Meeting Operating Reserves Requirements at the Lowest Cost

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FERC Orders Regarding Self-Supply

The ability of LSEs to self-supply their share of the ISO's operating reserves requirements using resources west of the Central East interface has been the subject of several FERC orders.

- **On May 31, 2000, FERC ordered the ISO "to consider ways of allowing generation in the west to self-supply if they acquire sufficient transmission capacity to deliver capacity and energy to the east."**
- **On July 1, 2003, FERC noted that it has "consistently emphasized that customers must be allowed to self-supply their own operating reserves…. Indeed, we previously directed the NYISO to devise a plan that would permit its customers to self-supply their own operating reserves, and we find that the NYISO must comply with our prior directive in that regard."**

Separating the Issues

Progress in response to these orders has been delayed, in part, because several issues that relate to the self-supply of OR have become entangled. They must be disentangled, because each can be addressed independently.

- **One issue is billing and accounting changes.**
  - ***These would facilitate hedging by explicitly recognizing self-supply and modifying invoices, credit requirements, etc., for LSEs that have self-supplied their share of OR requirements.***
  - ***They also might change the allocation of costs incurred to meet locational OR requirements.***
- **A separate issue relates to the procedures used to determine locational OR requirements and select the resources used to meet those requirements, and the impact of those procedures on the ISO's ability to meet locational OR requirements at the lowest possible cost.**

Financial Solution

The ISO has proposed a “financial” solution to the self-supply of operating reserves, which is the approach that the ISO applies to the self-supply of energy. Under this approach:

- **The ISO determines all energy and A/S schedules based on bids received from market participants.**
- **It reduces the net amount due from each LSE to reflect the value of resources that LSE is self-supplying to meet its share of the ISO’s requirements.**

Limitations of Financial Solutions

A financial solution could facilitate self-supply.

- **Under this approach, an LSE that has self-scheduled resources to meet precisely its share of each A/S requirement would receive a net bill of zero, permitting it to achieve the financial equivalent of self-supply.**

A financial solution also could change the current procedures for allocating costs associated with locational OR constraints among loads in different parts of the NYCA, if desired.

But it is hard to see how a financial solution could ensure that the ISO meets OR requirements at least cost.

- **Financial solutions will not change the net amount of energy or OR that each resource in the system is scheduled to provide in the DAM, so they cannot render suboptimal schedules optimal.**

Determination of OR Requirements

There are two sets of concerns regarding the way that the ISO sets OR requirements.

- **First, OR requirements are set based on the largest contingency.**
  - ***However, that contingency may not apply to a particular hour. It is not appropriate, for example, to set OR requirements for an hour based on a Bowline contingency when Bowline is not scheduled to operate.***
  - ***Even if that contingency applies for a given hour, it may not be appropriate to use that contingency to set some or all locational OR requirements.***
- **Second, locational OR requirements are set under the assumption that the relevant transmission interfaces are fully loaded.**
  - ***The energy and OR schedules that result from this procedure may be suboptimal.***
  - ***This presentation focuses on such cases.***

Determination of Locational OR Requirements

In particular:

- **When energy schedules do not cause the interfaces leading into a region to be fully loaded, it should be possible to reduce locational OR requirements.**
  - ***This may permit a reduction in OR costs.***
- **Additionally, in some cases, it may be possible to reduce the total cost of the dispatch by increasing energy schedules downstream of the interface and reducing energy schedules upstream.**
  - ***This will increase energy costs, but the reduction in the flows across the interface will permit locational OR requirements to be relaxed.***
  - ***The resulting decrease in OR costs may more than offset the increase in energy costs.***

I will present an example illustrating each of these cases.

Assumptions for Example

Consider an example in which we have:

- **A 200 MW closed interface, with one 600 MW generator on each side of the interface.**
  - ***Gen. W is on the west side of the interface, and Gen. E is on the east side.***
- **A single category of operating reserve, and a requirement for 200 MW of that category of operating reserve.**
  - ***Of that 200 MW, 100 MW of OR must be located to the east of the interface when the interface is fully utilized to transmit energy.***
  - ***Consequently, the minimum eastern OR requirement would be set at 100 MW under the current procedures.***
- **The following bids by generators to provide energy and OR:**
  - ***$30/MWh for energy and $1/MW for OR for Gen. W.***
  - ***$31/MWh for energy and $10/MW for OR for Gen. E.***

Assumptions for Example (cont.)

