Stakeholder Comments

Flexible Ramping Product Cost Allocation Straw Proposal

Submitted by	Company	Date Submitted
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Southern California Edison (SCE) respectfully offers these comments on the California Independent System Operator's (CAISO) Flexible Ramping Product (FRP) Cost Allocation Straw Proposal.

In summary, SCE recommends:

- The CAISO should allocate costs on an hourly basis, rather than daily, even if the costs of a particular hour are ultimately averaged monthly. Daily averaging reduces the accuracy of the hourly price-signal, a meaningful metric likely aligned with procurement costs, and forces Flexible Ramping Product (FRP) buyers in cheaper hours to subsidize buyers in more expensive hours.
- Rather than allocating 100% of costs based on deviations/forecast errors, the CAISO should use a two-tiered approach. As the CAISO will typically procure more FRP than is used, i.e., 95% confidence interval vs. 50%, much of the costs derive from purchases to meet large total system FRP needs. Thus allocating all costs to deviations becomes overly punitive to deviating parties. SCE therefore recommends a tiered allocation similar to that used in Residual Unit Commitment (RUC)
    - Similar to RUC, Tier 1cost should be allocated to deviations based on the average monthly cost for that hour to actual deviations.
    - Residual Tier 2 costs (which SCE expects should roughly equate in magnitude to Tier 1 costs), should be allocated to resource classes in a manner reflecting ex-ante procurement. In other words, classes of resources with similar operational or deviation characteristics should incur Tier 2 costs in line with their statistical impact on procurement.
    - SCE provides several possible Tier 2 allocation methods but recommends a variation of the FERC approved Westar allocation model as a preferred starting point for discussion.
- SCE requests clarification/examples for the treatment of interties and PIRP.

1. **SCE agrees with the direction of the settlement procedure but recommends hourly price allocation, rather than daily, to provide superior incentives for corrective action and to eliminate cross-subsidization.**[1]

The current resettlement plan allocates costs based on the average procurement cost for an entire month, across all days and hours. This approach can potentially result in resources bearing costs they did not cause.

For example, a solar resource can only deviate (and thus only drive flexible ramping costs) during daylight hours. Under the monthly resettlement process, however, procurement costs for the off-peak hours (driven by load, wind, and other resources) can be allocated to the solar resource. This structure cannot send proper price signals to resources and seems to unnecessarily stretch the "synchronization" principle. Hourly, rather than daily, measures synchronize costs with causation more appropriately.

The CAISO's proposal dulls incentives for resources to manage their variations in the flexibility-constrained hours more than in the less constrained hours. For example, in a large ramping-hour, such as hour ending (HE) 7, FRP may routinely cost more than in HE1, a non-ramping hour. Resources that cause FRP needs and or deviate from schedule in HE7 should see higher costs than for deviations in HE 1. The monthly resettlement at a system average procurement cost obscures this distinction and important price-signal. The market should encourage market participants to change their costly behaviors and so must distinguish between the high- and low-cost FRP periods.

All resources that drive procurement based on *expected* deviation should incur at least some costs. The current proposal only bills resources based on actual (not expected) deviation. By this, some resources bear costs they did not drive. The CAISO plans to procure enough FRP in each hour to handle 95% of events[2]. By this design, the CAISO routinely procure 45% more FRP than it usually needs. Thus, under the current allocation structure, resources that missed their schedules will almost always shoulder costs that are disproportionately larger than the costs they drove. In fact, there are only two cases in which this will not occur. The first is a scenario in which there are no deviations and the second is where each entity deviates precisely the way which the CAISO estimation predicted. The probability of either of these events occurring is extraordinarily low.

2. **Cost allocation should not go exclusively to deviations but instead should be apportioned in a two-tiered structure based on the statistical basis for procurement.**

When allocating costs to any class of resources/load, the CAISO should follow existing settlement processes of flowing such costs to the Scheduling Coordinator representing the specific resource/load. There may be instances were existing contracts might not have contemplated the allocation of new integrating costs. In such instances, limited grandfathering might be appropriate. However, by establishing proper costs allocation now, future contracts can deal directly with these costs.

[1] SCE is open to alternative approaches, such as settlement over four-hour blocks, but the design should not result in material "cross hour subsidization".

