BEFORE THE PUBLIC UTILITIES COMMISSION OF THE

STATE OF CALIFORNIA

Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769.	Rulemaking 14-08-013 (Filed August 14, 2014)
And Related Matters.	Application 15-07-002 Application 15-07-003 Application 15-07-006

(NOT CONSOLIDATED)

In the Matter of the Application of PacifiCorp (U 901-E) Setting Forth its Distribution Resource Plan Pursuant to Public Utilities Code Section 769.	Application 15-07-005 (Filed July 1, 2015)
And Related Matters.	Application 15-07-007 Application 15-07-008

DISTRIBUTION FORECASTING WORKING GROUP PROGRESS REPORT

MATTHEW W. DWYER
Attorney for
SOUTHERN CALIFORNIA EDISON COMPANY
2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770
Telephone: (626) 302-6521
Facsimile: (626) 302-1935
E-mail: Matthew.Dwyer@sce.com

Dated: July 2, 2018

Pursuant to the March 29, 2018 *Joint Ruling of the Commissioner and Administrative Law Judge Establishing Parameters and Schedule for the Distribution Forecasting Working Group Ordering Paragraph*, Southern California Edison Company ("SCE") respectfully submits the Distribution Forecasting Working Group Progress Report.

Attached as Attachment A is the Distribution Forecasting Working Group Progress Report.

.

MATTHEW W. DWYER

<u>/s/ Matthew W. Dwyer</u>

By: Matthew W. Dwyer
Senior Attorney for
SOUTHERN CALIFORNIA EDISON COMPANY

2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770
Telephone: (626) 302-6521
Facsimile: (626) 302-1935
E-mail: Matthew.Dwyer@sce.com

Dated: July 2, 2018

Attachment A

Distribution Forecasting Working Group

Progress Report

Itron
Knowledge to Shape Your Future

Electric | Gas | Water
information collection, analysis and application

Distribution Forecasting Working Group Final Report

June 28, 2018

Contents

List of Figures

DISTRIBUTION FORECASTING WORKING GROUP

Decision (D.) 18-04-002 established the process for incorporation of Distributed Energy Resource (DER) forecasts into Distribution Resource Planning (DRP). The process uses the DER forecasts developed by California Energy Commission (CEC) in the Integrated Energy Policy Report (IEPR) as the basis for the distribution system forecasts. The decision identified forecasting issues that required further consideration and directed the Energy Division to develop a scope and schedule to vet these issues in the Distribution Forecasting Working Group (DFWG).

On March 29, 2018, the California Public Utilities Commission (CPUC) issued the Joint Ruling of Commissioner and Administrative Law Judge Establishing Parameters and Schedule for the Distribution Forecasting Working Group (Ruling). The Ruling identifies seven questions to be addressed in a series of five meetings ending in June 2018 with a progress report filed by July 1, 2018.

The Distribution Forecasting Working Group (DFWG) objective is to "vet the disaggregation methods and data sources available and operational profiles, ensure that the circuit level forecasts apply the best data sources available, and incorporate evaluation feedback in future forecasts." The objective is addressed with the following seven questions.

1. What is the estimated magnitude of uncertainty in circuit level forecasts and what are the implications for distribution planning and capacity for evaluation and feedback to mitigate uncertainties?
2. Are there data sets that could improve the Investor Owned Utility (IOU) disaggregation of DER growth to the circuit level?
3. What are the disaggregation methods of system level load and DER forecasts to the circuit level, what are the shortcomings and possible improvements?
4. What are the best data sources for disaggregation of load and DER adoption, as well as DER operational profiles?
5. What dispersion methods should be used to allocate circuit-level forecasts along a circuit?
6. How will the IOUs modify future forecasts based on evaluation of actual results in forecasts?
7. Does the DER disaggregation align with CEC and California Independent System Operator's forecasting assumptions.

This report contains the DFWG conclusions based on the five meetings.

1. Executive Summary

The DFWG objective is to "vet the disaggregation methods and data sources available and operational profiles, ensure that the circuit level forecasts apply the best data sources available and incorporate evaluation feedback in future forecasts." Through the course of five meeting extending from April 18, 2018 through June 13, 2018, fourteen stakeholders met with the Energy Division, PG&E, SCE, and SDG&E to address this objective.

The DFWG vetted the disaggregation methods for the following five DER technologies.

- Photovoltaic Generation
- Electric Vehicles
- Additional Achievable Energy Efficiency
- Energy Storage
- Load Modifying Demand Response

The process included presentations and discussions about the current and planned disaggregation methods, uncertainties for the disaggregated technology adoption forecasts, data sources that are currently used, and potential data sources that could be used to improve the methods and reduce the forecast uncertainties.

Overall, DWFG participants were satisfied with the working group process and results. Participants have vetted each method and found that they are acceptable for disaggregating the IEPR DER forecast considering the state of each DER technology and the available data. Additionally, participants have agreed on the qualification of uncertainties associated with each DER and the list of data sources available to assist the DER disaggregation process.

Summaries of each meeting are contained in Appendix A. These summaries contain descriptions of the presentations on each DER disaggregation method, elements of the meeting discussion, and stakeholder positions on the methods. The meeting the presentations are archived in the 2018 Meeting Materials section of https://drpwg.org/growth-scenarios/.

While the key findings are described in Section 11, they are summarized below.

- **Disaggregation Methods.** Disaggregation methods vary in terms of complexity. While no method is perfect, the DFWG vetted each method and found that the methods are reasonable for disaggregating the IEPR

DER forecasts considering the state of each of the DER technologies and the available data.

- **Disaggregation Documentation.** The DFWG vetted the principles of DER disaggregation. While the methods were described in enough depth to understand the principles, the descriptions do not include details such as input data and model outputs for validation purposes. The DFWG recommends that the CPUC provide direction on where more detailed documentation of disaggregation methods should be presented. While the IOUs recommend that more detailed documentation take place through formal data requests, parties request CPUC direction.

- **Uncertainty.** Understanding uncertainty is essential to identifying where disaggregation methods may contain errors and inaccuracies that could create problems and risks in distribution planning. The DFWG qualified a list of uncertainties associated with each DER forecast and recommends that these qualifications be used to guide, not dictate, future analysis and modeling efforts.

- **Data Sources.** The availability of data impacts the range of methods that can be implemented as well as the level of uncertainty. The DFWG compiled an extensive list of data sources available for use. The DFWG recommends that the IOUs consider these data sources and any additional future data source that may improve the disaggregation methods and reduce uncertainty.

- **Dialogue.** A key result of the DFWG meetings is the education of all parties to the complexity of disaggregating the IEPR DER forecasts. The DFWG invited open discussion, stakeholder alternatives, the sharing of assumptions, and the explanation of techniques. The DFWG recommends a future update meeting (or meetings) in the one to two-year period to update parties on the status of methods, uncertainties, and data sources as well as to provide an opportunity for parties to suggest improvements and changes.

2. Participants

D.18-04-002 ordered the IOUs, consisting of PG&E, SCE, and SDG&E, to contract a facilitator to manage the working group meetings and submit a joint progress report at the conclusion of the meetings. The IOUs selected Itron, Inc. as the facilitator under management of the CPUC's Energy Division.

On April 6, 2018 Itron announced the DFWG formation and solicited registration information from interested stakeholders. The following companies and organizations responded and were registered as DFWG participants.

- California Efficiency and Demand Management Council (Council)
- California Energy Commission (CEC)
- California Energy Storage Alliance (CESA)
- California Independent System Operator (CAISO)
- Clean Coalition (CC)
- Electric Power Research Institute (EPRI)
- Energy Coalition (EC)
- Grid Unity (GU)
- Interstate Renewable Energy Council (IREC)
- Natural Resources Defense Council (NRDC)
- Office of Ratepayer Advocates (ORA)
- Pacific Gas and Electric (PG&E)
- San Diego Gas and Electric (SDG&E)
- Smarter Grid Solutions (SGS)
- Southern California Edison (SCE)
- Vote Solar (VS)

Party participation and representation in each meeting is contained in the Appendix A meeting summaries.

3. Schedule

The Ruling provided a preliminary scope for the biweekly meetings beginning on April 18. The scope was considered by the IOUs in conjunction with the Energy Division and Itron and modified as the meetings progressed to adjust to the pace of the discussions while still addressing the DFWG objectives. Below is a brief summary of the meeting contents and conclusions. Full meeting summaries are included in Appendix A.

Meeting 1 (4/18/18)

- Created a list of DERs.
- Created a list of uncertainties.
- IOUs described their prior-year disaggregation method by DER technology. SDG&E included proposed enhancement with their prior-year methods.

Meeting 2 (5/2/18)

- Completed the Photovoltaic (PV) discussion on the disaggregation method, uncertainties, and data source list.

- Completed the Electric Vehicle (EV) discussion on the disaggregation method, uncertainties, and data source list.
- Discussed Additional Achievable Energy Efficiency (AAEE), but did not conclude the discussion due to time limitations.

Meeting 3 (5/16/18)

- Clarified the definition of uncertainty.
- Completed the AAEE discussion on the disaggregation method, uncertainties, and data source list.
- Discussed Energy Storage (ES), but did not conclude the discussion due to time limitations.
- Completed the discussion about whether the assumptions underlying the CEC forecast aligned with the IOU disaggregation methods for PV, ES, and AAEE.

Meeting 4 (5/30/18)

- Completed the ES discussion on the disaggregation method, uncertainties, and data source list.
- Completed the discussion about whether the assumptions underlying the CEC forecast aligned with the IOU disaggregation methods for EV.
- Completed the Load Modifying Demand Response (LMDR) discussion on the disaggregation method, uncertainties, and data source list.
- Completed the discussion on load growth disaggregation.
- Completed the discussion on load dispersion along a circuit.

Meeting 5 (6/13/18)

- Completed the list of data sources identified in all meetings.
- Completed the uncertainty qualifications and rankings.
- Reviewed the draft report contents.
- Created initial recommendations.

4. Addressing the Objectives

The disaggregated circuit forecasts are used for distribution planning to ensure that deficiencies are identified and addressed in a timely manner. These forecasts are a key input into other proceedings, including the Grid Needs Assessments, Grid Modernization Plans, and Distribution Deferral Opportunities Reports.

The DFWG objective is to "vet the disaggregation methods and data sources available and operational profiles, ensure that the circuit level forecasts apply the best data sources available and incorporate evaluation feedback in future forecasts."

To achieve this objective, the Ruling included seven questions. These questions are categorized into three main topics.

1. **DER Disaggregation Method.** This topic encompasses the disaggregation methods applied to each DER and assesses whether the method is "best practice." Best practice is defined as an appropriate, or acceptable, method considering the state of the DER and the availability of data.

2. **Uncertainty**. This topic broadly captures sources of modeling and analysis uncertainties associated with the disaggregation of DER adoption forecasts. The purpose of understanding uncertainty is to assess the level of risk associated with disaggregation in the distribution planning process. The DFWG defines three components to this topic. First, "uncertainty" pertains to the range of possible outcomes within a DER. Second, "impact" captures the relative magnitude of one DER compared to another in terms of current and anticipated capacity. Finally, "risk" is a function of "uncertainty" and "impact" and identifies the areas of greatest concern.

3. **Data Sources**. Underlying the disaggregation method and uncertainty qualification is the availability of data to support the disaggregation process. Available data sources can provide historical technology adoption and penetration data, load impact profiles, and customer characteristics that inform the disaggregation methods. To the extent that data sources are plentiful, IOUs may develop sophisticated disaggregation methods. To the extent that data sources are sparse or immature, IOUs are limited to use of simpler methods.

These three topics directly address the Ruling's objective and questions. Each of these topics is fully discussed in this Report in Sections 5, 6, and 7.

In addition to these three topics, the Ruling's contains three additional questions. These questions address (1) CEC forecast coordination, (2) load growth disaggregation, and (3) dispersion along a circuit. These topics are discussed in this Report in Sections 8, 9, and 10 and summarized below.

- **CEC Forecast Coordination.** The CEC forecast coordination issue is identified in the Ruling as listed below.

"Does the DER disaggregation align with California Energy Commission (CEC) and California Independent System Operator's forecasting assumptions"

In this topic, the DFWG reviews the CEC's forecast methods and discusses whether the IOU disaggregation methods align with the CEC's forecast and assumptions.

- **Load Growth Disaggregation**. While the primary focus of the DFWG is DER disaggregation, the Ruling includes the discussion of system load growth disaggregation as shown below.

  "What are the disaggregation methods of system level load and DER forecasts to the circuit level, what are the shortcomings and possible improvements?"

  Under advisement of the Energy Division, this topic is discussed for informational purposes and not vetted for best practices.

- **DER Dispersion along a Circuit**. While the DER disaggregation methods allocate the IEPR's DER forecasts to the circuit, the Ruling includes a question about further disaggregation below the circuit level. This question addresses sub-circuit disaggregation, or "dispersion," as shown in the question below.

  "What dispersion methods should be used to allocate circuit-level forecasts along a circuit?"

  Under advisement of the Energy Division, this topic is discussed for informational purposes and not vetted for best practices.

5. DER Disaggregation Methods

DER disaggregation begins with the CEC's IEPR forecast for each DER and then distributes the DER forecast to the circuit level. Vetting the disaggregation methods means examining the methods that are used and evaluating whether these methods are appropriate given the state of each DER market and considering the availability of data and level of risk. This section discusses the IOU's disaggregation methods for the following five DERs.

- Photovoltaic Generation
- Electric Vehicles
- Additional Achievable Energy Efficiency
- Energy Storage

- Load Modifying Demand Response

Prior to discussing the disaggregation methods for each DER, this section presents a framework for understanding the disaggregation methods and a summary of how methods are evaluated.

Disaggregation Methods

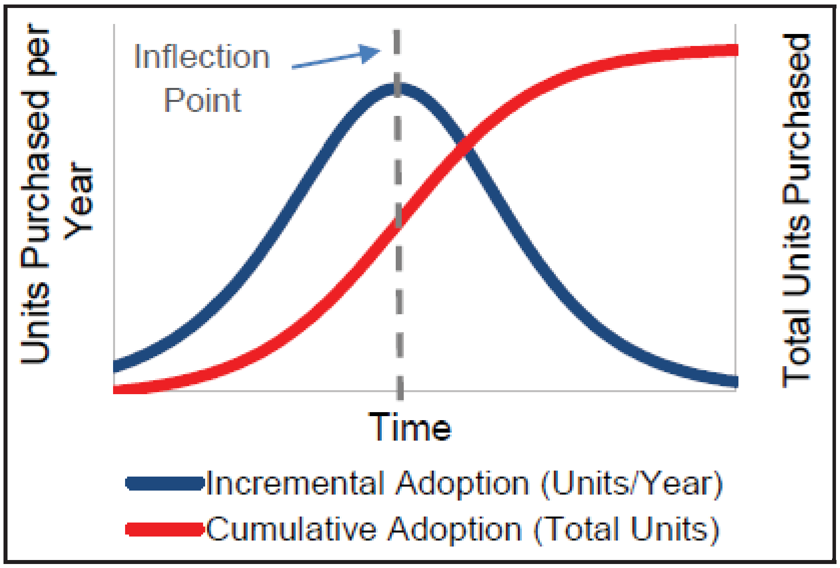
Disaggregation methods vary based on the maturity of the DER technology, available data, and known technology constraints. From a theoretical perspective, disaggregation methods should be based on information about the customer characteristics and historical adoption levels on each circuit. However, practical considerations such as limited data availability or low risk may result in applying simpler methods.

The DFWG identified three general classes of disaggregation techniques. These classes are summarized below.

- **Proportional Allocation.** A proportional allocation method disaggregates the DER forecast to circuits based on utility data for the circuit (load, energy, or number of customers). Based on these data, a fraction is computed for each circuit as the ratio of the data value for that circuit divided by the total across all circuits. For example, the ratio may be calculated as the amount of energy on a circuit divided by the total energy across all circuits and may be based on either historic or forecast load data. Another approach is to use adoption of one technology to drive adoption patterns for another technology. For example, residential PV adoption patterns can be used to compute allocation ratios for ES adoption. Refinements and complexity are introduced by including sector or rate class data (e.g., residential and non-residential) to compute the ratios. Typically, the allocation is performed after accounting for known projects in an IOUs interconnection queue.
- **Propensity Models.** Propensity models base the disaggregation on customer characteristics that are used to compute a propensity score. Based on the score, a fraction is computed for each area as the ratio of the score for that area divided by the sum of the scores across all areas. The scores are typically computed using statistical methods (e.g., regression, machine learning) with cross section data that identify key variables that are correlated with customer adoption and estimate scoring weights or parameters for these variables. For example, the propensity models could be estimated using ZIP code data, in which case the models relate historical adoptions to customer characteristics in each ZIP code.

- **Adoption Models.** This approach uses a bottom-up adoption forecast based on observed adoption patterns and estimated adoption model parameters. Generally, these models are based on time-series data that capture changes in adoption through time. These models are S-Curve models (e.g., Bass Diffusion Models) and they forecast technology adoption considering the characteristics of early adopters, factors that drive market potential, and adoption rates applied to the remaining potential. Figure 1 shows a generalized S-Curve model which forecasts cumulative (red) and incremental (blue) adoptions through time. The bottom-up adoption forecasts for all areas are used to compute a set of fractions that are then used to allocate DER impacts.

Figure 1: Generalized S-Curve Model



While the DFWG identified three general classes of disaggregation methods, the implementation of the method includes many steps. These steps may include additional methods as inputs into the overall method. For example, PG&E's PV allocation uses a Propensity Model to identify the market potential on a feeder, and then applies an Adoption Model to calculate the annual adoption. In this instance, the PG&E PV disaggregation method is still characterized as an adoption model because the propensity model is used as an input into the adoption model result.

The disaggregation methods used for each DER vary based on the availability of data, the maturity of the DER technology, resource constraints, and practical considerations. Each of these characteristics impacts the level of rigor applied to the disaggregation method. For example, for a DER with limited market adoption data, analysts are limited to simple disaggregation methods. However, for a DER with plentiful time series data on adoption location and customer characteristics, analysts may explore more complex methods.

Method Evaluation

Method evaluation considers the lifecycle of generating a disaggregated forecast, measuring the forecast against actual values, and identifying potential improvements over time. The Ruling asks the following evaluation question.

> *How will the IOUs modify future forecasts based on evaluation of actual results in forecasts?*

For each DER, the IOUs presented their current disaggregation method and discussed future improvements currently under consideration. The general evaluation process consists of (1) reviewing the current method against known data, (2) considering what additional data are available to improve the method, (3) adjusting the current methods, and (4) considering alternative methods that can be supported. Prior to adopting a new method, it is compared to the old method to measure improvement. Future forecasts are expected to follow this general evaluation process.

While the goal of evaluation is making improvements, there was discussion that the improvements process should be balanced and consider the costs and benefits. Careful analysis and testing should accompany each step in the development process. Changes in method should only be made to the extent that additional data can support the next iteration of the forecast cycle. While it may be a worthy goal to have complex disaggregation models for each DER, the value of these models is diminished where data do not support these techniques. The DFWG's vetting process is designed to confirm that IOUs are constantly evaluating methods and using techniques appropriate given the state of each DER market, the availability of data, and the level of risk.

Throughout the meetings, the IOUs discussed their long-term plans to improve the disaggregation techniques. As technologies mature and adoption data improves, the IOUs intend to refine their methods by evaluating actual results where available and by addressing the uncertainties presented in this report.

