

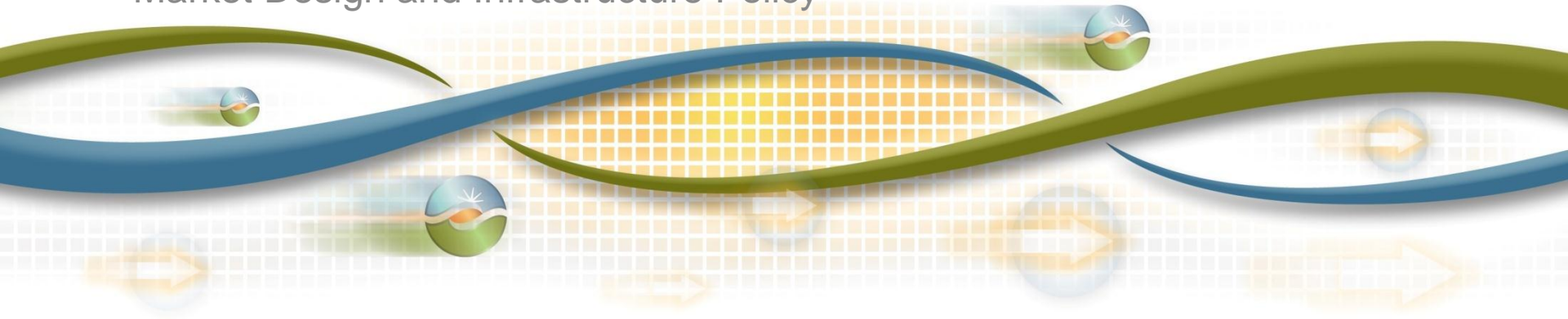


California ISO
Shaping a Renewed Future

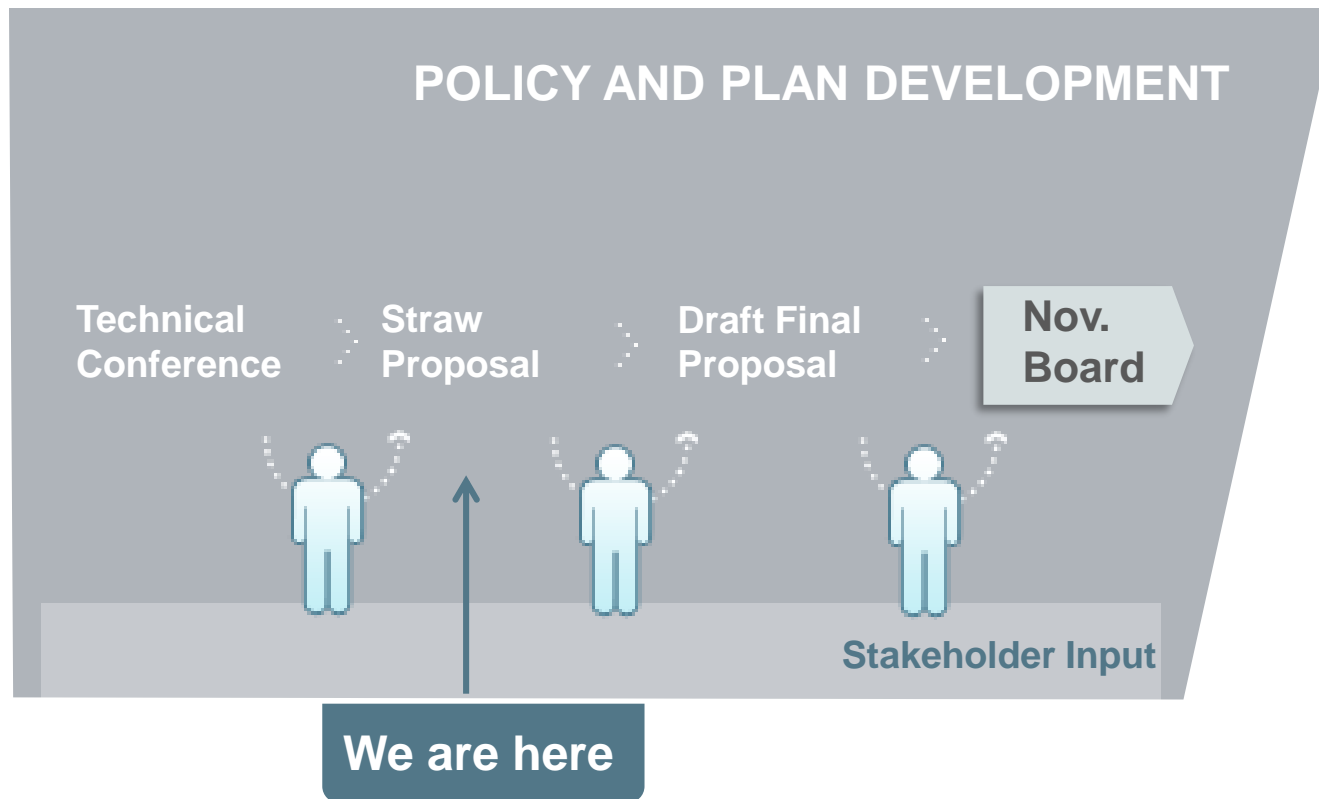
Commitment Cost Enhancements Phase 3 (CCE3) Straw Proposal

