California ISO
Shaping a Renewed Future

Briefing on proposed energy imbalance market benefit methodology

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Measure EIM Benefit

- EIM benefit equals the economic surplus gain (or cost saving) of having EIM
  - Measured by the difference in the economic surplus (or bid cost) between the EIM dispatch and without the EIM (counterfactual) dispatch
  - The benefits are attributable to various sources
    - EIM energy transfers
    - New participating resources
    - More efficient market clearing and congestion management
    - Flex ramp sharing and flex ramp transfers

Without EIM dispatch

- Counterfactual without EIM dispatch
  - Run the EIM market clearing engine with modifications:
    - Disallow EIM transfers
    - Do not dispatch new participating resources
    - Limit the dispatchable resource pool to those currently dispatched by the BAA operator, if known
    - Penalize dispatch deviations from base schedules by adding penalty cost to the objective function
    - Reset flexibility requirement to the regional level
  - Expected outcome
    - No EIM transfer or new participating resource is cleared
    - Base schedules cannot economically clear against each other
    - Transmission overloads from base schedules are relieved by the most physically effective resources
    - EIM Load is served by generation economic merit order without overloading transmission
    - Each region supplies its own flex ramp

Total and regional EIM benefit

- Total EIM benefit
  - Total economic surplus of EIM minus total economic surplus of counterfactual

    = change in the total bid cost of dispatch with and without EIM
- Regional EIM benefit
  - Regional (BA level) economic surplus of the EIM minus regional economic surplus of the counterfactual

    = change in regional total bid cost of the inc and dec dispatches + energy and flex ramp transfer cost
  - Energy and flex ramp transfers incur cost in the exporting region to serve the importing region, so the cost associated with the transfer cost should be shifted from the exporting region to the importing region
    - Transfer cost = transfer MW x market clearing price

Energy transfers and flex ramp transfer cost

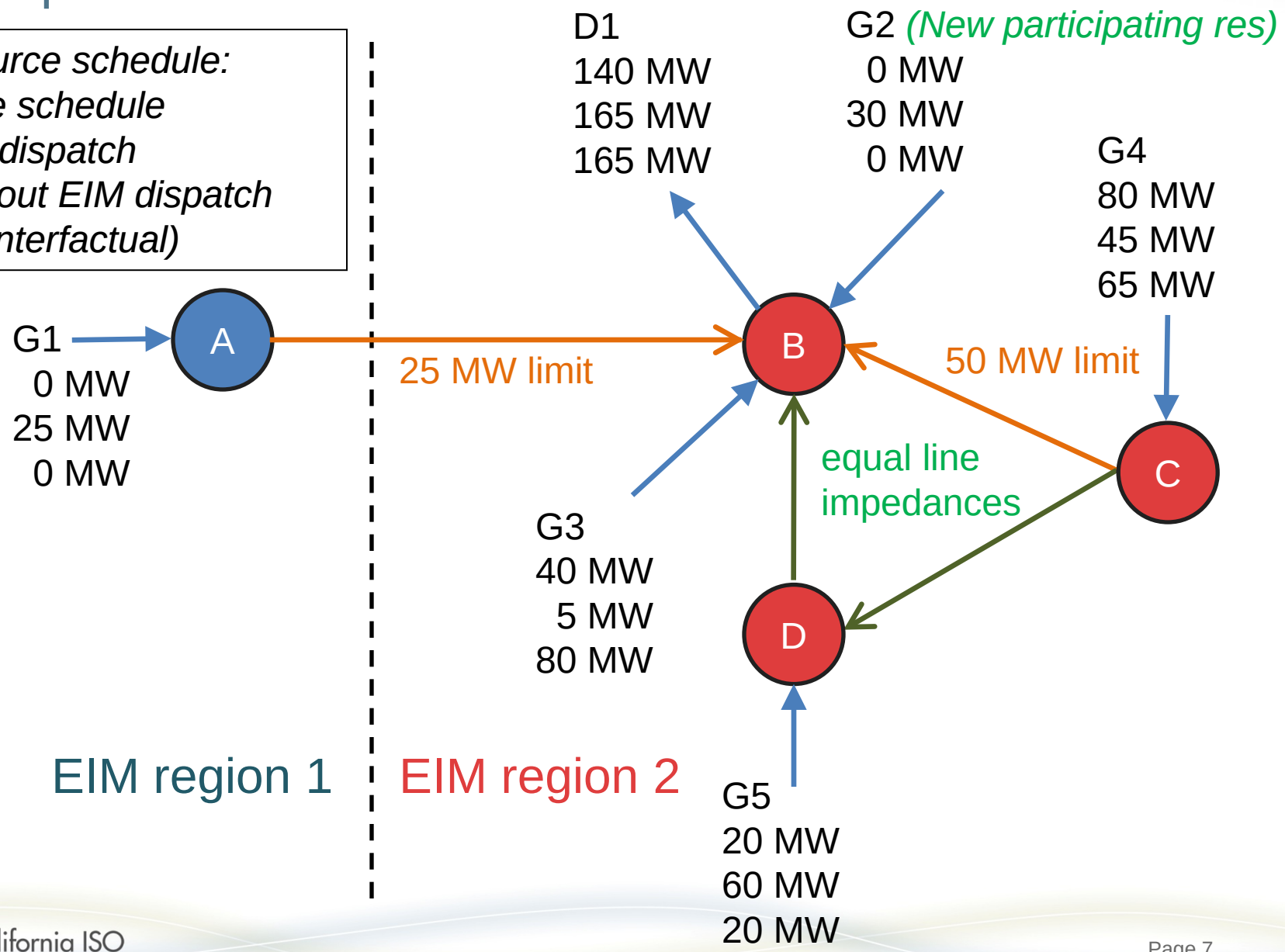
- Calculate energy transfer cost in the EIM dispatch
  - Energy transfer cost = transfer MW x 0.5 x (LMP_{IMP}+LMP_{EXP})
  - Importing transfer MW > 0, exporting transfer MW < 0
  - CAISO-PAC transfer price = LMP_{MALIN}+0.5 x $SP_{CAISO\text{-}PAC}$
  - PACW-PACE transfer price = LMP_{HMWY}+0.5 x $SP_{PACW\text{-}PACE}$
- Calculate flex ramp transfer cost in the EIM dispatch
  - Flex ramp transfer cost = allocated flex ramp cost – flex ramp award payment
  - Example:
    - System wide 100 MW flex ramp cleared at $1, with region 1 total awards = 70 MW and region 2 total awards = 30 MW
    - Individual regional requirement 60 MW each, so allocated flex ramp cost pre region = $50 based on 60/60 ratio
    - Region 1 flex ramp transfer cost = $50 – $70 = –$20
    - Region 2 flex ramp transfer cost = $50 – $30 = $20

