



Settlement of Energy Storage Resource Charging Energy and FERC Order 841: Manual 28 and Manual 27 Revisions

Andrew Levitt

Sr. Business Sol'n Architect, Applied Innovation

July 10, 2019

PJM Market Implementation Committee

Action Required	Deadline	Who May Be Affected
Assign Network Service Peak Load to Energy Storage Resource Model Participants	12/3/2019, or effective date of FERC approval, or opt-in date of any new resources	Electric Distribution Companies with resources that will use the Order 841 Energy Storage Resource market participation Energy Storage Resource marketers
Quantify and reconcile types of charging energy according to new methods in Manual 28	In service date for applicable Energy Storage Resources	Electric Distribution Companies and marketers of load-serving Energy Storage Resources



- Energy Storage Resource Notice of Proposed Rulemaking in November 2016
- Order 841 Final Rule on Electric Storage Participation in Regional Markets issued February, 2018
- PJM Compliance Filing Dec 3, 2018 targeting **Dec 3, 2019 implementation**
- FERC acceptance of new Energy Storage Resource and Capacity Storage Resource definitions on Feb 3, 2019 (all of ER19-462)
- PJM submitted additional clarifying Tariff language May 1, 2019 in response to FERC Request for Clarification
- FERC acceptance of PJM compliance filing still pending (ER19-469)

Committee		May	Jun	Jul	Aug	Sep	Oct
Manual 15	MIC	● 5/10	○ 6/12	★ 7/10			
	MRC				● 7/25	★ 8/22	
	MC				● 8/22	★ 9/26	
	Board						★
Manual 18 & 11	MIC		○ 6/12	★ 7/10			
	MRC				○ 7/25	★ 8/22	
Manual 27, 28	MSS		○ 6/20				
	MIC			○ 7/10	★ 8/7		
	MRC				○ 8/22	★ 9/26	
Manual 36, 40 & 14D	SOS		○ 6/6			★ 9/5	
	OC		○ 6/11			★ 9/10	
	MRC					○ 9/26	10/31 ★
Manual 36	DTS		○ 6/18				

- Information
- First Read
- ★ Endorsement

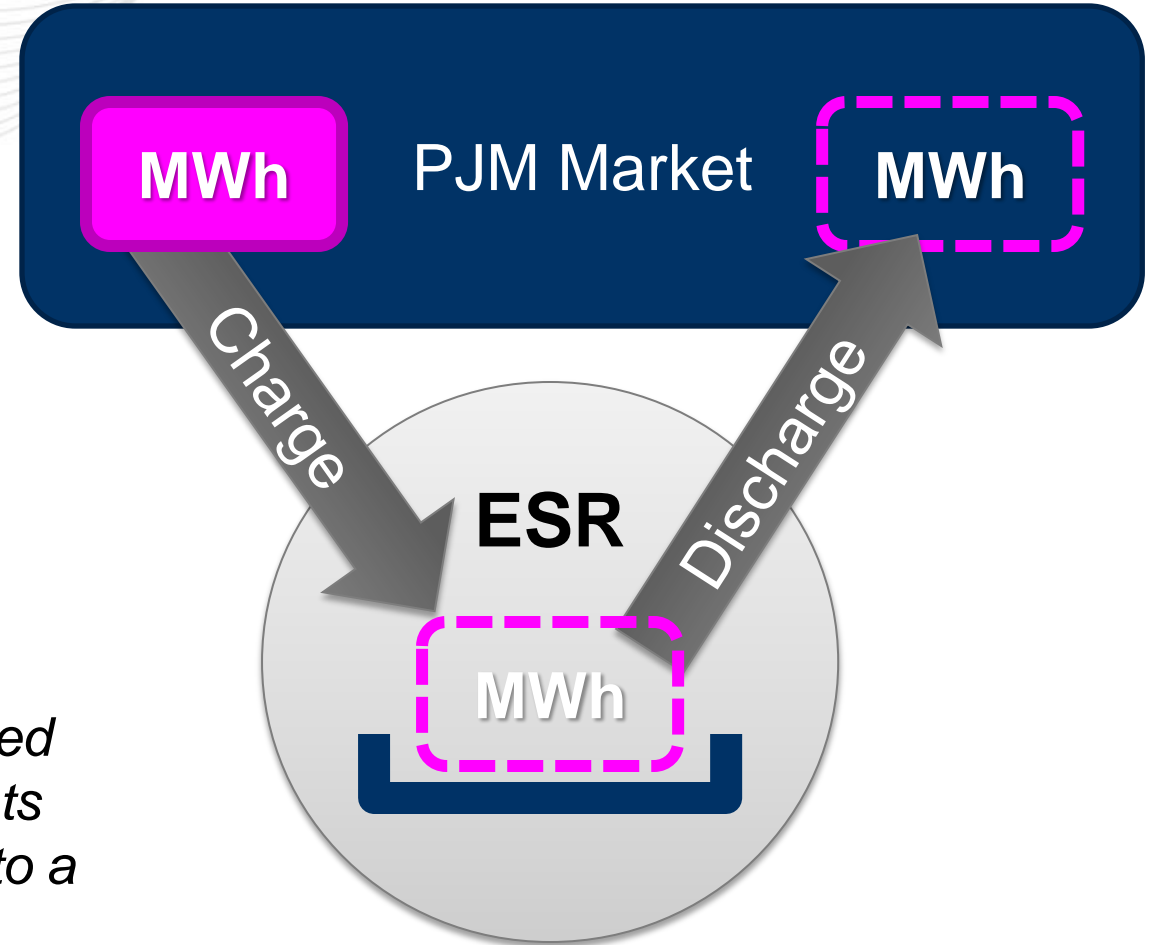
Definition of Energy Storage Resource and Charging

