Resource Adequacy Slice-of-Day Load Forecast and Showing Template

September 7, 2023

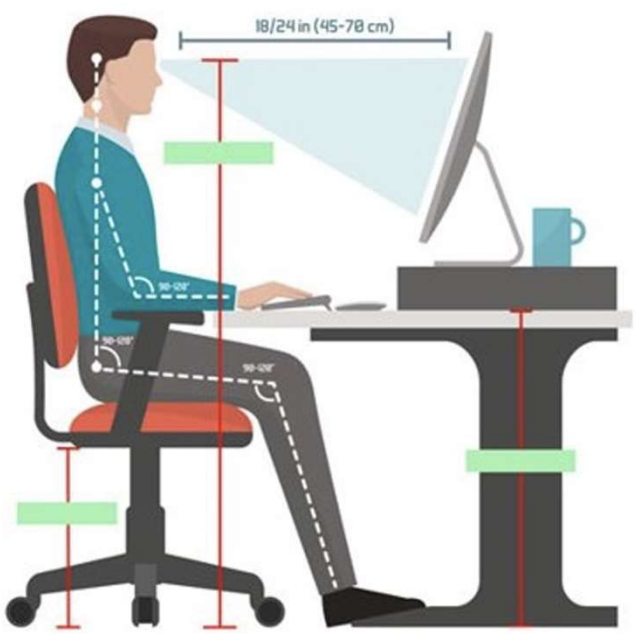
California Public Utilities Commission

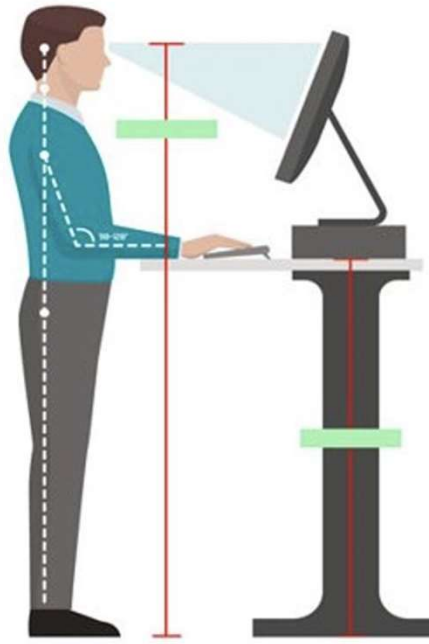
Logistics

- Online and will be recorded

- Today's presentation & recording will be uploaded onto RA history website
  - https://www.cpuc.ca.gov/General.aspx?id=6316

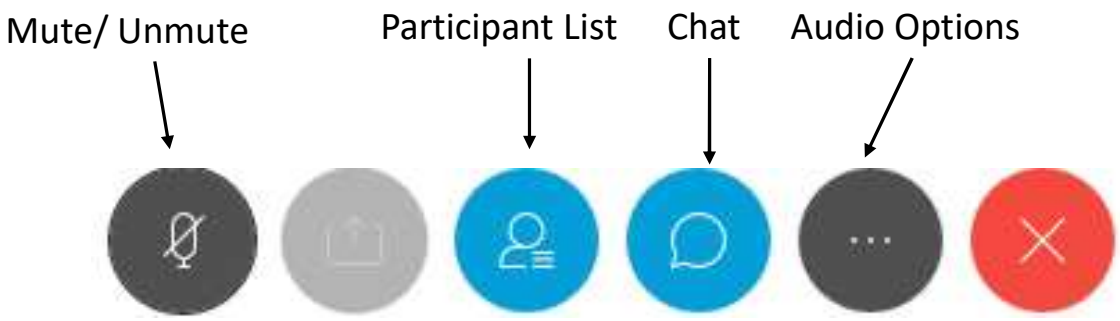
- Safety
  - Note surroundings and emergency exits
  - Ergonomic check



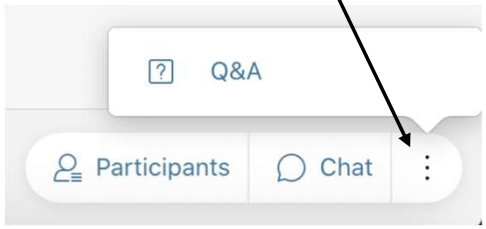


Logistics

- All attendees have been muted
- To ask questions, please use the "Q&A" function (send "To All Panelists") or raise your hand
- Questions will be read aloud by staff; attendees may be unmuted to respond to the answer. (Reminder: Mute back!)



"Q&A": on the bottom right of screen, click "3 dots"



RA Reform Background

- D.21-07-014: **Adopted "slice-of-day" (SOD) concept and six principles.** Established a process and timeline for developing a final restructuring proposal based on PG&E's "slice-of-day" proposal.
- D.22-06-050: **Adopted SCE's 24-hour approach to the "slice of day" framework.** Directed additional working groups and submittal of a working group report to address remaining implementation details.
- D.23-04-010: **Adopted implementation details** including compliance tools, resource counting rules, test year details and coordination with CAISO processes.

Next Steps – *Test Year Implementation*

- **LSE Compliance Templates** – Used for SOD RA showings.
- **Master Resource Database (MRD)** – CPUC will maintain an official database of resources eligible to sell RA that includes their key attributes, as listed below. Resources must be fully represented in the MRD to be eligible for use in the 24-hour slice RA showing.
- **Planning Reserve Margin (PRM) Calibration** – A SOD calibration tool is adopted that will convert the results of a LOLE study to the SOD framework.
- **LSE Filings for 2024 Test Year** – LSEs are required to make year-ahead SOD filing by November 30, 2023, and month-ahead compliance showings for March, June and September by the first day of the showing month.
  - SOD showings also used if LSE showing storage in MCC bucket 4.
- **Assessment Report** – CPUC staff to solicit public feedback after key milestones during the 2024 test year, and to prepare a report summarizing the feedback after the year-ahead test showings (due by February 1, 2024). Stakeholders will have an opportunity to provide formal comment on the staff report.

Agenda

- Update on Hourly Load Forecast – Lynn Marshall, CEC
- Slice of Day Showing Tool – Robert Hansen, Energy Division

Resource Adequacy Monthly Slice-of-Day Showing Proposed Template

Design and Usage

September 7, 2023

Presented by Robert Hansen

Senior Utilities Engineer

Resource Modeling Team

California Public Utilities Commission

Outline

- Presentation Objectives
- Template Design
- Preparing a Showing
- Reviewing a Showing
- Demonstration
- Project Timeline
- Questions

Presentation Objectives

Introducing the Resource Adequacy Slice-of-Day Showing Template

Presentation Objectives

- Familiarize users with the template design
- Demonstrate how to input a slice-of-day showing
- Review validation tests
- Address user questions

Template Design

Overview of the Slice-of-Day Resource Adequacy Showing Template

Template Design – *Primary Considerations*

The Slice-of-Day RA Template should:

- Clearly communicate capacity obligations and allocations to Load-Serving Entities
- Integrate with the new Slice-of-Day framework for system requirements
- Provide built-in validation checks to test showings prior to submittal
- Offer useful charts to visually compare showing against requirements
- Help users show single- and multi-cycle storage resources based on need

Tables and Queries

Higher-order data structures for improved stability

Template Design

Tables and Queries

- More structured than Cells and Ranges
- Manageable naming for tables and columns
- Automatically resizes range for, e.g., aggregation calculations
- Data Connections load Tables defined in Worksheets into Power Query, effectively building a relational database inside a single Excel file
- Query calculations tend to be easier to read and follow across multiple steps than equivalent cell formulas
- The M language used in Power Query differs from Excel formulas, but should be comprehensible to many users familiar with Excel

Template Design – *Tables vs. Ranges*

Range of Cells

	A	B	C
1	Column 1	Column 3	Column 3
2	Row 1	417	120
3	Row 2	433	872
4	Row 3	380	313

Excel Formula:

=SUM(B2:B4)

Result:

1,230

Table

	A	B	C
1	Column 1	Column 2	Column 3
2	Row 1	417	120
3	Row 2	433	872
4	Row 3	380	313

Excel Formula:

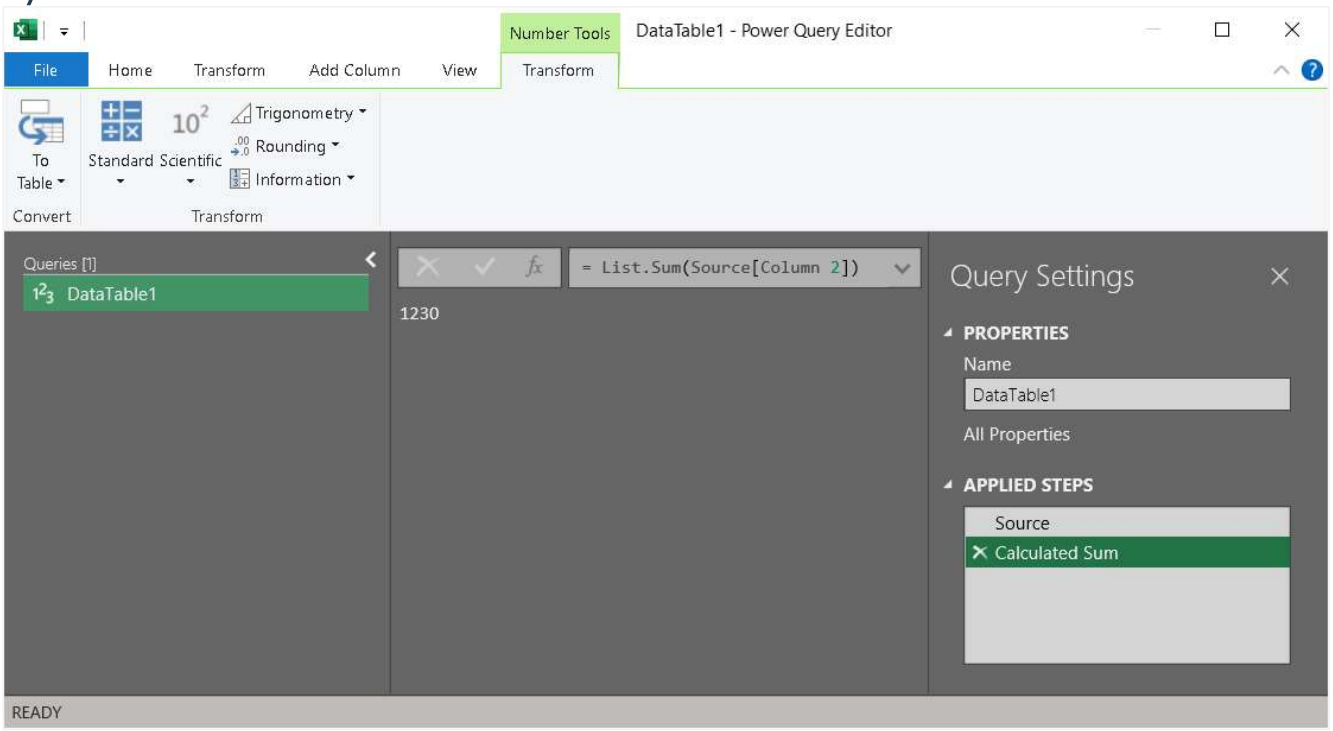
=SUM(Table1[Column 2])

Result:

1,230

Template Design – *Queries*

Power Query Editor



Template Design – *Queries vs. Cell Formulas*

Example Comparison: Checking Number of Hours Shown

- Power Query:

```
#"Added Valid Hours" = Table.AddColumn(
        #"Expanded ResourceMasterDatabase",
        "Valid Hours",
        each [Hours Shown] <= [ResourceDatabase.Maximum Daily Run Hours],
        type logical
)
```

- Cell Formula:

```
=IF(
        COUNTIF($O13:$AL13,">0") <= INDEX(
                Master_Resource_Table,
                MATCH(@Showing_Resource_ID,Master_Resource_ID,0),
                MATCH('3. LSE Showing'!CV$12,
                Master_Category_List,
                0
        )
),"Pass","Fail")
```

Workbook Organization

Distinguish data sets based on their source

Workbook Organization

Three types of data built into the template file in color-coded groups of sheets:

- LSE Showing (Inputs)

- LSE Requirements and Allocations (Included and unique to each LSE)

- Resource Descriptions (Included and common across LSEs)

Workbook Organization

Two groups of sheets used for reviewing a showing:

- Tabulated Results

- Showing Charts

Workbook Organization

- Most worksheets contains a single table
  - This should make it easier to find and input required information
  - "Certification" contains no table, instead maintaining a format similar to the LSE Filing template, but its data is loaded into a table in the hidden "Certification Table" sheet
  - "Profile Optimization" contains multiple tables to setup an optimization problem for Solver

Workbook Organization

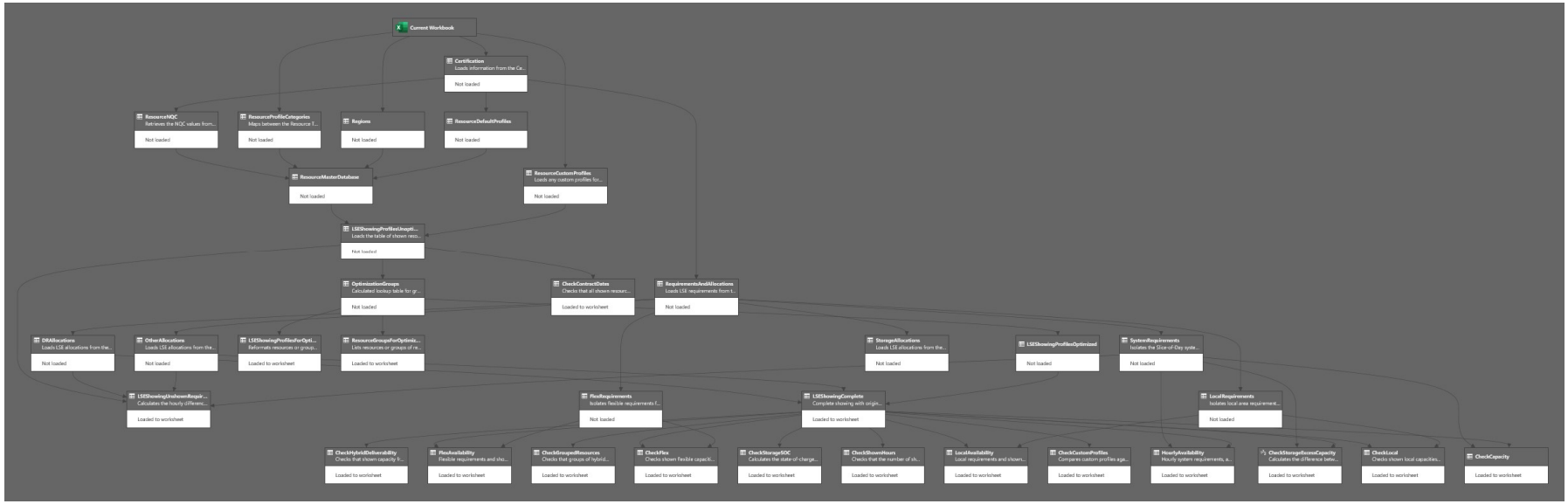
- Only the LSE Showing worksheets (blue tabs) should be edited by LSEs
- LSE Requirements worksheets (orange tabs) and Resource description worksheets (green tabs) will be updated by CPUC and included in blank templates sent to each LSE
- The Showing Results and Information worksheets (gold and grey tabs) update automatically and can help determine whether a showing is compliant