PV Disaggregation Method

All IOUs are exploring and refining adoption models for locational disaggregation of PV. Adoption models are S-curve models that capture how customers adopt a technology through time. The classic S-curve model is the Bass Diffusion model. Within a Bass Diffusion model, three parameters (P, Q, and M) are optimized to explain monthly adoption patterns. In dynamic models the values of these parameters may change through time in response to economic conditions, customer behavior, and market activities. These parameters are listed below and represent the key uncertainties in the model.

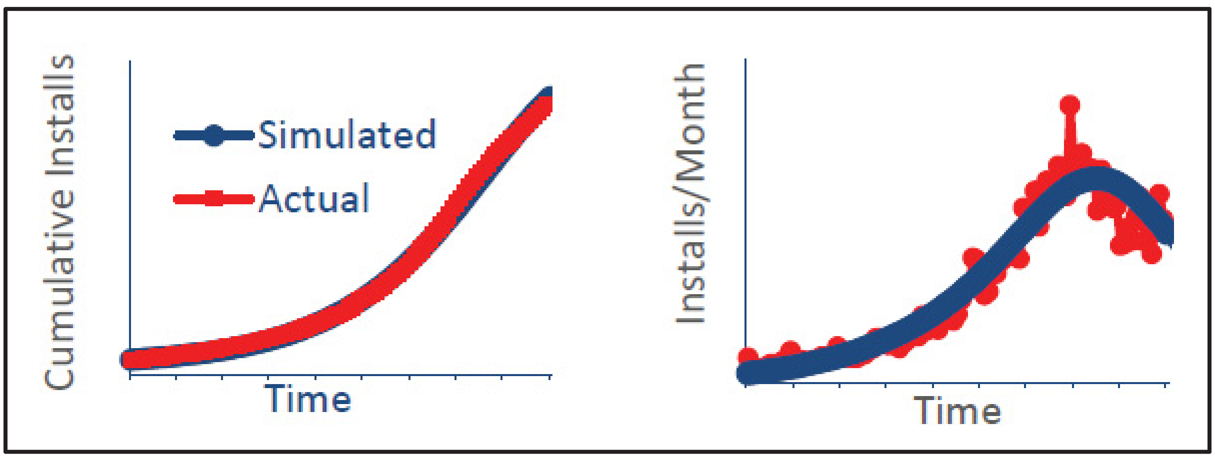
P: This parameter is for innovation and represents the behavior of early adopters for a technology as well as advertising effects. The value of this parameter may be modelled in a variety of ways.

Q: This parameter is for imitation and represents word-of-mouth adoption and the influence of pervious adopters. As with the P parameter, this value may be modelled in a variety of ways.

M: This parameter is the market potential for the technology. Market potential captures the impacts of policy, policy changes, economics, tax laws, customer attitudes, and technology evolution. As with the P and Q parameters, there are a variety of ways to model this parameter.

Figure 2 was presented by SDG&E and shows how an S-curve models captures cumulative adoption (left) based on incremental adoption (right). Actual adoption data are shown in red and the model results are shown in blue.

Figure 2: S-Curve Model



By using S-curve models, the IOUs have generated bottom-up forecasts of PV adoption with parameters estimated at the ZIP code level. The bottom-up forecasts are used for disaggregation.

While variations occur for each IOU's implementation of their adoption models, especially around how market potential is estimated, the general Adoption Model allocation process is as follows:

1. Identify adoption characteristics.

2. Develop S-Curve Model based on adoption characteristics (e.g. by ZIP code).
3. Forecast adoption by ZIP code.
4. Calculate allocation factors based on the ratio of ZIP code adoption to total adoption (sum of all ZIP code adoption).
5. Allocate PV DER to ZIP codes based on the allocation factors.
6. Allocate PV DER to circuits proportional to load or the number of customer meters on the circuit.

More details about the IOU adoptions models are contained in Appendix A. The Meeting 1 Summary contains descriptions of each IOU's disaggregation methods for all DERs. The Meeting 2 Summary contains a more focused discussion on the IOU's PV disaggregation methods including plans for improvements. Variations between the IOU methods are identified in these meeting summaries.

All stakeholders agree that using an S-curve adoption model framework as the basis for allocation represents the "best practice" for this DER given the known constraints for PVs. No alternative methods were proposed and no parties disagreed. However, the IOUs will continue to explore additional improvements to PV disaggregation.

EV Disaggregation Method

SCE and SDG&E base their EV allocations on a Propensity Model at the ZIP code level. PG&E uses a Propensity Model to drive the market potential component of an S-curve Adoption Model.

Propensity models use statistical methods (e.g., regression, machine learning) to identify key variables that are correlated with customer adoption. The models are used to disaggregate the EV forecast based on customer information at the ZIP code level and are discussed in Appendix A, Meetings 1 and 2.

While variations occur when implementing the propensity model, the general Propensity Model allocation process is as follows:

1. Identify adoption characteristics that drive adoption propensity.
2. Develop Propensity Model by ZIP code using adoption characteristics.
3. Score ZIP codes based on the propensity model results.
4. Calculate allocation factors based on the calculated scores.
5. Allocate EV DER to ZIP codes based on the allocation factors.
6. Allocate EV DER to circuits proportional to load or the number of customer meters on the circuit.

PG&E's adoption model, which uses a propensity model to drive market potential, generally follows the process described in the PV Section.

Because EVs are still in an early adoption phase, modelling adoption and charging patterns is difficult. All IOUs are in the process of exploring and refining their models to better identify key EV adoption characteristics. Two specific areas of potential improvement are listed below.

- **DMV Data.** Parties believe that Department of Motor Vehicle (DMV) data by ZIP code may improve the location of EV ownership history to explore more robust adoption modeling methods. However, these data are not currently available to the IOUs.

- **Charging Patterns.** Parties also believe that charging patterns will change as the market matures. The current data reflects early adopters and will need to be updated with widespread EV adoption and the increased presence of charging stations.

Descriptions of the IOU EV methods are contained in Appendix A. The Meeting 1 Summary contains the general description of the EV disaggregation methods. The Meeting 2 Summary contains a more focused discussion on the IOU's EV disaggregation methods including plans for improvements. Variations between the IOU methods are identified in these meeting summaries.

All stakeholders agree that the IOU methods for allocation are appropriate for this DER given the known constraints for EVs. No alternative methods were proposed and no parties disagreed.

AAEE Disaggregation Method

All IOUs base their AAEE allocations on a Proportional Allocation Method. This method consists of (1) using the CEC service territory or busbar forecasts, (2) allocating to circuits based on sector energy or peak, and (3) making adjustments based on local information.

While variations occur for each IOU's implementation of their proportional allocation method, the general Proportional Allocation method is as follows:

1. Determine sector load (i.e., energy or peak) by circuit.

2. Calculate allocation factors based on the ratio of sector load for a circuit to total sector load (i.e., the sum across all circuits in the system or busbar depending on the starting point).
3. Allocate system or busbar level AAEE to circuits based on the allocation factors.
4. Account for local information based on major upcoming projects.

While implementation differences among IOUs occur due to varying system configurations, these methods consistently allocate based on sector or class information.

A major challenge in predicting the AAEE location is the availability of reliable historic data. While there is general agreement that good locational data for downstream energy efficiency (EE) programs (e.g., direct customer rebate) is available, upstream programs (e.g., programs providing incentives to retailers to stock and market energy efficient appliances) only provide information about where retail purchases occurred and not where equipment and devices are installed. Additionally, the locational impacts from changes in appliance standards is not known. With location known for less than 50% of past EE programs and virtually no data available on locational impacts of building codes and appliance standards, understanding circuit-level adoption patterns is difficult.

While the initial discussion during Meeting 3 showed that all stakeholders agreed that using the proportional allocation method as the basis for allocation is "best practice," NRDC provided comments to the draft final report indicating a dissenting opinion.

While NRDC does not oppose the use of proportional allocation, NRDC believes that integration of historic and future program data and IOU local knowledge can improve the allocation. For NRDC, including these data would represent "best practice".

Descriptions of the IOU AAEE methods are contained in Appendix A. The Meeting 1 Summary contains the general description of the AAEE disaggregation methods. The Meeting 2 Summary and Meeting 3 Summary contain a more focused discussion on the IOU's AAEE disaggregation methods including plans for improvements. Variations between the IOU methods are identified in these meeting summaries.

ES Disaggregation Method

While the IOUs apply different methods for ES disaggregation, all IOUs currently use proportional allocation techniques (the generalized process is described in the AAEE section). SDG&E and SCE allocate residential ES based on PV adoption and non-residential ES based on load factor or peak. In both cases, the allocators (PV adoption, load factor, and/or peak) are based on load or a proxy of adoption characteristics. PG&E's approach adjusts load for known ES projects, and then allocates remaining ES proportional to load.

The IOUs use a simple allocation method because ES is a nascent market with low risk. However, all IOUs are monitoring available data and continually evaluating whether and when more complex methods may apply.

Descriptions of the IOU ES methods are contained in Appendix A. The Meeting 1 Summary contains the general description of SDG&E ES disaggregation method. The Meeting 3 Summary contain a focused discussion on the IOU's ES disaggregation methods including plans for improvements. Variations between the IOU methods are identified in these meeting summaries.

All stakeholders support the characterization of the ES uncertainty and data sources. All stakeholders agree that IOU's proposed disaggregation methods are acceptable considering the state of the ES market.

Two parties qualified their support for the IOU disaggregation methods. CESA's qualification assumes that the non-residential method does not preclude storage systems from distribution deferral eligibility. Vote Solar would like to see the IOU methods unified, but believes that the methods are sufficient considering the state of the ES market.

LMDR Disaggregation Method

LMDR includes time varying pricing programs that are not integrated into the CAISO markets. These programs include, but are not limited to, time-of-use (TOU) and critical peak pricing (CPP) programs.

The IOU disaggregation methods range from a simple proportional allocation method to a customer-level propensity model. PG&E uses proportional allocation based on the number of eligible customers in each class. SDG&E uses sector regression trend models based on the ratio of enrolled LMDR participants to total available customers to determine the allocation factors. SCE, after allocating existing LMDR to current participants, uses a customer-level propensity model to score nonparticipants then allocates LMDR to the highest ranking non-participants. Despite the method differences, stakeholders did not express concerns due to the low impact of LDMR and the uncertainty related to the upcoming change to time of use rates (i.e., moving customers to a default (opt-out) time-of-use rate).

Descriptions of the IOU LMDR methods are contained in Appendix A. The Meeting 1 Summary contains the general description of LMDR methods. The Meeting 4 Summary contains a focused discussion on the IOU's LMDR disaggregation methods including plans for improvements. Variations between the IOU methods are identified in these meeting summaries.

All stakeholders agree that the IOUs allocation method are acceptable given this DER's impact and known constraints for LMDR. No alternative methods were proposed and no parties disagreed.

6. DER Uncertainty and Risk

Integral to understanding whether a disaggregation method is appropriate is understanding the uncertainty related to each DER. The Ruling identified this relationship in the question stated below.

> *"What is the estimated magnitude of uncertainty in circuit level forecasts and what are the implications for distribution planning and capacity for evaluation and feedback to mitigate uncertainties?"*

In this section, DFWG participants define the meaning of uncertainty, identify the areas of uncertainty, and qualify the implication for disaggregation of the DER forecasts.

Uncertainty Definition

The term uncertainty is broad, and the DFWG participants required a more precise definition. Parties agreed that the term uncertainty has many meanings, and for purposes of the DFWG, the following definitions were adopted.

- **Uncertainty**. When used to describe a DER allocation, the term uncertainty refers to the range of possible outcomes for a component of the disaggregation process. The qualification ratings (High, Medium, and Low) provide a relative score within each DER technology. A High rating indicates a relatively wide range of possible outcomes. A Low rating indicates a relatively narrow range of possible outcomes.

- **Impact**. Impact defines the relative size (Large, Medium, and Small) of one DER against another for planning purposes. For instance, PV currently has a large impact relative to ES based on the expected energy and/or load impacts associated with the two DERs.

- **Risk**. Risk combines uncertainty and impact and guides the relative level of attention (High, Medium, and Low) that different technologies should receive in the planning process. For instance, a technology with high expected impact and high uncertainty ratings should be given a high priority for further study and analysis. In general, risk may be viewed as a function of expected impact and uncertainty as shown below.

  $$\text{Risk} = \boldsymbol{f}(\text{Impact , Uncertainty})$$

  While this general function may imply a mathematical relationship between risk, impacts, and uncertainty, no specific formulas were identified in this working group.

In the distribution planning process, risk has asymmetrical consequences. First, if loads exceed planned levels, the excess can cause instability or reliability problems on some parts of the distribution system. In this case, the planning error is not providing enough resources where they are needed. Second, if load falls short of planned levels, the deficit means that facility investments are inefficient. In other words, too many resources have been allocated where they are not needed. Understanding risk and the components that drive risk (uncertainty and impacts) will help IOUs improve the planning process.

The uncertainty qualifications agreed upon by parties are shown in Figure 3 through Figure 7 and summarized in Figure 8. These figures contain the uncertainty areas, their qualification ratings, and a brief description. The listed areas capture the challenges from multiple forecasting components, including the overall uncertainty in CEC forecast for the DER, uncertainty in utility allocation methods, uncertainty in the impact shape for the DER, and other locational uncertainties, such as the location and timing of large concentrated projects.

With this background, the following sections provide a summary of the uncertainty and risk levels for each DER. Appendix A contains a more detailed discussion of uncertainty in the meeting summaries. Components of uncertainty were discussed in all five meetings.

PV Uncertainty

The PV uncertainty, impact, and risk descriptions and ratings are shown in Figure 3. PV is the largest DER in terms of load impact with highly developed data sources. The availability of data makes allocation modelling and understanding generation load shapes medium and low uncertainties, respectively. Despite these rankings, the magnitude of PV makes the impact large and elevates the overall risk to high. All parties either agree or have no opinion with the uncertainty, impact, and risk qualifications.

Figure 3: PV Uncertainty

Area	Rating	Description
Uncertainty: IEPR	**High**	The IEPR PV system-level forecast captures the volume of PV growth allocated to circuits. Variance and uncertainty in the top-line forecast will proportionally impact the allocation to circuits.
Uncertainty: Method	**Medium**	The S-Curve models are used to allocate total PV adoption to the circuit level. The models are estimated with good quality geographic data providing a strong basis for allocation. All IOUs are in the process of testing, evaluating, and refining their models by exploring input variables and measuring their methods against prior year outcomes.
Uncertainty: Shapes	**Low**	While PV generation data for customers within the IOUs service territory is limited, hourly solar generation profile data are available from national and state level studies. These data may be applied to the IOU service territory, if appropriate.
Uncertainty: Near-Term Lumpiness	**Low**	Near term adoption for large projects is managed on a case-by-case basis with known projects in the interconnection queue.
Uncertainty: Long-Term Lumpiness	**High**	Timing and location of large projects in the long term are difficult to forecast accurately creating significant uncertainty.
Impact	**Large**	Due to the size of the PV market relative to other DERs, the expected impact on distribution planning is large.
Risk	**High**	Time series locational adoption data are well developed due to the requirement for interconnection agreements. These data support direct adoption modeling at the Zip code level, and adoption forecasts are used to allocate system totals. However, the impacts of PV are expected to be large and the location and timing of large projects is unknown in the long run. As a result, risk is judged to be high.

EV Uncertainty

EV uncertainty, impact and risk descriptions and ratings are shown in Figure 4. While the EV market is still considered nascent, current adoption projections indicate that it is accelerating. Given the state of the market, the greatest uncertainty is the overall pace of EV growth (i.e., IEPR forecast). However, adoption characteristics, load profiles, and charging shapes remain uncertain and add to the difficulty of developing complex models. In particular, the growth of commercial charging stations (e.g., "fast" charging stations) may have a significant impact on load and remains a significant driver of uncertainty. Despite these uncertainties, the smaller size of EV load relative to PV and AAEE make the overall risk medium. All parties support the qualification of EV uncertainty.

Figure 4: EV Uncertainty

Area	Rating	Description
Uncertainty: IEPR	**High**	The IEPR EV system-level forecast captures the expected growth of EV loads. The IEPR model and growth assumptions create uncertainty impacting the allocation to circuits.
Uncertainty: Method	**Medium**	Changes in the propensity model variables and parameters control the allocation of EV adoption. Because EVs are still in the early adoption phase, customer decision characteristics are still evolving making predictions more difficult and increasing model-related uncertainty. Improved location data which can serve as the basis for the model are expected to mitigate some of the model risk.
Uncertainty: Shapes	**Medium to High**	Additional data are needed to understand charging patterns. These patterns are expected to vary by battery size, type of charging station, vehicle type, and location (home, work, or other). IOUs, with the support of stakeholders, need to explore sources of data that might mitigate this risk.
Uncertainty: Near-Term Lumpiness	**Medium**	Location and timing uncertainty of commercial fast-charging stations increases the planning process uncertainty. This uncertainty is partially mitigated by the interconnection queue.
Uncertainty: Long-Term Lumpiness	**Medium**	Location and timing uncertainty of commercial fast-charging stations increases the planning process uncertainty.

Figure 4 (Cont'd): EV Uncertainty

Area	Rating	Description
Uncertainty: Charging Location	**Medium**	The discussion indicated that most charging currently occurs at home. This may change in the future as commercial charging facilities expand. The size and location of commercial charging elevates this uncertainty.
Impact	**Medium**	The EV market is growing. While the expected impact may not be as large as PV or AAEE, substantial growth is expected. Additionally, the concentration of charging from commercial stations may elevate the impact.
Risk	**Medium**	Time series location data are not currently available for EV. However, propensity models using cross section data can be used to identify key propensity factors and to estimate weights used to calculate propensity scores at the Zip code level. Uncertainty related to load shapes is increasing with the emergence of fast charging stations and flexibility in when and where vehicles are charged. In the 10-year planning horizon, EV impacts are expected to be significant, but not as large as PV and AAEE. The result is a risk assignment of medium.

AAEE Uncertainty

The AAEE uncertainty, impact and risk descriptions and ratings are shown in Figure 5. AAEE constitutes the second largest DER in terms of expected load impact. Due to its size, the lack of locational information regarding upstream location information, and lack of shape data for several programs, the overall risk is deemed high. All parties support the qualification of AAEE uncertainty.

Figure 5: AAEE Uncertainty

Area	Rating	Description
Uncertainty: IEPR	**High**	The IEPR AAEE forecast is a key uncertainty for the circuit level forecasts. The CEC's allocation method moves the AAEE forecast to the busbar level adding uncertainty to the IOU's allocation process. Additional coordination with the CEC may yield improvements when class definitions are better aligned or the CEC provides information at a more granular level.
Uncertainty: Method	**Medium**	Location is not known for more than 50% of past EE. This is an area where improved data and coordination can mitigate risk.
Uncertainty: Shapes	**Medium**	End-use or energy efficiency shapes are used in the planning process. IOUs discussed the lack of recent studies for EE impact shapes.
Uncertainty: Near-Term Lumpiness	**Medium**	Timing and location of large AAEE projects is impossible to forecast accurately. Coordination with EE teams who may get advanced notice of large projects might help to mitigate this uncertainty.
Uncertainty: Long-Term Lumpiness	**Medium**	Large AAEE projects are rarely visible on the long-term planning horizon.
Impact	**Large**	In terms of expected energy impacts, AAEE is the second largest DER.
Risk	**High**	AAEE includes impacts from codes, standards, and utility programs for a broad array of end uses and technologies. The main uncertainty comes from the difference between estimates based on potential studies and what is actually realized. If actual results fall short of the AAEE forecast, facility loads will be higher than expected. Because the aggregate AAEE impact is large, the result is a risk assignment of high.

