Integration Capacity Analysis Working Group

December 13, 2017

webinar

drpwg.org

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ICA and LNBA Working Group Background

<u>ICA and LNBA WG Purpose</u> - Pursuant to the May 2, 2016, Assigned Commissioner's Ruling (ACR) in DRP proceeding (R.14-08-013), the Joint Utilities are required to convene the ICA and LNBA WG to:

1. Refine ICA and LNBA Methodologies and Requirements
2. Authorize Demonstration Project A and Project B

<u>CPUC Energy Division role</u>

- Oversight to ensure balance and achievement of State objective (ensure adequate stakeholder representation in consensus statements, keeping WG activities on track with Commission expectations/needs, demonstration project results review, quality control on deliverables)
- Coordination with both related CPUC activities and activities in other agencies (IDER CSF WG, CEC and CAISO interagency matters, interconnection/Rule 21/SIWG, other proceedings that may impact or be impacted by locational value calculation such as AB 350/IRP and LTPP/TPP/RPS)
- Steward WG agreements into CPUC decisions when necessary

<u>More Than Smart role</u>

- Engaged by Joint Utilities to facilitate both the ICA & LBNA working groups. This leverages the previous work of MTS facilitating stakeholder discussions on ICA and LBNA topics.

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Remaining issues

Priority issues

- Planning use case
- Process – next step recommendations

Other issues to resolve

- Intro and overview
- Growth scenarios
- Smart inverters
- Op flex
- ICA maps
- PV profiles

Schedule

- 12/5 (ICA): Final comment on November meeting discussions
- 12/8 (ICA): MTS circulates first draft
- 12/15 (ICA): First round of edits
- *Follow up conversations as necessary*
- 12/27 (ICA): MTS circulates second draft
- 1/3 (ICA): Final edits
- 1/8 (ICA and LNBA): Report Due

First draft report: https://drpwg.org/wp-content/uploads/2017/12/ICA-WG-LTR-Report-First-Draft-12.8.docx

Procedural next steps – across all sections

- Areas of further refinement and procedural recommendations
  - Reporting, next steps for evaluating continuing refinement issues

Intro and Overview

- Check list of organizations
- Description of WG process
- Recommendations summary table

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Planning use case (Section 4.1) pg. 5- 12

- Summary of where there is WG agreement
- Characterization of ICA applications and associated technical requirements
- Timing?
- Recommendations for first system-wide rollout of ICA
  - Further evaluation needed, before or after first system-wide rollout?
  - Track 3 PD: "The ICA, for the planning use case, is a tool that the IOUs must use alongside traditional planning tools and methods in completing the annual planning exercise, such as power flow analyses."
- Discussion of policy scenario analysis use case vs. policy planning use case
- Areas of further refinement and procedural recommendations
  - Reporting, next steps for evaluating continuing refinement issues

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Growth scenarios (Section 6.2 pg. 22- 24)

Recommendations on growth scenario options (1, 2a, 2b)

- further evaluation needed, one recommendation for 2018-2019 planning cycle and then evaluate later, etc.?

Smart inverters (Section 4.3 pg. 14-17)

- Timeline for implementation/estimate of when it will be incorporated in ICA

Operational flexibility (Section 5.3 pg. 18-20)

- Consensus on IOU proposal?
  - For interconnection: coordinate with the Rule 21 Working Groups to decide how the limit can inform specific requirements that may be needed within the interconnection process
  - For long-term improvements: IOUs will continue work with research and vendor communities on efficient and reasonable techniques to perform ICA on abnormal switching conditions
- Stakeholder recommendations on classifying circuits/devices to better understand op/flex criteria

Making ICA maps more user friendly and accessible (Section 6.1 pg 20 – 22)

- Additional recommendations on load profiles display and on the ICA user guide?
- Data accessibility/API development:
  - Track 3 PD: We thus order the IOUs to develop a central DRP data access portal, by which users can click between tabs to view ICA, LNBA, GNA, and DDOR data on the circuit map, and can query and export data in tabular form based on a geographic search or keyword search.

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Locational Net Benefits Analysis Working Group

December 14, 2017

webinar

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Agenda

1:00 – 1:15: Agenda and overview of upcoming schedule
1:15 – 2:15: Planning use case
2:15 – 2:45: Growth scenarios
2:45 – 3:15: Procedural next steps

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- Steward WG agreements into CPUC decisions when necessary

<u>More Than Smart role</u>

- Engaged by Joint Utilities to facilitate both the ICA & LBNA working groups. This leverages the previous work of MTS facilitating stakeholder discussions on ICA and LBNA topics.

Schedule

- 12/6 (LNBA): Final comment on November meeting discussions
- 12/8 (LNBA): MTS circulates second draft
- 12/16 (LNBA): First round of edits

Follow up discussion as necessary

- 12/28 (LNBA): MTS circulates second draft
- 1/5 (LNBA): Second and final round of edits
- 1/8 (ICA and LNBA): Report Due

Priority Issues

- Confirm consensus:
  - Avoided energy
  - Avoided line losses
  - Uncertainty metric
  - Updates to the tool to reflect multiple projects
  - DER Profile Library, development of default PV/EE profiles
  - Asset life extension?
- Characterization of non-consensus proposals:
  - Avoided capacity
  - Situational awareness
  - CVR
  - Non-capacity related reliability
- Proposals related to cost-effectiveness/DERAC use case:
  - Unplanned projects
  - Avoided transmission

Intro and Overview

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Avoided energy, capacity, and line losses

- **Avoided capacity:** Non-consensus, with recommendations for next steps for the Commission (Joint IOUs + SEIA proposals)

- **Avoided energy:** Currently no written comments to the IOU recommendation (using interim solution to provide locational DLAP price forecasts, then later replacing with IRP production cost model forecasts) - taken as WG consensus?

- **Avoided line losses:** Incorporate a project-specific loss factor for distribution deferral use case, and revisit the cost-effectiveness use case/updates to DERAC as more granular public information on line loss factors are available

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Other consensus items

- **Uncertainty metric**
- **Update the tool to incorporate multiple projects**
- **For the DER Load Profile Library**:
  - Default inputs for solar PV?
  - Default EE measures to include?
- **Asset life extension**: "The WG agrees that asset life impacts of DERs should not be incorporated into LNBA currently, but should remain an active area of study. The WG agrees that asset life impact may be revisited at a later date if additional study results present reason for further discussion" – consensus?

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Non-consensus proposals: CVR, situational awareness, non-capacity related reliability, avoided capacity

- 1. Does the characterization of non-consensus accurately reflect your position and the discussion on the issue?
- 2. What are recommended WG next steps for the Commission?

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Avoided transmission

- Unplanned projects
- Avoided transmission:
  - Appropriate characterization of process with respect to the separate ED-led process?
  - Appropriate characterization of party submissions?
  - To add:
    - IOU proposals for the deferral use case?
    - IOU methodology proposals – summary overview for cost-effectiveness use case?

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Integration Capacity Analysis (ICA) – PV Generation Profiles

IOU Slides

November 13, 2017

Existing Evaluation Practices

- Interconnection Impact Study Practice
  - For solar Generating Facilities with no battery storage, daytime minimum load will be used (i.e. 10 am to 4 pm for fixed panel solar Generating Facilities
  - Constant Nameplate Output

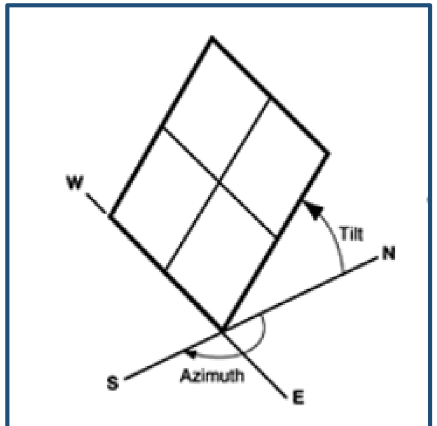
- Conservative approach was appropriate in order to maintain system safety, reliability and power quality requirements

- Utilization of new data and analysis can allow for more capability while still meeting the interconnection technical requirements (Safety, reliability, power quality)

PV-Watt ® PV output data (SCE Analysis)