Stakeholder Conference Call
August 31, 2015

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Market Design and Infrastructure Policy



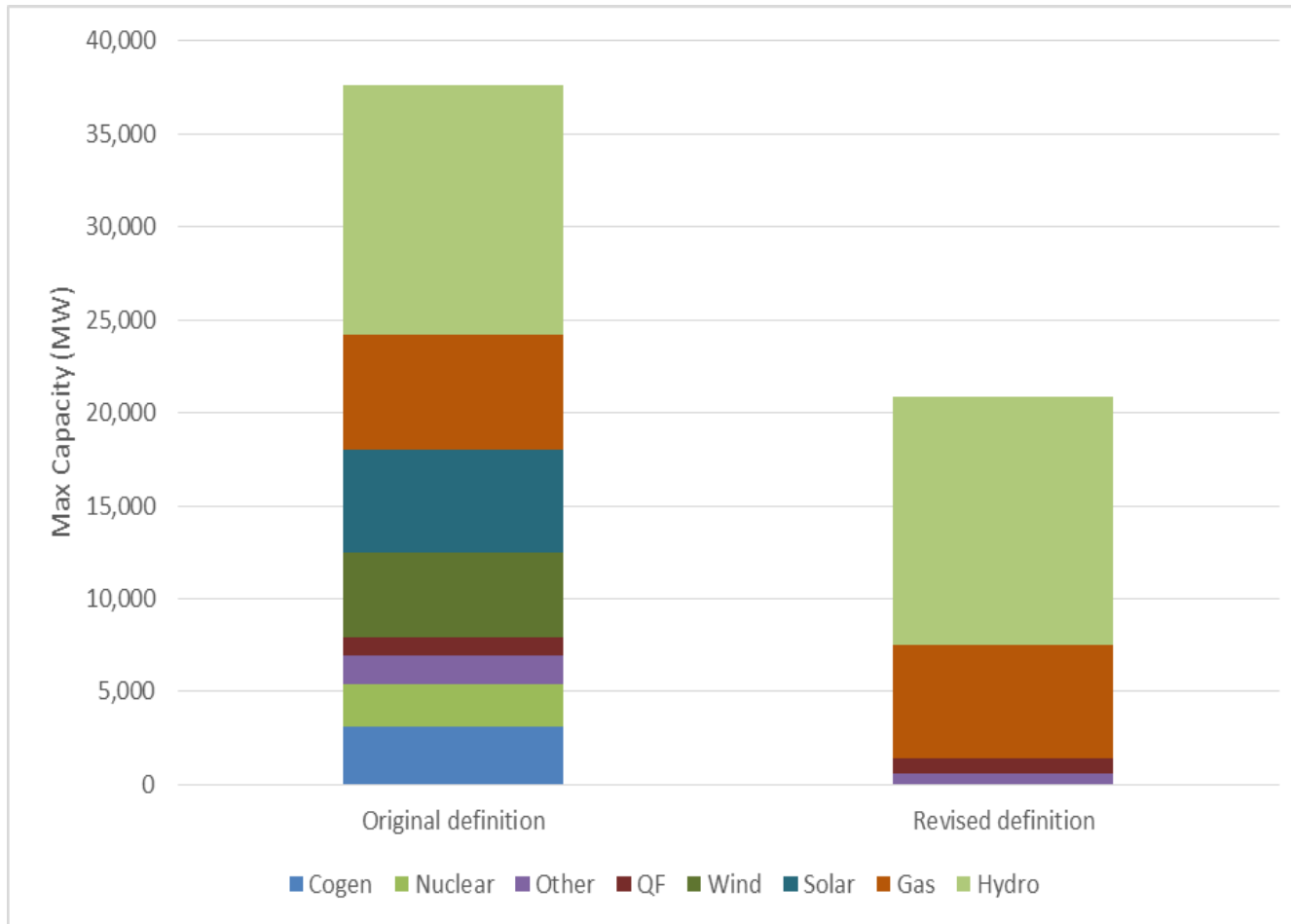
ISO Policy Initiative Stakeholder Process



