Resource Adequacy Slice-of-Day Showing Template User's Guide



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California Public Utilities Commission

Energy Division

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# Introduction

As the Resource Adequacy program transitions to the new slice-of-day framework, the existing filing process requires updating. As directed in D.23-06-029, Energy Division has developed a template for showing slice-of-day resources based on sample templates provided by two Load-Serving Entities (LSEs). This document describes the overall design of the template and includes general instructions on how to input a showing.

# Workbook Layout

The template consists of an Excel workbook containing 14 visible worksheets and 17 hidden worksheets. All information required for developing a valid resource adequacy showing should be available in the visible worksheets, but the hidden worksheets may be helpful for investigating specific issues especially pertaining to validation tests.

The worksheets are color-coded to help distinguish between their uses. Each set of worksheets is discussed in subsections below.

In addition to the visible and hidden workbooks, many of the calculations in the workbook are performed using Excel’s Power Query utilities, which load and transform data to and from tables in the worksheets. The Power Query editor is accessible from the “Data” tab of the ribbon menu by clicking on “Queries and Connections” to open a sidebar, and finally double-clicking on any of the listed queries. The Queries and Connections sidebar can be used to manually refresh queries if necessary.

Finally, the workbook includes a tool to help shape showings for storage resources by optimizing shown hours to best meet LSE requirements given the remaining need after other resources are shown. The optimization routine is set up in Power Query, exported to a worksheet, and then uses Solver to determine optimal hourly capacities. A Visual Basic script, triggered from a button in the worksheet, defines the solver parameters and calls Solver.

Worksheets are hidden to help the general user navigate areas of the workbook most critical to the typical workflow, but all data, queries, and Visual Basic code are freely accessible within Excel, and users are welcome to explore the workbook.

## Information Worksheets (greyscale)

Four visible sheets and three hidden sheets constitute a set of “informational” worksheets.

README – The first worksheet in the workbook contains basic information about how to navigate and use the template.

Hourly Availability Chart – Three charts included in the template show the capacity contributions of each resource type towards meeting the LSE’s hourly resource adequacy requirements. The bars show the combined capacities of resources from each group in different colors, while the line shows the hourly Resource Adequacy System Requirements less demand response (DR) and CAM Allocations with the exception of CAM Storage. The hourly availability chart may be helpful in determining whether a showing meets requirements, hours where additional capacity may be needed, and when battery storage systems may be charged using excess capacity.

The resource groups are “Battery Storage,” “Solar Fixed,” “Solar Thermal,” “Solar Tracking,” “Wind,” “Unspecified Imports,” and “Other,” and are primarily based on the Resource Type for each resource listed in the Master Resource Database. Resources that don’t otherwise map to a profile category will be labelled “Other” or “Unspecified Imports” if so indicated on the LSE Showing worksheet. The same resource groupings are used across all three charts.

Hourly Availability (hidden) – This sheet contains the underlying data for the Hourly Availability Chart. The Table is loaded from Power Query, generated by the query named HourlyAvailability.

Local Availability Chart – This chart shows the shown capacity attributed to each local capacity area, along with the LSE’s local capacity requirements (if applicable). Resources are grouped similarly to the Hourly Availability Chart.

Local Availability (hidden) – This sheet contains the underlying data for the Local Availability Chart. The Table is loaded from Power Query, generated by the query named LocalAvailability.

Flex Availability Chart – This chart shows the shown capacity attributed to each flexible resource adequacy category, along with the LSE’s flex requirements. Resources are grouped similarly to the Hourly Availability Chart.

Flex Availability (hidden) – This sheet contains the underlying data for the Flex Availability Chart. The Table is loaded from Power Query, generated by the query named FlexAvailability.

## Load-Serving Entity Input Worksheets (blue)

In general, LSEs should only need to edit the visible blue-colored worksheets when preparing a showing, and these should be completed in the order they appear in the workbook from left-to right.

