COMMENTS OF THE CALIFORNIA ENERGY STORAGE ALLIANCE

Energy Storage Roadmap

Submitted by	Company	Date Submitted
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The California Energy Storage Alliance (CESA)[1] appreciates the opportunity to participate in and comment on the Energy Storage Roadmap Stakeholder Process. These comments are based upon CESA's attendance at the Energy Storage Roadmap Stakeholder meeting held on September 4, 2014, and are a follow-up to comments CESA submitted to the CAISO on September 5, 2014.

General Comments on the Energy Storage Roadmap Process

CESA very much appreciates the outreach conducted by the CAISO, DNV GL, and Olivine. These comments reflect a number of changes in CESA's approach to energy storage barriers:

1. For clarity, barriers have been separated into three areas: 1) Barriers affecting energy storage connected at all levels of the grid 2) Transmission and Distribution Connected Systems, and 3) Behind the Meter Systems. We believe this will help stakeholders and staff better determine the appropriate actions required to mitigate or eliminate high priority barriers.

2. CESA has prioritized barriers that are preventing contracts from being signed, or behind the meter projects from being built. These barriers are marked as "High" priority. This approach prioritizes those applications that are being developed today.

3. Additional differentiation has been added to behind the meter system services, in order to determine which barriers apply to specific services that may be provided by an energy storage system sited behind the meter.

[1] The views expressed in these Comments are those of CESA, and do not necessarily reflect the views of all of the individual CESA member companies. (http://storagealliance.org).

4. Additional barriers have been added, based upon CESA member feedback and comments made by stakeholders during the discussion on September 4, 2014.

5. Where possible, CESA has mapped identified barriers to specific CPUC proceedings and stakeholder processes currently underway.

6. In response to the CAISO staff request for a solution-oriented approach, CESA recommendations have been added that would address the barriers identified.

Barriers to Energy Storage Adoption at All Levels

Barrier	Current Proceeding (if any)	Proposed Solution	Priority
Specific details of wholesale versus retail charging needs to be clarified.	None	See Appendix B to these Comments for CESA's proposed solution. Use LMP for wholesale charging tariff, which would not include transmission access and wheeling charges, consistent with PJM's practice.	High
Charging vs. discharging study scenarios are not the same.	CAISO Energy Storage Interconnection	Reliability studies for charging and discharging should be based on the same cases. A partial peak use case should be considered for flexible deliverability/flexible RA.	Medium
No cluster study opt-in is allowed for new interconnection rules.	CAISO Energy Storage Interconnection	Cluster 7 participants should have the right to opt in to new interconnection study rules under development at the CAISO.	Medium
No Flexible deliverability interconnection study option.	CAISO Energy Storage Interconnection	It would be helpful to create a "flexible deliverability" study to assess ability to provide system flexible RA in partial peak cases.	Medium
Safe Harbor for energy storage material modification approval when PMax is not changing.	CAISO Energy Storage Interconnection	Adding energy storage to pending interconnection study requests should not be deemed material so long as the PMax does not change.	Medium
EFC /NQC bundling is unhelpful.	CPUC RA and CAISO Interconnection	EFC should be unbundled from NQC, and flexible deliverability should be studied separately from peak deliverability in the interconnection process.	Low
Frequency response market rules are unclear.	None	Continue working on frequency response to clarify market rules	Medium
Energy storage resources cannot bid into multiple segments.	None	Revise NGR tariff to allow NGRs to bid into multiple segments to allow energy storage resource to submit higher bids for deep discharge vs. shallow discharge resources.	Low
Hybrid applications of energy storage (coupled with thermal, PV,	CPUC LTPP	Work to improve modeling of hybrid resources .	Medium

or wind) not accurately modeled and benefits are not being fully accounted for.			
Energy Storage resources need to be able to identify locational value on the distribution grid to be compensated for providing distribution grid benefits.	CPUC DRP	A locational value identification process should be developed.	Medium
The value of Voltage/VAR support is difficult to quantify.	None	Provide additional transparency on Voltage/VAR value in problematic areas	Medium
It is not possible to estimate RA value for different energy storage capabilities on the grid.	CPUC RA	Consider reforming RA process and rules based on public ELCC and EFC modeling. Standardization in the RA process would help developers propose systems with the highest value capabilities at the lowest cost.	Medium
GHG benefits of energy storage at the system level need to be specified.[2]	CPUC LTPP and SGIP	LTPP scenarios should be modeled accounting for GHG impacts with and without energy storage added to the system. Longer term, system modeling should include additional sensitivities to help quantify the GHG impacts of energy storage.	

[2] Energy storage conceptually provides benefits by:

- Increasing available flexible and spinning capacity without requiring additional starts and minimum run operations of generators.
- Providing fast ramping operations at a lower effective heat rate than traditional generators.
- Harnessing excess renewable generation and baseload power to offset high heat rate peaking and flexible generation.
- Providing highly localized capacity, which can reduce transmission losses.

