Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
DEPARTMENT OF ENERGY RESOURCES

SOLAR MASSACHUSETTS RENEWABLE TARGET PROGRAM (225 CMR 20.00)

GUIDELINE

Guideline on Energy Storage

Effective Date: September 13, 2018
Revised: May 18, 2020

1) Purpose and Background

This document provides guidance regarding the manner in which an Energy Storage System may qualify under the Department of Energy Resource's ("Department") Solar Massachusetts Renewable Target ("SMART") Program at 225 CMR 20.00.

Solar photovoltaic systems are widely recognized as an integral part of the energy generation mix that will help enable reduced emissions over the coming years; however, solar as a standalone technology has operational limitations and impacts that limit deployment and impose diminishing returns on additional installations. Some of the key limitations associated with solar electric generation include: intermittency at multiple levels (e.g. day/night, sunny/cloudy, summer/winter, etc.), 'Duck Curves' increasing required ramp rates for traditional generators, reverse power flows on the distribution and transmission system, as well as forecasting uncertainties for system operators.

Additionally, the Department's *State of Charge* Study, performed under the Energy Storage Initiative, found that peak demand accounts for a disproportionately high percentage of the cost of electricity for ratepayers in the Commonwealth. Solar alone does not necessarily coincide with peak demands, and as such may not address a root cause of higher electricity costs.

Energy storage can provide a variety of benefits across the electricity supply chain from generation to transmission and distribution. Some of the specific benefits of energy storage when implemented in conjunction with solar photovoltaic systems include: improved power quality (e.g. reduced voltage flicker associated with clouds temporarily shading solar installations), mitigating otherwise unnecessary substation upgrades often associated with installing solar, and the ability to shift solar energy production to peak demand (i.e. prevents reverse power flows and increases value and emissions savings of each kWh produced by solar). While providing these solar specific benefits, storage also provides the benefit of being dispatchable and may also be able to take advantage of other revenue streams, reducing required incentive costs and increasing benefits provided to ratepayers.

Chapter 75 of the Acts of 2016 directed the Department to establish a long-term sustainable solar incentive program to promote cost-effective solar in the Commonwealth. The Act also directed the Department to differentiate "incentive levels to support diverse installation types and sizes that provide unique benefits." In establishing the SMART Program as required by the Act, the Department considered different incentive levels for a variety of installation types and established adders to Base

Compensation Rates for certain facility types, including for Solar Tariff Generation Units that are co-located with Energy Storage Systems.

Throughout this document the term Publication Date is used to reference when certain provisions of the regulations go into effect. Publication Date is defined in 225 CMR 20.02 as "[t]he date established by the Department promulgation of revisions to the SMART Program pursuant to 225 CMR 20.07(5)." Based on this definition, and following the promulgation of the revised regulations, the Publication Date is established as April 15, 2020.

2) Technical and Operational Requirements

225 CMR 20.02: *Definitions* defines Energy Storage System as follows:

> *A commercially available technology that is capable of absorbing energy, storing it for a period of time and thereafter dispatching the energy.*

Additionally, 225 CMR 20.06(1)(e) specifies the following special provisions for STGUs co-located with Energy Storage Systems that are seeking qualification for an Energy Storage Adder:

> *(e) Special Provisions for Energy Storage Systems. Solar Tariff Generation Units co-located with an Energy Storage System will be eligible to receive an Energy Storage Adder under 225 CMR 20.07(4)(c), provided it meets the following eligibility criteria:*
>
> > *1. Minimum and Maximum Nominal Rated Power. The nominal rated power capacity of the Energy Storage System paired with the Solar Tariff Generation Unit must be at least 25%. The nominal rated power capacity of the Energy Storage System paired with the Solar Tariff Generation Unit may be more than 100% of the rated capacity, as measured in direct current, of the Solar Tariff Generation Unit, but the Solar Tariff Generation Unit will receive credit for no nominal rated power capacity greater than 100% in the calculation of its Energy Storage Adder, pursuant to 225 CMR 20.07(4)(c).*
> >
> > *2. Minimum and Maximum Nominal Useful Energy. The nominal useful energy capacity of the Energy Storage System paired with the Solar Tariff Generation Unit must be at least two hours. The nominal useful energy capacity of the Energy Storage System paired with the Solar Tariff Generation Unit may be more than six hours, but the Solar Tariff Generation Unit will receive credit for no nominal useful energy capacity greater than six hours in the calculation of its Energy Storage Adder, pursuant to 225 CMR 20.07(4)(c).*
> >
> > *3. Minimum Efficiency Requirement. The Energy Storage System paired with the Solar Tariff Generation Unit must have at least a 65% round trip efficiency in normal operation.*
> >
> > *4. Data Provision Requirements. The Owner of the Energy Storage System must provide historical 15-minute interval performance data in a manner established by the Department for the first year of operation, and upon request for the first five years of operation.*
> >
> > *5. Operational Requirements. The Energy Storage System must discharge at least 52 complete cycle equivalents per year, or must participate in a demand response program, and must remain functional and operational in order for the Solar Tariff Generation Unit to continue to be eligible for the energy storage adder. If the Energy Storage System is*