[2] http://www.caiso.com/Documents/RevisedFinalStrawProposal-FlexibleRampingProduct.pdf

To avoid allocation of costs beyond a resource's impact on procurement (despite monthly averaging), SCE believes cost allocation based just on deviations should be limited in certain circumstances. These costs can be deemed as Tier 1 costs. Remaining costs, known as Tier 2 costs, can be allocated based on expected performance. SCE believes that the principles used in Westar's[3] FERC-Approved[4] method to determine how various resource classes impact total portfolio variability (and procurement of integration products) should be applied to the Tier 2 allocation. SCE anticipates such a structure will provide more accurate incentives for parties to better manage deviations, especially in periods where FRP procurement is more expensive.

A basic example illustrates this Two-Tier approach and highlights its ability to provide more meaningful price signals while preventing cross-subsidization of FRP costs across hours.[5]

Example of SCE's Two-Tier Settlement for Flexible Ramping Product

Illustrative Scenario Details

Product	Flexiramp Up
Hour Ending	7
Sum of FR-Up Capacity Procured	300 *MW*
Sum of Deviations During Month	100 *MW*
Sum of FR-Up Capacity Costs	3000 *$*

For simplicity, assume no monthly averaging of the hour rate at this time, even though such a structure could apply. Under SCE's two-tiered methodology, the Tier 1 process allocates costs to parties that deviated in a particular hour at a rate up to the average hourly rate. In this case, since the CAISO spent $3000 to procure 300 MW of Flexible Ramping capacity, the average hourly rate is $10/MW. Accordingly, the resources that actually deviated during the hour incur costs at the average hourly rate. These costs flow to the scheduling coordinator (SC) of the resources that deviated.

At this point, only $1000 of the $3000 has been recovered. The additional $2000 is recovered through a Tier 2 allocation. SCE believes such an allocation should follow the statistical procurement drivers for each class of resources. For instance, for load's share, Tier 2 costs among load would be allocated ratably to SC's on their proportion of system load.

[3] Response to Deficiency Letter and Supplemental Filing of Westar Energy, Inc. under ER09-1273. http://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=12247892

[4] Order conditonally accepting proposed tariff revisions re Westar Energy, Inc. under ER09-1273. http://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=12295934

[5] Other time-periods may make sense and better align with the "rational" principle, e.g. four-hour periods. The CAISO should justify how one periodicity is more "rational" than others.

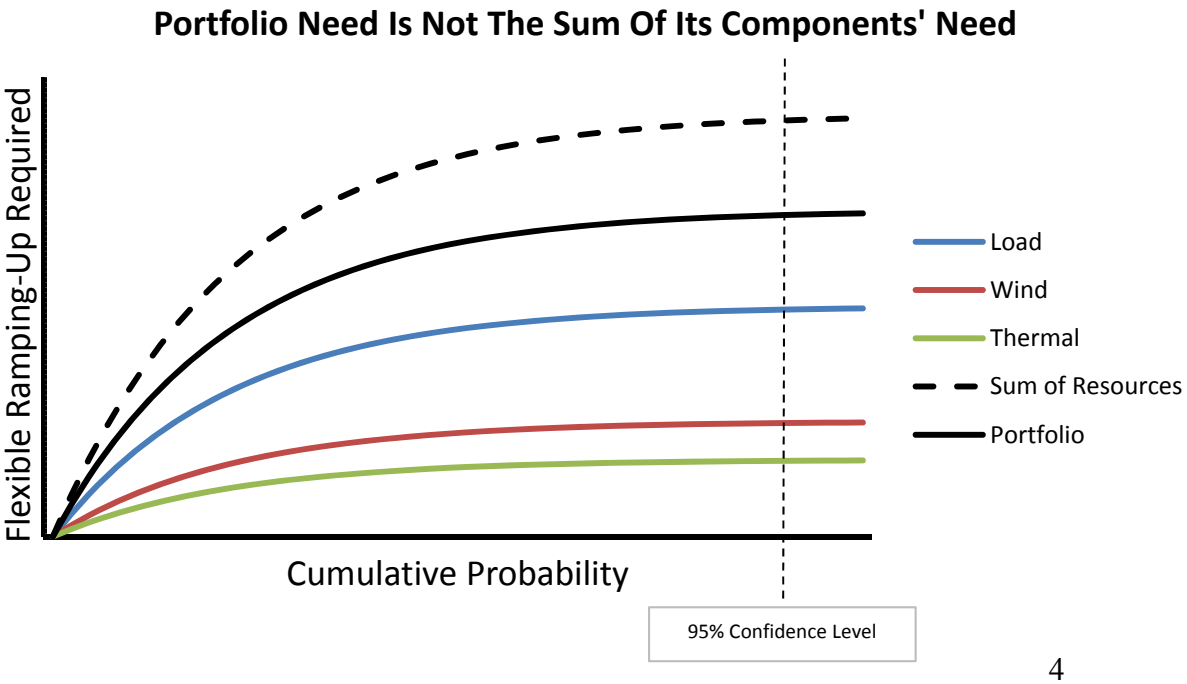
The CAISO's current proposal differs significantly from this approach. Per that approach, all $3000 of costs are allocated to the 100 MW of deviations, obligating payments at $30/MW.

