



# Storage as a Transmission Asset:

*Enabling storage assets providing regulated cost-of-service-based transmission service to access market revenues*

## Revised Straw Proposal

Karl Meeusen, Ph.D.  
Stakeholder Meeting  
August 21, 2018

# Storage as a Transmission Asset

## Revised Straw Proposal Meeting

### Agenda – 8/21/2018

Time	Topic	Presenter
10:00 – 10:10	Introduction	James Bishara
10:10 – 10:30	Scope and Background	Karl Meeusen
10:30 – 12:00	Transmission Cost Recovery and the FERC Policy Statement	Karl Meeusen, Neil Millar, Sheng Chen
12:00 – 1:00	Lunch	
1:00 – 1:45	Contractual Arrangements between ISO and SATA Accessing Market Revenues	Riddhi Ray
1:45 – 2:30	Cost Recovery Options	Karl Meeusen
2:30 – 2:45	Market Participation Rules Allocation to High or Low Voltage	
2:45 – 3:45	Next Steps & Web Survey	James Bishara

# Stakeholder Process



# Stakeholder Engagement Plan

Date	Milestone
<b>Aug 15</b>	Revised straw proposal
<b>Aug 21</b>	Hold stakeholder meeting on revised straw proposal
<b>Sep 4</b>	Stakeholder comments on revised straw proposal due
<b>Sep 24</b>	Draft final proposal
<b>Oct 4</b>	Hold stakeholder meeting on draft final proposal
<b>Oct 15</b>	Stakeholder comments due
<b>Nov 14-15</b>	Present proposal to ISO Board



California ISO

# Scope and Background

Karl Meeusen, Ph.D.

Market and Infrastructure Policy

August 21, 2018

Scope: If storage is selected for cost-of-service based transmission service, how can that resource also provide market services to reduce costs to ratepayers?

- Initiative will consider:
  - Storage resources providing reliability-based transmission services, economic, and policy projects
  - Indifferent to transmission or distribution connection
- Issues outside the scope of this initiative:
  - The TPP evaluation methodologies
  - The framework for competitive solicitation and the applicability of the ISO's current competitive solicitation framework
  - Cost allocation of the cost-based revenue requirements for rate-based assets
  - Resource adequacy value

The planning process and methodologies provide the context for the initiative.

## Background Topics Previously Reviewed in the Stakeholder Process

- Transmission Planning Process
- Scope of evaluation for storage assets
  - Types of projects considered
  - Interconnecting voltage
- FERC storage resource participation principles
- Assessments of need and technical requirements
- Economic evaluation of project alternatives
- Transmission Asset versus Market Local Resource considerations
- ISO Operational control of storage assets

## Storage – and other preferred resources - may meet different types of transmission planning needs

- Addressing grid reliability requirements:
  - The most frequent candidate for storage in the past, as identified by the ISO and stakeholder submissions
- Identifying upgrades needed to meet California's policy goals (e.g. Renewable Portfolio Standards)
  - While possible, no identified opportunities for storage thus far
- Exploring projects that can bring economic benefits to consumers
  - Upgrades alleviating congestion to provide access to lower cost resources, but not a competing resource
  - The bulk of all storage market economic benefits identified to date have been as market resources inside a constrained area
  - Differentiating between the two can be complex

## Storage, to be a Transmission Asset as a subset of Advanced Transmission Technologies, must:

- Provide a transmission service (e.g., voltage support, mitigate thermal overloads)
- Meet an ISO-determined need under the tariff (reliability, economic, public policy)
- Be the more efficient or cost-effective solution to meet the identified need
- “Increase the capacity, efficiency, or reliability of an existing or new transmission facility”
- Be subject to competitive solicitation if it is a regional transmission facility

## The ISO has considered proposals where storage provides cost-of-service based transmission services

- Over the past several years, the ISO has studied
  - 27 battery storage proposals; and
  - one pumped hydro storage proposal as potential transmission assets.
- To date, only two proposals have resulted in storage projects moving forward
  - Both in the 2017-2018 Transmission Plan
- The ISO's experience to date is that electric storage has best fit as a market resource providing local capacity rather than as a transmission asset

# Assessment of Need and Technical Requirements

## *TPP Consideration Of Preferred Resources-Identification and requirements determination*

- ISO has always assessed non-transmission alternatives albeit on a case to case basis due to labor intensive nature of the analysis
- ISO published a methodology document “Consideration of alternatives to transmission or conventional generation to address local needs in the transmission planning process,” to improve ISO’s past approach to evaluating non-conventional transmission solutions
- Methodology proposed a three step approach that includes identifying generic resource types, determining an effective mix and monitoring the development of the selected mix
- Methodology was advanced and used to establish the Moorpark sub-area local capacity requirements in the 17-18 TPP cycle

# Operational Control - Practical meaning of 'operational control' of SATA facilities

- Tariff Appendix A defines Operational Control as –  
*“The rights of the CAISO under the Transmission Control Agreement and the CAISO Tariff to direct Participating TOs how to operate their transmission lines and facilities and other electric plant affecting the reliability of those lines and facilities for the purpose of affording comparable non-discriminatory transmission access and meeting Applicable Reliability Criteria.”*
- In SATA proposal, the practical meaning of operational control is a hands-on out-of-market state-of-charge (SOC) control – a new definition may be appropriate
- Orchestrated in a way that the market system reflects any change in SOC



# Transmission Cost Recovery and the FERC Policy Statement

August 21, 2018



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# FERC Policy Statement and SATA Resources

