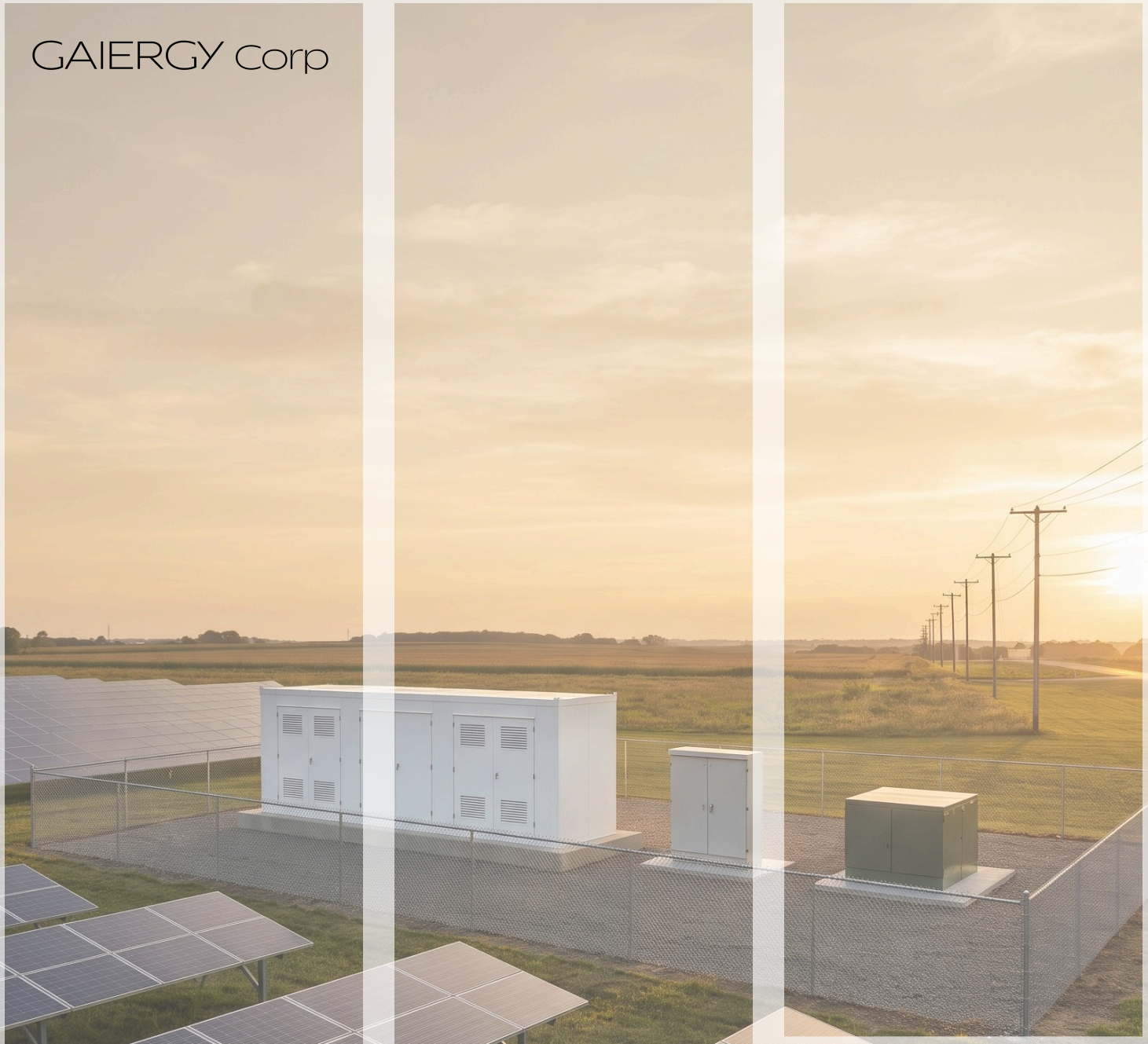
GAIERGY Corp



REPORT

NOVEMBER 2026

OPERATIONAL CONSIDERATIONS WHEN PAIRING BATTERIES WITH SOLAR







OVERVIEW

Operational Considerations When Pairing Batteries with Solar

How to add a battery to an existing solar site without going over the utility's export limit.

November 14, 2026

> Animated version of this report: gaiergy.com/research/Pairing_Batteries_with_Existing_Solar.html

GOAL

Show what equipment keeps a 5 MW solar array and a 5 MW battery from sending more power to the grid than the utility study allows.

TAKEAWAYS

Do not exceed the solar export permit

Unless the line already has spare capacity

Or the economics favor paying for upgrades

The utility sets the export limit

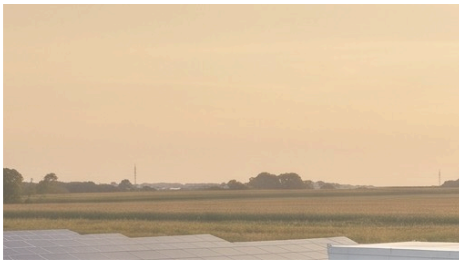
Through its interconnection study

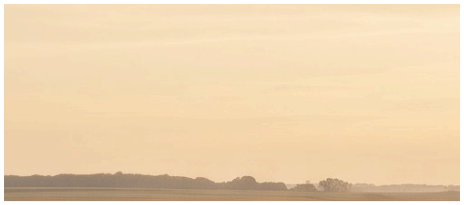
Invest in redundant export-limiting equipment

A controller plus a backup protection relay

The safety the utility requires

Example: 5 MW solar, 5 MW battery, export limit 5 MW. The real limit comes from the utility study.







BACKGROUND

Why pair a battery with existing solar

New York already has a very large number of solar sites without batteries. The interconnection queue data that the state's utilities file with the Department of Public Service lists 274,204 solar projects without storage that are complete and in service. Of these, 995 are 1 MW AC or larger. [E4] Many more solar-only sites operate across the country.

Federal law now treats solar and storage differently. Public Law 119-21, signed July 4, 2025, ends the clean electricity credits under sections 45Y and 48E for solar facilities placed in service after December 31, 2027. This applies to facilities that begin construction more than 12 months after the law was signed. [E3 Sec. 70512(a), 70513(a), 70513(g)(5)] The same law keeps section 48E for energy storage technology placed in service at a solar facility. [E3 Sec. 70513(a)] Storage that begins construction after December 31, 2025 does not qualify if its construction includes material assistance from a prohibited foreign entity. [E3 Sec. 70513(b)] This gives developers a reason to look at adding batteries to existing solar sites. This report does not look at cost, credits or tax.

This report looks at operations only. A battery can add export to a site that already exports its full solar output. The utility studies each new interconnection, and the study report describes any system upgrades it finds necessary. [E1 printed page 11] Under the state rule, "Applicants are responsible for payment of utility system modification cost estimates." [E1 Section I-D.1, printed page 13] The aim is to add the battery without triggering significant or additional upgrades on the circuit or the substation. Going over the existing export permit can make sense where the line or substation already has spare capacity, or where an economic assessment shows that paying for the upgrades is more profitable. This report does not cover that economic assessment.

The way to do that is to declare an export limit and protect it. The study then uses the declared limit, except for fault current, which it evaluates at full nameplate. [E1] The rest of this report shows the equipment and the operating steps that hold the limit. Figure 1 shows the example site. Figure 2 shows how the equipment acts in four situations. Figures 3 to 6 show a second way to build the site.







The site

Figure 1 is a drawing of the example site: a 5 MW solar array and a 5 MW battery that share one connection to the utility. The array is on the left. The fenced yard holds the solar inverters (1), the battery enclosure with its battery inverters (2), the step-up transformer (3) and a small cabinet. Markers 4, 5, 6 and 9 point to the cabinet: it holds the site main breaker, the power plant controller, the protection relay and the lockout relay. The line leaves the yard on utility poles that carry the utility recloser (8) and the utility meter (7). Marker 10 is the stop signal path to the solar and battery inverters. The same numbers appear in Figure 2 and in the equipment key.