Also assume that:

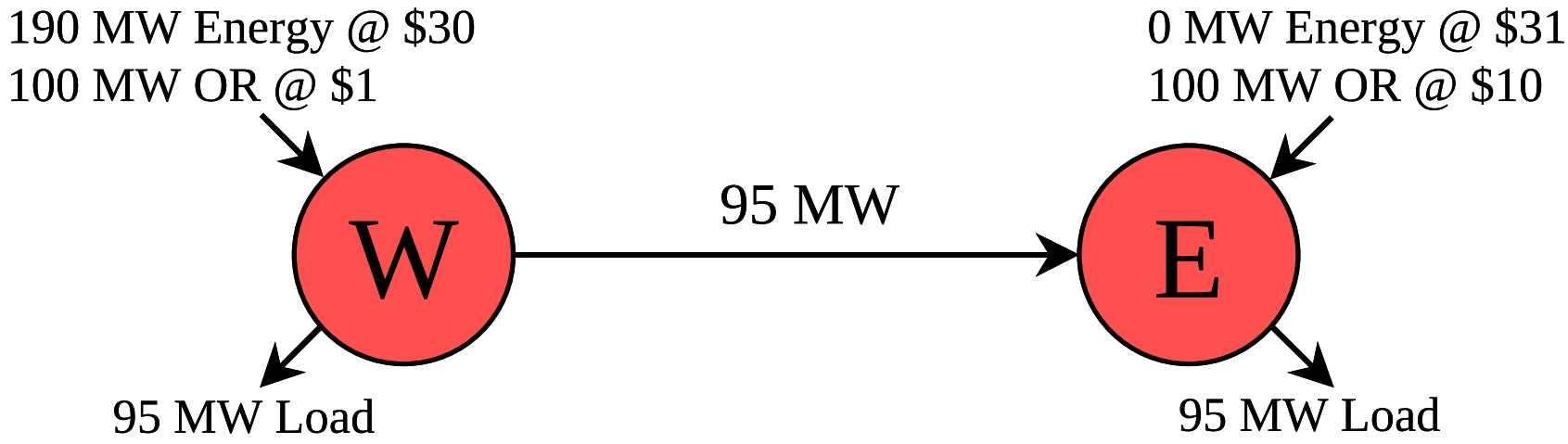
- **Each generator's minimum generation level is zero.**
  - ***This permits us to avoid issues relating to commitment, as we can effectively commit all generators costlessly.***
- **There are no losses, start-up costs, requirements for A/S other than OR, outages, or other complicating factors.**
- **Ramp rates do not limit the amount of OR each generator can provide.**

Contingency analysis will also be ignored.

DAM Example 1: Current Procedures

Initially, assume 95 MW of load are scheduled at both W and E in the DAM.

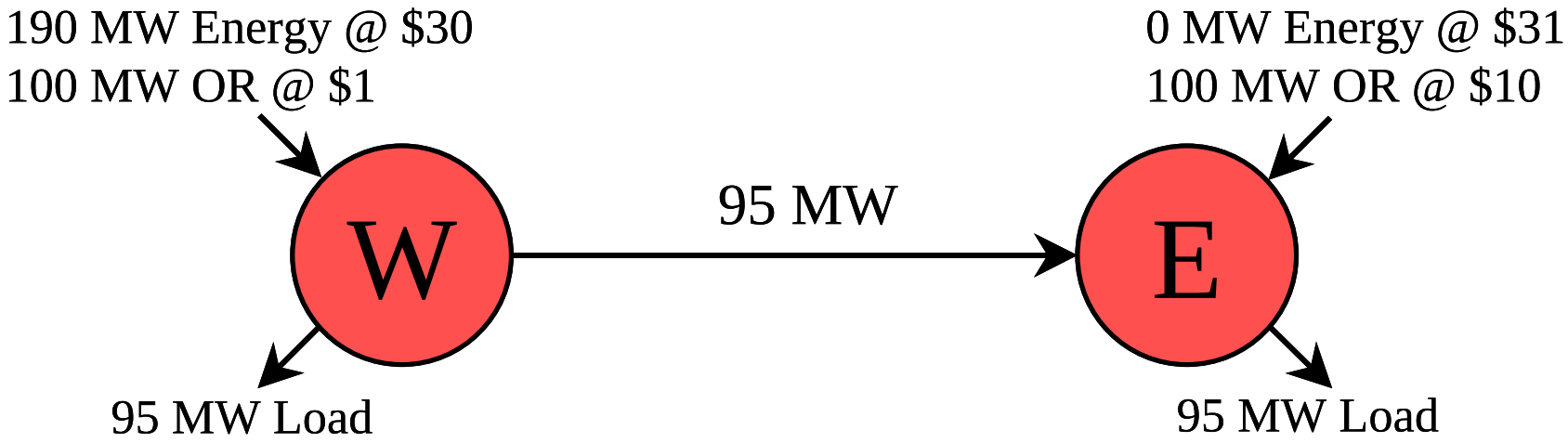
- **Under current procedures, the minimum eastern OR requirement is 100 MW.**
- **Therefore, Gen. W will be scheduled to provide 190 MW of energy, and Gens. W and E will each be scheduled to provide 100 MW of OR, as shown below.**



DAM Example 1: Cost Using Current Procedures

The total bid production cost of the DAM schedule below is $6800.