Background on CCE3

- CCE and CCE2 postponed the development of an opportunity cost model to this initiative to allow sufficient time for vetting business rules
- Revised definition: Use-limited capacity that cannot be fully optimized by the ISO's commitment processes due to operational limitations set by statutes, regulatory, ordinances, court orders, or design considerations.
- ISO has developed and tested two prototype models which were presented at the Technical Workshop on July 20th, 2015 along with preliminary results
 - Continue to develop and test models

Use-limited capacity under revised definition



- Based on current use-limited resources
- Gas-fired use-limited resources are anticipated to be majority that ISO models
- Hydro resources are anticipated to have negotiated opportunity costs

Overview of CCE3

- CCE3 will design a methodology to determine opportunity costs for limitations of use-limited resources.
- Use limited resources may have a calculated or negotiated opportunity cost reflected in commitment cost bids and/or default energy bids (DEBs).
- Upon implementation, registered cost option will be eliminated
 - Manual gas price spike update process will no longer be needed.
- Fall 2016 targeted implementation date

Use-limited registration process

- RSI modified the use-limited registration process
 - Submit required documentation to the ISO for approval of use-limited status
 - Identify limitations by type (start, run-hour, output, etc) and applicability (annual, quarterly, monthly)
- Upon approval of use-limited status, the ISO will evaluate which limitations can be modeled and which cannot
 - Modeled: Calculated opportunity cost
 - Not modeled: negotiated opportunity cost
- All submitted documentation, both for modeled and negotiated, will be validated by the ISO

Evaluating modeled limitations

- ISO anticipates being able to model all limitations on starts, run-hours, and output
 - Multi-stage generator (MSG) resources may have modeled limitations if they can be modeled at the parent level (i.e. not consider transitions)
- Daily, monthly, quarterly, annual, rolling basis limitations
- Emission or fuel based limitations that can be translated into starts, run-hours, and/or output will be translated by the market participant
 - Additional documentation required showing the translation of limitations in permits to those being modeled

Evaluating negotiated limitations

- Limitations that cannot be modeled will have a negotiated opportunity cost
- Provide to the ISO through the registration process
 - A proposed opportunity cost for each limitation
 - Documentation describing the methodology (process, assumptions, and inputs) used to determine proposed opportunity cost
- ISO will work with market participants to approve negotiated opportunity cost

Opportunity cost model: overview

- Use estimated LMPs and input variables in opportunity cost model
- Opportunity cost model estimates commitment and dispatch for each use-limited resource
 - 15 minute granularity
- Model is run for, at a minimum, the limitation time horizon.
 - Example: Run for a year for annual, quarterly, monthly limitations
- Determine the opportunity cost for each limitation as stated in the use-limitation registration process
 - The profits a resource would forego if it had one less (or one more) start, run hour, or MWh

Opportunity cost model: Inputs

Calculates an opportunity cost for resources and limitations that are able to be modeled

- Starts, run-hours, and output
- Daily, monthly, quarterly, annual, rolling basis

Model inputs	Opportunity cost calculation	Model outputs
<ul style="list-style-type: none">• Use plan limitations• Unit characteristics• Historical commitment costs• Historical implied heat rate• Natural gas futures• Greenhouse gas prices• Gas transportation costs• Future power price conversion factor	Unit commitment model over future time period (e.g., month) based on simulated node-specific LMPs.	Separate resource specific opportunity costs for start-up, minimum load, and energy, as appropriate. Can be reflected in commitment cost bids or resource's DEB.

