Integrated Capacity Analysis Working Group

July 7, 2017

In-person meeting

drpwg.org

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Agenda

Time	Topic
9:00 – 9:30	A. Introduction and review of ACR
9:30 – 10:00	B. Discuss overall plan and approach for ICA WG meetings
10:00 – 10:35	C. Develop Standard PV Generation Profile for Use in Online Maps *(Item 2)*
10:35 – 10:45	D. Break
10:45 – 11:20	E. Discuss comparative assessment
11:20 – 12:15	F. Tee up remaining Group 1 items and discuss plan for August Item 1: Planning Use Case and methodologies Item 5: Smart Inverter Functionality Wrap up and next-steps

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ICA and LNBA Working Group Background: June 7 ACR

June 7 ACR: Overview

The ACR sets scope and schedule, pre-Working Group deliverables, and status report and final reporting milestones for continued long-term refinement discussions pertaining to the ICA and LNBA in Track 1 of the DRP proceeding.

The ACR scopes and prioritizes ICA long-term refinement items as identified in the Final Working Group Report and the Interim Long-Term Refinement Report:

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ICA and LNBA Working Group Background: June 7 ACR

Group	Items: Explanations/Clarifications	Source (ACR/WG report)
I	Item 1: Further define ICA planning use case and methodologies	WG report
	Item 2: Develop standard PV generation profile for use in online maps – *near-term relevance to interconnection use case and online map display of ICA results*	WG report
	Item 5: Develop methods and tools to model smart inverter functionality in ICA calculations	WG Report
	Item 8: Perform comparative assessment of IOUs' implementation of ICA methodology on representative California reference circuits	WG Report
	Item A: Expansion of the ICA to single phase feeders – *requires creation of network models for single phase feeders*	ACR
II	Item E: Method for reflecting the effect of potential load modifying resources on integration capacity	ACR
	Item 4: Develop a non-heuristic approach to modeling operational flexibility	WG Report
	Item 6: Consider how online maps could reflect queued projects on a given circuit – *requires coordination with Rule 21 rulemaking and public interconnection queue*	WG Report
	DERs that serve peak load	Interim report

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ICA and LNBA Working Group Background: June 7 ACR

Group	Items: Explanations/Clarifications	Source (ACR/WG report)
III	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 • Item B: Ways to make ICA information more user-friendly and easily accessible (data sharing) • Interactive ICA maps • Market sensitive information	ACR
	Item 3: Incorporate findings and recommendations from DRP Track 3 Sub-track 1 on DER and load forecasting into ICA as appropriate – *requires coordination with DER growth and load forecasts under development in DRP Track 3 Sub-track 1, which will be occurring concurrently with ICA long-term refinement discussions*	WG report
	Voltage regulating devices – *if the Commission authorizes the IOUs to model voltage regulating devices as they did for Demo A in the initial system-wide ICA rollout, the ICA WG should work with software vendors to include this functionality as a long-term refinement topic*	WG report
IV	Solidify ICA methodologies for interconnection and planning use cases before developing the following: • Item F: Development of ICA validation plans, describing how ICA results can be independently verified • Item G: Definition of QA/QC measures	ACR
	Item 9: Explore divergences and tradeoffs between the methods employed by SCE and PG&E vs. SDG&E to create load shapes at the feeder, transformer, and customer levels – *WG reached consensus on utilizing IOUs' Demo A load shape development methodologies for initial system-wide rollout*	WG report

ICA and LNBA Working Group Background: June 7 ACR

The groupings provided in the ACR prioritize Working Group activities by front-loading work on topics of relatively high complexity and/or importance. The WG is to initiate discussions on long-term refinement topics in the order in which they are grouped.

More Than Smart facilitated the development of a ten page scoping document briefly summarizing discussions on these topics to date and detailing relevant framing questions or considerations to move discussions forward from the outset. These were circulated for input from active Working Group members who provided comments to the previously submitted reports, and finalized June 15.

- ICA WG Long-Term Refinement Scoping Document

This scoping document summarizes discussion points from the Interim Long-Term Refinement Report submitted December 2016, and the Final Demo A Working Group Report submitted March 2017.

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ICA and LNBA Working Group Background: June 7 ACR

Interim status reports are due as follows:

- **Group I: August 31, 2017**
- **Group II, III, IV: October 31, 2017**

The groupings, scoping documents, and interim status reports help form a tentative schedule for the Working Group going forward.

The ACR indicates that the Working Group is meant to pursue and develop the scoped topics to the fullest extent possible, including methodological development and/or modeling demonstrations where feasible, but also recognize that certain items may prove unworkable at this stage of ICA and LNBA development. In such cases, the Working Group is directed, in the status reports and Final Long-Term Refinement report, to document the extent of discussions, reason(s) for rescinding or tabling the topic, and relevant considerations and/or implementation plans (if any) for further discussions and methodological development beyond the Working Group process set forth herein.

ICA and LNBA Working Group Background: June 7 ACR

Interim status reports are due as follows:

- **Group I: August 31, 2017**
- **Group II, III, IV: October 31, 2017**

The groupings, scoping documents, and interim status reports help form a tentative schedule for the Working Group going forward.

July: Group I topics
August: Group I topics
August 31: Group I Status Report due
September: Group II topics
October: Group III and IV topics
October 31: Group II/III/IV Status Report due
November: Revisit priority topics from Group I and/or revisit other topics as necessary
December: Discuss draft final report
January: Final report due

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ICA & LNBA Working Groups: Process, Schedule, Scope

July 7, 2016

Process and Schedule

Discussion Sessions and Content Development (1 of 2)

- **For each topic identified in the scope:**
  - For each topic, IOUs (and other interested stakeholders) will perform pre-work to prepare information prior to the WG discussion. The required work includes:
    - Propose the basic requirements of a solution to the issues presented by the topic (i.e., "what is this topic looking for")
    - Identify a reasonable scope for a "realistic outcome" for the WG Final Report, given the many topics and limited time. Specifically, the "realistic outcome" could be a fully-baked solution, a plan or detailed scope for future analysis, or something else.
    - A proposal for the identified realistic outcome; i.e. a proposed solution, proposed scope for future analysis, etc.
  - At WG meeting when the topic is scheduled for discussion, IOUs (and other stakeholders who have developed a proposal) will present their proposal. This will provide a framework for discussion, questions, comments, initial feedback, etc.

Discussion Sessions and Content Development (2 of 2)

- **Following the discussion for each topic:**
  - IOUs (and other stakeholders who have developed a proposal or would like to include a proposal) will circulate a written document further explaining the proposal and rationale, including as appropriate modifications based on feedback from the discussion. The proposal(s) should include specific recommendations proposed to be included in the Final Report.
    - This document will provide an opportunity to formally document proposals and provide additional explanation.
  - Other stakeholders will then have an opportunity to submit one round of written responses. Written responses can recommend modifications to the proposal or to the "Realistic outcome" or anything else relating to the topic.
    - The written comments provide an opportunity to expand and document feedback from the WG discussion.
  - MTS will maintain the repository of all comments (IOU proposals and stakeholder responses.)
- Some topics might be discussed at multiple sessions; some will only be discussed at one session.

Final Report Development

- The Final Report will be developed from written proposals and responses.
- All recommendations in the final report will be drawn from previous written documents.
- During the revision process, parties will have chance to add supporting or opposing arguments to recommendations, but new recommendations will not be accepted unless they are consensus recommendations.

Schedule

The Schedule ensures that topics identified by the Commission will be addressed at least once. However, discussions are inherently limited by the number of topics and the limited time, and will be prioritized per the Ruling.

Meeting	ICA Topics	LNBA Topics
Jul.	Group I (4 topics, address subset)	Group I (5 topics, address subset)
Aug.	Group I (address topics not discussed above)	Group I (Address topics not discussed above)
Sep.	Group II (5 topics)	Group II (2 topics) + Group III (6 topics, address subset)
Oct.	Group III-IV (5 and 3 topics, respectively)	Group III (address topics not discussed above; all speculative and/or hard to quantify) Begin to revisit Priority topics* from Group I
Nov.	Revisit priority topics* from Group I and/or revisit other topics as necessary.	Continue to revisit priority topics and/or other topics as necessary.
Dec.	Discuss Draft Final Report	Discuss Draft Final Report
Jan. 7	Report Due	Report Due

Agenda Item C: Develop Standard PV Generation Profile for Use in Online Maps

Objective: The WG will develop a standard PV generation profile in the first system-wide rollout.

Background: The ICA WG reached full consensus on the six ICA values which will be published on the online maps within the first system-wide roll out. This includes publishing the uniform generation ICA, a uniform load ICA, and a solar PV ICA value based on a common PV shape. Two sets of these ICA values will be published, addressing two different operational flexibility constraints. The ICA WG is tasked with developing a standard PV generation profile to be used within the online map display within the first system-wide rollout of ICA. This profile should be sufficiently conservative to be relied upon for interconnection approval, and will include monthly variation in solar production.

Scoping questions: the ICA WG should work to determine:

i) A proposed PV generation profile using standard assumptions
ii) Determine whether this profile is sufficiently conservative to use for interconnection approval and will include monthly variation in solar production

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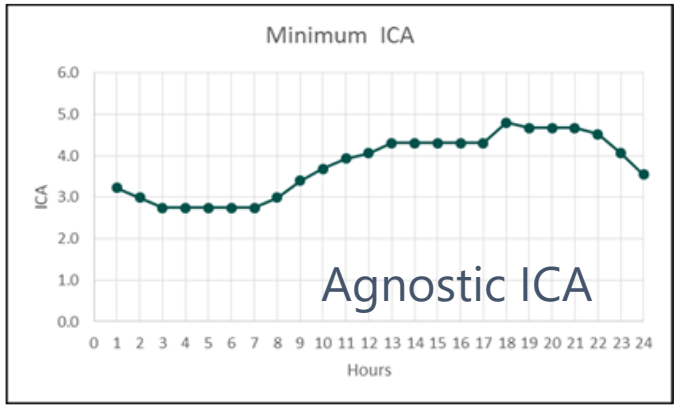
Process Developed For Demonstration Project A



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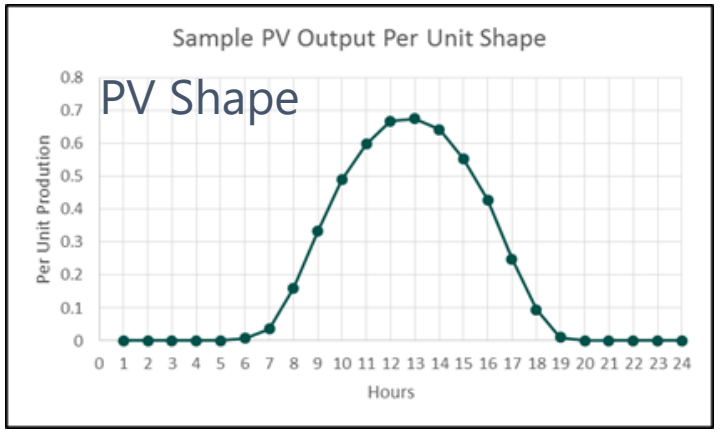

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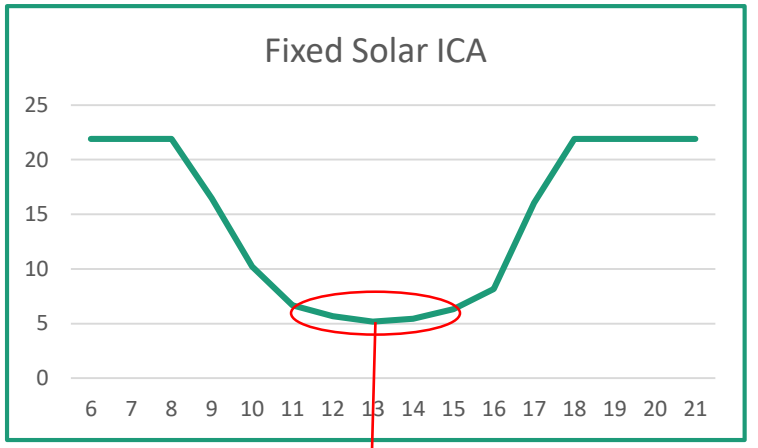
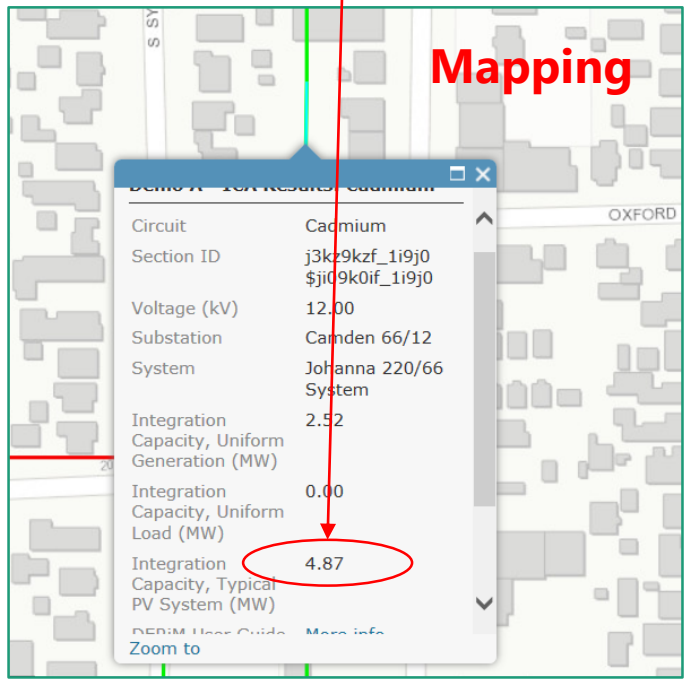


ICA Analysis
- Thermal
- Voltage
- Protection
- System Flexibility
- Etc.