- **Gen. W's bid production cost is (190 MW x $30/MWh) + (100 MW x $1/MW) = $5800.**
- **Gen. E's bid production cost is 100 MW x $10/MW = $1000.**



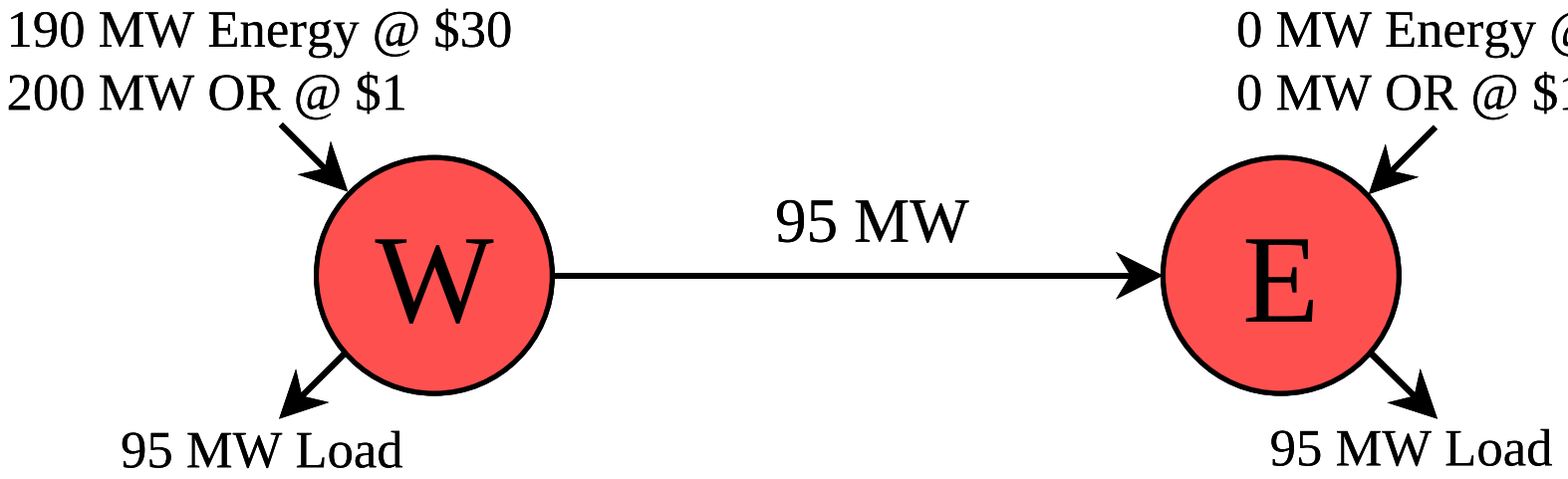
Proposed Modification to Current Procedures

Suppose instead that the ISO did not require at least 100 MW of OR to be located in the east.

- **Instead, suppose the rule were modified to permit this requirement to be relaxed if room is available on the interface after taking energy schedules into account.**
- **Because only 95 MW are flowing over the interface, this means that the minimum eastern OR requirement could be reduced by up to 200 MW – 95 MW = 105 MW.**
- **Since the eastern OR requirement is only 100 MW, this means that the minimum eastern OR requirement can be eliminated.**

DAM Example 1: Modified Procedures

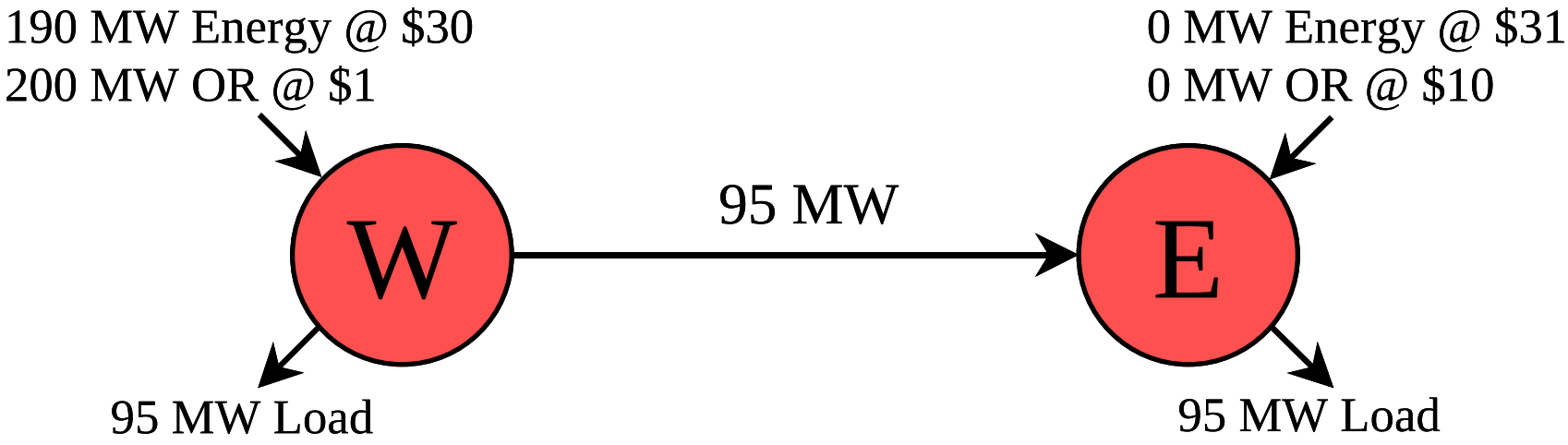
This change to the procedures for setting locational OR requirements would have permitted the ISO to schedule Gen. W to provide all 200 MW of OR, while Gen. E is not scheduled to provide any OR.