PJM Order 841 Compliance filing
ER19-462 and current Tariff:

“Energy Storage Resource” shall mean a resource capable of receiving electric energy from the grid and storing it for later injection to the grid that participates in the PJM Energy, Capacity and/or Ancillary Services markets as a Market Participant.

M28 draft:

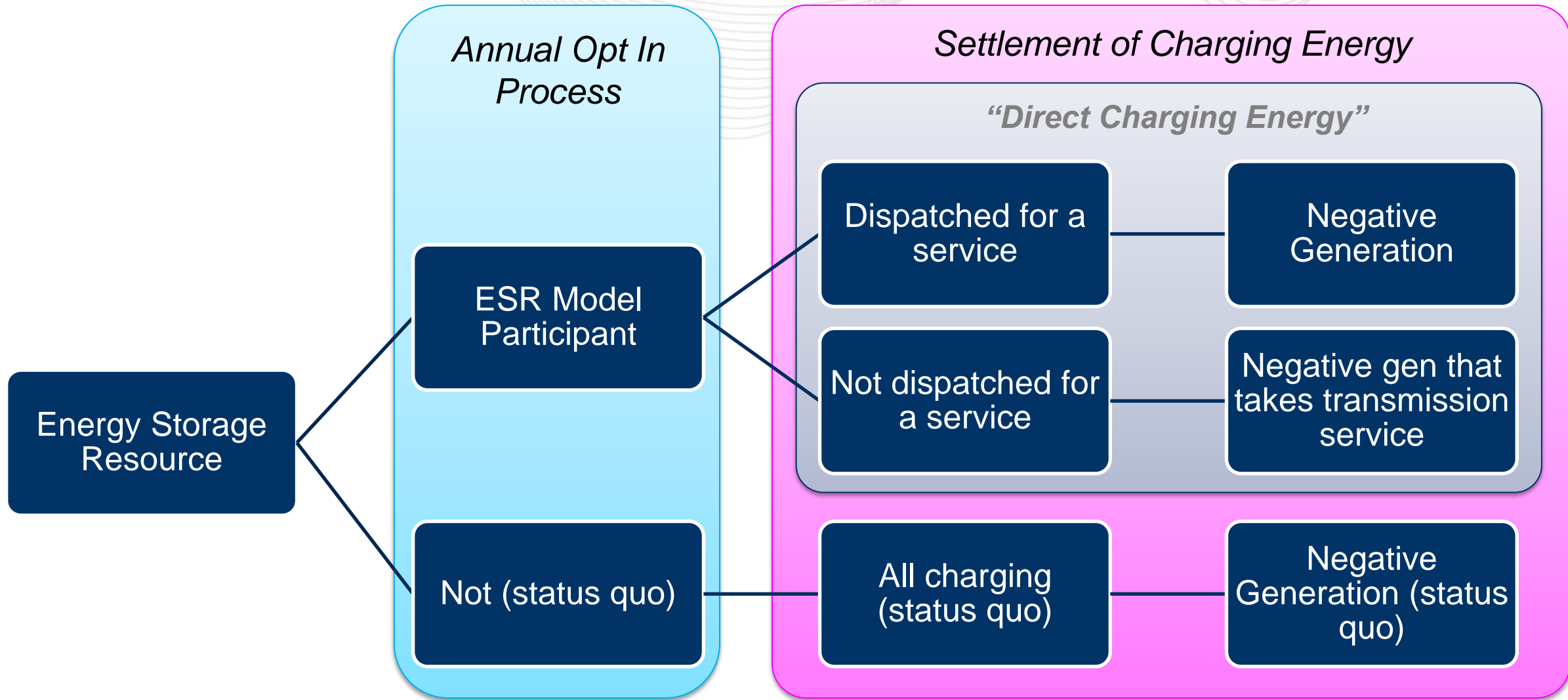
“An Energy Storage Resource shall be considered charging when the Revenue Data for Settlements for a Real Time Settlement Interval corresponds to a withdrawal.”



