape, and power and signal/CT cables run close to each other, which can introduce noise into the measurements the export control relies on. We would kindly suggest having the wireway and conduits reviewed against the electrical standard – typically cable fill of no more than about 20% of the wireway cross-section (NEC 376.22; the EIT wiring standard sets similar limits), derating where cables are bunched, and a separate route for CT/communication cables.

Notes – scope of responsibility. Solar ESS supplies energy from the solar system only: the PV array, the inverter, its protection and its connection point. The electrical system within the houses – the main meter connections, distribution boards, breakers, sub-circuits and all wiring carried out by the local electrician – is not part of Solar ESS's scope. Solar ESS is therefore not held responsible for any errors inside the houses' electrical system. The findings in this report are given to help the owner and their PEA-qualified electrician correct them.

Options to consider

The solar system is working and there is good potential to make more use of it. The options below are suggestions for the owner to choose from, depending on priorities and budget. They are grouped so that safety comes first, followed by the steps that could lower the monthly electricity bill. Savings are estimates at 4.7 THB/kWh.

Option A • Peace of mind: safety and balanced consumption (recommended first)

A gentle first step. We would recommend a general check of the whole electrical system by an electrician qualified to PEA standards – the main three-phase meter connections, the boards and breakers in houses 1, 2 and 3, the main-cable wireway and conduits, and the joints on the machine's supply path – with a short written test record (insulation resistance, phase identification, RCD test and a thermal scan while the machine runs). Solar ESS is happy to attend and to fine-tune the solar settings afterwards.

Suggestion	Benefit
General inspection by a PEA-qualified electrician, with a written test record	Safety assurance; a clear picture of the three phases
Review the main-cable wireway and conduits; give the cables more room and route CT cables apart from power cables	Cooler cables; steadier CT readings
Check that the joints repaired in September are tight and cool under machine load	Avoids repeat heating at the joints
House 3: ask the local electrician for photographs of the corrected connection, or invite Solar ESS to take a look	Confirms the double connection has been removed
Spread the single-phase loads more evenly, about 2 kW per phase (the factory's electrician is already aware of the imbalance)	Less load on L1 and the neutral

Option B · Use more of the solar you already produce (no new equipment)

Suggestion	Possible gain / month	Possible saving / month
Let our supplier check the meter/CT link so the export limit releases sooner after the machine starts	40–85 kWh	≈ 190–400 THB
Move office and working hours to follow the sun – for example 07:30–16:30 instead of about 09:30–21:00 – so the evening load is used while the panels are producing	up to ~500 kWh	up to ≈ 2,400 THB
Where the work allows, run the machine between 09:00 and 15:00 rather than after 17:30		adds to the gain above
On days without the machine, move flexible loads (water heating, cooling, charging, pre-heating) into 09:00–15:00 with simple timers	up to ~425 kWh	up to ≈ 2,000 THB

Option C · Store the daytime surplus (if the owner wishes to invest)

Suggestion	Possible gain / month	Possible saving / month
A 15–20 kWh battery on the existing hybrid inverter, best considered after Options A and B; export stays limited	~270–330 kWh	≈ 1,300–1,550 THB

The suggestions in Options B and C draw on the same daytime surplus, so their savings overlap rather than add up. Together they could recover a good part of the ~850 kWh (≈ 4,000 THB) currently curtailed each month.

Sources: SolisCloud daily data 27 Jun – 21 Oct 2026 and inverter per-phase 5-minute data 25 Sep – 21 Oct 2026; site photographs 1 Sep 2026; Solar ESS site records. "Expected" production assumes ~3.5 peak sun hours per day for Chiang Rai. Analysis by Solar ESS Co. Ltd. **Appendix A** (following pages): research report *Overheated electrical joints – fire, danger to life and the cost of heat*, Solar ESS, 3 October 2026.