decommissioned or non-functional for more than 15% of any 12-month period, the Department may disqualify the Solar Tariff Generation Unit from continuing to receive the Energy Storage Adder.

Further information on acceptable metering and reporting capabilities is provided in the *Guideline Regarding Metering of Solar and Energy Storage Systems*

Facilities must meet all of the above requirements in order to qualify for the Energy Storage Adder.

3) Requirement to Pair with Energy Storage

Pursuant to 225 CMR 20.05(5)(k), Solar Tariff Generation Units (STGU) greater than 500 kW applying for a Statement of Qualification for any available capacity in any capacity block available after the Publication Date must be co-located with an Energy Storage System.

4) Exception to Requirement to Pair with Energy Storage

Pursuant to 225 CMR 20.05(5)(k)1., A STGU that is subject to the energy storage requirement shall be exempt from this requirement, if it can demonstrate to the Department's satisfaction one of the following:

i. documentation required to meet the criteria set forth in 225 CMR 20.06(1)(c) was obtained on or before the Publication Date. These documents include:
    a. an executed Interconnection Service Agreement, as tendered by the Distribution Company;
    b. a sufficient interest in real estate or other contractual right to construct the STGU at the location specified in the Interconnection Service Agreement; and
    c. all necessary governmental permits and approvals to construct the STGU with the exception of ministerial permits, such as a building permit, and notwithstanding any pending legal challenge(s) to one or more permits or approvals.
ii. It should be granted an exception to the provisions of 225 CMR 20.05(5)(k) for good cause.

Requests for good cause exception for the energy storage requirement should be directed to doer.smart@mass.gov.

5) Energy Storage Adders

a) Reserving the Energy Storage Adder

An applicant will reserve its adder multiplier rate upon the initial application for the Energy Storage Adder. This rate is directly tied to the Energy Storage Tranche reserved by the applicant. However, changes to as-built solar photovoltaic (PV) capacity or the Energy Storage System relative to the information contained in the initial application may result in an increase or decrease to the size of the Energy Storage Adder. Additional information on applying for the Energy Storage Adder is provided in the *Statement of Qualification Reservation Period Guideline.*

b) Rationale and Energy Storage Adder Formula

225 CMR 20.07(4)(c)2. establishes the following formula for determining the value of an Energy Storage Adder:

$$Energy\ Storage\ Adder = \left[\frac{\left(\frac{Nominal\ Rated\ Power\ Capacity\ of\ Energy\ Storage\ System}{DC\ Rated\ Capacity\ of\ the\ Solar\ Photovoltaic\ System}\right)}{\left(\left(\frac{Nominal\ Rated\ Power\ Capacity\ of\ Energy\ Storage\ System}{DC\ Rated\ Capacity\ of\ the\ Solar\ Photovoltaic\ System}\right) + \exp\left(0.7 - \left(8 * \left(\frac{Nominal\ Rated\ Power\ Capacity\ of\ Energy\ Storage\ System}{DC\ Rated\ Capacity\ of\ the\ Solar\ Photovoltaic\ System}\right)\right)\right)\right)}\right]$$
$$* \left[0.8 + \left(0.5 * \ln\left(\frac{Nominal\ Rated\ Useful\ Energy\ of\ the\ Energy\ Storage\ System}{Nominal\ Rated\ Power\ Capacity\ of\ Energy\ Storage\ System}\right)\right)\right] * Energy\ Storage\ Adder\ Multiplier$$

In general, this formula looks at the ratios of storage capacity to PV capacity for STGUs that are co-located with Energy Storage Systems, providing more value to Energy Storage Systems that have a higher rated power capacity and/or a higher rated energy capacity. However, the rate of increase in adder values for larger energy storage power and energy capacities diminishes as one or both increase This is consistent with the findings of the *State of Charge* Study, which found that short to medium duration Energy Storage Systems provided greater benefits to ratepayers.