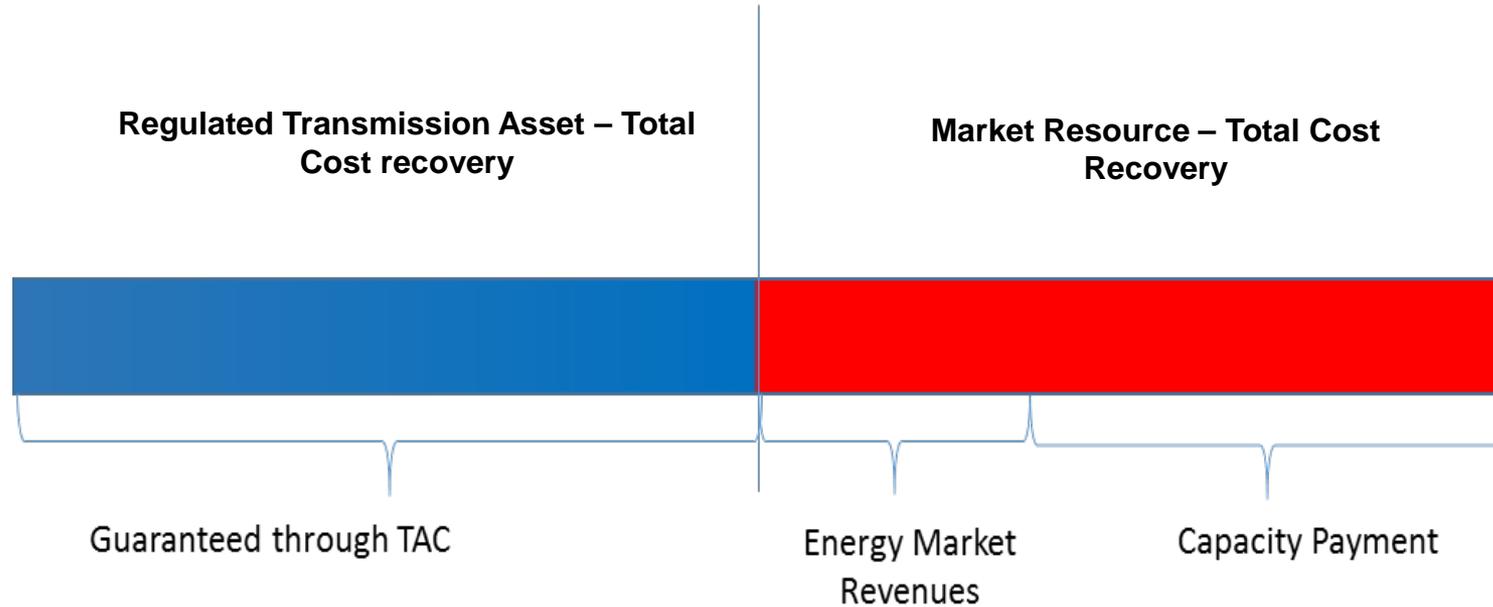
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# Transmission assets have traditionally been fully guaranteed and recovered through the ISO's TAC

- The lines between a transmission asset and market resource are clearly defined



If a cost-of-service based resource providing transmission service is also accessing market revenues, the following need to be addressed:

1. The potential for cost recovery through cost-based rates to inappropriately suppress competitive prices in the wholesale electric markets to the detriment of other competitors who do not receive such cost-based recovery;
2. The level of ISO control over the operation of an electric storage resource could jeopardize its independence as the market operator; and
3. The potential for combined cost-based and market-based rate recovery to result in double recovery of costs by the electric storage resource owner or operator to the detriment of the ratepayer.



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# Impact on Market Prices

Karl Meeusen, Ph.D.  
Market and Infrastructure Policy

August 21, 2018

The ISO must design incentives for SATA resources to bid at their marginal cost to ensure SATA resources do not inappropriately suppress market prices

- The impact of more supply resources on market prices depends on the marginal cost of resources
  - Lower marginal cost resources will lower market prices
  - Higher marginal cost resources will impact prices because they will not clear the market
- If resources do bid at marginal cost, then any market price reductions should be seen as appropriate

The ISO proposes to develop a TRR crediting mechanism based on the expected useful life of the resource

This incentive mechanism is necessary and intended to serve two purposes:

1. Protect ratepayers from early degradation of SATA resources operational capabilities due to dispatches from ISO market participation and potential for reduced useful lifespan for a SATA resource's ability to meet the identified transmission need(s) and,
2. Ensure the SATA resource owner considers all marginal costs when bidding into the market.

This provision insulates and protects ratepayers from subsidizing a transmission asset that is used primarily as a market resource

- The number of cycles or the total designed MWh capacity of a battery storage device over its useful lifecycle can be forecasted using OEM vendor warranties and/or industry standards
- The total designed MWh capacity is essentially the number of discharge hours multiplied by the capacity of the battery
- Allows the ISO to assess battery degradation values that are time based and will be included in the ultimate sizing of the resource

The ISO will calculate a capital cost TRR credit based on the project's overall capital costs and the resource's expected cycles or discharges over its full lifecycle

- Credit would be assessed against the SATA resource's TRR every time the resource is dispatched when bid into the market
  - i.e. When not providing transmission service
- Each MWh of discharge will be assessed a capital cost TRR credit
  - Reduces the resource's TRR recovery by this credit
  - Reflects the reduced lifecycle of the resource based on its use as a market based resource

The ISO will calculate a capital cost TRR credit based on the project's overall capital costs and the resource's expected cycles or discharges over its full lifecycle