Overheated electrical joints: fire, danger to life and the cost of heat

Research report on the distribution-board joints photographed at the Chiang Rai site, with evidence, case studies, a before-and-after comparison and recommended practice

Site: Chiang Rai · **Photographs dated:** 1 September 2026 · **Monitoring data:** 28 September to 3 October 2026

Finding

More than one cable, including a twisted bundle, is clamped in one RCBO terminal. The joint has overheated: insulation is melted and copper is corroded. A second board shows the same habit.

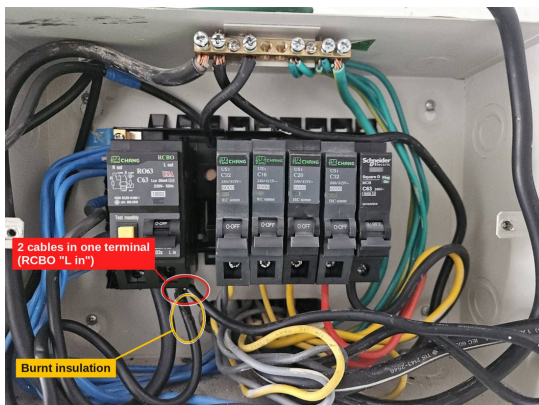
Danger

A hot joint is a source of ignition that no breaker detects. It also strips insulation from live conductors, so it threatens people by shock, smoke and fire.

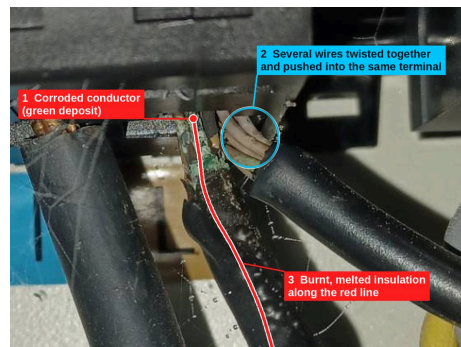
Cost and control

Heat at a joint is paid-for energy that does no work, and it is the first sign of larger losses and failures. Joints must be made correctly, tested and monitored under load.

1 What the photographs show



The board. The red circle marks the RCBO line-in terminal; the yellow outline marks scorched cable below it.



The terminal, enlarged. The numbers match the findings below.

1 Corroded conductor

Green deposit on the copper where it enters the terminal: a sign of heat, moisture and acid from overheated PVC.

2 Several wires in one terminal

Separate wires twisted into a bundle and forced in beside the main cable. The screw cannot grip them evenly.

3 Burnt, melted insulation

The damage runs down the cable from the terminal, which shows the heat started at the joint.

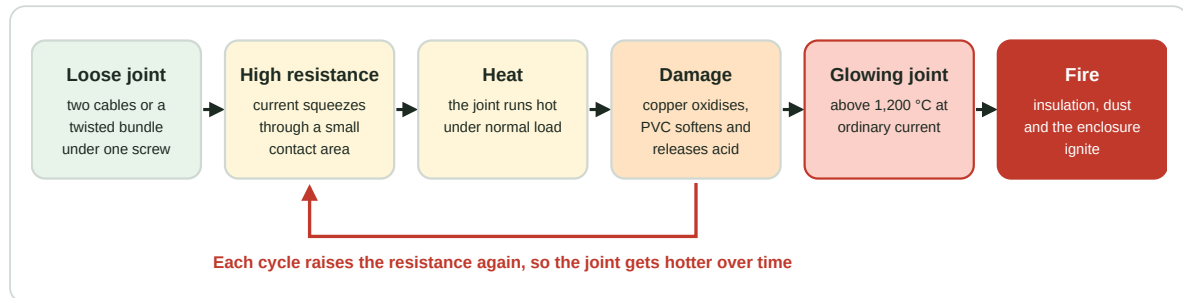


The same practice on a second board

Another board, judging by its different breakers, shows two conductors joined under tape and taken into one RCBO terminal. No burn is visible there yet. The fault looks like a working habit, not a one-off, so every board by the same installer should be opened and checked.

Also recorded at this site. The work was handed over with **no insulation resistance test, no thermal scan and wrong phasing**. These points are not visible in the photographs; Solar ESS recorded them on site.