Non-Dispatched Charging Energy

- New sections 22.1 and 22.2 of Manual 28 and matching new sections 8.1 and 8.2 of Manual 27
- Manual 28 new section 8.4

Summary of Charging Energy Settlement Categories



“Non-Dispatched Charging Energy must pay applicable transmission charges as a Network Service User. By contrast, Dispatched Charging Energy does not pay such charges. Charging energy qualifies as Dispatched Charging Energy when the Energy Storage Resource follows PJM dispatch within 10% of the desired output and meets one of the following conditions:

- Provides Energy Imbalance Service under Schedule 4 of the PJM Tariff. Energy Storage Resource Model Participants shall be considered to be providing Energy Imbalance Service when they are dispatchable by PJM in real time. An Energy Storage Resource shall be considered dispatchable when the fixed generation flag is set to “no” and the dispatchable range exceeds 10% of the absolute value of the relevant limit;*
- Assigned to Regulation, Tier II Synchronous Reserves, or Reactive Service;*
- Being manually dispatched for reliability.”*



Section 22.2: Charges for Non-Dispatched Charging Energy

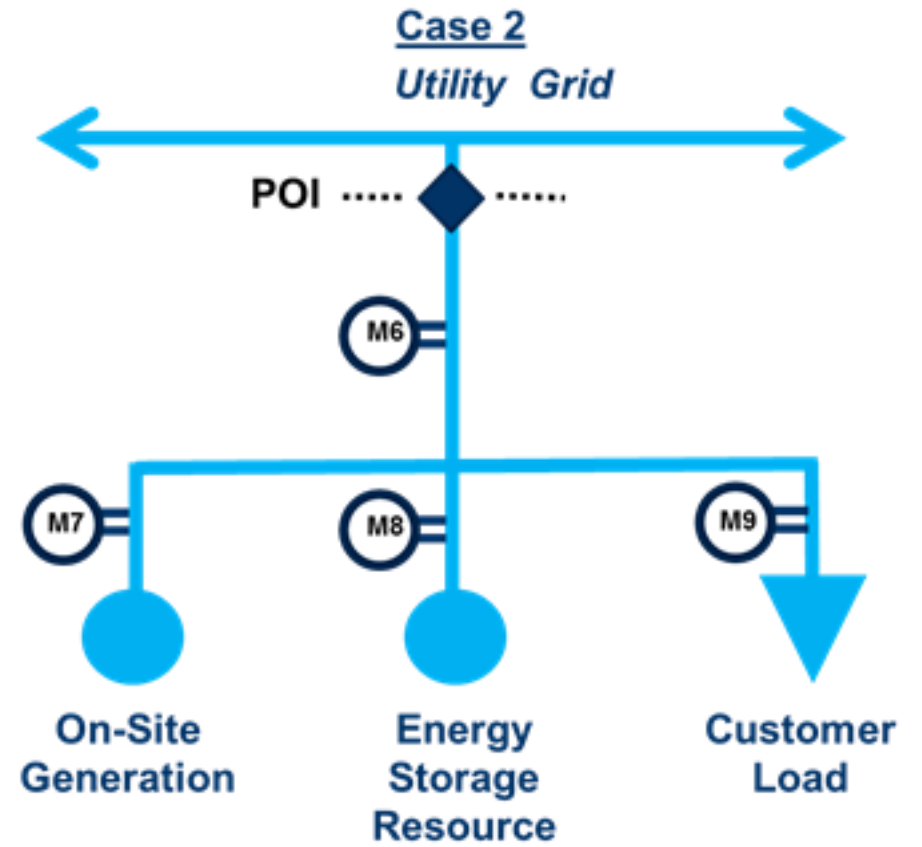
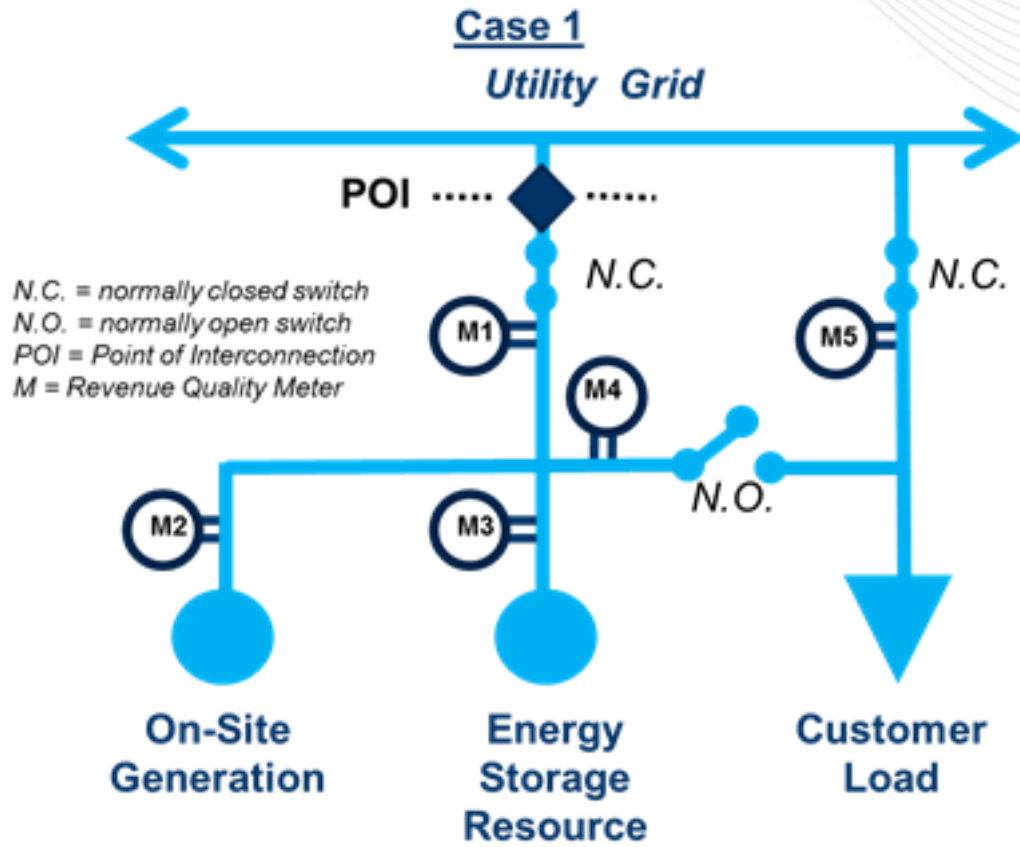
“Therefore, Non-Dispatched Charging Energy is eligible for allocation of the following non-LMP charges and credits:”