ES Uncertainty

The ES uncertainty, impact and risk descriptions and ratings are shown in Figure 6. While there are many uncertainties pertaining to ES adoption and usage, the overall risk is considered low due to the nature of the technology and the expected rate of market adoption. This technology presents a unique opportunity to develop data sources and requirements before widespread adoption. All parties support the qualification of ES uncertainty.

Figure 6: ES Uncertainty

Uncertainty Area	Rating	Description
Uncertainty: IEPR	**High**	ES is a new component of the IEPR. It is based on a simple trend analysis and not an adoption model. The overall growth and modelling assumptions create uncertainty in allocating ES to circuits.
Uncertainty: Method	**High**	The ES market is in very early adoption phase driven by public policy. The lack of adoption data makes model fitting and adoption modeling difficult at best.
Uncertainty: Shapes	**High**	Operation profiles vary for each customer based on the customer's objectives and utility rates. At best, IOUs may attempt to reverse-engineer operations when more data becomes available.
Uncertainty: Near-Term Lumpiness	**Low**	Near-term adoption may be managed for known customers based on the interconnect queue.
Uncertainty: Long-Term Lumpiness	**High**	The timing and location of large projects are impossible to forecast accurately.
Impact	**Small**	The ES market is small and still driven by public policy decisions.
Risk	**Low**	The expected low adoption levels for ES reduces the overall risk of any uncertainty. Additionally, the multiple capabilities of ES, when properly deployed, has the potential to mitigate deficiencies on the distribution grid.

LMDR Uncertainty

The LMDR uncertainty, impact and risk descriptions and ratings are shown in Figure 7. The major uncertainty for LMDR is the transition to default time-of-use (opt-out) rates. While the CEC captures this transition in their forecast, the new rates represent a new program creating uncertainty across all characteristics. All parties support the qualification of LMDR uncertainty.

Figure 7: LMDR Uncertainty

Uncertainty Area	Rating	Description
Uncertainty: IEPR	**Medium**	The IEPR forecast controls the overall impacts allocated to the circuits. The IEPR forecast assumptions and the evolution of the opt-out TOU rate impacts create uncertainty in this overall impact.
Uncertainty: Method	**Medium**	The variation in IOU methods range from a simple allocation to an individual customer propensity model. Regardless of the model, the challenges of changing programs and the evolution of opt-out TOU rates create uncertainty. As the market changes, IOUs are closely monitoring outcomes and trends and are looking for opportunities to improve their methods.
Uncertainty: Shapes	**Low**	Direct measurement of behavioral changes is not available. However, impact profiles from existing evaluation studies provide a reasonable shape.
Uncertainty: Near-Term Lumpiness	**Low**	The Distribution Investment Deferral Framework (DIDF) can provide information about near term adoption.
Uncertainty: Long-Term Lumpiness	**Medium**	In the long-term, clusters of adoption may introduce uncertainty
Impact	**Small**	Low LMDR load volume is the main driver in qualifying the impact as low.
Risk	**Low**	While the evolution of the opt-out TOU rates will increase the penetration of LMDR, the low expected impact reduces the risk to low.

Summary of Uncertainty, Impact, and Risk

Figure 8 summarizes the uncertainty, impact, and risk for each DER. The qualifications presented capture areas where additional analytical effort may yield improvements. Areas with a “high” risk, should garner more attention than areas with a “low” risk. Within a DER technology, areas with “high” uncertainty should garner more attention than area with a “low” uncertainty. For instance, improving the PV IEPR forecast (high risk and high uncertainty) promises to improve the disaggregated load forecasts. However, improving the ES IEPR forecast (low risk, high uncertainty) is comparatively less important to the disaggregated load forecasts.

While the uncertainty grid is useful for identifying high value areas, the grid does not address the effort or cost to achieve improved results. IOUs should use these results as a guide, not a directive, for future work.

Figure 8: Summary of Uncertainty Areas, Impact, and Risk

	PV	EV	AAEE	ES	LMDR
IEPR	High	High	High	High	Medium
Method	Medium	Medium	Medium	High	Medium
Shapes/Profile	Low	Med to High	Medium	High	Low
Charge Location	Not Applicable	Medium	Not Applicable	Not Applicable	Not Applicable
Lumpy (NT)*	Low	Medium	Medium	Low	Low
Lumpy (LT) **	High	Medium	Medium	High	Medium
Impact	*Large*	*Medium*	*Large*	Small	Small
Risk	*High*	*Medium*	*High*	Low	Low

* NT = Near-Term
** LT = Long-Term

The uncertainty, impact, and risk qualifications represented in Figure 8 are for the 10-year planning horizon for this forecast cycle. By nature, these qualifications are subjective based on the thoughtful discussion of all parties. On an ongoing basis, these ratings should be updated as methods change and new data become available.

Based on the final uncertainty qualifications agreed upon by the parties, the working group agreed on the following general recommendations to reduce uncertainties and risks. These recommendations are listed below.

- **IEPR forecast.** One of the key drivers of risk is the expected top-level adoption of DER technologies. This risk includes the overall uncertainty related to the level of load and DER growth as well as the CEC forecast and allocation techniques. For example, the CEC allocates impacts for some technologies to the WECC bus level adding additional allocation uncertainty. Parties recommend that IOUs work to improve cooperation and coordination with the CEC to ensure that the forecasts and disaggregation methods are based on the strongest data and methods available.

- **Allocation Methods and Data.** Parties recommend that IOUs continue working to improve allocation methods and the data upon which these methods are based. IOUs should continue to track locational forecast performance and use the results to update and improve modeling methods. IOUs should also continue to work with other stakeholders to identify and research new data sources that can be used to reduce uncertainties and risks. Finally, the IOUs should continue to coordinate with the CEC to maintain alignment of allocation methods with CEC forecasting and allocation methods.

- **Local knowledge.** Parties recommend that IOUs continue working to improve internal communications related to the timing and location of large DER projects. Taking full advantage of local knowledge ensures that risks related to short-term lumpiness remains low. By continually managing short-term lumpiness, IOUs will also mitigate long-term lumpiness. Where related information can be used to improve CEC DER adoption forecasts or busbar allocations, this information should be shared with the CEC.

- **Load Shapes.** Load shapes are a source of uncertainty for EV, AAEE, and ES. Parties recommend that IOUs look for opportunities to cooperate in research efforts that focus on load shape development for these technologies.

7. DER Data Sources

Improving disaggregation methods requires data to identify adoption characteristic and develop detailed models. The Ruling asks two questions regarding data sources. These questions are stated below.

> *Are there data sets that could improve the IOUs disaggregation of Distributed Energy Resources (DER) growth to the circuit level?*
>
> *What are the best data sources for disaggregation of load and DER adoption, as well as DER operational profiles?*

Through the five DFWG meetings, the IOUs and Stakeholders identified several data sources available to the IOUs. These data sources are listed in Figure 9 through Figure 13. These tables provide a listing of currently identified datasets. Associated with each data source is the provider of the data source, whether the data source is currently used or planned to be used, and the locational resolution (i.e., granularity) of the data. Additional data, if applicable, may be leveraged as they become available. All parties support the use of these data sources.

Figure 9: AAEE Data Sources

Data Source	Source	Current / Future	Resolution Level
IEPR Forecast The system-level AAEE forecast to be allocated to the circuits.	CEC	Current	System
Database for Energy Efficiency Resources (DEER) Load Shapes DEER provides load shape estimates for a limited selection of EE measures.	CPUC	Current	System
EE Potential and Goals Study CPUC-funded EE model to determine IOU goals. These results become the CEC's AAEE forecast.	CPUC	Current	System and Substation
EEStats and Evaluation Measurement & Validation (EM&V) Studies Sector-specific third-party evaluation of EE program accomplishments. Defines the Ex-Post results for IOU EE savings.	CPUC	Future	System
EE Stats Database This database contains all verified program savings from past EE programs.	CPUC	Future	Customer and System
Energy Usage Historical energy usage by sector and customer.	IOUs	Current	Customer and Feeder
Downstream Historical Installed Savings Savings with an installation address.	IOUs	Current	Customer
Coordination with IOU plans and evaluation Planned large construction or retrofit projects.	IOUs	Future	System, Circuit, and Feeder
System Topology The system topology provides the electrical hierarchy between customer, circuit, substation, and IOU system to allow allocation of the CEC system level forecast.	IOUs	Current	Electrical Hierarchy
New Construction Insight on location of new construction and timing to inform allocation of AAEE C&S.	Moody's	Future	Metropolitan Statistical Area
Building Types and North American Industry Classification System (NAICS) codes The standard used by Federal statistical agencies in classifying business establishments.	US Census Bureau	Current	Service Account

Figure 10: Energy Storage Data Sources

Data Source	Source	Current / Future	Resolution Level
IEPR Forecast of ES The system-level ES forecast to be allocated to the circuits.	CEC	Current	System
Self-Generation Incentive Program (SGIP) Incentive program supporting existing, new and emerging distributed energy resources containing interconnection and installed capacity; meter data for some projects.	CPUC	Current	ZIP Code and Customer
Energy Usage Historical energy usage by sector and customer.	IOUs	Current	Customer and Feeder
ES Adoption History and Metered Output (where available) Historical ES adoption and actual output of separately metered ES devices. The metered output provides information about the load shape.	IOUs	Current	Customer
Procurement via Regulatory Proceedings Regulatory proceedings may result in additional targeted energy storage procurement.	CPUC	Future	System
Results of PV Disaggregation The amount of PV projected on each circuit as a result of the disaggregation process.	IOUs	Current	Circuit and Feeder
System Topology The system topology provides the electrical hierarchy between customer, circuit, substation, and IOU system to allow allocation of the CEC system level forecast.	IOUs	Current	Electrical Hierarchy
CEC Building Efficiency Standards Building efficiency standards may result in advancing energy storage adoption	CEC	Future	System
New Construction Data New construction may implement energy storage to address efficiency standards	Moody's	Future	Metropolitan Statistical Area

Figure 11: Electric Vehicle Data Sources

Data Source	Source	Current / Future	Resolution Level
Demographic and Socio-Economic Data Customer characteristics.	American Community Survey by U.S. Census Bureau	Current	Census Tract and/or Zip Code
IEPR Forecast of EV The system-level EV forecast to be allocated to the circuits.	CEC	Current	System
Survey Results Characteristics of EV adopters who received CVRP rebate and responded to survey.	Clean Vehicle Rebate Project Center for Sustainable Energy	Current	Zip Code and Customer
EV Registration Data (Discussed as a potential source) Time series (monthly) of historical EV adoption and detailed customer attributes. Note, these data are not currently available to the IOUs from the CEC.	DMV Data from CEC	Future	Zip Code
EV Adoption History Aggregated historical EV adoption.	IHS Markit (POLK)	Current	Census Tract
EV Adoption History and Metered Output (where available) Historical EV adoption and actual output of EV which are separately metered. The metered output provides information about the load shape.	IOUs	Current	Customer
Energy Usage Historical energy usage by sector and customer.	IOUs	Current	Customer and Feeder
EV Rate Data Contains which customer is on an EV specific rate.	IOUs	Current	Customer
System Topology and Charging Infrastructure The system topology provides the electrical hierarchy between customer, circuit, substation, and IOU system to allow allocation of the CEC system level forecast.	IOUs	Current	Full Electrical Hierarchy
Economic Forecasts Building Stock.	Moody's	Future	Metropolitan Statistical Area
2016 California Vehicle Survey and 2017 National Household Travel Survey Survey Results.	National Renewable Energy Laboratory	Future	Household and Census Tract

Figure 11 (Cont'd): Electric Vehicle Data Sources

Data Source	Source	Current / Future	Resolution Level
EV Adoption History Aggregated historical EV adoption.	POLK Provided by EPRI	Current	Zip Code
Local Policies Local policies and incentives may inform the IOUs about charging locations and impact EV adoption behavior.	County and Municipal Code	Future	County/City
Policy Outcomes via Regulatory Proceedings Regulatory proceeding outcomes may impact policies regarding electric vehicle adoption and charging locations.	CPUC	Future	TBD

Figure 12: Solar Photovoltaics Data Sources

Data Source	Source	Current / Future	Resolution Level
Demographic and Socio-Economic Data Customer characteristics.	American Community Survey by the U.S. Census Bureau	Current	Census Tract/ ZIP Code
Demographic and Socio-Economic Data Customer Characteristics.	Experian	Current	Customer (Residential only)
PV Adoption History Historical PV adoption.	California DGStats Database	Current	ZIP Code
IEPR Forecast of Solar PV The system-level PV forecast to be allocated to the circuits.	CEC	Current	System
GIS and Parcel Data GIS-based information indicating areas of new development.	Integral Analytics	Current	Zip Code and/or Parcel
PV Adoption History and Metered Output (Where available) Historical PV adoption and actual output of PV systems which are separately metered. The metered output provides information about the load shape.	IOUs	Current	Customer

Figure 12 (Cont'd): Solar Photovoltaics Data Sources

Data Source	Source	Current / Future	Resolution Level
Energy Usage Historical energy usage by sector and customer.	IOUs	Current	Customer
Service Accounts and Rate Structure The number of service accounts used to inform the technical potential. In addition, the data contains the rate structure associated with each account.	IOUs	Current	Customer
System Topology The system topology provides the electrical hierarchy between customer, circuit, substation, and IOU system to allow allocation of the CEC system level forecast.	IOUs	Current	Electrical Hierarchy
PV Technical Potential and Profiles NREL conducted (and recently updated) a study to assess the technical potential for solar as well as typical solar shapes.	National Renewable Energy Laboratory	Current	ZIP Code
Building Stock Growth Forecast Moody's forecast.	New Solar Homes Partnership	Current	System

Figure 13: Load Modifying Demand Response Data Sources

Data Source	Source	Current / Future	Resolution Level
Demographic and Socio-Economic Data Residential customer characteristics.	Acxiom	Current	Customer
Demographic and Socio-Economic Data Customer characteristics.	American Community Survey by the U.S. Census Bureau	Current	Census Tract/ ZIP Code
IEPR Forecast of LMDR The system-level LMDR forecast to be allocated to the circuits.	CEC	Current	System
Annual Load Impact Reports/Monthly DR Report Average Demand Response (DR) program load impacts.	IOUs	Current	CAISO Local Capacity Area
Customer Interval Data Provides a customer's electricity usage.	IOUs	Current	Customer

Figure 13 (Cont'd): Load Modifying Demand Response Data Sources

Data Source	Source	Current / Future	Resolution Level
System Topology The system topology provides the electrical hierarchy between customer, circuit, substation, and IOU system to allow allocation of the CEC system level forecast.	IOUs	Current	Electrical Hierarchy
North American Industry Classification System (NAICS) codes The standard used by Federal statistical agencies in classifying business establishments.	US Census Bureau	Current	Customer

8. CEC Forecast Coordination.

The Ruling asked whether the IOU DER disaggregation aligns with the CEC's forecasting assumptions as shown below.

> *"Does the DER disaggregation align with California Energy Commission (CEC) and California Independent System Operator's forecasting assumptions"*

At the highest level, the IOUs are fully aligned with the CEC's DER forecasts because the IOUs are disaggregating the CEC's forecast.

Potential conflict between the CEC and IOU forecast assumptions may occur because the models and objectives of the CEC and IOUs are different. The CEC is forecasting. The IOUs are disaggregating. All parties agree that even though the IOUs and CEC use different variables or assumption, the differences do not mean the IOUs and CEC are misaligned.

During DFWG Meetings 3 and 4, the CEC presented their forecast methods for PV, ES, AAEE, and EV. A summary of the CEC's current methods is shown below.

- **PV.** CEC uses a Bass Diffusion model to forecast capacity for the residential and commercial classes by weather zone. The CEC uses a simple trend model for other classes.
- **ES.** The CEC forecasts storage based on SGIP data and uses a simple trend analysis with addition rates held constant over the forecast period.
- **AAEE.** The CEC allocation of AAEE at the busbar level is based on the CAISO prior year system peak.

- **EV.** CEC forecasts EVs using choice models for each sector (personal, commercial, and government). Vehicle stocks are then allocated to forecast zones based on propensity models that account for households and per capita income.

After reviewing the CEC forecast methods and the IOUs disaggregation methods, parties agreed that the IOU's disaggregation assumptions generally align (or do not misalign) with the CEC's forecast.

All parties agree that discussing the CEC forecast and disaggregation methods was useful and opened the way for future coordination. The coordination will help the IOUs disaggregate the CEC's forecast as well as provide more local knowledge information to the CEC.

9. Load Growth Disaggregation

Load disaggregation is the process of allocating the IEPR load growth to circuits. The Ruling asked the working group to address load disaggregation as shown below.

> *"What are the disaggregation methods of system level load and DER forecasts to the circuit level, what are the shortcomings and possible improvements?"*

Under guidance of the Energy Division, this topic is discussed for informational purposes and not vetted for best practices. This topic was addressed in Meeting 4.

The process begins with the IEPR load growth forecast. After adjusting this forecast for DERs to avoid double counting and known load additions (i.e., block loads), the remaining growth is allocated to circuits. PG&E and SDG&E use a geospatial model to develop circuit level allocation factors. SCE uses a historic trend forecast at the circuit level to create a bottom-up forecast to obtain allocation factors. After applying the allocation factors, the final disaggregation is submitted for review and adjustment based on local area knowledge.

The disaggregation process is driven by the high-level assumptions included in the IEPR forecast. The IOUs and CEC are committed to an open dialogue for clarifying assumption to remove double counting issues and align definitions. Improvements to the process are mainly at the local level where specialized knowledge of customers, industries, and mapping are essential to adjusting the allocation process. These adjustments are a regular part of the IOU disaggregation process.

10. DER Dispersion along a Circuit

While the DER and load disaggregation address where the IEPR forecasted load will occur at the circuit level, dispersion along a circuit addresses where load occurs within a circuit. The Ruling asked the working group to address dispersion methods as shown below.

> *What dispersion methods should be used to allocate circuit-level forecasts along a circuit?*

Under guidance of the Energy Division, this topic is discussed for informational purposes and not vetted for best practices. This topic was addressed in Meeting 4.

Dispersion along a circuit is modelled using power flow software. The software currently used by the IOUs are identified below.

- SDG&E uses Synergi.
- PG&E and SCE use CYME.

The power flow software uses four inputs.

- **Load profiles.** These data (1) come from SCADA or aggregated AMI data, (2) show the circuit peak and shape, and (3) control the total amount of load to be dispersed.
- **System topology.** Topology captures the characteristics of each circuit.
- **Customer load data.** Customer loads based on AMI data (to the extent available) are used to understand where the load occurs along segments of the circuit.
- **Generation information.** Known generation information (e.g., PV, ES, cogeneration) is modelled in parallel with load.

Within the software, loads are modelled based on the provided location data and generation information. The software allocates the circuit-level load to the distribution service transformers in order to perform power flow analysis. Variations among the IOUs occur in the generation model assumptions, availability of locational or AMI data, and level of modelling aggregation within a circuit.

At this point in time, no attempt is made to specifically locate forecasted DER along a circuit. The DER disaggregation impact occurs at the circuit level and is dispersed within a circuit based on the existing load and generation locations.

11. Working Group Conclusions and Recommendations

Through the course of the meetings, parties were encouraged by the open discussion about the challenging issues in the disaggregation process. By nature, disaggregation is a complex task as illustrated by the range of assumptions, availability of data, and the complexity of models. While the IOU DER assessments revealed both strengths and weaknesses, no party believes that the disaggregation methods employed by the IOUs are inappropriate. Additionally, parties generally agree with the techniques, characterization of uncertainties, and the available data sources identified in the DFWG.