- Based on common PV shape
- Intended for demonstration purposes
- Intended for use in ICA translator



Long Term Refinement Item #2:

Develop ***standard PV*** generation profile for use ***in online maps***, which will include monthly variations in solar production

Scoping Document Objective:

The Working Group will develop a standard PV Generation Profile in the first system-wide rollout.

- ❑ ICA working group should determine a proposed PV generating profile using standard assumptions
- ❑ The profile should be sufficiently conservative to use for interconnection approval and will include monthly variations in solar production.

Topics for consideration

- PV curve should represent performance for interconnection evaluation purposes
- Developed from a comprehensive set of data based on actual field recordings
- Should be based on typical installation type (fixed, south facing, etc.)
- Areas or zones specific curves may be appropriate

Agenda Item D: Discuss comparative assessment

Objective: The IOUs are asked to conduct comparative assessment on one or more representative California feeders, consistent with the May 23 ACR.

Background: In Demo A, the IOUs used the IEEE 123 test feeder as a reference circuit to compare IOU Demo A results (using both methodologies) and between power system analysis tools (PG&E and SCE use CYME software, while SDG&E uses Synergi software). It was concluded that ICA results do not show significant variation when tested across the IEEE 123 test feeder, with slight variations attributed to how power flow models are treated between CYME and Synergi. In the ICA WG Final Report, the WG recommended utilizing more representative California feeders as a long-term refinement issue, while considering prioritization of other LTR studies with regards to costs and resources.

Scoping questions:

i) What characteristics, and which representative CA feeder or feeders may be used as a more indicative reference circuit?
ii) How long and how many resources will it take to conduct comparative analysis?
iii) How will the results of comparative analysis be evaluated and acted upon?

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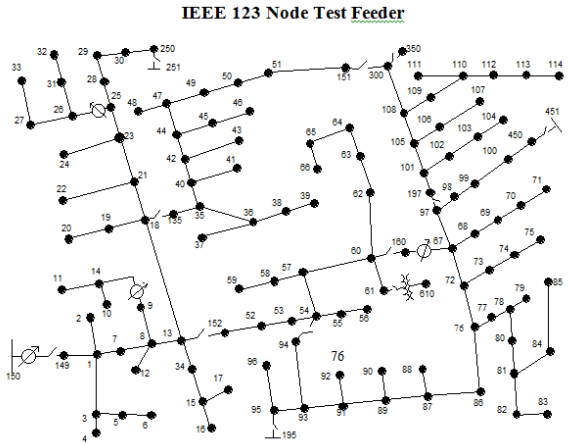
Demo A Comparison Using IEEE 123



- Overall the IC values track each other similarly and don't have significant variation.
- The little variation in PQ/Protection seen is mainly due to the small variation in power flow and fault model simulation

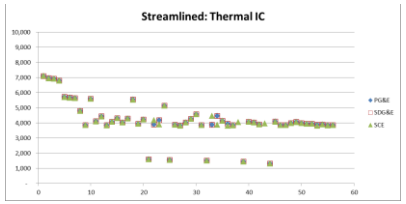


Figure 1: Streamlined Thermal IC Comparison

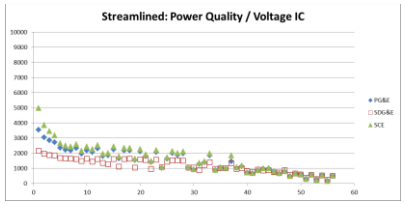


Figure 2: Streamlined PQ IC Comparison

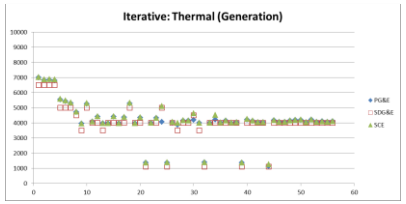


Figure 1: Iterative Thermal IC Comparison

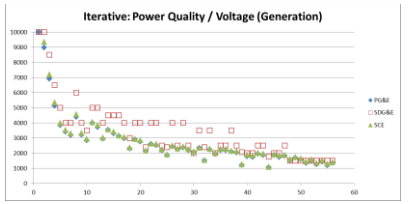


Figure 2: Iterative PQ IC Comparison

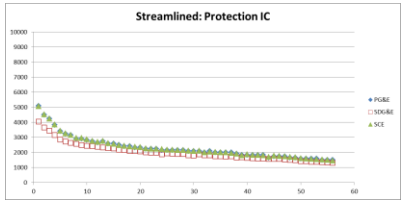


Figure 3: Streamlined Protection IC Comparison

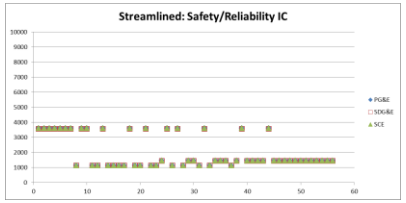


Figure 4: Streamlined S/R IC Comparison

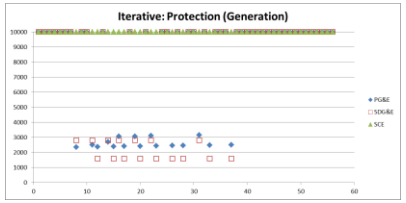


Figure 3: Iterative Protection IC Comparison

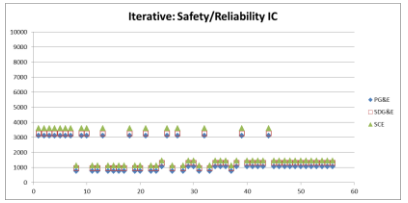


Figure 4: Iterative S/R IC Comparison

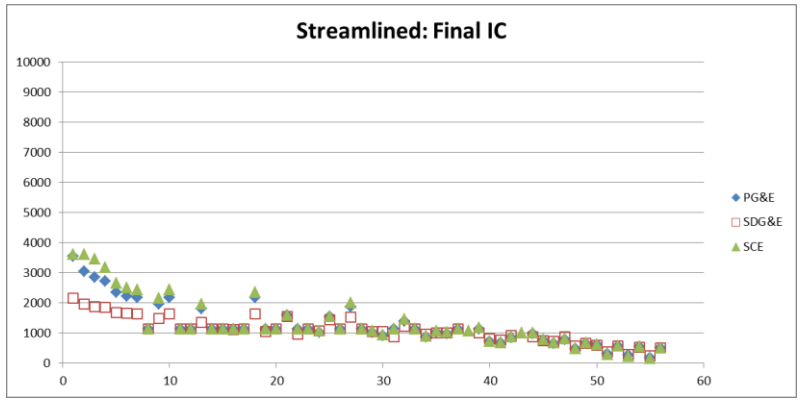


Figure 5: Streamlined Final IC Comparison

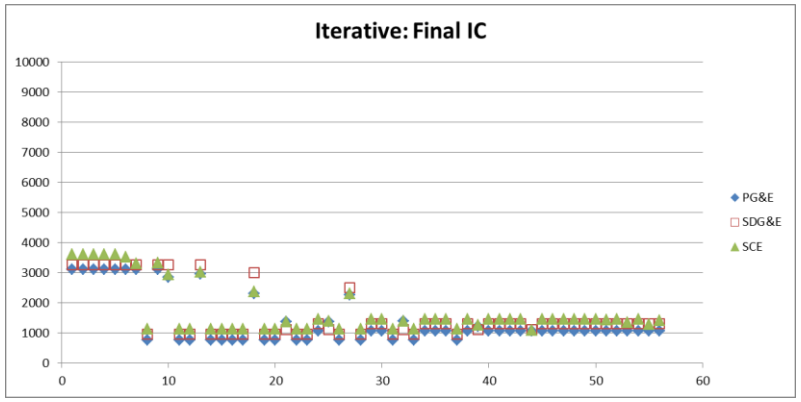


Figure 5: Iterative Final IC Comparison

Source: IOUs DRP Demo A Report

Questions and Additional Work on ICA Comparison and Validation

- Item 4 in Group I of MTS Scoping Document
  - Much overlap with Group IV items of Validation and Independent Verification

- What characteristics, and which representative CA feeder or feeders may be used as a more indicative reference circuit?
  - IEEE 123 has enough to generally understand most general feeder conditions
    - IOUs just had to add a line recloser to ensure alignment on Protection
  - EPRI Test Circuits from IEEE Distribution Test Feeder site could be good candidates for next phase
    - Consists of representative small-, medium-, and large-circuits that have 1379, 5694, and 3885 respectively
  - Functional alignment is important to tackle first
    - IOUs need external alignment on IEEE 123 before moving to more complex data set

- External Alignment and QA?
  - No non-IOU parties have provided analysis on the IEEE 123 circuit for comparison or QA
  - IOUs request external analysis on this publicly available model before moving to more complex model
  - IOUs can provide adjusted IEEE model file and results to party performing external QA

Agenda Item E: Tee up remaining Group I topics

Short summary of remaining Group 1 topics and discuss next-steps for August

Item 1: Planning Use Case and methodologies
Item 5: Smart Inverter Functionality

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Agenda Item E: Tee up remaining Group I topics

Item 1: Planning Use Case and methodologies

The ICA has been identified by the CPUC for use in multiple planning processes, including, but not limited to, grid modernization (within DRP) and the IRP. The Working Group has not yet reached a full consensus on whether the streamlined or the iterative methodology is more appropriate for this use case; the IOUs have proposed using the streamlined method. WG members would like additional information regarding the annual distribution planning process, discuss the full suite of potential applications for ICA within planning, and evaluate methodological needs to meet each of these applications. Discussion items are summarized within the scoping document.

Scoping questions: the ICA WG should work to determine:

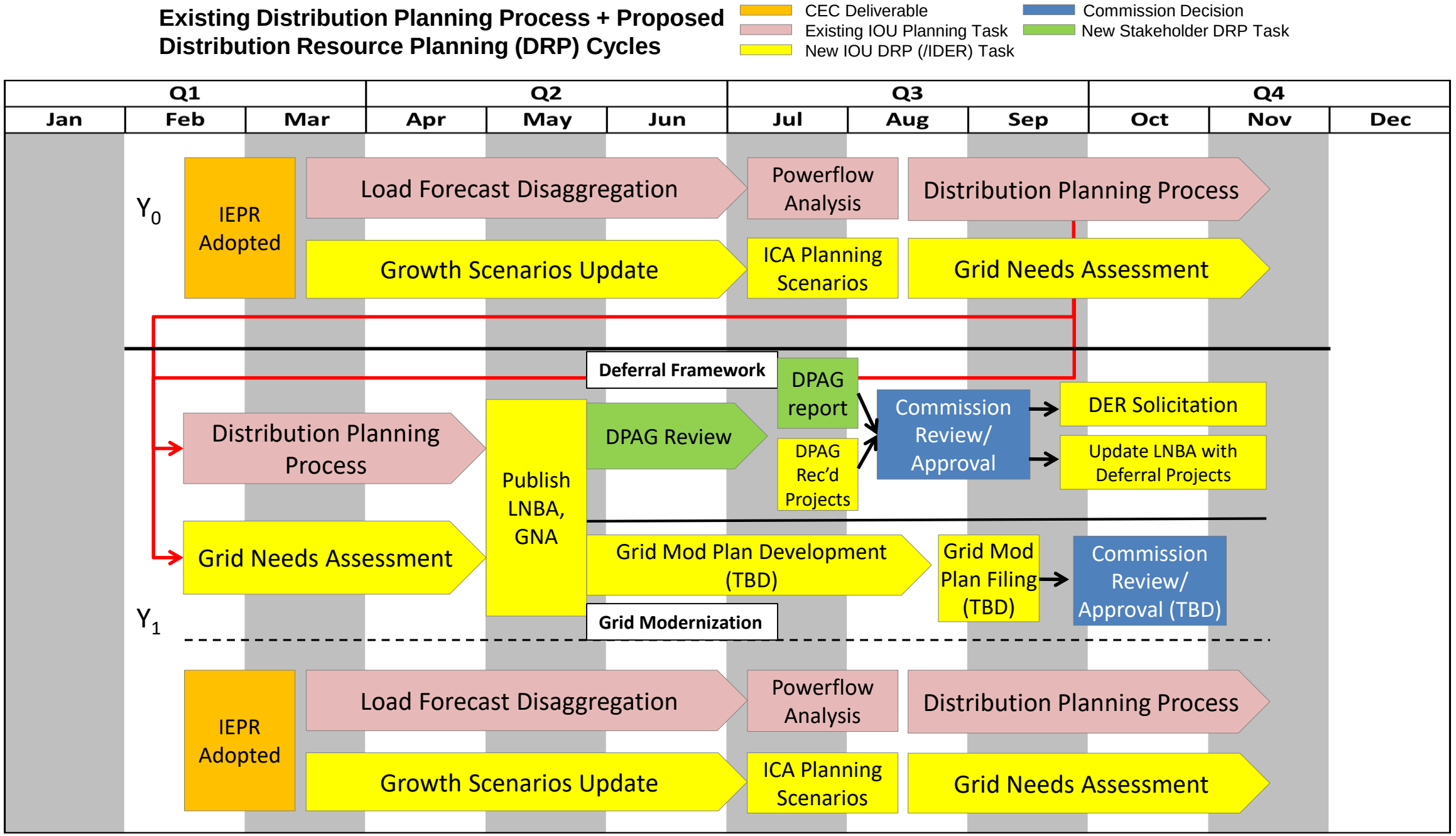
- What are the uses of ICA in planning as identified by other Tracks of DRP, other related proceedings (e.g., IDER) and other Commission guidance?
- From this pre-identified list of discussion questions, are there any to be added or subtracted?
- From these known uses, what methodological needs are required to meet these use cases? Would a streamlined, iterative, or blended approach be most sufficient to serve this use case?

