# Using GE-MARS to estimate resource need for 33% RPS scenarios

January 2012

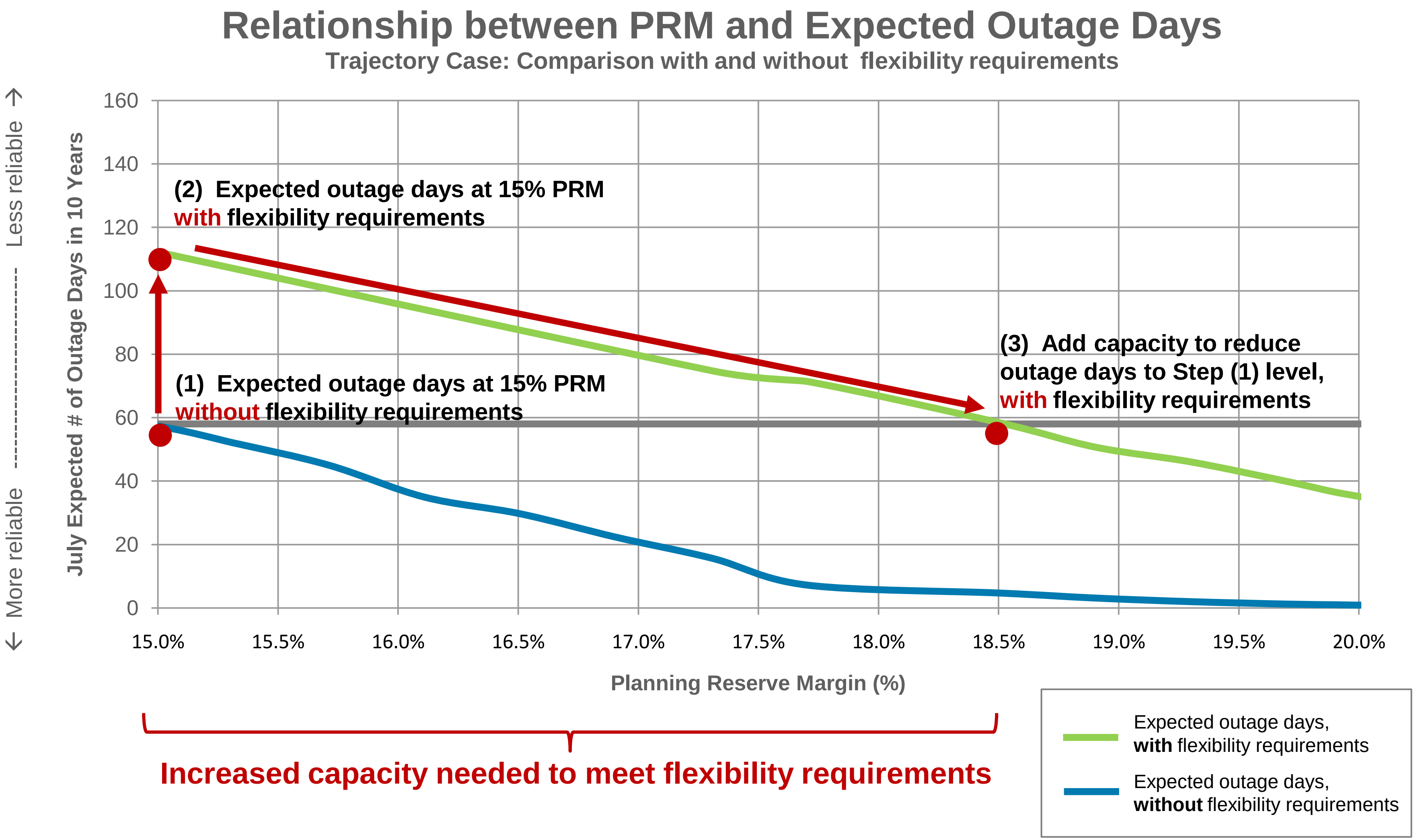
# Overview of methodology

- Uses GE-MARS, a loss-of-load probability (LOLP) model, to estimate the capacity needed to satisfy **loss of load** and **upward flexibility**[1] requirements.
- The steps used in the analysis are:
  1. Calculate the expected number of outage days[2] (loss of load expectation, or LOLE) in the Trajectory Scenario or any other scenario with 15-17% PRM[3], **considering loss of load requirements** but **ignoring flexibility requirements**.
  2. Calculate the expected number of outage days in the scenario with 15-17% PRM **considering both loss of load target and upward flexibility requirements**.
  3. Add capacity until the expected number of outage days is the same as in Step 1.
     - ✓ The resulting capacity satisfies loss of load and upward flexibility requirements
     - ✓ This analysis doesn't address downward flexibility needs
     - ✓ Since GE-MARS does not take ramping capabilities of individual units into account (e.g. it assumes that flexibility requirements can be met by any unit, regardless of its ramping capability), the capacity need estimated by GE-MARS needs to be tested with PLEXOS for a stress scenario