2 The mechanism: how a loose terminal becomes a fire



Why several wires under one screw are loose

The screw bears on the outer strands only. Inner wires sit slack, and every heating and cooling cycle lets the bundle settle further. A twisted joint is also several circuits drawing current through one point.

Why the breaker does not trip

An MCB reacts to too much current and an RCBO to current leaking to earth. A hot joint causes neither: tests show it wastes only about 5 to 50 W, with normal load current flowing. The protection sees nothing wrong.

Why the copper went green

Overheated PVC releases hydrogen chloride. With moisture it forms acid that turns copper into green copper salts. The deposit conducts poorly, which raises the resistance again.

3 Evidence: how often this ends in fire

47%

of 1,745 fires in Bangkok in 2023–2025 were traced to electrical equipment (823 fires). Wall outlets and wiring alone accounted for 269.

Bangkok Metropolitan Administration, Dec 2025

69%

of US home fires involving electrical distribution and lighting equipment start in wiring and related equipment: about 31,960 fires and 400 deaths a year in total.

NFPA fact sheet, 2010–2014 data

5 times

more consumer-unit fires in London within five years. The main cause identified: high-resistance connections from incorrectly terminated cables.

London Fire Brigade, via Professional Electrician, 2016

1,200 °C

and above is reached by a glowing connection, at currents as low as 10 A. Many simply burn open; some ignite what is around them.

V. Babrauskas, EC&M, 2021

4 Case studies

Hospital switchboard fire, Shandong, China (2021)

The fire began at the bolted joint between a busbar and a circuit-breaker terminal. The bolts were 8 mm in 12 mm holes, so the contact carried about 40% of its rated capacity. The joint reached about 1,040 °C, the busbar sagged onto another phase, and the short circuit ignited the cabinet. It was detected early and no one was hurt.

Zhang et al., Fire, vol. 8 no. 11, 2025

Consumer-unit fires, London (2010s)

After the fire brigade traced a sharp rise in fires to badly terminated cables inside plastic consumer units, the UK wiring rules were changed: from 1 January 2016 consumer units in homes must have a non-combustible enclosure (BS 7671 regulation 421.1.201). The workmanship fault was common enough to force a change in the product.

Professional Electrician, 11 Feb 2016

Case studies, continued

Laboratory evidence on glowing connections

Tests on overheating connections measured only 5 to 50 W of heat and a 3 to 25 V drop at the joint, at ordinary currents such as 10 to 12.5 A, yet temperatures above 1,200 °C, hotter than the melting point of copper (1,083 °C). Many such joints simply burn open; some ignite what is around them.

V. Babrauskas, EC&M, 2021

Forensic study of failed connections (2022)

Microscopy of overheated connections found that a filament or pool of liquid copper oxide often carries the current at the hot spot. The paper reports a food-processing plant fire traced to such a joint, and an appliance joint that overheated without igniting its surroundings.

T. Korinek, Journal of the National Academy of Forensic Engineers, 39(1), 2022

This site is the same failure at an earlier stage

The joint has already overheated enough to melt insulation and corrode copper, but has not yet ignited. Fires like the two above develop through this stage.

5 Comparative study: danger of fire and danger to life

The same joint produces two different hazards. Fire damages property and stops production; the hazards to people act faster and need less energy.

	Danger of fire	Danger to human life
How it starts	The joint becomes a heat source inside the board, at normal load current.	Heat melts the insulation and leaves live copper exposed inside the board.
What is at risk	PVC insulation, dust, plastic enclosures, then cable routes and the building.	Anyone who opens the board or touches metalwork that has become live; everyone in the building if fire starts.
Why protection fails	An MCB needs overcurrent and an RCBO needs earth leakage. A hot joint gives neither.	The damage is on the line-in side of the RCBO, upstream of its sensing, so that RCBO cannot clear a fault there.
How little it takes	5 to 50 W at the joint is enough to exceed 1,200 °C.	RCDs for personal protection are rated 30 mA because larger currents through the body can stop the heart (IEC 60479).
Secondary effects	A sagging or carbonised conductor can short to another phase and ignite the cabinet (Shandong case).	Burning PVC gives dense smoke and hydrogen chloride gas. Smoke, not flame, is what usually kills in fires, often at night.
Made worse here by	The 57 kW machine: about 82 to 97 A per phase, so joint heat is far higher on machine days.	Wrong phasing: three-phase machines can run backwards; no insulation test, so hidden damage is unknown.
Warning before harm	Weeks to months of heating, visible to a thermal camera.	Often none: the first sign can be the shock itself.