Providing volt/VAR support without a requirement to add synchronous thermal generation.

Barriers and Solutions Specific to Transmission and Distribution-Connected Systems

The following barriers apply specifically to T&D connected energy storage systems. Note that distribution-connected systems may include customer-sited systems interconnected on the utility side of the billing meter.

Barrier	Current Proceeding (if any)	Proposed Solution	Priority
System modeling insufficiently addresses energy storage, particularly bulk energy storage	CPUC LTPP	Bulk energy storage modeling is insufficient.	High
Ten-year system reliability is prioritized over almost all other parameters.	CPUC LTPP	LTPP should be refocused to include GHG impacts, as well as reliability needs beyond system peak.	High
Transmission study process does not provide informational evaluation projects in the GIDAP queue	CAISO TPP	T&D deferral, economic, and/or policy benefits should be evaluated to feed into the LTPP.	Medium
Current modeling methodologies do not adequately capture system benefits.	LTPP	Production cost modeling should account for the system benefits and GHG reduction potential of proposed energy storage projects.	Medium

Barriers and Solutions Specific to Behind the Meter Systems

Storage Services

Customer sited energy storage systems can provide a variety of different services from a variety of different utility customer types. Energy storage systems can also be aggregated or standalone. The table below shows different combinations of services and customer types that are possible.

	Potential Storage Services							
	Bill Management - demand management	Bill Management – Energy Shifting	Demand Side DR	Supply Side DR	CAISO Market Participation	PLS – Electric	PLS - Thermal	Reliability
Service Type								
Service allows export?	No	Possible	No	Possible	Possible	No	No	No
Requires CAISO metering?	No	No	No	TBD	Yes	No	No	No
Customer Types								
C&I - Single Location	●	●	●	●	●	●	●	●
C&I – Aggregated	●	●	●	●	●	●	●	●
Residential – Single Location	●	●	●	●				●
Residential – Aggregated	●	●	●	●	●			●
C&I Virtual Net Metering	●	●	●	●	●	●	●	●
Multi-Family Residential	●	●	●	●	●			●

Behind the Meter Barriers Differentiated by Energy Storage Service

Applicable Storage Service	Barrier	Current Proceeding (if any)	Proposed Solution	Priority
Charging Tariffs	Energy storage charging for wholesale market functions should be priced at wholesale rates. Rule 21 and PTO load interconnection tariffs should be revised to clearly define what functions of an energy storage resource constitute "load" vs. what is not considered end use load.	None	Charging with the intent of storing power for resale should be excluded from the definition of load because it is not an end use of power. This is a critical issue for energy storage due to the conflicting study processes and network upgrade cost allocation methodologies applicable to generation and load interconnection tariffs. See Appendix B to these Comments for a proposed solution.	High
CAISO market participation	CAISO metering costs are prohibitive for smaller projects/aggregations.	None	Secure IP should be implemented at the CAISO to enable reduced metering.	Medium
CAISO market participation	CAISO telemetry costs are prohibitive for smaller projects/aggregations.	None	Secure IP should be implemented to enable reduced telemetry.	Medium
CAISO market participation	Telemetry requirements for behind-the-meter frequency regulation are not determined.	None		Medium
CAISO market participation	CAISO single generator study process and cost is prohibitive for smaller projects/aggregations. ▪ The $50Kper site deposit is cost prohibitive for smaller/aggregated systems.	None	Future utility procurement should allow distributed aggregated resources to qualify as deliverable through the Deliverability for Distributed Generation Process. The CAISO Cluster Study processes could be updated to allow a bundle of aggregated	High

	▪ Single cluster study cycle per year creates significant delays and uncertainty for smaller projects. ▪ Current study process requires that the exact physical site of a facility be known to be part of a cluster, which creates challenges for distributed aggregated systems. This is a "chicken and egg" problem, where the resources cannot be sold or offered into a utility RFO without verifying that they will be deliverable, but they cannot be verified as deliverable until the exact customers and sites can be identified. Distributed solar developers would be willing to place a deposit on a study in a given area to allow them to develop the resource in that area, but the study process does not currently allow this. ▪ Proxy Demand Resources may not be subject to the same deliverability study requirements, confining storage to a PDR-only model would strand significant potential value to the extent the capacity of the system particularly in the residential context, exceeds the onsite needs in any given time interval.		resources to apply for an interconnection study. Rules for deliverability of resources with certain capabilities within regions should be developed.	
CAISO market participation	Minimum size requirements within sub-laps for aggregated systems are too high to participate in the DR market.	None	Reducing minimum size requirements for aggregated systems within sub-laps.	High