DAM Example 1: Cost Using Modified Procedures

This DAM schedule has a total bid production cost of only $5900, $900 below the bid production cost that results using the ISO's current procedures.

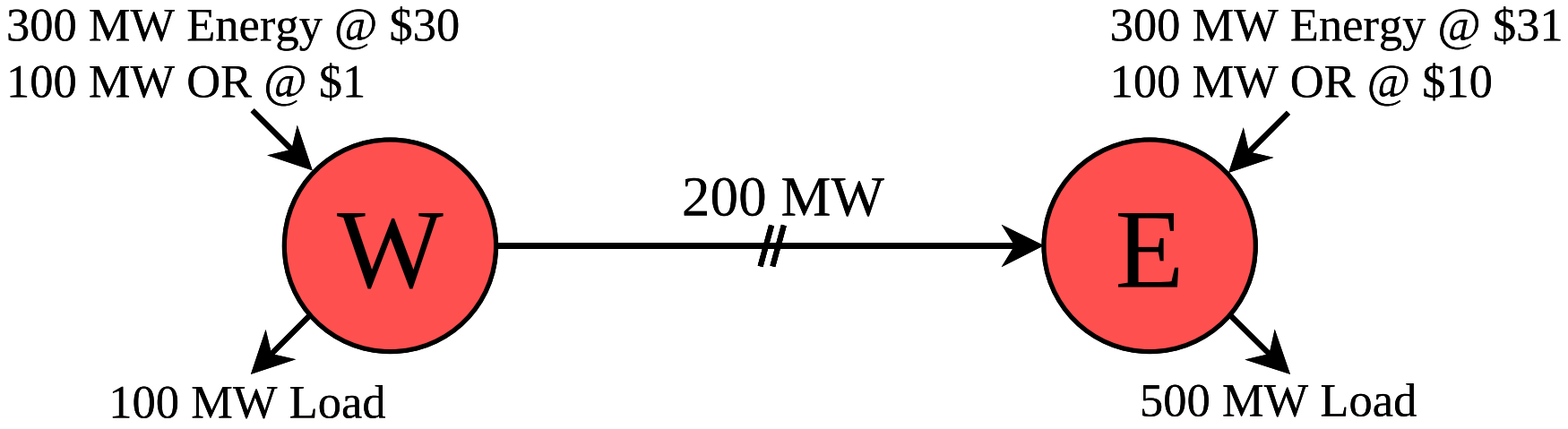
- **Gen. W's bid production cost is (190 MW x $30/MWh) + (200 MW x $1/MW) = $5900, while Gen. E's bid production cost is zero.**
- **Shifting OR from Gen. E to Gen. W saved $9 for each MW shifted.**



DAM Example 2: Current Procedures

Current procedures for determining locational OR requirements also may cause an above-optimal amount of energy to be scheduled upstream of binding interfaces.

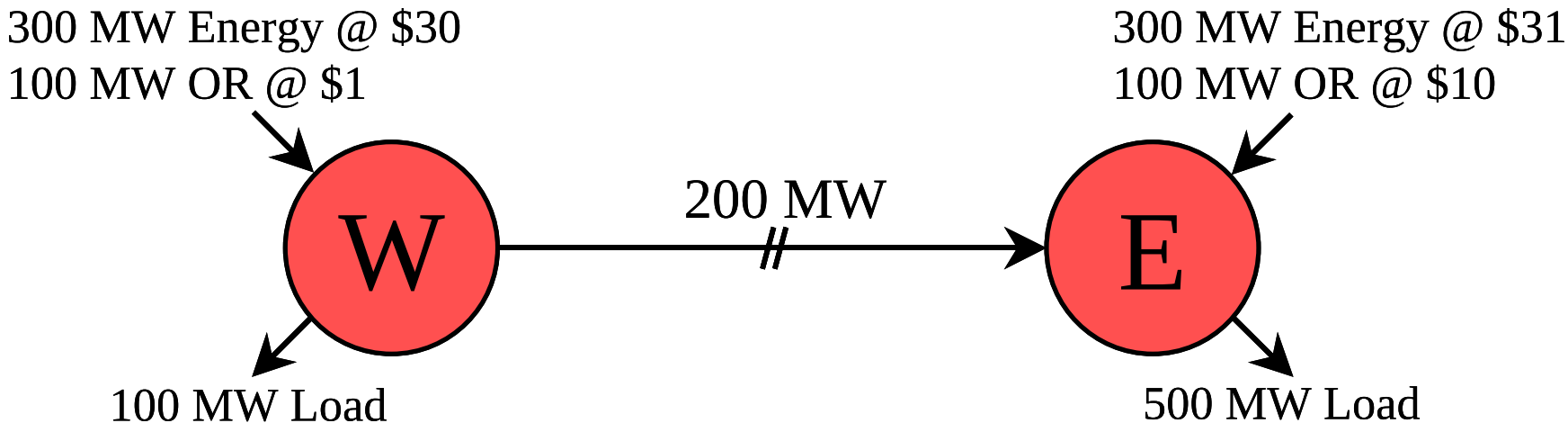
- **In the DAM, assume that 100 MW of load are scheduled at W and 500 MW are scheduled at E.**
- **In that case, Gens. W and E each will be scheduled to provide 300 MW of energy and 100 MW of OR, as shown below.**



