ARPA-E GO COMPETITION CHALLENGE 3: SCORING
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1. TERMINOLOGY

The following terminology will be utilized throughout the GO Competition and in this scoring document:

- ***Power system network model***: a defined topological structure and characteristics including, but not limited to, locations of generators, loads, transmission lines, transformers, equipment detail, control equipment, and operating parameters.
- ***Scenario***: an operating instance in time on a power system network model. The scenarios define a demand at each bus, renewable resource availability, and other system conditions.
- ***Dataset***: a collection of power system network models and scenario data on those models.
- ***A scenario score*** a score calculated for each scenario of a power system network model.
- ***A power system network model score*** a combined score for all of scenarios associated with a power system network model.
- ***A dataset score*** a combined score from all of the power system network models in a given dataset.

2. GO COMPETITION DIVISIONS

The GO Competition will host three different "divisions" with separate leaderboards (The Final Event will host a second set of three divisions for six total divisions). Each division will focus on a different market dispatch horizon. Division 1 will focus on a Real-Time Market including a look-ahead commitment with a 5-minute time limit per scenario. Division 2 will focus on a Day-Ahead Market dispatch with a 120-minute time limit per scenario. Division 3 will focus on a Week Ahead Advisory problem with a 240-minute time limit per scenario. All three scoring divisions will be scored based on the value of the objective function (maximizing the market surplus also known as market efficiency). All Entrants will be ranked with respect to the scenario scores within each division. The Eligible Entrants who rank at the top of each division will receive a prize based on their rank as either prize money or as a grant for follow-on research approved in writing by ARPA-E (for more details on prize money versus grant eligibility, see the Challenge 3 Rules document). Prizes and grants for placing in multiple divisions are additive. The ARPA-E Benchmark team may occupy a rank on the official leaderboard posted on the GO website, but will be removed from the consideration of prize

awards by rank (i.e. if the Benchmark team ranks third on the leaderboard, the fourth ranked team, if eligible, will receive the third rank prize, the fifth rank team, if eligible, will receive the fourth rank prize, and the sixth team, if eligible, will receive the fifth rank prize). This rule does not extend to a situation in which any other prize-ineligible team occupies a rank on the leaderboard. Figures 1 and 2 depict algorithm scoring by division for Competitive Event 3 and the Final Event. Scoring for all three divisions is discussed below.

Figure 1. Breakdown of the Divisions and Awards for Eligible Entrants in Competitive Event 3.

Figure 2. Breakdown of the Divisions (1, 2, and 3) and Awards for Eligible Entrants in the Final Event.

In addition, the Final Event will feature a second set of three divisions (4, 5, and 6). The objective of Divisions 4, 5, and 6 is to reward teams for the extra risk/effort associated with finding the best solution possible to each scenario. Divisions 4, 5, 6 will rank teams based on the count of top scenario scores in Divisions 1, 2, and 3. A top scenario score is defined as the highest score for a scenario found in the competition event by all competitor and benchmark algorithms. This metric was developed during Challenge 2 (although it was not the basis for any prize in that Challenge), and an example of the top score results from Challenge 2 may be viewed on the Challenge 2 Leaderboard supplemental information available on the GO

Competition webpage (https://gocompetition.energy.gov/challenge-2-Final-Event-supplemental-information). Each algorithm's results (i.e., raw count of top scenario scores) from Divisions 1, 2, and 3 will be ranked correspondingly in Divisions 4, 5, and 6 – the algorithms will not be re-run separately for Divisions 4, 5, and 6 (e.g., Division 4 will rank the competitors' algorithms by the count of top scores each algorithm achieved in Division 1, etc.).

Figure 3. Breakdown of the Divisions (4, 5, and 6) and Awards for Eligible Entrants in the Final Event.

Entrants will be able to submit their executable program (source code) with the ability to adjust their algorithmic approach based on division; there will be an input parameter that will reflect the selected division.

Each competitive event is scored independently of other competitive events. Within each event, each division is scored separately.

3. SCORING

For a given scenario, the solution provided by each entrant is assigned a score representing the increase in market surplus of that solution relative to the market surplus of the prior point solution. The market surplus (ms) of a solution is defined (details in the formulation document) as:

$$z^{ms} = \sum_{t \in T} \left\{ z_t^{ms} + \min_{k \in K} z_{tk}^{ms} + \frac{1}{|K|} \sum_{k \in K} z_{tk}^{ms} \right\}$$

where T is the set of time intervals and K is the set of contingencies.

For a given scenario *s*, let z_s^{ms} denote the market surplus objective of a solution on scenario *s*.

4. NETWORK AND TOTAL DATASET SCORING (DIVISIONS 1, 2, AND 3)

For Event 3 and the Final Event, the following process described in this section will be employed to calculate scores for each scenario in divisions 1, 2, and 3. The total dataset score will be the score used to determine the ranking within each division for purposes of assigning prize awards to each team.

For each scenario *s*, the competition administrator will set a minimum possible feasible score for each dataset, $z_s^{ms}{}_{min}$. This does not necessarily represent the actual global minimum feasible solution to any dataset, but is considered the minimum feasible solution for the context of ranking teams in the GO Competition.

For any entrant, the solution to scenario *s* is evaluated and a market surplus z_s^{ms} is assigned. If no solution is returned, or the solution is incorrectly formatted, or the solution is determined to be infeasible, or the evaluated market surplus is less than $z_s^{ms}{}_{min}$, then the assigned market surplus is $z_s^{ms}{}_{min}$.

The score MS_s^{gain}, representing the gain in market surplus relative to the minimum feasible score, is computed as

$$MS_s^{gain} = z_s^{ms} - z_s^{ms}{}_{min}$$

The score over a given set S of scenarios is

$$MS^{gain} = \sum_{i \in S} MS_s^{gain}$$

For each division (1, 2, and 3), competitor rankings will be determined based upon the total score (MS^{gain}) for the dataset.

5. NETWORK AND TOTAL DATASET SCORING (DIVISIONS 4, 5, AND 6)

For the Final Event, the process described in this section will be employed to set rankings for teams in divisions 4, 5, and 6. The rankings (based on the count of top scores for each scenario in divisions 1, 2, and 3) will be used to determine the leaderboard ranking within each division.

For all participants (including both competitors and the benchmark team) P, A Top scenario Score TS_s is defined as the highest score found for each scenario across all participants:

$$TS_s = \max_P (MS_s^{gain}{}_p)$$

For each division (4, 5, and 6), competitors will be ranked by the count of scenarios that their algorithm found the MS^{gain} which achieved a TS_s within the corresponding division (1, 2, and 3). Any ties will be resolved by ranking tied teams by the total score (MS^{gain}) for the dataset in the corresponding division (1, 2, and 3).