CAISO market participation	Double billing issues should to be resolved.	None	subtractive metering arrangements for wholesale/retail behind the meter systems should be addressed	High
Interconnection	Combined WDAT/Rule 21 interconnections with wholesale and retail functions are not addressed	CAISO/CPUC	Rule 21 should address systems providing both wholesale and retail functions at different times.	High
Behind the meter CAISO market participation	Settlement processes for mixed-use assets are unclear.	CAISO, Utilities	Settlement processes for mixed use assets should be clarified	Medium
Demand Response	In some cases, limiting PDR portfolios to a single LSE creates barriers to participation that are administrative in nature and not related to technical capability.	CAISO	Consider reducing PDR minimum size. Alternatively, consider enabling PDR portfolios to serve multiple LSEs.	Medium
Demand Response	DR programs for residential customers are very limited	CPUC DR	Enable new DR programs, including Supply Side DR	Medium
Demand Response	interactivity for DR has low value	CPUC DR	Enable new DR programs, including Supply Side DR	Low
Interconnection	Utilities assess costs associated with interconnecting storage and solar, which involves simply summing the inverter capacities of the solar and the storage system to assess the distribution capacity that is required to accommodate a project		Where there is a single point of interconnection for storage and generation, that point should be used to assess maximum output capacity of the paired system, rather than separately counting individual generator and storage capacities.	Low
Interconnection	Implementation of D.14-05-033 is problematic.	CPUC Interconnection	The CPUC should revise Rule 21 should be revised to make any necessary changes required to conform to the direction provided in D.14-05-033 to interconnection of energy storage paired with generation	

			that is NEM-eligible, as well as generation paired with energy storage that does not operate under Schedule NEM.	
Interconnection	Non-Exporting Interconnection Agreements are not addressed.	CPUC Interconnection	Rule 21 should be revised to exempt behind-the-meter energy storage resources that either only operate when the grid is down or will never export energy to the grid from signing interconnection agreements.	
Interconnection	Rule 21/WDAT Transitions should be streamlined.	CPUC Interconnection	The CPUC should address streamlining the interface between Rule 21 and WDAT queue management processes.	
Interconnection	Non-Exporting Interconnection Fees are too high.	CPUC Interconnection	The $800 interconnection application fee for non-exporting energy storage should be cost-based at a considerably lower level and capped. See Appendix A to these Comments regarding recommended interconnection procedures by system type.	
Interconnection	Supply/Demand Side DR program rules are not finalized for energy storage.	CPUC DR	Continue addressing energy storage in Supply Side DR	
Interconnection	Lack of open standards relating to information models and communications protocols limits customer choice in purchasing energy storage systems and integrating them into their operations and increases non-recurring engineering costs	CPUC Interconnection		
Interconnection	Rule 21, Screen I, Options 3 & 4 and	CPUC	These screens should be revised to	

	Screen J	Interconnection	allow for larger systems without non-export relays in view of non-export relay costs and the fact that operation under Schedule NEM eliminates any economic incentive to export energy.	
Interconnection	Rule 21, Screen B	CPUC Interconnection	This screen should be revised to make UL 1741 listing clearly sufficient to meet all requirements, and that UL 1741 listing of individual generators is sufficient, and It should also be clarified that a bank of generators does not need to be UL Listed as such whether or not a group is separately packaged or further enclosed within an additional chassis.	
Interconnection	Rule 21, Screen I	CPUC Interconnection	This screen non---export path Option 3 should be revised to Increase the rating threshold to 50% rather than the current 25% of the service equipment. In the case of a 100 amp rated service equipment, a 25% limit would be 25 amps, which is equivalent to 6,000 watts at 240 VAC (25A x 240V = 6,000W). In cases where the customer is planning to use a battery inverter to supply the entire house load at times, a 6,000 W inverter may be too small.	
Interconnection	Rule 21, Screen M	CPUC Interconnection	The 15% peak load limit of his screen should be modified for integrated	

			storage/renewable energy projects with shaped dispatch.	
Interconnection	Interconnection processes are not harmonized between utilities.	CPUC Interconnection	Create clear processes that are consistent between utilities	High
Interconnection	Utility personnel are not aware of interconnection processes.	CPUC Interconnection	Conduct utility interconnection personnel training.	High

Appendix A: Interconnection

From an interconnection perspective, CESA sees that behind the meter energy storage systems can be separated into four basic types, as outlined below. It makes sense to study systems in a way that takes into account their capabilities and intended use.

Export Status	Relevant Services	Recommended interconnection process
System is operational only when grid power is down, and does not export.	Reliability Only Systems (emergency backup)	• No interconnection/study required
System operates in parallel with the grid, but does not export as part of operations.	Demand Charge Reduction, Peak Load Reduction	• Verification/approval that system software does not allow export; • Penalties/disconnection for storage system net exports under this interconnection type.
System operates in parallel with the grid, with limited export as part of normal operations.	Energy time shifting, Demand Side DR	• Follows Rule 21 interconnection processes, with options to limit net exports. • Verification/Approval process to validate that system software will impose operational restriction/flow limitations based upon utility specifications. • Penalties/disconnection for violation of interconnection agreement parameters. • Investigate pre-approval for a given amount of export in certain distribution areas.
System operates in parallel with the grid, operating entirely independently of load, with full export capability.	Wholesale market services (REM, Ramping, Spin), Supply Side DR	• WDT/WDAT for wholesale functions, assuming full system export. • Verification/Approval process to validate that system software will impose operational restriction/flow limitations based upon utility specifications. • Penalties/disconnection for violation of interconnection agreement parameters. • Investigate pre-approval for a given amount of export in certain distribution areas.