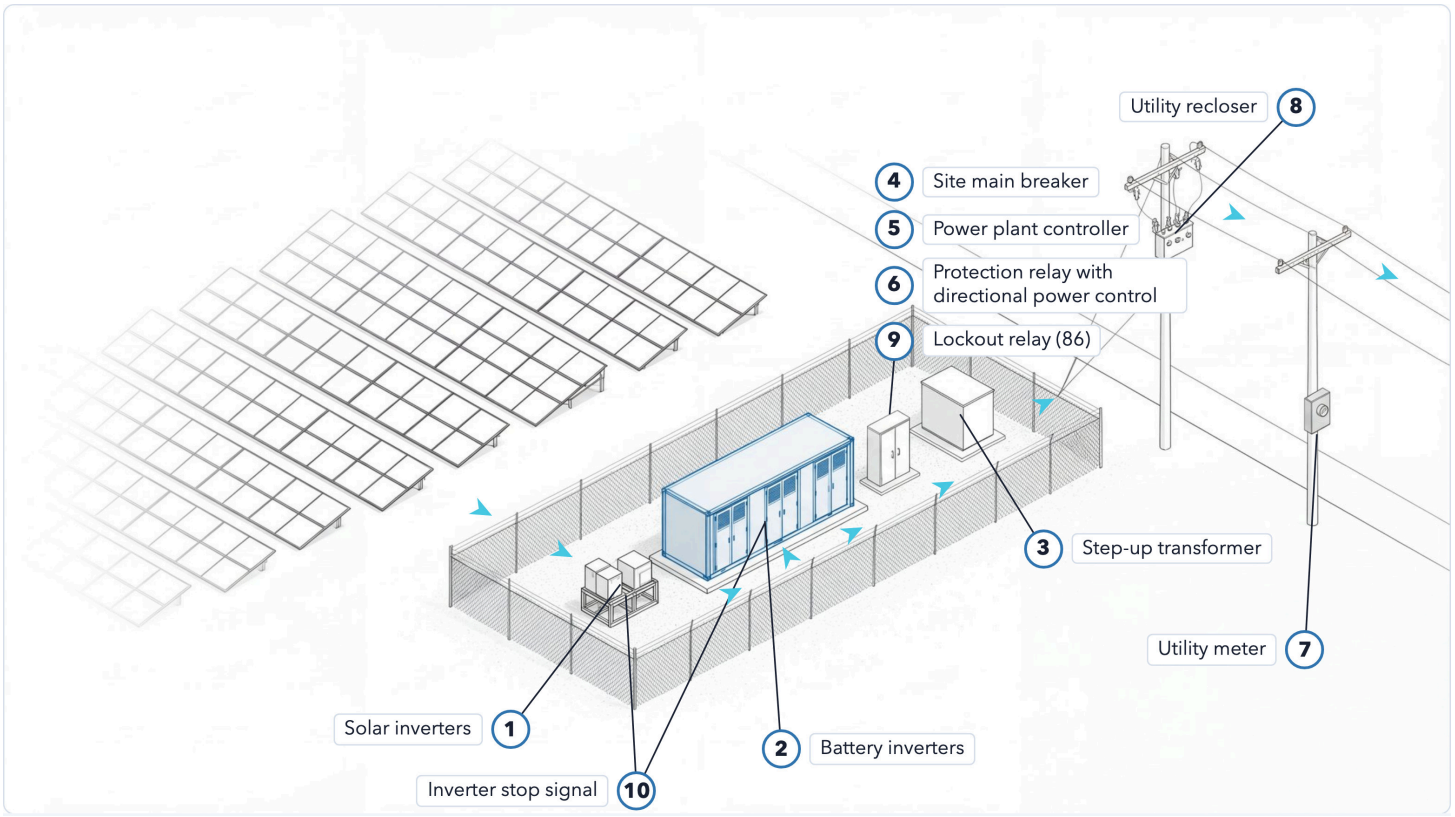


Figure 1. The site. The numbers match the diagram below.

How to read Figure 2

Figure 2 is a one-line diagram of the same site. A one-line diagram draws each circuit as a single line; one line stands for all three phases of the circuit. Power flows from left to right: from the solar array and the battery, through the inverters and the step-up transformers, onto the 13.2 kV site bus, and out through the meter and the recloser to the utility feeder. The bold readouts on the left give the solar and battery power. The readout above the main line gives the export at the point of common coupling (PCC), where the site meets the utility line. The gauge on the right shows the same export against the 5 MW limit line. Arrows on the power lines show the direction of power flow. Dashed lines are control and trip signals, not power.

The figure shows four situations. Situation 1 shows the problem: solar and battery export together with no control. Situation 2 shows a sunny midday: the controller holds export under the limit while the battery charges. Situation 3 shows the evening: the battery makes up for the falling solar, up to the limit. Situation 4 shows what happens when the controller fails. It is shown in five steps, from the controller failure to the circuit that opens and locks.

Figure 2. One-line diagram.

FIGURE 2, SITUATION 1

No limit: the problem

Solar makes 5.0 MW and the battery discharges 5.0 MW. Nothing limits the two inverter groups, so export at the PCC is 10.0 MW, twice the 5 MW limit, and the gauge reads over the limit. Without control, the electric utility counts solar plus battery: 10 MW on the circuit. This is the case the rest of the report avoids.

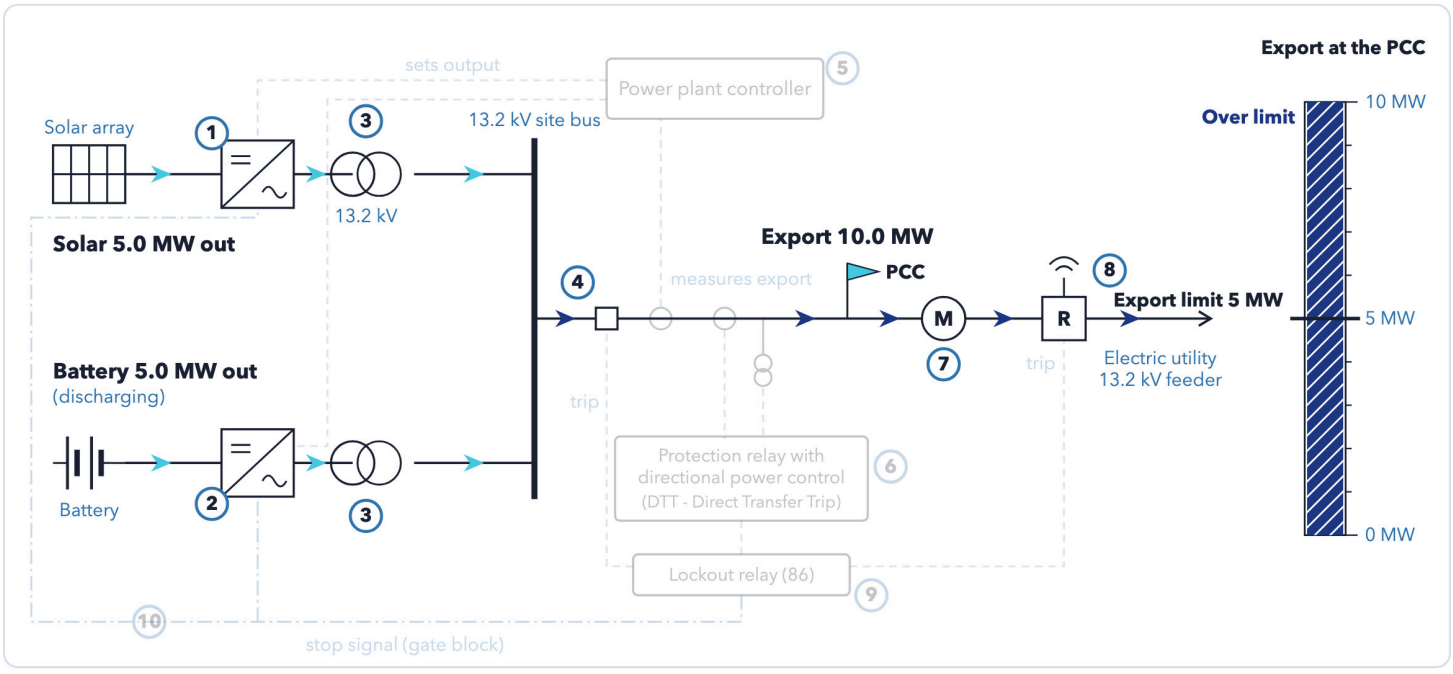


FIGURE 2, SITUATION 2

Sunny midday: the controller holds the limit

Solar makes 5.0 MW. The power plant controller (5) measures export at the PCC and tells the battery inverters to charge at 2.0 MW. Export is 3.0 MW, under the 5 MW limit. The controller is the daily guard: it measures and sets each inverter all day.