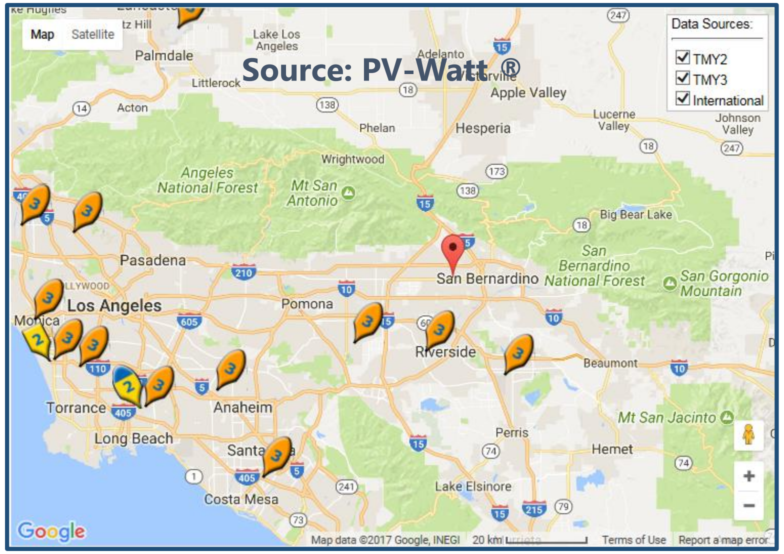
- Used over 100,000 PV systems from SCE's Interconnection Database to determine the "***most prevalent***" PV parameters
- Zip codes where used to provided granularity at the "region" level – SCE has 8 regions in its service territory to break its desert, rural, urban and coastal areas.
- PV-Watt ® weather stations nearest to the Zip codes are used to develop the Region PV curves

System Info	Value	Source
DC System Size	5.2	Application Information (Average)
Module Type	standard	Default
Array Type	fixed (roof mount)	Application Information (Average)
System Losses	14%	Default
Tilt	18	Application Information (Average)
Azimuth	180	Application Information (Average)
Advanced Parameters		
DC to AC Ratio	1.15	Application Information (Average)
PV Inverter Efficiency	96.5%	Application Information (Average)
Ground Cover Ratio	0.4	Default



PV array facing south at fixed tilt.

Source: PV-Watt ®



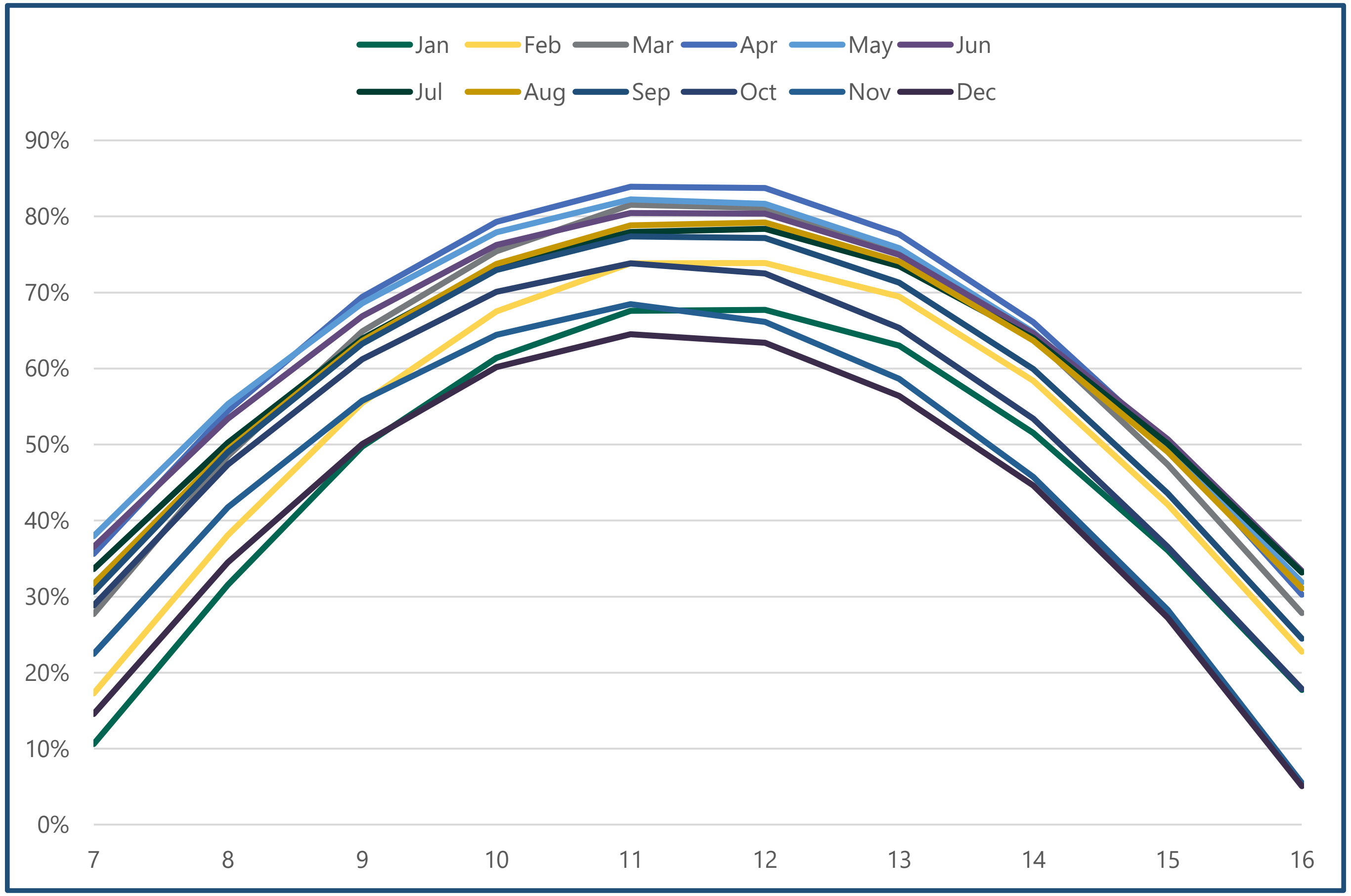
Initial thoughts – Further refinement is necessary

Observations

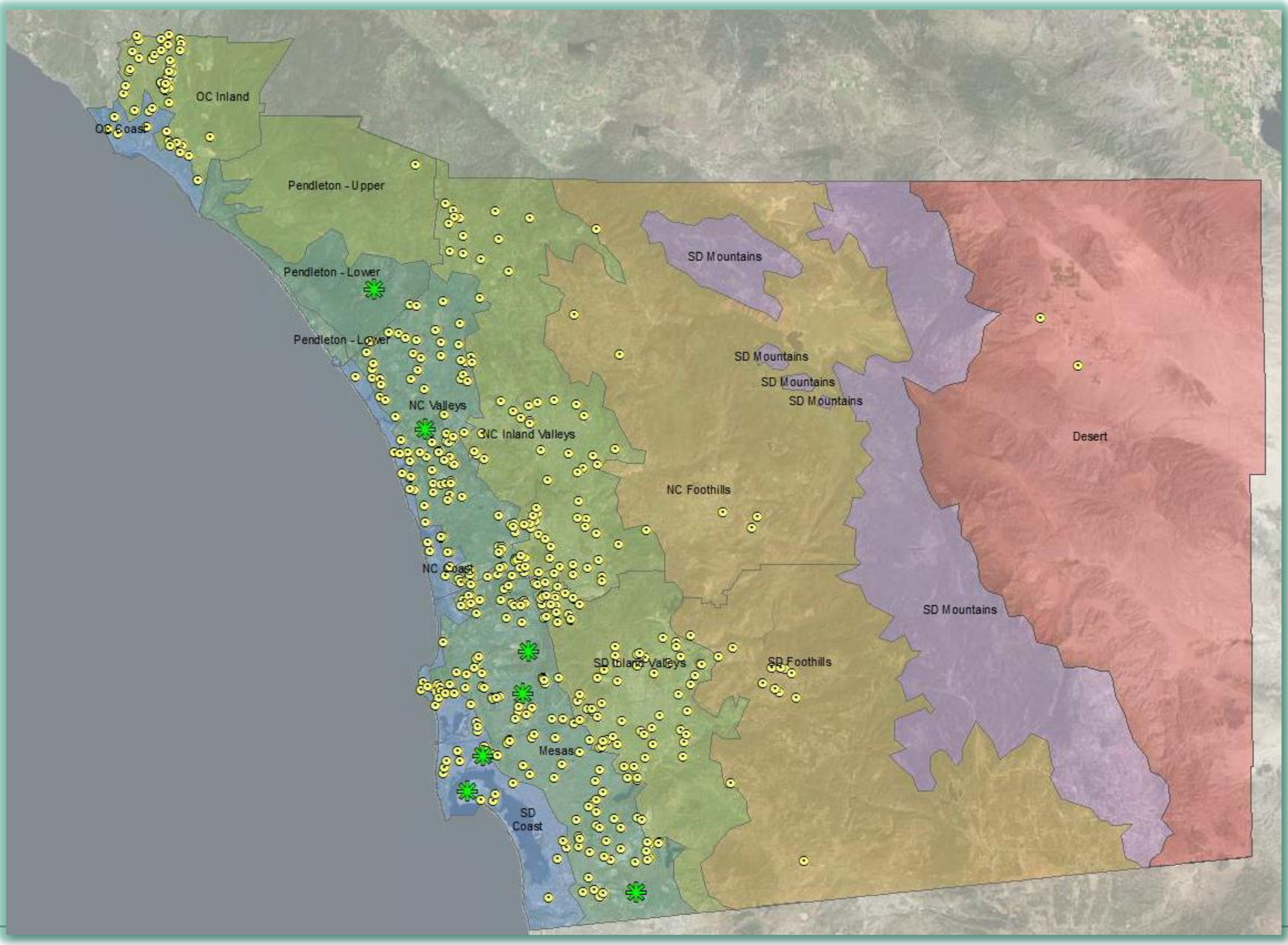
- DC output fluctuates based on month and that should be accounted for in ICA calculations