Role of ICA in Envisioned Distribution Resources Planning Process

Marc Monbouquette
California Public Utilities Commission

July 7, 2017

Existing Distribution Planning Process + Proposed Distribution Resource Planning (DRP) Cycles



ICA Planning Use Case

- Main function: determine impact of load forecast and DER Growth Scenarios on hosting capacity
- Informs DPP, DRP frameworks, and IRP:
  - **DPP**: IDs circuits that may require hosting capacity upgrades, either through traditional investments or distribution deferrals
  - **Grid Mod**: IDs potential location-specific grid modernization investments
  - **IRP**: determine impact of optimized DER portfolios on hosting capacity

ICA Planning Use Case

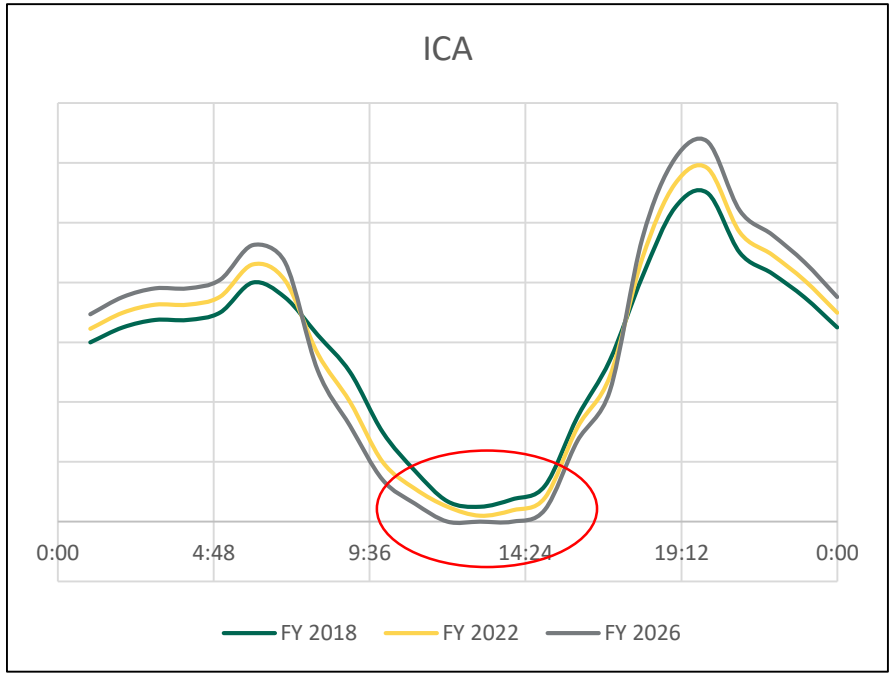
- The final WG report called for the identification of use cases and methodologies for applying ICA to distribution planning
- From the ICA WG scoping document:

  Objective: The ICA WG will determine how the ICA may inform and identify DER growth constraints and opportunities in the planning process, in which applications and how ICA may be used, and what methodology (streamlined or iterative), levels of granularity and frequency of updates, may best serve the planning use case.

- The IOUs propose to use ICA to validate distribution needs analysis and identify areas where new technologies can enable growth of DER

Distribution Planning Using ICA and Growth Scenarios

- ICA can be used in conjunction with growth scenarios to identify areas of high penetration
- In places where ICA is forecasted to approach zero, grid upgrades can be made to increase hosting capacity
  - Only where forecasted retail DERs are expected to exceed ICA
  - Type of upgrade is dependent upon limiting ICA factor
- ICA can be used to validate existing system needs



- Specific technologies may cause reductions in ICA, requiring new control and automation systems
  - e.g., Solar PV and the midday duck curve

- Operational flexibility can be maintained via new technologies

Agenda Item E: Tee up remaining Group I topics

Item 5: Smart inverter functionality

Additional studies are needed to develop an appropriate methodology to incorporate smart inverters in an automated and efficient manner. Smart inverter standards are not yet finalized. The WG will also need to agree on operational assumptions.

Some studies identified by the WG for consideration include:

- How the following smart inverter functions and applicable function ranges affect ICA values: 1) Volt-var; 2) fixed power factor; 3) Volt-watt; 4) function prioritization; 5) Phase II communication implications; 6) Phase III advanced functions implications; and 7) future IEEE 1547 oversizing implications, if approved
- Determine the range of settings and curves that can provide maximum ICA without negatively affecting the distribution system
- Determine the effects of the applications of smart inverter functions to the distribution system reactive capacity and system efficiency

Scoping questions: Within long-term refinement, the ICA WG will discuss prioritization of studies, and work to develop an appropriate methodology for including smart inverter functionality within ICA.

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Group 1 – Item 5: Smart Inverters

Develop methods and tools to model smart inverter functionality in ICA calculations

Scoping Document Objective:

Determine which additional studies are needed, and use the results to develop a methodology to include Smart Inverters with ICA:

- ❑ How the Smart Inverter functions and ranges affect ICA values
- ❑ Determine balance of maximum ICA without negatively affecting the distribution system
- ❑ Determine the effects of smart inverter functions to distribution system reactive capacity

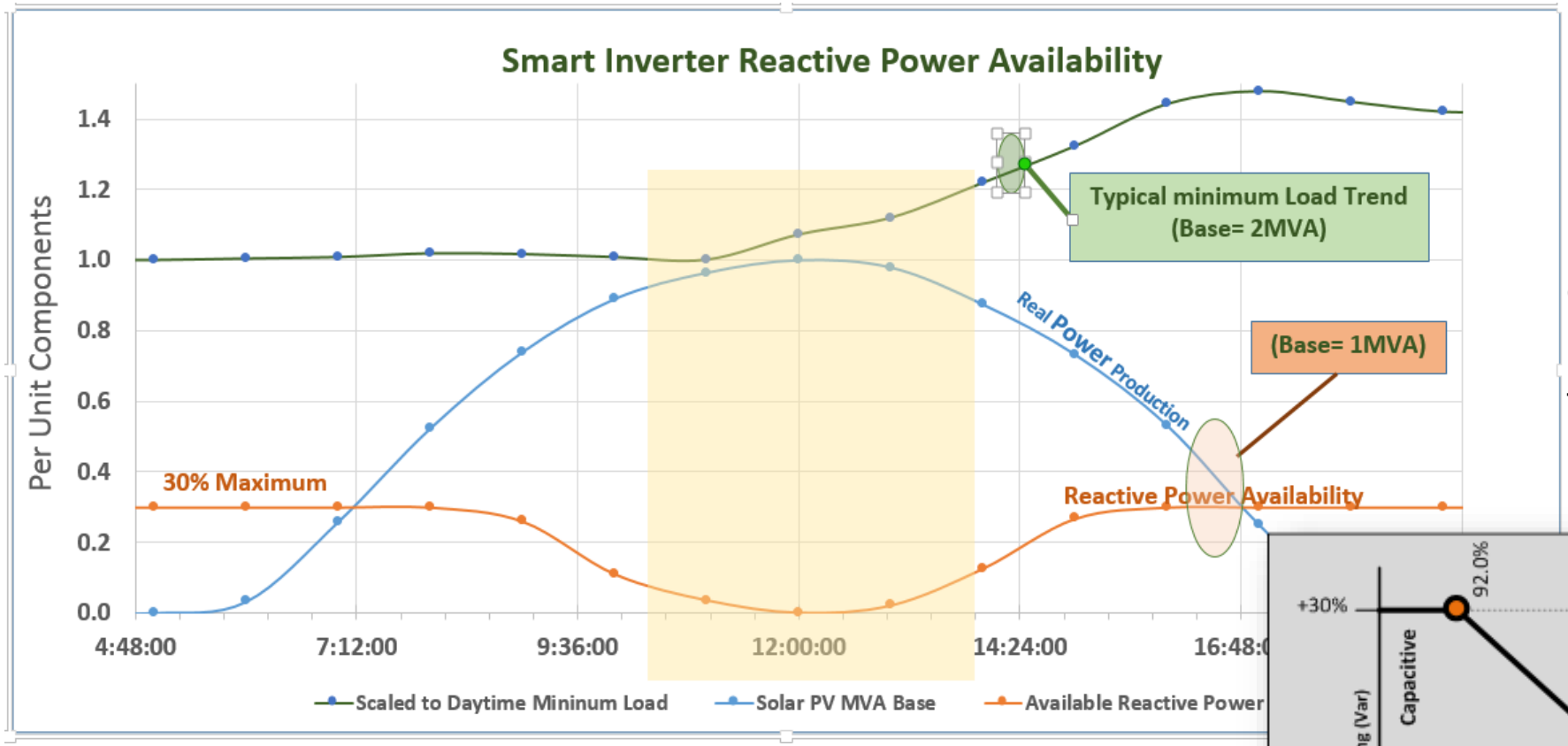
Topics for consideration

- Timing of Smart Inverters' implementation in California
- Functions' limitations that may support higher integration capacity levels
- Electric power system power factor
- Tools' capability to model Smart Inverter functionality in an automated and efficient manner
- Engineering resources (e.g., what should the focus be for the next one to two years?)

Smart Inverter Functions Capable To Support Higher ICA values

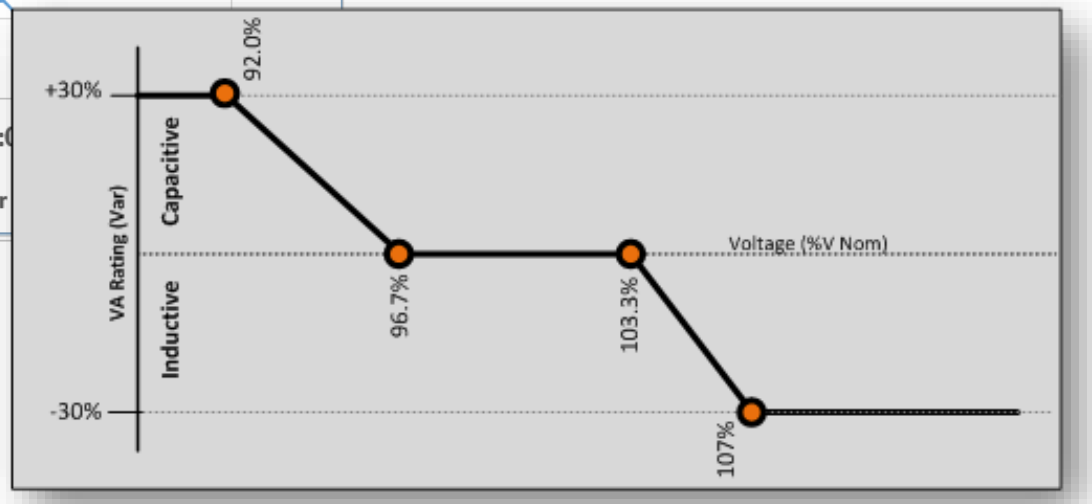
Function	Phase	Timing	Supports Higher ICA Values	Limintations
Anti-Islanding	I	Q4-2017	NO	
Low/High Voltage Ride-Through	I	Q4-2017	NO	
Low/High Frequency Ride-Through	I	Q4-2017	NO	
Dynamic Volt-Var Operations (Watt priority)	I	Q4-2017	Yes	Watt Priority Reduces Ability To Support Voltage Control
Dynamic Volt-Var Operations (Reactive priority)	Extended Phase I	Q4-2018- Q4 2019	Yes	Pending IEEE 1547.1 or CA stakeholders suport to activity earlier in CA
Ramp Rates Controls	I	Q4-2017	No	
Fix Power Factor	I	Q4-2017	NO	Deactivated, may connflict with voltage control
Reconnect via soft start	I	Q4-2017	NO	
Communciation Capability	II	Q4-2018	NO	Capability Only - Not a requirement to apply
Frequency Watt	III	Q4-2018	No	
Voltage/Watt	III	Q4-2018	Yes	Will Reduce Real Power Production
Monitor Key Data	III	Q4-2018	No	Capability Only - Not a requirement to apply
DER Cease-to Energy/Return to service	III	Q4-2019	NO	Pendinng IEEE 1545.1 Standard Development- Capability Only
Limit Maximum Active Power Mode	III	Q4-2019	NO	Pendinng IEEE 1545.1 Standard Development- Capability Only
Scheduling Power Values and Modes	III	Q4-2018	NO	Capability to Schedule Only