Certification – This worksheet will be partially completed when the template is sent to each LSE, but LSEs will be responsible for ensuring the sheet is current, accurate, and complete. This certification attests that the resource adequacy showing contained in the rest of the book, upon submission to CPUC, is accurate.

Ensure that the correct showing month is entered before entering data since this determines which monthly LSE requirements are used in the compliance tests.

Certification Table (hidden) – This worksheet reshapes the input data from the Certification worksheet into a Table for use in Power Queries.

LSE Showing – This worksheet contains one table constituting most of the information required from LSEs for their showing. This information includes a contract and resource identifiers, and specific information about each resource’s contract capacity. The workbook matches shown resources against the Master Resource Database worksheet for additional information used in validating the showing.

Resource Custom Profiles – Users are able to manually input custom hourly capacity profiles for certain shown resources in a single table in this worksheet. The Resource ID and Resource SubID for each row of the table should match an entry in the LSE Showing worksheet. A custom profile must be entered for all Unspecified Imports.

Profile Optimization – This worksheet is automatically populated with resources entered into the LSE Showing worksheet for which the Use Default Profile field is False and where no matching entry in Resource Custom Profiles is found. The worksheet contains three tables and three buttons used to prepare and control the optimization routine. See the Profile Optimization Tab for instructions on running the optimizer.

## Showing Results Worksheets (gold)

Showing results worksheets are intended to help users develop a valid and compliant showing. This group includes two visible and 11 hidden worksheets.

Validation Overview – This worksheet is a dashboard presenting the results of various validation tests shown in the subsequent hidden worksheets.

Check Capacity (hidden) – This worksheet contains the Hourly System Capacity test. The table shows the difference between requirements and shown capacity for each hour and is generated by the CheckCapacity query.

Check Local (hidden) – This worksheet contains the Local Capacity test. The table shows the capacities and requirements for each shown resource and all local capacity areas. The test is considered to pass if the sum of each column is nonnegative, indicating greater capacity than required. The table is generated by the CheckLocal query.

Check Flex (hidden) – This worksheet contains the Flexible Capacity test. The table shows the capacities and requirements for each shown resource and the three flexible capacity categories. The test is considered to pass if the sum of each column is nonnegative, indicating greater capacity than required. The table is generated by the CheckFlex query.

Check Contract Dates (hidden)– This worksheet contains the Contract Date test. The table shows the contract start and end dates for each resource and a column indicating whether the current month is fully contained within the date range. The table is generated by the CheckContractDate query.

Check Custom Profiles (hidden)– This worksheet contains the Custom Profile test. The table shows the resources for which custom profiles have been input, with the difference between each resource’s NQC or total VER MW under contract and the custom shown capacity for each hour. The NQC or total VER MW value is the lower value from between the NQC or VER MW Under Contract in the LSE Showing worksheet or the current month NQC in the Resource NQC worksheet. The table is generated by the CheckCustomProfiles query.

Check Shown Hours (hidden) – This worksheet contains the Shown Hours test. The table shows each resource with its shown hours of use, its available hours of use as listed in the Master Resource Database worksheet if available, and a check of shown vs. available hours. The table is generated by the CheckShownHours query.

Check Storage Excess Capacity (hidden) – This worksheet contains the Storage Excess Capacity test.

Check Storage SOC (hidden)– This worksheet contains a table used in both the Storage Minimum and Maximum State-of-Charge tests. The table shows each shown resource determined to be a battery storage resource, along with an hourly estimate of the resource’s state-of-charge in terms of MWh energy stored, assuming the resource starts at hour ending 1 with zero available stored energy. The table is generated by the CheckStorageSOC query.

Check Grouped Resources (hidden) – This worksheet contains the Grouped Resource Interconnection test. The table shows groups of shown resources which the Master Resource Database indicates are either co-located or hybrid, with the group’s total hourly capacity and the interconnection power limit. The table is generated by the CheckGroupedResources query.

Check Hybrid Deliverability (hidden)– This worksheet contains the Hybrid Deliverability test. The table shows each shown hybrid pair of resources and whether hourly capacities shown for the solar resource are consistent with its deliverability status.