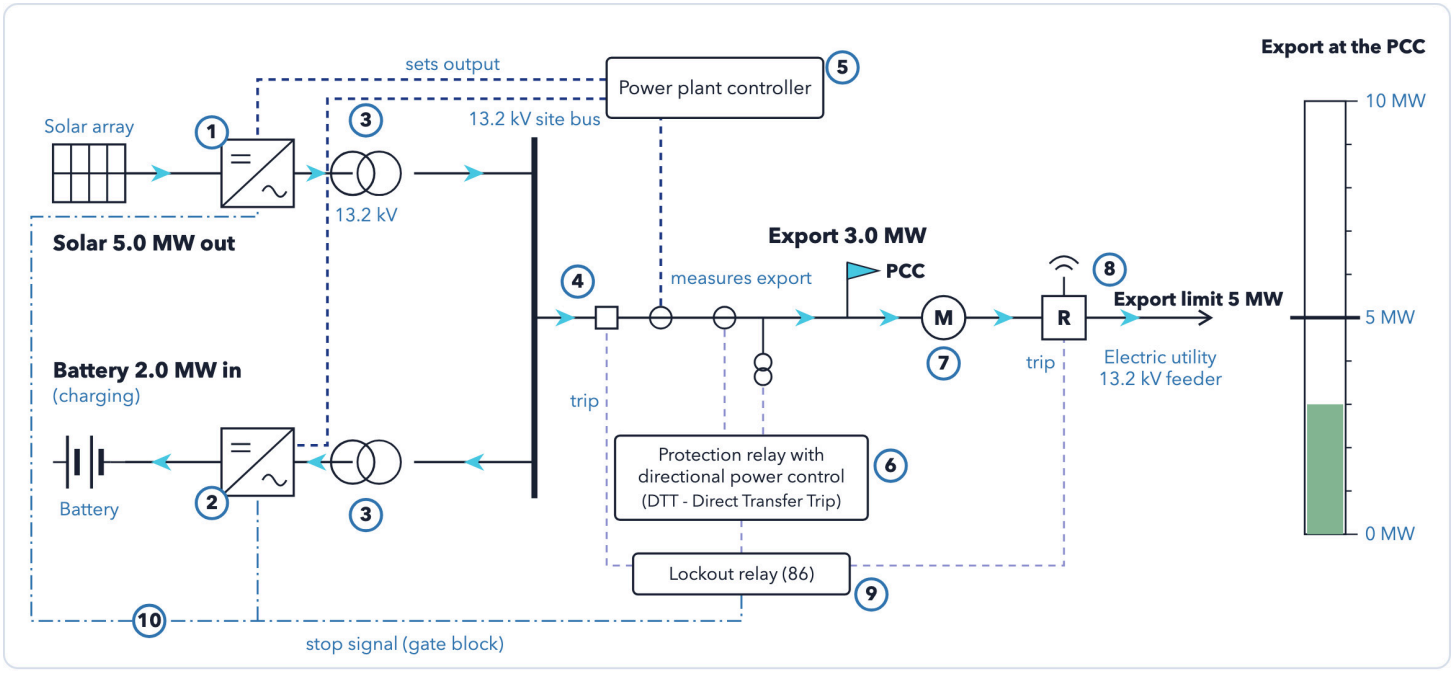


FIGURE 2, SITUATION 3

Evening: the battery fills the gap

As the sun drops, solar falls to 0.5 MW. The controller lets the battery discharge 4.5 MW to make up the difference. Export is 5.0 MW: at the limit, not over it. The battery adds energy in the evening without adding export capacity.

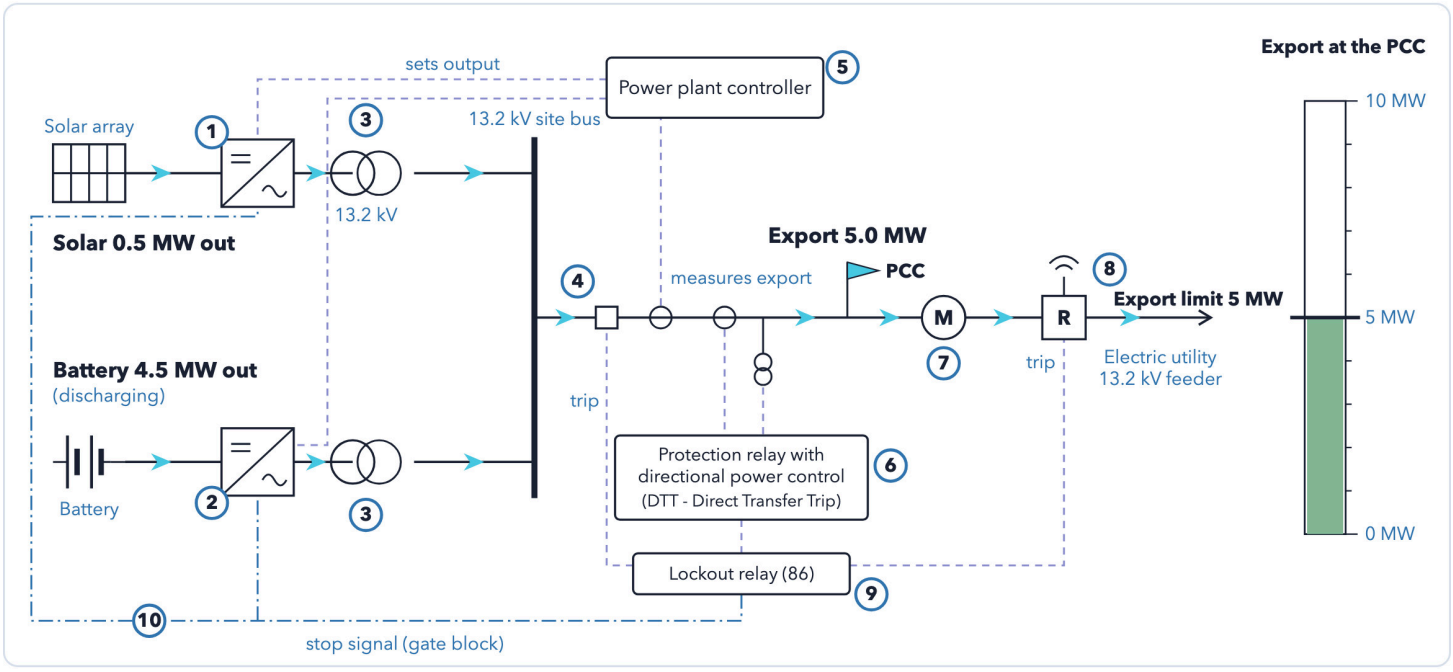


FIGURE 2, SITUATION 4

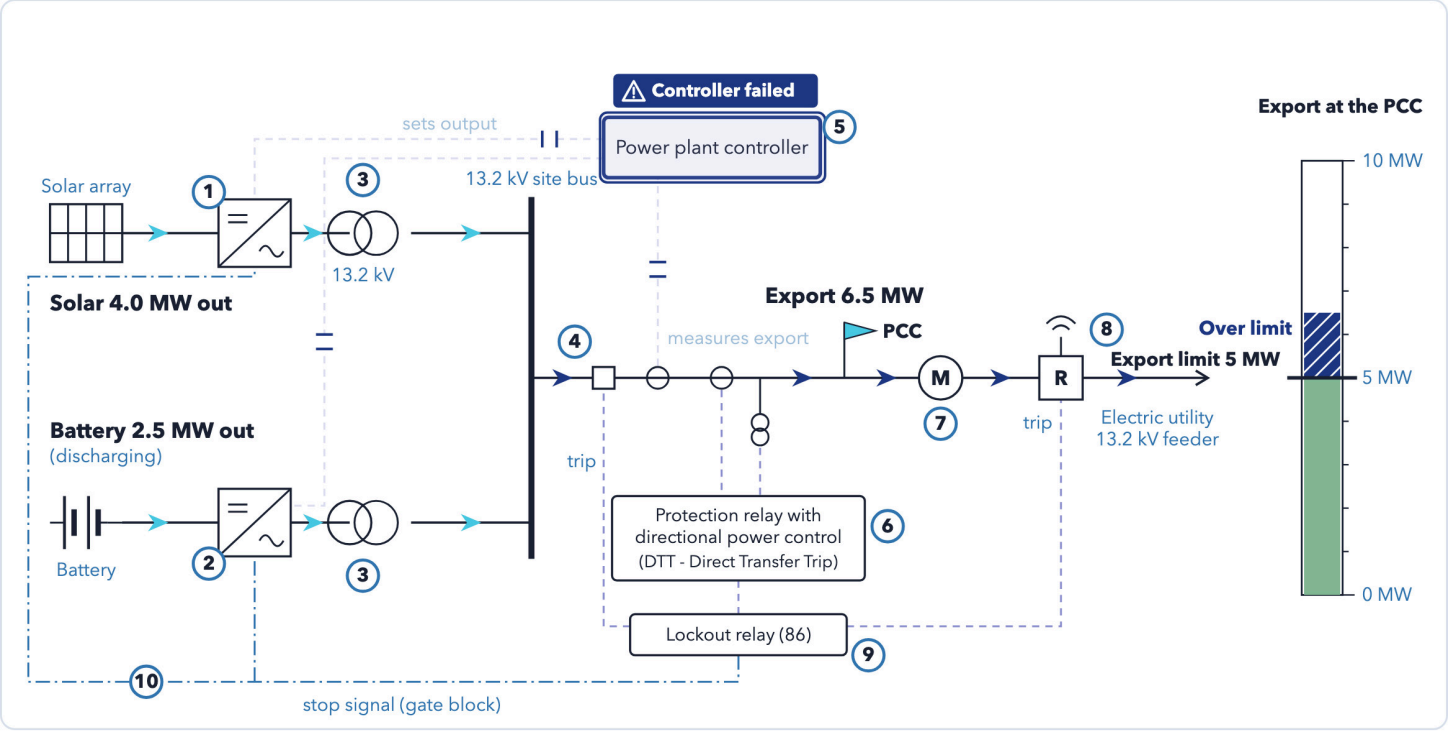
Controller fails: the relay trips

Situation 4 asks what happens if the controller fails. Nothing then holds the inverters back, so a second, independent guard is needed: the protection relay (6) with its own sensors, and the lockout relay (9) it drives. The next five steps follow the chain in order.