- Further refinements are needed to determine correct default values:
  - What is the adequate dc-ac ratio?
  - Typical systems have a DC rating higher then AC rating which affects PV output curves which affect PV-ICA calculations

Sample of DC output monthly curves



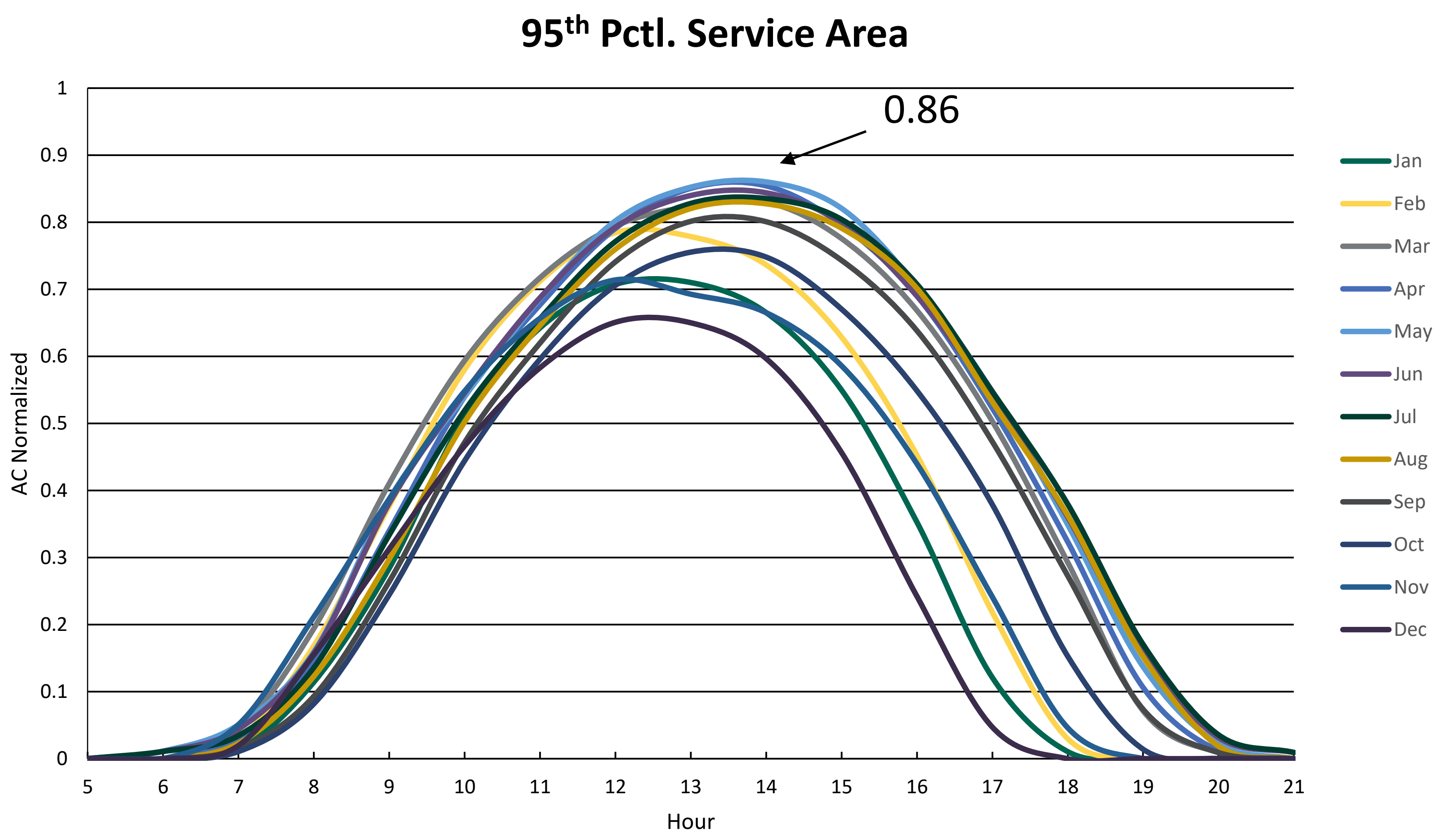
SDG&E Service Territory Data Points



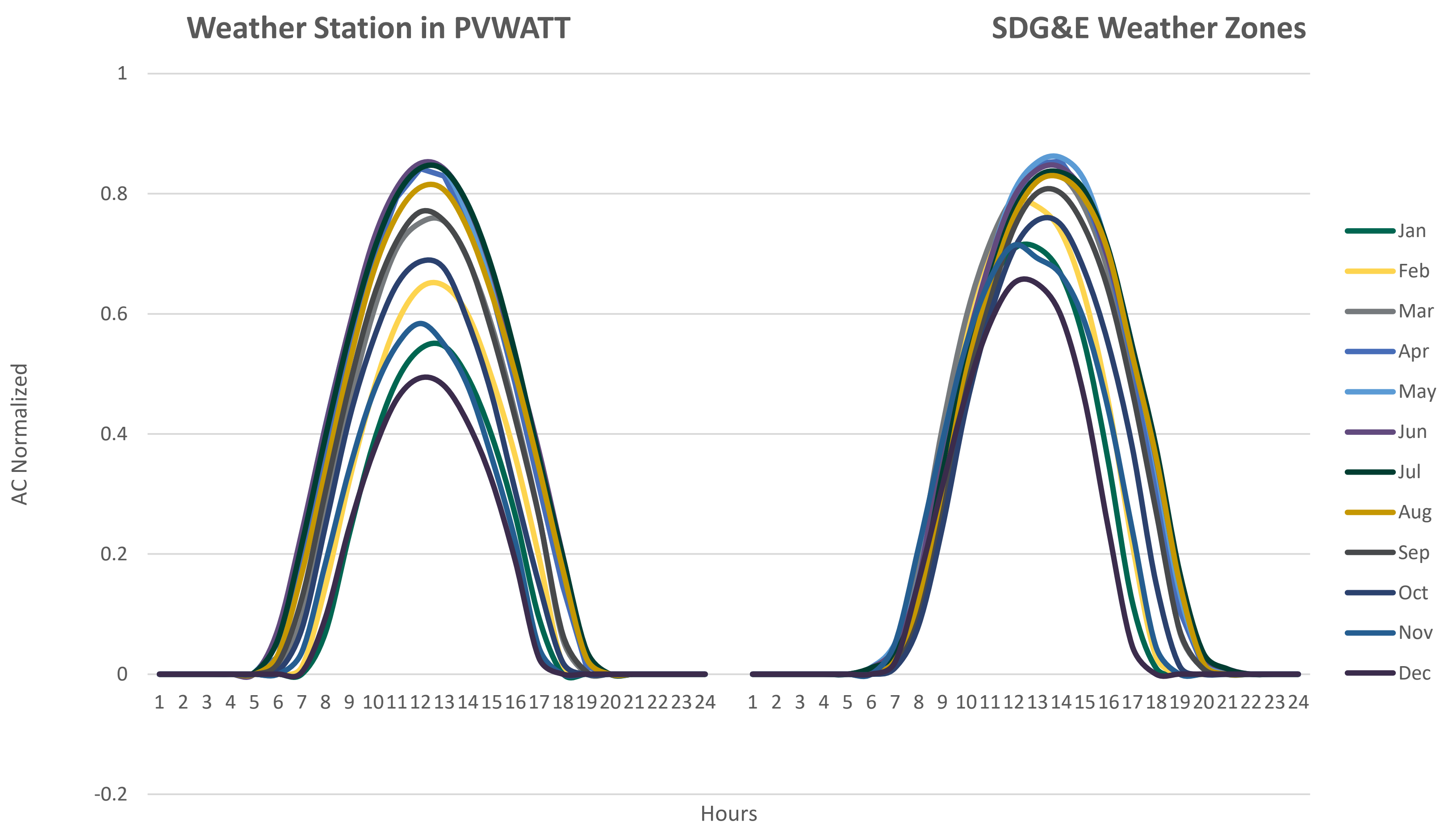