- Credit would be fixed for all MWhs of a resource's discharges due to market participation awards
  - Not applied to discharges due to ISO dispatches for transmission service
- Credit becomes a marginal cost that any SATA owner includes in any market service bid
  - Creates incentive to bid into the market with full consideration of the capital cost implications of providing market service
- **Effectively eliminates any cross subsidization of market services from transmission service cost recovery**

# Formulas describing capital cost TRR credit for market based participation and for shared ISO market revenues

## Without shared energy market TRR credit:

$$\text{TRR} = ((\text{Capital Costs} - (\text{Cap Cost Credit Multiplier} \times \text{MWh discharge})) \times \text{ROE}) + \text{Variable O\&M} + \text{A\&G}$$

## With shared energy market TRR credit:

$$\text{TRR} = ((\text{Capital Costs} - (\text{Cap Cost Credit Multiplier} \times \text{MWh discharge})) \times \text{ROE}) + ((\text{Variable O\&M} - \text{Ratepayer Share of ISO Market Revenues Credit}) + \text{A\&G})$$

## The TRR adjustment is appropriate given the nature of the resources primary intended use

- Ensure SATA resources will not inappropriately suppress competitive wholesale electricity prices
  - Resource owners have the proper incentive to reflect any marginal costs of foregone TRR in market bids
- SATA resources may lower energy prices in some intervals while discharging, but will would increase the price in other hours when the resource is charging

## The TRR adjustment is appropriate given the nature of the resources primary intended use

- SATA resource would be able to access market revenues in intervals that are already competitive
  - Combined with the proposed TRR reduction, SATA resources are unlikely to inappropriately suppressing market prices
- Should not be significant energy market power concerns
  - The days in which the resource will be most needed for transmission service will be the same as those in which the resource would most likely have the ability to significantly increase energy market prices



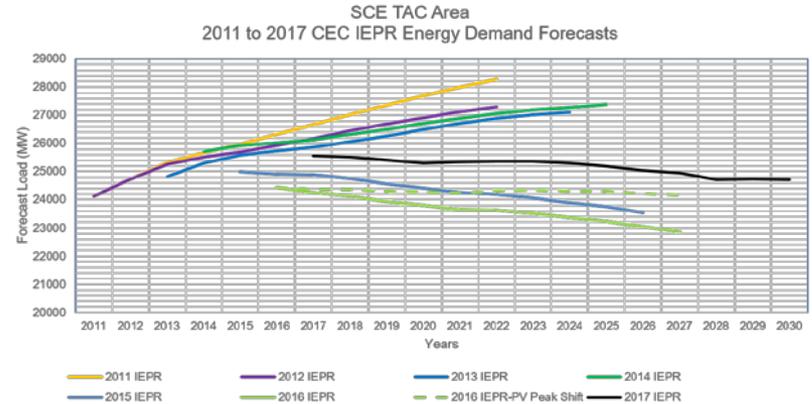
# Considerations demonstrating lack of long term predictability

Neil Millar  
Infrastructure Development

August 21, 2018

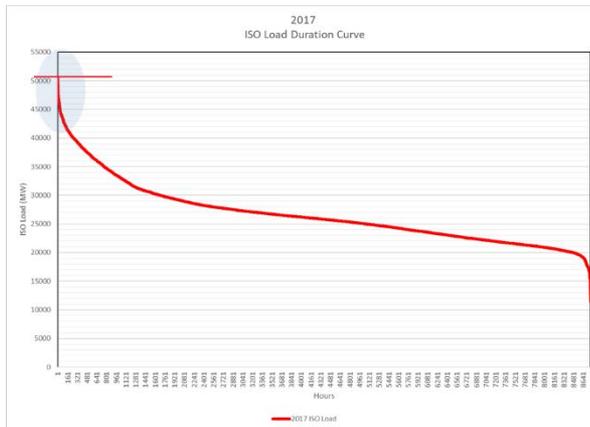
# Previously provided information has raised concerns with the reasonable ability to predict longer term usage requirements for storage

## 1. Varying load forecasts



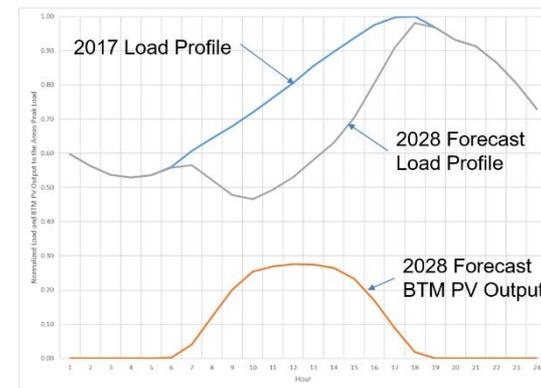
## 2. Nature of ISO load duration curves

Example: ISO 2017 Load Duration Curve



The relatively low load factor also makes the amount of time at peak loads very susceptible to change

## 3. Increasing impact of load modifiers



Example: Greater Bay Area Planning Area

2017 Load Profile and Current 2028 Forecast Load and Behind-The-Meter Profile Normalized to the Area's Peak Load

## SATA Use Cases: More specific examples explored to consider impacts of varying input assumptions on constraint predictability