DAM Example 2: Cost Using Current Procedures

The total bid production cost of the DAM schedule below is $19,400.

- **Gen. W's bid production cost is (300 MW x $30/MWh) + (100 MW x $1/MW) = $9100.**
- **Gen. E's bid production cost is (300 MW x $31/MWh) + (100 MW x $10/MW) = $10,300.**



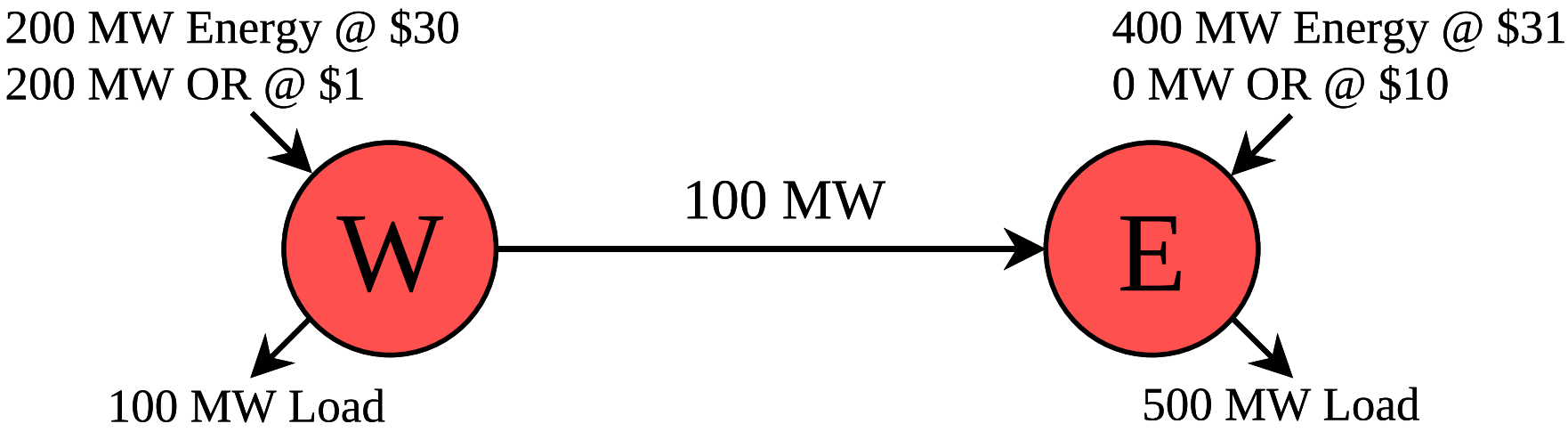
Additional Modification to Current Procedures

Suppose that the procedure for determining locational OR requirements were modified further, to permit energy schedules to be changed if doing so decreases the total bid production cost of the DAM schedule.

- **This rule still would permit the ISO to schedule 100 MW of OR in the east if that was the most economic solution.**
- **But this rule would permit the ISO to schedule OR in the west and back down energy scheduled to flow over the interface, if that would lower costs.**