Appendix B: Wholesale vs. Retail Rate Treatment

The following table illustrates CESA's recommendation for Wholesale versus Retail rate treatment.

Interconnection Type		Storage Input Energy Function	Wholesale vs. Retail	Comments
Transmission Connected	1	Storage charging during REM	Wholesale	Includes Round Trip Efficiency Losses
	2	Storage charging for Non-REM wholesale market functions	Wholesale	Includes Round Trip Efficiency Losses
	3	Storage charging for Transmission Support activities	Wholesale	Includes Round Trip Efficiency Losses
	4	Pre-chilling of a thermal resource that directly offsets chilling at a later time	Wholesale	
Distribution Connected	1	Storage charging for REM	Wholesale	Includes Round Trip Efficiency Losses
	2	Storage charging for Non-REM wholesale market functions	Wholesale	Includes Round Trip Efficiency Losses
	3	Storage charging for Distribution Support activities	Wholesale	Includes Round Trip Efficiency Losses
	3	Round Trip Efficiency Losses	Wholesale	
	4	Pre-chilling of a thermal resource that directly offsets chilling at a later time	Wholesale	
Behind the meter - Non NEM Tariff	1	Storage charging during REM	Wholesale*	See note (below)
	2	Storage charging for Non-REM wholesale market functions	Wholesale*	See note (below)
	3	Storage charging to offset customer load	Retail	
	4	Storage charging to provide Demand Side DR	Retail	
	5	Storage charging to provide Supply Side DR	TBD	
	6	Ancillary battery heating/cooling	Retail	
	7	Pre-chilling of a thermal resource that directly offsets chilling at a later time	Retail	
Behind the Meter - NEM Tariff	1	Storage charging during REM	Wholesale*	See note (below)
	2	Storage charging for Non-REM wholesale market functions	Wholesale*	See note (below)
	3	Storage charging to offset customer load	Retail	

	4	Storage charging to provide Demand Side DR	Retail	
	5	Storage charging to provide Supply Side DR	TBD	
	6	Ancillary battery heating/cooling	Retail	
	7	Pre-chilling of a thermal resource that directly offsets chilling at a later time	Retail	

Appendix C: CESA's Proposed Energy Storage Use Case List

In an effort to provide a relatively complete list of use cases, CESA has compiled the following table. We believe this list represents the most common use cases being deployed in California.

Connection	Category	Use Case
Transmission Sited	Standalone	Rate Based (Trans Deferral & NERC Reliability)
		Rate Based (Economic - Congestion Mgt, Avoiding lost cust. svc)
		Rate Based (Policy - Renewables Integration)
		Dual Use (Partial Rate Based, Partial Market Participant)
		Market Participant - Bulk Peaker *(Energy & AS)*
		Market Participant - AS Only
	Generator Paired	VER 1 (wind/solar)
		VER 2 (CSP molten salt)
		Thermal + Turbine Inlet Chilling or CAES
		Hybrid Thermal + Fast Response Storage
		Thermal + Oxygen Chilling
Distribution Sited	Standalone	Rate Based (Reliability - Dist Deferral, load mgt.)
		Rate Based (Policy - enabling more cost effective DG, EVs)
		Dual Use (Partial Rate Based, Partial Market Participant)
		Market Participant - Bulk Peaker *(Energy & AS)*
		Market Participant - AS Only
		Community Energy Storage
	Generator Paired	Community Energy Storage + VER
		VER 1 (wind/solar)
		VER 2 (CSP molten salt)

		Thermal + Turbine Inlet Chilling or CAES
		Hybrid Thermal + Fast Response Storage
		Thermal + Oxygen Chilling
Load-Paired / BTM	Demand Side PLS	Permanent Load Shifting - electric
		Business Customer, Building Thermal Mgt.
	Bill Management & Demand Response	Business Customer, Peak/Max Demand Mgt.
		Residential Customer, TOU Bill Management
		Residential Customer, Solar Integration and bill management
		Aggregated C&I / VNM Solar + Storage
		Multi-family Residential, Solar and Demand Mgt.
	Bill Management + Market Participation	Business Customer, Bill + Market Participation
		Residential Customer, Bill + Market Participation
	Utility Controlled	Grid Operation Benefits
	Reliability	Storage to provide reliability and aggregated market services
		Storage to provide reliability and DR
	EV Charging	EV Charging, Public Charging Station
		EV Charging, Commercial or Municipal Fleet
		EV Charging, Residential Home
		Solar + Storage + EVs with bidirectional mkt participation
		Storage + Evs with bidirectional mkt participation
		EV Aggregated Charging with Market Participation (V1G)
		EV Aggregated Charging/Discharging with Market Participation (V2G)

Appendix D: Single Lines for Priority Behind the Meter Use Cases

CESA recognizes that many barriers may span multiple use cases, but the some barriers are highly sensitive to the system architecture. In addition, there can be confusion about what words like "dual use" and "hybrid" mean in the context of energy storage system configuration.