Workbook Organization

- Input tables are loaded into Power Query for most calculations
- See Data→Queries & Connections in the ribbon menu for the list of queries
- Double-click on any listed query to open the Power Query Editor and inspect the calculations

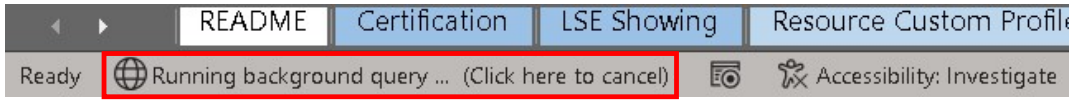
Workbook Organization – *Power Query*

Interconnected Queries handle most calculations and load results to worksheets



Workbook Organization – *Power Query*

- Queries must be refreshed after changes to input data
- VBA scripts trigger refreshes when opening certain sheets to refresh relevant queries only when necessary (see "ThisWorkbook" in the VBA editor):
  - LSE Showing Complete
  - System Availability Chart
  - Local Availability Chart
  - Flex Availability Chart
- Buttons on two sheets allow users to manually trigger refreshes as needed
  - Profile Optimization
  - Validation Overview
- Refresh status appears at the bottom of the window



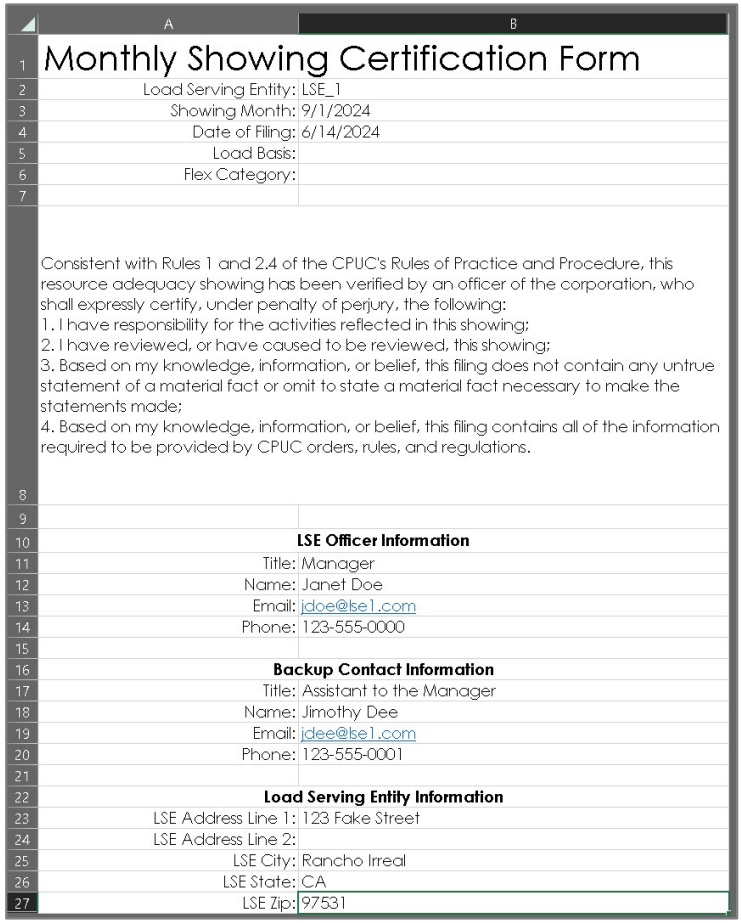
Preparing a Showing

Specifying Resources and Slice-of-Day Profiles

Preparing a Showing

Certification Form

- Should be partially completed upon receipt with at minimum the LSE name and showing month
- Fill in with all applicable information
- The form constitutes attestation of a submitted showing's accuracy



	A	B
1	Monthly Showing Certification Form	
2	Load Serving Entity:	LSE_1
3	Showing Month:	9/1/2024
4	Date of Filing:	6/14/2024
5	Load Basis:	
6	Flex Category:	
7		
8	Consistent with Rules 1 and 2.4 of the CPUC's Rules of Practice and Procedure, this resource adequacy showing has been verified by an officer of the corporation, who shall expressly certify, under penalty of perjury, the following: 1. I have responsibility for the activities reflected in this showing; 2. I have reviewed, or have caused to be reviewed, this showing; 3. Based on my knowledge, information, or belief, this filing does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made; 4. Based on my knowledge, information, or belief, this filing contains all of the information required to be provided by CPUC orders, rules, and regulations.	
9		
10	**LSE Officer Information**	
11	Title:	Manager
12	Name:	Janet Doe
13	Email:	jdoe@lse1.com
14	Phone:	123-555-0000
15		
16	**Backup Contact Information**	
17	Title:	Assistant to the Manager
18	Name:	Jimothy Dee
19	Email:	jdee@lse1.com
20	Phone:	123-555-0001
21		
22	**Load Serving Entity Information**	
23	LSE Address Line 1:	123 Fake Street
24	LSE Address Line 2:	
25	LSE City:	Rancho Irreal
26	LSE State:	CA
27	LSE Zip:	97531

Preparing a Showing – *LSE Showing Worksheet*

LSE Showing

- Pre-filled with any CAM Storage allocation
- Input additional resources as new rows in the table
- Resource IDs and SubIDs generally must match Resource Database
- "Use Default Profile" for most resources, unless specifying a custom profile or requiring automated optimization

	A	B	C	D	E	F	G	H	I	J	K	L
1	Contract ID	Resource ID	Resource SubID	NQC or VER Under Contract (MW)	Local RA (MW)	Committed Flexible RA (MW)	Capacity Effective Start Date	Capacity Effective End Date	SCID or Counterparty if not available	MCC Bucket 4	Unspecified Import	Use Default Profile
2	CAM Storage	CAM Storage 2		20	0	0	2024-09-01	2024-09-30	TEST	FALSE	FALSE	FALSE
3												
4												
5												
6												
7												
8												

Contract ID
Enter a contract identifier associated with each resource. Several resources may share a single Contract ID.

Preparing a Showing – *LSE Showing Worksheet*

LSE Showing

- The showing month indicated on the Certification worksheet must be fully contained by the Capacity Effective Start and End Dates
- Unspecified Import resources need not match Resource Database but need to be flagged as such
- Storage resources indicated as MCC Bucket 4 are subject to the both the regular Storage Excess Capacity Test and a second, similar test for MCC Bucket 4.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Contract ID	Resource ID	Resource SubID	NQC or VER Under Contract (MW)	Local RA (MW)	Committed Flexible RA (MW)	Capacity Effective Start Date	Capacity Effective End Date	SCID or Counterparty if not available	MCC Bucket 4	Unspecified Import	Use Default Profile
2	CAM Storage	CAM Storage 2		20	0	0	2024-09-01	2024-09-30	TEST	FALSE	FALSE	FALSE
3												
4												
5												
6												
7												
8												

Contract ID
Enter a contract identifier associated with each resource. Several resources may share a single Contract ID.