- *Schedule 1A Transmission Owner Scheduling, System Control and Dispatch Service*
- *Schedule 9-3, 9-FERC, 9-OPSI, 9-CAPS, 9-FINCON, 9-MMU, and 9-PJM Settlement*
- *Schedule 10-NERC and 10-RFC*
- *Network Integration Transmission Service*
- *Network Transmission Service Offset*
- *Network Integration Transmission Service (ATSI Low Voltage)*
- *MTEP Project Cost Recovery*
- *Transmission Enhancement*
- *Other Supporting Facilities*
- *Non-Firm Point-to-Point Transmission Service*
- *RTO Start-up Cost Recovery*
- *Black Start Service*
- *Unscheduled Transmission Service*
- *Reactive Supply and Voltage Control from Generation and Other Sources Service”*

Load Serving Charging Energy

- New section 22.1 of Manual 28 and matching new section 8.1 of Manual 27
- Manual 27 new section 8.3
- Manual 28 new sections 22.3, 22.4, and 22.5

Possible Load Serving Energy Storage Resources



- Load Serving Energy Storage Resources are capable of directly serving end use load.
- Metering and methods are defined to distinguish:
 1. Charging energy that is later returned to PJM (“Direct Charging Energy”) from
 2. Charging energy that is later provided to end use load (“Load Serving Charging Energy”)
- PJM to provide Electric Distribution Company with processes to appropriately account for Direct Charging Energy (as negative generation) vs. Load Serving Charging Energy (as load).

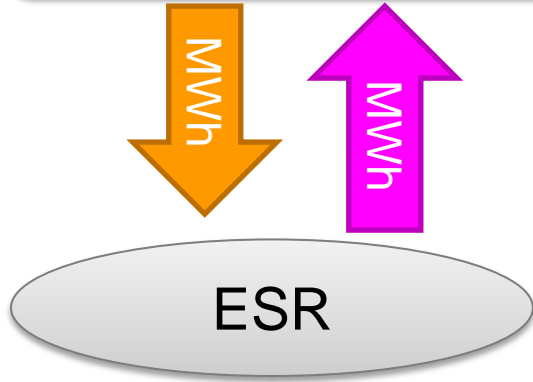
Appendix on Load Serving Charging Energy

See also:

<https://www.pjm.com/-/media/committees-groups/subcommittees/mss/20190522/20190522-01b-esr-that-serve-load-and-order-841.ashx>

<https://www.pjm.com/-/media/committees-groups/subcommittees/mss/20190620/20190620-item-03c-order-841-for-energy-storage-resources-m27-and-m28.ashx>