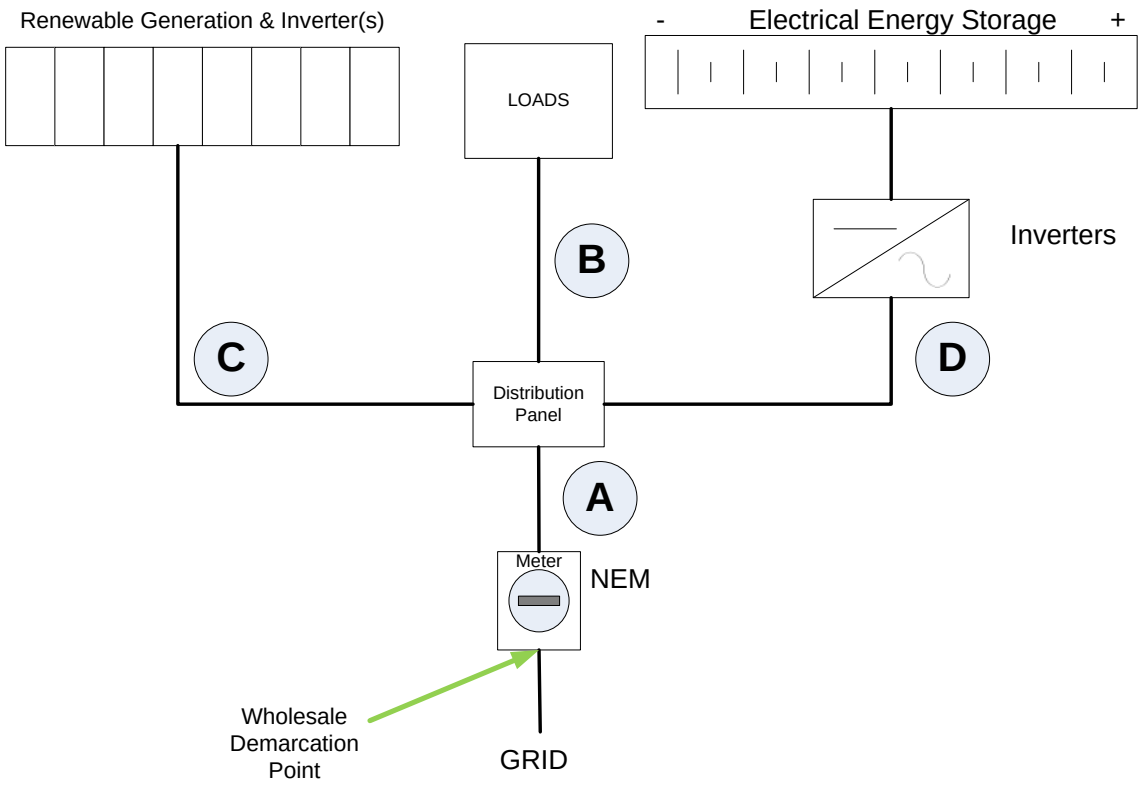
CESA is committed to supporting CAISO's road mapping efforts by documenting the architecture of each of our priority use cases. In some cases, the architecture itself has the potential to address certain barriers. For example: the location of metering equipment for behind the meter storage that provides peak shifting and wholesale market participation can help address potential interconnection and tariff barriers.

The following are single line descriptions of several priority behind the meter use cases. CESA commits to working with the Roadmap Team and other stakeholders to add to this list and build consensus around appropriate system architectures for different use cases.

Use Case Details Provided by Stacey Reineccius, Powertree Services Inc.

Following are several feasible and useful installations for electrical energy storage with and without NEM.
The elements called out are:
A – NEM meter
B- End use loads
C- CEC eligible renewable generator (Wind, Solar PV, etc.)
D- Electrical energy storage system (AC in AC out) with grid interactive Inverters (typical of input and output sides of said inverter)
E- Wholesale meter qualified for use with CAISO or Utility for wholesale operations.
F- Retail bidirectional meter.

All illustrated scenarios assume a single customer facility.