The Energy Storage Adder multiplier will decline by 4% after each Energy Storage Adder tranche is filled.[1] The first tranche will be equal to 80 MW AC and is based on the amount of solar PV capacity qualified to receive the Energy Storage Adder.

The resulting output values of this formula are intended to stimulate the development of Energy Storage Systems paired with STGUs and assist Energy Storage System Owners to overcome the "revenue gap" identified in the Department's *State of Charge* Study.[2] The Department expects that most Energy Storage System owners will look for alternative sources of financing for their solar plus storage projects.

The Department has created a calculator fo prospective applicants to determine the potential value of an Energy Storage Adder as well as a table and chart that illustrate potential adder values for Energy Storage Systems of different sizes. These resources are available at: https://www.mass.gov/doc/energy-storage-adder-calculator.

6) Frequently Asked Questions

The following questions and answers are meant to provide clarification to eligibility requirements defined in 225 CMR 20.06(1)(e): *Special Provisions for Energy Storage Systems.*

a) How is co-located defined?

To be deemed co-located, the STGU and the Energy Storage System must be located on the same or adjacent parcels within the same distribution company's service territory, and must be interconnected to the same common collector located on the same parcel(s) on which the STGU and ESS facilities are located (i.e. an electric service on such parcel(s) connected to the same circuit at nominal AC voltage or distribution element that serves no other utility customers and no load other than that associated with the parcels on which the STGU(s) and Energy Storage Unit are located).

[1] *See* 225 CMR 20.07(2)

[2] For example, please see: *State of Charge*, Exec. Summ. p. xvi, and Section 5 - Use Cases of Specific Applications in Massachusetts, in particular, Figure 5-12; available at: https://www.mass.gov/files/2017-07/state-of-charge-report.pdf

If a Generation Unit Owner has a separate Interconnection Service Agreement ("ISA") or an amendment to its original ISA for the Energy Storage System, the Owner must also provide that ISA with their application for the Energy Storage Adder.

b) How is nominal rated power capacity of an Energy Storage System defined?

The nominal rated power capacity of an Energy Storage System is the limiting continuous apparent power rating (kVA) of the Energy Storage System's ability to discharge power while grid connected (i.e. the lesser of the inverter or battery continuous power ratings).[3]

c) How is nominal useful energy defined?

Nominal useful energy is the amount of usable energy stored. The usable energy is the amount of kilowatt-hours available to discharge from the Energy Storage System when starting at a full state-of-charge. Other synonymous terms may include usable capacity, usable battery capacity, typical cycle capacity, usable energy, and usable storage capacity.

d) How is the round trip efficiency calculated?

The Energy Storage System round trip efficiency should be listed by the manufacturer and may be verified by the Department by reviewing the interval data that must be provided pursuant to 225 CMR 20.06(1)(e)4.

e) How does a system generate the data required to be reported under 225 CMR 20.06(1)(e)4

Data generated by system components (e.g. inverter) is acceptable to meet the data provision requirements. Information on the format in which the data must be presented to the Department will be provided at time of qualification for the Energy Storage Adder.

Please reference the Department's *Guideline Regarding Metering of Solar and Energy Storage Systems* for additional technical guidance on metering specifications that are required by the Distribution Companies to calculate the Incentive Payment for the STGU. Note that these metering specifications may differ from the Department's specific reporting requirements.

f) How does an Energy Storage System demonstrate compliance with the operational requirements in 225 CMR 20.06(1)(e)5[4]

An Energy Storage System must accomplish one of the following to comply with operational requirements:

1) discharge at least 52 complete cycle equivalents in a calendar year, whereby the 52 cycles may be pro-rated in the first operational year of the Energy Storage System based on its Commercial Operation Date; or
2) participate in a demand response program, such as the Distribution Companies' Connected Solutions programs or similar programs approved through the Department of Public Utilities' three-year plans for energy efficiency.

[3] See examples provided in appendix below

[4] Note that the operational requirements detailed in this Guideline are designed to ensure that ratepayer benefits from the deployment of Energy Storage Systems under the SMART Program are maximized and are subject to change upon further review by the Department or as circumstances change over time (e.g. summer or winter peak hours shift over time).

