# Consideration of Distribution Costs and Benefits of DERs in IRP

CPUC Modeling Advisory Group Webinar

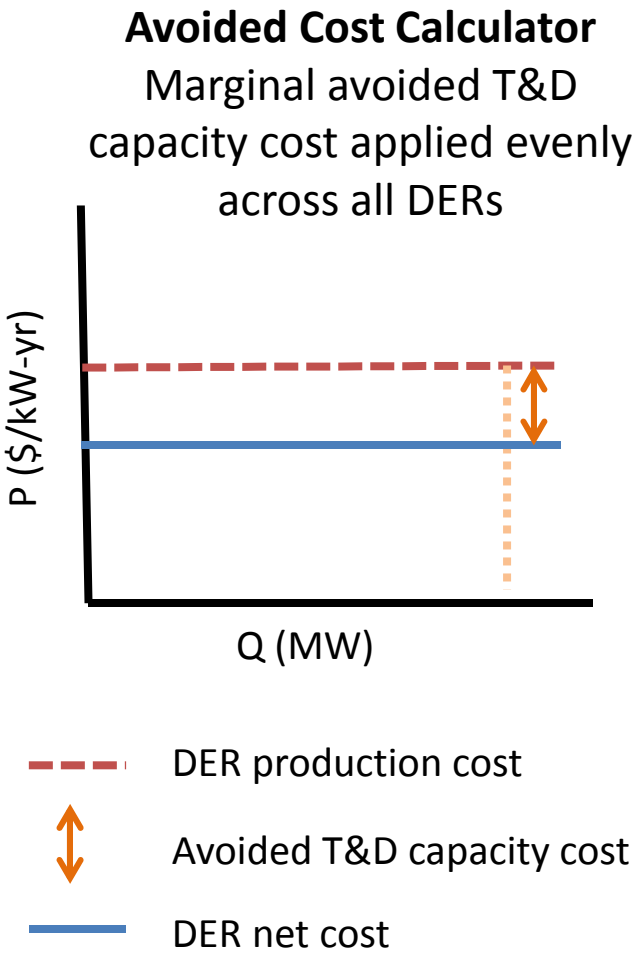
May 30, 2018

# INTRODUCTION

# Problem Statement

- To identify the optimal resource mix of supply side and demand side resources, the IRP must be able to account for the impact of Distributed Energy Resources (DERs) on the transmission and distribution system
- 2017 IRP modeling included simplified representations of DERs and did not capture their location-specific grid impacts, which include:
  - Avoided costs for transmission (not in scope of this proposal) and distribution
  - DER Integration costs: Interconnection, renewable integration
- These costs and benefits can vary significantly based on location and depend on load growth/associated DER resource mix forecasted to occur
- Without capturing locational value, tariffs and procurement policies may under or overvalue DERs

# How Have Avoided T&D Costs Been Calculated in the Past?




Marginal Avoided T&D Capacity:

- System-wide value assumes DERs avoid the same level of T&D expenses regardless of location
- Based on past GRC revenue requirement
- T&D cost is allocated to hourly load shape of DER production profile

Limitations of this method:

- Inaccurately calculates value of DERs to grid
- Certain quantity of DERs will provide high value for deferring distribution upgrades
- Other DERs will provide no value or incur additional costs to the system

# How to Develop Location-Specific Distribution Impact Values

- **Dx Impacts = location specific DER integration costs + avoided costs of distribution**
- Distribution Resource Planning (DRP) Proceeding has adopted a framework and analytical tools that assess to what extent DERs can defer distribution system upgrades. The tools:
  - Identify circuits where distribution system deficiencies are forecasted to occur
  - Identify potential distribution upgrade projects that could be deferred by DERs
  - Determining the avoided costs of the deferral opportunities
- Dx planning tools should be used to provide avoided $ and MW of DERs to IRP as inputs
- **Avoided transmission will not be addressed in this presentation**
  - DRP proceeding is reviewing proposals to update avoided transmission values