Behind the Meter renewable Generation plus Electrical Storage and NEM
Storage in parallel with Loads and Renewable Generation

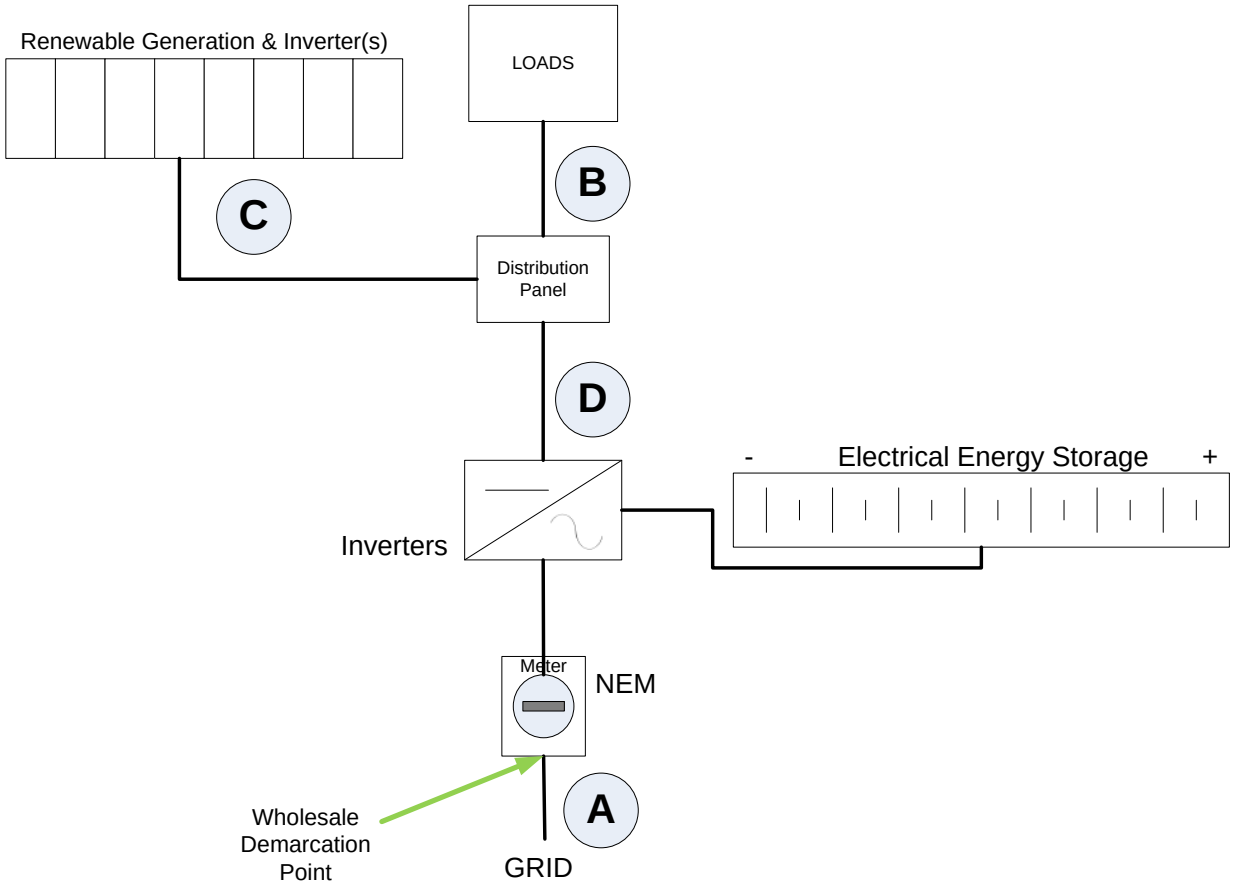
This scenario is a simple common installation and enables certain features and functions to be available. These include

- Load Leveling
- NEM generation
- Peak Shaving
- Renewable Load Shaping
- Generation Output Shifting

This scenario does NOT enable

- Backup Power for loads
- Wholesale Operations or ISO market participation
- Renewable Generation and storage during grid outage (reliability/emergency)

This scenario is currently highly limited in effectiveness due to sizing constraints on storage imposed in latest NEM decision.



Behind the Meter renewable Generation plus Electrical Storage and NEM Storage in <u>Series</u> with Loads and Renewable Generation