Standalone Systems: An Energy Storage System co-located with a Standalone STGU may demonstrate compliance with the operational requirements in 225 CMR 20.06(1)(e)5. by demonstrating compliance with one of the following two options:

> **Option #1**: The Energy Storage System may fulfill the operational requirements by dispatching the Energy Storage System during the summer peak hours and winter peak hours.[5] Energy Storage System Owners may choose when to cycle during any hours included during this window.
>
> **Option #2**: The Energy Storage System may fulfill the operational requirement through registration in the ISO-NE wholesale market or a retail-level program aimed at reducing ratepayer costs, if deemed satisfactory to the Department.

Behind the Meter Systems: An Energy Storage System co-located with a Behind-the-Meter STGU may comply with the operational requirements in 225 CMR 20.06(1)(e)5. by demonstrating that the Energy Storage System reduces on-site customer peak demand or increases self-consumption of on-site generated solar energy.

g) How is a complete cycle equivalent measured?

A complete cycle equivalent is the amount of useful energy available in a single complete discharge. For example, if an Energy Storage System is registered as 25 kW / 2 hour duration, then the complete cycle equivalent would be 25 kW x 2 hours = 50 kilowatt-hours (kWh). In order to meet operational requirements, this example system must discharge 2,600 kWh (i.e. 52 x 50 kWh = at least 2,600 kWh discharged annually). As a second example, an Energy Storage System is registered as a 100 kW/ 3 hour duration, then the complete cycle equivalent would be 100 kW x 3 hours = 300 kWh. In order to meet operational requirements, this second example system must discharge 15,600 kWh (52 x 300 kWh) annually. Operational requirements and functionality may be confirmed utilizing the data provision requirements in *225 CMR 20.06(1)(e)4*.

h) What if my Energy Storage System does not meet the minimum 2 hour duration eligibility criteria?

If an Energy Storage System co-located with a STGU does not meet the minimum 2 hour duration requirement, an applicant may de-rate the Energy Storage System's nominal rated power capacity for the purpose of calculating the SMART Energy Storage Adder.[6] Note that in this case an applicant is not required to physically change any equipment used, but rather would de-rate the Energy Storage System power value to a point at which the storage has a useful energy duration of 2 hours at the nominal rated power capacity. See Example 3 in the Appendix for further details.

i) Can multiple STGUs be co-located with an Energy Storage System? If yes, how is the adder calculated?

An applicant may co-locate multiple STGUs to a single Energy Storage System. In these instances, the combined capacity of the STGUs will be used in the formula for PV capacity (kW

[5] Summer peak hours are defined as Business Days, June 1st – September 15th, between 3 PM and 8 PM. Winter peak hours are defined as Business Days, December 1st – March 1st, between 4 PM and 9 PM.
[6] See examples provided in appendix below

DC) in comparison to the Energy Storage System. The resulting adder is then applied to each individual Statement of Qualification. See Example 4 in the Appendix for further details.

7) Energy Storage Guideline Appendix: Examples

Example 1: A proposed SMART customer applies to install a STGU consisting of 9 kW of cumulative DC panels behind a 7.6 kW AC inverter. The customer intends to pair (in an AC coupled manner) the STGU with an Energy Storage System with the following spec sheet:

PERFORMANCE SPECIFICATIONS

AC Voltage (Nominal)	120/240 V
Feed-In Type	Split Phase
Grid Frequency	60 Hz
Total Energy[1]	14 kWh
Usable Energy[1]	13.5 kWh
Real Power, max continuous	5 kW (charge and discharge)
Real Power, peak (10s, off-grid/backup)	7 kW (charge and discharge)
Apparent Power, max continuous	5.8 kVA (charge and discharge)
Apparent Power, peak (10s, off-grid/backup)	7.2 kVA (charge and discharge)
Maximum Supply Fault Current	10 kA
Maximum Output Fault Current	32 A
Overcurrent Protection Device	30 A
Imbalance for Split-Phase Loads	100%
Power Factor Output Range	+/– 1.0 adjustable
Power Factor Range (full-rated power)	+/– 0.85
Internal Battery DC Voltage	50 V
Round Trip Efficiency[1,2]	90%
Warranty	10 years

[1]Values provided for 25°C (77°F), 3.3 kW charge/discharge power.
[2]AC to battery to AC, at beginning of life.