7 Weather Stations

502 NEMs

SDG&E Service Area 95th PCTL PV-Output Profile

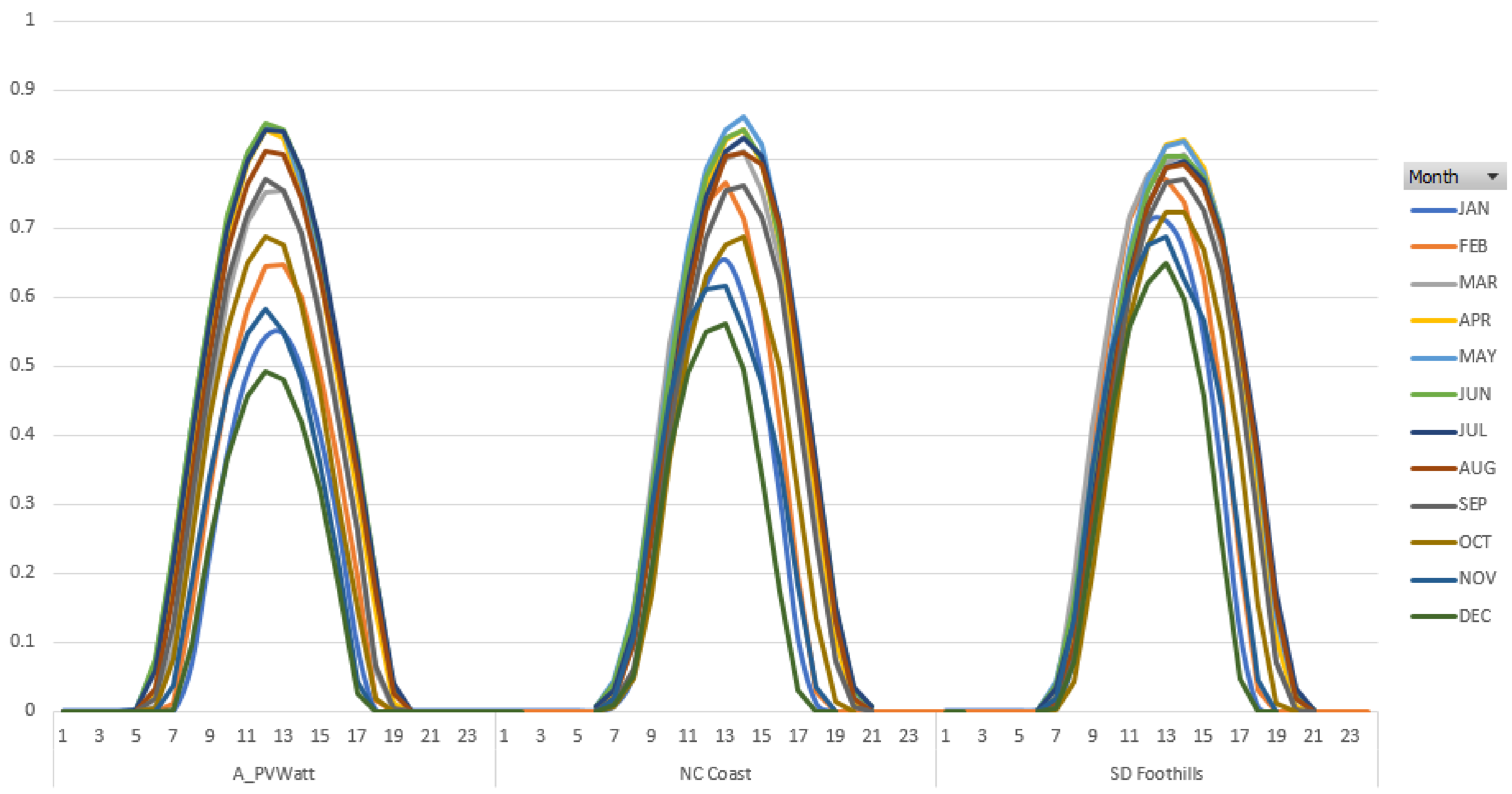


SDG&E 95th PCTL PV-Output Profile Comparison

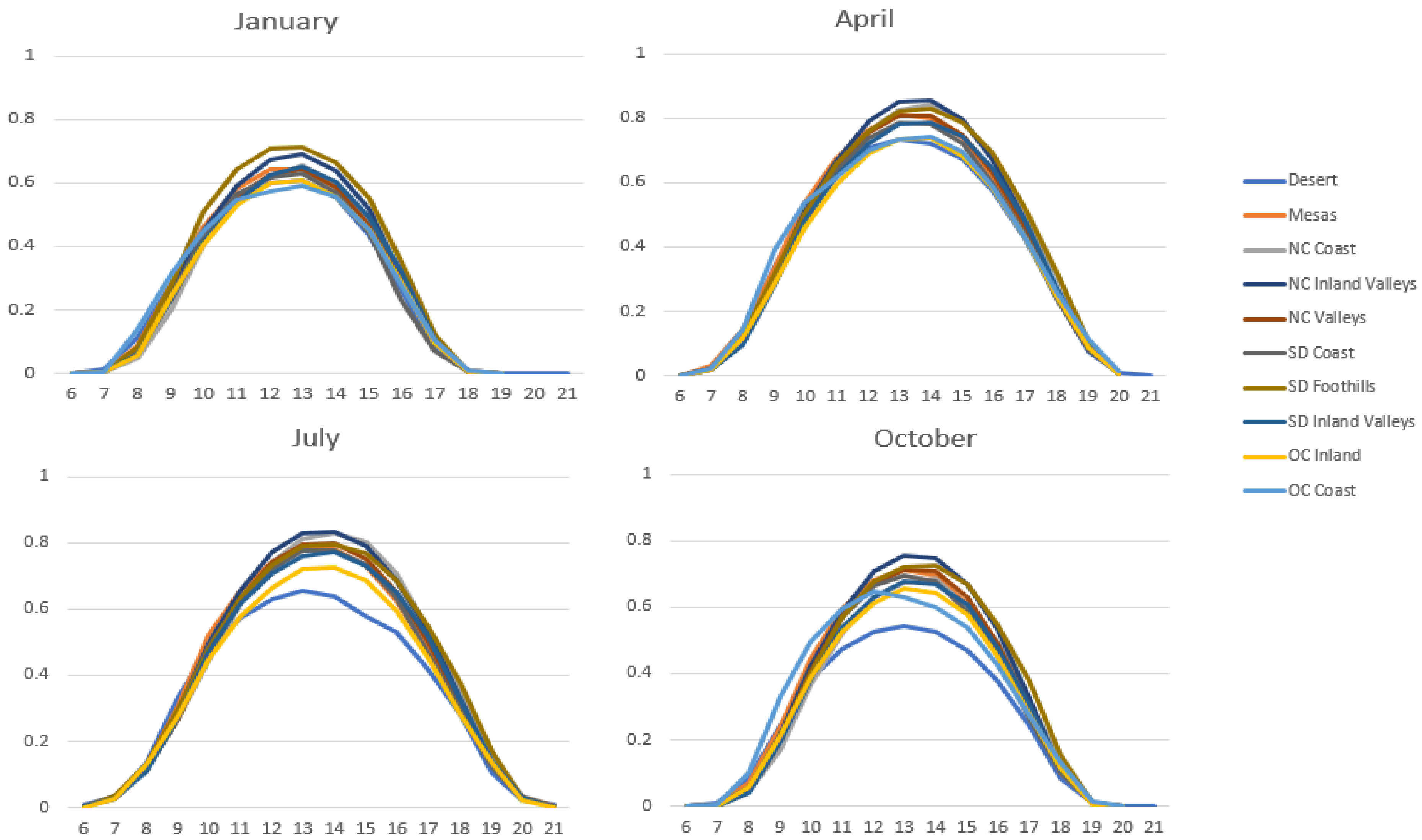


Note: PVWATT data is normalized, using a 1000 W/m2 , 96% efficiency and 86% loss factor.
SDGE is normalized data of all the meters in the zone From Jan-2015 to July-2017.