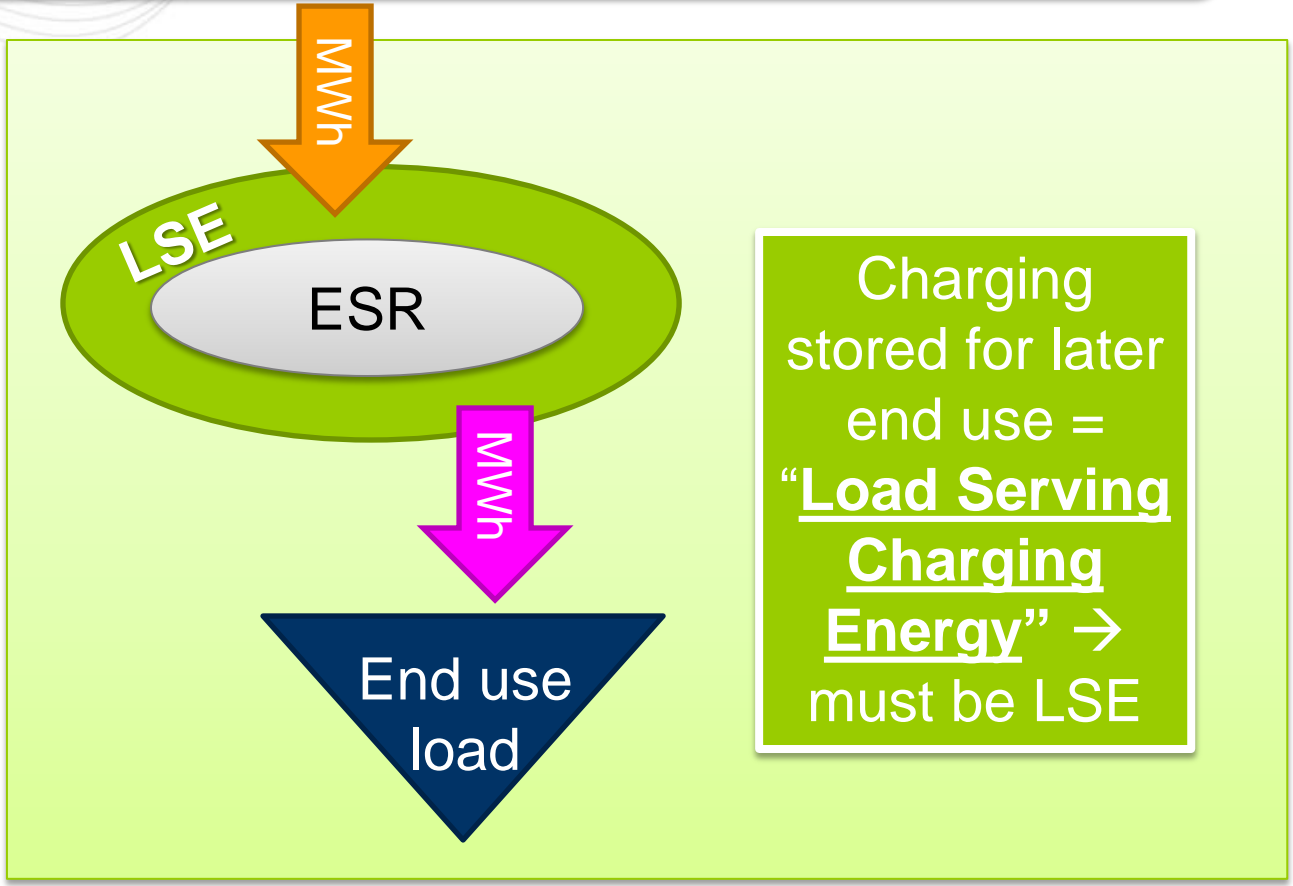
PJM Energy Market



Charging stored for later wholesale sale = **“Direct Charging Energy”**

Dispatched Charging Energy

Non-Dispatched Charging Energy



“Direct Charging Energy” shall mean the energy that an Energy Storage Resource purchases from the PJM Interchange Energy Market and (i) later resells to the PJM Interchange Energy Market; or (ii) is lost to conversion inefficiencies, provided that such inefficiencies are an unavoidable component of the conversion, storage, and discharge process that is used to resell energy back to the PJM Interchange Energy Market.

“Dispatched Charging Energy” shall mean Direct Charging Energy that an Energy Storage Resource Model Participant receives from the electric grid pursuant to PJM dispatch while providing a service in the PJM markets.

“Non-Dispatched Charging Energy” shall mean all Direct Charging Energy that an Energy Storage Resource Model Participant receives from the electric grid that is not otherwise Dispatched Charging Energy.

“Load Serving Charging Energy” shall mean energy that is purchased from the PJM Interchange Energy Market and stored in an Energy Storage Resource for later resale to end-use load.

“Direct Charging Energy – charging energy that is returned to PJM, including associated losses. Direct Charging Energy purchased by Energy Storage Resource Model Participants is divided into two subcategories.”

“Dispatched Charging Energy – Direct Charging Energy withdrawn from the grid by an Energy Storage Resource Model Participant pursuant to PJM dispatch while providing a service.”

“Non-Dispatched Charging Energy – Direct Charging Energy withdrawn from the grid by an Energy Storage Resource Model Participant that is not Dispatched Charging Energy (for example, charging energy at an ESR that is self-scheduled and not dispatchable mode).”

“Load Serving Charging Energy – charging energy that is withdrawn from the grid and stored for later direct sale to an on-site end user. Only Load Serving Entities may purchase Load Serving Charging Energy. Load Serving Charging Energy comparable to ordinary load.”

“Direct Charging Energy” is negative generation, is not end-use load, is not Station Power.

“Direct Charging Energy is purchased by an Energy Storage Resource for later resale to PJM markets, is not purchased by a Load Serving Entity, and is not end-use load. Direct Charging Energy is reported to PJM through Power Meter, similar to generation energy sales; Direct Charging Energy is not reported through Inschedule in the way that Load Serving Entity purchases of end-use load is reported. Direct Charging Energy shall not be included in a Load Serving Entity’s Total Hourly Energy Obligation.

“Load Serving Charging Energy” is end-use load.

“Load Serving Charging Energy is purchased at the aggregate nodal LMP that is applicable to the corresponding Load Serving Entity load. Load Serving Charging Energy is eligible for the same charges as ordinary load, including all Load Serving Entity charges, end-use load charges, and Transmission Customer charges.”