For Energy Storage Adder calculation purposes, the Energy Storage System has a nominal rated power capacity of 5.8 kVA and has nominal useful energy of 13.5 kWh.

For Energy Storage Adder calculation purposes, the 9 kW DC is the STGU rated power which the energy storage will be compared against.

To confirm eligibility:

- 5.8 kW ES / 9 kW PV = 0.64 = 64%
  - ✓ 64% $\geq$ 25%, the system has a 64 percent ratio of energy storage power to solar power, which exceeds the 25 percent minimum eligibility criteria
- 13.5 kWh / 5.8 kW = 2.3 hours
  - ✓ 2.3 $\geq$ 2, the Energy Storage System has useful energy of more than a 2 hour duration at the rated power, which exceeds the 2 hour eligibility criteria

Variables to be entered into the Energy Storage Adder:

Nominal Rated Power Capacity of Energy Storage System:	5.8 kW
Nominal Rated Useful Energy of the Energy Storage System:	13.5 kWh
Storage Hours at rated capacity:	2.3
DC Rated Capacity of the Solar Photovoltaic System:	9 kW

Example 1 resultant Energy Storage Adder if in Block 1: $0.0538 / STGU kWh

Example 2: A proposed SMART customer applies to install an STGU consisting of 5 kW of cumulative DC panels behind a 3.8 kVA AC inverter with the following spec sheet:

OUTPUT - AC (LOADS/GRID)			
Rated AC Power Output	3800	7600	VA
Max AC Power Output	4175	8350	VA
AC Output Voltage Min-Nom-Max (L-L)[2]	211-240-264		Vac
AC Frequency Min-Nom-Max [2]	59.3 - 60 - 60.5		Hz
Maximum Continuous Output Current @240V	16	32	A
GFDI	1		A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes		
Charge Battery from AC (if Allowed)	Yes		
THD	<3		%
Typical Nighttime Power Consumption	<5		W
OUTPUT - AC (BACKUP POWER)[3]			
Rated AC Power Output	5000[4]		VA
Max AC Power Output - Surge	6600[4]		VA
AC Output Voltage Min-Nom-Max (L-L)	211-240-264		Vac
AC Output Voltage Min-Nom-Max (L-N)	105-120-132		Vac
AC Frequency Min-Nom-Max	55 - 60 - 65		Hz
Maximum Continuous Output Current @240V - Backup Mode	21		A
Max Continuous Output Current per Phase @120V	25		A
GFDI	1		A
AC Circuit Breaker	Yes		
THD	<5		%
Automatic switchover time	<2		sec
Typical Nighttime Power Consumption	<5		W
INPUT - DC (PV and BATTERY)			
Transformer-less, Ungrounded	Yes		
Max Input Voltage	500		Vdc
Nom DC Input Voltage	400		Vdc
Reverse-Polarity Protection	Yes		
Ground-Fault Isolaton Detection	600kΩ Sensitvity		
Maximum Inverter Efficiency	98		%
CEC Weighted Efficiency	97.5		%
INPUT - DC (PV)			
Maximum DC Power (STC)	5100	10250	W
Max Input Current[5]	13	23	Adc
2-pole Disconnection	Yes		
INPUT - DC (BATTERY)			
Supported Battery Types	LG Chem RESU10H		
Number of Batteries per Inverter	1 or 2[6]		
Continuous Power	5000		W
Peak Power	7000		W
Max Input Current	17.5		Adc
2-pole Disconnection	Yes		
DC Fuses on Plus and Minus	25A (field replaceable)		

The customer plans to DC couple the paired energy storage behind the same inverter. The proposed Energy Storage System has the following spec sheet:

Electrical Characteristics		
Total Energy		9.8 kWh @25°C (77°F)
Usable Energy[1)]		9.3 kWh @25°C (77°F)
Voltage Range	Charge	400 ~ 450 VDC
	Discharge	350 ~ 430 VDC
Absolute Max. Voltage		520VDC
Max. Charge/Discharge Current		11.9A@420V / 14.3A@350V
Max. Charge/Discharge Power [2)]		5kW
Peak Power (only discharging)[3)]		7kW for 10 sec.
Peak Current (only discharging)		18.9A@370V for 10 sec.
Communication Interface		RS485
DC Disconnect		Circuit Breaker, 25A, 600V rating
Connection Method		Spring Type Connector
User interface		LEDs for Normal and Fault operation
Protection Features		Over Voltage / Over Current / short circuit / Reverse Polarity
Scalability (Total Energy, Max. Charge/Discharge Power, Peak Power (only discharging))		Max. 2 in parallel (19.6 kWh @25°C (77°F), 6.6KW, 7kW for 10 sec.)