While both approaches provide a price-signal, the two-tiered allocation does so more fairly and rationally. All resources that drove procurement are eligible to pay for it through tier 2 costs, yet no SC will pay a tier 1 cost higher than the actual hourly (or self-provision) rate. If the total deviations exceed the capacity procurement, all costs can be recovered through Tier 1. In this case, the rate will calculate to the actual procurement rate or lower

Most of the time, SCE expects the Tier 2 cost-recovery approach will be used. This outcome results because, with a 95% confidence interval procurement target, the CAISO will usually procure more FRP than there are actual deviations. Tier 2 can allocate these costs more fairly via an allocation that reflects each resource's, or resource type's, contribution to the overall portfolio deviation risk.

The Westar allocation method provides a template for this approach in which the correlation of a resource classes' contributions to total portfolio variability are considered. Considerations of portfolio effect are important and reflect causation in a fair and reasonable statistical manner. The portfolio effect also aligns with the total procurement level, which is set for the total system, inclusive of diversification benefits.

Consider the example below, which profiles a portfolio with only three resource classes: Load, Wind, and Thermal units. Because of the lack of perfect correlation of errors (i.e. the "portfolio effect"), the portfolio need (solid black line) is significantly less than the sum of the individual components (the dashed black line). Since the CAISO procures FRP based on the portfolio need, the challenge for cost allocation is decomposing the individual contribution made by Load, Wind and Thermal resources toward the total portfolio-driven need. Several alternate applications of this statistical effect are described herein.



Tier 2 Cost Allocation –
Tier 2 costs are allocated based on the causation that drove the procurement in the first instance. Consistent with FERC precedents in Westar, the impact of resources or classes of resources on the total procurement of the portfolio are measured and used.

To do this, the CAISO uses performance statistics (by "resource class" in this alternative) to determine the variance of errors and the covariance between classes. As a starting point for discussion, SCE suggests the CAISO study resource classes based on fuel source, e.g. gas, hydro, nuclear, wind, solar, geothermal and perhaps imports/exports. Load is also a component but is not categorized by fuel source. This method allows a lot of flexibility to the CAISO, is simple, follows a FERC-approved methodology, and is mathematically supportable.

Option 1: Pro Rata based on Resource Class 95% Deviations
The simplest, but least accurate[6] approach is to allocate Tier 2 costs pro-rata based on individual resource class variation relative to the sum of resource class variation. For the data in the graph above, "Load" would be allocated costs in proportion to the magnitude of deviations of $\frac{\text{Load}}{\text{Load+Wind+Thermal}}$ where the magnitude of each deviation is calculated at the 95th percentile. The CAISO has proposed a method to calculate deviations for load, generation and PIRP. In any option, deviations should be an "apples to apples" comparison among resource classes. While simple, SCE does not recommend this approach because it ignores the "portfolio effect" of interaction among resources.

Option 2: Pro Rata based on the Standard Deviation of Resources Classes
Given a data set of deviations, simple statistics such as the standard deviation of these Deltas are then calculated[7]. The standard deviation for such Deltas would identify typically how much variation (from schedule or last time period, etc.) one can expect from a resource class. The following pro-rata methodologies are some ways of allocating shares of System Needs cost. Pro rata by standard deviation (σ) allocation for Load would be $\frac{\sigma_L}{\sigma_L+\sigma_W+\sigma_T} \times \$(\text{System Needs cost})$, where L, W, T are Load, Wind, Thermal, respectively.

While this method is also easy to calculated. However, SCE does not recommend it because it does not consider the portfolio effect.