SDG&E 95th PCTL PV-Output Profile Comparison



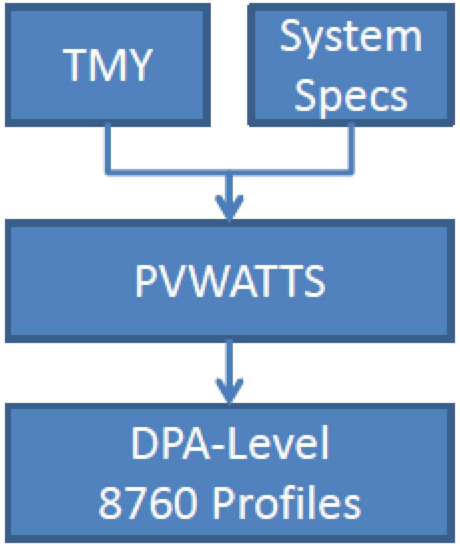
Variation in PV Profile by Month and SDG&E Weather Zones



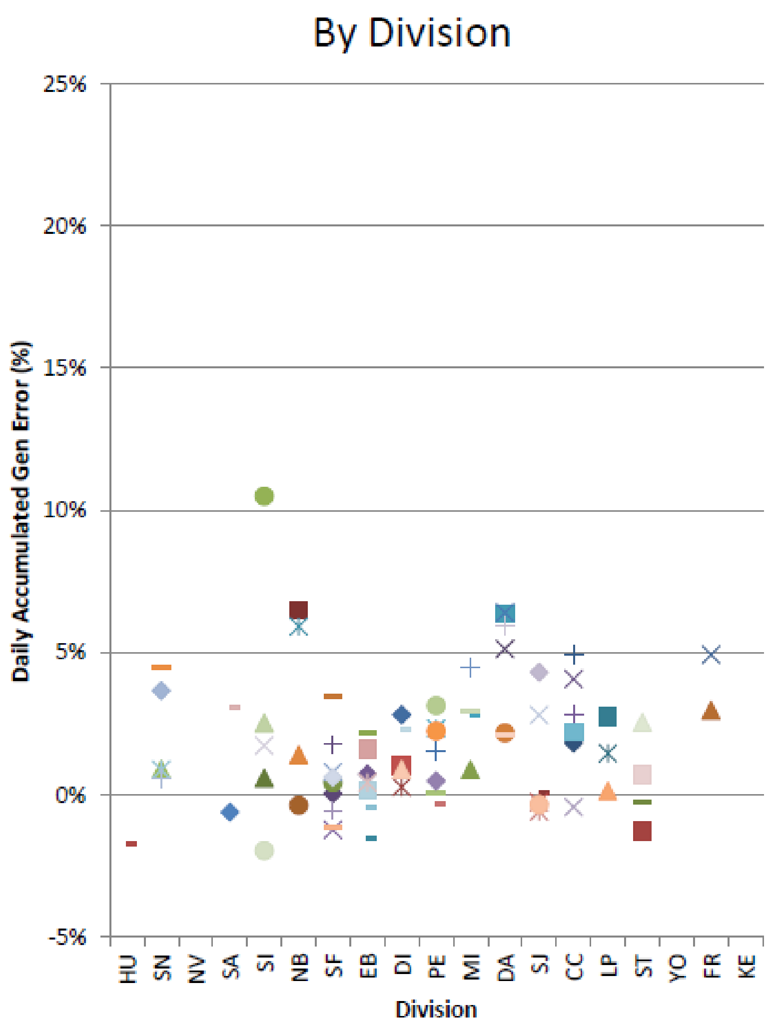
PG&E SolSource Project

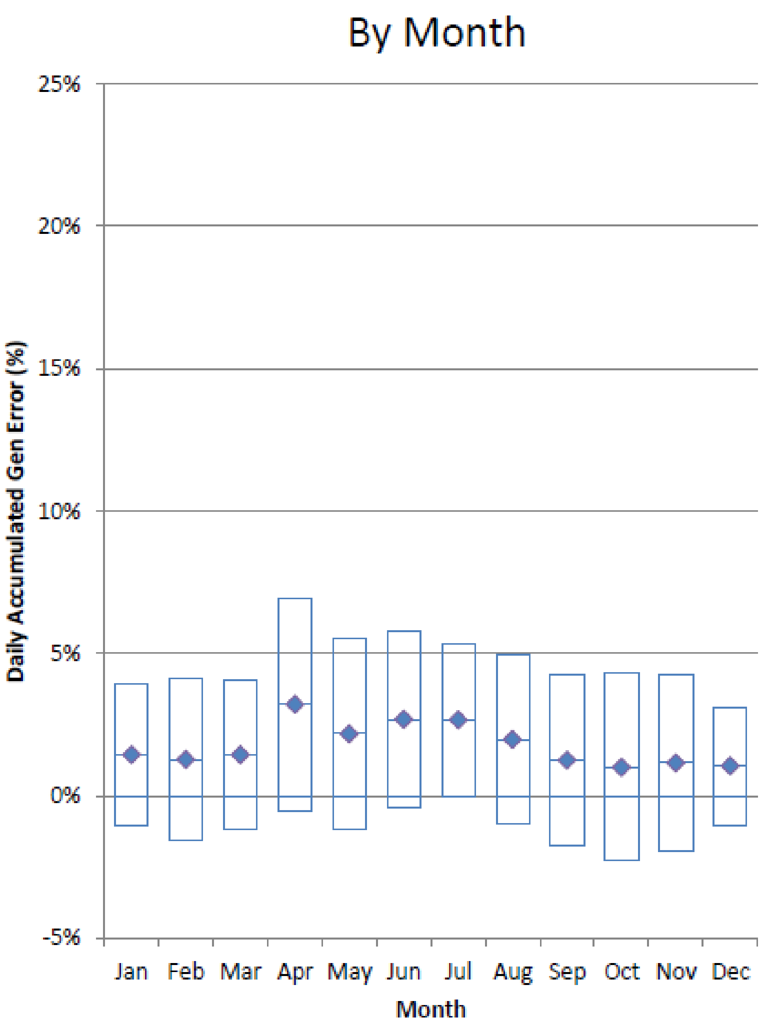
Weather Data Source

- Typical Meteorological Year (TMY) Data: Synthetic irradiance dataset that covers the entirety of the PG&E Service Territory.
  - Resolution: 4-kilometer (geospatial) & 60-min (temporal)
  - Time Period: 1-year (8760 Hourly Values)
- SolSource Data: Historical irradiance estimates (real-time forecast solar irradiance also available) available in a gridded format, over the entirety of the PG&E service territory. Resolution is 3-km & 60-minute
- PVWATTS: NREL methodology for converting weather/irradiance drivers and PV system configurations into PV power output.
  - Inputs: DC Size, module type panel tilt, panel azimuth, AC rating, inverter efficiency, DNI, GHI, DIF, temperature, wind speed, solar position
- California Solar Initiative Data: CSI-rebate participant site metadata and PV output actuals
- ENOS Data: PG&E's NEM interconnect list, which includes site metadata
- Customer to DPA and Customer to CECCZ mappings: customer hierarchy look-up tables
- Transformer to TMY/Solsource: weather to transformer look-up table