Consensus Findings

The five key findings of the DFWG are listed below. All parties agree to these findings.

- **Disaggregation Methods.** Disaggregation methods vary in terms of complexity. The selected methods are based on the maturity and characteristics of each DER and the availability of data. Where data are plentiful, such as in the PV market, more sophisticated customer adoption or propensity models are used to disaggregate the IEPR forecast. Where data are sparse, simpler methods such as proportional allocation methods are sufficient for disaggregation. While no method is perfect, the DFWG vetted each method and found that they are reasonable for disaggregating the IEPR DER forecasts considering the state of each of the DER technologies and the available data.

- **Disaggregation Documentation.** The DFWG developed and vetted the principles of DER disaggregation. The process focused on methods, plans, and challenges. While the methods are described in enough depth to understand the principles, the descriptions do not include modeling detail such as input data and model outputs for validation purposes. The DFWG recommends that the CPUC provide direction on where more detailed documentation of disaggregation methods should be presented. While the IOUs recommend that more detailed documentation take place through formal data requests in the specific proceeding in which the forecast is being evaluated, parties request that the CPUC provide direction.

- **Uncertainty.** Understanding uncertainty is essential to identifying which DER technologies may create problems and risks for distribution planning. By qualifying uncertainty, the DFWG provides a summary of the relative magnitude of risks across technologies. The DFWG recommends that the IOUs consider the uncertainty qualifications and use them as an input to help prioritize their analysis and modeling efforts. While the IOUs should focus on the largest uncertainties, the IOUs should consider the effort and benefits since some uncertainties may be irreducible or too costly to reduce. As a result, the DFWG recommends that these qualifications be used to guide, not dictate, future analysis and modeling efforts.

- **Data Sources.** The availability of data dictates the appropriateness of the disaggregation method and the qualification of uncertainty. In vetting the disaggregation methods, parties compiled an extensive list of available data sources for analysis. The DFWG recommends that the IOUs consider these data and any additional future data source that may improve the disaggregation methods and reduce uncertainty.

- **Dialogue.** A key result of the DFWG meetings is the education of all parties to the complexity of disaggregating the DER forecasts. The forum invited open discussion, the sharing of assumptions, and the explanation of techniques. Additionally, the CEC understands how their forecast is used and is committed to working with the IOUs to improve future coordination. The DFWG recommends that the Commission invest the Energy Division with the responsibility to monitor related proceedings and set the timing and scope for future update meetings focusing on DER disaggregation and/or related issues with the expectation that this would occur in a one to two-year timeframe. These meetings may address, but are not limited to, updates to disaggregation methods, uncertainties, and data sources and to provide an opportunity for parties to suggest improvements and changes.

Non-Consensus Party Recommendations

All parties were invited to provide specific recommendations to the CPUC based on the discussion in this working group. While these recommendations are listed below, they do not reflect the consensus of all parties.

IREC Recommendations

- IREC agrees that this working group has engaged in a thorough process with opportunity for stakeholder feedback. Assuming that this final report reflects stakeholder input and documents non-consensus positions, IREC does not request an additional formal comment opportunity for itself. IREC is neutral with respect to whether there should be an opportunity for public (as opposed to working group participant) comment.

- IREC recommends that the DFWG conversation resumes after one or two years to provide stakeholders with an update and opportunity to provide feedback about the status of the IOUs' disaggregation methods, data sources, and areas of uncertainty. Further, there may be value in revisiting certain issues (e.g., the appropriateness of the disaggregation methods, the continued use of the IEPR forecast as the starting point for DER forecasting, the development of alternative growth scenarios, etc.). IREC recommends that the CPUC give the Energy Division the discretion to set the timing and scope for future meetings focused on DER forecasting, with the expectation that the next meeting(s) would be in one to two years.

- IREC recommends additional discussion regarding the "Dispersion Along a Circuit" topic. IREC believes that the DFWG conclusion "no attempt is made to specifically locate forecasted DER along a circuit" is insufficient for the following two reasons.

    - First, this conclusion does not answer the question framed by the ruling guiding this working group, "*What dispersion methods should be used to allocate circuit-level forecasts along a circuit?"* The conclusion does not address what methods "should" be used, and the IOUs' did not adequately explain the reasons for this approach. Additionally, since this topic was presented as an education only topic, stakeholders were not invited to propose their own answers.

    - Second, this conclusion does not advance the conversation supporting the planning use case for the Integration Capacity Analysis (ICA), which requires an understanding of how forecasted DERs are allocated along a circuit. DERs can have significantly different impacts on hosting capacity depending on where on a circuit they are deployed.

    IREC recommends that this topic should not be considered "resolved" and that more discussion is needed.

- The DFWG identified prior DER ownership as a potentially relevant predictor of future DER adoption (e.g., an individual who has installed a PV system may be more likely to purchase an EV or install ES). However, the IOUs and CEC currently do not model these DER interactions due to the limited availability of interaction data. IREC recommends that the IOUs and CEC incorporate prior DER ownership into their Bass Diffusion models when data becomes available. Additionally, IREC recommends that the IOUs and/or CEC pursue the collection of data on DER interactions. Data on DER interactions could inform not only adoption behavior, but also load shapes (i.e., customers employing PV+EV or PV+ES may have different load shapes from customers employing those DERs independently).

- IREC recommends, if possible, archiving the presentations given over the course of the working group meetings and making them available online. These presentations contain valuable information, and stakeholders (and other readers of this report) could benefit from having access to these presentations in the future, for the purposes of both general education and providing a basis of comparison for future proposed disaggregation methods.

ORA Recommendations

While Meeting 5 included a topic "identify missing issues," the DFWG did not directly address this question. ORA identified the following issues that were not resolved and require further work.

- **Level of Detail.** ORA believes that the level of detail in the disaggregation method descriptions and data provided within this report and discussed with in the DFWG meetings is insufficient for stakeholders to assess the appropriateness of each method and data source for DER and distribution load forecasting. ORA believes that much greater detail is required to support distribution net-load forecast assumptions that accompany regulatory filings seeking funding authorizations for distribution grid improvements and DER-based distribution deferral. ORA's concern was briefly discussed during the DFWG meetings where there was general agreement that the DFWG was not the appropriate venue to review and evaluate the detailed methods and data inputs for distribution net-load forecasting. Parties agreed that this review is more appropriately conducted within the annual distribution planning process beginning with the Grid Needs Assessment (GNA) filing and incorporated into the DIDF. ORA provided its recommendations for the detailed review of distribution load forecasting assumptions in its July 1, 2018 comments on the IOUs' GNA filings.

- **Method Evaluation.** The objectives for the DFWG include "*incorporate evaluation feedback in future forecasts*" and the proposed scope of meeting 3 included "*discussion of the potential role of calibration at the system or circuit level, and how evaluation feedback should be incorporated into future iterations of the forecast*" (March 29, 2018 Joint Ruling, pp, 3 and 6 respectively). ORA believes that these issues were not discussed in detail as planned. While the DFWG acknowledged the need to track distribution load forecasting methods and data sources over time, neither the DFWG nor the IOUs were requested to develop a detailed evaluation plan. ORA recommends that the IOUs prepare an explicit evaluation plan that includes timelines and methods for evaluating the accuracy of distribution load forecasting methods and data as well as milestones for participation and review of stakeholders. ORA recommends that the evaluation plan be subject to stakeholder discussion and input.

- **Determination of Net Loads**. The DFWG discussed how IOUs disaggregate forecasts for each of the five DER types in Meetings 1, 2, and 3, and how they disaggregate load or demand forecasts in Meeting 4. However, the DFWG did not discuss how IOUs combine these six disaggregated forecasts to obtain a net load profile for each substation, transformer bank, and feeder. Since the net load profile is used to determine grid needs and deferral opportunities, it is important to understand how the various profiles are combined to ensure a coincident net load result. ORA raised this as an issue in its comments on the DRP Track 3 Proposed Decision: "the overarching goal of sub-track 1 [of DRP Track 3] is to establish transparent and reasonable forecasts of future electrical demands on the distribution system as a first step towards estimating 'grid needs,' and associated upgrades or modifications to accommodate the forecasted electrical demands. This requires forecasts of load growth, DER growth, and the interaction between load growth and DER growth under one or more scenarios that estimate future distribution infrastructure conditions." (ORA Comments filed January 8, 2018 in R.14-08-013, p.3). The CPUC acknowledged ORA's concerns and expanded the "scope of issues in 2018 to include load forecasting as it relates to distribution planning." (Decision 18-02-004, p.18). ORA recommends that the IOUs include this detail in their GNAs. If this information is not provided in their GNA (or with sufficient detail), ORA recommends that issue should be addressed in future DFWG meetings.

IOU Joint Recommendations

- **Proper Venue/Process**. Because the load growth and DER allocation projections inform many proceedings including the GRC, the DRP and the IDER, the DFWG briefly discussed which of these proceedings may be best positioned to include a more detailed showing on the load growth allocation and DER allocation methods and results. No consensus was developed. However, the IOUs jointly provide the following recommendation for communicating more detailed information regarding load growth allocation and DER allocation methods and results to stakeholders:

  The IOUs recommend that stakeholders in each of the proceedings (e.g., GRC, DRP, IDER) should utilize the existing data request processes and procedures to request information on methods and/or results that are tailored to their needs.

Distribution Forecasting Working Group

Appendix A – Meeting Summaries

Itron
Knowledge to Shape Your Future

Electric | Gas | Water
information collection, analysis and application

Distribution Forecasting Working Group Meeting 1 Summary

May 1, 2018

DISTRIBUTION FORECASTING WORKING GROUP

The Distribution Forecasting Working Group (DFWG) is organized under the Joint Ruling of Commissioner and Administrative Law Judge (Ruling) issued on March 29, 2018 in R. 14-08-013. The Ruling identifies the following seven (7) objectives.

1. What is the estimated magnitude of uncertainty in circuit level forecasts and what are the implications for distribution planning and capacity for evaluation and feedback to mitigate uncertainties?
2. Are there data sets that could improve the IOUs disaggregation of Distributed Energy Resources (DER) growth to the circuit level?
3. What are the disaggregation methods of system level load and DER forecasts to the circuit level, what are the shortcomings and possible improvements?
4. What are the best data sources for disaggregation of load and DER adoption, as well as DER operational profiles?
5. What dispersion methods should be used to allocate circuit-level forecasts along a circuit?
6. How will the IOUs modify future forecasts based on evaluation of actual results in forecasts?
7. Does the DER disaggregation align with California Energy Commission (CEC) and California Independent System Operator's forecasting assumptions.

This document summaries the first DFWG meeting held on April 18, 2018.

1. Agenda

Based on the Ruling, this meeting focused on reviewing the list of Distributed Energy Resources (DERs), describing the Investor Owned Utilities (IOUs) method of disaggregating DERs, and identifying key uncertainties associated with disaggregation. The following agenda provided each IOU an opportunity to discuss their methods, DERs, and uncertainties.

Distribution Forecasting Working Group (DFWG)

Meeting 1 Agenda

Location: PG&E General Office
77 Beale Street, Conference Room 1876
Date: 4/18/2018
Time: 9:30 AM – 3:30 PM

9:30 – 9:45 Introduction — Mark Quan, Itron

- Welcome/ Introductions
- Review of the Objectives and Workplan

9:45 – 10:00 Forecast Uses — Daniel Donaldson (SCE) on behalf of all IOUs

- Presentation on how utilities use the disaggregated forecast

10:00 – 11:10 SCE Presentation — Muhammad Dayhim and Daniel Donaldson (SCE)

- Present description of disaggregation and dispersion forecasting methodology
- Present list of uncertainties and DERs
- Questions & Discussion

11:10 – 11:25 Break

11:25– 12:35 SDG&E Presentation — Dan Wilson (SDG&E) and Cory Welch (Lumidyne)

- Present description of disaggregation and dispersion forecasting methodology
- Present list of uncertainties and DERs
- Questions & Discussion

12:35 – 1:35 Lunch

1:35– 2:45 PG&E Presentation — Jordon Wilkerson (PG&E)

- Present description of disaggregation and dispersion forecasting methodology
- Present list of uncertainties and DERs
- Questions & Discussion

2:45 – 3:00 Break

3:00 – 3:30 Uncertainties and DER Lists Discussion — Catherine Izard (PG&E) on behalf of all IOUs

- Discussion on List of Uncertainties
- Discussion on List of DERs

3:30 Adjourn

2. Presentation Summary

The meeting consisted of six (6) presentations. The presentations included time for discussion and questions. Below are summaries of the presentations.

Introduction Presentation

The introduction highlighted the DFWG objectives and mapped the scheduled meetings to meeting the objectives. This logistical presentation included the website address for documents (http://capabilities.itron.com/DFWG/index.htm), meeting dates/locations, and contact information.

The working group will culminate in a final report discussing best practices and lessons learned based on the meeting discussions of IOU disaggregation methods, data sources, and operational profiles. The report will capture both consensus and non-consensus views.

Forecast Uses Presentation

The Forecast Uses presentation placed the DFWG objectives in the context of distribution planning. The DFWG's purpose is to discuss the methods that the IOUs will use to disaggregate the System DER forecasts to circuit DER forecasts for the next IOU planning cycle based on the next IEPR. The circuit forecasts are used for planning to ensure that deficiencies are identified and addressed in a timely manner. The presentation included a list of DERs which will be addressed in the DFWG. This is shown below.

- Solar Photovoltaics (PV)
- Electric Vehicles (EV)
- Additional Achievable Energy Efficiency (AAEE)
- Load Modifying Demand Response (LMDR)
- Energy Storage (ES)
- Additional Achievable Photovoltaics (AAPV)
- Other Private Generation ("Non-PV DG")

SCE Presentation

SCE provided an overview of their prior year (2017-18 distribution planning cycle) disaggregation process, a deeper discussion on EV and higher-level discussion on the following DERs.

- AAEE
- LMDR
- PV

For each DER, SCE provided the data inputs, the data sources, the analysis process, and the outputs. The user for the forecasts was identified as Distribution Planning for each DER.

The EV disaggregation uses a regression model to select the most important adoption characteristics and identifies education level and commute time as the primary variables. The regression results are used to score each zip code, then allocate the EV forecast to the zip code and circuit level.

Throughout the presentation, parties raised clarifying questions that provided better insights into SCE's method descriptions. Of these questions, the following three (3) are notable.

- **Constraints.** The methods used in allocation create the primary forecasts which are "checked" against constraints such as the number of service accounts. Hosting capacity was discussed by several parties, but it is not currently used as a constraint by the IOUs. Instead, the circuit forecasts will predict when hosting capacity is met or exceeded so that distribution planners may make or request investments as needed.

- **DER Interaction.** All parties acknowledged the interaction between DERs. However, the IOUs and CEC currently do not model DER interactions due to the limited availability of interaction data. If these data become available, the IOUs will consider how to include them in the future.

- **Model Details.** A few parties expressed interest in reviewing SCE's model coefficients. While SCE possesses these values, the DFWG scope focuses on developing "best practices," not on reviewing the implementation of these practices. At this point in time, requiring IOUs to provide specific modelling coefficients and results is better left to proceedings where the IOUs are submitting forecasts for review. However, IOUs providing hypothetical or demonstration calculations could help clarify how the IOUs' methodologies function and facilitate a more detailed discussion concerning best practices and areas for improvement.

SDG&E Presentation

Unlike SCE, SDG&E's presentation captured this year's tentative plan (2018-2019 distribution planning cycle) for DER disaggregation. Throughout the presentation, SDG&E verbally highlighted how the plan differs from the prior year forecast method. SDG&E provided a deeper discussion on PV and higher-level discussion on the following DERs.

- EV
- AAEE
- LMDR
- ES

For each DER, SDG&E provided the data inputs, the data sources, the analysis process, the outputs. The user of the forecast was identified as Distribution, Transmission, Operations Planning in all cases.

The PV disaggregation uses a Bass diffusion model for adoption by zip code. The model coefficients are applied at the circuit level. SDG&E cited technical references, illustrated the Bass diffusion model characteristics through a causal loop diagram, and illustrated the model fit. Additionally, SDG&E noted different modelling assumptions between new residential construction and existing building retrofits.

Throughout the presentation, parties raised clarifying questions that provided better insights into SDG&E's method descriptions. Of these questions, the following four (4) are notable.

- **CEC Role.** The IOUs clarified that DFWG is about "allocating" the CEC forecast, not generating a new forecast. The allocation is focused on predicting where and when the CEC's forecasted DERs will occur. The CEC system-level DER forecast is based on information provided by the IOUs in the IEPR process. Discussion about impacting the CEC process may occur in a future meeting.
- **PV Consistency.** All IOUs are currently using a Bass diffusion model technique for PVs. Each year, the IOUs are refining and improving their model.
- **EV Data.** All IOUs agree that having DMV electric vehicle data would be useful in allocating EVs. While the CEC has these data, concerns about privacy are paramount. The IOUs believe that the DMV data would be

useful if aggregate EV adoption numbers can be obtained at the zip code level.

- **ES Data.** All IOUs indicated that the dearth of ES data makes ES allocation difficult. SDG&E is planning to allocate with a similar technique as PV.

PG&E Presentation

PG&E's presentation was similar to SCE and SDG&E's presentations. However, PG&E provided a deeper discussion on AAEE and higher-level discussion on the following DERs.

- PV
- EV
- LMDR

For each DER, PG&E provided the data inputs, the data sources, the analysis process, and the outputs. In all cases, the user for the forecast was identified as Distribution Planning.

The AAEE disaggregation starts with impacts from the CEC at the WECC busbar level. These results are further allocated to feeders based on consumption and coincident demand estimates.

Throughout the presentation, parties raised clarifying questions that provided better insights into PG&E's method descriptions. Of these questions, the following two (2) areas are notable.

- **Problem Size.** CEC publishes their forecast at the service territory level. Each IOU allocates the AAEE forecast based on the configuration of their system. The CEC also produces a forecast of AAEE at the busbar level. The level of granularity that this provides differs by IOU as PG&E has more WECC busbars than the other IOUs. PG&E's system aligns well with the CEC busbar forecast and begins their allocation process at the busbar. Because the CEC busbar forecast provides less granularity for SCE and SDG&E's systems, SCE and SDG&E use the CEC's service territory forecast as the starting point for their allocation methods.
- **Feeder Level.** Unlike the other IOUs, PG&E's presentation referenced forecasting at the feeder level in addition to the circuit level.

Uncertainties and DER List Discussion Presentation

The final presentation discussed the impact, the sources, and mitigation of uncertainty. The presentation included a list of uncertainties which all parties agree captures the general range of issues. The slide that captures the uncertainty list is shown below (Figure 1).

Figure 1: Uncertainty List

Key Sources of Uncertainty in DER Forecast Allocation

Universal Sources of Uncertainty:

- Uncertainty in the system level forecast propagates down and compounds
- Data availability and quality
- Amount of recorded historical adoption
- Methodology
- Impact profiles/customer dispatch behavior
- Weather
- Adoption not necessarily independent between DERs
- Technical potential uncertain
- …

DER Specific Drivers of Uncertainty in the Allocations:	
PV	• "Lumpy" non-res adoption • Rapidly changing policy/economic landscape • Limited information on roof type/shading
EV	• Location of most EV customers unknown • Driving & charging patterns • Bias toward large battery size adopters
EE	• Impact shape varies by measure adoption • Unknown distribution of "upstream" measures • Customer class definition between CEC and PG&E
DR	• Load consumption variation (significant deviation of actual load may underestimate or overestimate DR projections) • Fluctuating enrollments and engagement
Storage	• Extremely limited historic data • Dispatch behavior not guaranteed

In addition to general clarification questions about uncertainty, the following issues were discussed.