Effects of Watt Priority



Rule 21 does not require oversizing of the inverters

Inverters may not have the capacity to help mitigate voltage issues



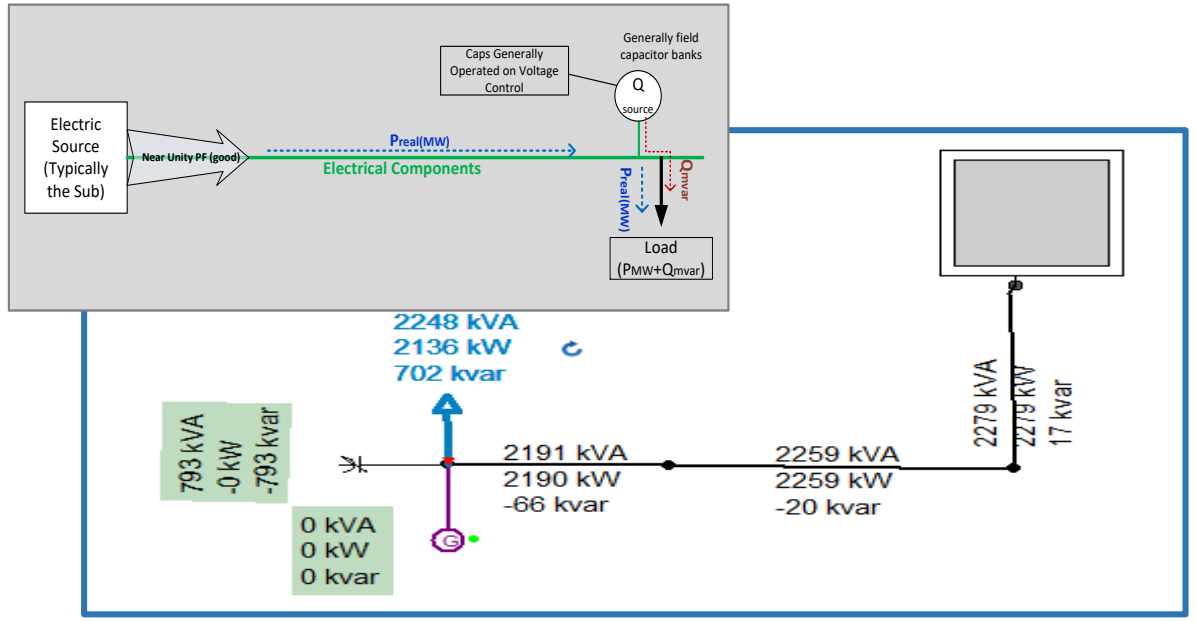
Consider Electric Power System Power Factor

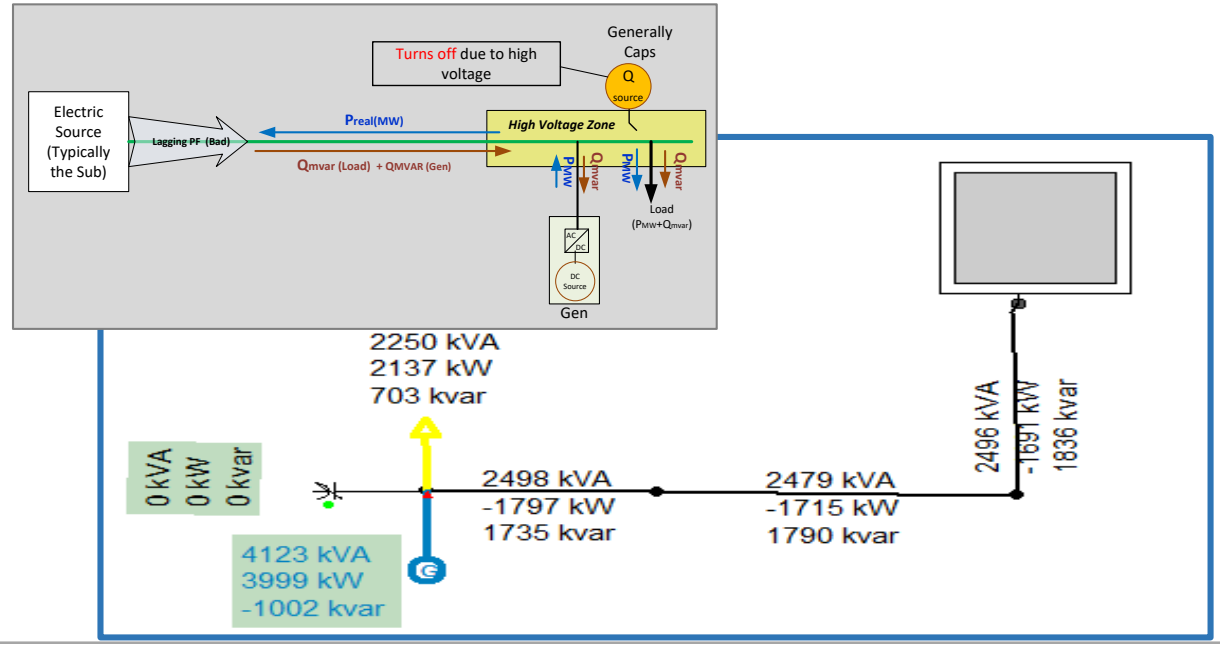
General Principles

- Maintain electric components (wires, transformers, etc.) Flowing Real (MW) power
  - Real power to customer using electric power
  - Real power flow from customer producing electric power
- Inject reactive power support (such capacitors) close the reactive power load

Considerations

- The Reactive Power (Q) absorbed by Smart Inverters must be produced (generated) elsewhere
- Additional reactive capacitive sources may be required
- The increase reactive power through the distribution lines may increase the load on the lines specially when real power reverses to the substation.
  - Increase real power from distributed generating sources to substation
  - Increase reactive power from substation to distributed resources
  - Overall increase in MVA load on the distribution system





Updating Current Tools

- Once ICA WG determines how Smart Inverters should be incorporated into the ICA Methodology, the tools (e.g., CYME, Synergi) must be updated to automate the ICA calculation with Smart Inverter functionality
- SCE is currently engaging with CYME to determine implementation, but design and development requires Final PUC decision on application of Smart Inverters
- Currently, Smart Inverters would have to be modeled manually which is not possible for a system wide implementation

Where Should Engineering Resources Focus?

- The approaching system wide implementation of ICA methodology
- Development and support of tools to allow fully automated ICA for all Smart Inverter Functions and prioritization
- Smart Inverters are not ready to be utilized for increased levels of hosting capacity
  - Need at least 1.5-2 years to have VAR-priority (through Advise Letter or when IEEE1547.1 is completed and adopted – currently projected in Q4-2018)

Locational Net Benefits Analysis Working Group

July 7, 2017

In-person meeting

drpwg.org

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Agenda

Time	Topic
1:15 – 1:30	A. Discuss overall plan and approach for LNBA WG meetings
1:30 – 2:30	B. Discuss item 2.i and 2.ii **2.i** – including options to automatically populate DER generation profile input **2.ii** – enabling modeling of a portfolio of DER projects at numerous nodes to respond to a single grid need
2:30 – 2:45	C. Break
2:45 – 3:15	D. Discuss Item 4 – Additional granularity into energy and capacity values
3:15 – 4:00	E. Preview remaining Group I items and discuss plan for August Item B and Item 2 iii – Valuing location-specific grid service provided by advanced smart inverter capabilities; allowing hourly VAR profiles to be input in order to capture DERS ability to inject or absorb reactive power – *optional stakeholder call prior to discussion at August meeting.* Item 5 - Non-zero transmission value -- *form sub-group* Item 4- Line losses – *to be discussed at August meeting* E. Wrap up and next steps

ICA and LNBA Working Group Background: June 7 ACR

June 7 ACR: Overview

The ACR sets scope and schedule, pre-Working Group deliverables, and status report and final reporting milestones for continued long-term refinement discussions pertaining to the ICA and LNBA in Track 1 of the DRP proceeding.

The ACR scopes and prioritizes LNBA long-term refinement items as identified in the Final Working Group Report and the Interim Long-Term Refinement Report into three Groups, and designates others as Out of Scope:

ICA and LNBA Working Group Background: June 7 ACR

Group	Items: Explanations/Clarifications	Source (ACR/WG report)
I	Item B: methods for valuing location-specific grid services provided by advanced smart inverter capabilities	ACR
	Item D: Method for evaluating the effect on avoided cost of DER working "in concert" in the same electrical footprint of a substation (same as Item 2.ii)	ACR
	Item 2: Improve heat map and spreadsheet tool by: i) Including options to automatically populate DER generation profile input; ii) Enabling modeling of a portfolio of DER projects at numerous nodes to respond to a single grid need; iii) Allowing hourly VAR profiles	WG Report
	Item 4: Incorporate additional locational granularity into energy, capacity, and line losses system-level avoided cost values	WG Report
	Item 5: Form technical subgroup in LT refinements to develop methodologies for non-zero location-specific transmission costs (requires coordination/co-facilitation with CAISO)	WG Report

Items 2, 4, and 5 should constitute WG primary focus

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ICA and LNBA Working Group Background: June 7 ACR

Group	Items: Explanations/Clarifications	Source (ACR/WG report)
II	Item 7: Incorporate a (forecasting) uncertainty metric in LNBA tool for panned deferrable projects (requires coordination with development of deferral screening criteria under development in DRP Track 3 Sub-track 3	WG report
	Item 11: Only use base DER growth scenario, not high growth scenario (may entail substantive discussion but likely will not entail incremental methodology development, requires coordination with DER growth scenarios under development in DRP Track 3 Sub-Track 1	WG report

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ICA and LNBA Working Group Background: June 7 ACR

Group	Items: Explanations/Clarifications	Source (ACR/WG report)
III	Valuing unplanned grid needs over long-term (>10 years) - *speculative and likely difficult to quantify for practical use in the LNBA* • Item A: Methods for evaluating location-specific benefits over a long term horizon that matches with the offer duration of the DER project • Item 8: Develop a methodology to quantify the likelihood of an unplanned gird need (deferrable project) emerging in a given location • Item 9: Value locational value of DERs beyond 10 years	ACR and WG report
	Item 13: Explore possible value of situational awareness or intelligence - *value of data-as-service for situational intelligence is likely hard to quantify on avoided or marginal cost basis, and is driven to some degree by Commission policy on the use of DER data for grid operations and/or planning*	WG report
	Items 12, 14, 16, 17: value proposition is speculative and potentially low: WG should only address these issues if time permits	
	Item 12: Explore asset life extension/reduction value provided by DERs	WG report
	Item 14: Include benefits of increased reliability (non-capacity related) provided by DERs	WG report
	Item 16: LNBA should value benefits of DERs reducing the frequency/scope of maintenance projects	WG report
	Item 17: LNBA should include benefits of DER penetration allowing for downsized replacement equipment due to be installed in the case of equipment failure or routine replacement of aging assets	WG report

ICA and LNBA Working Group Background: June 7 ACR

Group	Items: Explanations/Clarifications	Source (ACR/WG report)
Out of Scope	Item C: Consideration, and if feasible, development of, alternatives to the avoided cost method, such as distribution marginal cost or other methods Alternatives to the avoided cost method would entail developing new methodological approaches from that which was required for Demo B. As long-term refinement discussions should build on the Demo B methodology, alternatives to the avoided cost method will be considered in a parallel track outside of the LNBA WG. Further discussions on this topic will be held in coordination with the IDER proceeding, where this topic is part of Phase 3 of the IDER Cost-Effectiveness plan.	ACR
	Item 1: Spend significant time to determine how LNBA tool and map may be expanded to meet future use cases LTR discussions should focus on improving the LNBA valuation methodology developed for Demo B through introducing more locational granularity to system-level values (e.g., Item 4), exploring values that were unable to be quantified for Demo B (e.g., Item 5), and exploring values that were not included in Demo B (e.g., Item 12). See rationale for Item C.	WG report
	Item 3: Clarify Renewable Integration Cost component ordered by ACR Renewable Integration Cost component is under examination in the IRP and/or the RPS proceedings, and the LNBA should incorporate the value(s) determined in those proceedings	WG report
	Item 6: Examine methods to reduce uncertainty in planning and utility investment In scope for DRP Track 3 Sub-Tracks 1 and 3	WG report
	Item 10: LNBA should include cost of DER penetration by testing ICA hosting capacity limits under different DER growth scenarios LNBA calculates estimated avoided costs (or deferral benefits) and does not include DER integration costs. To the extent that planned upgrades to accommodate autonomous DER growth can be evaluated as a DER deferral opportunity, this process would occur between the Grid Modernization and Distribution Investment Deferral Frameworks in scope for DRP Track 3 Sub-Tracks 2 and 3, respectively.	WG report
	Item 15: Evaluate planned upgrades meant to accommodate additional DER growth as potential deferral opportunities In scope for DRP Track 3 Sub-Tracks 2 and 3	WG report

ICA and LNBA Working Group Background: June 7 ACR

The groupings provided in the ACR prioritize Working Group activities by front-loading work on topics of relatively high complexity and/or importance. The WG is to initiate discussions on long-term refinement topics in the order in which they are grouped.