Check MCC Bucket 4 (hidden) – This worksheet contains a clone of the Storage Excess Capacity test applying only to storage resources flagged as “TRUE” in the MCC Bucket 4 column on the LSE Showing worksheet.

LSE Showing Complete – This worksheet constitutes the showing information that will be considered by CPUC in its resource adequacy process. The table is synthesized from the LSE’s inputs, the requirements and allocations assigned to the LSE, and general information about the resources.

## Requirement and Allocation Worksheets (orange)

Requirements and Allocations – This worksheet contains a table representing all system, local, and flexible requirements, and specifies all CAM allocations for a given LSE and month. These are used in evaluating the compliance of a filing.

## Resource Description Worksheets (green)

Resource Database – This worksheet contains a snapshot of the official Master Resource Database maintained by CPUC’s Energy Division. The included data are used in validating a slice-of-day showing.

Resource NQC – This worksheet contains the monthly NQC values for certain resources listed in the Master Resource Database.

Resource Default Profiles – This worksheet contains default slice-of-day profiles for certain resources that may be shown.

Resource Profile Categories (hidden)– This worksheet is a lookup table used in mapping a shown resource to a default profile. The table includes Resource Types as listed in the Master Resource Database, and Profile Categories as appearing in the Resource Default Profiles worksheet.

Regions (hidden) – This worksheet is a lookup table used in mapping a shown resource to a default profile. The table includes Path 26 Designations and Balancing Authority Areas as listed in the Master Resource Database, and Regions as listed in the Resource Default Profiles worksheet.

# How to Input Resources

Many components in the template use Excel Tables rather than regular Ranges and Cells. This helps structure the data for use across worksheets and facilitates automated input or extraction. Tables can be recognized in the template by banded blue or green rows with dark blue or green headers with white text.

When adding data to a Table, the Table will automatically resize within the worksheet to include new rows. Table rows should be removed by either overwriting the contents entirely or by deleting the entire row, rather than deleting the contents of the cells. When done working with a Table, users should ensure that no rows within the Table’s boundaries are empty.

## LSE Showing Worksheet

The simplest showing can be entered exclusively on the LSE Showing worksheet. LSEs will receive a fresh template each month with updated resource information and the current month’s requirements and allocations. A CAM storage allocation, reflective of the allocation specified on the Resource and Allocations worksheet, should also be present on the LSE Showing worksheet. Additional resources should be entered in subsequent, contiguous rows, using the following procedure:

1. Enter a Contract ID in Column A reflecting the contract for resource adequacy capacity in a new row of the LSE Showing worksheet.
2. Check that the table boundaries automatically expanded to include the new row. Also check that no empty rows appear in the table or before the new row.
3. Enter a Resource ID matching an entry in the Master Resource Database worksheet in Column B. The ID can either be typed in, pasted from the Master Resource Database worksheet or another source or selected using the dropdown menu.
4. For most resources, the Resource SubID (Column C) should be left empty. Enter a SubID only for hybrid resources that have been assigned sub-IDs for their components in the Master Resource Database.
5. In column D (NQC or VER Under Contract (MW), enter the NQC value under contract for all resources except solar and wind (VERs). For variable energy resources (VERs), enter the total MW under contract. The template will shape those showings based on their hourly profiles.
6. Fill in the Local RA capacity, and Committed Flexible RA capacity shown for the resource, all in units of MW, in Columns E and F.
7. Fill in the Capacity Effective Start Date and End Date as listed in the contract for the resource in the new row in Columns G and H.
8. Fill in the SCID or Counterparty if available in Column I.
9. In Column J, type in or select “TRUE” for storage resources being shown in MCC Bucket 4 in 2024 compliance showings.
10. In Column K select “TRUE” if the resource is an Unspecified Import.
11. Type in or select “TRUE” in Column L from the dropdown menu to use the Default Profile for the resource. For battery storage, the default profile is a single daily discharge from HE18-HE21.
12. When finished entering custom profiles, open the LSE Showing Complete worksheet and refresh the table by right-clicking on it and selecting “Refresh”.
13. Verify the resource appears in the table as entered, and the Profile Source column indicates “Default”.