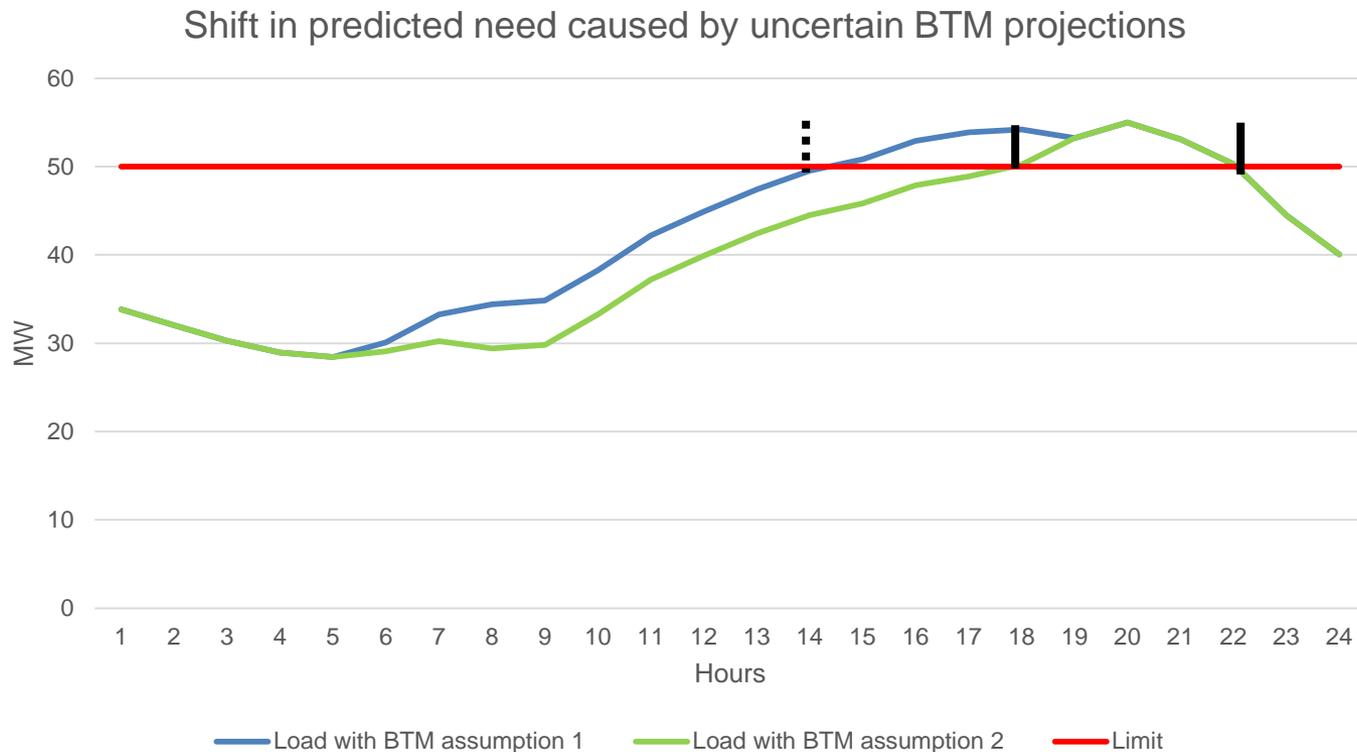
These explored input assumptions that have been particularly volatile in the recent past:

1. Variation in behind-the-meter solar projections
2. Variation in assumptions/forecasts about transmission connected generation (e.g. gas generation retirement at a short notice)

The ISO concludes that firm long-term projections of time-of-day and time-of-year requirements are not feasible

# Use case 1: Variation in behind-the-meter resource projections

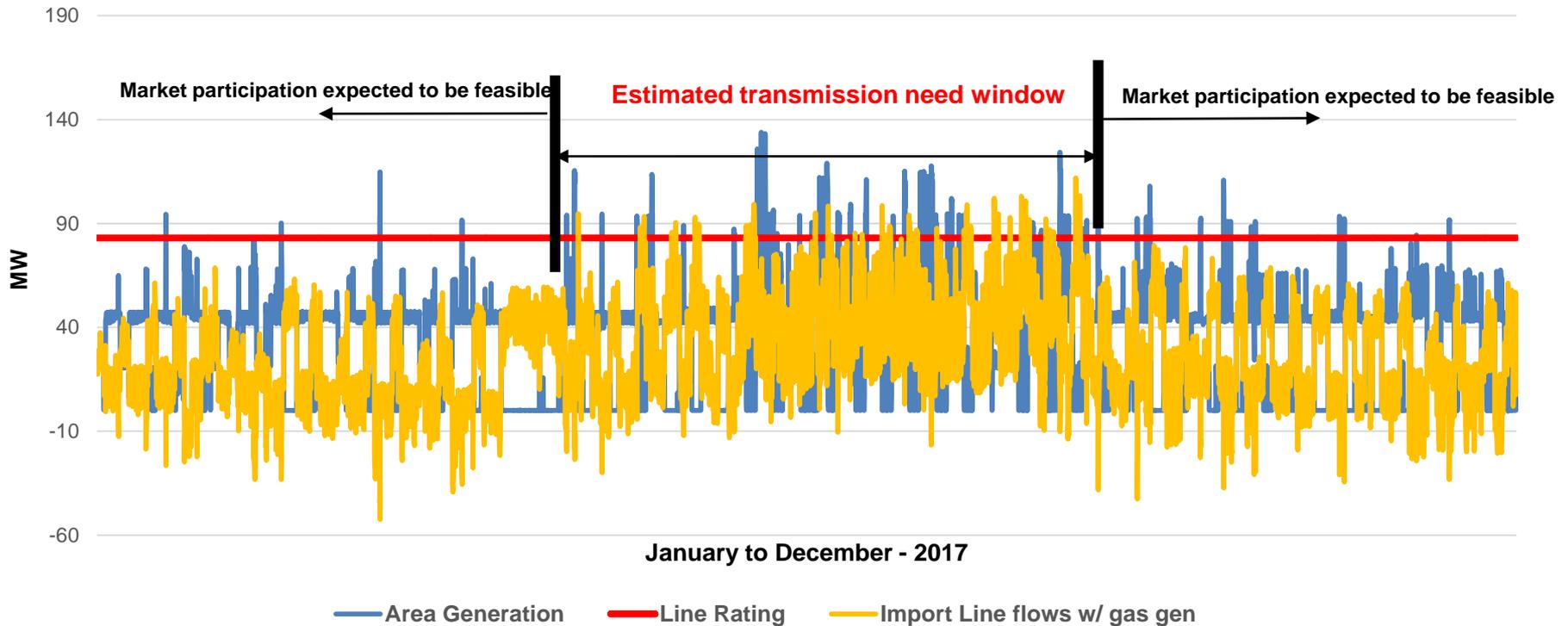
San Ysidro Area : 5 MW variation in behind-the-meter solar projections could shift the transmission need window by several hours.