More Than Smart facilitated the development of a ten page scoping document briefly summarizing discussions on these topics to date and detailing relevant framing questions or considerations to move discussions forward from the outset. These were circulated for input from active Working Group members who provided comments to the previously submitted reports, and finalized June 15.

- LNBA WG Long-Term Refinement Scoping Document

This scoping document summarizes discussion points from the Interim Long-Term Refinement Report submitted November 2016, and the Final Demo B Working Group Report submitted March 2017.

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ICA and LNBA Working Group Background: June 7 ACR

Interim status reports are due as follows:

- **Group I: August 31, 2017**
- **Group II, III: October 31, 2017**

The groupings, scoping documents, and interim status reports help form a tentative schedule for the Working Group going forward.

The ACR indicates that the Working Group is meant to pursue and develop the scoped topics to the fullest extent possible, including methodological development and/or modeling demonstrations where feasible, but also recognize that certain items may prove unworkable at this stage of ICA and LNBA development. In such cases, the Working Group is directed, in the status reports and Final Long-Term Refinement report, to document the extent of discussions, reason(s) for rescinding or tabling the topic, and relevant considerations and/or implementation plans (if any) for further discussions and methodological development beyond the Working Group process set forth herein.

ICA and LNBA Working Group Background: June 7 ACR

Interim status reports are due as follows:

- **Group I: August 31, 2017**
- **Group II, III: October 31, 2017**

The groupings, scoping documents, and interim status reports help form a tentative schedule for the Working Group going forward.

July: Group I topics
August: Group I topics
August 31: Group I Status Report due
September: Group II and III topics
October: Group III topics, revisit Priority topics* from Group I
October 31: Group II/III Status Report due
November: Revisit priority topics from Group I and/or revisit other topics as necessary
December: Discuss draft final report
January: Final report due

* For LNBA, a few topics from Group I are specifically called out as primary topics.

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ICA & LNBA Working Groups: Process, Schedule, Scope

July 7, 2016

Process and Schedule

Discussion Sessions and Content Development (1 of 2)

- **For each topic identified in the scope:**
  - For each topic, IOUs (and other interested stakeholders) will perform pre-work to prepare information prior to the WG discussion. The required work includes:
    - Propose the basic requirements of a solution to the issues presented by the topic (i.e., "what is this topic looking for")
    - Identify a reasonable scope for a "realistic outcome" for the WG Final Report, given the many topics and limited time. Specifically, the "realistic outcome" could be a fully-baked solution, a plan or detailed scope for future analysis, or something else.
    - A proposal for the identified realistic outcome; i.e. a proposed solution, proposed scope for future analysis, etc.
  - At WG meeting when the topic is scheduled for discussion, IOUs (and other stakeholders who have developed a proposal) will present their proposal. This will provide a framework for discussion, questions, comments, initial feedback, etc.

Discussion Sessions and Content Development (2 of 2)

- **Following the discussion for each topic:**
  - IOUs (and other stakeholders who have developed a proposal or would like to include a proposal) will circulate a written document further explaining the proposal and rationale, including as appropriate modifications based on feedback from the discussion. The proposal(s) should include specific recommendations proposed to be included in the Final Report.
    - This document will provide an opportunity to formally document proposals and provide additional explanation.
  - Other stakeholders will then have an opportunity to submit one round of written responses. Written responses can recommend modifications to the proposal or to the "Realistic outcome" or anything else relating to the topic.
    - The written comments provide an opportunity to expand and document feedback from the WG discussion.
  - MTS will maintain the repository of all comments (IOU proposals and stakeholder responses.)
- Some topics might be discussed at multiple sessions; some will only be discussed at one session.

Final Report Development

- The Final Report will be developed from written proposals and responses.
- All recommendations in the final report will be drawn from previous written documents.
- During the revision process, parties will have chance to add supporting or opposing arguments to recommendations, but new recommendations will not be accepted unless they are consensus recommendations.

Schedule

- The Schedule ensures that topics identified by the Commission will be addressed at least once. However, discussions are inherently limited by the number of topics and the limited time, and will be prioritized per the Ruling.

Meeting	ICA Topics	LNBA Topics
Jul.	Group I (4 topics, address subset)	Group I (5 topics, address subset)
Aug.	Group I (address topics not discussed above)	Group I (Address topics not discussed above)
Sep.	Group II (5 topics)	Group II (2 topics) + Group III (6 topics, address subset)
Oct.	Group III-IV (5 and 3 topics, respectively)	Group III (address topics not discussed above; all speculative and/or hard to quantify) Begin to revisit Priority topics* from Group I
Nov.	Revisit priority topics* from Group I and/or revisit other topics as necessary.	Continue to revisit priority topics and/or other topics as necessary.
Dec.	Discuss Draft Final Report	Discuss Draft Final Report
Jan. 7	Report Due	Report Due

Agenda Item B: Discuss 2.i and 2.ii

2.i – including options to automatically populate DER generation profile input

2.ii – enabling modeling of a portfolio of DER projects at numerous nodes to respond to a single grid need

Background: After reviewing Demo B projects, the LNBA WG identified short-term improvements that improve the functionality of the LNBA tool and heat map. These improvements do not change the underlying LNBA analysis, but rather refine the tool to improve its accuracy and add improvements to both the tool and map. These three recommendations were made with consensus by the LNBA WG after review of the Final Demo B reports.

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Agenda Item B: Discuss 2.i and 2.ii

2.i – including options to automatically populate DER generation profile input

The LNBA tool currently asks users to manually provider DER information, benefits that the DER can obtain, and a DER hourly profile. The WG came to a consensus recommendation to modify the tool so that there is an option to select a typical or generic hourly DER generation profile and capacity and automatically populate output. These sample profiles would be illustrative only.

Scoping questions:

i) Which profiles should be added in a public resource library? What publicly available resources already exist (e.g., EM public tool, typical solar PV and EE profiles, etc.)

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Item 2.i – DER Shapes

- ACR:
  - "Improve heat map and spreadsheet tool by: i) including options to automatically populate DER generation profile input"

- MTS Scoping Document:
  - "The WG came to a consensus recommendation to modify the tool so that there is an option to select a typical or generic hourly DER generation profile and capacity and automatically populate output. **These sample profiles would be illustrative only.**"

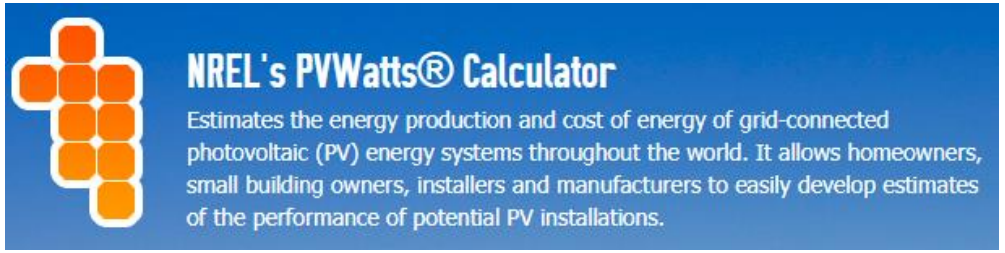
Item 2.i – DER Shapes

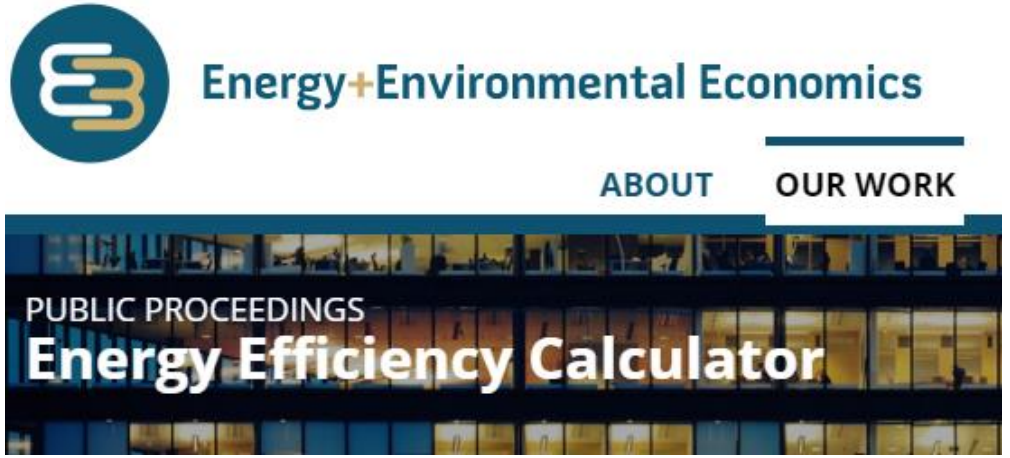
- IOU Proposal:
  - Populate the LNBA Tool with publicly available DER shapes for solar, energy efficiency, and generic baseload generation (flat shape)
    - Include simple profiles – no operating assumptions needed
    - Keep tool streamlined and fast

Item 2.i – DER Shapes (Details)

- Solar:
  NREL's PVWatts Calculator

- Energy Efficiency:
  E3's Energy Efficiency Calculator for 2013-2014
  - Profiles from Database For Energy Efficient Resources (DEER)





Item 2.i – DER Shapes

- NREL and E3/DEER represent public, reputable sources
- The availability of the sources allows for users to reproduce or obtain the DER shapes
- Working Group: Recommendations for additional sources

Agenda Item B: Discuss 2.i and 2.ii

2.ii – enabling modeling of a portfolio of DER projects at numerous nodes to respond to a single grid need

Enable modeling of portfolio of DER projects at numerous nodes to respond to a single (or more) grid need(s): The LNBA WG came to a consensus recommendation to refine the LNBA tool to allow for modeling for a portfolio of projects, as a DER alternative to a larger distribution upgrade may require a portfolio of projects as numerous nodes.

Scoping questions:
How might the LNBA tool be enhanced to support benefit analysis of deferring one or more projects with multiple locational elements?

Items 2.ii and D – Portfolio of DERs

- Topic:

  ACR 2.ii : “enabling modeling of a portfolio of DER projects at numerous nodes to respond to a single grid need”

- MTS Scoping Document:

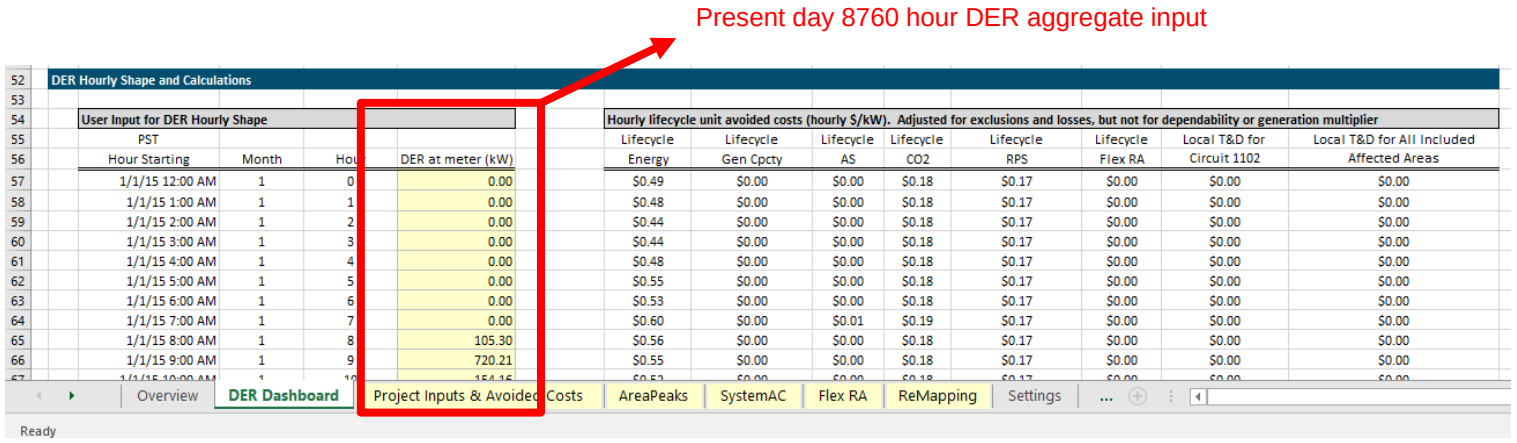
  “After review of the final Demo B projects, the WG was in consensus that the LNBA tool should be refined to support benefit analysis of a portfolio of projects at numerous nodes.”

- IOU Proposal:

  IOUs suggest that the spreadsheet is modified in the DER dashboard tab to have several columns for various DER types that all add into the existing DER hourly shape column. This will allow the user to select, scale, and layer various DERs to evaluate their combined impact.