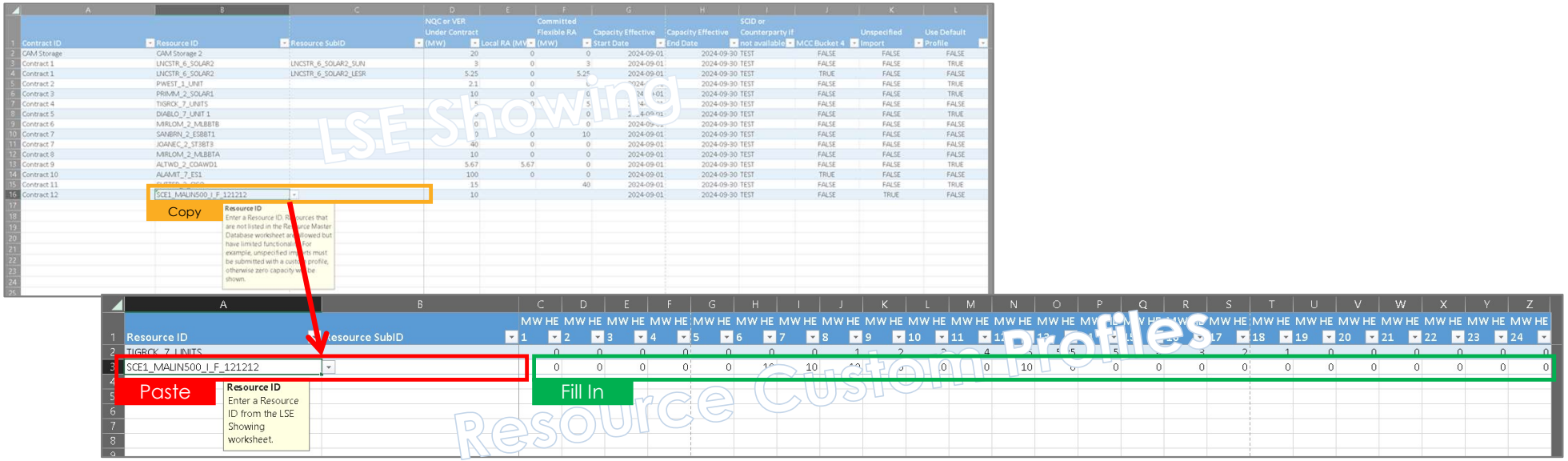
LSE Showing

Preparing a Showing – *Resource Custom Profiles*

When default slice-of-day profiles are not applicable for resources, custom profiles may be entered manually

- Set "Default Profile" to false on the LSE Showing worksheet
- Copy Resource ID and SubID from LSE Showing worksheet into a new Resource Custom Profiles worksheet
- Fill in custom MW capacities for each slice-of-day hour
- Custom profiles must not exceed NQC or VER MW Under Contract

Preparing a Showing – *Resource Custom Profiles*



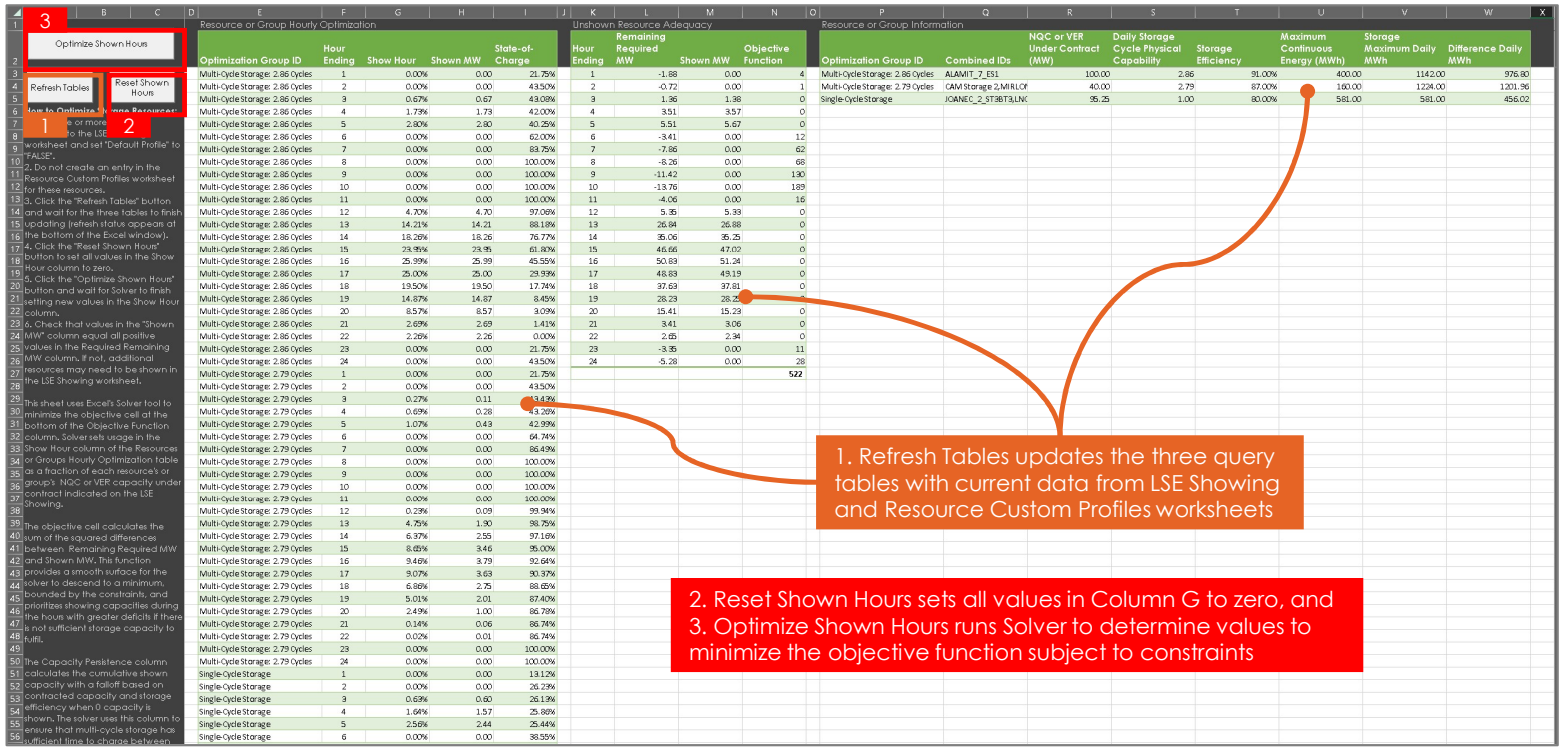
Preparing a Showing – *Optimize Storage Profiles*

Storage resources may be shown with default, custom, or optimized profiles

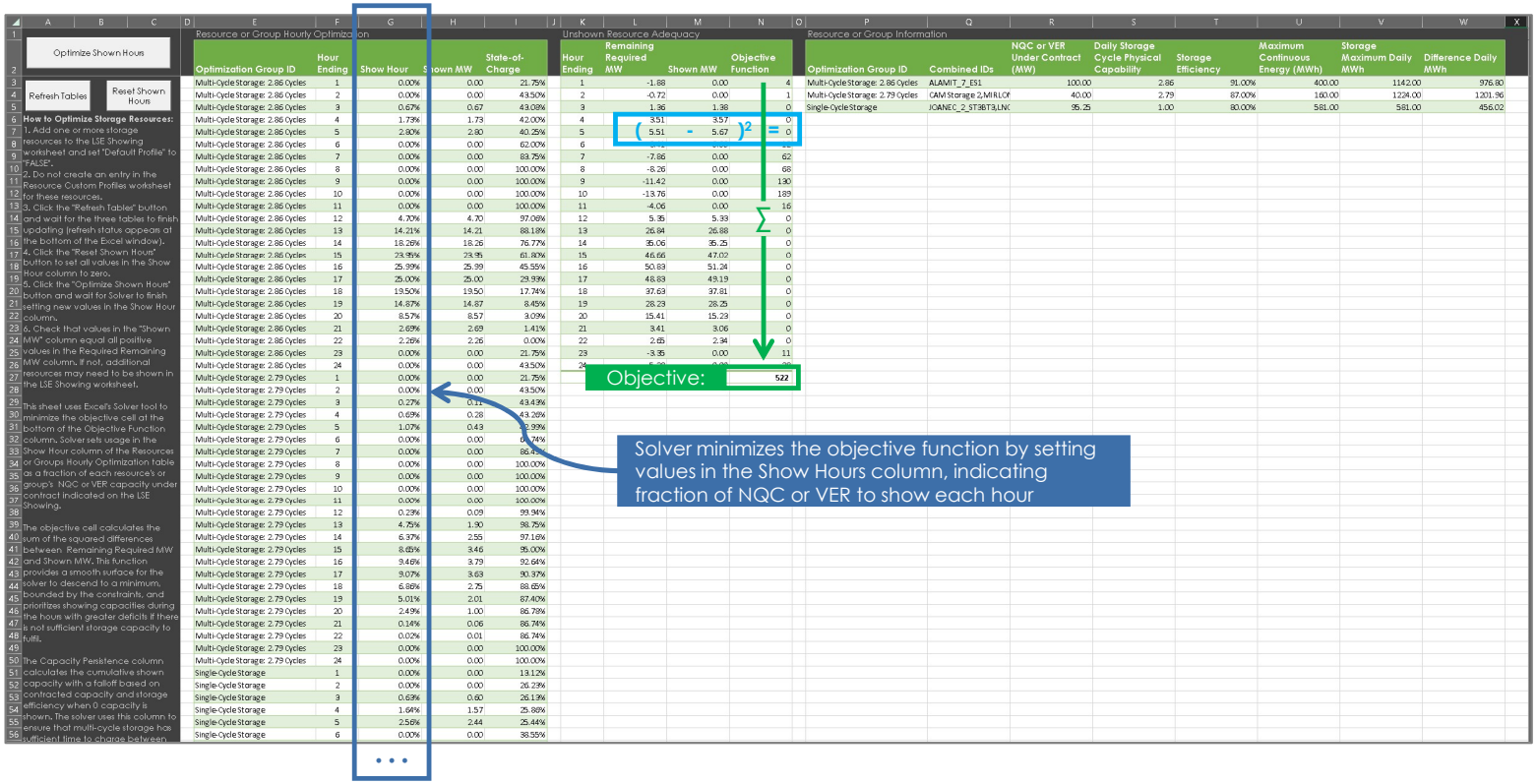
To automatically optimize storage resources according to their physical capabilities:

- Set "Default Profile" to false on the LSE Showing worksheet
- Do not list the resources in Resource Custom Profiles worksheet
- On the Optimize Profiles worksheet, click the three buttons in the following sequence:
  1. Refresh Tables
  2. Reset Shown Hours
  3. Optimize Shown Hours

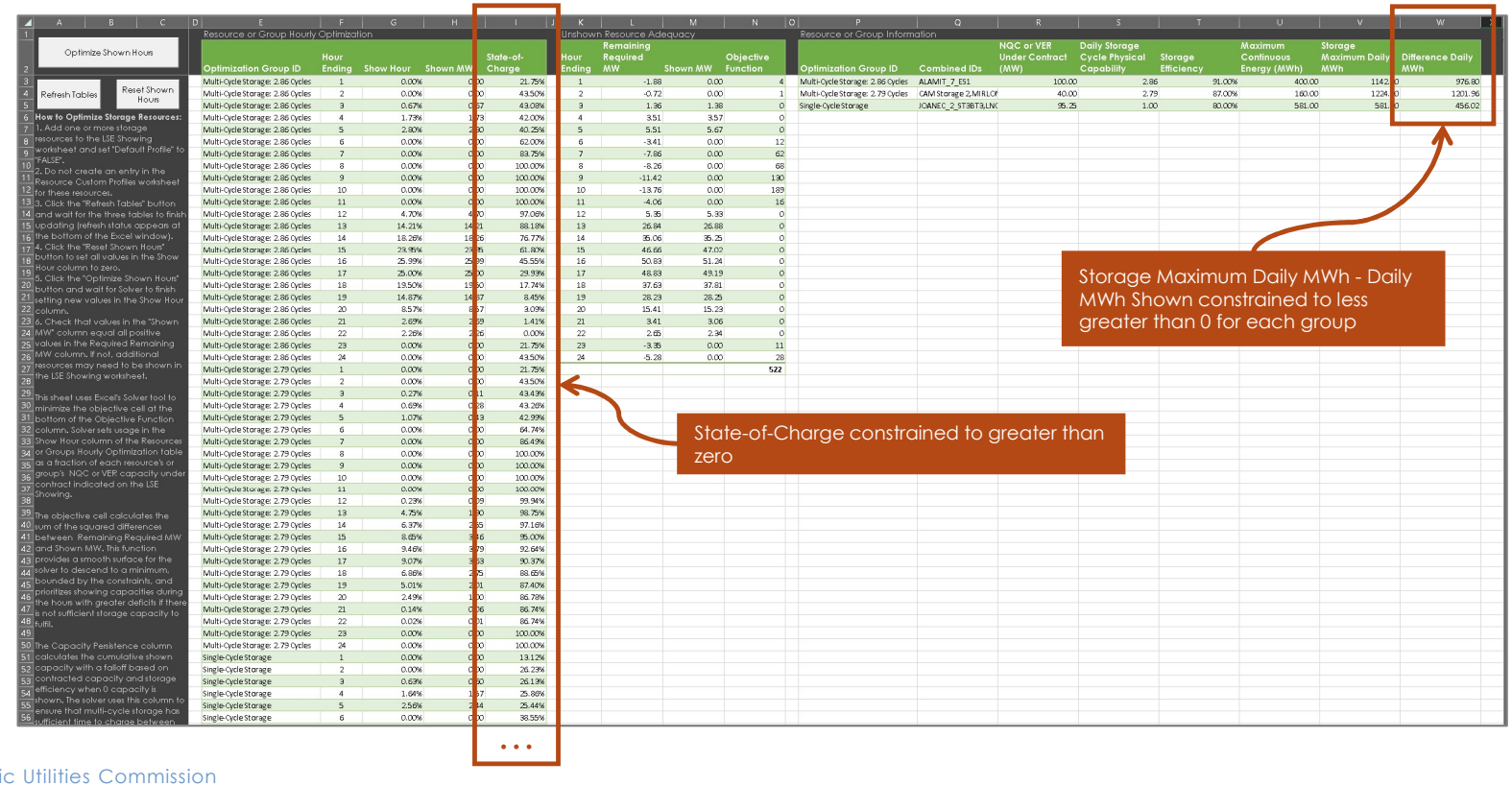
Preparing a Showing – *Optimize Storage Profiles*



Preparing a Showing – *Optimize Storage Profiles*



Preparing a Showing – *Optimize Storage Profiles*



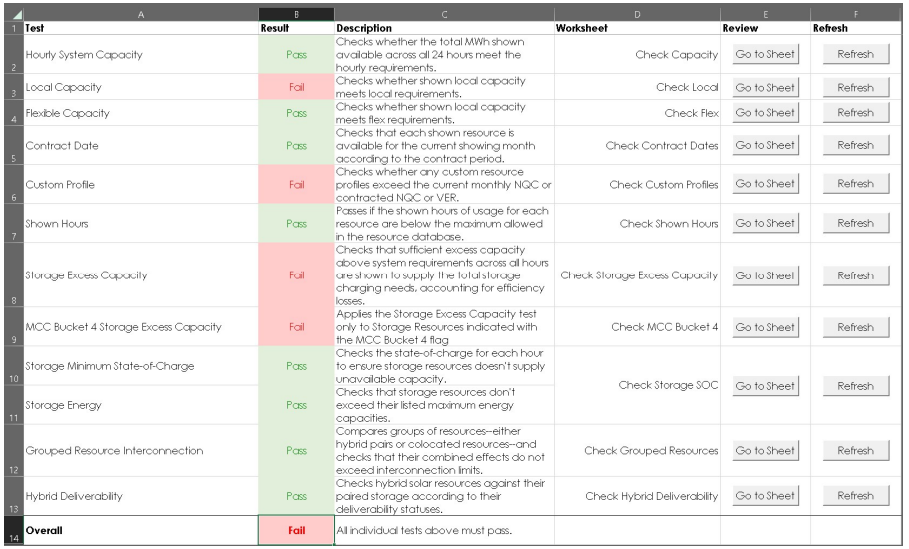
Reviewing a Showing

Test results and charts

Built-In Validation Tests

Built-In Validation Tests

- Multiple validation checks are summarized on the Validation Overview sheet
- No tests can fail for a valid showing
  - For test year, the Storage Excess Capacity test may fail as long as the MCC Bucket 4 test passes
  - The overall test will indicate Fail
  - The MCC Bucket 4 test will be removed following the test year