SITUATION 4, STEP 1 OF 5

When the controller fails

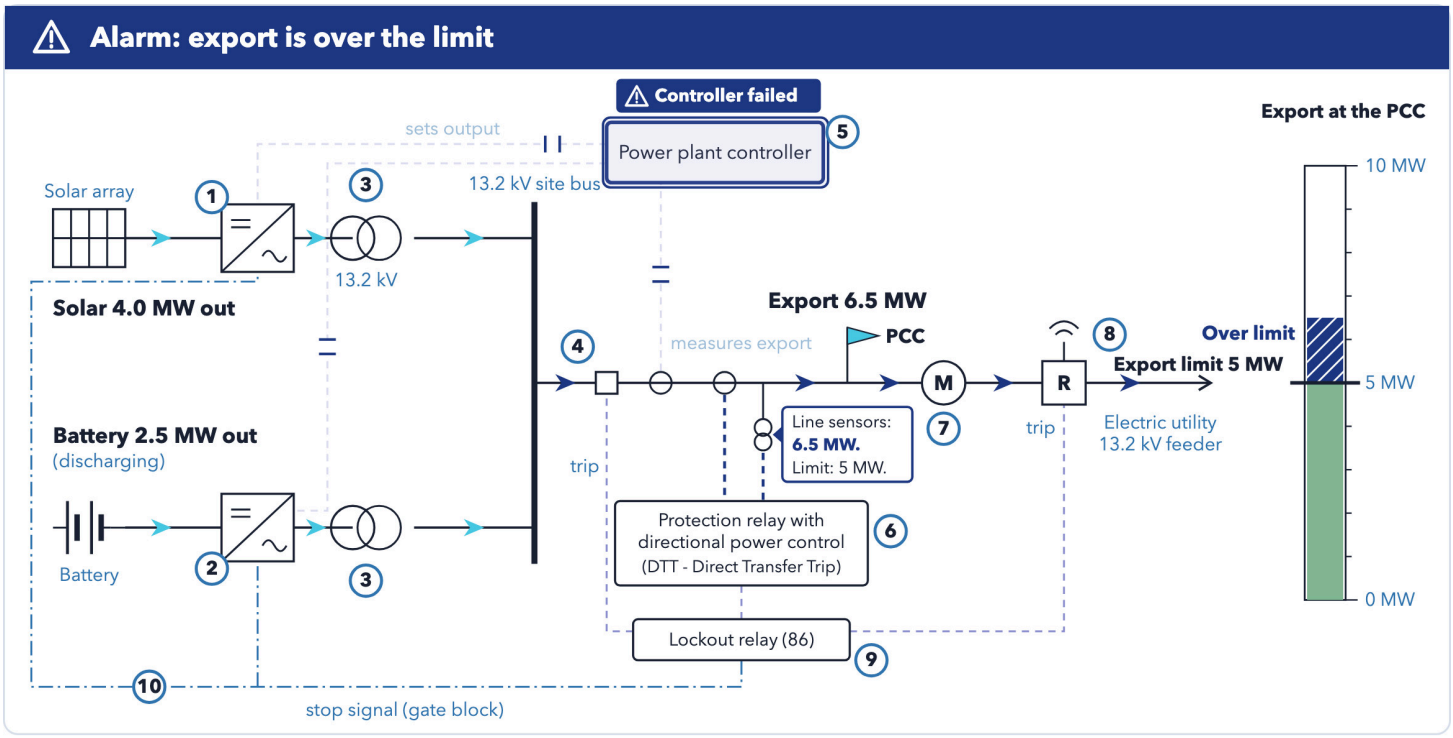
The power plant controller (5) has failed. Nothing is holding the inverters back. Solar rises to 4.0 MW and the battery discharges 2.5 MW, so export climbs past the limit to 6.5 MW.



SITUATION 4, STEP 2 OF 5

When the line sensors read over the limit

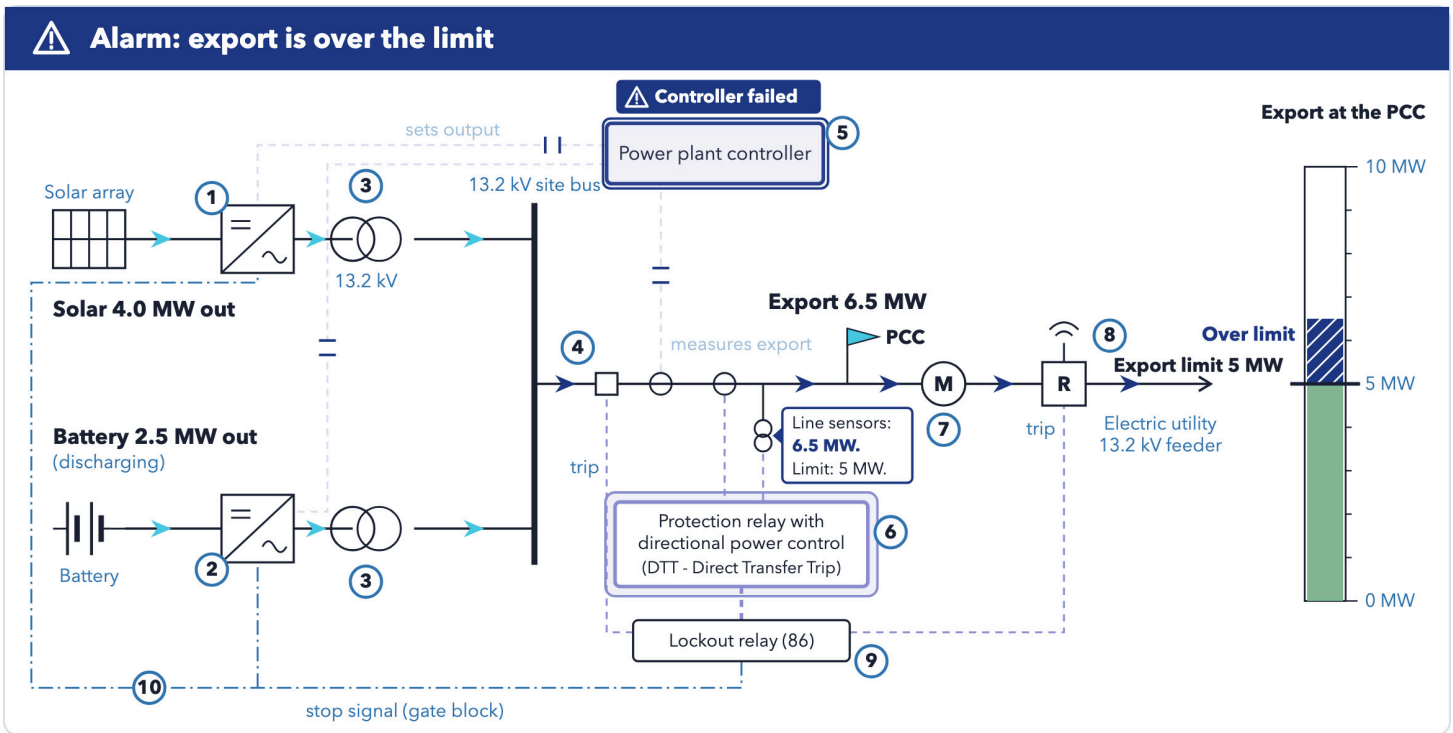
The line sensors just before the PCC confirm it: 6.5 MW against a 5 MW limit. These are the current and voltage sensors (CT and PT) of the protection relay, separate from the controller. The alarm turns on.



SITUATION 4, STEP 3 OF 5

When the protection relay trips (DTT)