Option 3: Pro Rata by "adjusted variance"[8] as used in Westar's FERC-Approved method
Note that a System's variation is all due to the variation of its constituent resources and interactions between resource variations. Thus, a System's variations depend on: 1) Variance/deviations of its constituent resources, and 2) Offsetting effects of constituent resource variations. Based on the individual resource effect/contribution to system variation, each resource's cumulative influence on the system can be estimated. The cumulative influence of any

[6] By accuracy, SCE means that a standardized deviation measure is a better estimator of variation.
[7] Variance is simply the square of the standard deviation. So, other than calculating standard deviation, any true portfolio measurement would only additionally require calculation of the correlation of any two resources. All these measures are easily estimated using simple software such as EXCEL.
[8] Covariance is a measure of paired variation of two resources. It is equal to the product of the standard deviations of the two resources and their correlation or mathematically $\text{Cov}_{L,W} = \rho_{L,W}\sigma_L\sigma_W$. The correlation, ρ, is a measure of how closely the two resources track each other over time, either in-synch or out-of-synch.

resource on the system manifests itself through that resource's correlations with other resources[9]. This estimate is the sum of the resource's system-variation-contributing interactions with other resources. The pro-rata measure of this sum determines the cost-allocation. FERC approved Westar uses of this method as a basis for the allocation of Regulation cost.

The attached appendix provides a numerical example for illustration. For simplicity, SCE performed calculations for Option 1,2, and 3 assuming only two resources classed, Load and Wind. SCE calculated the "adjusted variance" shown in the 2X2 matrix on slide 5. SCE notes that the same process can be used for any number of resource classes

SCE supports the use of Westar-style covariance measures

The Westar method allows costs to be allocated based on both causation and in consideration of the impact classes of resources have on total portfolio procurement[10]. SCE notes that BPA uses a similar portfolio impact approach in allocating balancing service costs[11]. SCE recommends the CAISO explore this method in detail as part of this process.

For the above reasons, SCE endorses using the Westar method as a basis for Tier 2 cost allocation and urges the CAISO to consider its merits over any proposals to-date. Regarding the category granularity for constituents of the system, SCE proposes a fuel-type breakdown, but is open to other approaches. Under a fuel-type categorization, variances/deviations should be measured for Load, Wind, Solar, Thermal, Hydro, Nuclear, etc. However, the method is versatile enough to handle any definition of "resource class". An alternative could be too categorize resources based on historic performance, rather than fuel type.

3. While SCE understands the need for a deviation baseline, additional detail is needed regarding how deviation calculations will work for specific resources.

Per the proposal, PIRP resources are eligible to submit profiles every 15 minutes. SCE requests clarification on how deviations are calculated for the CAISO proposal when the resources fail to submit a profile. SCE seeks to ensure that all parties receive fair cost-allocation. No exemptions should apply.

For intertie transactions, Section 3.1.4 states that cost allocation will be based on a scheduling coordinator's net import and export positions. Additionally, Figure 1 states that imports and exports are "deemed delivered." SCE seeks clarification from the CAISO on how these ideas will be implemented? SCE would find it useful if the CAISO walked through an example that assesses costs to intertie transactions. SCE supports cost-causation for all resources that have a bearing on CAISO costs and interties must not be excluded.

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[9] Correlations and Covariances are related measures that determine the paired variation exhibited by two resources interacting with each other.

[10] In addition, SCE finds the Westar based cost allocation method attractive because it is 1) Mathematically and logically supportable, 2) FERC-Approved for Westar's Regulation cost allocation needs, 3). Reasonable given a statistical approach for procurement, 4) Flexible enough to incorporate even arbitrary procurement decisions, 5) Flexible enough to incorporate any time-period outlook – hourly, weekly, monthly, etc. 6) Versatile in that it can be applied to any number of granular categories or resource classes, and 7) computationally simple enough to be easily automated.

[11] http://www.bpa.gov/corporate/ratecase/2012/docs/BP-12-FS-BPA-05.pdf and http://www.test.bpa.gov/corporate/ratecase/2012/docs/bp-12-E-BPA-05A.pdf

Market Strategy & Resource Planning

Appendix to the Flexible Ramping Cost Allocation Comments of Southern California Edison

March 29, 2012

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Market Strategy & Resource Planning

Agenda

- Portfolio effect and basic stats review
- Understand importance
  - Westar - Portfolio approach
- Identify three cost allocation options. Proportionate cost assignment based on
  - Confidence level of errors
  - Standard deviation of errors
  - “Adjusted standard deviation” of errors