- **Location.** The DER allocation process introduces locational uncertainty. This has a spatial dimension (where DER is installed) as well as timing dimension (when it is installed in different areas). Generally, there was agreement that stronger allocation methods based on quality data will have less locational uncertainty.
- **Large Project Timing.** The granular level of the forecast encounters a "lumpy" adoption issue for some DERs (such as non-residential PV projects). While the forecast may be correct in the long-term, year-to-year timing of a large projects create a lumpy result which is inherently difficult to forecast.

- **Surveying Customers.** While specific surveys of customers may provide near-term insight into the addition of DER (e.g. PV), customers are unable to provide long-term plans for additions. As a result, surveys or specific customer information may be helpful for adjusting the short-term forecast, but not the long-term.
- **PV Interconnection Queue.** Using the interconnection queue data is useful on a case-by-case basis, but it only covers a few years. Once again, these data are useful for short-term adjustments, but not long-term adjustments.
- **EV Profiles.** IOUs have some EV profile data based on EV rates. However, these data are not a representative sample of all EV owners due to an apparent correlation between rate selection and battery capacity.
- **EV Identification.** Identifying EVs using AMI data is problematic. While large battery vehicles may be detected, small battery vehicles or vehicles with short charging times are difficult to see in the AMI data.
- **ES.** The lack of data for storage is problematic. ES usage profiles may dramatically change customer usage patterns increasing the complexity of the distribution planning process. All parties generally agree that telemetry and sharing of data related to storage will be important to understanding ES patterns and to mitigating ES uncertainty.
- **Uncertainty Scale.** Identifying the scale of uncertainty relative to the forecast helps capture the size of the problem. The challenge of identifying scale results from the different sizes of the technologies. This issue will be discussed in some later meetings.
- **Measuring Accuracy.** ORA expressed interest in ways to determine accuracy. While no methods were suggested, the interest in accuracy is noted as a tool to evaluate the disaggregation methods.

3. Meeting Conclusions

Based on the presentations and discussions, the following capture the general conclusions.

List of DERs. Based on the Forecast Uses presentation the following list of DERs represents the scope that will be discussed in the DFWG. All parties agree to this list.

- Solar Photovoltaics (PV)
- Electric Vehicles (EV)
- Additional Achievable Energy Efficiency (AAEE)
- Load Modifying Demand Response (LMDR)

- Energy Storage (ES)
- Additional Achievable Photovoltaics (AAPV)
- Other Private Generation (Non-PV DG)

List of Uncertainties. Based on the uncertainties presentation, Figure 1 contains the preliminary list of uncertainties. All parties agree that this list is sufficient for discussion but additional uncertainties may be added in future meetings.

Description of Methods. IOU methods vary by DER. The following generalizes the methods. This summary is not meant to replace the detailed descriptions in the IOU presentations.

- **PV.** All IOUs apply a regression and/or Bass diffusion model as the mathematical basis for disaggregation.
- **EV.** PG&E and SCE apply a regression model as the mathematical basis for disaggregation. SDG&E uses allocation on the existing geographic distribution, but plans to evaluate Bass diffusion models, if time-series data becomes available.
- **AAEE.** All IOUs allocate by sector energy.
- **LMDR.** All IOUs first allocate to participants, then allocate remaining by sector energy or an adoption model.
- **ES.** Only SDG&E reported on storage and allocation was based on the geographic distribution of PV.
- **AAPV.** Only SDG&E mentioned AAPV, and they plan to allocate in the 2018-19 distribution planning cycle based on the distribution of new construction.
- **Non-PV DG.** Because of the small number of these resources deployed, IOUs use simple allocation across the system or based on specific projects and the related interconnect queue.

4. Attendees

The following parties were represented at this meeting.

- Itron (As Facilitators)
- Energy Division
- PG&E
- SCE
- SDG&E
- ORA

- CEC
- Vote Solar
- IREC
- EPRI (by phone)
- Lumidyne (SDG&E Consultant)
- Integral Analytics (PG&E Consultant)

Attachment: DFWG ADL

Term	Definition
DFWG	Distribution Forecasting Working Group
ADL	Acronym definition list
DER	Distributed energy resources. Also distributed generation (DG) or on-site generation. Includes photovoltaic systems (PV or rooftop PV), small wind systems, fuel cells, combined heat and power (CHP).
PV	Photovoltaic, often referred to as rooftop solar
AAPV	Additional achievable photovoltaics
EV	Electric vehicle
PHEV	Plug in hybrid electric vehicle
EE	Energy efficiency, usually associated with utility programs
AAEE	Additional achievable energy efficiency, usually from potential and goals study
DG	Distributed Generation
Non-PV DG	Distributed generation other than PV (wind, combined heat and power, …)
BTM	Behind the meter, usually combined with PV or DG
DR	Demand response
PDR	Proxy Demand Response, load curtailment though CalISO. Also called Economic DR.
RDRR	Reliability Demand Response Resource, load curtailment through CalISO with reliability triggers.
LMDR	Load Modifying Demand Response, usually associated with time of use rates or variable pricing. Not dispatched through CalISO.
ES	Energy storage or just storage. Use of batteries with a charge and discharge pattern.
Bass Model	Bass diffusion model. Well known model for modeling product adoption. Typically has a component for market potential and a component for adoption as a fraction of remaining potential. Both components can include the influence of economic and other factors.
DEER	Database for energy efficiency resources, developed by California PUC.
IEPR	Integrated Energy Policy Report produced by California Energy Commission
CVPR	Clean vehicle rebate project, source of data for EVs.
SGIP	CPUC Self Generation Incentive Program

Term	Definition
DGStats	Distributed generation statistics, the official reporting site of the California Solar Initiative (CSI)
Circuit	Connects a collection of utility customers to the distribution substation. Components are main feeder, main branches, express feeder, and branch lines or lateral taps.
Hosting Capacity	The amount of DER that can be installed on a circuit without adversely impacting power quality or reliability.
GNA	Grid needs assessment. Part of planning that identifies system deficiencies
WECC	Western Electricity Coordinating Council, coordinates high voltage interstate transmission in the western region. Focus on reliability and open access.
WECC Busbar	High voltage (e.g ABank, 220 KV) connection with transmission system.
Sector	Utility customer segment, usually Residential/Commercial/Industrial or Residential/Non-residential
R or Res	Residential sector as in PV-R
NR	Non-residential as in PV-NR
NAICS	North American Industry Classification System (adopted in 1997 to replace Standard Industrial Classification or SIC codes)
SB 350	Clean Energy and Pollution Reduction Act of 2015. California law establishing clean expanded clean energy and greenhouse gas goals for 2030 and beyond.

Itron

Knowledge to Shape Your Future

Electric | Gas | Water

information collection, analysis and application

Distribution Forecasting Working Group Meeting 2 Summary

May 14, 2018

DISTRIBUTION FORECASTING WORKING GROUP

The Distribution Forecasting Working Group (DFWG) is organized under the Joint Ruling of Commissioner and Administrative Law Judge (Ruling) issued on March 29, 2018 in R. 14-08-013.

This document summaries the second DFWG meeting held on May 2, 2018.

1. Agenda

This meeting focused on disaggregation methods for Photovoltaics (PV), Electric Vehicles (EV), and Additional Achievable Energy Efficiency (AAEE). For each technology, one IOU led the discussion with the remaining IOUs adding higher level summaries of their approaches.

The meeting reached conclusion and agreement on modeling methods and uncertainties for PV and EV. The AAEE discussion was terminated at the end of the day and will be continued in the next meeting (Meeting 3, May 16, 2018).

The agenda is shown below. All presentation materials are located on the website at http://capabilities.itron.com/DFWG/Meeting2.htm.

Distribution Forecasting Working Group (DFWG)

Meeting 2 Agenda

Location: CPUC, Golden Gate Room
Address: 505 Van Ness Ave, San Francisco
Time: 9:30 AM - 3:30 PM

9:30 – 9:45	Objectives Review	Itron

- Updated Meeting Plan
- Meeting 2 Objectives

9:45 – 10:15	Context for Improving DER Methods	SCE on behalf of IOUs
10:15 – 11:15	Photovoltaics (PV)	SDG&E

- Uncertainty
- Lessons Learned
- Proposed Improvements

11:15 – 11:30	Break	
11:30 – 12:30	Electric Vehicles	SCE

- Uncertainty
- Lessons Learned
- Proposed Improvements

12:30 – 1:30	Lunch	
1:30 – 2:30	AAEE	PG&E

- Uncertainty
- Lessons Learned
- Proposed Improvements

2:30 – 2:45	Break	
2:45 - 3:30	Wrap Up Discussion	Itron

- Summary of Methods/Uncertainty
- Objectives and Questions for Meeting 3

2. Presentation Summary

The meeting consisted of six (6) agenda items and presentations. Below are summaries of each item.

Objectives Review Presentation

Itron summarized how Meetings 1 through 3 address the Ruling objectives, and set the objectives for Meeting 2. The objectives for this meeting were to (1) determine best practices for PV, EV, and AAEE, (2) quantification/qualification of uncertainty, and (3) identification of data sources.

During this presentation, the IOUs questioned whether Ruling Objective 5 ("What dispersion methods should be used to allocate circuit-level forecasts along a circuit?") should be addressed in this working group. The consensus belief is that the Integrated Capacity Analysis (ICA) working group is discussing this issue. All parties agreed that this issue should be removed from the DFWG subject to confirmation that the ICA is addressing this issue. Itron committed to confirm with the ICA and report back to the DFWG.

After the meeting, IREC and Itron independently confirmed with the ICA that this issue was discussed, but not resolved. Specifically, the ICA is looking for recommendations from this working group as stated in the Integration Capacity Analysis Working Group Final ICA WG Long Term Refinements Report.

> "The ICA planning use case envisions that ICA will assist with future planning decisions. ICA, combined with growth forecasts (discussed under DRP Track 3, Sub-track 1), can be used to identify circuits that require upgrades to accommodate forecasted DER. This activity will take findings and recommendations from CPUC Final Decisions on Track 3 issues and incorporate any necessary changes into ICA, as appropriate." (p 31)

As a result, Itron will include the dispersion method question in DFWG Meeting 4 on May 30.

Stakeholders also discussed the definition of "best practices" in the context of this working group. Stakeholders asked whether a best practice is (1) the absolute ideal practice, or (2) the best possible practice given the current conditions and constraints. The working group concluded that both definitions of "best practice(s)" are important. Where possible, the working group notes and report will specify which definition of best practices is intended.

Context for Improving DER Methods Presentation

This presentation reiterated the uncertainties listed from Meeting 1 and how uncertainty increases in allocation. While uncertainty is unavoidable, the planning process can mitigate the uncertainty with improved data and continuously improving allocation methods.

Stakeholders commented that "uncertainty" is a broad term referring underlying data, model accuracy, and forecast assumptions. Where possible, the working group will define the uncertainty as appropriate.

Photovoltaics (PV) Presentation

SDG&E led this discussion by presenting a detailed explanation and example of how allocation is performed using a Bass Diffusion model (Bass) which is a type of S-curve model. While the nuances of the utility models are different, all IOUs are using the S-curve framework as the basis for their allocation.

Within SDG&E's Bass, three parameters are optimized at the zip code level to explain the monthly adoption patterns. In dynamic models the values of these parameters may be changed through time in response to economic conditions, customer behavior, and market activities. These parameters are listed below and represent the key uncertainties in the model.

- P: This parameter is for innovation and represents the behavior of early adopters for a technology as well as advertising effects.
- Q: This parameter is for imitation and represents word-of-mouth adoption and the influence of pervious adopters.
- M: This parameter is the market potential for the technology.

IOUs use zip code level data because these data are stable relative to circuit-level data and fit the S-shape curve framework.

For PV, the uncertainty within the S-curve modelling framework was qualified as low due to the strong theoretical framework. However, moderate uncertainty within the framework still exists regarding the coefficients, particularly with the long run market potential (M). For PV, uncertainty is being reduced over time with increasing availability of adoption data and maturing adoption trends.

The uncertainty risk relative to the overall allocation with respect to circuit-level planning were qualified as listed below.

IEPR: **High**. The IEPR forecast is a key source of uncertainty for the circuit level allocations. A large error in the IEPR forecast results in corresponding large errors in the allocation results.

Model: **Low**. The Bass models are used to allocate total PV adoption to the circuit level. The models are estimated with good quality geographic data providing a strong basis for allocation. All IOUs are in the process of testing, evaluating, and refining their models by exploring input variables and measuring their methods against prior year methods.

Impact Shapes. **Low**. While PV generation data for customers within the IOUs service territory is limited, hourly profile data are available from national and state level studies.

Lumpy Adoption - Near Term. **Low**. Near term adoption for large projects is managed on a case-by-case basis with known projects in the interconnection queue.

Lumpy Adoption - Long Term. **High.** Timing and location of large projects in the long term are difficult to forecast accurately creating significant uncertainty.

The IOU allocation process is iterative with continual evaluation to improve model inputs. IOUs identified that the following data would be useful in improving the modelling process.

- **CA DG Stats Database.** The CA DG Stats Database currently aggregates PV retrofits with new construction. Separating retrofits from new construction in the database may improve the allocation model because retrofits and new construction adoption characteristics are different.
- **Impact Shapes.** Impact shapes for PV customer are required in distribution planning. While the IOUs indicated their usefulness, no specific data source was identified.

By using the Bass model for allocation, the IOUs have also generated a bottom-up forecast of PV adoption with parameters estimated at the Zip-code level. Stakeholders expressed an interest in understanding how these forecasts compare with the CEC forecast at the system total level. IOUs acknowledged that this comparison has not been examined given the scope of the DRP Track 3 on forecasting. Stakeholders suggested the comparison could be reviewed through future IEPR DAWG meetings.

Electric Vehicle (EV) Presentation

SCE led this discussion by presenting a detailed explanation and example of how allocation is performed for EVs. All IOUs base their allocations on a Propensity Model at the Zip-code level. These models use statistical methods (e.g. regression, machine learning) to identify the key variables for customer adoption and to estimate the propensity models. While SCE's primary characteristics include (1) education level, and (2) travel time to work, all IOUs are constantly exploring alternative variables (e.g. income) to improve their models.

The propensity models are used to develop a score for each Zip code. The scores are used to allocate total vehicles to Zip codes and the associated circuits. To illustrate the process, SCE displayed maps comparing its forecast against actual adoption data from 2017. While the propensity model performed better than prior year methods, the comparison highlighted situations where other variables, including income, home ownership rates, and detached home rates, may be helpful in the propensity models. Stakeholders expressed appreciation for the SCE's additional level of detail.

The discussion included ideas for where improvements to the model may be made. The following ideas were explored.

- **Location Data.** Parties agreed that improved locational data and time series data would support the use of more formal Bass-like models.
- **Additional Variables.** Parties discussed the choice of explanatory variables for the propensity models, for example using education instead of income. Parties generally agreed that this is a topic for further research and that these models will evolve, especially when better data become available.
- **Changing Stations.** The parties explored the idea that forecasting charging stations instead of vehicle adoption might make more sense. In the future, as more vehicles penetrate the market and commercial charging stations become more prevalent, directly forecasting charging station load may be useful. However, the current state of the market implies forecasting vehicle adoptions is a reasonable proxy for charging stations.
- **CEC Alignment.** Parties expressed interested in understanding the CEC EV adoption forecast and how the IOU model assumptions align with it. During the meeting, the CEC stated that the IOU model assumptions are aligned with CEC assumptions.

The uncertainty risk relative to the overall allocation for circuit-level planning were qualified as listed below.

IEPR: **High**. The IEPR forecast is a key source of uncertainty for the circuit level allocations. Large error in the IEPR forecast results in large error in the allocation result.

Model: **Medium**. Changes in the propensity model variables and parameters control the allocation of EV adoption. Because EVs are still in the early adoption phase, customer decision characteristics are still evolving making predictions more difficult and increasing model-related uncertainty. Improved location data which can serve as the basis for the model are expected to mitigate some of the model risk.

Charging Location: **Medium.** The discussion indicated that most charging currently occurs at home. This may change in the future as commercial charging facilities expand.

Charging Shapes. **Medium to High**. Additional data is needed to understand charging patterns. These patterns are expected to vary by battery size, type of charging station, vehicle type, location (home, work, or other). IOUs need to explore sources of data that might mitigate this risk with the support of stakeholders.

Lumpiness: **Low.** Concentrated charging facilities will be visible in the planning process with enough lead time to plan accordingly.

Parties believe that DMV data can mitigate some of the allocation model uncertainty. The DMV data are expected to add clarity into location adoption patterns and vehicle types. The data sources discussed are listed below.

- **DMV Data.** Assuming the DMV can provide data at the zip code level, IOUs believe that these data can create monthly timeseries that will advance the modelling effort.
- **NREL data sources.** 2016 California Vehicle Survey and 2017 National Household Travel Survey – California Add-On are available through NREL's Transportation Secure Data Center (TSDC). Utilities and CEC acknowledged that these data sources may be useful for IOUs' modeling efforts in the future forecast cycles.
- **EV Rate Data.** Parties discussed using EV rates as a data source. SCE estimates that only about 30% of its EV drivers applied for EV rates. Similarly, PG&E estimated that it can only identify about 50% of its EV customers through similar programs. Adoption through rates and

programs are not representative of the common uses rendering these sources insufficient.

Finally, stakeholders agreed that the EV market is less mature than the PV marketing creating opportunities for information sharing among parties to refine and improve the modelling techniques.

Additional Achievable Energy Efficiency (AAEE) Presentation

PG&E led this discussion by presenting a detailed explanation and example of how allocation is performed for AAEE. All IOUs base their allocations on a Proportional Allocation Method. This method begins with the IEPR forecast at either the WECC busbar level (PG&E) or service territory level (SCE & SDG&E). This difference is due to the IOU's system configuration. The IOUs allocate to circuits/feeders based on sector energy. While the details of the allocation are different by IOU, the framework consistently allocates based on sector or class information.

There was general agreement that there is good locational data for past EE impacts for downstream programs (e.g. direct customer rebates, new construction, targeted EE programs). Upstream programs, however, provide information about where retail purchases occurred but do not indicate where equipment and devices are installed.

The uncertainty risk relative to the overall allocation with respects to circuit-level planning were identified as listed below.

IEPR: **High.** The IEPR forecast is a key uncertainty for the circuit level forecasts. Additional coordination with the CEC may yield improvements when class definitions are better aligned or the CEC provides information at a more granular level.

Models. **Medium**. Location is not known for more than 50% of past EE. This is an area where improved data and coordination can mitigate risk.

Shapes. **Low to Medium.** End-use or energy efficiency shapes are used in the planning process. IOUs discussed the lack of recent study producing shapes.

Lumpy Adoption. **Medium.** Timing and location of large AAEE projects are impossible to forecast accurately. Coordination with EE teams who may get advanced notice of large projects might help to mitigate this uncertainty.

Qualification of the uncertainty was not validated during the meeting due to the lack of time. Parties expect to discuss this during Meeting 3.

While no new data source was identified to assist in the AAEE allocation process, some parties suggested that MV&E studies may provide insight into the allocation process.

- **MV&E Studies.** Measurement, Verification and Evaluation studies contain information about individual programs. These studies may contain information useful to improving the allocation method. IOUs suggested that CPUC make MV&E studies available more quickly so that IOUs may benefit from this information in future modeling efforts of AAEE area.

A full discussion of data did not occur due to the lack of time. Parties expect to discuss this during Meeting 3.