DAM Example 2: Modified Procedures

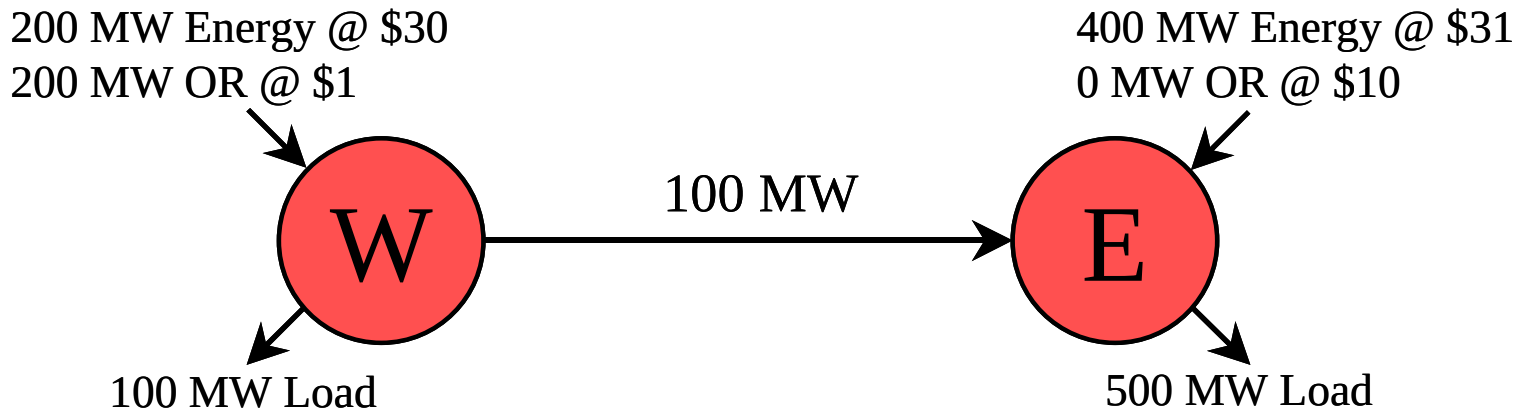
In this example, this rule would have permitted the ISO to schedule Gen. W to provide all 200 MW of OR, if it reduces the amount of energy scheduled to flow over the interface by 100 MW.



DAM Example 2: Cost Using Modified Procedures

This DAM schedule has a total bid production cost of only $18,600, $800 below the bid production cost that results using the ISO's current procedures.

- **Gen. W's bid production cost is (200 MW x $30/MWh) + (200 MW x $1/MW) = $6200, while Gen. E's bid production cost is (400 MW x $31/MWh) + (0 MW x $10/MW) = $12,400.**
- **Each MWh of energy generated by E instead of W costs $31 – $30 = $1/MWh, but by permitting an additional MW of OR to be provided by W, it saves $10 – $1 = $9/MWh, for a net saving of $8/MWh.**



Real-time Market

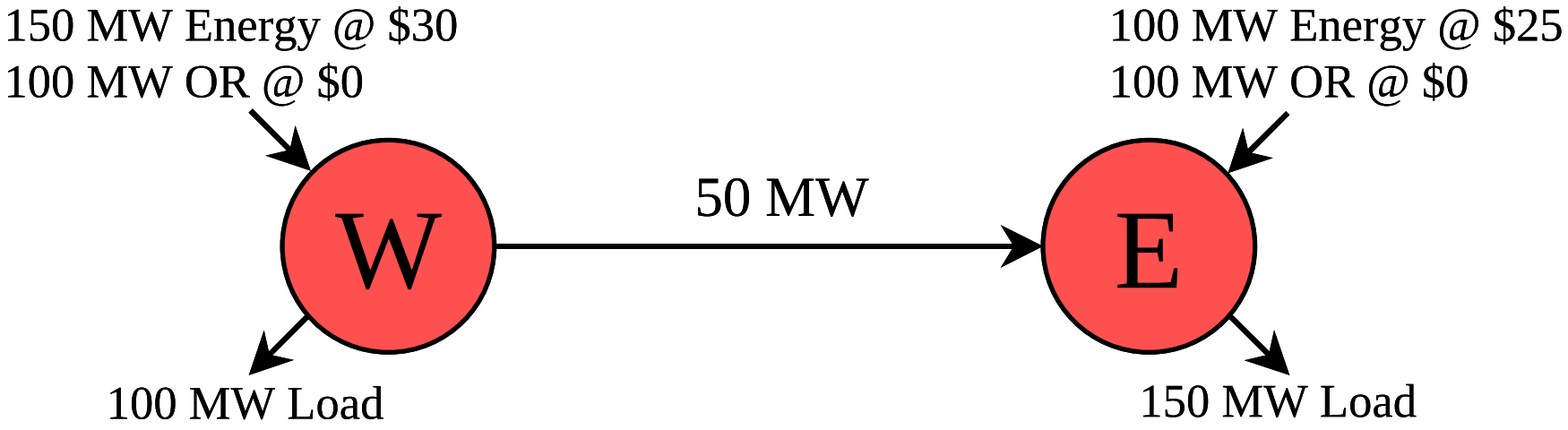
The benefits to modifications in these procedures are not limited to the DAM.

- **It would also be possible to reduce costs in the RTM, if procedures for determining locational OR requirements were modified to permit reduction of energy output upstream of a constraint if doing so leads to a decrease in overall bid production costs.**

RTM Dispatch Using Current Procedures

Assume there are 100 MW of load at W and 150 MW of load at E, and suppose that we replace Gen. E with a 200 MW generator with a $25/MWh incremental energy bid.