	A	B	C	D	E	F
1	**Test**	**Result**	**Description**	**Worksheet**	**Review**	**Refresh**
2	Hourly System Capacity	Pass	Checks whether the total MWh shown available across all 24 hours meet the hourly requirements.	Check Capacity	Go to Sheet	Refresh
3	Local Capacity	Fail	Checks whether shown local capacity meets local requirements.	Check Local	Go to Sheet	Refresh
4	Flexible Capacity	Pass	Checks whether shown local capacity meets flex requirements.	Check Flex	Go to Sheet	Refresh
5	Contract Date	Pass	Checks that each shown resource is available for the current showing month according to the contract period.	Check Contract Dates	Go to Sheet	Refresh
6	Custom Profile	Fail	Checks whether any custom resource profiles exceed the current monthly NQC or contracted NQC or VER.	Check Custom Profiles	Go to Sheet	Refresh
7	Shown Hours	Pass	Passes if the shown hours of usage for each resource are below the maximum allowed in the resource database.	Check Shown Hours	Go to Sheet	Refresh
8	Storage Excess Capacity	Fail	Checks that sufficient excess capacity above system requirements across all hours are shown to supply the total storage charging needs, accounting for efficiency losses.	Check Storage Excess Capacity	Go to Sheet	Refresh
9	MCC Bucket 4 Storage Excess Capacity	Fail	Applies the Storage Excess Capacity test only to Storage Resources indicated with the MCC Bucket 4 flag	Check MCC Bucket 4	Go to Sheet	Refresh
10	Storage Minimum State-of-Charge	Pass	Checks the state-of-charge for each hour to ensure storage resources doesn't supply unavailable capacity.	Check Storage SOC	Go to Sheet	Refresh
11	Storage Energy	Pass	Checks that storage resources don't exceed their listed maximum energy capacities.			
12	Grouped Resource Interconnection	Pass	Compares groups of resources--either hybrid pairs or colocated resources--and checks that their combined effects do not exceed interconnection limits.	Check Grouped Resources	Go to Sheet	Refresh
13	Hybrid Deliverability	Pass	Checks hybrid solar resources against their paired storage according to their deliverability statuses.	Check Hybrid Deliverability	Go to Sheet	Refresh
14	**Overall**	**Fail**	All individual tests above must pass.			

Built-In Validation Tests

RA Capacity Showing Check – Compares overall system capacities of all shown resources against LSE obligation

Contract Date Check – Compares each resource's start and end dates in the Resource Database against the current filing month

Custom Profile Check – Compares any custom capacity profiles against resource limitations defined in the Resource Database

Hourly Capacity Check – Compares the number of hours each resource is shown supplying capacity against the listed maximum daily run hours in the Resource Database

Built-In Validation Tests

Local Check – Compares shown capacities in each local area against the LSE's local obligations

Flex Check – Compares shown capacities for each flexible category against the LSE's flex obligations

Storage State-of-Charge Check – Verifies that storage resource states of charge do not fall below zero

Built-In Validation Tests

Storage Capacity Exceedance Check – Verifies that overall shown negative capacity does not exceed shown energy storage across all resources

MCC Bucket 4 Storage Capacity Exceedance Check – Verifies that overall shown negative capacity does not exceed shown energy storage across MCC Bucket 4 resources

Storage Energy Check – Verifies that individual storage resource states of charge do not exceed their energy storage capabilities

Storage Charge/Discharge Rate Check – Verifies that storage resource states do not exceed their charge or discharge capacities

Built-In Validation Tests

Grouped Resource Interconnection – Verifies that collocated and hybrid resources do not exceed their shared interconnection limits

Hybrid Deliverability – Checks the deliverability status of hybrid solar resources and verifies shown capacities do not exceed the applicable deliverable limits.

Built-In Validation Tests

- Click “Refresh” to update the data for each test
- More detailed results can be accessed by clicking “Go to Sheet”
- Main calculations are accessible from the Power Query Editor

	A	B	C	D	E	F
1	**Test**	**Result**	**Description**	**Worksheet**	**Review**	**Refresh**
2	Hourly System Capacity	Pass	Checks whether the total MWh shown available across all 24 hours meet the hourly requirements.	Check Capacity	Go to Sheet	Refresh
3	Local Capacity	Fail	Checks whether shown local capacity meets local requirements.	Check Local	Go to Sheet	Refresh
4	Flexible Capacity	Pass	Checks whether shown local capacity meets flex requirements.	Check Flex	Go to Sheet	Refresh
5	Contract Date	Pass	Checks that each shown resource is available for the current showing month according to the contract period.	Check Contract Dates	Go to Sheet	Refresh
6	Custom Profile	Fail	Checks whether any custom resource profiles exceed the current monthly NQC or contracted NQC or VER.	Check Custom Profiles	Go to Sheet	Refresh
7	Shown Hours	Pass	Passes if the shown hours of usage for each resource are below the maximum allowed in the resource database.	Check Shown Hours	Go to Sheet	Refresh
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10	Storage Minimum State-of-Charge	Pass	Checks the state-of-charge for each hour to ensure storage resources doesn't supply unavailable capacity.	Check Storage SOC	Go to Sheet	Refresh
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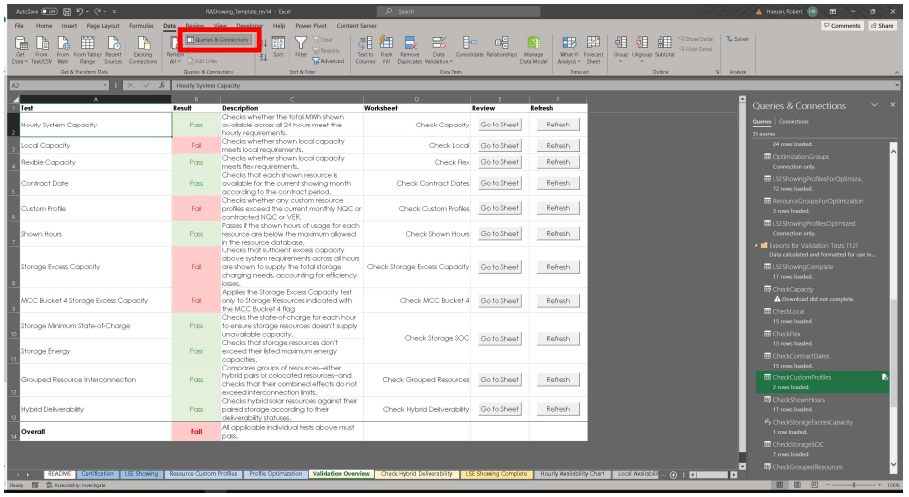
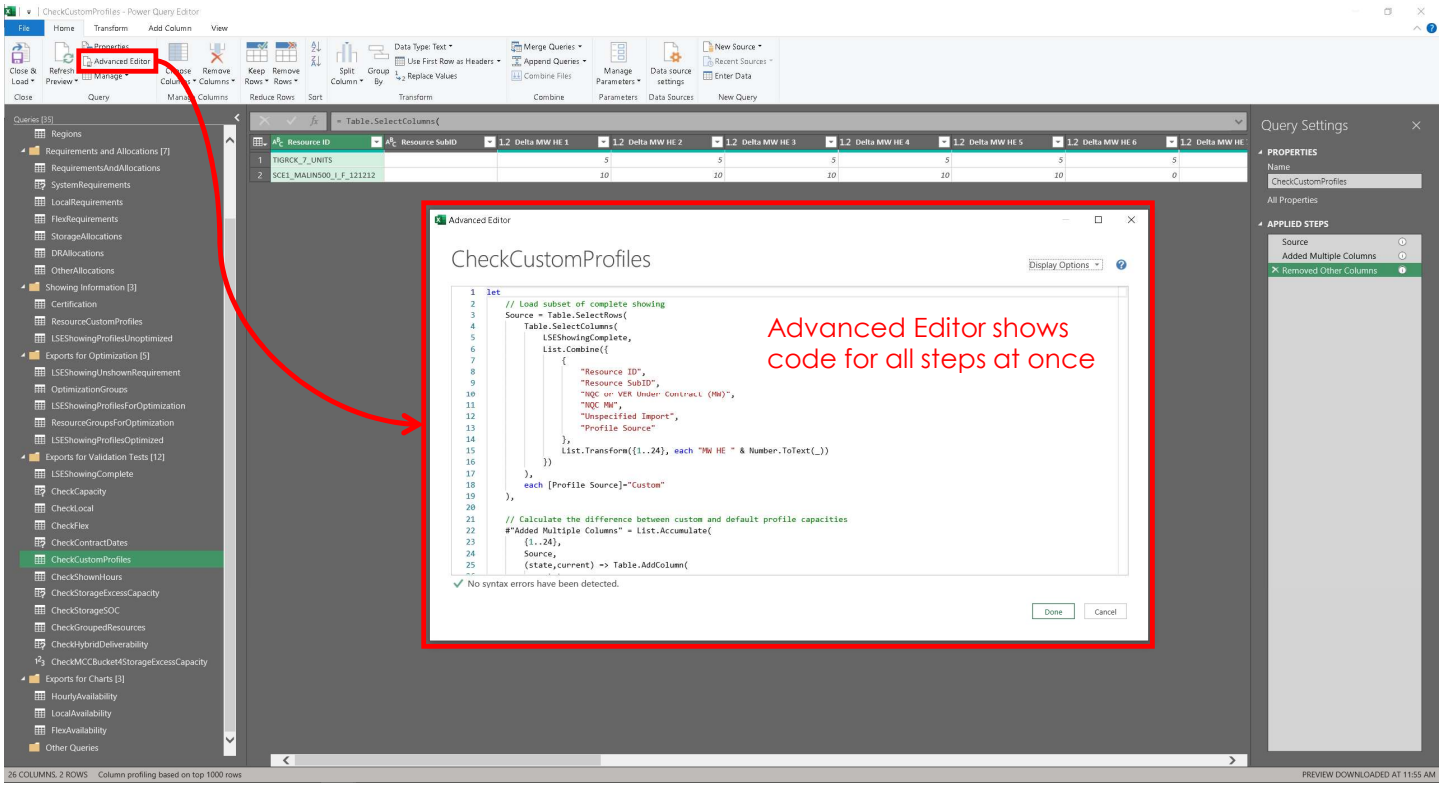
13	Hybrid Deliverability	Pass	Checks hybrid solar resources against their paired storage according to their deliverability statuses.	Check Hybrid Deliverability	Go to Sheet	Refresh
14	**Overall**	**Fail**	All individual tests above must pass.			