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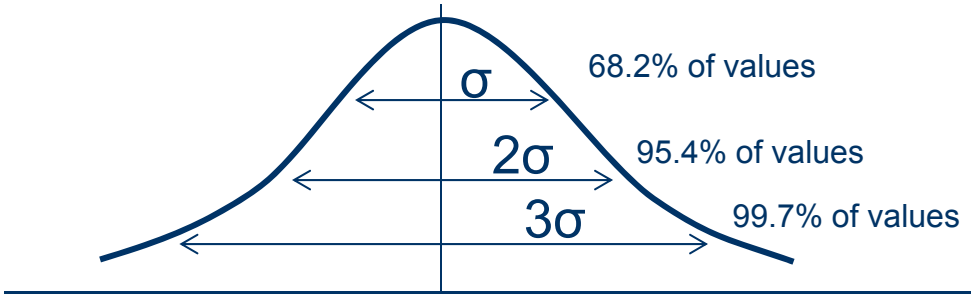
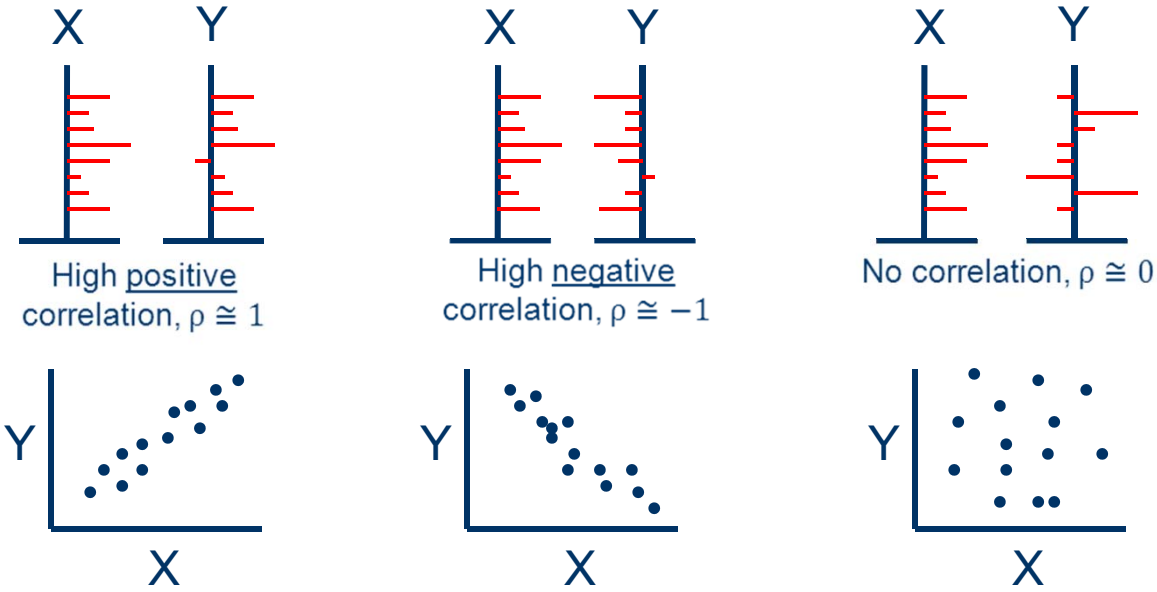
Statistics Review

Standard Deviation, σ



Correlation, ρ



Covariance

$$Cov_{1,2} = \rho\sigma_1\sigma_2$$

Big Picture

General Problem:
The total system flexible ramping requirement is known. How do we allocate this total based on individual resource / load contribution to need?