Where this joint stands on the path to fire

Stage 1: Loose

No sign. Found only by a torque check.

Stage 2: Warm

Found only by thermal camera under load.

Stage 3: Discoloured

Melted insulation, green copper. **This site.**

Stage 4: Glowing

Above 1,200 °C. Smell, flicker, buzzing.

Stage 5: Fire

Insulation, dust and enclosure burn.



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Research report · Overheated joints: fire, life safety and energy cost

3 October 2026

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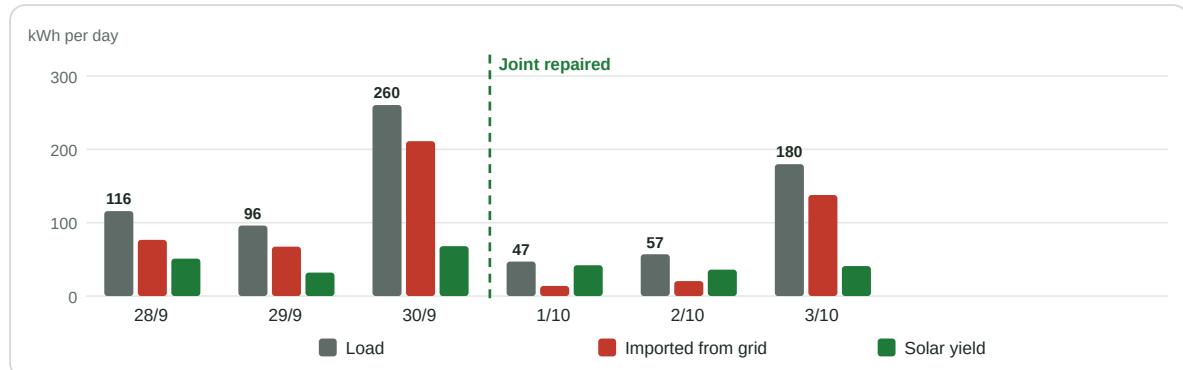
www.solar-ess.org

6 Comparison: before and after the joint was repaired

Condition	Before repair (as photographed)	After a correct repair	How to confirm
Contact	Several conductors under one screw; uneven grip	One conductor per terminal, ferrule, maker's torque	Torque check, pull test
Joint temperature	Hot enough to melt PVC and corrode copper	Within a few degrees of the neighbouring terminals	Thermal scan while the machine runs
Insulation	Melted and scorched along the cable	Damaged length cut out or cable replaced	Insulation resistance at 500 V DC, at least 1 MΩ
Shock risk	Bare live copper inside the board	No copper visible outside terminals	Visual inspection, cover fitted
Fire risk	Stage 3 of 5 and rising with every load cycle	Returned to that of a sound installation	Repeat scan after one month
Energy	Heat wasted at the joint; voltage drop to the load	Loss at the joint negligible	Voltage at board and at load, under load

The "after" column describes what a correct repair achieves. Solar ESS has no photographs or test records of the repaired joint in this report; the confirmations in the last column should be recorded on site.

