MegaWatt Storage Farms, Inc Comments
Subject: Integration of Renewables Report

Submitted by (Name and phone number)	Company or Entity	Date Submitted
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MegaWatt Storage commends the CAISO staff for its path breaking work in this study. Our comments are intended to further strengthen the final version of this excellent draft report.

1. Transmission Planning Issues associated with the Integration of Renewables
    a. Storage devices such as batteries can be located anywhere on the grid (and can be moved) to support the dual needs of integrating intermittent renewables and mitigating congestion. Mitigating congestion includes deferring or eliminating the need for transmission upgrades near the renewables generation, and for transmission and distribution upgrades near the loads. How will the CAISO assist storage resource developers in locating the storage resources to meet these dual needs, as well as providing for capacity payments based on location?
    b. The report suggests that additional transmission control devices such as SVC's, reactors, and capacitors may be needed. The contributions of fast response of the power electronics on battery and flywheel storage could also be part of the solution. Alternatively, instead of a multiplicity of device types, it may be feasible to add burst power capability to battery storage to permit some multiple of normal output for short durations. The storage operator would need to be compensated accordingly due to higher initial system cost and shortened battery lifetime arising from high power bursts.

2. Grid Operations Issues

    a. Adequacy of Existing Resources -The study indicates that existing resources can accommodate the renewables integration needs, but it does not address whether additional renewables may speed the retirement of existing units and whether more new fast response capacity such as storage may then be needed for both reliability and economics.
    b. New Generation Resources – If most new generation is renewable and there is retirement of existing thermal, how will the mix of fast response and energy producing generation be procured?
    c. Role of Battery Storage

        A well designed multi-MW battery storage system can address the increased needs for (1) regulation, (2) ramping and load following, and (3) over generation, while also providing time shifting of wind and solar generation to higher load periods. Such batteries may be the only technology that can provide all these capabilities from a single resource.

Most thermal and other storage cannot respond as fast as batteries and flywheels. Flywheels address regulation only, and have limited storage duration.

i. The study correctly highlights storage as a major potential contributor to integration of intermittent resources; however it appears to not fully recognize the capability of batteries to provide very fast regulation and supplemental energy services along with other services. For example, some of the conclusions regarding storage in Section 7, could be repeated in the Executive Summary of the report to emphasize the role that storage can play in efficiently integrating wind and solar into the grid and facilitating even more wind and solar on the grid.

ii. The report states that battery storage is relatively costly and has limited storage duration. However, cost needs to be evaluated in the context of alternatives such as new generation and transmission projects that can also be costly and much more difficult to site and build quickly. And while battery storage capacity is limited, many of the uses of storage for fast response, regulation, ramping, over generation and shifting of solar energy a few hours do not require large MWh of storage per MW of storage capacity.

iii. The cycle efficiency of some battery systems is 75% or higher, which is better than most pumped storage and compares favorably with flywheel storage efficiencies.

iv. Battery storage is a readily available solution (RAS) that can be deployed incrementally and moved if necessary. Lead times for battery storage are short in comparison to most generation and transmission alternatives.

v. Battery storage is a clean technology partner enabling the introduction of more intermittent renewables on the grid.

d. <u>Markets</u>

i. Volatile prices for hourly and 5–min supplemental energy, regulation and other services will provide the primary economic drivers for revenues to support the operation and of existing and new resources including storage to respond to the renewables intermittency. However, such prices are often capped and RUC, out of market purchases, and other operating procedures may distort and dampen such signals.

ii. During over generation periods the CAISO report suggests that the CAISO may go out of market, use HASP to export over generation energy, or require the wind plants to curtail output. Similarly, the report states that the CAISO will use decremental regulation to the maximum extent in the event of over generation. However, all such actions will reduce the price volatility that is necessary for the efficient dispatch of storage and other fast responding resources and for recovering investment costs in these resources. An alternative would be to change the lower price cap from -$30 per MWh to the same limit as the upper price cap which is now $400 per MWh and to change the lower price cap in the same steps as the upper price cap as MRTU is implemented. And if over generation is declared, the 5-min supplemental price could be set at the lower cap (a reverse version of scarcity pricing). Still other revenue streams may need to be provided to storage to compensate for depressed price volatility.