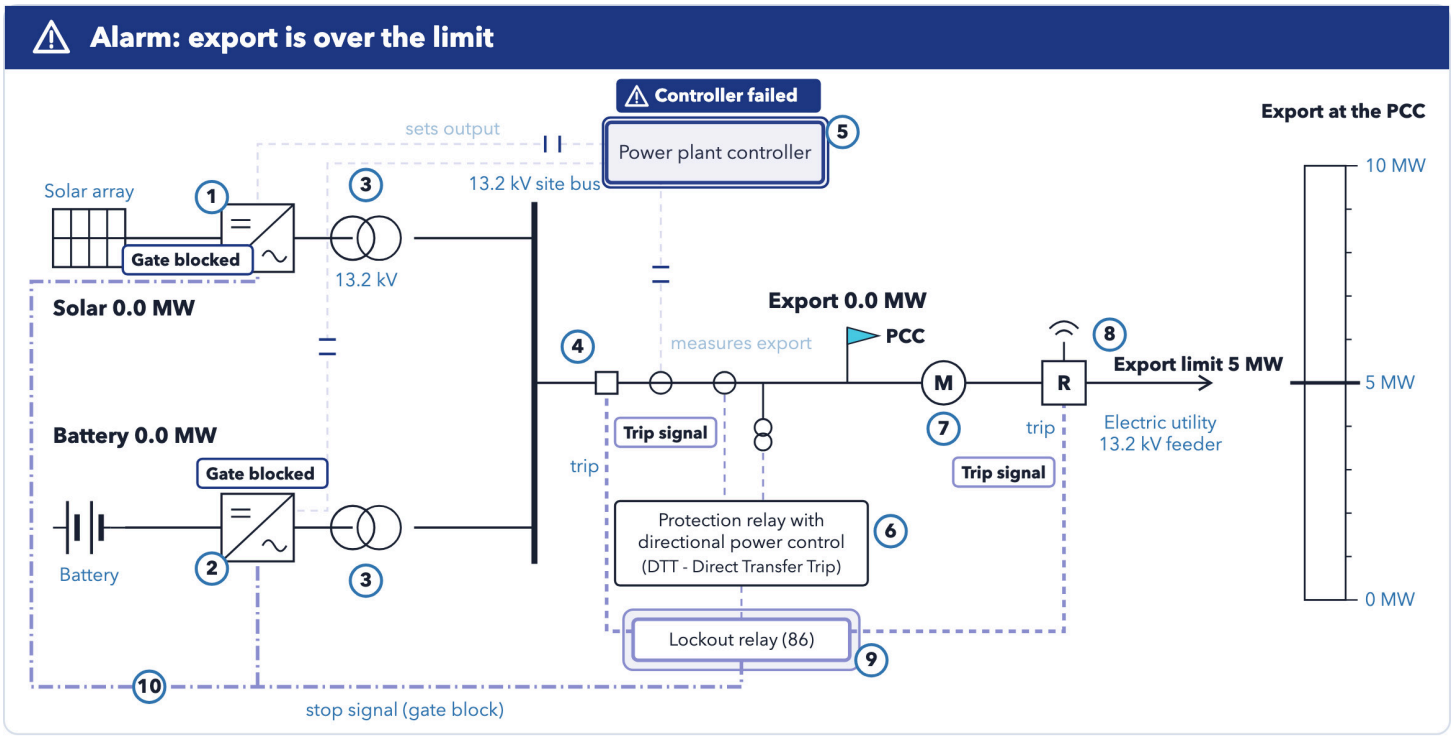
That confirmation triggers the protection relay (DTT). The relay does not open the breaker by itself. It energizes the lockout relay (9).



SITUATION 4, STEP 4 OF 5

When the lockout relay acts (device 86)

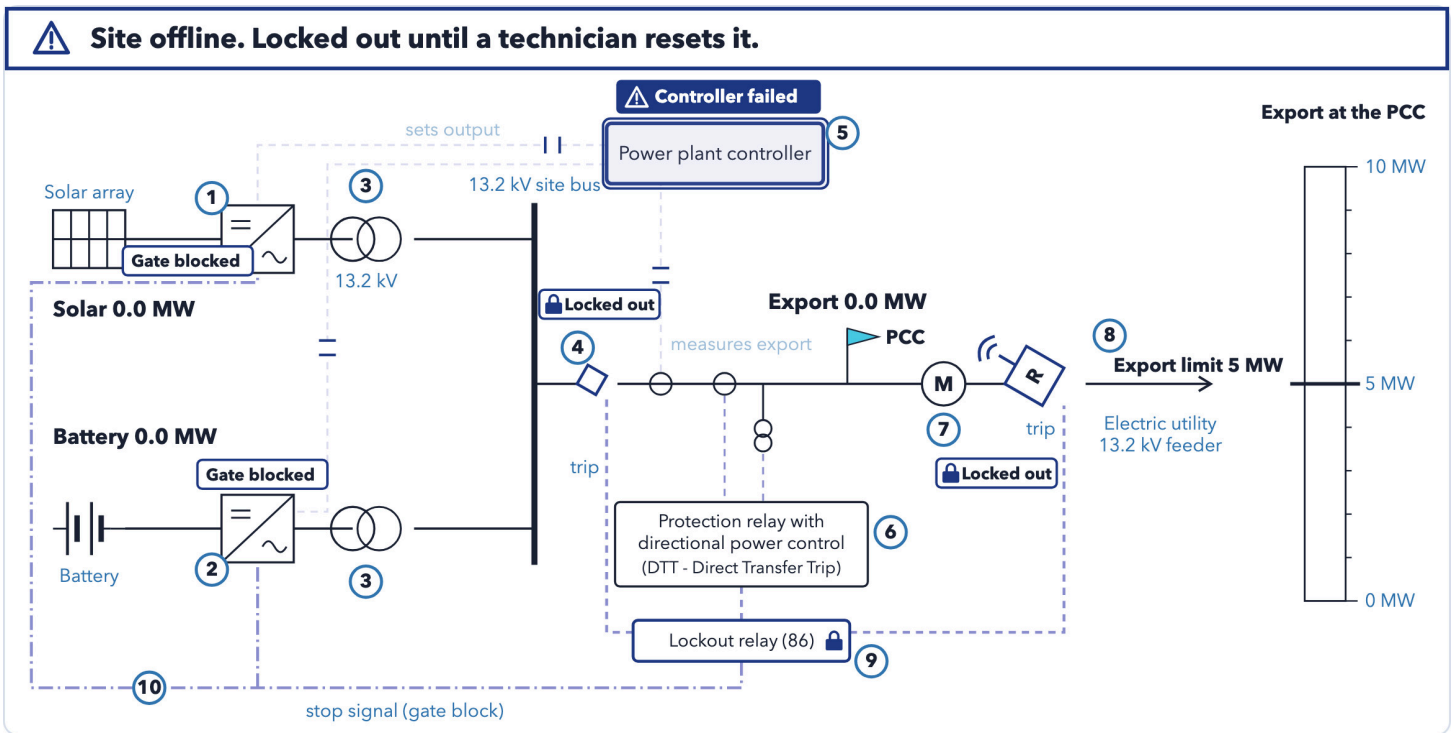
The lockout relay sends two signals at once: a trip to the breaker or the recloser, and a stop signal straight to the inverters (10). The inverters stop current within milliseconds, and solar, battery and export all read 0.0 MW.



SITUATION 4, STEP 5 OF 5

When the circuit opens and locks

The breaker and the recloser both open with little current on their contacts. The lockout relay holds them open until a technician resets it. The site is offline, and the plant cannot reconnect to a dead grid by accident.



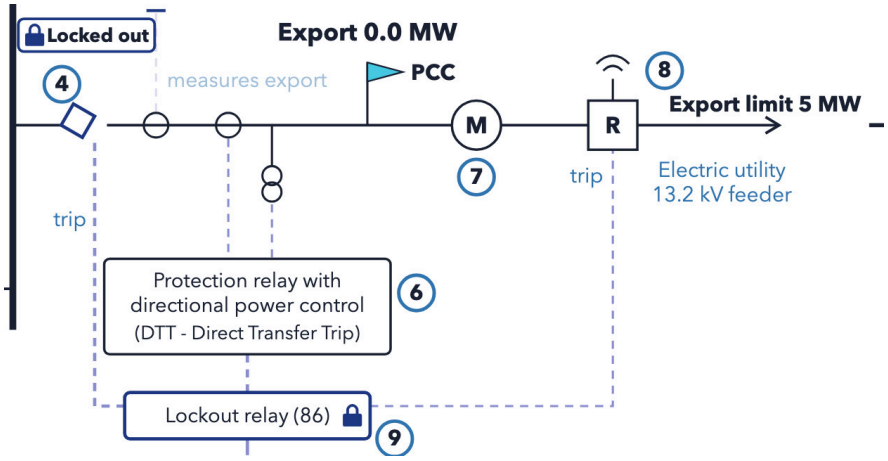
SITUATION 4, STEP 5

The trip opens: three options

At step 5 the trip can open the site main breaker (4), the utility recloser (8), or both. The protection relay can open any of the three, and it can sit at the site or inside the utility's recloser (see item 6 in the equipment key). Each still below shows the part of Figure 2 that changes: the device that opens and its locked out tag. In every option the lockout relay holds the open device open until a technician resets it.

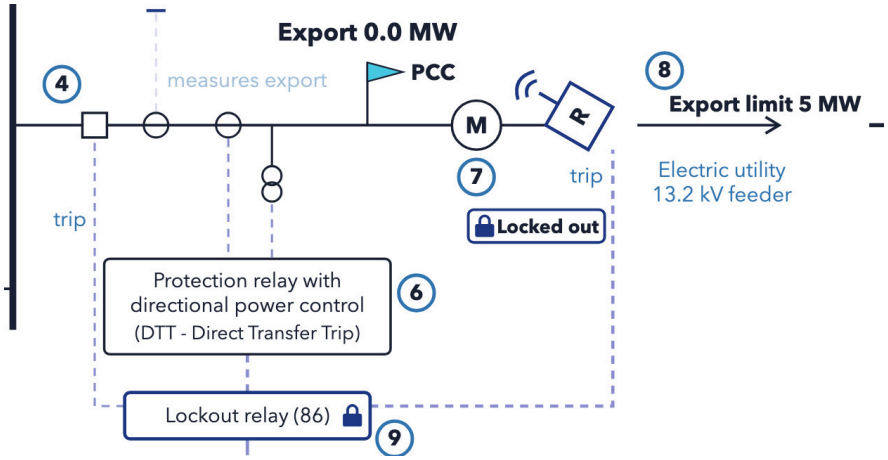
SITE MAIN BREAKER

The site main breaker opens with little current on its contacts. The lockout relay holds it open until a technician resets it.