7 Measured energy before and after the repair



Average per day

Per day	Before (28–30 Sep, 3 days)	After (1–3 Oct, 3 days)	Change
Load (consumption)	157.4 kWh	94.6 kWh	–40%
Imported from grid	118.4 kWh	57.3 kWh	–52%
Net import	103.8 kWh	52.0 kWh	–50%
Solar yield	50.3 kWh	39.6 kWh	–21%
Exported	14.6 kWh	5.3 kWh	–63%
Grid cost at 4.7 THB/kWh	556 THB	269 THB	–52%

The 57 kW machine and the high days

Day	Load	Extra over 50 kWh base	Equivalent hours at 57 kW
30/9	260.4 kWh	~210 kWh	~3.7 h
3/10	179.8 kWh	~130 kWh	~2.3 h
28/9	115.8 kWh	~66 kWh	~1.2 h
29/9	96.1 kWh	~46 kWh	~0.8 h

What the data supports

Comparing three days each side of the repair, average load fell from 157 to 95 kWh a day and grid import from 118 to 57 kWh a day: about 287 THB a day at 4.7 THB/kWh.

What it does not prove

Each period has one heavy machine day (260 kWh on 30 September, 180 kWh on 3 October) and two lighter days. Three days each side is a small sample, and the result follows how long the machine ran.

What would settle it

Compare days with the same machine hours before and after, using the hourly curve and a machine log, and record voltage at the load while it runs.

Hours assume full power; at part load the machine ran longer. The 50 kWh base is taken from the two quiet days (1 and 2 October). The repair date (between 30 September and 1 October) and the system size (about 20 kWp, no battery) are inferred from the data.

8 How heat raises the price of energy

Every hot joint is electricity bought and turned into heat

Heat at a joint = $\text{current}^2 \times \text{joint resistance}$. The meter counts it exactly like useful load. Because the current is squared, the 57 kW machine multiplies the loss: nine times the current gives eighty-one times the heat.

Joint resistance	Heat at 10 A	Heat at 30 A	Heat at 90 A (machine running)
0.005 Ω (slightly loose)	0.5 W	4.5 W	~40 W
0.01 Ω	1 W	9 W	~80 W
0.05 Ω (badly corroded)	5 W	45 W	~400 W

1. Direct loss

A 400 W joint running 4 hours a day for 250 working days wastes about 400 kWh a year, about 1,900 THB, for one joint on one phase. A board has dozens of joints.

2. Heat feeds itself

Copper resistance rises about 0.4% per °C. A conductor running 50 °C hotter has about 20% more resistance, so it loses more and heats further.

3. Voltage drop

The volts lost at the joint are taken from the machine. Motors draw more current at low voltage and heaters run longer for the same work.

4. Peak demand

Where the tariff carries a demand charge per kW of monthly peak, losses and inrush from stalled restarts add to the peak that sets the charge.

5. Failure costs

A burnt breaker, cable or busbar means replacement parts, an emergency call-out and lost production while the machine stands idle.

In proportion

At this site the machine itself, not the joint, accounts for most of the bill (section 7). The joint adds a smaller, avoidable loss, and it is the one that can burn the building.

9 Practice: make connections carefully, then monitor them

Making the connection

- One conductor per terminal unless the maker identifies it for more (NEC 110.14(A))
- Ferrules on stranded conductors; no twisted or taped joints in the board
- Tighten to the maker's torque with a torque screwdriver, then pull-test
- Breaker and cable rated for the load: about 82 to 97 A per phase for the 57 kW machine
- Use a busbar or rated terminal block to split circuits
- Seal cable entries; fit covers

Testing before handover

- Insulation resistance at 500 V DC: at least 1 MΩ, and investigate any low value in a new installation
- Phase identification and phase sequence, with the board labelled
- RCD and RCBO trip test
- Thermal scan at working load, with images kept as the baseline
- Signed test record given to the owner

Monitoring in service

- Thermal scan at least once a year, and always while the machine runs
- Re-check torque one month after any new work
- Compare each joint with its neighbours on the other phases
- Watch the monitoring data for rising import on like-for-like days
- Act on smell, discolouration, buzzing or flicker at once

Reading a thermal scan (ANSI/NETA MTS criteria)

Temperature rise	Compared with	Meaning and action
1 to 3 °C	similar component, same load	Possible deficiency: investigate
4 to 15 °C	similar component, same load	Probable deficiency: repair as time permits
over 15 °C	similar component, same load	Major discrepancy: repair immediately
over 40 °C	ambient air	Major discrepancy: repair immediately