Built-In Validation Tests – *Reviewing Queries*

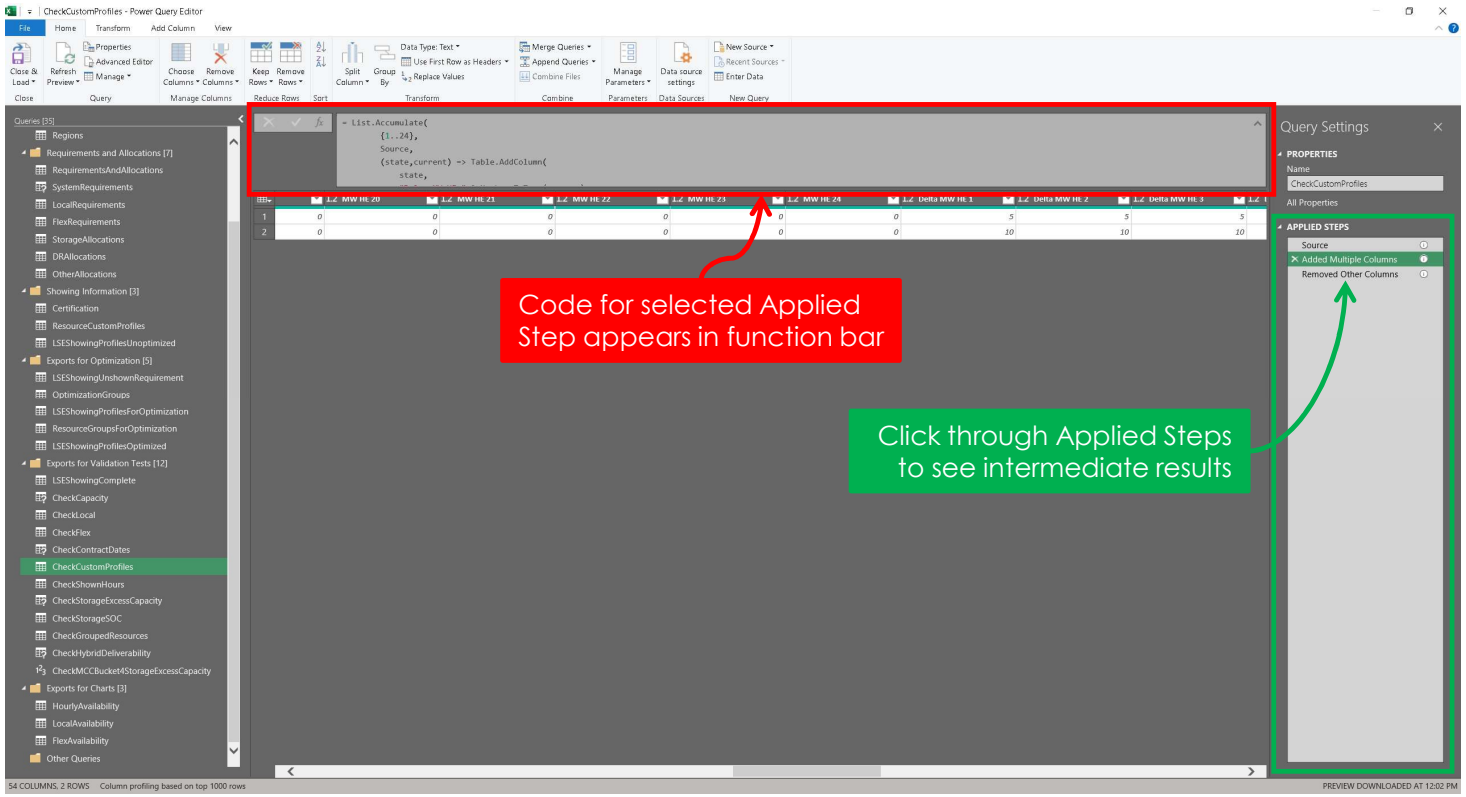
- Open the Queries & Connections Sidebar via
  Ribbon Menu→Data→Queries & Connections
- Double-Click on any query