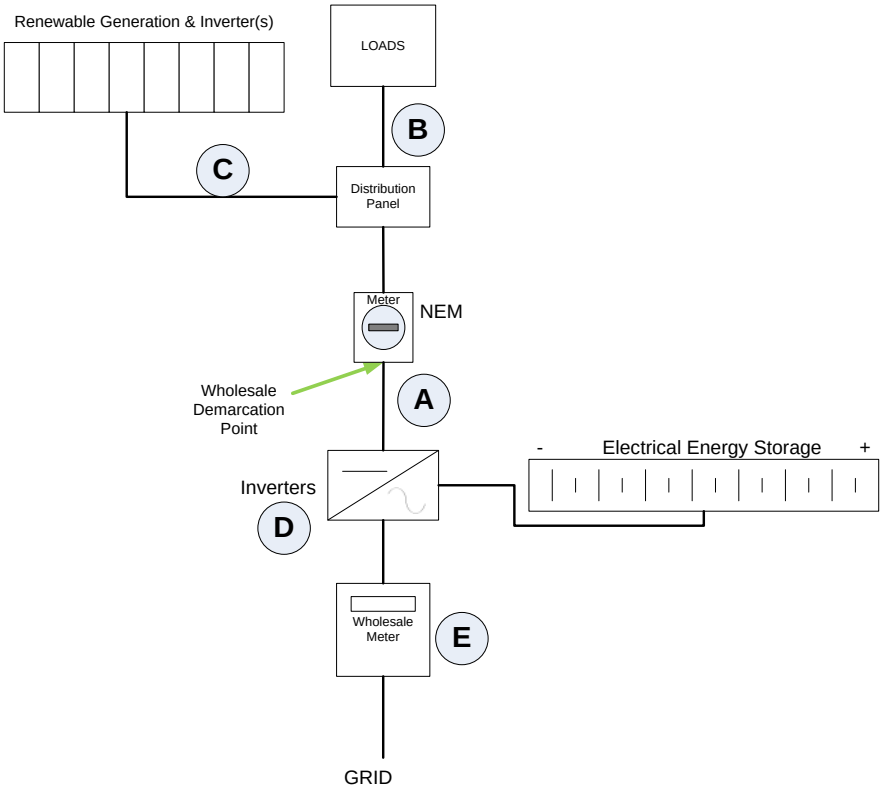
This scenario is a simple common installation and enables certain features and functions to be available. These include

- Load Leveling
- Peak Shaving
- Renewable Load Shaping
- Generation Output Shifting
- Backup Power for loads
- Accurate NEM credit for Renewable Generation
- Renewable Generation and storage during grid outage (reliability/emergency)

This scenario does NOT enable

- Wholesale Operations or ISO market participation

This scenario is currently highly limited in effectiveness due to sizing constraints on storage imposed in latest NEM decision.



Behind the Meter Renewable Generation, Load and NEM Storage in <u>Series</u> on Wholesale Side

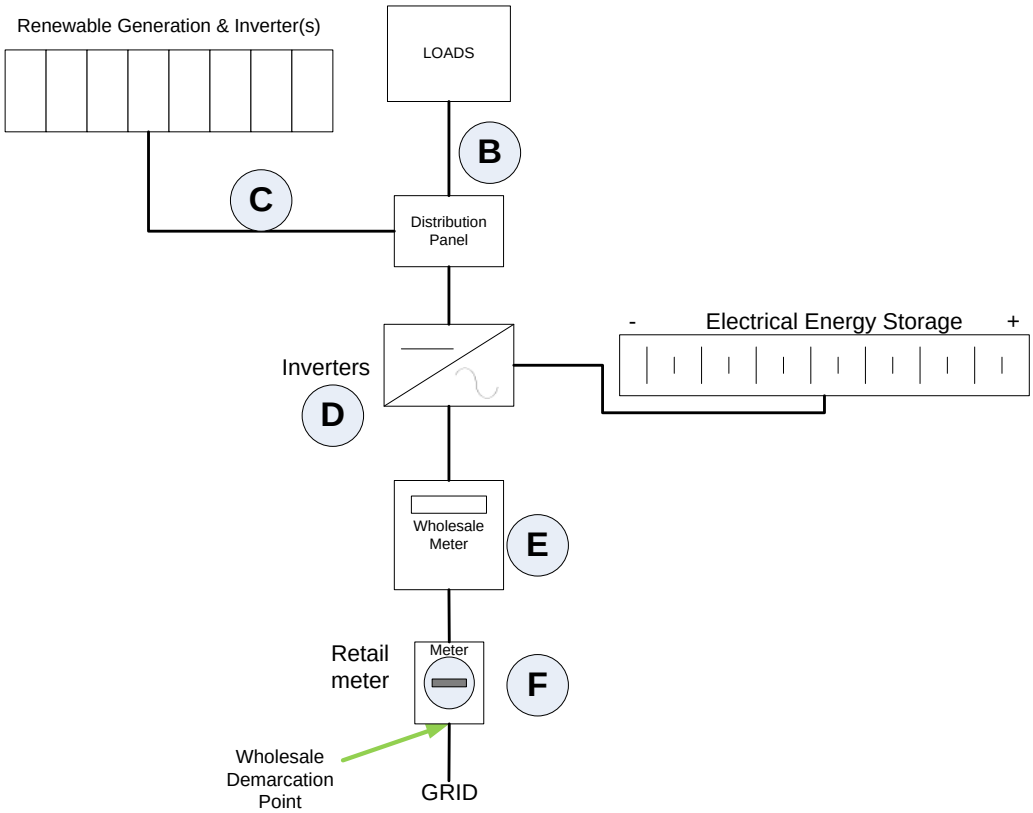
This scenario is a more sophisticated installation and enables certain features and functions to be available. These include

- Load Leveling at Grid Distribution level (not behind the meter)
- Peak Shaving at Grid Distribution level (not behind the meter)
- Renewable Load Shaping at Grid Distribution level (not behind the meter)
- Generation Output Shifting at Grid Distribution level (not behind the meter)
- Backup Power for loads without loss of retail revenue to utility
- Renewable Generation and storage during grid outage (reliability/emergency)
- Accurate NEM credit for Renewable Generation
- ISO market participation
- Avoids Double Billing of retail and Wholesale energy/power in wholesale operations

This scenario does NOT enable

- Consumer Load Shifting or Shaping
- Consumer Load leveling or Peak Shaving

This scenario is currently not available as utilities have insisted on charging retail for energy storage round trip efficiency losses at retail.