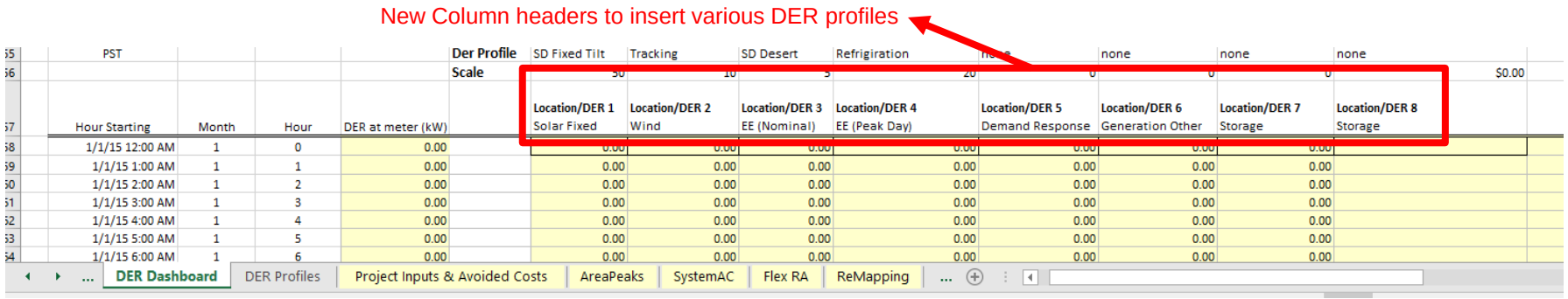
Existing Tool

- The existing tool is designed so that the user inputs a 8760 hour DER profile to generate avoided cost values. The tool essentially leaves it up to the user to forecast the aggregate output of the DER(s), whether one or several DER types/locations combined. Although still possible to model DERs working in concert the existing tool requires more front end work by the user and contributions from various resource types would be difficult to discern within the tool.



IOU-Proposed Tool Alterations

- The tool will be altered to include columns to reflect DERs at multiple locations that the user can populate and scale with typical DER profiles, but the user could ultimately add even more columns, to represent more DER profiles simultaneously if desired.

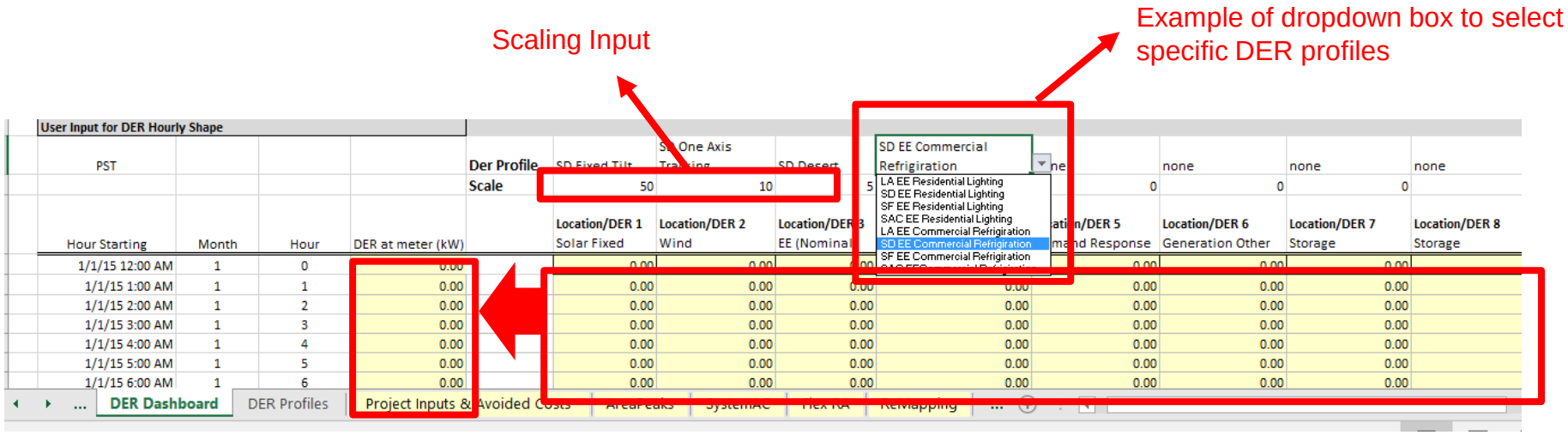


	PST				Der Profile	SD Fixed Tilt	Tracking	SD Desert	Refrigiration		none	none	none	
					Scale	50	10	5	20	0	0	0		$0.00
	Hour Starting	Month	Hour	DER at meter (kW)		Location/DER 1 Solar Fixed	Location/DER 2 Wind	Location/DER 3 EE (Nominal)	Location/DER 4 EE (Peak Day)	Location/DER 5 Demand Response	Location/DER 6 Generation Other	Location/DER 7 Storage	Location/DER 8 Storage	
	1/1/15 12:00 AM	1	0	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	1/1/15 1:00 AM	1	1	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	1/1/15 2:00 AM	1	2	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	1/1/15 3:00 AM	1	3	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	1/1/15 4:00 AM	1	4	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	1/1/15 5:00 AM	1	5	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	1/1/15 6:00 AM	1	6	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		

DER Dashboard | DER Profiles | Project Inputs & Avoided Costs | AreaPeaks | SystemAC | Flex RA | ReMapping

IOU-Proposed Alterations Continued

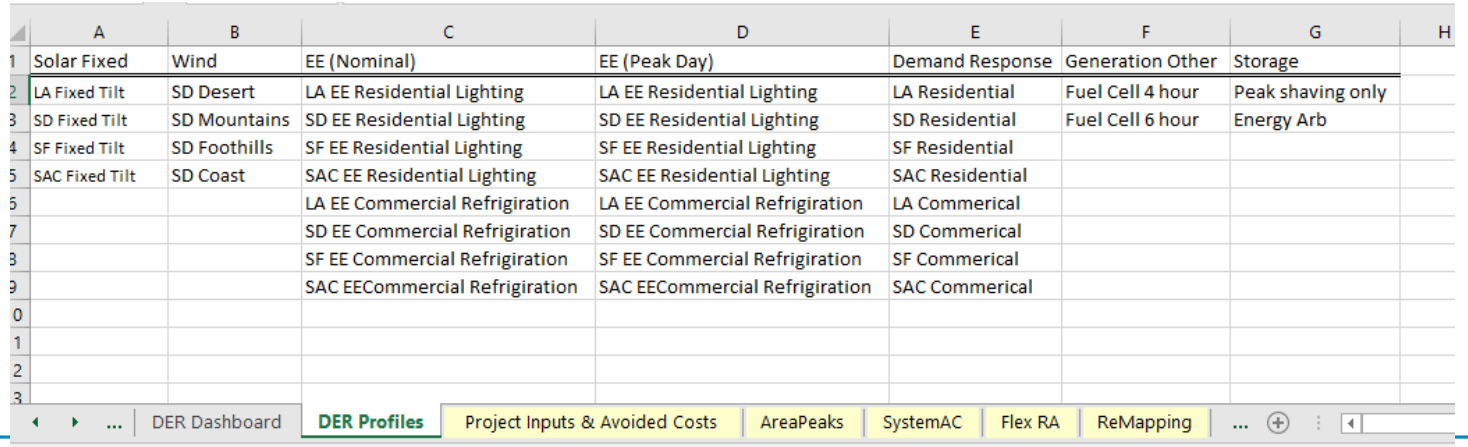
- The user will select the DER profiles they want to model by using the dropdown menus for each DER type which will then reference a DER library (of public/generic DER profiles) which will contain DER profiles all normalized to 1 kw
- The user can then scale the resource based on maximum nameplate kw to generate expected load reduction numbers for 8760 hours
- The various load reduction values will then be summed to aggregate the impact of various DERs and loaded into the existing DER profile column which will then evaluate the system level values associated with the overall load reduction achieved



All DER profiles will be summed to aggregate a total DER output column

IOU-Proposed New Tab/Sheet DER Profiles

- The altered DER Dashboard Sheet will contain dropdowns that reference/import specific DER profiles that a user may chose from for each resource type.
- The dropdown lists will be created and stored on a new sheet in the existing tool as shown below (DER profiles)
- The working group however will have to decided how to store the actual DER profile data; it can be stored on the E3 tool file if only a relatively small amount, but if we were to input many DER profile options we would need the dropdowns to reference a separate excel file/library to keep the doc running smoothly.
- It is expected the WG will come to a consensus of how to implement once the desired number of DER profiles is agreed to



	A	B	C	D	E	F	G	H
1	Solar Fixed	Wind	EE (Nominal)	EE (Peak Day)	Demand Response	Generation Other	Storage	
2	LA Fixed Tilt	SD Desert	LA EE Residential Lighting	LA EE Residential Lighting	LA Residential	Fuel Cell 4 hour	Peak shaving only	
3	SD Fixed Tilt	SD Mountains	SD EE Residential Lighting	SD EE Residential Lighting	SD Residential	Fuel Cell 6 hour	Energy Arb	
4	SF Fixed Tilt	SD Foothills	SF EE Residential Lighting	SF EE Residential Lighting	SF Residential			
5	SAC Fixed Tilt	SD Coast	SAC EE Residential Lighting	SAC EE Residential Lighting	SAC Residential			
6			LA EE Commercial Refrigiration	LA EE Commercial Refrigiration	LA Commerical			
7			SD EE Commercial Refrigiration	SD EE Commercial Refrigiration	SD Commerical			
8			SF EE Commercial Refrigiration	SF EE Commercial Refrigiration	SF Commerical			
9			SAC EECommercial Refrigiration	SAC EECommercial Refrigiration	SAC Commerical			
10								
11								
12								
13								

... DER Dashboard | DER Profiles | Project Inputs & Avoided Costs | AreaPeaks | SystemAC | Flex RA | ReMapping ...

Agenda Item D: Item 4 – Additional granularity into energy and capacity values

Overview: Additional components of avoided costs which currently employ system-level values should incorporate additional locational granularity.

Background: The LNBA Demo B tool directly used DERAC values for certain avoided cost components. The LNBA WG was in consensus recommendation to update energy, capacity, and line loss avoided costs with more location-specific values. IOUs may update the tool using known values for energy and capacity. Specifically, avoided energy costs may be developed using locational information such as CAISO LMPs. Avoided generation capacity values may be represented by local resource adequacy (RA) values in constrained areas.

Scoping questions:

i. What values should be used to make energy and capacity avoided costs more location-specific?
ii. What pricing forecast methodologies should be used to provided consistency and develop future prices at each location?

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Item 4.i – Locational Avoided Energy

- ACR:
  - "Incorporate additional locational granularity into Energy"
- MTS Scoping Document:
  - "The LNBA WG was in consensus recommendation to update energy, capacity, and line loss avoided costs with more location-specific values. IOUs may update the tool using known values for energy and capacity."

Item 4.i – Locational Avoided Energy

- IOU Proposal:
  - Remove system-wide avoided energy values and replace with Default Load Aggregation Point (DLAP) forecasts for the three IOUs. Consistent with avoided energy currently in the tool, the GHG component would be removed from the DLAP forecasts and forecasted separately.

Item 4.i – Locational Avoided Energy

- DLAP – "The LAP defined for the TAC Area at which all Bids for Demand shall be submitted and settled"[1]
  - DLAP Price is the weighted average of locational marginal prices (LMPs) within the DLAP area
- "Load is bid in and settled at the DLAP LMP as opposed to the nodal LMP."[2]
  - The DLAP prices are what the IOUs paid to serve load to its customers

1 "Business Practice Manual for Definitions & Acronyms," CAISO, version 16, October 3, 2016, pg. 36.
2 "Load Granularity Refinements, Pricing Study Results and Implementation Costs and Benefits Discussion," CAISO, January 14, 2015, pg. 11.

Item 4.ii – Locational Avoided Capacity

- ACR:
  - "Incorporate additional locational granularity into… Capacity"

- MTS Scoping Document:
  - "The LNBA WG was in consensus recommendation to update energy, capacity, and line loss avoided costs with more location-specific values. IOUs may update the tool using known values for energy and capacity."

Item 4.ii – Locational Avoided Capacity

- LNBA uses the 2016 DERAC for avoided capacity value
  - The 2016 DERAC utilizes Cost of New Entry (CONE) for a CT proxy to determine the avoided capacity value
  - CONE represents the net cost to build a new generator, and is the maximum value for capacity
- IOUs value resources in procurement using a Resource Balance Year (RBY), short run value of capacity (RA cost), and long run value of capacity (CONE).