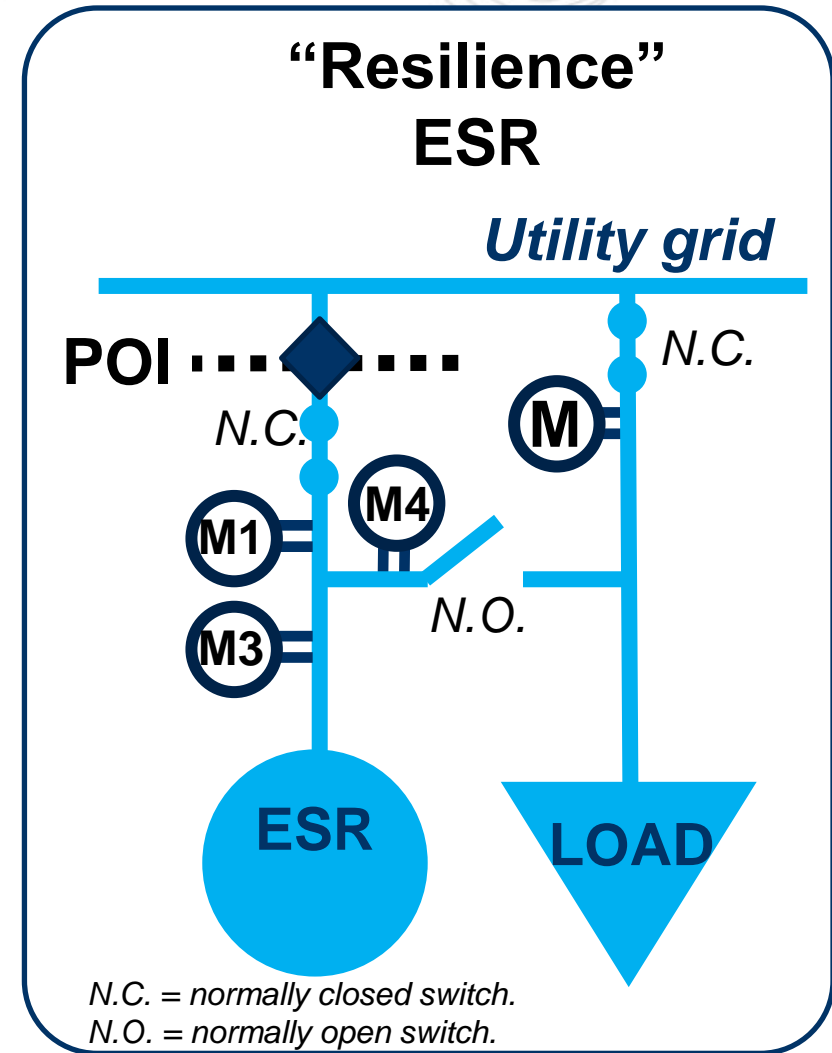
“Dispatched Charging Energy” is Direct Charging Energy that is dispatched to provide a service.

“Dispatched Charging Energy does not pay transmission charges...”

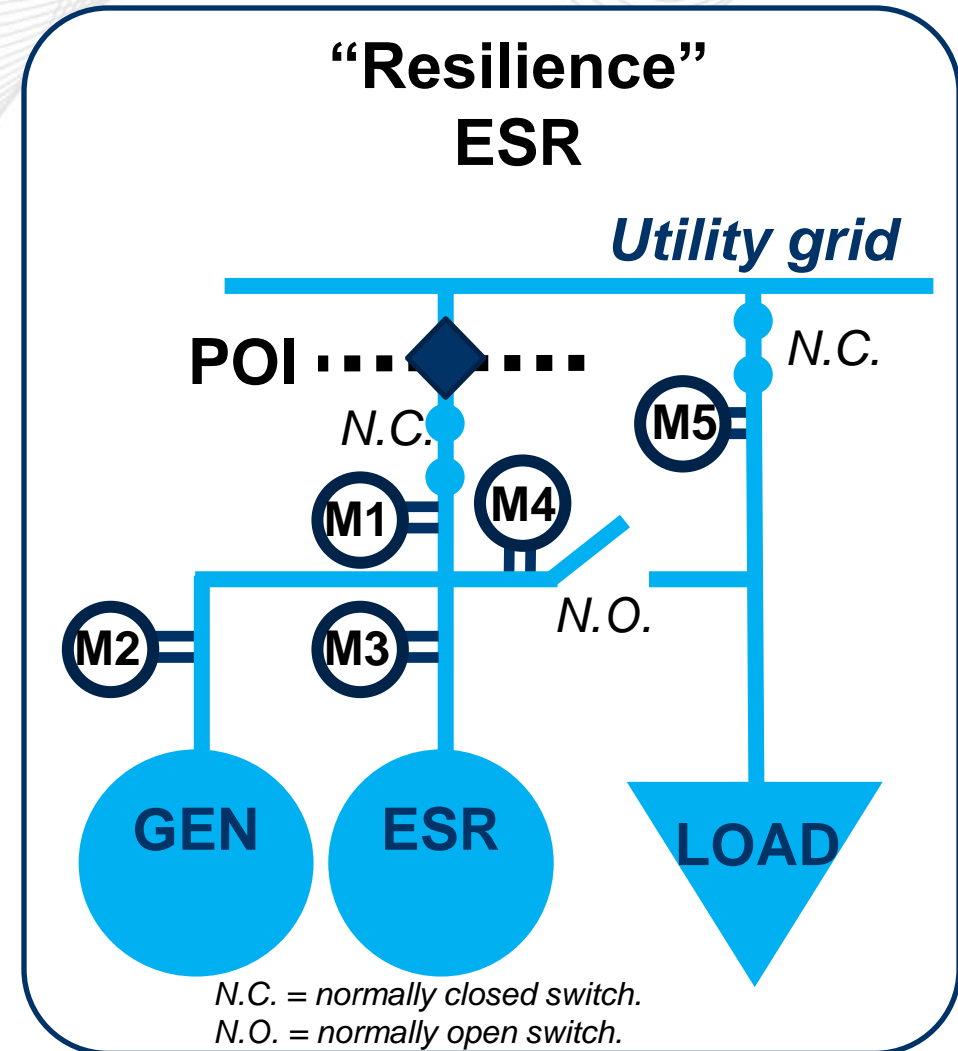
“Non-Dispatched Charging Energy” is Direct Charging Energy that is not dispatched to provide a service and it does take transmission service.