Selecting “TRUE” for Default Profile will apply a slice-of-day profile from the Resource Default Profiles worksheet to the shown resource, based on the shown NQC or total VER MW Under Contract. When a default profile is selected, the resource is fully specified by the user’s input in the LSE Showing worksheet, and the default profile will be applied to all validation tests and will be represented in the LSE Showing Complete worksheet.

If a resource does not map to a default to a default profile, or the default profile, the user may need to input a custom profile according to the next section.

Custom profiles must be used for all Unspecified Imports. Ensure that “FALSE” is selected under Use Default Profile for these resources.

Aside from Unspecified Imports, Custom Profiles and Profile Optimization will primarily be used for battery storage resources. The user may select whether to use the Default Profile, a Custom Profile where the user inputs a specific daily profile or the Optimization tool which will shape storage showings to meet the LSE’s hourly RA needs.

## Custom Profiles

Users may manually specify hourly profiles for resources by setting Default Profile to “FALSE” in the LSE Showing worksheet and filling in the Resource Custom Profiles worksheet. This may be useful where the default profiles do not apply to a specific resource and the user has more detailed information about a given resource’s capabilities.

Use the following procedure to input a custom profile:

1. Enter a new resource as described for Basic Resources, but input “FALSE” for Use Default Profile.
2. Copy the desired Resource ID and Resource SubID from the LSE Showing worksheet into a new row of the table in the Resource Custom Profiles worksheet.
3. Check that the table boundaries automatically expanded to include the new row.
4. Enter the hourly capacities to be shown in the MW HE \_\_ columns, making sure no hours exceed the value listed in the corresponding NQC listed on the LSE Showing worksheet.
5. When finished entering custom profiles, open the LSE Showing Complete worksheet and refresh the table by right-clicking on it and selecting “Refresh”.
6. Verify the resource shows the custom profile as entered, and the Profile Source column indicates “Custom”.

## Storage Resources and Hourly Optimization

The Profile Optimization worksheet is designed to facilitate showing storage resources based on the LSE’s requirements, allocations, and other shown resources, while accounting for the physical limitations of battery energy storage systems. Storage resources can be input according to the following procedure:

1. Enter a new resource as described for Basic Resources selecting “FALSE” for Use Default Profile. Make sure the corresponding entry in the Master Resource Database worksheet has values for the following fields Daily Storage Cycle Physical Capability, Storage Efficiency, Maximum Continuous Energy, and Storage Maximum Daily MWh.
2. When finished entering resources into the LSE Showing worksheet, open the Profile Optimization worksheet.
3. Click on the button labelled “Refresh Tables” to update the three tables on the worksheet.
4. Click on the button labelled “Reset Shown Hours” to set all hours to show 0 MW.
5. Click on the button labelled “Optimize Shown Hours” to run Solver and determine the best hours and capacities to show for each set of storage resources.
6. Once Solver has completed, the table in the LSE Showing Complete worksheet, and the Hourly Availability Chart will update automatically. Open the LSE Showing Complete worksheet and verify that the resource is correctly shown with the Profile Source listed as “Optimized” and corresponding hourly capacities based on the optimization results.

There should be positive values in the Shown MW column of the table labelled “Unshown Resource Adequacy” in each row with a positive value in the Remaining Required MW column of the same table.

In most cases, users need only use the buttons in the Profile Optimization worksheet, but users are welcome to adjust the Objective Function to suit their needs (e.g., set the cost of using one class of storage higher than others), or to run Solver manually using the Solver Dialog. The buttons trigger Visual Basic scripts which users are further welcome to modify.

Solver’s GRG Nonlinear algorithm is used to accommodate nonlinearity in the optimization problem arising from constraints introduced for multi-cycle storage. For this reason, the Solver’s results are not guaranteed to be the absolute optimal showing, but should be very close.