# Use-case 2: Variation in assumptions/forecasts about transmission connected generation

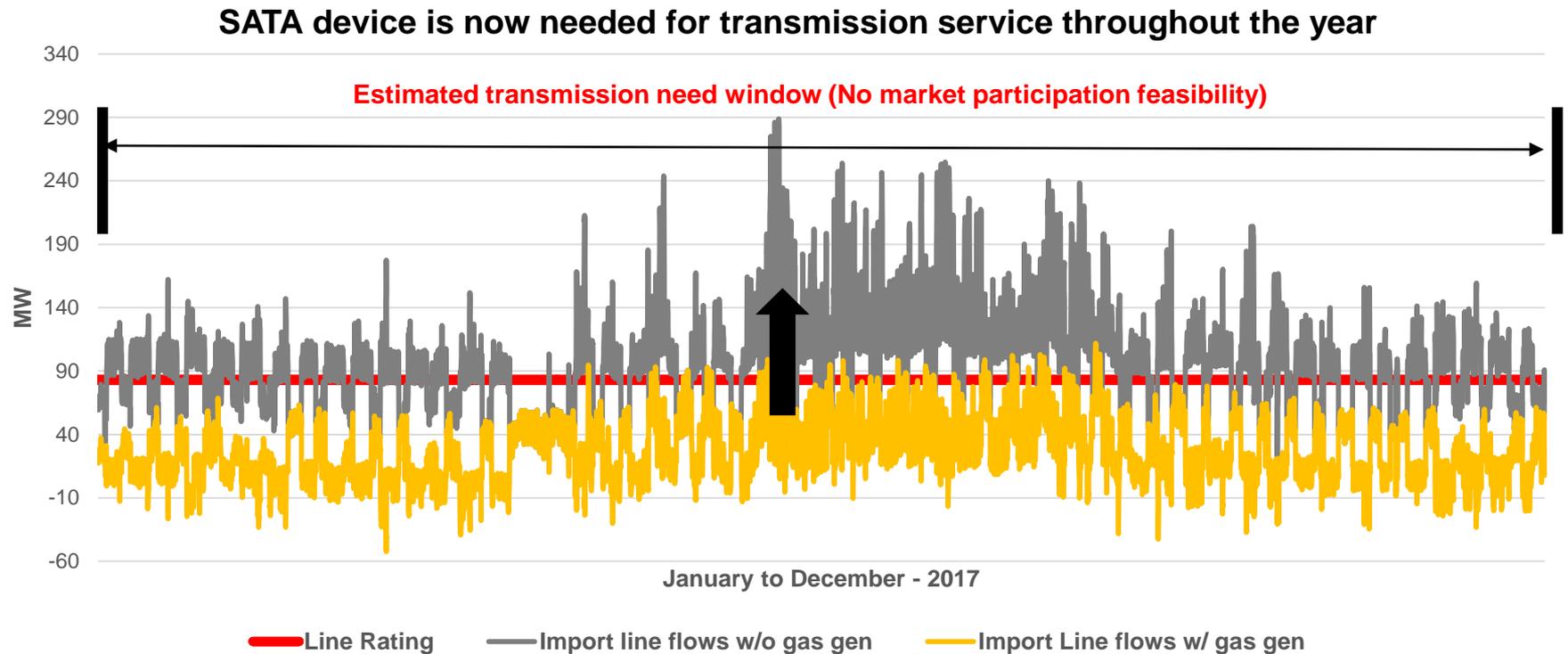
## Constraint Prediction with Gas Generation

Line flows when gas generation is dispatched to maintain the loadings within facility limits



# Use case 2: Variation in assumptions/forecasts about transmission connected generation

Constraint Prediction with Gas generation exiting the market at a short notice due to economic reasons



The ISO concludes that firm long-term projections of time-of-day and time-of-year requirements are not feasible

- Cost recovery options depending on firm long-term projections of time-of-day and time-of-year transmission service usage requirements, and therefore the availability for market participation are not viable, at least at this time



# Maintaining ISO independence through notification practices

Karl Meeusen, Ph.D.  
Market and Infrastructure Policy

August 21, 2018

# Maintaining ISO independence through notification practices

- ISO proposes to ensure
  - Independence through the use of notification practices
  - Transmission services take primacy over market participation
- ISO proposed notifications allowing for market participation will be made prior to the relevant market runs
- The owner of the SOTA resource, not the ISO, will be responsible for the bidding and market participation of the resource once notified