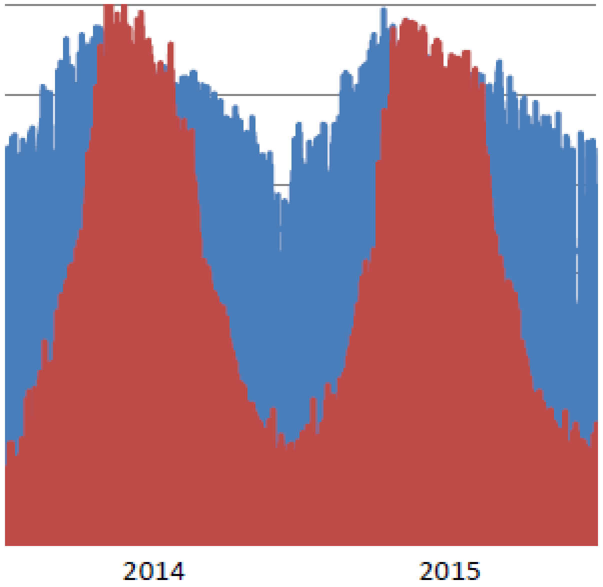
PVWATTS Estimation Error





Biggest Outliers: Shading

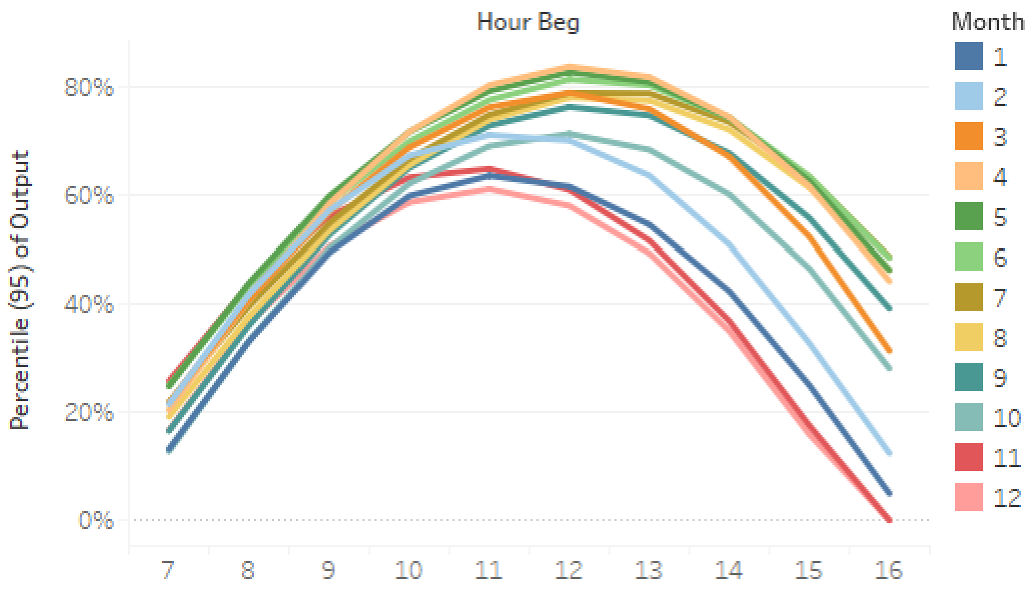
- Ex: Trees to the South impose major shading during winter



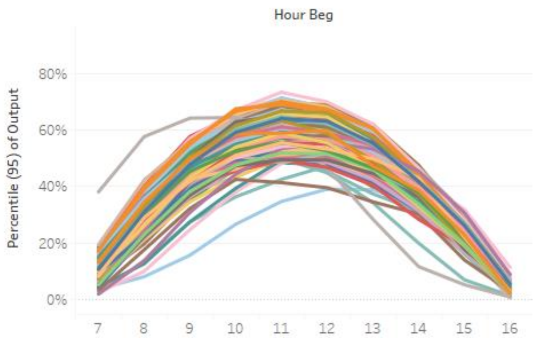
PGE 95th Percentile for Residential PV Output

- Final data is a normalized expected 8760 output by DPA
- Data analyzed to get 95th percentile month hour shapes

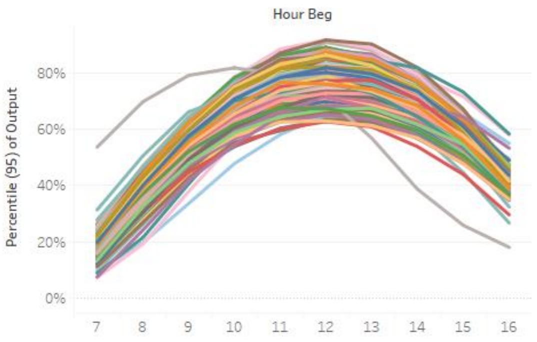
System Wide - By Month



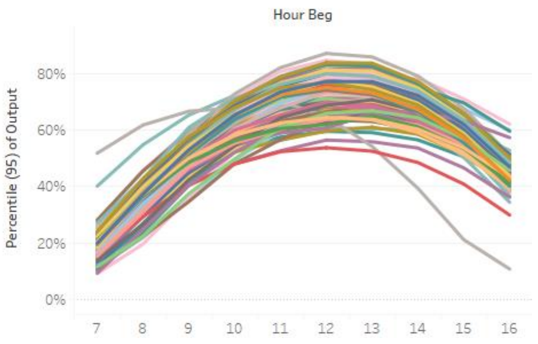
By DPA - Month 1



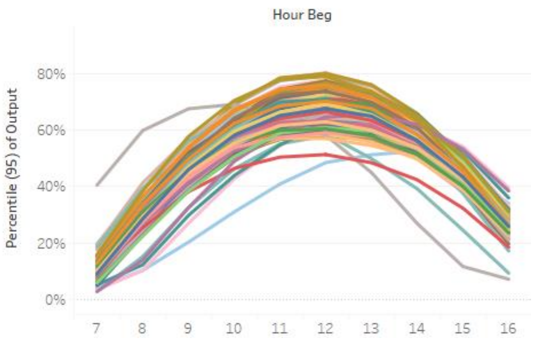
By DPA - Month 4



By DPA - Month 7



By DPA - Month 10



ACR Item 5 – Smart inverters

Joint IOUs’ written comments from 9/29 propose the following as a path forward:

1. *Perform more detail analysis to determine how the tools should be updated to perform an automated ICA process.*
2. *Work with modeling tool vendors to incorporate the required functions.*
3. *Update ICA with Smart Inverter ICA values when the volt/var functions has been incorporated in the modeling tools ICA modules.*

Stakeholders would like further clarification on what additional analysis is needed before implementation of smart inverter functions into ICA

ACR Item 5 – Smart inverters

Joint IOUs' written comments from 9/29 propose the following as a path forward:

"CALSEIA and IREC do not view the need to perform additional analysis as outlined in bullet #1 and comment that "IOUs should simply be working with the software vendors to incorporate smart inverter functionality and use it in the ICA calculations". While the IOUs do not agree that additional studies are not necessary, the IOUs are in agreement to remove bullet #1 and perform "internal research and analysis as they roll out the ICA" as suggested by CALSEA and IREC.

The IOUs do want to clarify that since the existing ICA tools do not have the automated functionality to incorporate the volt/var function in the ICA calculations, this function may not be ready for utilization as part of the first system wide rollout as required by Track I Decision. This function would be utilized on subsequent ICA updates when the tool has been updated with this functionality."

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ACR Item 1 – ICA Planning Use Case

After October meeting, ORA/IREC submitted a modified draft proposal aiming to develop consensus.

- All parties agree with the following as a plan towards defining and optimizing an ICA for the planning use case that strives for flexibility, transparency, accuracy, and cost effectiveness:
  - Use the iterative ICA developed for the interconnection use case for the 2017/2018 DPP :
    - DER forecast will be consistent with pending Track 3 decision,
    - Forecast DER and load growth will be applied to load per IOU option 1 , and forecast ICA values compiled and archived,
    - ICA values using same input values except for DER and load growth will be calculated and archived as a baseline,
    - IOUs will provide a narrative description how the ICA was used for determination of grid needs and any adjustments or correction required will be explained and supported quantitatively

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ACR Item 1 – ICA Planning Use Case

- IOUs will compile data and report (referred to subsequently as the initial planning use case report) on how well the iterative ICA worked for the DPP, and recommendations going forward. The report should address accuracy, computational efficiency, cost, and limitations. This report will be included in the 2018 Grid Needs Assessment (GNA) if the GNA is adopted in the Track 3 decision, or by March 31, 2018 if not.
- The ICAWG should reconvene to discuss the results of the initial planning use case report, options for the next DPP, and recommendations going forward.
- The ICAWG will also use the results from the first ICA use in the 2017/2018 DPP to discuss the policy uses within the planning use case, revisit the alternative methodologies (iterative, streamlined, stochastic, EPRI DRIVE, etc.) and recommend modifications for policy uses.
- QA/QC and validation plans will include all uses within the planning use case.

ACR Item 1 – ICA Planning Use Case

- Open issues to be evaluated and resolved:
  - Define desired functionality of the ICA for the planning use case (this could be characterized as multiple different use cases, or rather an identification of the specific ways it would be used in order to shape ICA modeling functionality (scenarios))
  - Define ICA requirements for the use case, while considering future needs for additional functionality
    - Incorporate findings, conclusions, and orders from the Track 3 proposed decision to help define planning use case, understanding that these are draft pending a final decision
    - Incorporate input from IRP proceeding
  - Determine if the iterative methodology and process for producing ICA values and maps can be modified to meet planning use cases, or if another methodology is needed.
  - Determine whether the iterative methodology is able to produce reliable and consistent ICA results when combined with the higher-level granularity of a forecast.
  - Determine if any of the identified functionality will be difficult to meet within current capabilities and/or reasonable costs. Prioritize functionalities accordingly.
  - Finalize ICA methodologies to be used, and define interactions if more than one method is used.