Item 4.ii – Locational Avoided Capacity

- What is CONE?
  - "The long-run generation capacity cost is the levelized capital cost of a new simple cycle CT unit less the margin that the CT could earn from the energy and ancillary service markets."[1]

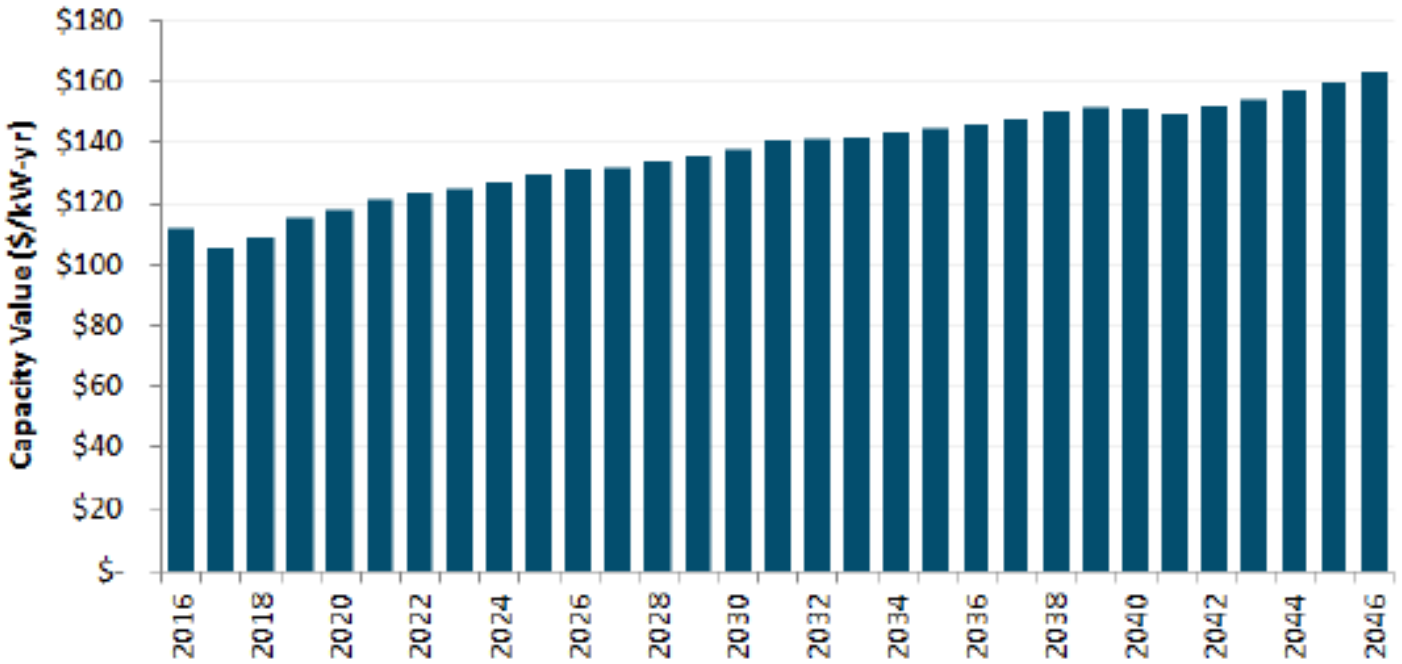
$$CONE = CT\ Capital\ Cost - (Energy\ Revenue + Ancillary\ Service\ Revenue)$$

1 "Avoided Costs 2016 Interim Update," Energy and Environmental Economics, Inc., August 1, 2016.

4.ii – Locational Avoided Capacity

What is the current forecast of avoided capacity in DERAC?

Figure 11. Adjustment of capacity value to account for temperature derating during periods of peak load (losses still excluded)



http://docketpublic.energy.ca.gov/PublicDocuments/16-BSTD-06/TN211817_20160615T100505_Draft_Avoided_Cost_Update_2016531.pdf

4.ii – Locational Avoided Capacity

What public info is available on actual costs that IOUs avoid today when load is reduced?

Table 7. Aggregated RA Contract Prices, 2015-2019

	All RA Capacity Contracts			Local RA Capacity Contracts			CAISO System RA Capacity Contracts		
	Total	NP-26	SP-26	Subtotal	NP26	SP26	Subtotal	NP26	SP26
Contracted Capacity (MW)	264,060	140,413	123,647	167,143	52,588	114,555	96,917	87,825	9,092
Percentage of Total Capacity in Data Set	100%	53%	47%	63%	31%	69%	37%	91%	9%
Number of Monthly Values	2,321	1,097	1,224	1,780	667	1,113	541	430	111
Weighted Average Price ($/kW-month)	$2.93	$2.45	$3.47	$3.21	$2.32	$3.62	$2.45	$2.53	$1.59
Average Price ($/kW-month)	$2.74	$2.26	$3.17	$2.97	$2.38	$3.32	$1.97	$2.06	$1.61
Minimum Price ($/kW-month)	$0.09	$0.60	$0.09	$0.09	$0.65	$0.09	$0.60	$0.60	$0.79
Maximum Price ($/kW-month)	$26.54	$11.47	$26.54	$26.54	$4.00	$26.54	$11.47	$11.47	$4.20
85% of MW at or below ($/kW-month)	$4.25	$3.00	$4.34	$4.25	$3.00	$4.34	$3.00	$3.00	$1.83

[26] The 2016 Net Qualifying Capacity list can be found at http://www.caiso.com/planning/Pages/ReliabilityRequirements/Default.aspx

[27] Path 26 is defined in the WECC Path Rating Catalog, viewable at https://www.wecc.biz/Reliability/NDA/WECC_2016_Path_Rating_Catalog.pdf

[28] The CAISO System RA category is applied to contracts with resources that are not located in Local Capacity Areas. It can be further divided into NP-26 and SP-26 sub-categories, which indicate whether those contracts are north or south of Path 26.

Table 7. Aggregated RA Contract Prices, 2015-2019

	All RA Capacity Contracts			Local RA Capacity Contracts			CAISO System RA Capacity Contracts		
	Total	NP-26	SP-26	Subtotal	NP26	SP26	Subtotal	NP26	SP26
Weighted Average Price ($/kW-month)	$2.93	$2.45	$3.47	$3.21	$2.32	$3.62	$2.45	$2.53	$1.59
Average Price ($/kW-month)	$2.74	$2.26	$3.17	$2.97	$2.38	$3.32	$1.97	$2.06	$1.61

Jan, 2017 CPUC Report: http://docketpublic.energy.ca.gov/PublicDocuments/15-AFC-01/TN215438-8_20170118T161031_Testimony_of_Jim_Caldwell_Exhibit_CPUC_2015_Resource_Adequacy_R.PDF

4.ii – Locational Avoided Capacity

What public info is available on actual costs that IOUs avoid today when load is reduced?

Table 8. Capacity Prices by Local Area, 2015-2019

	LA Basin	Big Creek/Ventura	Bay Area	Other PG&E Area	San Diego-IV	CAISO System
Contracted Capacity (MW)	21,644	58,955	49,129	3,459	33,956	96,917
Percentage of Total Capacity in Data Set	8.2%	22.3%	18.6%	1.3%	12.9%	36.7%
Weighted Average Price ($/kW-month)	$3.44	$3.41	$2.30	$2.55	$4.11	$2.45
Average Price ($/kW-month)	$2.99	$3.05	$2.19	$2.67	$3.83	$1.97
Minimum Price ($/kW-month)	$0.15	$0.16	$0.65	$0.65	$0.09	$0.60
Maximum Price ($/kW-month)	$16.12	$15.34	$4.00	$3.50	$26.54	$11.47
85% of MW at or below ($/kW-month)	$5.10	$4.34	$3.00	$3.00	$4.25	$3.00

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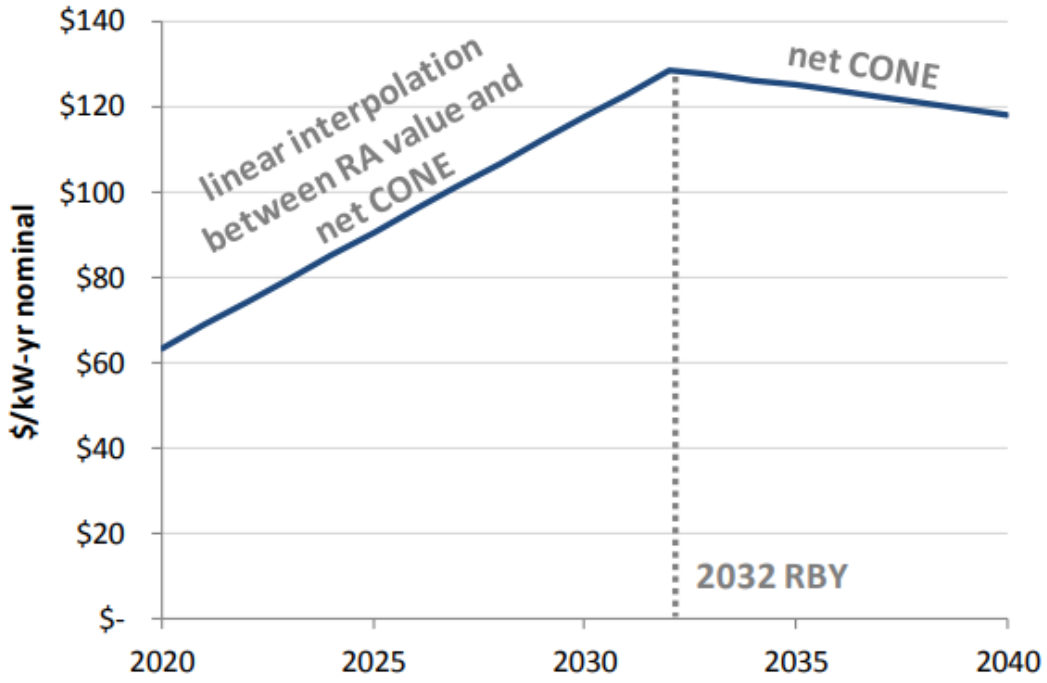
4.ii – Locational Avoided Capacity

How can you forecast capacity avoided cost based on market information?

Figure 6. Capacity Value Forecast

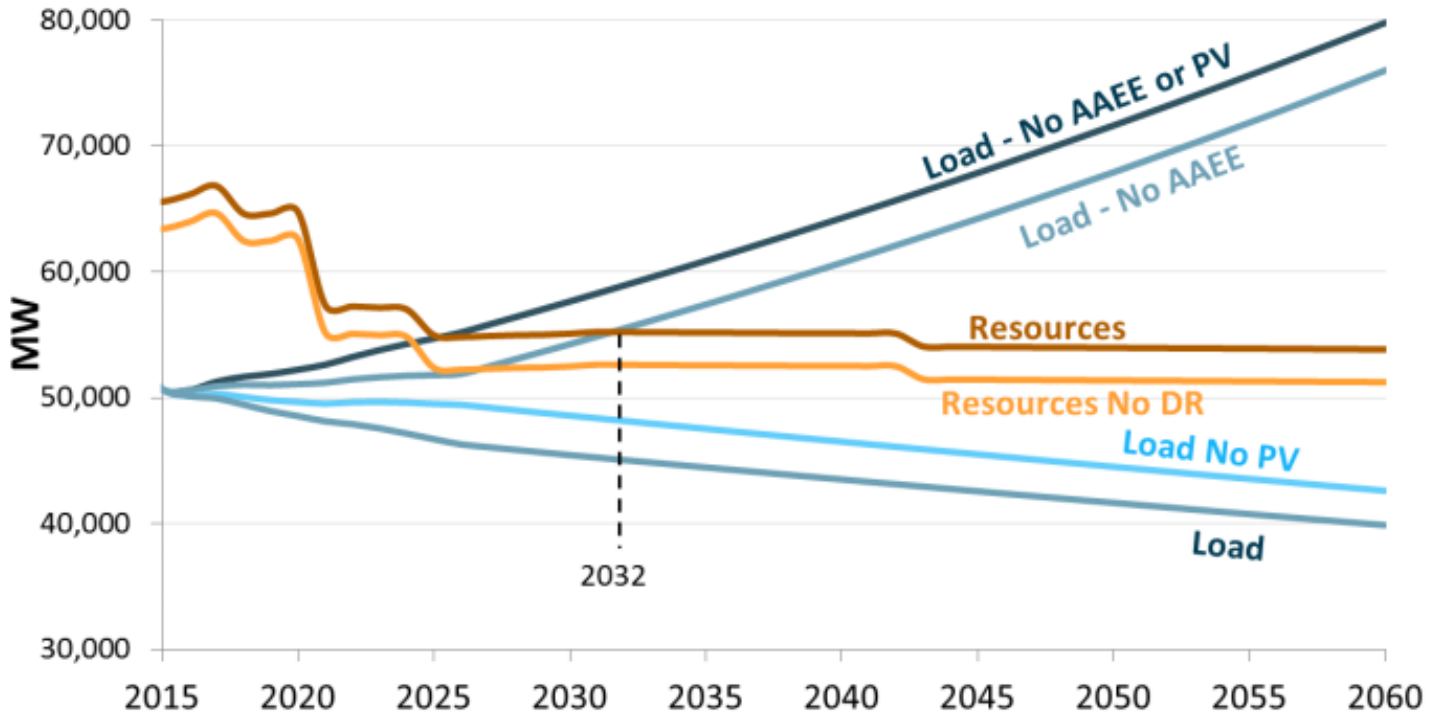


http://docketpublic.energy.ca.gov/PublicDocuments/16-BSTD-06/TN216062_20170216T113300_2019_TDV_Methodology_Report_21517.pdf

4.ii – Locational Avoided Capacity

How can you forecast capacity avoided cost based on market information?