For Energy Storage Adder calculation purposes, the Energy Storage System has a nominal rated power capacity of 3.8 kVA (the inverter in this case is the limiting factor, where the inverter's 3.8 kVA is less than the storage's 5 kW), and has a nominal useful energy of 9.3 kWh.

For Energy Storage Adder calculation purposes, the 5 kW DC is the PV rated power which the energy storage will be compared against.

To confirm eligibility:

- 3.8 kVA ES / 5 kW PV = 0.76 = 76%
  - ✓ 76% $\geq$ 25%, the system has a 76 percent ratio of energy storage power to solar power, which exceeds the 25 percent minimum eligibility criteria
- 9.3 kWh / 3.8 kVA = 2.4
  - ✓ 2.4 $\geq$ 2, the Energy Storage System has useful energy of more than a 2 hour duration at the rated power, which exceeds the 2 hour eligibility criteria

Variables to be entered into the Energy Storage Adder:

Nominal Rated Power Capacity of Energy Storage System:	3.8 kVA
Nominal Rated Useful Energy of the Energy Storage System:	9.3 kWh
Storage Hours at rated capacity:	2.447
DC Rated Capacity of the Solar Photovoltaic System:	9 kW

Example 2 resultant Energy Storage Adder if in Block 1: $0.0483 / STGU kWh

Example 3: A proposed SMART customer applies to install an STGU consisting of 8 kW of cumulative DC panels behind a 7.6 kVA AC inverter with the following spec sheet:

OUTPUT - AC (LOADS/GRID)			
Rated AC Power Output	3800	7600	VA
Max AC Power Output	4175	8350	VA
AC Output Voltage Min-Nom-Max (L-L)[2]	211-240-264		Vac
AC Frequency Min-Nom-Max [2]	59.3 - 60 - 60.5		Hz
Maximum Continuous Output Current @240V	16	32	A
GFDI	1		A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes		
Charge Battery from AC (if Allowed)	Yes		
THD	<3		%
Typical Nighttime Power Consumption	<5		W
OUTPUT - AC (BACKUP POWER)[3]			
Rated AC Power Output	5000[4]		VA
Max AC Power Output - Surge	6600[4]		VA
AC Output Voltage Min-Nom-Max (L-L)	211-240-264		Vac
AC Output Voltage Min-Nom-Max (L-N)	105-120-132		Vac
AC Frequency Min-Nom-Max	55 - 60 - 65		Hz
Maximum Continuous Output Current @240V - Backup Mode	21		A
Max Continuous Output Current per Phase @120V	25		A
GFDI	1		A
AC Circuit Breaker	Yes		
THD	<5		%
Automatic switchover time	<2		sec
Typical Nighttime Power Consumption	<5		W
INPUT - DC (PV and BATTERY)			
Transformer-less, Ungrounded	Yes		
Max Input Voltage	500		Vdc
Nom DC Input Voltage	400		Vdc
Reverse-Polarity Protection	Yes		
Ground-Fault Isolaton Detection	600kΩ Sensitvity		
Maximum Inverter Efficiency	98		%
CEC Weighted Efficiency	97.5		%
INPUT - DC (PV)			
Maximum DC Power (STC)	5100	10250	W
Max Input Current[5]	13	23	Adc
2-pole Disconnection	Yes		
INPUT - DC (BATTERY)			
Supported Battery Types	LG Chem RESU10H		
Number of Batteries per Inverter	1 or 2[6]		
Continuous Power	5000		W
Peak Power	7000		W
Max Input Current	17.5		Adc
2-pole Disconnection	Yes		
DC Fuses on Plus and Minus	25A (field replaceable)		
ADDITIONAL FEATURES			
Supported Communication Interfaces	RS485 for battery, RS485, Ethernet, Cellular, ZigBee (optional)		
Revenue Grade Data, ANSI C12.20	Optional[7]		
Integrated AC, DC and Communication Connection Unit	Yes		
AC Disconnect	Yes		
Manual Inverter Bypass Switch	Yes		
DC Voltage Rapid Shutdown (PV and Battery)	Yes, according to NEC 2014 and 2017 690.12		
Auto-transformer thermal protection	Yes		