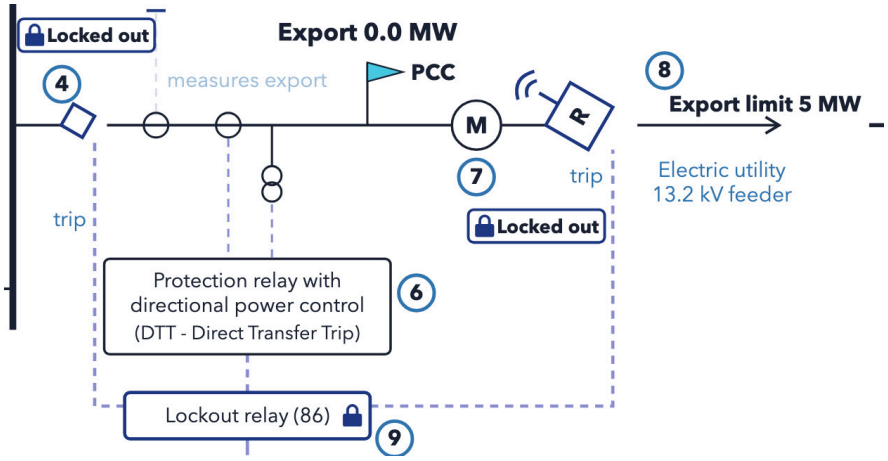
UTILITY RECLOSER

The utility recloser opens with little current on its contacts. The lockout relay holds it open until a technician resets it.



BOTH

The breaker and the recloser both open with little current on their contacts. The lockout relay holds them open until a technician resets it.









Equipment key

1. **Solar inverters.**
   Turn solar power into grid power. They accept an output limit from the controller.
   Owner: the site.

2. **Battery inverters.**
   Charge and discharge the battery. They accept an output limit from the controller.
   Owner: the site.

3. **Step-up transformers.**
   Raise the voltage to the 13.2 kV site bus.
   Owner: the site.

4. **Site main breaker.**
   The switch the relay opens.
   Owner: the site.

5. **Power plant controller.**
   The daily limiter. It measures export at the PCC and tells both inverter groups what to do.
   Owner: the site.

6. **Protection relay with directional power control.**
   The backstop. Utility grade, with its own current and voltage sensors. It trips the breaker if export goes over the setting. It can open the site main breaker, the utility recloser, or both.
   Owner: the site, or the electric utility inside its recloser.

7. **Utility meter.**
   Measures what crosses to the grid.
   Owner: the electric utility.

8. **Utility recloser with remote control.**
   The electric utility can open it from its control room.
   Owner: the electric utility.

9. **Lockout relay (device 86).**
   The trip signal rarely goes straight to the breaker alone. It energizes this relay. The lockout relay trips the breaker or the recloser and holds it open until a technician resets it by hand. The plant cannot reconnect to a dead grid by accident.
   Owner: the site, or the electric utility.

10. **Inverter stop signal (runback or gate block).**
    Some utility schemes also send the trip to the power plant controller or straight to the inverters. The inverters stop current within milliseconds. That reduces wear on the breaker or recloser contacts as they open.
    Owner: the site.







Excerpts from one electric utility

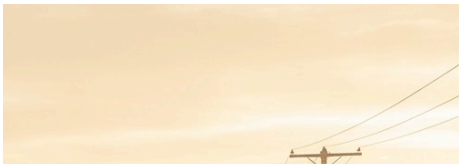
RULE	EXACT WORDS	SOURCE
The study uses the declared limit	"operating characteristics including maximum export and import capacity shall be utilized, except that fault current contribution shall be evaluated based on aggregate AC nameplate rating"	The state rule this utility follows [E1]
A limited site needs a relay	"For energy storage systems or distributed generation where net export is limited, Reverse Power (Function 32) shall be required."	The state rule this utility follows [E1]
The utility wants utility grade controls	"The customer shall utilize a power limiting scheme (e.g. 32 element) with utility grade controls. PT, CT, and relay percent error will be factored into the final setpoint of the 32 element." *(32 element: a protection relay with directional power control.)*	The utility's own bulletin, Section 7.6.14 [E2]
A lockout relay has a standard device number	"86 Lock Out Relay" *(From the bulletin's table of device numbers.)*	The utility's own bulletin [E2]
What a stop signal makes the inverters do	"Cease to Energize: Cessation of energy flow capability."	The state rule this utility follows [E1]

What to plan for

The relay setting sits below the limit, because sensor and relay error come off the top. One electric utility says a relay in its recloser at a 5,000 kVA site "may require a reduction in site export by as much as 7.5%". [E2 Section 7.6.14.2]

Fault current is studied at full nameplate. A 5 MW array plus a 5 MW battery counts as 10 MW for protection. [E1]

The export limit and the charging limit go on the storage application form, Appendix K. The utility studies what that form says. [E1]



Another way to build it

It depends on where the solar inverters are.

The rules name both layouts: DC coupled and AC coupled. [E1 Appendix K, page 2] [E2 Section 5.1.1.4, page 11]

FORM 1 One main inverter: the battery sits behind it

Figure 3 shows the first layout. One main inverter serves the whole array, and the battery joins on the DC side of that inverter through a DC link. The battery does not reach the grid on its own; everything passes through the one inverter.

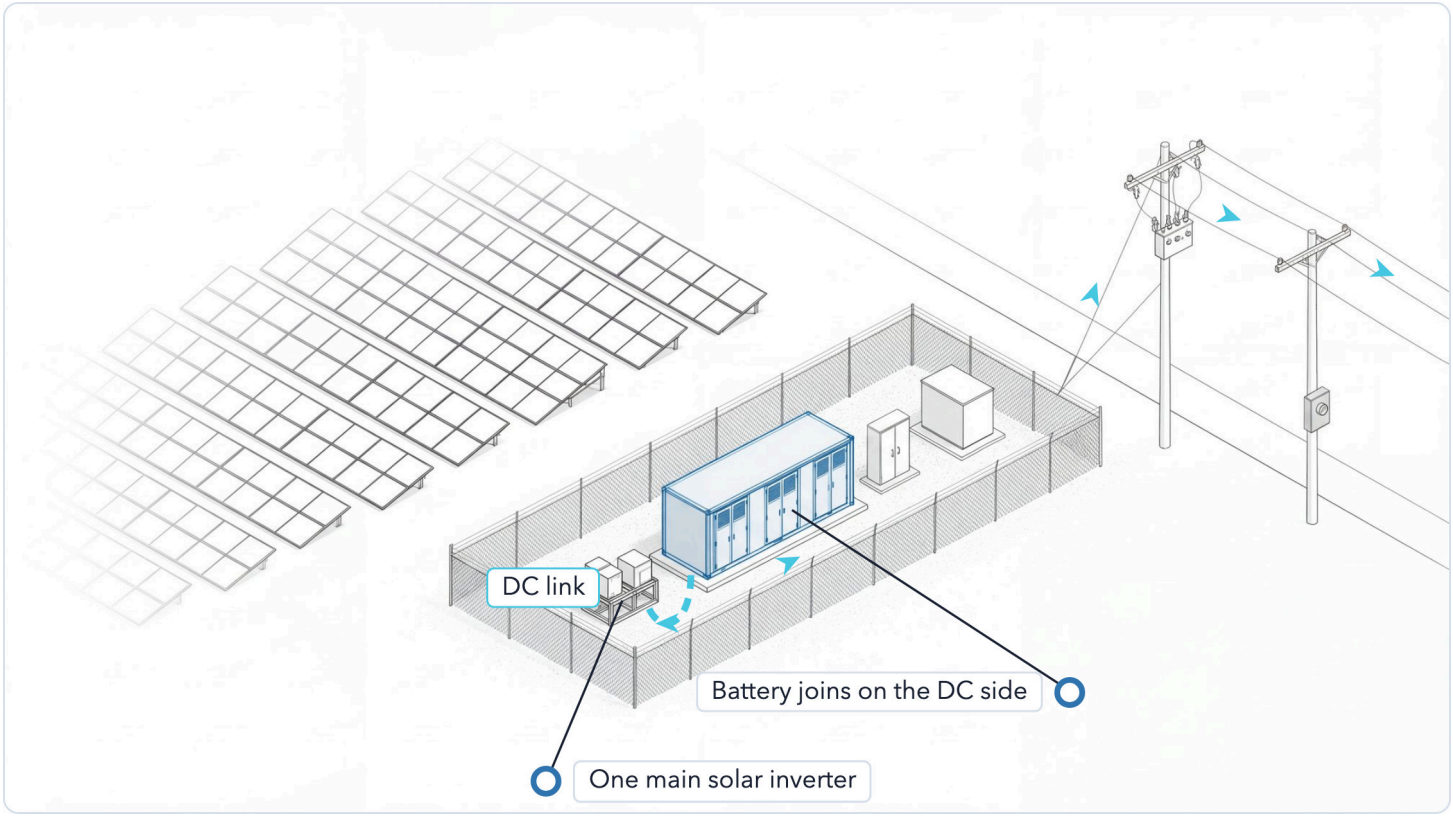


Figure 3. One main inverter. The battery connects to it on the DC side.

