Real Time Market Parameter Settings: Analytic Results

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Objectives of Case Study

- Study scheduling and pricing outcomes under the uneconomic adjustment parameters proposed for the Real Time Market.
- Focus on relaxation of power balance constraint and flowgate transmission constraint and their interactions in the Real Time Dispatch.

Real-Time Dispatch (RTD)

- RTD is an energy-only real-time dispatch with a security constrained economic dispatch (SCED) engine, observing network transmission constraints and individual resource inter-temporal constraints.
- RTD is executed every 5 minutes with optimization horizon comprised of 7 five-minute intervals.
- Non-participating loads are modeled as fixed at the forecast level.
- Distributed load slack is employed in SCED formulation.
- LDF-weighted average of LMPs across all load buses equals the energy component of LMPs at different nodes. We call this quantity the **System Energy Price** here.

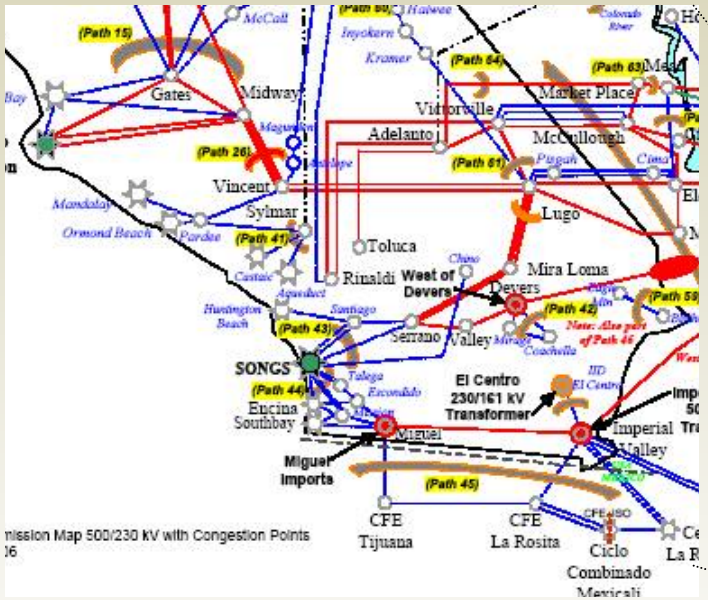
Proposed Uneconomic Adjustment Parameters for Real Time Market

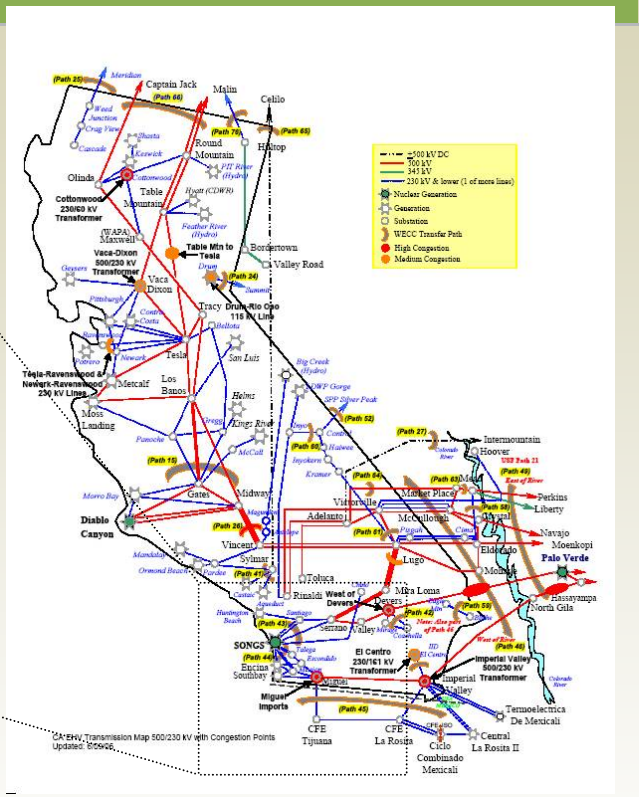
Constraint Type	Scheduling Run Penalty Price	Pricing Run Pricing Parameter
Power Balance	$6500 Previously $45000	$1500 Unchanged
Flowgate	$5000 Unchanged	$1500 Unchanged

Design of Test Cases to Evaluate the Functioning of Proposed Parameter Values

- Raise the Load forecast for the first five-minute interval within the optimization horizon, to exceed the available energy supply capacity.
- Enable one transmission flow constraint, namely, the North of SONGS branch group between SCE and SDGE service areas; disable all other transmission constraints.
- Disable individual resource ramping constraints.
- Perform the study using pricing run pricing parameters as proposed, and zero values as alternatives for comparison.