# The ISO will ensure its independence through the use of effective market participation notification practices

- All of the determinations will be made for an entire day
  - Potential for forecast errors that may result in transmission needs at times that differ from the initial projection
  - Resource may not be fully charged
- Additional analysis and sensitivity studies show it is not possible to provide SATA resources upfront/long term notification

**ISO is assessing two alternative notification options**



# Exploring Notification Options

Sheng Chen  
Operations Planning

August 21, 2018

# Option 1: The Day-Ahead Market Option

- ISO will evaluate the needs for SATA resources to be used as transmission assets in the Day-Ahead Market
- ISO will generate a bid right below the transmission relaxation penalty in Day-Ahead Market RUC run
- If DAM clears a SATA resource, then SATA resource will be deemed as a “Transmission Service Asset” and will not be allowed market based participation
- If DAM does not clear a SATA resource, then the SATA resource will be allowed to bid in the Real-Time Market

# Option 1: The Day-Ahead Market Option

## Pros:

- The DAM clears with sufficient bids and the ISO is able to use an accurate load forecast to determine how the resource should be utilized
- A complete bid stack is assessed

## Cons:

- SATA resources will not be able to participate in the Day-Ahead Market, and will only be allowed to participate in the Real-Time Market
  - Limits opportunity to provide certain market services

## Option 2: The D+2 Option

- ISO will evaluate the needs for SATA resources to be used as transmission assets two days prior to the operating day, at D+2
- ISO will generate a bid right below the transmission relaxation penalty for SATA resources in D+2 RUC run
- If SATA resources are cleared in this process, then SATA resources will be deemed as a “Transmission Service Asset” and will not be allowed market based participation
- If SATA resources do not clear in the D+2 process, then SATA resources will be allowed to bid in both Day-Ahead and Real-Time Market

## Option 2: The D+2 Option

### Pros:

- SATA resources can participate in both the Day-Ahead and the Real-Time Markets.

### Cons:

- RUC run with bids and load forecast data available in D+2 which could be less accurate.



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# Ensuring No Double Payments for Providing the Same Service

Karl Meeusen, Ph.D.

Market and Infrastructure Policy

August 21, 2018

## Modifications to the ISO proposal ensure there are not opportunities for SATA resource to receive double compensation

- SATA resources participating in the market may earn combined revenues in excess of its total cost-of-service
- Energy market revenues are earned by providing market services, not transmission services
  - Energy market revenues will only occur when the ISO does not expect the resource to be needed for transmission services (i.e. Not double recovery for the same services)
- Proposed TRR reduction and notification processes ensure that transmission and market services are clearly delineated



# SATA agreement provisions

Riddhi Ray

Infrastructure Contracts and Management

August 21, 2018

# Outline

- Different scenarios of SATA resources
- Structure of SATA agreement
- Main agreement provisions
  - Maintenance obligation
  - Performance obligation
  - Market participation
  - Market revenue accounting
  - Capital additions/lifecycle replacement

# Different scenarios of SATA resources

- Scenario 1: SATA asset has full cost of service recovery, no market participation
- Scenario 2: SATA asset has partial cost of service recovery, market participation, retains all market revenues
- Scenario 3: SATA asset has full cost of service recovery, market participation, retains portion of market revenues

## Structure of SATA agreement- broad terms and conditions

- Performance, including obligation to perform
- Operations and maintenance
- Lifecycle replacement/capital additions
- Dispatch and scheduling of resource
- CAISO operational control vs market participation
- Accounting of market and cost of service revenues
- Implementation schedule
- Resource characteristics
- Interconnection requirements

# Agreement provisions – Maintenance obligations

- Broad section detailing all maintenance obligations for SATA resource:
  - Reliability standards,
  - CAISO standards,
  - Other industry standards,
  - Good utility practice, etc.

# Agreement provisions – Performance obligations

- Details performance obligations of SATA as a transmission resource
- Describes how SATA resource will respond to CAISO dispatch instructions and perform on those instructions.
- Any obligations and available mechanisms to maintain certain state of charge

## Agreement provisions – Market participation

- Describes how and when the SATA resource can participate in the market
- Will describe how CAISO will notify SATA resource of market participation and how SATA resource shall respond to such instruction
- CAISO will also retain right to pull SATA resource out of market participation if needed for reliability and may also describe any restrictions around bidding of the resource

## Agreement provisions – Cost of Service and Market revenue accounting

- Describes annual fixed revenue requirement of the SATA resource
- Necessary cost accounts to be included in the rate schedule. It should also describe any revenue sharing we are contemplating in the agreement, if applicable
- Capital degradation recovery adder description to be provided and included if market participation impacts use as a transmission asset

# Agreement provisions- Capital additions/lifecycle replacement

- Describes the entire process for requesting, approving and implementing any capital additions required for this project.
- Capital additions could include lifecycle replacements, unplanned capital items and repairs.
- Will also define the cost obligations of the parties involved for funding these capital additions, as applicable.