Excel’s standard Solver tool limits the number of variables that can be solved, so if more than four resources, including CAM Storage, are listed, resources will be grouped according to their physical capabilities. The grouping algorithm is implemented in the OptimizationGroups query.

## Hybrid Resources

Hybrid resources generally should be listed as pairs, with the same Resource IDs and different Resource SubIDs. Otherwise, they may be entered using the LSE Showing, Resource Custom Profiles, and Profile Optimization worksheets according to the procedures listed above. Two validation tests check that the hybrid resources are shown within constraints defined in the Master Resource Database.

## Co-Located Resources

Co-Located resources can be input into the LSE Showing worksheet according to any of the procedures above, but a validation test will check that each group of co-located resources do not exceed their interconnection MW limits.

## MCC Bucket 4

For the 2024 Test Year, in which the existing RA framework is binding, an LSE may show storage capacity in MCC Bucket 4 if it demonstrates sufficient charging capacity on the Slice-of-Day showing template. As such, storage resources in MCC Bucket 4 are subject to their own version of the Storage Excess Capacity test. Inputting “TRUE” in the MCC Bucket 4 column on the LSE showing will include the resource in this test. The MCC Bucket 4 column only affects storage resources and should be set to “FALSE” for all others.

## Unspecified Imports

Unspecified imports will not be included in the Master Resource Database. Such resources will thus trigger an informational validation message to this effect. Users should input the resource normally on the LSE Showing sheet, indicating NQC Under Contract, Capacity Effective Start and End Dates, and SCID, and set MCC Bucket 4 to “FALSE”, Unspecified Import to “TRUE”, and Use Default Profile to “FALSE”. Note that if Unspecified Import and Use Default Profile are both set to “TRUE”, the workbook will attribute zero capacity for all hours.

## Demand Response

Demand response should be entered similarly to basic physical resources, with the Use Default Profile column set to “TRUE”. Note this feature has not been implemented at this time. Resources will be added to the Master Resource Database when final 2024 values are available.

# RA Allocations

CAM and DR resources will be allocated by resource type. For resources with a fixed hourly profile, allocations will be made as an aggregate unit and debited or credited to an LSE’s hourly RA requirement.

## CAM Storage Allocations

CAM storage resources will be allocated as resources that can be shown flexibly by LSEs similarly to other storage resources. Each aggregate CAM storage resource will have particular characteristics (daily cycles, charging efficiency, etc.) that can be optimized. IOUs must show their negative CAM storage during the availability assessment hours.

The template should include a completed row in the LSE Showing worksheet to reflect the CAM Storage Allocations listed in the Requirements and Allocations worksheet. Either default or optimized profiles may be applied, although the default profile for storage resources does not reflect multi-cycle capabilities. Storage validation tests apply to CAM storage.

## Demand Response and Other CAM Allocations

DR Allocations and Other CAM Allocations are applied to showings through queries. These allocations apply default profiles which LSEs are not permitted to modify in their showings.

# Reviewing a Showing

Once a set of resources are defined in the worksheets with blue tabs, users can check whether the showing is compliant by reviewing the worksheets with golden tabs. The process for developing a valid showing may involve iteratively adjusting the shown resources, including custom and optimized resources, and reviewing the validation test results, charts, and complete showing.

## Validation Overview

The Validation Overview worksheet lists all validation tests performed within the workbook. Each test result, indicating “Pass” or “Fail,” represents a summary of a Power Query output on a hidden worksheet. If all tests pass, the showing may be ready to submit. The worksheet offers a brief description of each test, and users may investigate test results by un-hiding the corresponding worksheets, listed in Column D, which may provide information about the cause of a failed test. Buttons labeled “Go to Sheet” unhide and navigate to the listed worksheets. Users can use the buttons labeled “Refresh” to update the data supporting each test in order to ensure test results reflect the current showing. Additional information may be found by inspecting the pertinent query in the Power Query editor.