NSONGS Branch Group and its Proximity





- North of SONGS (NSONGS) branch group comprised of four 230-kV lines between SCE and SDGE service areas.
- Transmission capability of NSONGS is set to its normal limit value in both directions for this study.

Four Study Cases

Load exceeds generation supply for all cases.

Case #	NSONGS Flowgate Constraint Enabled (Y/N)	Pricing Run Parameter of Power Balance Constraint	Pricing Run Parameter of Flowgate Constraint
1	N	0	NA
2	N	1500	NA
3	Y	1500	0
4	Y	0	1500

Results of Test Case 1 Shows the Marginal Economic Bid Setting the System Energy Price

Scenario: Load exceeds generation supply; transmission constraint disabled, $0 as pricing parameter for power balance constraint

- Power Balance constraint must be relaxed: slack variable for power balance is "dispatched" to a positive value to meet system load.
- All generators are dispatched at their maximum levels, and MW flow through NSONGS branch group is from south to north.
- Energy bid prices ≤ $132.96. Loss Penalty Factors of Econ Bids ≤ 1.13
- System Energy Price = $140.22 set by generator with highest product of bid price times loss penalty factor, i.e., the marginal resource in the pricing run.
- LMP at any location = System Energy Price / Loss Penalty Factor;
  LMP Congestion Component = $0 for all locations

Location	LMP
Bay Area	$139.30
North of NSONGS	$132.46
South of NSONGS	$127.66

Results of Test Case 2 Shows the Pricing Run Parameters Setting the System Energy Price

Scenario: Load exceeds generation supply; transmission constraint disabled; $1500 as pricing parameter for power balance constraint

- Same observations as Case 1 for scheduling run.
- System Energy Price = $1500 in pricing run, set by the pricing parameter.
- LMPs are scaled up by the ratio of $1500 and the energy price of previous case.

Location	LMP
Bay Area	$1490.16
North of NSONGS	$1416.99
South of NSONGS	$1365.64

Results of Test Case 3 Shows the $0 Pricing Parameter for Transmission Not Changing the System Energy Price

Scenario: Load exceeds generation supply; transmission constraint enabled; $1500 as pricing parameter for power balance constraint; $0 as pricing parameter for flowgate transmission constraint

- With higher penalty price in scheduling run, enforcing power balance constraint takes precedence over flowgate transmission constraint in scheduling run.
- In addition to the relaxation of power balance constraint, NSONGS transmission constraint is also relaxed to accommodate all available power from SDGE area to serve CAISO load.
- Shadow price of relaxed transmission constraint is $0 in pricing run resulting from a) $0 pricing parameter, and b) all resources dispatched at maximum levels, so that no system cost reduction can be achieved by further increasing transmission capability of this branch group.
- System Energy Price = $1500 set by the pricing parameter of power balance, same as case 2.
- LMPs are identical to case 2.

Results of Test Case 4 Shows the Standalone Effect of Transmission Pricing Parameter on System Energy Price

Scenario: Load exceeds generation supply; transmission constraint enabled; $0 as pricing parameter for power balance constraint; $1500 as pricing parameter for flowgate transmission constraint

- Shadow price of the relaxed transmission constraint is $1500 in pricing run, resulting in an LMP differential across the transmission constraint
- System Energy Price = $1471.32, slightly below case 3. A generator in south of constraint becomes marginal in the pricing run.
- With both pricing parameters at the proposed $1500, it is expected that System Energy Price = $1500 set by the power balance pricing parameter, while LMP differential remains approximately at $1500 across the branch group.

Location	LMP
Bay Area	$1461.76
North of NSONGS	$1495.48
South of NSONGS	$109.59

Conclusions

- Consider the disabling of ramping constraint. Consider $500 for energy bid cap. With $0 pricing run parameter for power balance constraint and $1500 for flowgate transmission constraint, System Energy price under energy supply deficiency can rise to approximately $2000 due to transmission relaxation but could be less than $1500, depending on the locations of relaxed transmission constraints and the economic bids behind the constraints.
- With $1500 pricing run parameter for energy balance constraint, System Energy price will be at least $1500 under energy supply deficiency.