3. Meeting Conclusions

At the conclusion of the meeting, CPUC staff asked generally whether DER forecasting is helpful to distribution planning or disrupting the distribution planning due to the uncertainty. The IOUs responded that well-aggregated DER forecasts help distribution planners and improve the planning process.

At the end of the PV and EV discussion, stakeholders were polled to determine whether the IOU methods were "best practice" and whether the qualification of uncertainties was appropriate.

Photovoltaics

- Method: All IOUs use the S-Curve framework as the basis for allocation.
- Uncertainty: The uncertainties and their qualifications are listed in the Photovoltaics (PV) Presentation Section.

The following parties agree that the Method was at "best practice" given the known constraints for PV.

- NRDC.
- ORA.
- IREC. IREC notes in their comments that it would be helpful to compare the methods with those used by utilities in other states.
- Vote Solar.
- CEC.

- CESA.

The following parties were present, but provided no comment and no dissent.

- EPRI.

The following parties did not provide a response and were not present for this portion of the meeting.

- CAISO.
- CA Efficiency & Demand Council.
- Clean Coalition.
- Grid Utility.
- Energy Coalition.

No alternative disaggregation methods were offered by stakeholders.
No parties presented any objections to the qualification of risk.

Electric Vehicles

- Method: All IOUs used a propensity model based on a zip-code level of granularity.
- Uncertainty: The uncertainties and their qualifications are listed in the Electric Vehicle (EV) Presentation Section.

The following parties agree that the Method was at "best practice" or "acceptable" given the known constraints for EV.

- NRDC.
- ORA.
- IREC. IREC notes in their comments that it would be helpful to compare the methods with those used by utilities in other states.
- CEC.
- CESA.

The following parties were present, but provided no comment and no dissent.

- EPRI.
- Vote Solar.
- CA Efficiency & Demand Council.

The following parties did not provide a response and were not present for this portion of the meeting.

- CAISO.
- Clean Coalition.
- Grid Utility.

- Energy Coalition.

No alternative disaggregation methods were offered by stakeholders.
No parties presented any objections to the qualification of risk.

Additional Achievable Energy Efficiency (AAEE)

- Method: All IOUs used a Proportional Allocation Method as the basis for allocation.
- Uncertainty: The uncertainties identified are listed in the Additional Achievable Energy Efficiency (AAEE) Presentation Section.

Due to time limitations the end of the meeting, parties decided to defer their opinion on best practices and uncertainties until Meeting 3. Meeting 3 will include polling on this DER.

4. Attendees

The following parties were represented at this meeting. Individuals joining by phone are indicated with their names.

- Itron (As Facilitators)
    - Mark Quan
    - Stuart McMenamin
    - Paige Schaefer (Phone)
- Energy Division
    - Dina Mackin
- PG&E
    - Jordin Wilkerson
    - Jim Himelic
    - Samantha Weaver
    - Mark Dean
    - Catherine Izard
    - Alexander (Sandy) Allan
    - Richard Aslin
    - Jennifer Goncalves (Phone)
    - Donovan Currey – Integral Analytics (Phone)
- SCE
    - Ally Guilliatt
    - Hongyan Sheng
    - Daniel Donaldson
    - Michael Barigian
    - Muhammad Dayhim
    - Alan Wong (Phone)
    - Jen Szuhua (Phone)

- Tram Camba (Phone)
- SDG&E
  - Dan Wilson
  - Jose Lopez
  - Cory Welch (Lumidyne Consulting)
- ORA
  - Ben Gutierrez
  - Brian Goldmen
  - Stanly Kuan
- CEC
  - Anne Fisher (Phone)
  - Liet Le (Phone)
  - Nick Fugate (Phone)
  - Sudhakar Konala (Phone)
- Vote Solar
  - Madeline Yozwiak
  - Ed Smeloff (Phone)
- NRDC
  - Mohit Chhabra
- IREC
  - Aaron Stanton (Shute, Mihaly & Weinberger)
- EPRI
  - Alex Melhorn (Phone)
  - Jason Taylor (Phone)
  - Mobolaji Bello (Phone)
- CESA
  - Jin Noh (Phone)
- CA Efficiency & Demand Council
  - Michelle Vigen (Phone)
- Grid Unity
  - Peter Deschenes (Phone)

The following people joined by phone but did not indicate who they represent. And in a few cases, did not register their full name.

- Amir Javanbakht (Phone)
- Aniss Bhreinian(Phone)
- Louie Liu (Phone)
- Mark Palmere (Phone)
- Nadav Enbar (Phone)
- Scott (Phone)
- Stanley (Phone)

Itron

Knowledge to Shape Your Future

Electric | Gas | Water

information collection, analysis and application

Distribution Forecasting Working Group Meeting 3 Summary

May 28, 2018

DISTRIBUTION FORECASTING WORKING GROUP

The Distribution Forecasting Working Group (DFWG) is organized under the Joint Ruling of Commissioner and Administrative Law Judge (Ruling) issued on March 29, 2018 in R. 14-08-013.

This document summaries the third DFWG meeting held on May 16, 2018.

1. Agenda

This meeting was designed to finish the discussion on Additional Achievable Energy Efficiency (AAEE) from Meeting 2 and cover Energy Storage (ES), Load Management Demand Response (LMDR), and California Energy Commission (CEC) coordination. Due to time limitations, LMDR was not discussed and the CEC's Electric Vehicle (EV) discussion was not finished. Both these topics (LMDR and CEC's EV) are moved to Meeting 4 (May 30, 2018).

Meeting 4 is scheduled as a web-based meeting for May 30, 2018 from 12:30 PM to 4:30 PM. Parties agreed on the following topics for Meeting 4:

- Polling on Energy Storage.
- Finish CEC's Electric Vehicle Discussion.
- LMDR.
- Load Disaggregation.
- Dispersion along a Circuit.
- Datasets.

With the number of the Meeting 4 agenda items, parties agreed that topics that are not covered in Meeting 4 will be moved to Meeting 5 (June 13). Any remaining time in Meeting 5 will be dedicated to reviewing available portions of the final report draft. The parties agreed to remain flexible about moving topics to ensure that all topics are adequately covered.

The agenda for Meeting 3 is shown below. All presentation materials are located on the website at http://capabilities.itron.com/DFWG/Meeting3.htm.

Distribution Forecasting Working Group (DFWG)

Meeting 3 Agenda

Location: PG&E General Office
77 Beale Street, Conference Room 938A/B
Date: 5/16/2018
Time: 9:30 AM – 3:30 PM

9:30 – 10:00 Introduction — Itron

- Review of the Objectives and Workplan
- Polling for AAEE Discussion

10:00 – 10:30 Energy Storage Assumptions and Forecasts — Jin Noh, CESA

10:30 – 11:00 SDG&E Storage Discussion — SDG&E

- Description of key uncertainties and their quantification
- Description of the method changes from prior year

11:00 – 11:15 Break

11:15– 12:00 SCE LMDR Discussion — SCE

- Description of key uncertainties and their quantification
  Description of the method changes from prior year

12:00 – 1:00 Lunch

1:00– 3:00 CEC Forecasting Discussion (Includes 15-minute break)

- Self-Generation/PV Discussion — Nick Fugate, CEC
- AAEE Allocation Discussion — Anne Fisher, CEC
- EV Forecast Discussion — Mark Palmere, CEC

3:00 – 3:30 Meeting Wrap-Up — Itron

- Meeting 4 Logistics and Topics

2. Presentation Summary

The meeting consisted of five (5) agenda items. Below are summaries of each item.

Introduction Presentation

Itron's introduction (1) reviewed how Meetings 1 through 3 address the Ruling objectives, and (2) the summarized the Meeting 3 objectives.

The meeting's objectives were to (1) poll parties on allocation methods for AAEE best practices, uncertainty, and identification of data sources, (2) discuss ES and LMDR best practices, uncertainty, and data sources, and (3) understand the CEC's forecast for coordination.

AAEE. While refreshing the AAEE discussion, the IOUs clarified that the AAEE disaggregation method consists of (1) using the CEC service territory or busbar forecasts, (2) allocating to circuits based on sector energy, and/or (3) making adjustments based on local information including information about upcoming major projects. The IOUs emphasized that they are working with the CEC staff to explore refinements and alternative techniques to improve the disaggregation process. Stakeholders also encouraged the IOUs and CEC to communicate so that the IEPR forecast can benefit from the IOUs' knowledge about local projects. The IOUs are mandated to use the CEC's WECC busbar AAEE allocations for transmission planning studies

In addition to the data sources listed in the Meeting 2 summary, parties added three additional data sources. The AAEE data sources are listed below.

- **MV&E Studies.** These studies are described in the Meeting 2 Summary.
- **Utility Plans.** Known utility plans for energy efficiency programs.
- **New Construction.** Known new construction that is consistent with evolving codes and standards.
- **Internal Coordination.** The disaggregation should reflect internal IOU efficiency program planning and program evaluation results.

The following parties agree that the Method was at "best practice" or "acceptable" given the known constraints for AAEE and accounting for the available data sources.

- CA Efficiency & Demand Council.
- ORA.
- NRDC.

- Vote Solar.
- CEC.

The following parties were present, but provided no comment and no dissent.

- CAISO.
- CESA.
- EPRI.
- IREC. IREC comments that “best practice” or “acceptable” should be conditioned on whether the additional data sources identified above are incorporated into the AAEE disaggregation method.
- SGS.

The following parties did not provide a response and were not present for this portion of the meeting.

- Clean Coalition.
- Energy Coalition.
- Grid Unity.

Qualification of Uncertainty. The uncertainty discussion clarified that the qualification ratings used to describe the relative uncertainty within each DER technology. A High rating indicates a relatively wide range of possible outcomes. A Low rating indicates a relatively narrow range of possible outcomes.

Parties agreed that the uncertainty qualification should be paired with an “expected impact” to determine “risk”. Expected Impact is defined as the relative size of one DER against another for planning purposes. For instance, PV currently has a high expected impact relative to ES based on the relative energy and or load impacts associated with the two categories. Risk combines uncertainty and expected impact and should guide the relative level of attention that different technologies receive in the planning process. For instance, a technology with high expected impact and high uncertainty ratings should be given a high priority for further study and analysis. Similarly, a technology with low expected impact and high uncertainty ratings should be given a lower priority for study. In general, risk is a function of expected impact and uncertainty as shown below.

$$\text{Risk} = f(\text{Impact}, \text{Uncertainty})$$

The qualification for AAEE uncertainty is the same as described in the Meeting 2 Summary except for the Shapes category. The Shapes uncertainty is moved from Low to Medium because of (1) lack of shapes for some detailed efficiency measures and (2) the age of the shape studies. Below are the uncertainty qualifications.

- IEPR: **High.**
- Models. **Medium**.
- Shapes. **Medium.**
- Lumpy Adoption. **Medium.**

The following present parties agree or maintain no position regarding the above uncertainty qualification for AAEE.

- CAISO.
- CA Efficiency & Demand Council.
- CEC.
- CESA.
- EPRI.
- IREC.
- NRDC.
- ORA.
- SGS.
- Vote Solar.

The following parties did not provide a response and were not present for this portion of the meeting.

- Clean Coalition.
- Energy Coalition.
- Grid Unity.

Parties did not discuss AAEE impact or risk.

Energy Storage (ES) Assumptions and Forecasts Presentation

CESA discussed the state of the storage market, adoption factors, and provided a recommendation for ES forecasting. CESA recommends using a bottom-up forecast of market adoption adapting NREL's Distribution Generation Market Demand model (dGen) for ES. CESA understands the difficulty of adapting the model for disaggregation purposes and acknowledges this approach may not be possible until more data are available.

The discussion captured the following challenges and characteristics of ES.

Self-Generation Incentive Program (SGIP). Currently, SGIP is a good data source for understanding the ES market because it is supported by major behind-the-meter (BTM) ES system. The data is developing and will contain information such as rated kW and kWh, customer sectors, location, and usage shapes for participating ES projects. This program is funded through 2019, and projects will submit performance and operational data on an ongoing basis for five years. Beyond the current funding, the future of this data source is uncertain.

Market Adoption Models. CESA has successfully adapted a market adoption model at the IOU service territory level by leveraging dGen. This work illustrates that an S-Curve adoption model is possible in the long-term. PG&E agrees that developing a market adoption model is a worthy long-term goal provided the data support the modeling method. Parties agreed that because it may be another 5 or 10 years before there is enough data to move toward a market adoption model, this technology's market should be monitored in case the technology matures faster than expected.

Market Characteristics. The main characteristics of today's market are (1) policy mandates that drive market potential (including AB2514 which requires total ES procurements of 1,325 MW by 2020), (2) complex profiles driven by rates, payback, and customer load profiles, and (3) utility solicitations for specific grid needs.

CESA reported three main adoption characteristics for early ES adopters.

- Residential customers on NEM and/or TOU rates are motivated by bill savings from rate arbitrage.
- Commercial and industrial customers are motivated by demand charge savings.
- Some customers motivated by resiliency or backup purposes. These customers may not be relevant for distribution planning purposes since their storage is not regularly dispatched.

Double Counting. Because storage customers find some value in rate differentials, the penetration of ES may overlap with LMDR and PV. While these technologies may be useful in understanding one another, they also create the potential for double counting. For instance, a customer with ES and LMDR may have their impacts counted for both ES and LMDR due to the inability to completely disaggregate ES impacts from LMDR impacts.

SDG&E Storage Discussion Presentation

SDG&E continued the ES discussion by (1) highlighting that ES's expected impact is low relative to other DER technologies in the near term, (2) explaining their disaggregation method, and (3) listing the uncertainties.

While the impact is low, SDG&E is developing a two-pronged strategy for ES disaggregation. In the near-term, SDG&E is using a simple allocation method. The allocation for residential ES is based on new PV adoption and the allocation for commercial (and industrial) ES is based on load factor or peak. In the long-term, SDG&E is working toward an S-curve adoption model. SCE stated that they are using a similar approach. PG&E's current approach is to first adjust load for known ES projects, and then allocate remaining ES proportional to load.

The uncertainty within the DER is identified below.

IEPR: **High**. ES is a new component of the IEPR. It is based on a simple trend analysis and not an adoption model.

Model: **High**. The ES market is in very early adoption phase driven by public policy. The lack of adoption data makes model fitting and adoption modeling difficult at best.

Profiles. **High**. Operation profiles vary for each customer based on the customer's objectives and utility rates. Customer objectives are generally based on their values streams. At best, IOUs may attempt to reverse-engineer operations when more data becomes available.

Near-Term Lumpiness. **Low**. Near-term adoption may be managed for known customers based on the interconnect queue and any large projects adopted through the Distribution Investment Deferral Framework (DIDF).

Long-Term Lumpiness. **High**. The timing and location of large projects are impossible to forecast accurately.

The impact of ES, which shows the expected importance of ES relative to other DERs in the near-term, is identified as **Low**. The risk of ES is considered **Low**.

Parties identified the following data sources that may be helpful in ES disaggregation. The data sources discussed are listed below.

- **SGIP**. SGIP is a good data source for understanding the ES market.
- **Interconnection Queue**. Large projects will notify the IOUs through the interconnection queue. IOUs should use these data to manage near-term lumpiness.

- **IRP Guidance.** IOU forecasts at the system level will include ES. These forecasts should be considered along with the IEPR as a possible source of information about ES.
- **PV Adoption Data.** SDG&E's assumption that ES is related to PV adoption implies that data sources for PV can be leveraged to provide insights into ES historic and forecast adoption.
- **DIDF.** Projects sourced through the DIDF can help IOUs manage near-term lumpiness in the same way as projects appearing in the interconnection queue.

The following present parties agree with the proposed modeling approach, uncertainty qualification, and data sources for ES.

- CESA. CEC support the IOU methods for the residential sector. For the non-residential sector, CESA has concerns that this method may preclude ES systems from being eligible in distribution deferral. If a BTM ES profile is assumed where ES is already "mitigating" the circuit-level peak, then an ES system may be deemed ineligible, even when the assumed profile is not entirely accurate. If BTM ES will not be deemed ineligible for distribution deferral RFOs based on these forecasts, then CESA supports this method until a better one is developed.
- ORA.
- NRDC.

The following parties requested more time to consider the proposal. However, they did not dissent during the meeting.

- CA Efficiency & Demand Council.
- IREC.
- Vote Solar.

While the following parties were present, they did not dissent and did not offer a position.

- CAISO.
- CEC.
- EPRI.
- SGS.

The following parties did not provide a response and were not present for this portion of the meeting.

- Clean Coalition.

- Energy Coalition.
- Grid Unity.

SCE LMDR Discussion Presentation

Due to time constraints, this presentation was skipped. The presentation is moved to Meeting 4 on May 30.

CEC Forecasting Discussion – Self-Gen/PV Discussion Presentation

In the CEC's first presentation, they discussed their PV and ES forecast methods.

Photovoltaics (PV). For PV, a Bass Diffusion model is used to forecast capacity for the residential and commercial classes by weather zone. Simple trend models are used for other classes. Capacity is converted to energy with a capacity factor. While the current PV forecast is provided by forecast zone, the CEC is evaluating alternatives. The CEC understands the IOU's request for the subcategories of new construction and retrofits categories for both residential and non-residential groups.

PV Alignment. The Ruling asked whether the IOU DER disaggregation aligns with the CEC's forecasting assumptions. Parties recognized that method and assumptions will be different because the models and objectives for the IOU's disaggregation and CEC's forecast are different. However, parties agreed that the IOU's disaggregation assumptions generally align (or do not misalign) with the CEC's forecast. At the highest level, the IOUs are fully aligned with the CEC's DER forecasts because the IOUs are disaggregating the CEC's forecast.

Energy Storage (ES). 2017 was the first time the CEC forecasted storage. The forecast is based on SGIP data and uses a simple trend analysis with addition rates held constant over the forecast period. The CEC is monitoring available data and does not believe that the data support an adoption model at this time. The CEC understands the IOU's request for transparency and more granular details in future forecast cycles.

ES Alignment. As with PV, parties recognize that the specific models and techniques employed by the IOUs and the CEC are different, but that there is no significant misalignment between the IOU and CEC assumptions.

CEC Forecasting Discussion – AAEE Allocation Presentation

In the second presentation, the CEC presented their allocation of AAEE to the busbar level. The allocation is based on the prior year (e.g. 2016) system peak.

IOUs provided load data at the time of the ISO system peak by zone, bus, and sector. The CEC uses these data to proportionally allocate total AAEE savings. The technique was originally used to meet CAISO's request for bus level data. The CEC understands the need for more granular separation of impacts by customer type and by programs, building codes, and standards.

AAEE Alignment. As with EV and PV, parties recognize that the specific models and techniques employed by the IOUs and the CEC are different, but that there is no significant misalignment between the IOUs and CEC's assumptions.

CEC Forecasting Discussion – EV Forecast Presentation

In the final presentation, the CEC presented their EV forecast process. EVs are forecast using light duty vehicle choice models for each sector (personal, commercial, and government). Vehicle stocks are then allocated to forecast zones based on propensity models that account for households and per capita income. Key inputs include, but are not limited to, the 2017 California Vehicle Survey, CA Transportation Energy Price Forecast, DMV vehicle population, and vehicle attributes. An updated forecast is expected to be published in early 2019. Additionally, the CEC is working on EV load shapes which should be ready for the 2018 IEPR.

Due to time limitations, the group was unable to discuss EV alignment. This discussion will take place in Meeting 4.

3. Meeting Conclusions

Based on the meeting discussion, the following five conclusions summarize the decisions and agreements of the parties.

Uncertainty Clarification. Meeting 3 provided clarity on qualification of uncertainty. For all DER technologies, three concepts will be used.