Calculation details

- EIM benefits will be calculated for the FMM, not the 5-minute RTD to make it practical to automate these calculations
- A standard alone environment will be used to take production EIM cases and automatically rerun the case with the modifications for the without EIM case
- The difference between with- and without-EIM dispatch, and the associated difference in bid cost, will be calculated for every resource
- Calculate the transfer cost for EIM transfers and flex ramp transfers based on EIM results
- For each region, sum up the total change in bid cost, sum up the transfer cost, and add them together
- Negative total value indicates cost saving benefit

Example

Resource schedule:
- *Base schedule*
- *EIM dispatch*
- *Without EIM dispatch (counterfactual)*



EIM and Without EIM market clearing results

Energy

Res.	BAA	Type	Capacity	EIM bid price	Base sched	EIM sched	CF sched	Delta sched	Delta bid cost
G1	1	Gen	35	$0	0	25	0	+25	0
G2	2	NPR	30	$35	0	30	0	+30	1050
G3	2	Gen	90	$110	40	5	80	–75	–8250
G4	2	Gen	80	$20	80	45	65	–20	–400
G5	2	Gen	80	$60	20	60	20	+40	2400
D1	2	Load	N/A	$1000	–140	–165	–165	+0	0

Flex ramp

Res.	BAA	Type	Ramp capacity	EIM award	EIM price	EIM payment	EIM cost allocation	Transfer cost
G1	1	Gen	35	10	$5	$50	$100	$50
G2	2	NPR	5	0	$5	$0	$100	–$50
G3	2	Gen	5	5	$5	$25		
G4	2	Gen	5	5	$5	$25		
G5	2	Gen	40	20	$5	$100		
Tot.				40	$5	$200	$200	$0

Regional EIM benefits

Region 1

Res.	BAA	Type	EIM bid price	EIM sched	CF sched	Delta sched	Delta bid cost
G1	1	Gen	$0	25	0	+25	0
ET-exp	1	En Transfer	$55	–25	0	–25	–1375
RT-imp	1	Flex ramp Transfer					50
Total	1	BAA		0	0	0	–1325

Region 2

Res.	BAA	Type	EIM bid price	EIM sched	CF sched	Delta sched	Delta bid cost
G2	2	NPR	$35	30	0	+30	1050
G3	2	Gen	$110	5	80	–75	–8250
G4	2	Gen	$20	45	65	–20	–400
G5	2	Gen	$60	60	20	+40	2400
D1	2	Load	$1000	–165	–165	0	0
ET-imp	2	En transfer	$55	25	0	+25	1375
RT-exp	2	Flex ramp Transfer					–50
Total	2	BAA		0	0	0	-3875

Summary

- The method systematically calculates EIM benefit for each region
  - Measured by economic surplus gain = cost saving
  - Calculated by comparing the dispatch cost difference between the EIM dispatch and a counterfactual without EIM dispatch
  - Costs (MW x price) associated with EIM energy transfers and flex ramp transfers are shifted from the exporting region to the importing region
- The ISO plans to do this calculation based on the FMM