“...however Non-Dispatched Charging Energy does pay transmission charges, and must arrange for Network Transmission Service. Non-Dispatched Charging Energy uses the transmission system, and an Energy Storage Resource Model Participant purchasing Non-Dispatched Charging Energy is a Network Service User. As a result, certain Transmission Customer charges apply to Non-Dispatched Charging Energy that do not apply to generation output.”

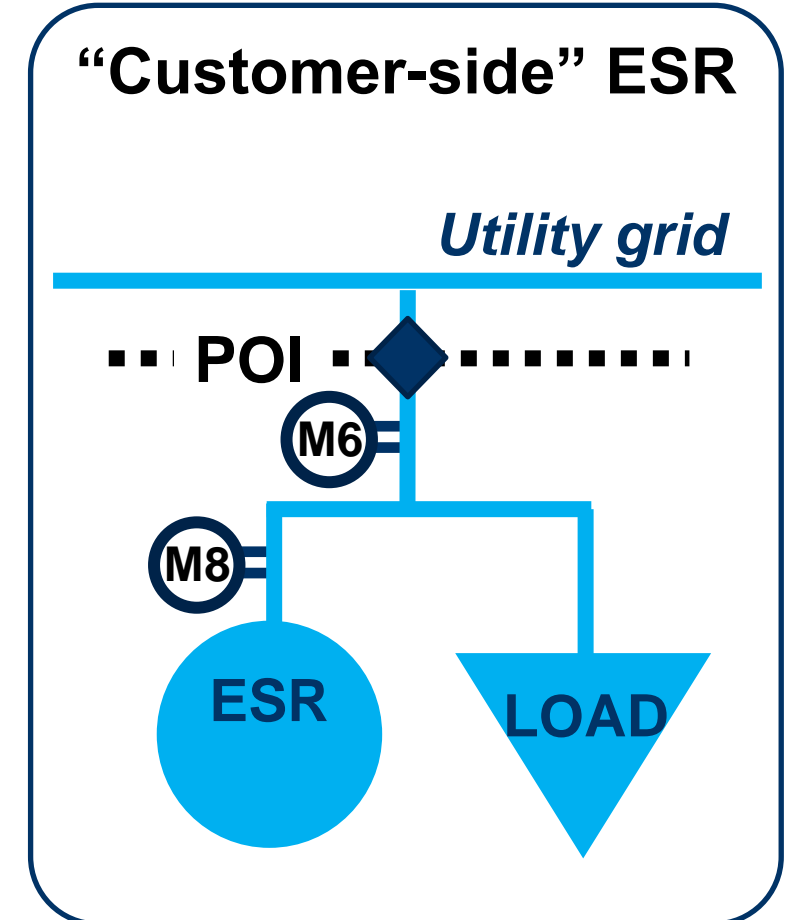
- 100% of withdrawals initially settled as negative generation (i.e., Direct Charging Energy)
- ESR can only charge from grid.
- **Monthly M4 appropriately captures stored grid energy that is sent to end user → monthly “Load Serving Charging Energy”.**
- The sum of M4 over a month is the monthly quantity that should be ex-post adjusted from “Direct Charging Energy” into “Load Serving Charging Energy”.