[1] Because the LOLP model doesn't consider the flexibility capabilities of resources, only upward requirements can be considered in the LOLP simulation.
[2] An outage day is a day in which operating reserves drop below 3% in one or more hours.
[3] Unidentified imports are removed to reach desired 15-17% PRM.

# Outage days with vs. without flexibility requirements

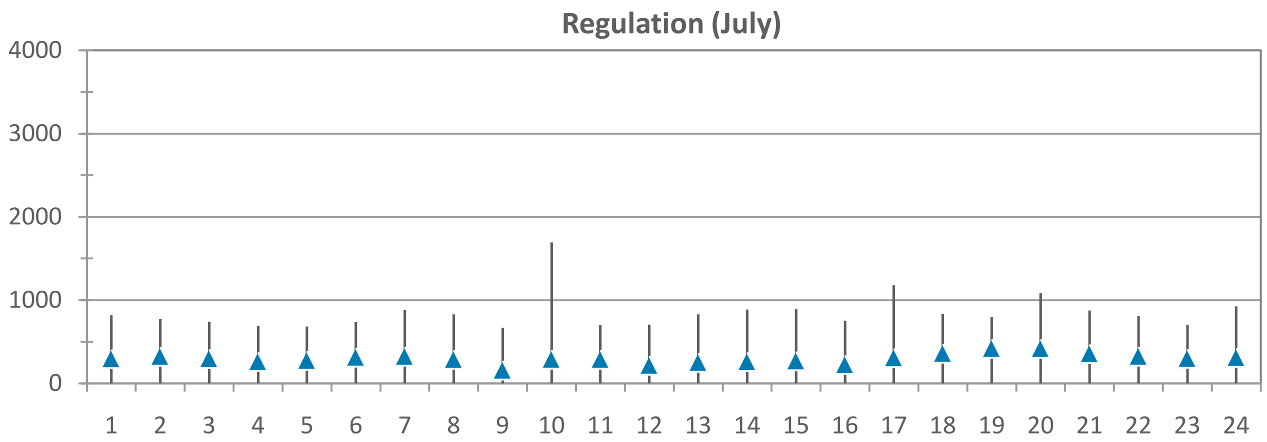
- **The capacity added to reduce expected outage days to a level similar to Step (1) *(without flexibility requirements)* at 15-17% PRM is the increased capacity needed to meet flexibility requirements.**



# Representing flexibility requirements in MARS

- GE-MARS draws daily flexibility requirements at random from a pool of 31 24-hour profiles
  - Regulation-up and load following-up requirements are drawn independently of each other
  - Pool of profiles is derived from CAISO-PNNL 100 model iterations (744 hours x 60 minutes/hour x 100 iterations, per type of requirement)
- For example, the process for July is:
  - Take July’s minute-by-minute regulation and load following requirements from the CAISO-PNNL model
  - Take the maximum minute value per hour for each iteration (744 hours x100 iterations)
  - Take 31 representative days of hourly profiles of Regulation-Up and Load Following-Up to capture the distribution of requirements from the 100 maximum minute values of each type of requirement