10 Conclusions

- ✓ **The joint was a fire in progress:** melted insulation and corroded copper place it at stage 3 of 5; the published cases reached fire through this same stage
- ✓ **It endangered people as well as property:** exposed live copper upstream of the RCBO, with smoke and fire to follow
- ✓ **No protective device would have stopped it:** only inspection, testing and thermal scanning find a hot joint
- ✓ **The repair removes the hazard:** provided it is confirmed by torque, insulation resistance and a thermal scan under machine load
- ✓ **The measured saving is not yet proven:** average import halved after the repair, but the 57 kW machine explains most of the day-to-day change
- ✓ **Heat is always a cost:** it is energy paid for and wasted, it grows with the square of the current, and it ends in failure if left alone
- ✓ **Every connection point must be made with care and monitored:** one conductor per terminal, correct torque, tests before handover, and a thermal scan every year under load

11 Recommended next steps at this site

- ✓ **Inspect the RCBO terminal:** replace the RCBO if the terminal or body is discoloured, pitted or melted.
- ✓ **One conductor per terminal:** unless the maker states that the terminal accepts more.
- ✓ **Split the circuits properly:** use a busbar, a rated terminal block, or a separate breaker for each circuit.
- ✓ **Use ferrules on stranded wire and tighten to the maker's torque:** then pull-test each conductor.
- ✓ **Test the insulation:** measure the insulation resistance of every circuit before re-energising, and record the values.
- ✓ **Correct the phasing:** confirm which phase feeds each circuit and the phase sequence, then label the board.
- ✓ **Open every board by the same installer:** the second board shows the same practice
- ✓ **Scan under machine load:** record the temperature of every joint on the supply path to the 57 kW machine
- ✓ **Keep a machine log:** daily running hours, to compare energy on like-for-like days

Limits of this report

Findings on the joint are read from photographs dated 1 September 2026; the missing tests and wrong phasing are as recorded by Solar ESS on site. No photographs, thermal images or test results of the repaired joint were available, so the "after" condition is what a correct repair achieves, not a verified result. Energy figures come from six daily monitoring totals, three before and three after the repair; the repair date, system size and machine hours are inferred. Joint resistances and heat figures are worked examples from $P = I^2R$, not measurements. The demand-charge point applies only if the site's tariff includes one. Standards are cited from the secondary sources named; check the current editions before quoting them in a contract or claim.

References

1. Bangkok Metropolitan Administration fire statistics 2023–2025, reported by Matchon, 21 Dec 2025. · 2. NFPA Research, Electrical Fires Fact Sheet (2010–2014 data). · 3. London Fire Brigade findings and BS 7671:2008+A3:2015 regulation 421.1.201, reported by Professional Electrician, 11 Feb 2016. · 4. V. Babrauskas, "Fires Caused by Poor Connections", EC&M, 8 Dec 2021. · 5. Zhang et al., "Case Study on Investigation of Electrical Cabinet Fire Caused by Poor Electrical Contact", Fire 8(11):412, 2025. · 6. C. R. Miller, "General Installation Requirements, Part VI" (NEC 110.14(A)), Electrical Contractor, 15 Jul 2015. · 7. T. Korinek, "FE Investigation and Analysis of Poor Electrical Connections and Related Fire Investigation Case Studies", Journal of the National Academy of Forensic Engineers 39(1), 2022. · 8. ANSI/NETA MTS, Standard for Maintenance Testing Specifications, thermographic survey criteria (Table 100.18); see also Infraspection Institute, "Setting Temperature Limits". · 9. NFPA 70B:2023, Standard for Electrical Equipment Maintenance, section 7.4 (thermography, temperature differences documented), as summarised by FLIR. · 10. BS 7671 Table 61 / IEC 60364-6 (insulation resistance, 500 V DC, minimum 1 MΩ), as summarised by Voltimum. · 11. IEC 60479-1, Effects of current on human beings and livestock.