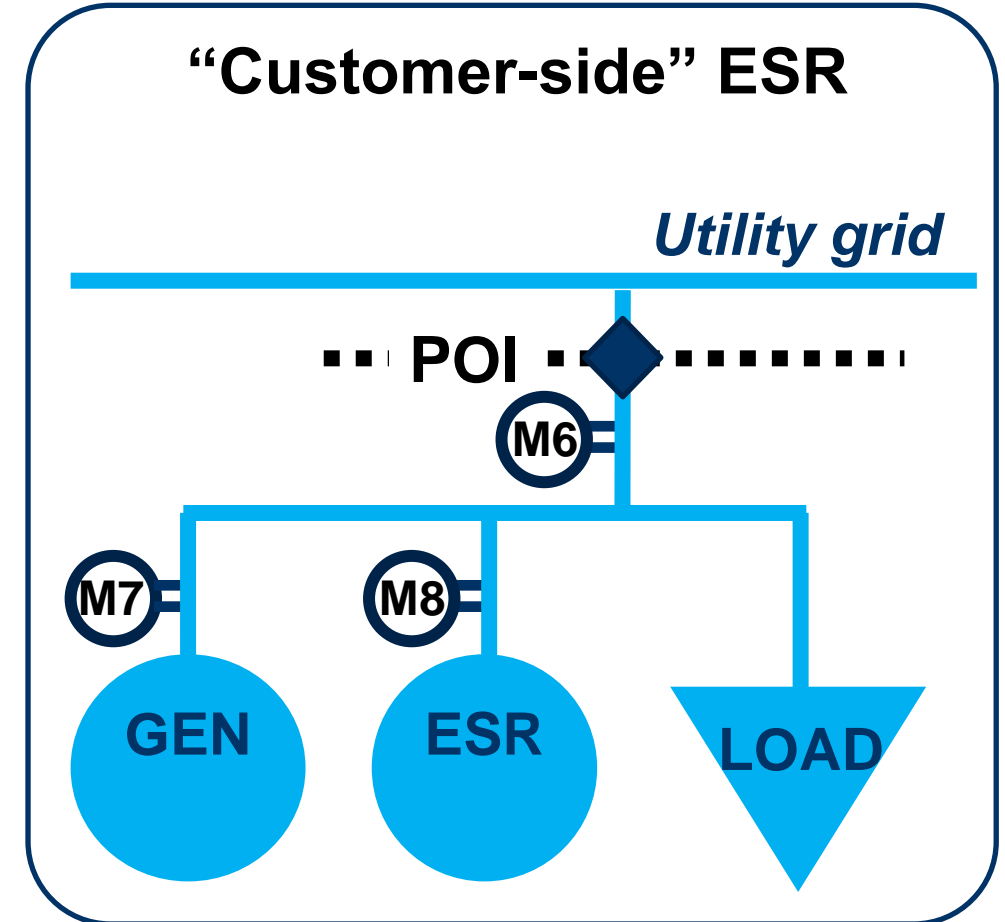
- 100% of withdrawals initially settled as negative generation (i.e., Direct Charging Energy)
- ESR can charge from grid or on-site gen.
- EDC to determine how much of the ESR inventory that was discharged to the end user consisted of energy charges from the grid → “Load Serving Charging Energy”
- **An appropriate billing convention: if monthly $M2 > \text{monthly } M4$, then all end-use energy came from stored or directly-provided on-site gen, and no Load Serving Charging Energy was consumed.**

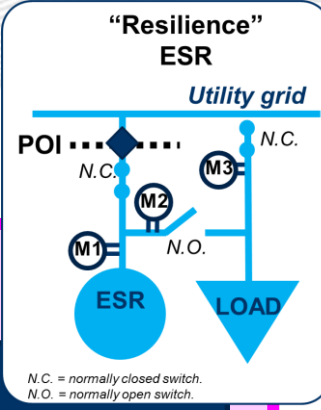


- 100% of withdrawals initially settled as load (i.e., load and/or Load Serving Charging Energy)
- Net injections measured at M6 consist of previously-stored Direct Charging Energy.
 - Corresponding losses are also Direct Charging Energy. ESR can report losses to EDC through PJM, or EDC can work directly with ESR to quantify losses.
 - **Monthly Direct Charging Energy is the sum of monthly injections at meter “M6” plus associated losses.**
 - EDC calculates monthly quantity for ex-post adjustment from Load Serving Charging Energy into Direct Charging Energy.
- M8 is required to identify which intervals the ESR was charging to use in ex-post adjustment.



- Net injections measured at M6 could consist of Direct Charging Energy, self-supplied charging energy, and/or on-site Generation.
 - The inventory in the ESR could also consist of a mix of grid energy and self supplied energy.
 - Losses corresponding to stored grid energy that is resold to PJM is also Direct Charging Energy.
- **EDC calculates monthly Direct Charging Energy for ex-post adjustment.**
- M8 is required to identify which intervals the ESR was charging for ex-post adjustment.





Initial Settlement

PJM Settlements

Debit

100% of Charging

ESR

LSE

Final Settlement

PJM Settlements

EDC

Meter Correction
Credit

90% of Charging

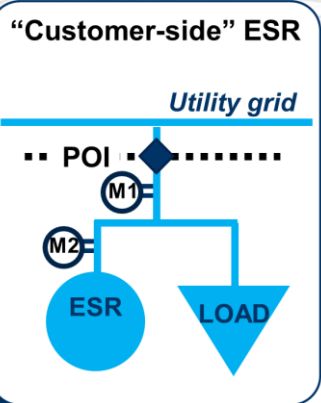
10%

ESR

Load reconciliation
Debit

10%

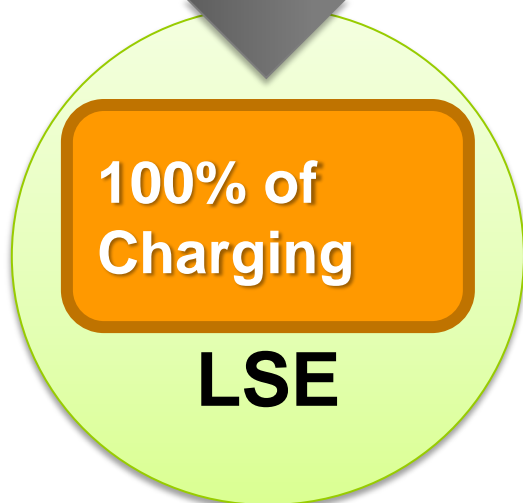
LSE



Initial Settlement

PJM Settlements

Debit



Final Settlement

PJM Settlements

EDC

Meter Correction

Debit



Load reconciliation

Credit