Behind the Meter Renewable Generation, Load Storage in <u>Series</u> on Wholesale Side with Retail Meter (no NEM)

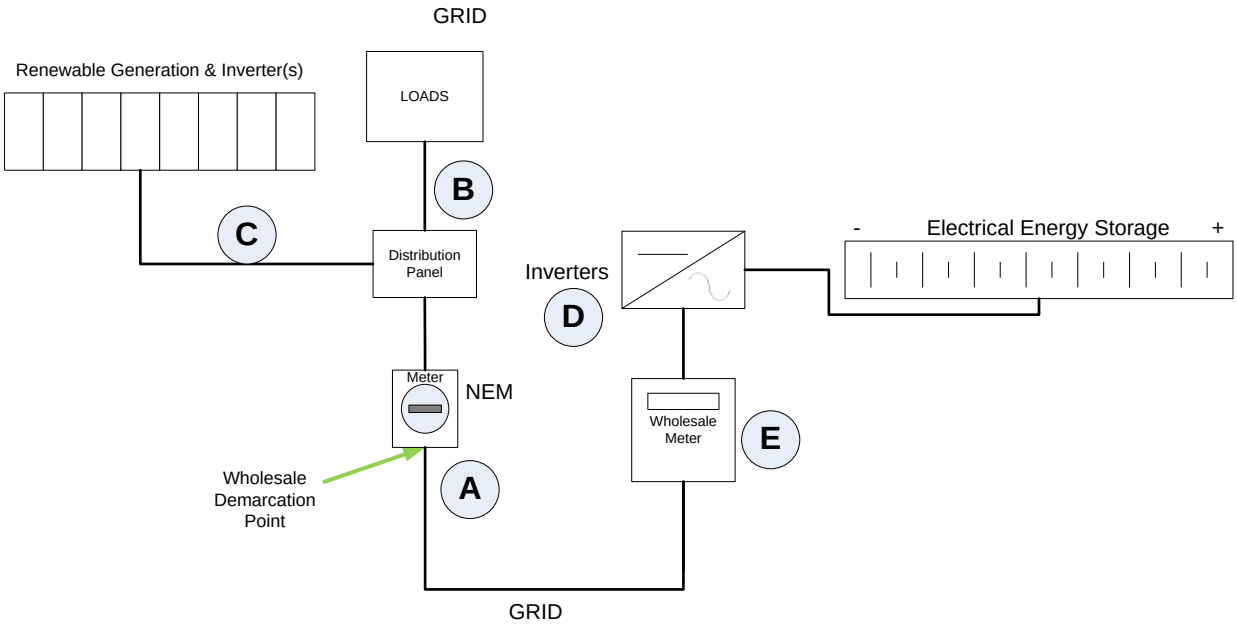
This scenario is a more sophisticated installation and enables certain features and functions to be available. These include

- Load Leveling
- Peak Shaving
- Renewable Load Shaping
- Generation Output Shifting
- Backup Power
- Renewable Generation and storage during grid outage (reliability/emergency)
- ISO market participation

This scenario does NOT enable

- Avoids Double Billing of retail and Wholesale energy/power in wholesale operations
- Accurate NEM credit for Renewable Generation
- Credit for Energy fed back to grid in excess of consumption

This scenario is limited due to sizing constraints of recent NEM decision. To be effective and allow market participation storage should be at larger power size (possibly much larger) than on site



Behind the Meter Renewable Generation, Load and NEM
"Standalone" Storage in <u>Parallel to premise</u> on Wholesale Side

This scenario is a more sophisticated installation and enables certain features and functions to be available. These include

- Load Leveling at Grid Distribution level (not behind the meter)
- Peak Shaving at Grid Distribution level (not behind the meter)
- Renewable Load Shaping at Grid Distribution level (not behind the meter)
- Generation Output Shifting at Grid Distribution level (not behind the meter)
- Accurate NEM credit for Renewable Generation
- CAISO market participation
- Avoids Double Billing of retail and Wholesale energy/power in wholesale operations

This scenario does NOT enable

- Backup Power for loads without loss of retail revenue to utility
- Renewable Generation and storage during grid outage (reliability/emergency)
- Consumer Load Shifting or Shaping
- Consumer Load leveling or Peak Shaving

This scenario is currently not available, as utilities have insisted on charging retail for energy storage round trip efficiency losses at retail