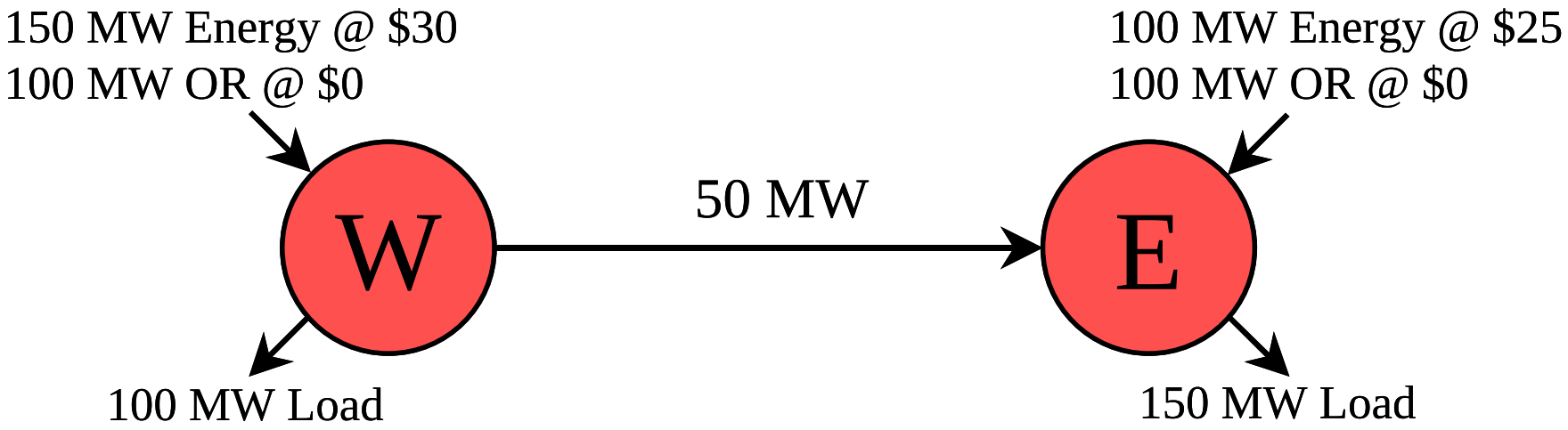
- **Also assume all OR availability bids have been set to zero, since this is the RTM.**
- **Under current procedures, Gen. W will produce 150 MW of energy and 100 MW of OR in the RTM, and Gen. E will provide 100 MW of energy and 100 MW of OR.**



Cost of RTM Dispatch Using Current Procedures

The total bid production cost of the RTM dispatch below is $7000.

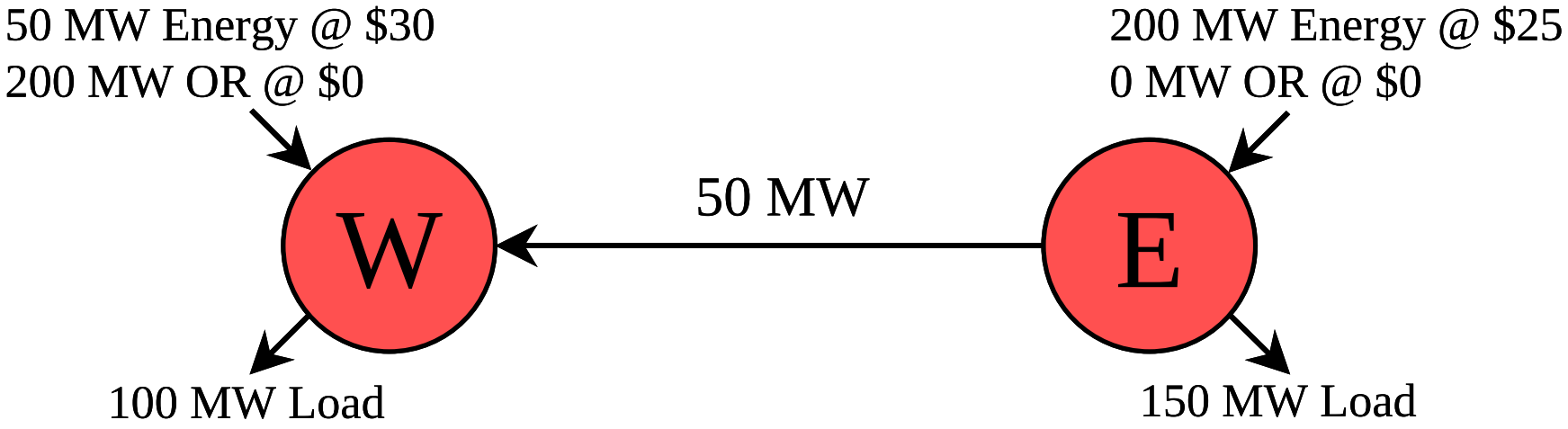
- **Gen. W's bid production cost is 150 MW x $30/MWh = $4500.**
- **Gen. E's bid production cost is 100 MW x $25/MWh = $2500.**



RTM Dispatch Using Modified Procedures

The total bid production cost of the dispatch could be reduced by modifying the procedure used to calculate locational OR requirements.