Opportunity cost model: Estimated LMPs

- Estimate a series of unit specific 15 minute nodal LMPs
 - 15 minute prices preserve volatility
 - Only 3 long start use-limited resources
- Determine a series of resource specific implied heat rates based on the prior year's fifteen minute prices, natural gas prices, and greenhouse gas costs
- Multiply the implied heat rates by a future power price conversion factor
- Forecast converted implied heat rates by applying future gas prices and most recent gas transportation and greenhouse gas costs

Opportunity cost model: Estimated LMPs

Implied heat rate:
$$\text{Im } pHR_{i,t-1} = \frac{LMP_{i,t-1}}{NatGasP_{l,t-1} + (GHGas_{t-1} * EmRate)}$$

Conversion factor:
$$PPConv_{h,m,tou} = \text{Max} \left(1, \left(\frac{ImpHRF_{h,m,tou}}{ImpHRH_{h,m-12,tou}} \right) \right)$$

Estimated LMP:
$$= ImpHR_{i,t-1} * PPConv_{h,m,tou} * \left(NatGasF_{l,t} + GasTrans_{l,m-1} + (GHGas_{m-1} * EmRate) \right)$$

Opportunity cost model: other input variables

- **Estimated proxy start-up and minimum load costs**
 - Uses future gas prices, and
 - most recent months' costs for other costs included in the commitment cost calculation (i.e greenhouse gas, major maintenance adder, O&M, and GMC costs)
- **Estimated DEB curves**
 - MW weighted average DEB
- **Masterfile characteristics**
 - P_{min} , P_{max}
 - Minimum up and down times
- **Use plan limitations**

Opportunity cost model: limitation types

- **Start-up** limitations: Estimated foregone profits if resource had one less start
 - Profit of n^{th} most profitable start
 - Reflected in bid for start-up cost
- **Run-hour** limitations: Estimated foregone profits if resource had one less run-hour
 - Profit of n^{th} most profitable hour
 - Reflected in bid for minimum load cost
- **Energy** limitations: Estimated foregone profits if resource had one less MWh to generate
 - Profit of n^{th} most profitable MWh
 - Reflected in DEB

Opportunity cost model: limitation applicable period

- **Calendar year:** Calculate an opportunity cost valid for calendar year
- **Rolling 12-month:** Calculate an opportunity cost valid for modeled 12 month period
- **Quarterly:** Calculate an opportunity cost for each quarter
- **Monthly:** Calculate an opportunity cost for each month
- **Daily:** Calculate an opportunity cost for each month
 - Set at the maximum daily opportunity cost of all days within the month

Opportunity cost model: nested limitations

- Limitation of same type (start, run-hour, energy) but differing applicable periods (i.e. annual and monthly)
 - Need to combine to create one opportunity cost which can be reflected in start-up cost bid, minimum load cost bid, or DEB
- If both limitations are binding, opportunity cost for a given period could be over-stated if the two binding opportunity costs were added to generate final opportunity cost that can be reflected in bids
- Opportunity cost should be high enough to ensure resource is dispatched in most profitable intervals

Opportunity cost model: nested limitations

Example resource has 20 starts/month and 140 starts/year

Month	Total Starts	Total Profit
January	10	\$1,000
February	10	\$1,000
March	10	\$1,000
April	10	\$1,200
May	10	\$1,200
June	20	\$4,000
July	10	\$1,500
August	20	\$6,000
September	10	\$1,500
October	10	\$1,200
November	10	\$1,200
December	10	\$1,200
Total	140	\$22,000

Assume:

- 140th most profitable start = \$100
- 20th most profitable start in June = \$500
- 20th most profitable start in August = \$800

Three potential options:

1. Sum all non-zero for all months:
\$1400 valid Jan – Dec

2. Sum annual and monthly by month:
\$100 Jan – May, July, Sept – Dec
\$600 June
\$900 July

3. **Max annual and monthly by month:**
\$100 Jan – May, July, Sept – Dec
\$500 June
\$800 July

Page 21 should read: “the opportunity cost in August is the maximum of the annual (\$100) and monthly opportunity cost for **August(\$800).**”

Opportunity cost model: scheduled runs

- Run the model in December for upcoming calendar year
- Monthly scheduled runs of model
 - Reflect *actual usage* of resources and changes in future prices

Limit applicability	Current year Dec	Calendar year limitations are applicable				
		Jan	Feb	Mar	Apr	May . . . Dec
Daily and Monthly	Model Jan - Dec					
		Model Feb - Dec				
			Model Mar - Dec			
Quarterly	Model Jan - Dec					
		Model Feb - Dec				
			Model Mar - Dec			
Annual	Model Jan - Dec					
		Model Feb - Dec				
			Model Mar - Dec			
Rolling 12-months	Model Jan - Dec					
		Model Feb - Jan				
			Model Mar - Feb			

Where

	Binding
	Binding, subject to updates
	Advisory

Opportunity cost model: scheduled runs

- During scheduled runs, the limitations used in the model need to be updated to reflect the remaining starts, run-hours, or output for the modeled period
 - three options were presented at the technical workshop and previous Market Surveillance Committee meeting
- Limitations used in the model throughout the year (or limitation period) will reflect actual usage of the resource
 - For example, the model run for March – December will reduce the start limitation by the number of times the resource was actually started in January and February
- Scheduling coordinators (SCs) can communicate to the ISO any usage of the resource not captured by ISO data that reduces the remaining limitations

Opportunity cost model: outputs

- Opportunity cost adder for start-up, run hours, or output
 - Start-up cost bids can reflect up to 100% of opportunity costs due to limitations on starts
 - Minimum load bids can reflect up to 100% of opportunity costs due to limitations on run hours
 - Opportunity costs due to limitations on output will be added to the resource's DEB
- Upon completion of each model run, ISO will provide a summary to SCs
 - Estimated usage of each limitation
 - Calculated binding and advisory opportunity costs for each limitation

Negotiated Opportunity Costs

- Use-limited resources that the ISO will not be able to model
 - Submit to ISO through the registration process an opportunity cost for each limitation and a methodology showing how it was determined
 - ISO will review submitted documentation and approve, or work with market participant to approve, an opportunity cost
- Updated negotiated opportunity cost
 - Resources can submit updated opportunity costs on a monthly basis
 - Must describe what factors have changed to warrant an updated opportunity cost
- Amending ISO tariff to allow the ISO to review and propose modifications to existing negotiated default energy bids

Multi-stage generating resources

- Applies to both modeled and negotiated opportunity costs for MSG resources
- Limitations may apply to a collective resource or individual configurations
- **Collective resource:** opportunity cost can be reflected in start-up cost bids (start limitations), minimum load cost bids (run-hour limitations), or the DEB (energy limitations) of all configurations
- **Configuration level:** opportunity costs by configuration
 - Start limitation opportunity costs: reflected in start-up cost bids and transition costs *to* the configuration, for each configuration.
 - Run-hour limitation: Opportunity costs reflected in minimum load cost for configuration, for each configuration
 - Energy limitation: Opportunity costs reflected in DEB for configuration, for each configuration

Resource adequacy availability incentive mechanism

- **RSI developed two outage cards specific to use-limited resources**
- **Use-limited reached:** When resource has reached its use limit, it can submit an outage card and be exempt from RAAIM
- **Short-term use-limited reached:** Resources can manage use limitations by submitting outage card to allow them to stop bidding and be exempt from RAAIM
 - Intended as an interim outage card until opportunity costs implemented
 - ISO is proposing to retain short-term use-limited reached card for a transition period after opportunity cost is implemented

Next steps

- Submit written comments on the Straw Proposal and discussion to initiativecomments@caiso.com by close of business September 8, 2015
- Draft Final Proposal late September
- Questions following the call can be submitted to email provided above