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# Cost Recovery Options

Karl Meeusen, Ph.D.  
Market and Infrastructure Policy

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## The ISO is proposing three cost recovery options for regional SATA projects

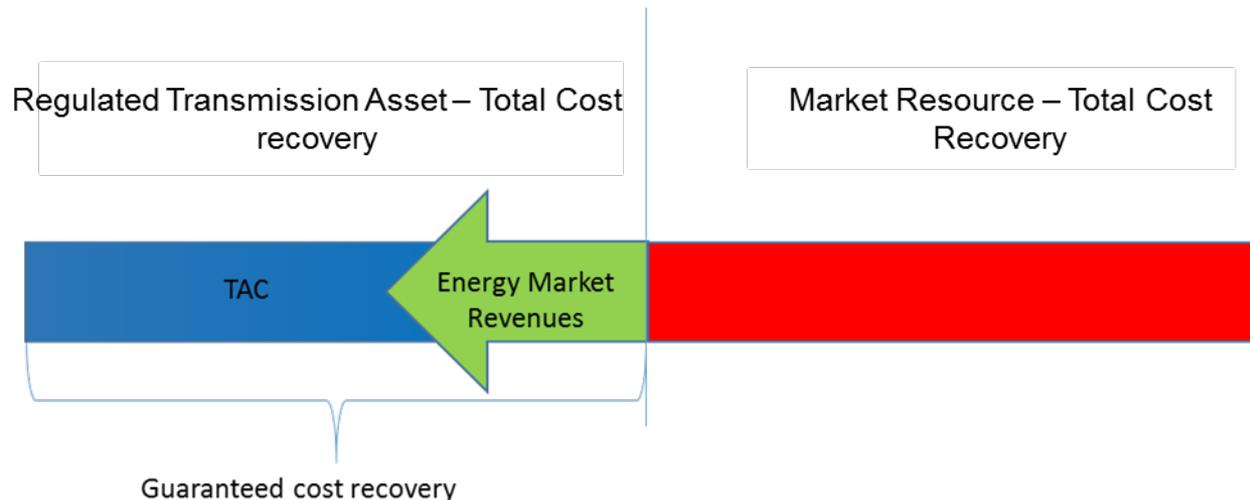
1. Full cost-of-service based cost recovery with complete energy market crediting to ratepayer
2. Partial cost-of-service based cost recovery and retain energy market revenues
3. Full cost-of-service recovery with partial market revenue sharing between owner and ratepayer

Market services must not conflict with the fundamental reliability purpose for which the resource was selected in the TPP

Local projects may only use full cost-of-service options (1 & 3) because they are not eligible for competitive solicitation process

# Full cost-of-service based cost recovery with energy market crediting ensures that a resource's TRR is covered through TAC

- Any revenue received from market services would be treated as a revenue offset
  - Reduces the revenues otherwise required through TAC

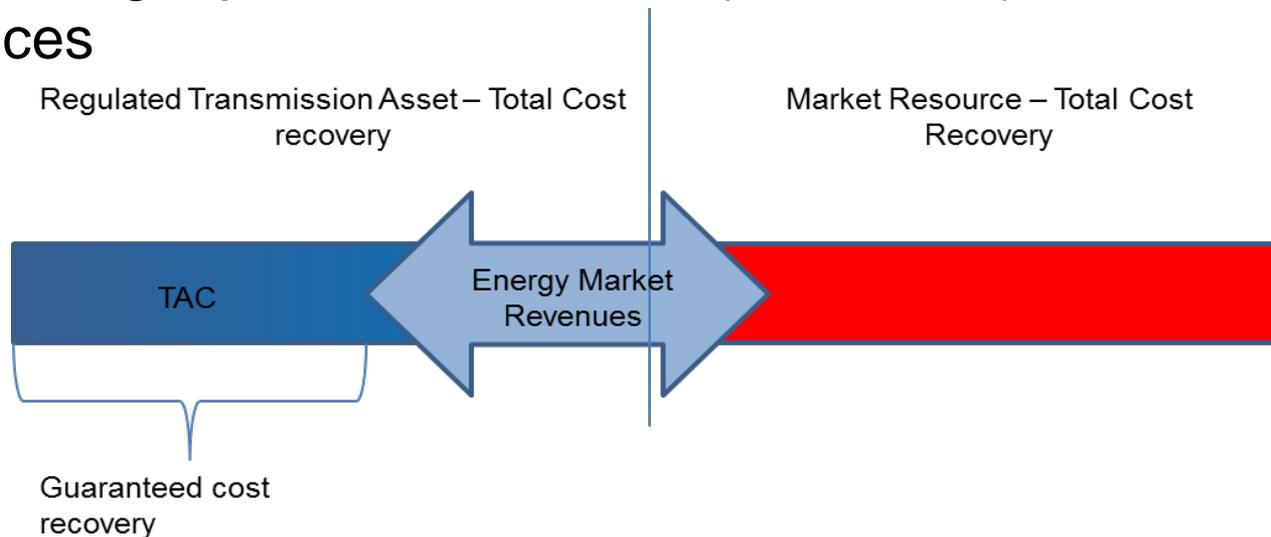


Resources must be available to meet identified need,  
and may participate in the market

- Resources will not have any specified must-offer obligation
  - As a result, and as a starting point, the ISO will assume zero market participation in the assessment of alternative projects
    - The ISO remains open to revisions based on stakeholder feedback

Partial cost-of-service with no energy market crediting ensures that a portion resource's total costs are covered, the remainder is recovered through market

- Guarantees less of the TRR through TAC
  - ISO market revenues would not be credited against the TAC recovery
- Resource owner accepts both upside and downside risk of recovering a portion of its costs (and return) from market services