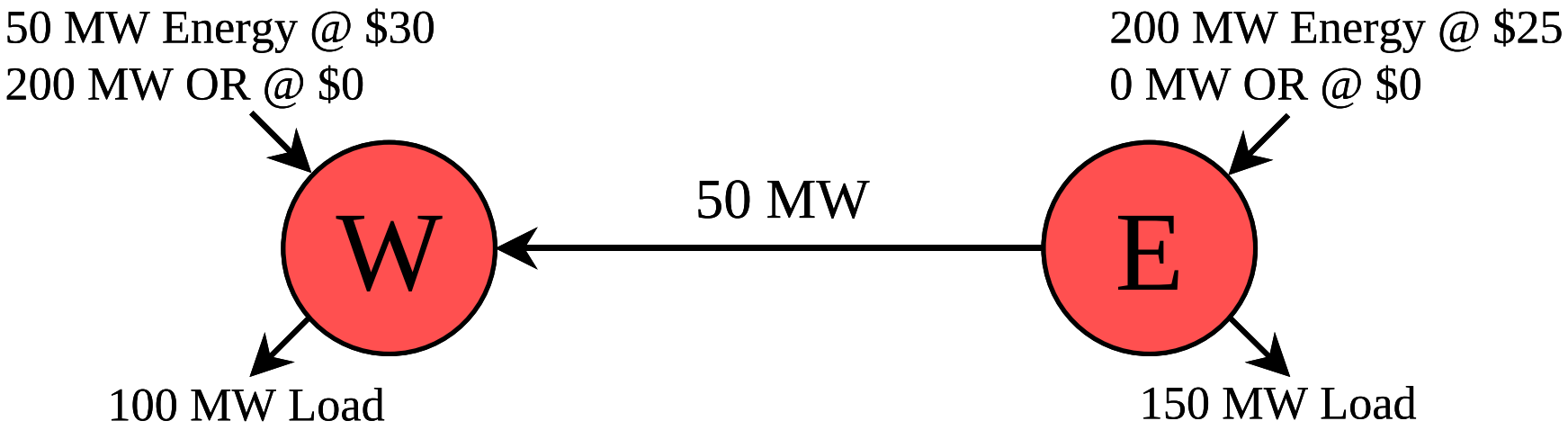
- **Permitting Gen. W to provide all 200 MW of OR, instead of requiring 100 MW to be provided by Gen. E, would permit Gen. E to provide an additional 100 MW of energy.**
- **The W-to-E flows that result from this redispatch are far below the W-to-E limit (in fact, the flows are from E to W), so there is no need for a separate minimum eastern OR requirement given these flows.**



Cost of RTM Schedule Using Modified Procedures

This RTM dispatch has a total bid production cost of only $6500, $500 below the bid production cost resulting from the ISO's current procedures.

- **Gen. W's bid production cost is 50 MW x $30/MWh = $1500, while Gen. E's bid production cost is 200 MW x $25/MWh = $5000.**
- **A $30 – $25 = $5/MWh increase in cost resulted from backing down Gen. E to provide OR instead of backing down Gen. W. By permitting Gen. E to be dispatched up, $5/MW x 100 MW = $500 are saved.**



Ability to Modify Dispatch/Scheduling Programs

We see two potential objections to this proposal.

One is that it would be too difficult to make the program modifications necessary to change the determination of locational OR requirements so that they can be met at least cost.

- **The ISO has asserted this in the past, but the ISO should provide additional support for its assertion.**
- **My experiments with LPs that calculate the most efficient schedules for small examples such as this indicate that it is easy to convert a program that produces the less efficient results (corresponding to the examples in which the locational OR requirement was fixed) into a program that produces the more efficient results.**

Changes Needed to Model

The only changes I needed to make to the LP that produced the less efficient results were to:

- **Add a variable calculating the maximum amount that western resources can contribute towards the eastern OR requirement, which is set equal to the maximum flow limit over the interface minus flows that would occur over the interface given DAM energy schedules and load forecasts; and**
- **Replace a constraint which forbids western resources from contributing to the eastern OR requirement with a constraint that limits the sum of the contributions of such resources to the eastern OR requirement with the contribution limit described above.**

Some modification of this approach would be required in the case of open interfaces, since each MW of room on such interfaces would permit more than one MW of OR to be supplied upstream of the interface.

Cost-Benefit Comparison

The other potential objection is that while this proposal would yield benefits, they would be small and would be outweighed by the cost of development and implementation.

- **Again, some support should be offered for any such assertion.**