Scope of the Planning Use Case

- What is it used for?
  - The utilization of ICA in the planning use-case is intended to assist with other planning and analysis techniques used by engineers
  - Helps find areas that may need proactive actions or investments to accommodate growth of retail DG
- What does it calculate?
  - Utilization of ICA in the planning use-case helps determine violations caused by the forecast
  - Timing and category components in ICA might help figure out what types of violations need to be addressed but not necessarily how to fix them
- What does not it calculate?
  - Utilization of ICA in the planning use-case does not determine the final solution needed to fix the violations identified
  - The utilization of ICA in the planning use-case must be coordinated with the overall system planning assessment to determine the final DER system upgrades needs
- Scope
  - Should align with normal planning cycle and be performed once a year
  - 1-5 year analysis including load growth and DER growth

Large Single Interconnection versus Small Dispersed Interconnection

- Planning requires us to evaluate the aggregate impact of many new DER versus a single DER at a specific location
- ICA so far has had a “interconnection” focus which evaluates DG impacts at single interconnection location(node) based on existing conditions
- The planning use case of ICA needs similar thinking to load planning where general overall growth is considered versus one location at a time
  - Not as easy given that every customer doesn’t have DG so applying growth factors is not as appropriate
- Ways to consider this
  - **Stochastic Placement:** Stochastically placing forecasted DG across circuit and then performing power flows to identify the violations created by the forecasted DER.
  - **EPRI DRIVE**: Applying Weibull distribution algorithms to equations to account for dispersion

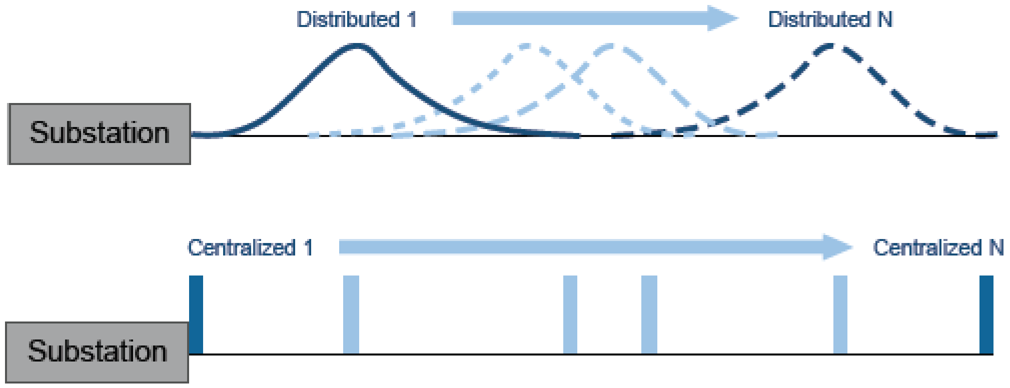
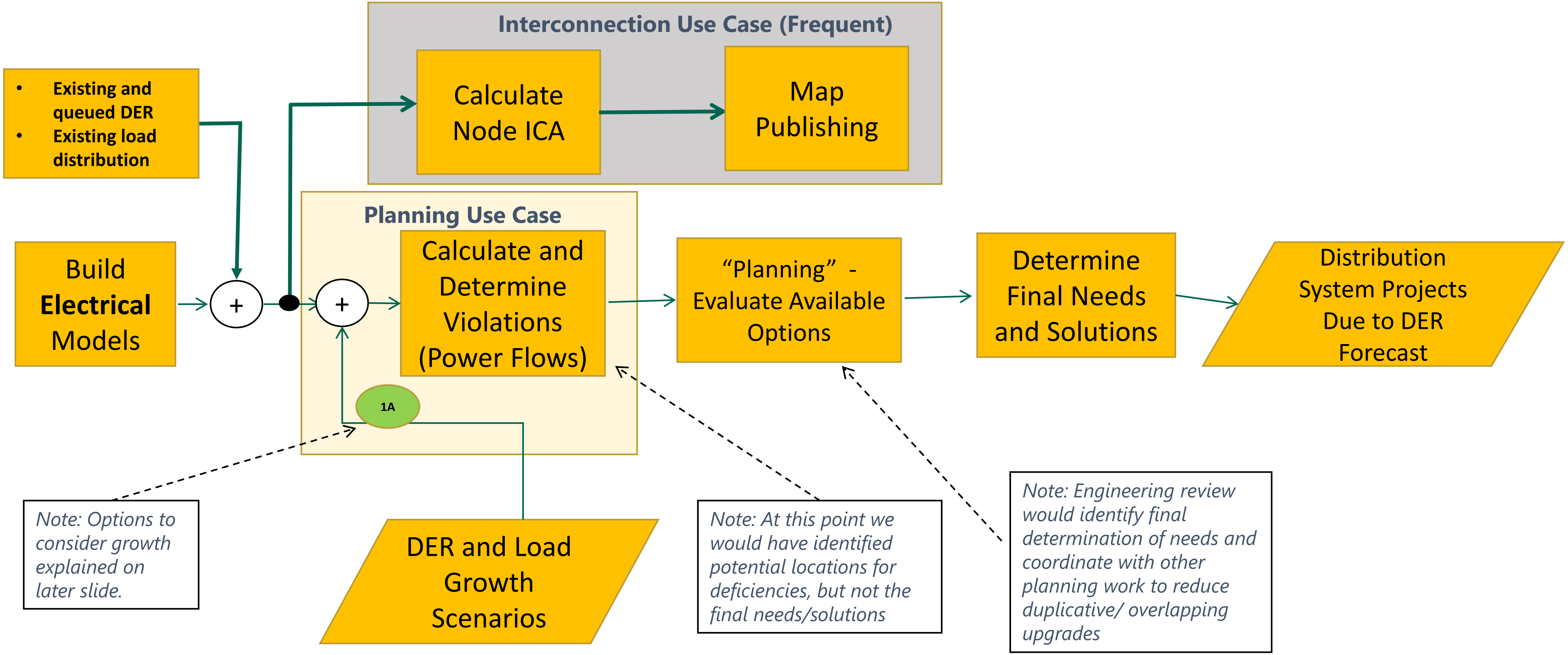


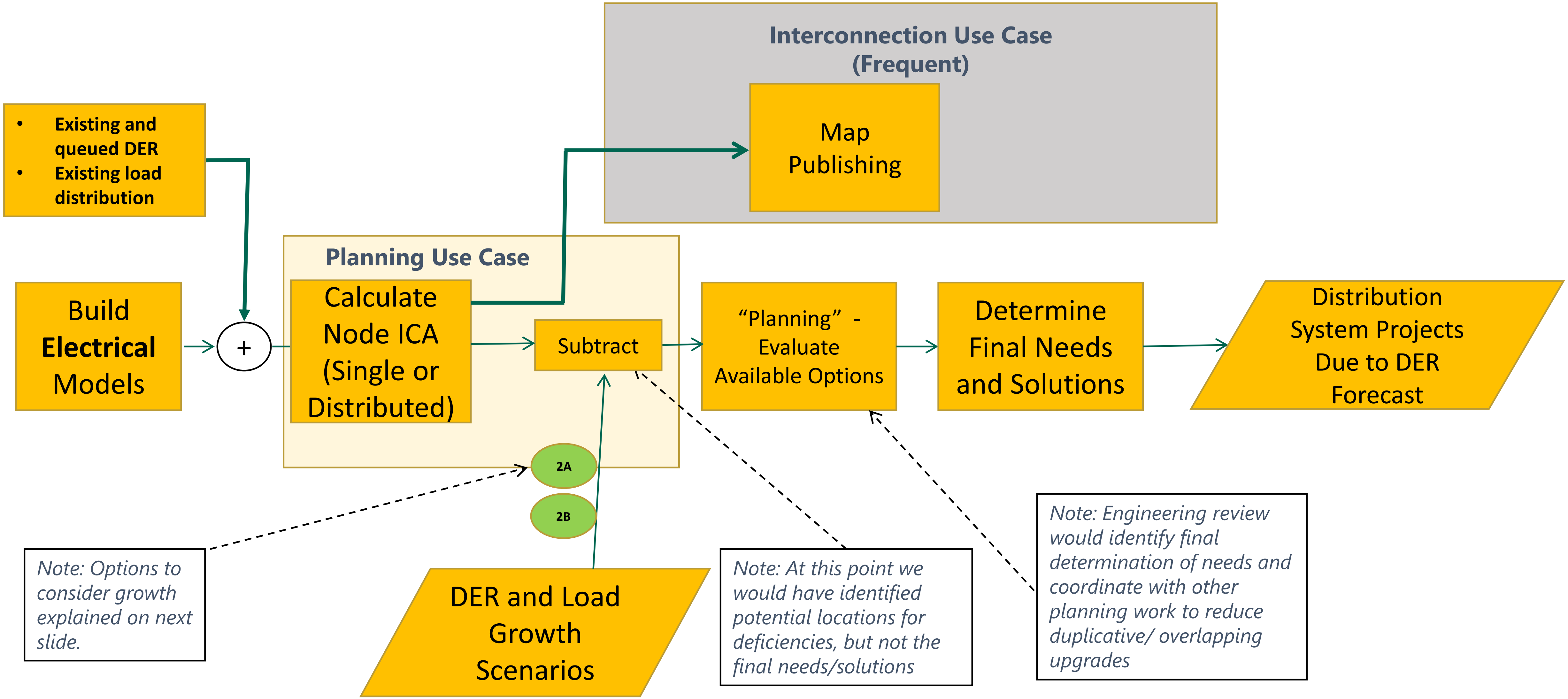
Figure 6 – Subset of DER Scenarios Analyzed in the Streamlined Analysis