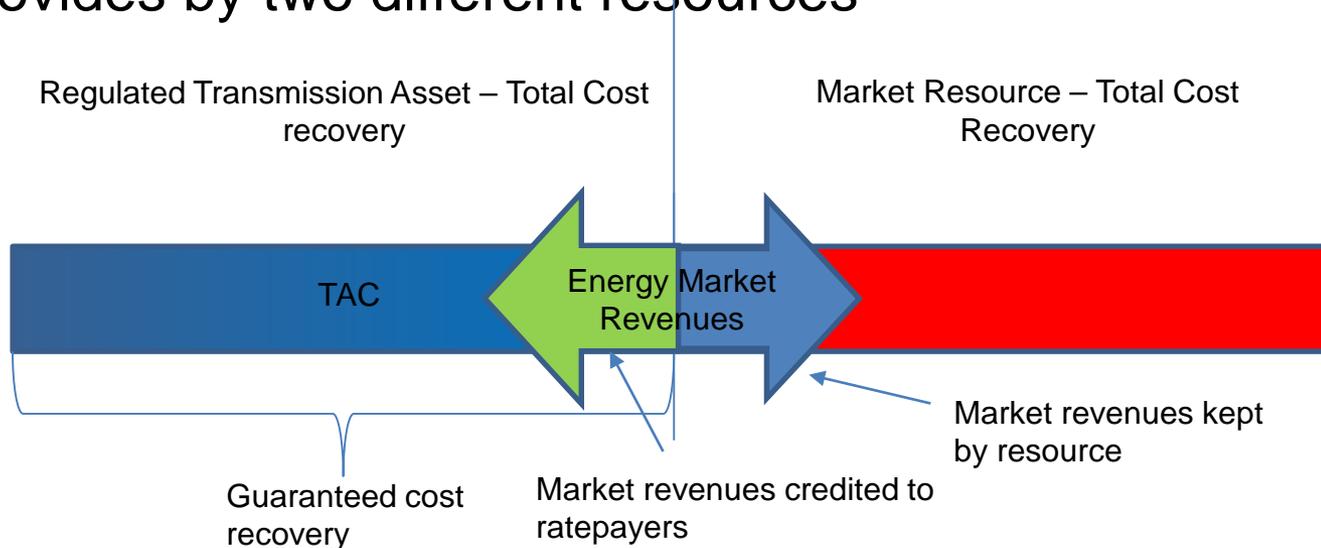
## Unpredictable changes in market participation opportunities can impact a resource's ability to cover costs

- In Phase 3 competitive solicitations, the ISO will evaluate each bid to determine
  - If it assumes reasonable levels of expected market revenues and/or
  - If the project sponsor is able to accept the risks that all costs may not be recovered.
- Not clear if proposed notification processes provide sufficient information to facilitate financing.

**ISO is seeking stakeholder input to determine if this option remains viable or should be eliminated**

# Full cost recovery with revenue sharing provides an incentive to bid into the market and can reduce overall cost to ratepayer

- Guarantees full submitted cost-of-service recovery through TAC
- Revenue split provides incentive to bid into market, but total transmission and energy costs for rate payers are less than if provided by two different resources



Full cost of service with revenue sharing can help project sponsors balance risks while still providing benefits to ratepayers

- Two basic means by which this option could be administered.
  - *Any* market revenues would be split,
  - Resource would have to first surpass a given amount of market revenues before retaining portion of market revenues.

Is a threshold of market revenue necessary or desirable before a SATA resources retains a portion of market revenues?

Should the split of market revenues should be fixed or allowed to vary across projects and/or bids?

# The ISO is considering options in the event of insufficient qualified project sponsors

1. Require at least three qualified project sponsors for the partial cost-of-service or full cost of service with revenue sharing to be options for consideration.
  - All project sponsors would be required to also submit a full cost-of-service bid as a contingency option
2. Requiring a set percent of total TRR be recovered before any market revenues be could be retained by the project sponsor
3. Limiting the total allowable market revenue retention be limited to a fixed percent of the total annual TRR, or limiting the revenue split to no more than 50-50.

**ISO seeks stakeholder feedback regarding which of these options, or any other offered by stakeholders**

# Cost recovery for shared facilities will apply only to network upgrades

- Network and interconnection upgrades for the “right-sized” SATA resource will be covered under the TRR
- Some project sponsors may seek to include opportunities to add additional market based resources or capability
  - Any incremental cost for interconnection facilities and generation beyond the ISO’s preferred solution will not be covered by the TRR
- ISO will not require the project sponsor to enter to the interconnection queue for the approved SATA capacity
  - Any incremental capacity must complete the generation interconnection process (i.e. not permitted to jump the interconnection queue)



# Market Participation Rules Allocation to High or Low Voltage

Karl Meeusen, Ph.D.  
Market and Infrastructure Policy

August 21, 2018

## SATA resources may bid like any other non-RA resource when participating as a market resource

- SATA resources would be able to bid similarly to other storage resources when participating in the ISO markets
- Treats SATA resources in a fair and equitable manner compared to other market resources by maintaining similar bidding requirements and parameters

The ISO plans to maintain the current practice of allocating costs to high or low voltage TAC based on the point of interconnection

- Transmission connected resources are resources that are connected to the ISO controlled grid
  - Regional resources – greater than 200 kV and
  - Local resources – lower than 200 kV

The ISO plans to maintain the current practice of allocating costs to high or low voltage TAC based on the point of interconnection

- SATA resource may be connected to the transmission system at a level that differs from the transmission issue it has been identified to resolve
  - For example, the ISO may identify a Regional need, but identify a SATA resource connecting at a Local level as the best solution
- The ISO plans to allocate to high or low voltage TAC based on point of interconnection to the CAISO controlled grid

## Next steps

- Stakeholders are asked to submit written comments by September 4, 2018 to: [initiativecomments@caiso.com](mailto:initiativecomments@caiso.com)
- The initiative page is available at the following link: <http://www.caiso.com/informed/Pages/StakeholderProcesses/StorageAsATransmissionAsset.aspx>
- Draft final proposal September 24, 2018