| Question | Answer |
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| when will the SOC mgt study be available? | The first phase of the report was completed earlier this year. The full report is available to EPRI members. A few summary reports are being produced for public consumption. Contact EPRI technical leads for more info. |
| Thank you Erik and Nikita. You briefly mentioned about computational issues with ISO-SOCM. Could you elaborate on any computational issues and solve times across various SOCM modes ? | Self-SOCM: Fairly straightforward impact since ESRs are just modeled as additional resources. No additional variables or constraints will be needed hence computationally tractable.<br>SOCM-Lite: Moderate complexity. Requires two variables: one for charging, and one for discharging, and additional SOC related constraints per ESR unit.<br>ISO-SOCM: More complexity. All variables and constraints from SOC-Management Lite plus additional time-coupling constraints to respect desired SOC limitations, which impacts computational tracatability significantly. There are some references to roundtrip efficiency levels also affecting solve times in this mode, but the studies need to verified quantitatively. |
| You alluded to Distribution connected Storage, but can you expand? In particular some of the smaller sized units allowed under FERC 841 are likely to be distribution connected, which might introduce additional considerations. ALso interested in quick thoughts on aggregation of storage | In terms of technical challenges, many of the unknowns are being dealt separately in ISOs' DER initiatives as well as FERC's still open docket on DER aggregation participation in wholesale markets. |
| Is there a role envisaged by ISOs to be played by aggregators that can aggregate storage capacity in the distribution level and contribute on a transmission level? | There is certainly a role for aggregators. This was separated from FERC Order 841 and is still an open docket that has not been ruled upon. |
| what type of electrical storage technologies are accepted? such as batteries/ forced air/ flywheels.... | The Order and ISO designs are technology agnostic. Storage is anything that stores energy from the grid to inject it back onto the grid at a later time point (definition for ESR included in the slide deck). |
| How about ERCOT for ESR? | While ERCOT is not FERC jurisdictional, they have many similar design concepts that follow FERC Order 841. |
| To qualify as capacity how many hours would ESR have for the different markets? | See table in the slide deck. |
| What is an MSR? | Market storage resource. The full forms of the abbreviations are included the presentation. |
| ESR at the distribution level will not be charged a transmissin tariff? Will ESRs that are DER in the grid be charged for wholesalre rates for charges | Transmission charges will not be assessed if providing a service to the ISO. Most ISOs, excepting MISO, have included charging to inject later within this service definition. |
| What is a BSF and DARD? | Binary storage facility and dispatchable asset related demand (which ISO-NE uses for pumped storage). The full forms of the abbreviations are included the presentation. |
| By hybrid co-located technologies, do you mean an ESR added to a gas turbines like in CA an ESR + LM-6000? | That fits under our definition of hybrid resources, but we have primarily been considering renewables plus storage in our studies so far. |
| How about performance requiremnets for connection? e.g, is an ESR required to regulate the voltage during charging and discharging? | There are interconnection requirements that also apply to storage resources. |

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| I saw that all ISO's , except CAISO , are dragging in the compliance with FERC 841 , how the ongoing installations of Energy Storage are still feasible and creating revenue ? | ESRs are likely participating using participation models that are already in place, e.g., a combination of demand response and generator models, or are participating in the provision of regulation service (typically the higest price service) alone. This allows for feasibility and a potential revenue stream. Furthermore, for energy, ISOs have begun to use maximum daily energy (MWh) limits, which allows for a single charge-discharge cycle, with the ESRs charging in the hours that have the lowest prices and discharging in the hours that have the highest prices. |
| is there a solution to the real time forecast dilemma? | We are looking into this. Likely the real-time forecast dilemma as described in the presentation will lead to inefficiencies and not reliability issues. |
| What research exists for ESR around accelerated aging costs of the resources cycled by ISO SOC MGMT to Self-SOC and comparative long-term opportunity costs | There is a part in the report which touches on the literature, e.g., rainflow counting algorithm, for ESRs around degradation impacts. From the perspective of an ESR asset owner, it is highly desirable to prevent deep cycling. An appropriate consideration of this unique operational characteristic of ESRs with the ISO-SOC-Management option potentially necessitates a significant overhaul of contemporary market auction models subsequently reducing their computational tractability. With the Self-SOC-Management and the SOC-Management-Lite options, the cycling lifetime cost can potentially be accounted for appropriately when developing the offer curves. This can potentially assist ESRs in avoiding deep cycling instructions from ISOs/RTOs. In other words, the cycle aging cost is proposed to be factored in the economic bidding process with the goal of avoiding deep cycling occurrences. |
| Is the report public? Can a reference be provided? | The report is completed through EPRI programs and full reports are available to participating companies and otherwise for purchase. Shorter summary reports are being produced as well that are/will be public. The reference is included in the presentation. |
| Do these tools use constant round trip efficiencies or more sophisticated efficiency models? How woiuld this impact different storage technologies? | We had a part in our study that evaluated the use of variable roundtrip efficiencies (with varying output levels) and the formulations for doing so. As expected, this impacts computation time significantly due to the increase in the number of integer variables. Furthermore, with increasing penetration levels of ESRs this will further impact the solution times. |