Source: EPRI, INTEGRATION OF HOSTING CAPACITY ANALYSIS INTO DISTRIBUTION PLANNING TOOLS

Using ICA to determine Grid Needs for DER Growth

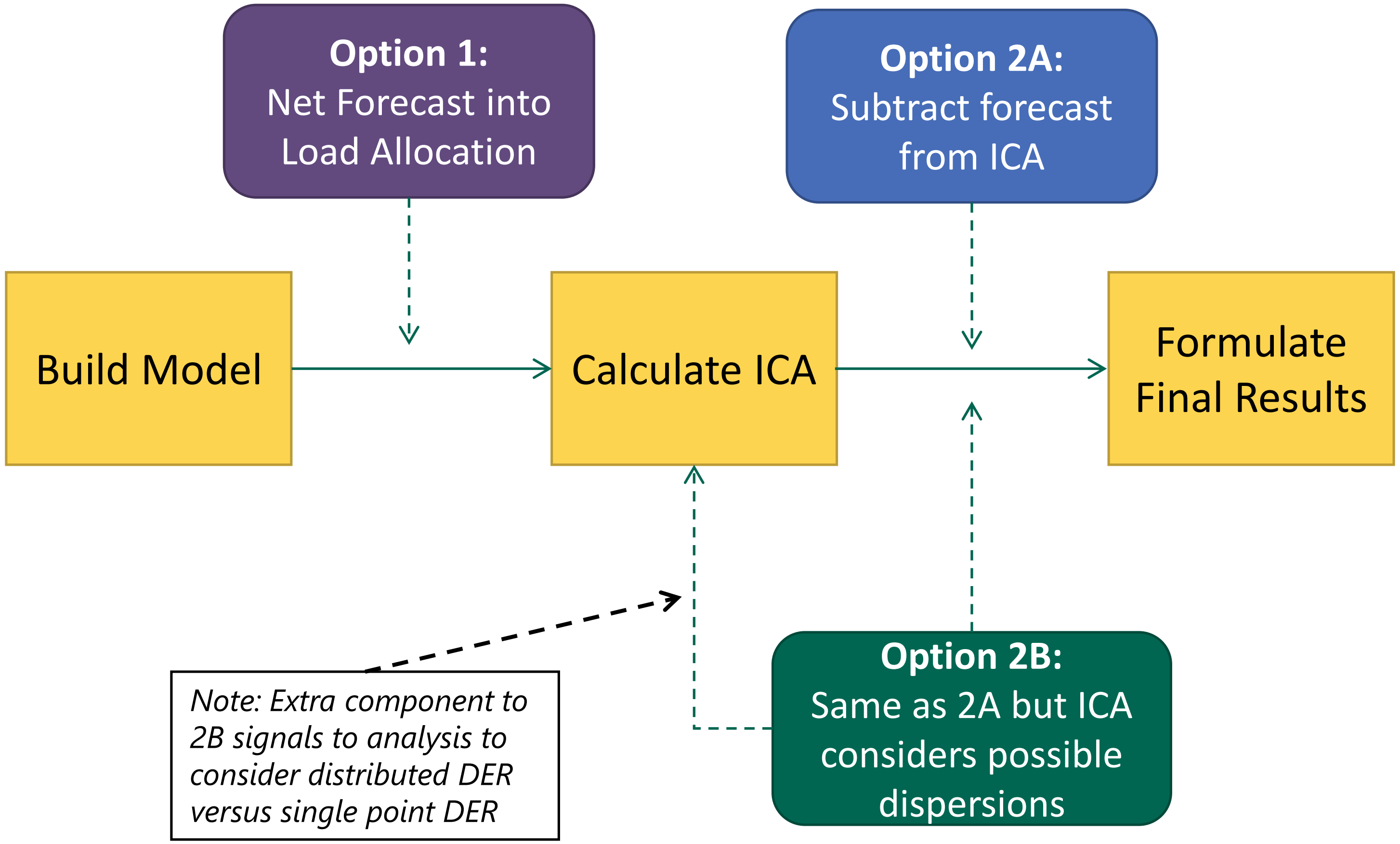


Using ICA to determine Grid Needs for DER Growth



How to Consider DER Growth in ICA

NOTE: DER Growth would be by feeder and thus makes specific line section ICA difficult to consider



1. Net Forecast into Load Allocation
   – DER growth netted into the load allocation before ICA is calculated
   – Attempts to more directly account for growth, but only accounts for a peanut butter distribution of DER

2A. Compare Growth to ICA
   – Option A utilizes current output of ICA evaluating single point ICA
   – The easiest to perform, but results don’t really have any consideration of dispersion of DER on circuit

2B. Compare Growth to modified ICA
   – utilizes an ICA output that has considered the distribution of DER in the analysis
   – Would require adjustments to ICA for considering small dispersed DER versus large single point DER

ACR Items B, C, D – user friendliness ,data access, market sensitive info

<u>ACR Items B, C, and D:</u>

• **Item B:** Ways to make ICA information more user-friendly and easily accessible (data sharing)
• **Item C:** Interactive ICA maps
• **Item D**: Market sensitive information

Items B, C, and D: pertain to IT requirements for data sharing, access to market sensitive information, and expanding the functionality and range of data displayed on ICA maps

Purpose: provide feedback to ICA development, for both near term (first system wide rollout) and long term refinement.

ACR Items B, C, D – user friendliness ,data access, market sensitive info

October and November

- IOUs will include refinements to 1) load profiles display, 2) color display, and 3) range display within the first system roll out.
- Stakeholders will provide additional information on what should be included in the ICA User Guide, including.
    - How to access and understand the downloadable Excel file
    - Explanation of the operational flexibility ICA number
    - How to use the ICA Translator tool
- November follow-up call with DER developers: ask to provide input and recommendations by Friday, 11/17

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ACR Item 4: Operational Flexibility

Summary of Recommendations

•IOUs will display ICA with and without Operational Flexibility using the "reverse flow" method
•There is no established method other than performing power flows on various possible switching scenarios
•The IOUs continue to invite researchers and the vendor community to develop approaches to efficiently analyze abnormal conditions
•The IOUs will catalog SCADA operated devices in their systems and provide them to the CPUC and ORA

ORA written comments additionally note that, based on EPRI's September presentation with regards to op flex, it might be more practical to recalculate hosting capacity on a daily basis and use those results to potentially curtail DER.
Regarding this point, some non-IOU Working Group members suggested that, since abnormal circuit configurations exist for limited periods of time, other alternatives need to be considered, including DER curtailment using Phase 3 smart inverter functions, and limiting circuit reconfigurations.

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Circuit Classification to Address Operational Flexibility Concerns

- Some utilities have classified circuits to determine whether they are good candidates for Conservation Voltage Reduction (CVR)
- IOUs should do a similar classification for operational flexibility limits
  - Stable circuits do not need to be concerned about backfeed during abnormal configurations
  - Volatile circuits would not allow backfeed within ICA

Classification Criteria

Criteria for classifying circuits would include:

- Voltage regulation capability including automated voltage regulators
- Power electronic voltage controllers like D-STATCOM
- Automatic capacitor banks controls
- Configurable relay settings
- Storage capacity

Classification Will Help Data Quality

- Utilities have stated they are not certain of the specifications of protective equipment and voltage regulators
- This data would be improved as part of the classification process