- **Uncertainty.** Uncertainty ratings capture the relative range of possible outcomes for one DER within that DER.
- **Impact**. Impact is defined as the expected size of the load impacts of one DER relative to other DERs.
- **Risk**. Risk is the combination of uncertainty and impact indicating the measure of priority in the planning process.

With the expanded definition of uncertainty, the group will need to address the Impact and Risk conclusions for PV and EV from Meeting 2. These will be addressed in Meeting 4 or 5.

AAEE. Parties reached consensus on the AAEE method, data sources and uncertainty. Parties did not discuss Impact or Risk.

ES. Method, data sources, uncertainty, impact, and risk were discussed for ES. Most stakeholders asked for more time to consider the methods, data sources and uncertainty (uncertainty, impact, and risk) qualification. However, no stakeholder currently opposes the characterization presented above.

CEC Alignment. Parties agreed that the IOU's disaggregation is aligned with the CEC for PV, ES, and AAEE. The CEC EV alignment discussion was not finished and will be continued in Meeting 4.

Remaining topics. Time limitations moved the CEC's EV and the IOU's LMDR discussion to Meeting 4. These items will be covered with the planned items of Load Disaggregation, Dispersion, and Datasets. Because parties asked for more time on ES, ES polling will also occur in Meeting 4. The following is a list of topics for Meeting 4.

1. Polling on Energy Storage.
2. Finish CEC's Electric Vehicle Discussion.
3. LMDR.
4. Load Disaggregation.
5. Dispersion along a Circuit.
6. Datasets.

The last meeting, meeting 5, will include any remaining items from Meeting 4 and will finalize all uncertainty, impact, and risk qualifications.

Meeting 4 is a scheduled as a web meeting from 12:30 to 4:30 PM on May 30, 2018.

4. Attendees

The following parties were represented at this meeting. Individuals joining by phone are indicated with their names.

- Itron (As Facilitators)

- Mark Quan
    - Stuart McMenamin
    - Paige Schaefer (Phone)
- Energy Division
    - Dina Mackin
- PG&E
    - Samantha Weaver
    - Jennifer Goncalves
    - Alexander (Sandy) Allan
    - Jordin Wilkerson
    - Mark Dean
    - Catherine Izard
    - Jim Himelic
    - Richard Aslin
    - Donovan Currey – Integral Analytics (Phone)
- SCE
    - Ally Guilliatt
    - Hongyan Sheng (Phone)
    - Daniel Donaldson
    - Michael Barigian
    - Alan Wong
    - Muhammad Dayhim (Phone)
    - Jen Szuhua (Phone)
    - Jerry Cui (Phone)
- SDG&E
    - Dan Wilson
    - Cory Welch (Lumidyne Consulting)
    - Ken Schiermeyer
- ORA
    - Tim Drew
    - Benjamin Gutierrez
- CEC
    - Nick Fugate
    - Anne Fisher
    - Mark Palmere
    - Cynthia Rogers (Phone)
- CAISO
    - Delphine Hou (Phone)
- Vote Solar
    - Madeline Yozwiak
    - Ed Smeloff
- IREC
    - Aaron Stanton (Shute, Mihaly & Weinberger)
- NRDC

- Mohit Chhabra
- EPRI
  - Jason Taylor (Phone)
  - Melhorn (Phone)
- Smarter Grid Solutions (SGS)
  - Michael Lee
- CESA
  - Jin Noh
- CA Efficiency & Demand Council
  - Patricia Hurtado

The following people joined by phone but did not indicate who they represent. In one case, the party registered by a group name

- Liet Le
- Louie Liu
- Malachi Weng-Gutierrez
- Chloe Lukins
- Nicholas Janusch
- Aida Escala
- DAO Office

Itron
Knowledge to Shape Your Future

Electric | Gas | Water
information collection, analysis and application

Distribution Forecasting Working Group Meeting 4 Summary

June 11, 2018

DISTRIBUTION FORECASTING WORKING GROUP

The Distribution Forecasting Working Group (DFWG) is organized under the Joint Ruling of Commissioner and Administrative Law Judge (Ruling) issued on March 29, 2018 in R. 14-08-013.

This document summaries the fourth DFWG meeting held on May 30, 2018.

1. Agenda

Meeting 4 was a web-based meeting designed to discuss all remaining outstanding topics and address them sequentially. Topics covered in this meeting include the following:

Topic 1: Introduction
Topic 2: Energy Storage Polling
Topic 3: Finish Discussion on CEC's Electric Vehicle Presentation
Topic 4: LMDR Discussion
Topic 5: Load Disaggregation
Topic 6: Dispersion Along a Circuit

The following topics were not covered due to time constraints. These topics are moved to Meeting 5.

Topic 7: Dataset Summary
Topic 8: Uncertainty Grid

The agenda for Meeting 4 is shown below. All presentation materials are located on the website at http://capabilities.itron.com/DFWG/Meeting4.htm.

Distribution Forecasting Working Group (DFWG)

Meeting 4 Agenda

Location: Web Meeting (WEBEX)
Dial-In Numbers: +1-855-797-9485 (Toll free)
Meeting number (access code): 922 176 026

Date: 5/30/2018
Time: 12:30 PM – 4:30 PM

Topics will be discussed in sequential order beginning at 12:30 PM.
Topics that are not completed will be moved to Meeting 5.

Topic 1:	Introduction	Itron
Topic 2:	Energy Storage Polling	Itron
Topic 3:	Finish Discussion on CEC's Electric Vehicle Presentation *This topic will include polling on IOU alignment with the CEC on electric vehicles.*	Itron
Topic 4:	LMDR Discussion *This topic will include polling on LMDR best practices, uncertainty, and datasets.*	SCE
Topic 5:	Load Disaggregation *Under advisement of the Energy Division, Load disaggregation is an educational topic. This topic will NOT include polling.*	PG&E/SCE
Topic 6:	Dispersion Along a Circuit *Under advisement of the Energy Division, Dispersion is an educational topic. This topic will NOT include polling.*	SDG&E
Topic 7:	Dataset Summary *Overview of all DER data sources.*	SCE
Topic 8:	Uncertainty Grid *Overview of all DER uncertainty ratings.*	Itron

2. Presentation Summary

While the meeting identified eight (8) topics for discussion, only six (6) were covered due to time constraints. The topics covered are summarized below.

Introduction Presentation

Itron's introduction reviewed how Meetings 1 through 4 address the Ruling objectives, and summarized the Meeting 4 objectives.

This meeting's objectives were to (1) finish the Meeting 3 agenda items including Energy Storage (ES) polling, the California Energy Commission (CEC) Electric Vehicle (EV) discussion, and the Load Modifying Demand Response (LMDR) discussion, (2) cover the remaining Ruling questions including Load Disaggregation and Dispersion along a Circuit, and (3) finalize the data sources and uncertainty lists.

Energy Storage Polling

After reviewing the ES conclusions from Meeting 3, stakeholders were polled on the ES disaggregation method, uncertainty ratings, and data sources. The ES review included the following descriptions.

Methods:

Two methods are used for disaggregation in the near-term. These methods are summarized below.

- SDG&E/SCE use a simple allocation method. The allocation for residential ES is based on new PV adoption and the allocation for commercial (and industrial) ES is based on load factor or peak.
- PG&E's also uses a simple allocation method. PG&E adjusts load for known ES projects, and then allocates the remaining ES proportional to load.

In the long-term, the IOUs may transition to S-curve adoption models once the ES market and data mature.

Data Sources:

The data sources reviewed are described in the Meeting 3 Summary. Below is the list of the data sources.

- Self-Generation Incentive Program (SGIP).
- Interconnection Queue
- Integrated Resource Plan (IRP) Guidance.

- PV Adoption Data.
- Distribution Investment Deferral Framework (DIDF).

Uncertainty:

The uncertainties reviewed are described in the Meeting 3 Summary. Below is the list of the final qualification ratings.

- Uncertainty - IEPR: **High**
- Uncertainty - Model: **High**
- Uncertainty - Profiles: **High**
- Uncertainty - Near-Term Lumpiness: **Low**
- Uncertainty - Long-Term Lumpiness: **High**
- Impact: **Low**
- Risk: **Low**

The following stakeholders either agreed or stated no position on the proposed modeling approaches, uncertainty qualification, and data sources for ES considering the state of the ES market and available data.

- CA Efficiency & Demand Council. No position.
- CEC. Agree with models, uncertainty, and data sources.
- IREC. Agree with uncertainty and data sources. No position on models.
- NRDC. Agree with models, uncertainty, and data sources.
- ORA. Agree with models, uncertainty, and data sources.

The following parties agreed with models, uncertainty and data sources, but stated qualifications to their support.

- CESA. As summarized in the Meeting 3 Summary, CESA supports the IOU methods for the residential sector. For the non-residential sector, CESA is concerned that the method may preclude ES systems from being eligible in distribution deferral. If ES is not deemed ineligible for distribution deferrals based on these forecasts, then CESA supports the method.
- Vote Solar. Vote Solar would like to see the IOU methods combined, but believes that the methods are sufficient considering the state of the ES market.

The following parties were not present or did not respond when asked for their position.

- CAISO.

- Clean Coalition.
- Energy Coalition.
- EPRI.
- Grid Unity.
- Smarter Grid Solutions (SGS).

CEC Electric Vehicle Presentation

At the conclusion of Meeting 3, the CEC's Electric Vehicle (EV) presentation was terminated due to time. For this item, Itron presented an overview slide of the CEC's EV presentation and allowed parties to continue the discussion.

The Ruling asked whether the IOU DER disaggregation aligns with the CEC's forecasting assumptions. Parties recognized that method and assumptions will differ because the models and objectives for the IOU's disaggregation and CEC's forecast are different. While some parties noted that the propensity variables used by the CEC and IOUs (e.g., income vs. education and commute time, respectively) are not the same, it is not clear that these differences create a misalignment problem.

The following parties agree or state no position that the IOU's disaggregation assumptions generally align (or do not misalign) with the CEC's forecast.

- CA Efficiency & Demand Council. No Position.
- CEC. Agree.
- CESA. No Position.
- IREC. Agree
- NRDC. NRDC believes the IOUs have not investigated whether they are in alignment with the CEC forecast. PG&E and SCE indicated that they will work towards better alignment with the CEC forecast in future cycles. However, NRDC is agrees with this outcome.
- ORA. ORA regards the IOU DER disaggregation and CEC forecasting assumptions as complementary and expects the IOUs to work with the CEC to come to greater alignment.
- Vote Solar. While VS does not disagree with the alignment, VS requested more time to consider this topic. VS committed to providing a written position in its comments to this document. Vote Solar did not provide comments on the draft summary.

The following parties were not present or did not respond when asked for their position.

- CAISO.

- Clean Coalition.
- Energy Coalition.
- EPRI.
- Grid Unity.
- Smarter Grid Solutions (SGS).

LMDR Discussion Presentation

SCE led the Load Modifying Demand Response (LMDR) discussion by defining LMDR and presenting their disaggregation process.

LMDR are time variant pricing programs that are not integrated into the CAISO markets. These programs include, but are not limited to, time-of-use (TOU) and critical peak pricing (CPP) programs. These programs are largely non-dispatchable and not event-based. LMDR does not include supply-side demand response, which is integrated into CAISO markets, dispatchable, and largely event-based. Unlike the other DER technologies, customers participating in LMDR programs can opt-out at any time adding an additional layer of complexity to forecasting.

SCE's customer level disaggregation method for residential customers consists of five steps.

1. Allocate Ex Ante LMDR to existing participants.
2. Develop a propensity model (i.e. regression) to identify LMDR adoption factors for existing LMDR programs. Identified factors include home square footage, year built, and the ACXIOM defined green investors.
3. Score individual non-participant customer accounts (customer not currently participating in LMDR programs) based on the propensity model. This model is applied at the customer-level.
4. Rank the non-participant customers based on the scores and assign LMDR growth to the highest-ranking customers.
5. Summarize the assigned customers by circuit to complete the LMDR disaggregation.

SCE evaluated the model results and demonstrated strong alignment with existing participation patterns. However, SCE is continuing to review the model performance to identify areas for improvement. SCE's proposed future improvements includes of leveraging other survey research data (e.g. residential TOU pilot, load impact outreach results) to identify possible additional adoption indicators and how these indicators may change with future programs. Also, SCE intends to test transactional data (customer historical activity leading up to adoption) to better understand the timing of opt-in/opt-outs decisions.

PG&E's disaggregation method begins with projected LMDR impacts growth by CAISO local capacity area (LCA) from the most recent Load Impact Protocols Report (same data source as the CEC's LMDR projections). For PG&E, non-residential LMDR consists of Peak Day Pricing (PDP), Time of Use (TOU) rates and Permanent Load Shifting. Residential LMDR consists of SmartRate and TOU programs. Of these programs only residential TOU has a material amount of projected growth (approximately 95 MW of projected peak load reduction over the period 2018-2018). PG&E allocates the LCA projected growth for each LMDR program proportional to the number of remaining eligible customers on each feeder within an LCA. Because of the low projected LMDR, this simple method is sufficient to ensure that LMDR is included for distribution planning studies. PG&E is committed to monitoring and analyzing potential changes related to TOU opt-out rates, TOU impacts studies, procurements of LMDR through DIDF/IDER, and CCA's development and deployment of LMDR options.

SDG&E's disaggregation method accounts for current LMDR enrollment then applies a regression trend model by sector at the WECC busbar level to proportionally allocate LMDR. The regression model uses data from the Load Impact Report and captures trends in the ratio of enrolled participants to total available customers. The disaggregation is performed and provided as part of the CPUC's data request in the Long-Term Procurement Planning process. Due to the difficulty in directly measuring the impacts of time-of-use rates on hourly electric consumption and to the low impact of LMDR, the approach is appropriate for SDG&E.

The uncertainty qualifications are summarized below.

IEPR: **Medium**. The IEPR forecast is a key source of uncertainty for the circuit level allocations. A large error in the IEPR forecast results in corresponding large errors in the allocation results. The evolution of the opt-out TOU rate impacts is uncertain, but is modelled in the IEPR forecast.

Model: **Medium**. The variation in IOU models range from a simple allocation to an individual customer propensity model. Regardless of the model, the challenges of changing programs and the evolution of opt-out TOU rates create uncertainty. As the market changes, IOUs are closely monitoring developing trends looking for opportunities to improve their methods.

Shapes. **Low**. Direct measurement of behavioral changes is not available. However, impact profiles from existing evaluation studies provide a reasonable shape.

Lumpy - Near Term. **Low**. The Distribution Investment Deferral Framework (DIDF) can provide information about near term adoption.

Lumpy - Long Term. **Medium**. In the long-term, clusters of adoption may introduce uncertainty.

The impact is qualified as **small** relative to other DERs. All IOUs cited low LMDR load volume as the main driver in qualifying the impact as low.

The risk is deemed **low** in the near-term due to the small expected impact. The risk may increase if LMDR impacts increase over time.

Parties identified two areas where additional data may be helpful.

- **Opt-out propensities.** Current programs are opt-in. With the expected introduction of TOU opt-out programs, understanding opt-out adoption and usage profiles may improve the disaggregation process.
- **Customer Choice Aggregators (CCA).** As CCAs serve more customers, the IOUs need to understand how much LMDR is associated with each CCA as well as what programs each CCA is offering. Communication with CCAs may improve the disaggregation process.

After the discussion, Itron developed the following summary slide to characterize LMDR. This summary is shown below.

UNCERTAINTY QUALIFICATION GRID

	LMDR
IEPR	Medium
Model	Medium
Shapes	Low
Lumpy (NT)	Low
Lumpy (LT)	Medium
Impact	Small
Risk	Low

Allocation Method:
SCE: Propensity model on individual customers on top of ex ante data
PG&E: Proportional allocation based on number of customers by class
SDG&E: Allocation enrollment trend model by class

Data Sets:

- Waiting for data on opt out propensities.
- Waiting to see if CCAs offer time-based rates

The following parties agree on the proposed modeling approaches, uncertainty qualification, and data sources for LMDR considering the state of the LMDR market and available data.

- CEC. Agree.
- IREC. Agree with uncertainty and methods especially considering the small scale of LMDR growth.
- NRDC. Agree with uncertainty. Considering the overall impact of LMDR, the choice of method may not be important.
- ORA. Agree
- Vote Solar. Agree with uncertainty, but asked for more time to consider methods and committed to include their position in comments on the draft summary. Vote Solar did not provide comments on the draft summary.

The following parties were not present or did not respond when asked for their position.

- CA Efficiency & Demand Council.
- CAISO.
- CESA.
- Clean Coalition.
- Energy Coalition.
- EPRI.
- Grid Unity.
- Smarter Grid Solutions (SGS).

Load Disaggregation Presentation

Load disaggregation is the process of allocating the IEPR load growth to circuits. Under advisement of the CPUC's Energy Division staff, this topic was presented for educational purposes only. Stakeholders were not asked whether the load disaggregation methods were "best practice".

Two presentations were provided for Load Disaggregation. PG&E and SDG&E provided the first presentation and SCE provided the second presentation.

PG&E and SDG&E Method.

PG&E and SDG&E use a similar method based on the same geospatial modelling vendor (Integral Analytics). The method consists of six major steps.

1. **Baseline Growth**. Adjust the CEC's Mid Baseline Scenario load projections (i.e. MW) to avoid double counting specific DERs. A minor difference between the PG&E and SDG&E methods is that SDG&E's adjustment for storage is based on their ES model results.
2. **Calculate Growth**. Calculate load growth (i.e. annual percent growth) from the adjusted baseline projections and apply the growth to the latest observed normalized distribution system coincident peak.
3. **Allocate Block Loads**. Allocate known block load growth based on applications for service.
4. **Allocate Geospatial Loads**. Allocate remaining load growth based on the geospatial model. The geospatial model is a predictive model that captures location and environmental factors influencing growth on the distribution system. The geospatial models are calibrated to each utility's distribution system.
5. **Local Planner Review**. Results are reviewed by local planners with specialized knowledge of local areas.
6. **Feeder Level Review**. Senior planners review and approve adjustments to the feeder level.

SCE Method.

SCE's method is similar to the PG&E and SDG&E method. However, instead of a geospatial model allocation, SCE develops base demand growth at the circuit and substation level based on a trend analysis. The circuit and substation growth is used to establish allocation factors which are used to allocate the IEPR load growth forecast to the circuit level. SCE also incorporates additional load growth that may not have been fully reflected in the CEC forecast (e.g. cultivation load growth not in the 2016 IEPR). SCE plans to work with CEC to incorporate these additional load growth factors into the future IEPR cycles.

ORA Comments.

Despite notifications in the draft agenda, agenda, and DFWG meeting notice emails, ORA stated that is was not aware that this topic was “for educational purposed only”.

In its comments to the Meeting 4 Draft Summary, ORA introduced statements based on its recent review of General Rate Case applications and PG&E’s recent Grid Needs Assessment (GNA).

Generally, ORA believes that this topic is more complex than expressed in the IOU DFWG presentations and as summarized in this meeting summary. Specifically, ORA believes that the method discussed in PG&E’s GNA does not fully align with PG&E’s DFWG presentation. However, ORA understands that the forecasting processes discussed in the DFWG are to be applied in the 2018-2019 DPP and are not required to be aligned with the current GNA.

Considering this new information, ORA recommends the following.