Figure 5. Resource Balance Year assumed based on modeled California load and available capacity resources



http://docketpublic.energy.ca.gov/PublicDocuments/16-BSTD-06/TN216062_20170216T113300_2019_TDV_Methodology_Report_21517.pdf

Agenda Item E: Preview remaining Group I items and discuss plan for August

Item B and Item 2 iii – Valuing location-specific grid service provided by advanced smart inverter capabilities; allowing hourly VAR profiles to be input in order to capture DERS ability to inject or absorb reactive power – *optional stakeholder call prior to discussion at August meeting.*

Item 5 - Non-zero transmission value -- *form sub-group*

Item 4- Line losses – *to be discussed at August meeting*

MORE THAN SMART

B and 2.iii – Advanced Smart Inverters and Hourly VAR Profiles

- Item B: Smart Inverter
  - "Methods for valuing location-specific grid services provided by advanced smart inverter capabilities"
- Item 2.iii) Add VAR Profile to LNBA tool
  - 2.iii "Improve heat map and spreadsheet tool by: … iii) allowing hourly VAR profiles to be input in order to capture DERs' ability to inject or absorb reactive power"
- Item 2 is a "consensus recommendation that should constitute the working group's primary focus." Item B is not.

B and 2.iii – Advanced Smart Inverters and Hourly VAR Profiles

- IOU Proposal:
  - Purpose of adding hourly VAR profiles is to capture ability of DERs to inject/absorb reactive power, not just active or “real” power.
  - This is a key capability enabled by smart inverters
  - Propose making 2.iii (VAR profiles) a sub-item under B (smart inverters)
  - VAR profiles will be the priority item under B
    - Within 6 months:
      - Develop proposal to modify tool to include VAR injection/rejection profiles to defer VAR support projects
      - Develop recommendations for calculating VAR profiles
- TODAY:
  - Consider (hopefully agree on) the merging/prioritizing proposal
  - Get list of participants interested in this topic for developing more detail in a one-time sub-team conversation prior to next meeting .

SEIA Perspective on Smart Inverter Functions

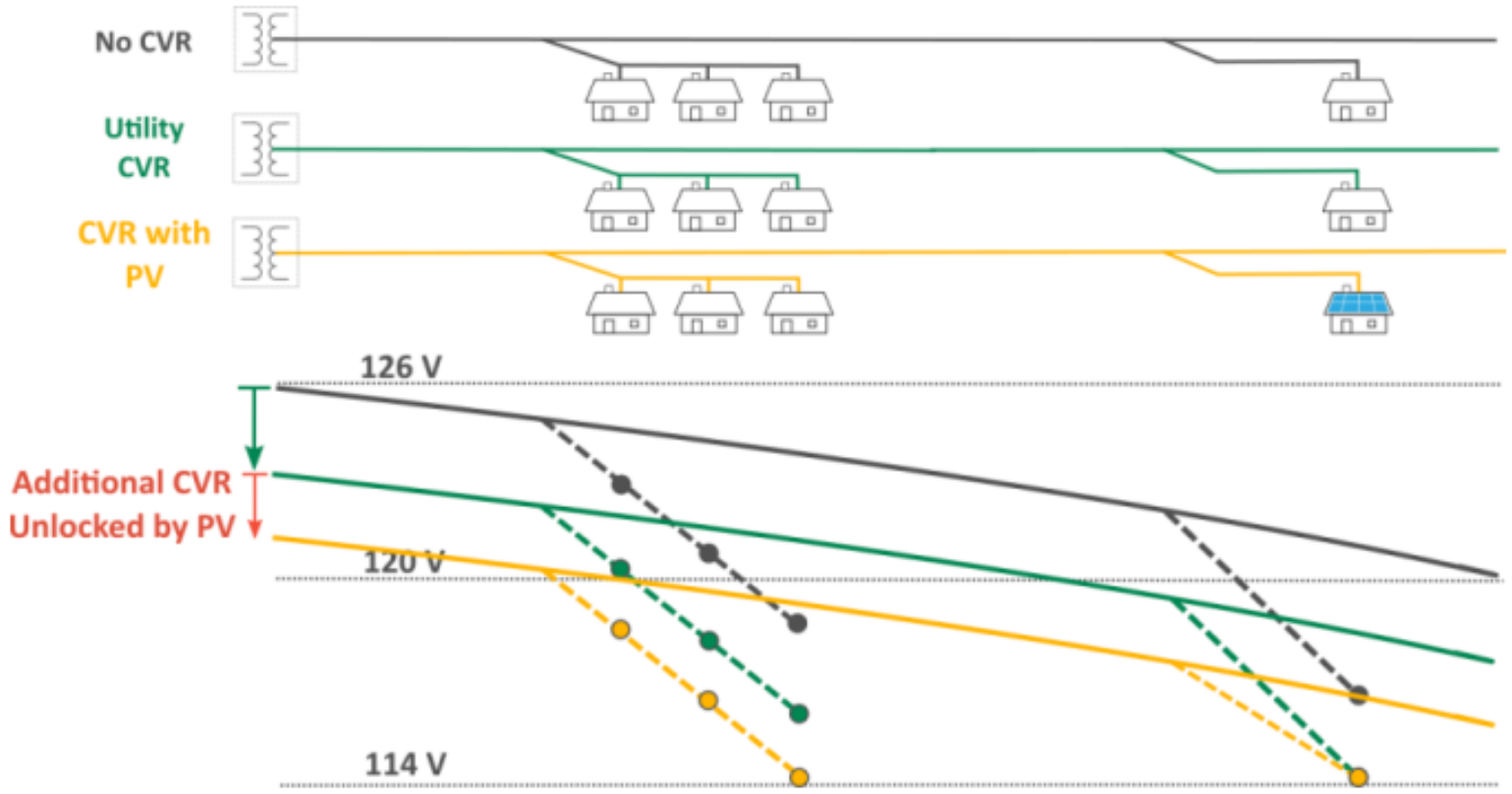
Brandon Smithwood, SEIA
Damon Franz, Tesla

August 15, 2017

Smart Inverter Enabled Locational Benefits

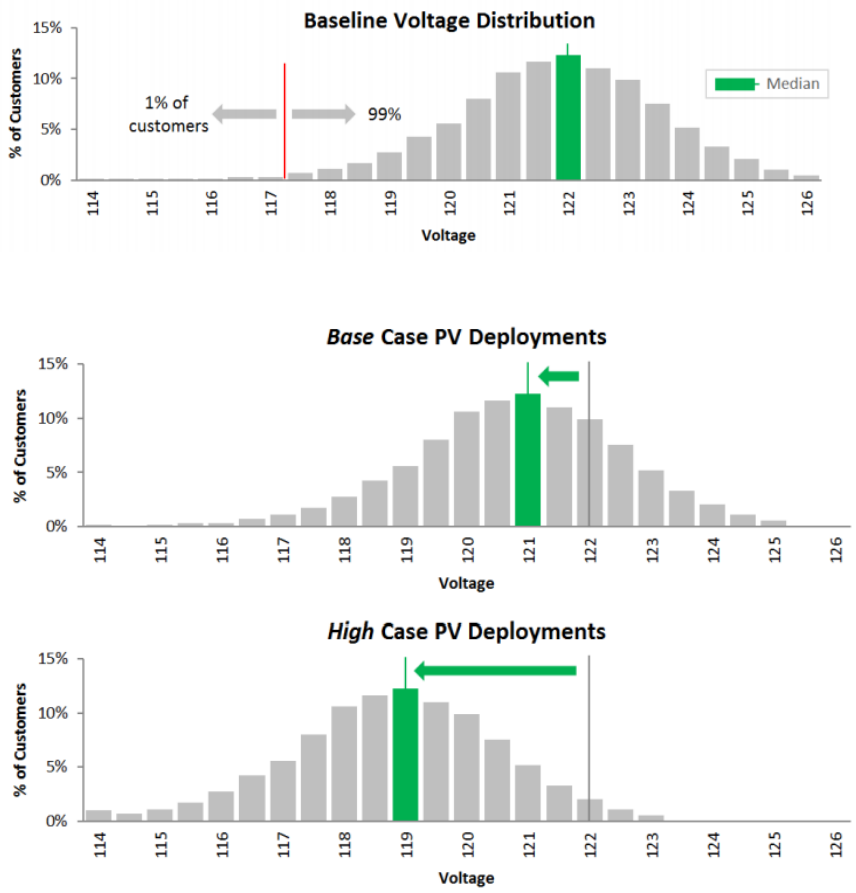
1) Avoidance of investments needed to maintain voltages within Rule 2 limits
2) Enhanced Conservation Voltage Reduction
3) Data Services/Situational Awareness (June 7th ACR Group 3 item)

Conservation Voltage Reduction



DERs control voltage locally and enable increased CVR benefits

Conservation Voltage Reduction



Avoidance of Investments to Maintain Voltages

- Value: DERs can avoid investments in voltage management equipment
  - Equipment:
    - Load tap changers
    - Capacitors
    - Line regulators
    - Line reconductoring
- There is a need for a 8760 VAR profile to capture ability of inverters to manage voltage through production or absorption of reactive power
  - Currently the LNBA only captures voltage management benefits that come from reducing load
  - SEIA is looking forward to the IOU's development of this VAR profile

Conservation Voltage Reduction (IOU Positions)

- PG&E:
  - **Quantifying this potential additional savings on any particular circuit requires understanding the extent to which CVR has already been achieved under standard practice.** Any incremental CVR benefits beyond standard practice are highly dependent on a variety of factors specific to that circuit and the customer end use devices that are on that circuit.
  - One simple method to estimate CVR energy savings is to use the CVR factor, which is the ratio of percent energy savings to percent voltage reduction: [percent energy savings] = [CVR Factor] x [percent voltage reduction]. (PG&E DRP Demonstration B Final Report, P. 15)

Conservation Voltage Reduction (IOU Positions)

- SCE:
  - **SCE needs to perform detailed engineering analysis and field research which involve extensive testing over an extended period of time in order to accurately evaluate the benefit** of CVR and/or VVO in its own system. In addition, **necessary communications and controls will be required to enable the functionalities** and full benefits of the program. Therefore, CVR and VVO are not currently estimated or otherwise included in Demo B LNBA values. (SCE LNBA Demo Final Report, P. 16)

Conservation Voltage Reduction (IOU Positions)

- SDG&E
  - Additional CVR-based energy consumption reduction beyond that achieved by standard practice may be achieved by more sophisticated voltage controls, such as those that enable VVO. The problem with crediting DERs for avoided costs through CVR, however, is twofold. First, **quantifying the potential savings on any particular circuit requires thorough knowledge of how voltage level effects consumption which is highly dependent on a variety of factors specific to that circuit and the customer end use devices that are on that circuit.** Second, to achieve CVR**, DERs must be working in concert and be coordinated with utility devices; so CVR is a service that DERs individually cannot effectively provide.** In addition to this, the avoided costs are mainly on the customer end and are not incremental investments. **The two benefits would include the minor reduction in capacity constraints and the small reduction in losses due to less demand, which to accurately calculate would require rigorous dynamic powerflow studies.** (SDG&E DRP Demonstration B Final Report, P. 12)

Rebuttal to IOU Arguments on CVR

- Lack of modeling for greater granularity of CVR benefits does not mean this value should be assumed to be zero
- The value is not *de minimus*: range of values from 1-3c per kWh of generation for strategically placed PV systems
- This value has been demonstrated on PG&E and HECO distribution system models
- Communications and control are not necessary: benefits can be realized through inverters set to dynamic volt/VAR acting autonomously

Conservation Voltage Reduction

- Should be considered a system-wide value rather than a locational value
  - Value is avoided energy and line losses
  - Will vary by location, but limitations of secondary system modeling require an averaged, if more conservative, calculation
- Should be calculated by summing incremental avoided energy and line losses

$$\left(\frac{\$}{kWh}\right)_{Energy} = \frac{\sum_{t=1}^{8760}\left[\overbrace{\frac{VD_{noPV}-VD_{PV}}{V_{Base}}}^{\text{\% Change in Voltage}} * \underbrace{CVR_f\left(1-\%_{Targeted}\right)}_{\text{\% Reduction in Energy due to PV reducing voltage drop}} * \overbrace{E_{RegulationZone}C}^{\text{Utility CVR Energy Cost}}\right]}{\underbrace{E_{PV\_AnnualProducedByPVtion/Customer} * \%_{Targeted} * n_{TotalCustomers}}_{\text{Annual Energy Production of all Targeted PV Systems}}}$$

Data backhaul/situational awareness

- This value will be discussed in the DRP Working Group as part of the Group III items identified in the June 7th Assigned Commissioner's Ruling
- Distributed energy resources collect a substantial amount of data at a nodal level, including data collected from smart inverters
- This data can be transmitted more frequently than utility data and aggregated and analyzed for utility use
- The value of this service could be calculated as the avoided cost of the utility-owned equipment that would otherwise be installed to provide the service.

5 – Avoided Transmission

- Item 5: Transmission
  - "Form technical subgroup in LT refinements to develop methodologies for non-zero location-specific transmission costs"
  - Sub-team should consider a range of methods to improve the granularity of current "peanut butter" Tx avoided cost

Item 4.iii – Line Losses

- ACR:
  - " Item 4: Incorporate additional locational granularity into …, and **Line Losses** [into] system-level avoided cost values
- Prior Discussion:

"…WG proposes that a first step should be to estimate the variability of this parameter across the system to understand the benefits of enhancing the LNBA in this way vs the cost."

Additional discussion in August WG meeting