The customer plans to DC couple the paired energy storage behind the same inverter. The proposed Energy Storage System has the following spec sheet:

Electrical Characteristics		
Total Energy		9.8 kWh @25°C (77°F)
Usable Energy[1)]		9.3 kWh @25°C (77°F)
Voltage Range	Charge	400 ~ 450 VDC
	Discharge	350 ~ 430 VDC
Absolute Max. Voltage		520VDC
Max. Charge/Discharge Current		11.9A@420V / 14.3A@350V
Max. Charge/Discharge Power [2)]		5kW
Peak Power (only discharging)[3)]		7kW for 10 sec.
Peak Current (only discharging)		18.9A@370V for 10 sec.
Communication Interface		RS485
DC Disconnect		Circuit Breaker, 25A, 600V rating
Connection Method		Spring Type Connector
User interface		LEDs for Normal and Fault operation
Protection Features		Over Voltage / Over Current / short circuit / Reverse Polarity
Scalability (Total Energy, Max. Charge/Discharge Power, Peak Power (only discharging))		Max. 2 in parallel (19.6 kWh @25°C (77°F), 6.6KW, 7kW for 10 sec.)

For Energy Storage Adder calculation purposes, the Energy Storage System has a nominal rated power capacity of 5 kW (the battery in this case is the limiting factor), and has a nominal useful energy of 9.3 kWh.

For Energy Storage Adder calculation purposes, the 8 kW is the PV rated power which the energy storage will be compared against.

To confirm eligibility:

- 5 kW ES / 8 kW PV = 0.63 = 63%
  - ✓ 63% ≥ 25%, the system has a 63 percent ratio of energy storage power to solar power, which exceeds the 25 percent minimum eligibility criteria
- 9.3 kWh / 5 kW = 1.86
  - ✓ 1.86≤ 2, the Energy Storage System has useful energy of **Less** than a 2 hour duration at the rated power, which **does not meet** the 2 hour eligibility criteria
    - If the customer would still like to utilize this hardware, they have the option to de-rate the nominal rated power capacity of the Energy Storage System for Energy Storage Adder calculation purposes.
    - With 9.3 kWh of available useful energy, the maximum eligible nominal rated power capacity for the Energy Storage System will be 4.65 kW. Re-confirm eligibility at the now de-rated energy storage power.
- 4.65 kW ES / 8 kW PV = 0.58 = 58%
  - ✓ 58% ≥ 25%, the system has a 58 percent ratio of energy storage power to solar power, which exceeds the 25 percent minimum eligibility criteria
- 9.3 kWh / 4.65 kW = 2

- ✓ 2 ≥ 2, the Energy Storage System has useful energy of equal to a 2 hour duration at the rated power, which meets the 2 hour eligibility criteria

Variables to be entered into the Energy Storage Adder:

Nominal Rated Power Capacity of Energy Storage System:	4.65 kW
Nominal Rated Useful Energy of the Energy Storage System:	9.3 kWh
Storage Hours at rated capacity:	2.0
DC Rated Capacity of the Solar Photovoltaic System:	8 kW

Example 3 resultant Energy Storage Adder if in Block 1: $0.0499 / STGU kWh

Example 4: A proposed SMART facility Owner applies to install a 200 kW DC building mounted STGU and a 250 kW DC parking canopy, co-located and AC coupled with an Energy Storage System with a nominal rated power capacity of 200 kVA and a nominal useful energy of 500 kWh.

For Energy Storage Adder calculation purposes, the combined total of the two STGU installations of 450 kW DC is the STGU rated power which the energy storage will be compared against.

To confirm eligibility:

- 200 kW ES / 450 kW PV = 0.44 = 44%
  - ✓ 44% ≥ 25%, the system has a 44 percent ratio of energy storage power to solar power, which exceeds the 25 percent minimum eligibility criteria
- 500 kWh / 200 kW = 2.5 hours
  - ✓ 2.5 ≥ 2, the Energy Storage System has useful energy of more than a 2 hour duration at the rated power, which meets the eligibility criteria

Variables to be entered into the Energy Storage Adder:

Nominal Rated Power Capacity of Energy Storage System:	200 kW
Nominal Rated Useful Energy of the Energy Storage System:	500 kWh
Storage Hours at rated capacity:	2.5
DC Rated Capacity of the Solar Photovoltaic System:	450 kW

Example 4 resultant Energy Storage Adder if in Block 1: $0.0501 / STGU kWh