Built-In Validation Tests – *Reviewing Queries*



Built-In Validation Tests – *Reviewing Queries*



Charts

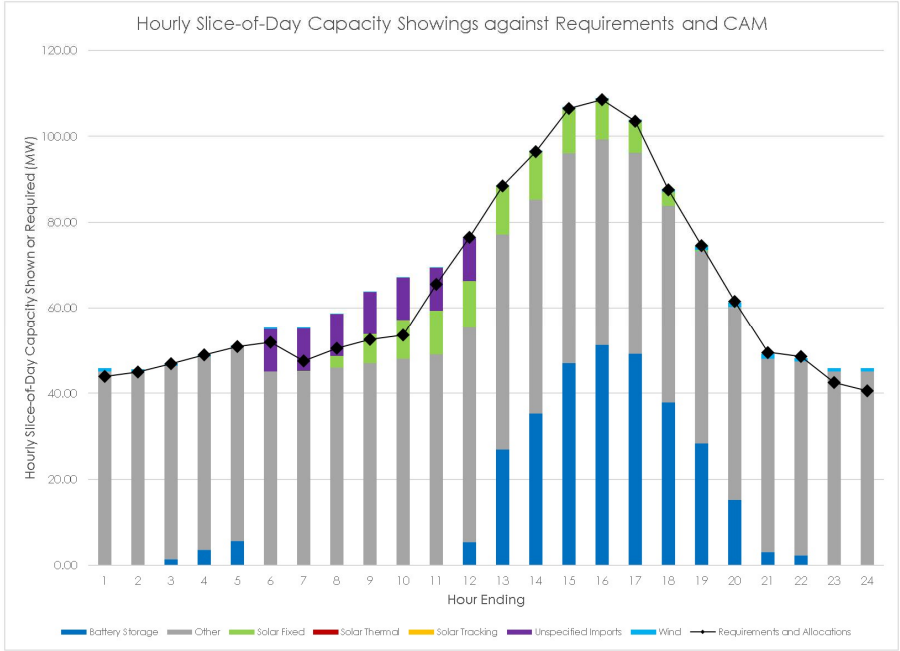
Charts

- Chart sheets use data loaded from Power Query to hidden sheets
- Data should automatically refresh when accessing a chart
- Use charts to visually assess compliance
- Resources are grouped together according to profile category for readability

Charts – *Hourly Slice-of-Day Capacity Showings*

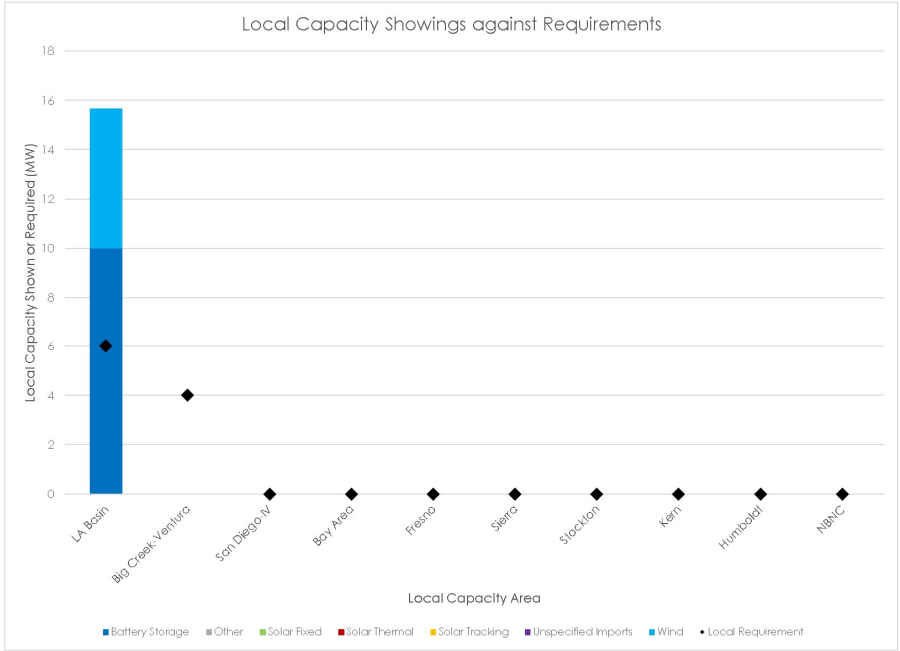
- Required hourly capacities include CAM DR and Other CAM Allocations , and are represented by the black line
- Shown capacities each hour are represented by vertical bars
- Shown capacities above requirements contribute toward excess capacity for charging Storage

  (Storage resources do not contribute toward excess capacity in test)



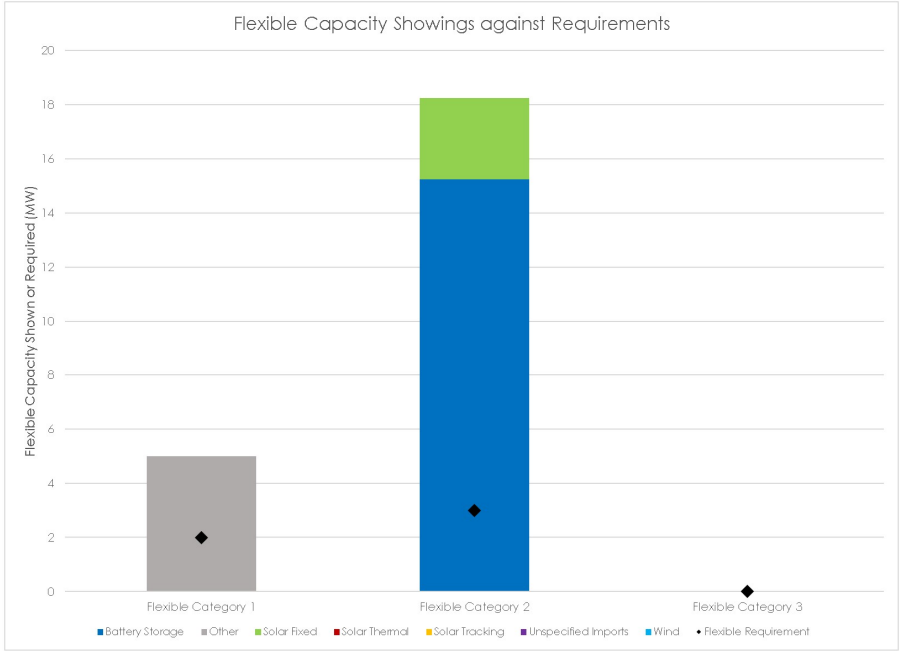
Charts – *Local Area Capacity Showings*

- Required local capacities for each area are represented by black diamonds
- Shown local capacities represented by vertical bars
- Local Capacity Areas are assigned to each resource in the Resource Database
- Local capacities are specified on the LSE Showing worksheet



Charts – *Flexible Capacity Showings*

- Flexible Requirements for each category are represented by black diamonds
- Shown flexible capacities are represented by vertical bars
- Flexible Categories are assigned for each resource in the Resource Database
- Flexible Capacities are specified on the LSE Showing worksheet



Macros

VBA Security and Workarounds

Visual Basic Macros and Security

- The template uses macros written in Visual Basic for Applications (VBA) to help control Power Query and Solver
- View the macro code through Excel's VBA editor via [alt]+[F11] or
  Ribbon Menu→Developer→Visual Basic
- If macros are not permissible, the macro actions can be performed manually:
  - Refresh queries manually
    - Opening the Queries & Connections sidebar via
      Ribbon Menu→Data→Queries & Connections
    - Right-click on the required query
    - Click Refresh
  - Run Solver manually
    - Make sure the Solver Add-In is active via
      Ribbon Menu→File→Options→Add-ins→Manage: Excel Add-ins→Go…→Solver Add-in
    - Open the Solver dialog via Ribbon Menu→Data→Solver

Demonstration

Navigate worksheet, specify resources, optimize storage

Project Timeline

Project Timeline

- Test Year
  - Users are encouraged to provide feedback regarding the template throughout the upcoming test year
  - Expect periodic changes to the template design throughout the year along with documentation
  - A final template design, to be released in Summer 2024, will reflect new RA rules, and incorporate feedback and improvements from the test year
- Post Test-Year
  - CPUC will send LSEs fresh templates each month with current data for the Resource Database, requirements, and allocations

Tentative Office Hours

- Parties can submit questions and comments for Office Hours beforehand
- Energy Division Staff will respond during Office Hours
- Dates are tentative and will be confirmed as the dates approach
- Please submit Office Hours questions with screenshots if possible to: rafiling@cpuc.ca.gov

Office Hours (2-4 pm)	Submit Questions By
September 21	September 18
October 19	October 16
November 16	November 13

Questions?

For more information:

robert.hansen@cpuc.ca.gov