## LSE Showing Complete

After completing all relevant worksheets with blue-colored tabs (LSE Showing, Resource Custom Profiles, and Profile Optimization), the LSE Showing Complete worksheet will contain a summary of all information about the showing. Once submitted, the CPUC will extract data from the table in this worksheet as the data source used when validating the showing.

## Availability Charts

The three availability charts allow users to compare the capacities shown for each hour and for local and flexible resource adequacy against their requirements.

The Hourly Availability chart shows groups of resources as stacked bars contributing towards the total capacity shown during each slice-of-day hour. A black line overlaying the bars indicates the system requirements adjusted for any CAM and DR allocations aside from storage. A compliant showing must have capacities at or above the requirements for each hour plus sufficient excess capacity to account for storage charging and losses.

The Local and Flex Availability charts show the same groupings of resources as stacked bars with the contributing capacities toward each local capacity area and flexible capacity category. Black points indicate the local and flexible RA requirements. A compliant showing must have capacities at or above the requirements for each applicable local area and meet the flexible RA requirement.

# Power Query

The template contains 34 queries organized into six groups based on their use. All queries are available for inspection in the Power Query Editor. To access the Power Query Editor from the Excel Ribbon Menu select:

Data 🡪 Queries and Connections 🡪 Double-click on any listed query

Power Query is primarily an extract, transform, and load (ETL) utility that has been built into Excel since 2010. The tool allows for queries to be written in Microsoft’s proprietary M language and translates these queries to connect to a variety of underlying data sources, such as external flat files and offsite SQL servers.

Although capable of managing external connections, Power Query is used in this case to work with data contained within the single Excel workbook constituting the Resource Adequacy Slice-of-Day Showing template. Power Query provides some advantages over cell-based formula calculations particularly when handling variably-sized data tables. Specifically, Power Query is designed to operate on data tables rather than individual values, so table and column references tend to be more intuitive and readable in calculations than equivalent calculations in cell formulas. Furthermore, complicated calculations can be presented as a sequence of table operations within the Power Query editor, presented as Steps, available for inspection but otherwise out of the way for users interested only in the outputs. Similar calculations in cell formulas may require either convoluted formulas in a small number of cells or a large number of cells with less complicated formulas which are nonetheless difficult to read and understand across steps.

One downside of Power Query is its speed. Users accustomed to immediate results when updating formulas or values in Excel cells may find the need to refresh tables generated by queries cumbersome or be put off by the comparatively slow loading times to and from Power Query. While query performance was a consideration when developing the template and designing the queries, some tables may still take several seconds to refresh. We recommend avoiding using the “Refresh All” tool, and instead refreshing individual tables only when necessary as this significantly improves processing speed. VBA scripts are included to control when queries refresh using manual button controls and worksheet events. These should help limit the number of queries refreshing at a given time and minimize time spent waiting for queries. Additionally, it may be possible to further optimize the queries in future versions of the template to improve loading times.

The queries are grouped according to their purpose, with each group described in the following subsections.

## Resource Information

The five queries in this group correspond to the two visible and three hidden worksheets with green tabs, extracting data from the tables contained therein and applying filters and transformations to make the data useable in later queries.

*ResourceDatabase* – This query loads data from the Master Resource Database worksheet and joins the table to the ResourceNQC and ResourceDefaultProfiles queries, using the ResourceProfileCategories and Regions queries as intermediate lookup tables. The joined table is used throughout the queries discussed in later subsections.

*ResourceNQC* – This query loads data from the Resource NQC worksheet. The table is filtered based on the current month indicated in the Certification query and reshaped to have 24 value columns representing each slice-of-day hour.

*ResourceDefaultProfiles* – This query loads data from the Resource Default Profiles worksheet. The table is designed to allow many resources to match each profile, based on several resource properties listed in the ResourceDatabase query, as described for the ResourceProfileCategories and Regions queries below.

*ResourceProfileCategories* – This query loads data from the Resource Profile Categories worksheet. The query is a small lookup table that matches the Resource Type values listed in the ResourceDatabase query and the ProfileCategory values listed in the ResourceDefaultProfiles query.