- All details of the disaggregation process that impact the bank and circuit net-load forecast should be documented.
- Words are insufficient to document this complicated process: flow charts and annotated spreadsheets with actual calculations are required.
- IOU discussion should focus on describing the process to be used in the 2018-2019 DPP, but should also indicate in their GNA documentation which steps of the methodology are new versus continuation of historic methods.
- The DFWG scope did not include the interaction of the load and DER forecasts and the DFWG is not scheduled to address this issue. This critical interaction must also be documented,

Finally, ORA’s comments will be included in their comments on the GNA reports.

Because the load disaggregation topic was only designed for educational purposes, no recommendations or actions are expected for this topic. ORA’s introduction of additional information, while included in this summary, should be discussed in their source (e.g. General Rate Cases) forums.

Dispersion Along a Circuit

While the DER and load disaggregation address where the IEPR forecasted load will occur at the circuit level, dispersion along a circuit addresses where load occurs within a circuit. Under advisement of the CPUC’s Energy Division staff, this topic was presented for educational purposes only. Stakeholders were not asked whether the load disaggregation methods were "best practice".

SDG&E presented the general dispersion method and provided a simple example. The method uses four inputs.

- **Substation load profiles.** These data (1) come from SCADA or aggregated AMI data, (2) show the circuit peak and shape, and (3) control the total amount of load to be dispersed.
- **System topology.** Topology captures the characteristics of each circuit.
- **Customer load data.** Customer loads based on AMI data (to the extent available) are used to understand where the load occurs along segments of the circuit.
- **Generation information.** Known generation information (e.g. PV, ES, cogeneration) is modelled in parallel with load.

These data are input into the power flow software to model the loading condition being studied. SDG&E uses Synergi. PG&E and SCE use CYME. Within the software, loads are modelled based on the provided location data and generation information. The software then allocates the circuit-level load to the distribution service transformers in order to perform power flow analysis. Variations among the IOUs occur in the generation model assumptions, availability of locational or AMI data, and level of modelling aggregation within a circuit.

In the SCE's, 576 structure-level profiles are created to inform the allocation. The circuit-level load is allocated to each structure using the coincidence of the 576 structure-level profiles.

At this point in time, no attempt is made to specifically locate forecasted DER along a circuit. The DER disaggregation impact occurs at the circuit level and is dispersed within a circuit based on the existing load and generation locations. In the future, forecasting DER may need to be addressed in future Integrated Capacity Analysis (ICA) working groups or proceedings.

3. Meeting Conclusions

Based on the meeting discussion, the following four conclusions summarize the decisions and agreements of the parties.

Energy Storage. Stakeholders generally approve and support the methods, uncertainty, and data sources for ES disaggregation. CESA's qualification on the non-residential sector allocation method is based on whether the method precludes ES systems distribution deferral eligibility. Vote Solar's qualification is a desire to see the IOU methods combined, but does not suggest that the methods are insufficient considering the state of the ES market.

LMDR. Stakeholders generally approve of and support the methods, uncertainty, and data sources for LMDR disaggregation. However, several parties expressed the desire for more time to consider the methods and to indicate their level of support in their comments to this draft summary.

Load Disaggregation and Dispersion. Load growth disaggregation and dispersion along a circuit were educational topics that informed stakeholders of the current IOU methods and where additional improvements are being pursued. Discussion on these topics provided an overview of the methods and highlighted the complexity of the locational issues.

Meeting 5 Items. Due to time limitations, finalizing the data source list and discussing the uncertainty grid are moved to Meeting 5.

4. Attendees

The following parties were represented at this meeting. In some cases, parties connected to the web meeting from a conference room containing more than one individual. This list does not identify parties who did not individually log into the web meeting.

- Itron (As Facilitators)
  - Mark Quan
  - Stuart McMenamin
  - Paige Schaefer
- Energy Division
  - Dina Mackin
- PG&E
  - Ali Moazed
  - Catherine Izard
  - Jennifer Goncalves
  - Jim Himelic
  - Jordin Wilkerson
  - Richard Aslin
  - Donovan Currey (Integral Analytics)
- SCE
  - Alan Wong

- Ally Guilliatt
    - Daniel Donaldson
    - Hongyan Sheng
    - Michael Barigian
    - Muhammad Dayhim
    - Tyson Laggenbauer
- SDG&E
    - Dan Wilson
    - Cory Welch (Lumidyne Consulting)
- CA Efficiency & Demand Council
    - Michelle Vigen
- CEC
    - Nick Fugate
    - Mark Palmere
- CESA
    - Sarah Busch
- IREC
    - Aaron Stanton (Shute, Mihaly & Weinberger)
- NRDC
    - Mohit Chhabra
- ORA
    - Tim Drew
    - Tom Roberts
- Vote Solar
    - Ed Smeloff

The following people joined by phone but did not indicate who they represent.

- Jonathan Hughes
- Louie Liu
- Tom Huynh
- Scott

Itron
Knowledge to Shape Your Future

Electric | Gas | Water
information collection, analysis and application

Distribution Forecasting Working Group Meeting 5 Summary

June 28, 2018

DISTRIBUTION FORECASTING WORKING GROUP

The Distribution Forecasting Working Group (DFWG) is organized under the Joint Ruling of Commissioner and Administrative Law Judge (Ruling) issued on March 29, 2018 in R. 14-08-013.

This document summarizes the fifth DFWG meeting held on June 13, 2018.

1. Agenda

Meeting 5 is the last scheduled DFWG meeting. This meeting was designed to finalize recommendations and review the draft report. The topics covered in this meeting include the following:

Topic 1: Introduction
Topic 2: Dataset Summary
Topic 3: Uncertainty Grid Summary
Topic 4: Process Going Forward
Topic 5: Working Draft Report Discussion

The agenda for Meeting 5 is shown below. All presentation materials are located on the website at http://capabilities.itron.com/DFWG/Meeting5.htm.

Distribution Forecasting Working Group (DFWG)

Meeting 5 Agenda

Location: CPUC, Golden Gate Room
Address: 505 Van Ness Ave, San Francisco
Time: 9:30 AM - 3:30 PM

Topics will be discussed in sequential order beginning at 9:30 AM.

Topic 1:	Introduction *Itron will present the meeting objectives and plan.*	Itron
Topic 2:	Dataset Summary *SCE will lead the discussion on finalizing the data sources.*	SCE
Topic 3:	Uncertainty Grid Discussion *Itron will lead the discussion on finalizing the uncertainty qualifications.*	Itron
Topic 4:	Process Going Forward • *Identify Missing Issues* • *Discuss Report Recommendations* • *Present Schedule for the Final Report*	Energy Division
Topic 5:	Working Draft Report Discussion *Itron will present portions of the draft report for discussion, editing, and finalizing.*	Itron

2. Presentation Summary

The topics covered are summarized below.

Introduction Presentation

Itron introduced the meeting by reviewing the priorities and objectives for the meeting. The meeting was designed to finalize the data source list, uncertainty qualifications, and working group recommendations as listed in the meeting agenda.

Dataset Summary

SCE's presentation listed all datasets identified in prior meetings and requested parties to review and correct the list for missed items. In reviewing data sources, SCE reiterated that the purpose of the data source list is to identify data sources that support the disaggregation process. During this presentation, parties reached consensus about data sources and their characterizations.

Data Source Information

In the discussion, parties agreed to expand the data source information by adding the following information.

- **Current/Future.** This is a status flag that indicates whether the data source is currently used or planned to be used. Sources listed as "current" mean that at least one IOU is using the data source. Sources listed as "future" mean that at least one IOU is planning to review the data source for use in the next forecast cycle.
- **Location Resolution.** Location resolution is the level of locational granularity contained in the data source. Locational granularity includes, but is not limited to, county, zip code, WECC bus, substation, circuit, and customer premise.
- **Description.** A brief description will be added to each data source identifying the type of data and how it may be applied.

The IOUs agreed to provide this additional information for inclusion into the Final Report.

Data Source Additions and Corrections

The following additions and corrections were made to the data source lists for each DER.

AAEE:

- **EE Stats Database.** Associated with the Evaluation, Measurement & Validation data source already listed, the EE Stats database contains all the verified program savings from past programs in a central database.

ES:

- **CEC Building Efficiency Standards**. Building efficiency standards may result in advancing energy storage adoption. These standards should be monitored for future impacts on storage adoption.
- **New Construction Data.** New construction may implement energy storage to address efficiency standards. Usage of these data may assist in energy storage location.
- **Energy Storage Targets**. Parties agreed to remove IRP energy storage targets from the list because storage targets are at the system level and do to inform location disaggregation.

EV:

- **Local Policies.** Where available, local policies and incentives may inform the IOUs about charging locations and impact EV adoption behavior.
- **Policy Outcomes via Regulatory Proceedings.** Like local policies, regulatory proceeding outcomes may impact policies regarding electric vehicle adoption and charging locations.

PV:

- **PV Technical Potential and Profiles (National Renewable Energy Laboratories)**. While already included in the list of data sources, this data source description should include new weather station data for insolation.

LMDR:

- No data sources changes were made to the LMDR list.

<u>Disaggregation Method Discussion</u>

Unrelated to data sources, an additional item was raised during this discussion regarding the level of detailed disaggregation steps that should be described by this working group.

ORA asked where in the regulatory process detailed information about the IOU DER disaggregation methods should be reviewed. To illustrate the issue, ORA cited a recent example in PG&E's Grid Needs Assessment (GNA). In the GNA, ORA observed a different level of DER and load disaggregation descriptions from this working group. This observation prompted ORA's questions about where the detailed steps describing DER and disaggregation should be located. In other words, should this working group describe the disaggregation steps in enough detail for an independent party to replicate the process? Or, should the detailed explanations be deferred to other parts of the Distributed Resource Plans (DRP) proceeding (e.g. GNA) or other regulatory proceedings (e.g. General Rate Case) in which an IOU is requesting action?

While parties recognized that there is an interaction between this working group and other parts of the DRP as well as other regulatory proceedings, parties are unclear about where detailed steps should be presented. Through the first four meetings, this working group has discussed, vetted, and summarized the principles of disaggregation but not at a level where an independent party can replicate the steps with actual data.

At this stage in this working group's process, the detailed steps requested by ORA will not be developed in the DFWG. However, parties are encouraged to submit their recommendations on how and where these detailed steps should be discussed in comments to the Draft Final Report.

Uncertainty Grid Discussion

Itron presented the uncertainty grid containing all previously agreed upon qualifications. Because the uncertainty definitions were clarified in Meeting 3, additional qualifications and corrections to previously decided uncertainties for PV, EV, and AAEE were discussed in this presentation. The final uncertainty grid is shown below.

	PV	EV	AAEE	ES	LMDR
IEPR	High	High	High	High	Medium
Method	Medium	Medium	Medium	High	Medium
Shapes/Profile	Low	Med to High	Medium	High	Low
Charge Location	Not Applicable	Medium	Not Applicable	Not Applicable	Not Applicable
Lumpy (NT)*	Low	Medium	Medium	Low	Low
Lumpy (LT) **	High	Medium	Medium	High	Medium
Impact	*Large*	*Medium*	*Large*	Small	Small
Risk	*High*	*Medium*	*High*	Low	Low

* NT = Near-Term
** LT = Long-Term

<u>Qualification Grid Uses</u>
The uncertainty, impact, and risk qualifications represent the DFWG's agreed upon qualifications for the 10-year planning horizon. By nature, these qualifications are subjective based on the thoughtful discussion of all parties. On an ongoing basis, these ratings should be updated as methods change and new data become available.

Parties emphasized that these ratings should be used to help prioritize analysis, but were careful to avoid dictating a specific priority. In other words, the uncertainty grid is designed to guide, not dictate, future analysis directions. Decisions on pursuing analysis should be based on available resources, costs, and potential benefits of the analysis. Participants recognized that the uncertainty grid does not address these issues. As a result, the grid should not be used as a stand-alone directive for analysis priorities and directions.

<u>Types of Risk.</u>
Risk is defined as the combination of uncertainty and the expected size of energy impacts, and is intended to guide the relative level of attention that different technologies should receive in the planning process. In discussing risk, participants identified two types of planning risk. First, if loads exceed planning expectations, the excess can cause instability or reliability problems on some parts of the distribution system (i.e. not enough resources where they are needed). Second, if load falls well short of planning expectations, the deficit

means that facility investments are inefficient (i.e. too many resources where they are not needed).

<u>Changes to Past Qualifications.</u>

The following changes to past qualifications were made to better align the uncertainties based on the definitions created in Meeting 3.

- **Model Label.** The uncertainty area previously labelled "model" is changed to "method". This change provides a broader description of the disaggregation process.
- **PV, Method.** This qualification is changed from "Low" to "Medium" reflecting the challenge of adoption modelling and the impacts of lumpy adoption.
- **EV, Lumpy (Near Term - NT).** This qualification is changed from "Low" to "Medium" due to the variability in commercial (e.g., DC super chargers) charging station size, location, and timing.
- **EV, Lumpy (Long Term - LT).** This qualification was previously left blank and is changed to "Medium" reflecting uncertainties in the size, location, and timing of commercial charging stations
- **AAEE, Lumpy (Long Term - LT**). This qualification was previously left blank and is changed to "Medium" due to the challenges to of accurately forecasting the timing and location of large energy efficiency projects.

<u>New Qualifications</u>

The uncertainty grid proposed qualification ratings for impact and risk for PV, EV, and AAEE. These qualifications were required based on the expanded definition of uncertainty from Meeting 3. The following are the agreed upon qualifications.

- **PV, Impact.** Adopted "**Large**" as proposed in the slide. Due to the size of the PV market relative to other DERs, the expected impact on distribution planning is large.
- **EV, Impact.** Adopted "**Medium**" as proposed in the slide. The EV market is growing. While the expected impact is not as large as PV or AAEE, substantial growth is expected.
- **AAEE, Impact.** Adopted "**Large**" as proposed in the slide. In terms of expected volume, AAEE is the second largest DER.
- **PV, Risk.** Adopted "**High**" as proposed in the slide. Time series locational adoption data are well developed due to the requirement for interconnection agreements. These data support direct adoption modeling at the Zip code level, and adoption forecasts are used to allocate system totals. However, the impacts of PV are large and the location and timing

of large projects is unknown in the long run. As a result, risk is judged to be high.

- **EV, Risk**. Adopted "**Medium**" as proposed in the slide. Time series location data are not currently available for EV. However, propensity models using cross section data can be used to identify key propensity factors and to estimate weights used to calculate propensity scores at the Zip code level. Uncertainty related to load shapes is increasing with the emergence of fast charging stations and flexibility in when and where vehicles are charged. In the 10-year planning horizon, EV impacts are expected to be significant, but not as large as PV and AAEE. The result is a risk assignment of medium.
- **AAEE, Risk.** Adopted "**High**" as proposed in the slide. AAEE includes impacts from codes, standards, and utility programs for a broad array of end uses and technologies. The main uncertainty comes from the difference between estimates based on potential studies and what is actually realized. If actual results fall short of the AAEE forecast, facility loads will be higher than expected. Because the aggregate AAEE impact is large, the result is a risk assignment of high.

<u>Recommendations to reduce uncertainties and risk</u>

Based on the uncertainty, impact, and risk discussion, the parties created the following recommendations to reduce future risk.

- **IEPR forecast.** One of the key drivers of risk is the expected top-level adoption of DER technologies. This risk includes the overall uncertainty related to the level of load and DER growth as well as the CEC forecast and allocation techniques. For example, the CEC allocates impacts for some technologies to the WECC bus level adding additional allocation uncertainty. Parties recommend that IOUs work to improve cooperation and coordination with the CEC to ensure that the forecasts and disaggregation methods are based on the strongest data and methods available.

- **Allocation Methods and Data.** Parties recommend that IOUs continue working to improve allocation methods and the data upon which these methods are based. IOUs should continue to track locational forecast performance and use the results to update and improve modeling methods. IOUs should also continue to work with other stakeholders to identify and research new data sources that can be used to reduce uncertainties and risks. Finally, the IOUs should continue to coordinate with the CEC to maintain alignment of allocation methods with CEC forecasting and allocation methods.

- **Local knowledge.** Parties recommend that IOUs continue working to improve internal communications related to the timing and location of large DER projects. Taking full advantage of local knowledge ensures that risks related to short-term lumpiness remains low. By continually managing short-term lumpiness, IOUs will also mitigate long-term lumpiness. Where related information can be used to improve CEC DER adoption forecasts or busbar allocations, this information should be shared with the CEC.

- **Load Shapes.** Load shapes are a source of uncertainty for EV, AAEE, and ES. Parties recommend that IOUs look for opportunities to cooperate in research efforts that focus on load shape development for these technologies.

Process Going Forward

In this presentation, the Energy Division (ED) discussed the next steps for the DFWG. Two areas were discussed. First, parties discussed how to proceed with final recommendations and working group conclusions. Second, ED discussed the remaining process and will research the next steps for this working group.

Final Recommendations.
While parties may include additional recommendations in their comments to the Draft Final Report, parties agreed that following recommendation should be included in the final report.

- DWFG participants were satisfied with the working group process and results. However, because DER technologies are evolving, there is a general desire to review progress, risk assessments and, potentially methods, as more information becomes available. Parties recommend that the Commission instruct the Energy Division with the responsibility to monitor related proceedings and set the timing and scope for future update meetings focusing on DER allocation and/or related issues with the expectation that this would occur in a one to two-year timeframe.

Process.
Itron intends to publish the Draft Final Report by June 18th with comments from all partied due by June 22nd. Itron will submit the final report, based on these comments, by June 29th. Parties are invited to include report recommendations in their comments for inclusion into the Final Report.

Upon receiving the Final Report, the Energy Division will work with the Commission to finalize the report with a ruling and identify the mechanisms for archiving the documents from this working group.

Draft Report Discussion

In the final portion of the meeting, Itron presented the Working Draft of the Final Report. This is the first draft of the Final Report and includes the conclusions and summaries through Meeting 4. The draft also includes placeholder descriptions based on expectations from Meeting 5. All placeholder descriptions will be updated to reflect the actual discussions from this meeting.

While parties are invited to submit comments on the Draft Final Report, they specifically asked for improved cross-referencing with the meeting summaries contained in the appendix. This cross referencing will direct the report reader to the meeting summaries which contain fuller descriptions of the working group discussions.

3. Meeting Conclusions

Meeting 5 achieved all planned objectives. The four main conclusions from this meeting are listed below.

- **Data Sources.** This meeting finalized the list of data sources with no disagreement from present parties. Along with the expected additional information provided by the IOUs, these data sources will be included in the Final Report.

- **Uncertainties.** All uncertainty qualifications were finalized with no disagreement from present parties. These qualifications will be included in the Final Report.

- **Recommendations.** The working group composed recommendations for reducing uncertainties and creating a follow up meeting. These recommendations will be included in the Final Report.

- **Process.** All parties are invited to submit additional recommendations when commenting on the Draft Final Report by Friday, June 22nd. Itron will review the comments and submit the Final Report by June 29th.

4. Attendees

The following parties were represented at this meeting.

- Itron (As Facilitators)
  - Mark Quan
  - Stuart McMenamin
  - Paige Schaefer
- Energy Division
  - Dina Mackin
- PG&E
  - Ali Moazed
  - Jordan Wilkerson
  - Samantha Weaver
  - Richard Aslin (Phone)
- SCE
  - Ally Guilliatt (Phone)
  - Daniel Donaldson
  - Hongyan Sheng (Phone)
  - Michael Barigian
  - Jonathan Hughes (Phone)
- SDG&E
  - Dan Wilson
- CESA
  - Jin Noh (Phone)
- IREC
  - Aaron Stanton (Shute, Mihaly & Weinberger)
- NRDC
  - Mohit Chhabra
- ORA
  - Tim Drew
  - Tom Roberts
  - Brian Goldman (Phone)