# Resulting distribution of hourly flexibility requirements for July

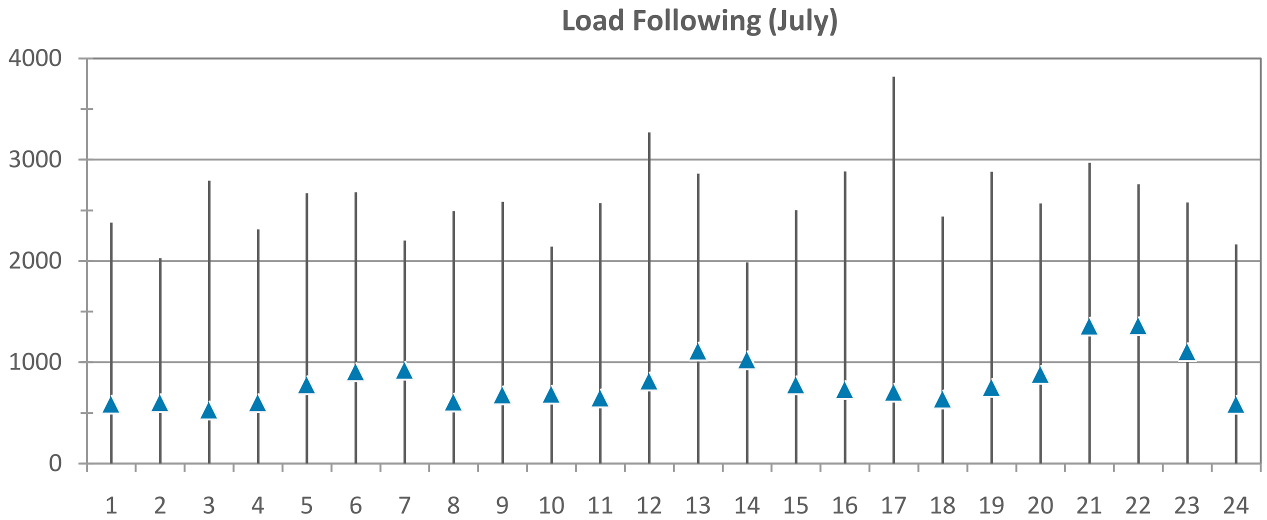



**Regulation Up**

Min: 0 MW

Avg: 300 MW

Max: 1,700 MW




**Load Following Up**

Min: 0 MW

Avg: 800 MW

Max: 3,800 MW

▲ Indicates mean , for the given hour, of flexibility requirements across the pool of 31 profiles

# 2020 Trajectory Scenario assumptions for GE-MARS

| | |
|---|---|
| **General** | • CAISO is divided into three transmission access charge (TAC) regions, local areas ignored<br>• Each scenario is run over 1000 iterations or until LOLE converges<br>• A loss-of-load event occurs when operating reserves fall below 3%, consistent with CAISO's operating procedures (Stage 2 curtailments of non-firm load are initiated when reserves fall below 5%; Stage 3 firm load curtailments when reserves fall below 1.5% - 3%) |
| **Load** | • Load profiles reflect 2005 historic load scaled to CEC's CAISO 2020 peak forecast (with adjustments for uncommitted energy efficiency, non-dispatchable DR, and demand-side CHP)<br>• Four load uncertainty levels corresponding to 1-in-2, 1-in-5, 1-in-10, and 1-in-20 weather years are modeled, with up to 10.4% increase in July and August for the 1-in-20 case |
| **Resource Capacities** | • Existing: ~50,000 MW (from 2011 CAISO NQC list)<br>• Retirements: ~13,000 MW aging steam and peakers (4,500 MW in NP; 9,000 MW in SP)<br>• Fossil additions: 3,400 MW of conventional in NP (Humboldt, Colusa, Lodi, Russell City, Mariposa, Tracy, Los Esteros, Marsh Landing, Avenal in NP); 3,200 MW in SP<br>• Demand Response: 327 MW non-dispatchable (load side); 5,800 MW dispatchable (including 15% RA credit, gen side)<br>• RPS additions: Based on 33% RPS scenarios used in CAISO's integration study<br>• Imports: Includes dedicated imports (846 MW to NP, 1423 MW to SP) and WAPA imports (700 MW); non-dedicated imports are added only as needed to meet LOLE targets<br>• Regional ties: 3,750 MW physical NP to SP transfer capacity; 2,649 MW physical flow from SCE TAC to SDGE TAC |
| **Resource Characteristics** | • Outage characteristics from PLEXOS database<br>• Hourly profiles for intermittent renewables from PLEXOS database |