Regions – This query loads data from the Regions worksheet. The query is a small lookup table that matches combinations of Path 26 Designation and Balancing Authority Area values listed in the ResourceDatabase query and Region values listed in the ResourceDefaultProfiles query.

## Requirements and Allocations

The seven queries in this group include one query which extracts data from the Requirements and Allocations worksheet with an orange tab, and six queries which filter the data for specific uses.

*RequirementsAndAllocations* – This query loads data from the Requirements and Allocations worksheet and reshapes the table to have 24 value columns representing each slice-of-day hour, along with one additional value column for non-slice of day requirements and allocations.

*SystemRequirements* – This query contains a subset of the RequirementsAndAllocations, filtered to the single row with the Name column containing “System Requirements”.

*LocalRequirements* – This query contains a subset of the RequirementsAndAllocations, filtered to include only rows where the Name column is “Local RA”.

*FlexRequirements* – This query contains a subset of the RequirementsAndAllocations, filtered to include only rows where the Name column is “Flex RA”.

*StorageAllocations* – This query contains a subset of the RequirementsAndAllocations, filtered to the single row with the Name column containing “CAM Storage Allocation”.

*DRAllocations* – This query contains a subset of the RequirementsAndAllocations, filtered to the single row with the Name column containing “DR Allocation”.

*OtherAllocations* – This query contains a subset of the RequirementsAndAllocations, filtered to the single row with the Name column containing “Other CAM Allocation”.

## Showing Information

The three queries in this group represent the information completed by LSEs in the worksheets with blue tabs.

*Certification* – This query loads data from the hidden CertificationTable worksheet which itself pulls data from the Certification worksheet into a table format.

*ResourceCustomProfiles* – This query loads data from the Resource Custom Profiles worksheet.

*LSEShowingProfilesUnoptimized* – This query loads data from the LSE Showing worksheet and joins the table to the ResourceDatabase and ResourceCustomProfiles queries.

## Exports for Optimization

This group of five queries prepares showing and resource data from groups described above for hourly showing optimization using Solver in the Profile Optimization worksheet.

*LSEShowingUnshownRequirements* – This query filters the resources in the LSEShowingProfilesUnoptimized query for resources that use either default or custom profiles. The query then evaluates the hourly differences between the SystemRequirements query results and the sum of the shown capacities of the filtered resources. The results are then reshaped to be loaded into the Profile Optimization worksheet under the label “Unshown Resource Adequacy”.

*OptimizationGroups* – This query loads the LSEShowingUnoptimized query results, applies the complementary filter to the LSEShowingUnshownRequirement query to include only resources requiring optimization, and generates labels for each filtered resource. The labels depend on the total number of resources requiring optimization—if the number of resources exceeds four, resources are grouped according to their physical storage characteristics with the same labels applied within each group, otherwise the label is unique to each resource. The threshold of four is used due to limitations in the number of decision variables Excel’s Solver can set. The results are used in later queries and not loaded to the workbook.

*LSEShowingProfilesForOptimization* – This query loads the LSEShowingUnoptimized query results, applies the same filter as the OptimizationGroups query, and joins the OptimizationGroups labels. Each group is then expanded to up to 24 rows based on the first and last available hours within each group. The resulting table is loaded into the Profile Optimization Worksheet under the label “Resource or Group Hourly Optimization”.

*ResourceGroupsForOptimization* – This query loads the LSEShowingUnoptimized query, applies the same filter as the OptimizationGroups query, and joins the OptimizationGroups query. The labels generated in the OptimizationGroups query are joined, and the table is grouped according to the labels. The resulting table includes group information required in constraining the optimization and is loaded into the Profile Optimization Worksheet under the label “Resource or Group Information”.

*LSEShowingProfilesOptimized* – This query re-loads the table exported by the LSEShowingProfilesForOptimization query in the Profile Optimization worksheet with additional columns including “Show Hour” which is applied in later queries to individual resources within each group to determine their hourly shown capacities.