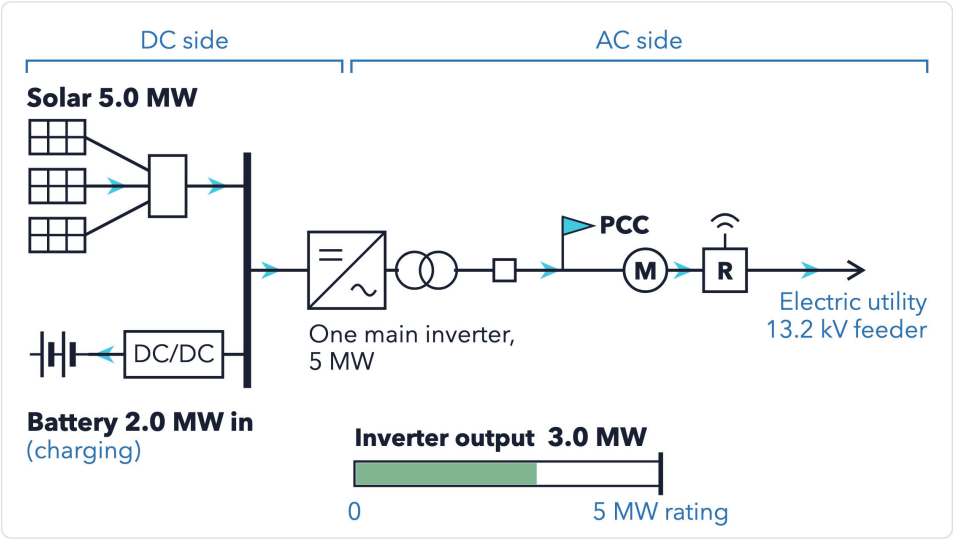
Nameplate is 5 MW, not 10 MW, because the one inverter sets it. [E1 Appendix K, page 2] Fault current is studied at 5 MW. [E1] If the study limit is below 5 MW, the controller and the relay from Figure 2 are still needed. [E1] The trade-off is that the array and the battery share one 5 MW path. The battery charges from the grid only if the inverter works in both directions.

Figure 4 shows the first layout as a one-line diagram in three states. At midday, solar makes 5.0 MW, the battery charges at 2.0 MW, and the inverter sends out 3.0 MW. In the evening, solar makes 0.5 MW and the battery adds 4.5 MW, so the inverter sends out 5.0 MW. When both push, solar makes 4.0 MW and the battery asks for 3.0 MW out. The inverter sends out 5.0 MW and holds back 2.0 MW. The inverter rating is the ceiling, so the site cannot send more than 5 MW.

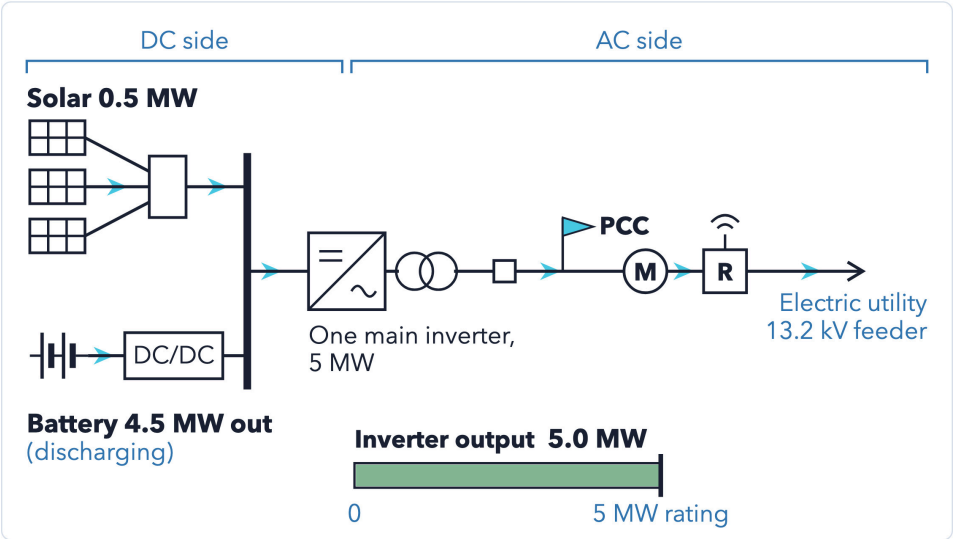
FORM 1

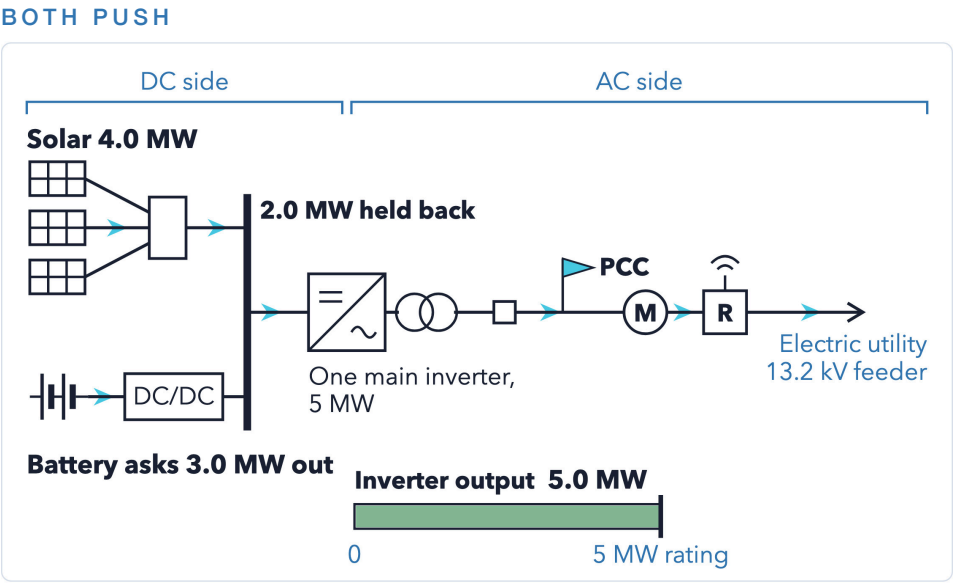
Figure 4. The inverter rating is the ceiling. The site cannot send more than 5 MW.

MIDDAY



EVENING





FORM 2 Many small inverters across the array: use Figure 2

Figure 5 shows the second layout. A small inverter sits at the end of each panel row, and each one sends grid power from its own row. There is no single point for the battery to sit behind.