iii. Fast responding storage such as batteries and flywheels can provide instant energy to adjust frequency, as opposed to regulation from

generators, which can take minutes to respond. As suggested in the report, existing regulation markets need to be modified to take advantage of fast responding storage as well as to compensate such resources for their fast response. Use of fast responding resources will reduce the total MW of regulation purchases and costs, and provide more precise grid regulation.

iv. Storage resources are energy limited and MRTU market rules and software may not be fully tuned to efficient dispatch of storage resources for wind and solar integration.

v. Battery storage is a resource adequacy technology than can contribute to an LSE capacity requirements. Counting rules for storage need to be addressed.

vi. Batteries and flywheels can provide voltage support but there appears to be no clear compensation mechanism to incent the installation of such capability and its effective operation within wind parks or close to load.

vii. Studies have shown that the use of storage for regulation not only reduces the costs of operation of thermal units and saves fuel, but it also reduces carbon emissions from these services about 70%. However, such benefits may not accrue to the storage plants.

viii. Forecasting, Scheduling and RUC – Does the use of RUC reduce the price volatility necessary to compensate storage? Will the installation of storage reduce RUC costs? How can storage be compensated for the effects of RUC? Can storage be eligible for RUC payments?

ix. Hour-Ahead Dispatch and HASP - How will storage be integrated into HASP and at what prices?

e. Incentives for Storage – The report states that "New storage technologies should also be encouraged and tested within the state". Presumably this statement would also apply to commercially proven storage technologies that are not yet deployed in the state. The report further states "Market incentives may be required to secure the flexibility needed to operate the system with large amounts of renewables." What specific policy directions are recommended by the CAISO in this regard?

i. Load Following Ancillary Service - Load following defined as an ancillary service with market based capacity payments as other ancillary services would help incent storage? No harm would be done by this, because if the capacity payments are unnecessary to attract the necessary response the capacity payments would be low or zero.

ii. Special Tariff for Storage – The report asks whether there should be a special tariff for storage. Would this be a wholesale, CAISO tariff or a retail tariff?

iii. Grid Services Performance Contract – The report suggests "The first commercial deployments of new storage technology will probably need some type of a grid services performance contract to share the financial risk. This will help the owner/operator get financial backing for the new venture and a chance to validate the business economics of the system. Part of the services they provide could still be market based and part could be contract performance based similar to RMR contracts."

A storage project will provide a portfolio of transmission, distribution, generation and reliability benefits. Separate, independent operation of storage from transmission owners and operators is important to the

integrity and proper functioning or CAISO energy, ancillary service and transmission rights markets. As a result, shouldn't ownership and operation of storage projects be independent of transmission and distribution ownership? Transmission and distribution entities can enter into contracts with independent storage operator/owners for services. This will provide an incentive for such independent storage services to develop.

3. Forecasting Issues
    a. Forecasting lead times and hence forecasting error could also be reduced by the use of fast responding storage to fully increment or decrement 5-min dispatches immediately after a forecast is published and the dispatch computed, with no ramping necessary. How would storage be compensated for this faster response and reduced forecast error?

4. Implementation Issues
    a. Ramp Mmitigation Strategies – Storage can be charging at the start of a ramp and discharging at the end of a ramp, subject to its storage and operating limits – dispatch of the storage for ramping mitigation may require improved signals and coordination.
    b. Over Generation Issues – Storage can respond effectively to over generation if the state of charge of the storage devices is properly managed in response to forward prices and other operating signals. Improvements in such signals for storage may be helpful.
    c. Improvements in Forecasting - The report also focuses on improvements in forecasting systems, especially for renewables. Will such forecasting be provided to operators of fast response resources such as storage to assist in mitigation of over generation?
    d. Impact on Resource Adequacy – What will be the counting rules for storage resources – will fast response needs and contributions be counted as well?