## Exports for Validation Tests

The 11 queries in this group represent different aspects of the complete Resource Adequacy showing, including shown resources with their default, custom, or optimized profiles. Each query is exported to a worksheet with a golden tab, with all but one hidden by default.

*LSEShowingComplete* – This query combines the resource listed in the LSE Showing tab with whichever slice-of-day profile is selected and appends Demand Response and Other CAM allocations. The results are loaded to the LSE Showing complete worksheet.

*CheckCapacity* – This query compares system requirements and allocations against the total shown capacities of resources. A compliant showing must show positive values for each row in the Delta Capacity (MW) column. The results are loaded to the hidden Check Capacity worksheet.

*CheckLocal* – This query lists each resource and Local RA requirements, with the required or shown capacities for each local capacity area. The sum of capacities within each local capacity area must be positive in a compliant showing. The results are loaded to the hidden Check Local worksheet.

*CheckFlex* – This query lists each resource and Flexible RA requirements, with the required or shown capacities for the three flexible categories. The sum of capacities within each flexible category must be positive in a compliant showing. The results are loaded to the hidden Check Flex worksheet.

*CheckContractDates* – This query compares the contract Effective Start and End Dates for each shown resource against the current showing month listed in the Certification worksheet and checks whether the capacity will be available throughout the showing month. The results are loaded to the Check Contract Dates worksheet.

*CheckCustomProfiles* – This query compares shown capacities in any custom profiles against the NQC or total VER MW Under Contract listed in the LSE Showing worksheet and the NQC MW in the ResourceDatabase query to ensure the custom profile does not exceed either value during any hour. The results are loaded to the Check Custom Profiles worksheet.

*CheckShownHours* – This query determines the hours during which the active profile for each resource shows capacity. The shown hours are compared against the first and last available hours listed in the Master Resource Database worksheet. The results are loaded to the Check Shown Hours worksheet.

*CheckStorageExcessCapacity* – This query compares excess capacity from non-storage resources and allocations shown above hourly system requirements against the total storage capacity shown, accounting for efficiency losses. Compliant showings must provide sufficient excess capacity to charge shown storage resources. The results are loaded to the Check Storage Excess Capacity worksheet.

*CheckStorageSOC* - This query estimates the state-of-charge for each storage resource at each slice-of-day hour in terms of MWh available energy. The query assumes starting at 0 MWh and cannot exceed the resource’s Maximum Continuous Energy (MWh) listed on the Master Resource Database worksheet. The results are loaded to the Check Storage SOC worksheet.

*CheckGroupedResources* – This query identifies co-located or hybrid resources which share an interconnection and calculates the combined capacities for each hour. A compliant showing must not exceed the interconnection limit. Results are loaded to the Check Grouped Resources worksheet.

*CheckHybridDeliverability* – This query identifies hybrid resources, which share a Resource ID and have unique Resource SubIDs and determines the deliverable capacity for the solar resource based on its Deliverability Status and the attributes of both resources in each hybrid pair. The results are loaded to the Check Hybrid Deliverability worksheet.

## Exports for Charts

The three queries in this group serve as the backing datasets for each of the three charts. Each of the queries load to hidden worksheets with grey tabs. Resources are grouped using labels consistent across all three charts to reduce clutter and to maintain the chart formatting as the data changes.

*HourlyAvailability* – This query groups resources and combines requirements with DR Allocations and Other CAM Allocations. The hourly shown and required less allocated capacities are loaded to the Hourly Availability worksheet.

*LocalAvailability* – This query groups resources and shows local requirements for each local capacity area. The results are loaded to the Local Availability worksheet.

*FlexAvailability* – This query groups resources and shows local requirements for each flexible category. The results are loaded to the Flex Availability worksheet.

# Conclusion

We hope this template is helpful for developing compliant resource adequacy showings in the slice-of-day framework and anticipate further refinement as it is used by more people throughout the upcoming year. We look forward to your feedback and questions as you begin to use the template.