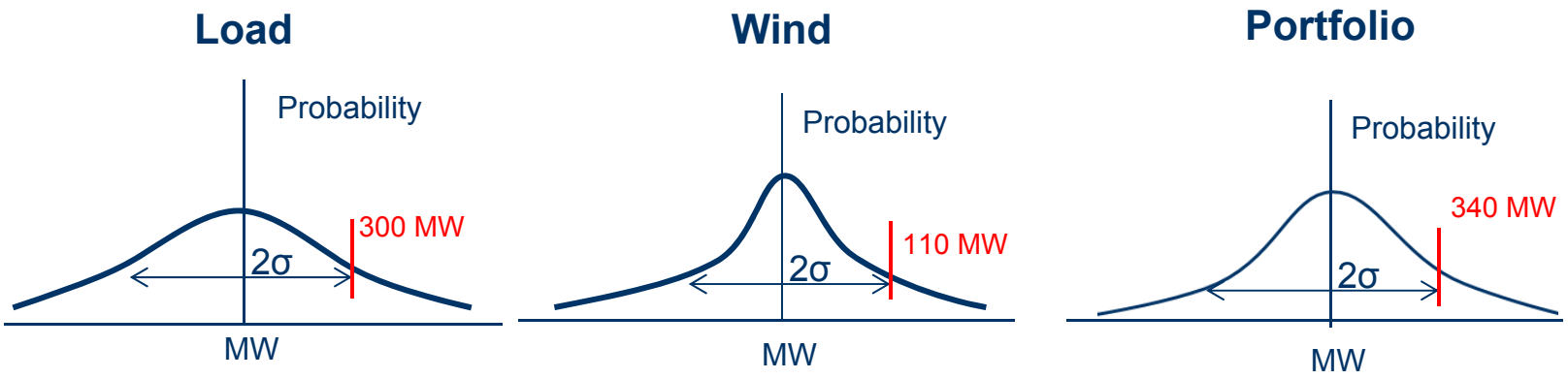
Portfolio Benefits:

System total ≤ sum of needs to manage each individual resource/ load

- Portfolio need almost always less *(rarely equal, never greater)*
- This reduction is commonly called “Portfolio Effect”, “Diversity Benefit”, or “Offsetting Errors”

Example: Portfolio of Wind and Load

Distributions of Uninstructed Deviations



- Assume CAISO procures enough flexible ramp to cover 2σ of uninstructed movement (~95% of all events)
- Without benefits of a portfolio, CAISO would procure:

$$FRP_{Total} = 2\sigma_{Load} + 2\sigma_{Wind} = 300MW + 110\ MW = 410\ MW$$

Because of portfolio benefits, this formula overprocures. Actual portfolio need is only 340 MW.

Example: Portfolio of Wind and Load *(cont.)*

The *adjusted standard deviation* captures each resource's contribution to the portfolio need.

Covariance Matrix of Resource Errors

	Load	Wind	Adjusted Standard Deviation = Square Root of Sum of Row Covariances
Load	σ_L^2	$Cov_{L,W}$	$\hat{\sigma}_L = \sqrt{\sigma_L^2 + Cov_{L,W}}$
Wind	$Cov_{W,L}$	σ_W^2	$\hat{\sigma}_W = \sqrt{\sigma_w^2 + Cov_{W,L}}$

σ_{Load} = 150 MW
σ_{Wind} = 55 MW
$\rho_{load,wind}$ = 0.2

	Load	Wind	Adjusted Standard Deviation = Square Root of Sum of Row Covariances
Load	22,500	1,650	155
Wind	1,650	3,025	68
		Total	223

Option 1: Allocation by Confidence Level

- This method assigns quantities based on the 95% confidence level of a resource's errors, compared to the sum of all resource uncertainty.

Formula

$$\textbf{Allocation} = \text{Tier 2} \times \frac{\text{Resource's 95\% Confidence Quantity}}{\text{Sum of all 95\% Confidence Quantities}}$$

Example: Load's Allocation

$$\textbf{Load's Allocation} = \text{Tier 2} \times \frac{300\ MW}{300\ MW + 110\ MW} = 0.73 \times \text{Tier 2}$$

Option 2: Allocation by Standard Deviation

- This method assigns quantities based on the standard deviation of a resource's error, compared to the sum of all resource deviations.

Formula

$$\text{Allocation} = \text{Tier 2} \times \frac{\text{Standard Deviation of Resoure's Errors}}{\text{Sum of all Standard Deviations of Resource Errors}}$$

Example: Load's Allocation

$$\text{Load's Allocation} = \text{Tier 2} \times \frac{150\ MW}{150\ MW + 55\ MW} = 0.73 \times \text{Tier 2}$$

Note: In this example, the allocations in options 1 and 2 (by confidence level and standard deviation) are the same because of the assumption that the errors are normally distributed. If the errors have a different distribution, these methodologies would produce different results.

Option 3: Allocation by Adjusted Standard Deviation

- This method assigns quantities based on the fraction of the portfolio's deviation due to a resource's "adjusted standard deviation"

Formula

$$\text{Allocation} = \text{Tier 2} \times \frac{\text{Adjusted Standard Deviation of a Resource}}{\text{Sum of All Resources' Adjusted Standard Deviations}}$$

Example: Load's Allocation

$$\text{Load's Allocation} = \text{Tier 2} \times \frac{155}{223} = 0.69 \times \text{Tier 2}$$