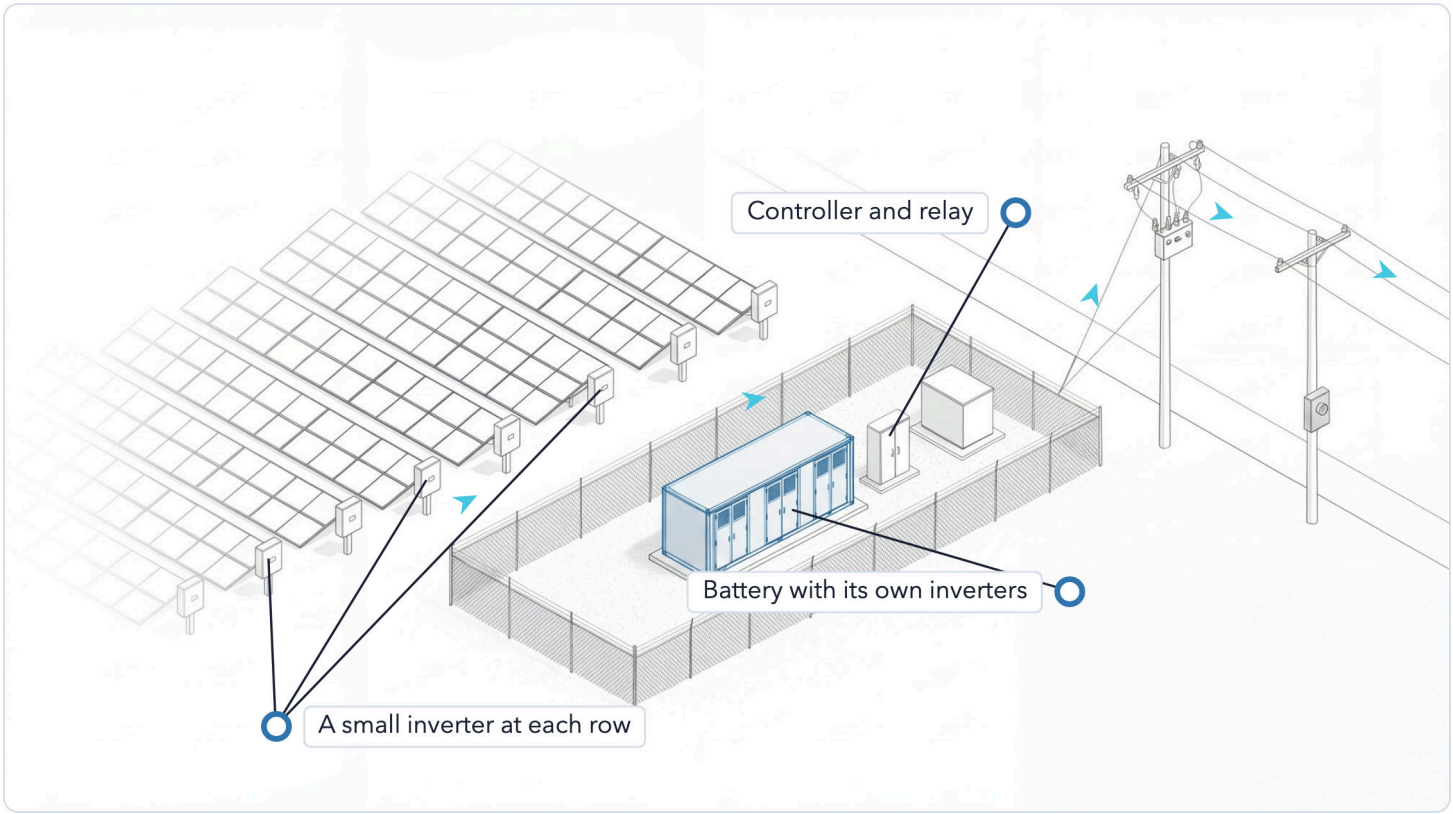


Figure 5. Small inverters at the rows. Each one sends grid power from its own row.

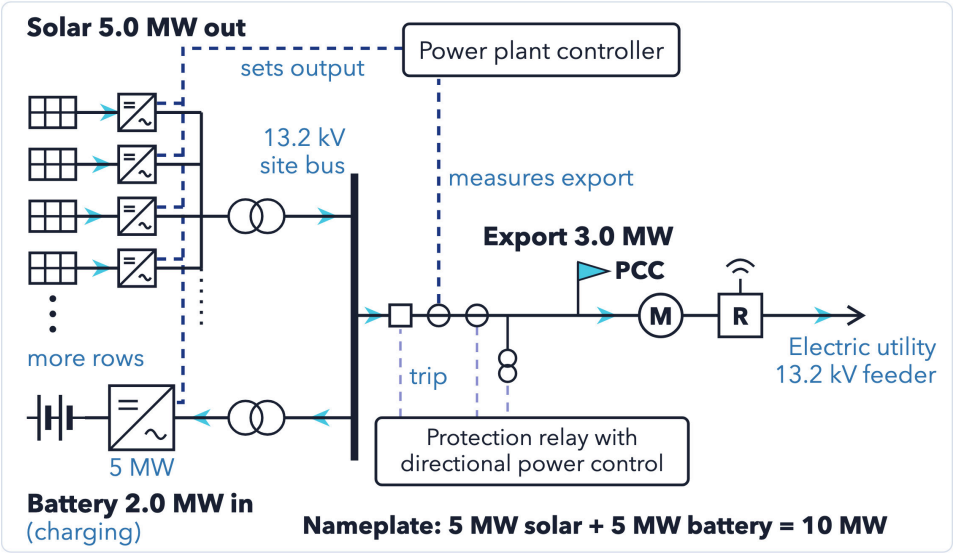
The battery needs its own inverters, so nameplate adds up to 10 MW. [E1] Use the Figure 2 equipment: the controller, the protection relay with directional power control, and the main breaker. [E1] [E2 Section 7.6.14] The controller must be able to turn down every small inverter. Confirm this with the inverter maker.

Figure 6 shows the second layout as a one-line diagram. At midday, the row inverters send 5.0 MW of solar, the battery charges at 2.0 MW, and export is 3.0 MW. In the evening, solar falls to 0.5 MW and the battery adds 4.5 MW, so export is 5.0 MW. Nameplate is 5 MW solar plus 5 MW battery, 10 MW, so the controller and the relay hold the export limit as in Figure 2.

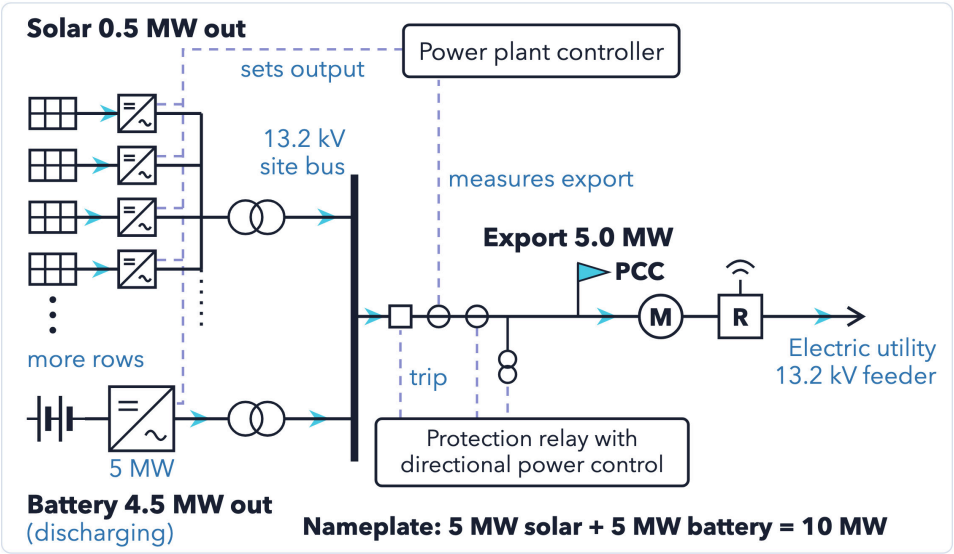
FORM 2

Figure 6. No shared DC point exists. The battery needs its own inverters, and the controller must reach every small inverter.

MIDDAY



EVENING



Excerpts on the two layouts

EXACT WORDS	SOURCE
“Indicate DER system nameplate rating based on the proposed project configuration, i.e., stand-alone, AC-coupled or DC-coupled.”	The state rule, Appendix K, item d [E1]
“(2) Distributed Generator (DG) and ESS DC coupled; (3) DG and ESS AC coupled”	The utility's own bulletin, Section 5.1.1.4 [E2]

Details

Abbreviations

CT, PT	current transformer and potential (voltage) transformer. Sensors that feed the relay.
Device 32	the standard number for a directional power relay.
Device 86	the standard number for a lockout relay.
Gate block	a command that makes an inverter stop current at once.
PCC	point of common coupling. Where the site meets the utility line.
kVA, MW	units of power. 5,000 kVA is about 5 MW.
DC coupled	the battery and the solar share one inverter.
AC coupled	each has its own inverters.
Direct transfer trip (DTT)	the utility opens the site's breaker from a distance, over a communication channel. The state rule defines it as “Remote operation of a circuit breaker by means of a communication channel.” [E1]

Sources

Each source is a public document.

- **E1.** New York State Standardized Interconnection Requirements, effective October 1, 2026: the CESIR contents (Section I-C), the payment requirements (Section I-D.1), the section on Hybrid Projects and energy storage (Step 2, Protection and Control Review), the protective function table, Appendix K, item d, and the Glossary of Terms (Section III). Printed pages 11, 13, 18, 25, 32 and 33 (PDF pages 14, 16, 21, 28, 35 and 36); Appendix K page 2 (PDF page 108).
  https://dps.ny.gov/system/files/documents/2026/10/24-e-0621-et-al.-sirs-effective-october-1-2026.pdf. Read November 14, 2026.
- **E2.** One electric utility's interconnection bulletin, 2024 edition, Section 5.1.1.4 (printed page 11) and Sections 7.6.14, 7.6.14.1 and 7.6.14.2 (printed pages 41 and 42), and Exhibit 1, List of Standard Device Numbers (printed page 38). Read November 14, 2026.
- **E3.** Public Law 119-21 (H.R. 1), signed July 4, 2025, 139 Stat. 72. Section 70512(a) (139 Stat. 252) and Section 70512(l)(4) (139 Stat. 270), on the clean electricity production credit (section 45Y); Section 70513(a) and (b) (139 Stat. 270 and 271) and Section 70513(g)(5) (139 Stat. 273), on the clean electricity investment credit (section 48E). PDF pages 182, 200, 201 and 203.
  https://www.govinfo.gov/content/pkg/PLAW-119publ21/pdf/PLAW-119publ21.pdf. Read November 14, 2026.
- **E4.** New York State Department of Public Service, Utility Interconnection Queue Data (September 2026): the interconnection queue files of the state’s utilities, linked from the Distributed Generation Information page. Files downloaded November 1, 2026.
  https://dps.ny.gov/distributed-generation-information. Read November 14, 2026.

> Animated version of this report: gaiergy.com/research/Pairing_Batteries_with_Existing_Solar.html