# Difference Between Distribution Avoided Costs Calculated in DRP and those Needed by IRP

Avoided Costs will be calculated using the same fundamental data/analytical platform, but providing outputs for different applications:

### DRP: Locational Net Benefits Analysis

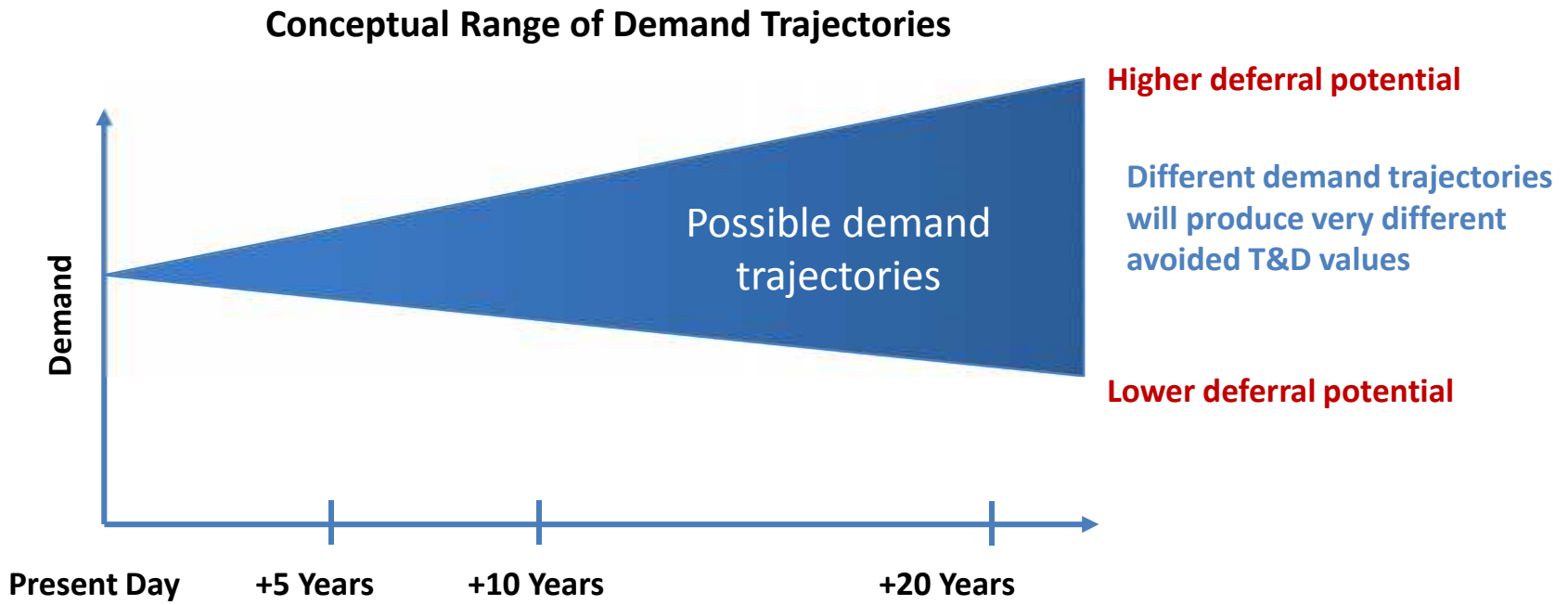
- Developing avoided costs:
  - Reflect deferral opportunities under trajectory stress conditions defined by IEPR forecast
- Using avoided costs:
  - Used to identify circuit-specific, relatively (<5 year) short-term DER procurement opportunities
  - Used to evaluate DER proposals for short-term distribution deferral projects via DIDF

### IRP: Distribution Impacts Analysis

- Developing avoided costs:
  - Reflect deferral opportunities under higher stress conditions resulting from higher DER adoption levels driven by GHG reduction needs
- Using avoided costs:
  - Used to evaluate optimal overall amounts of DERs over a 20 year period via IRP and RESOLVE
  - Analysis used to inform long-term DER-related programs and policies
- Includes DER integration costs

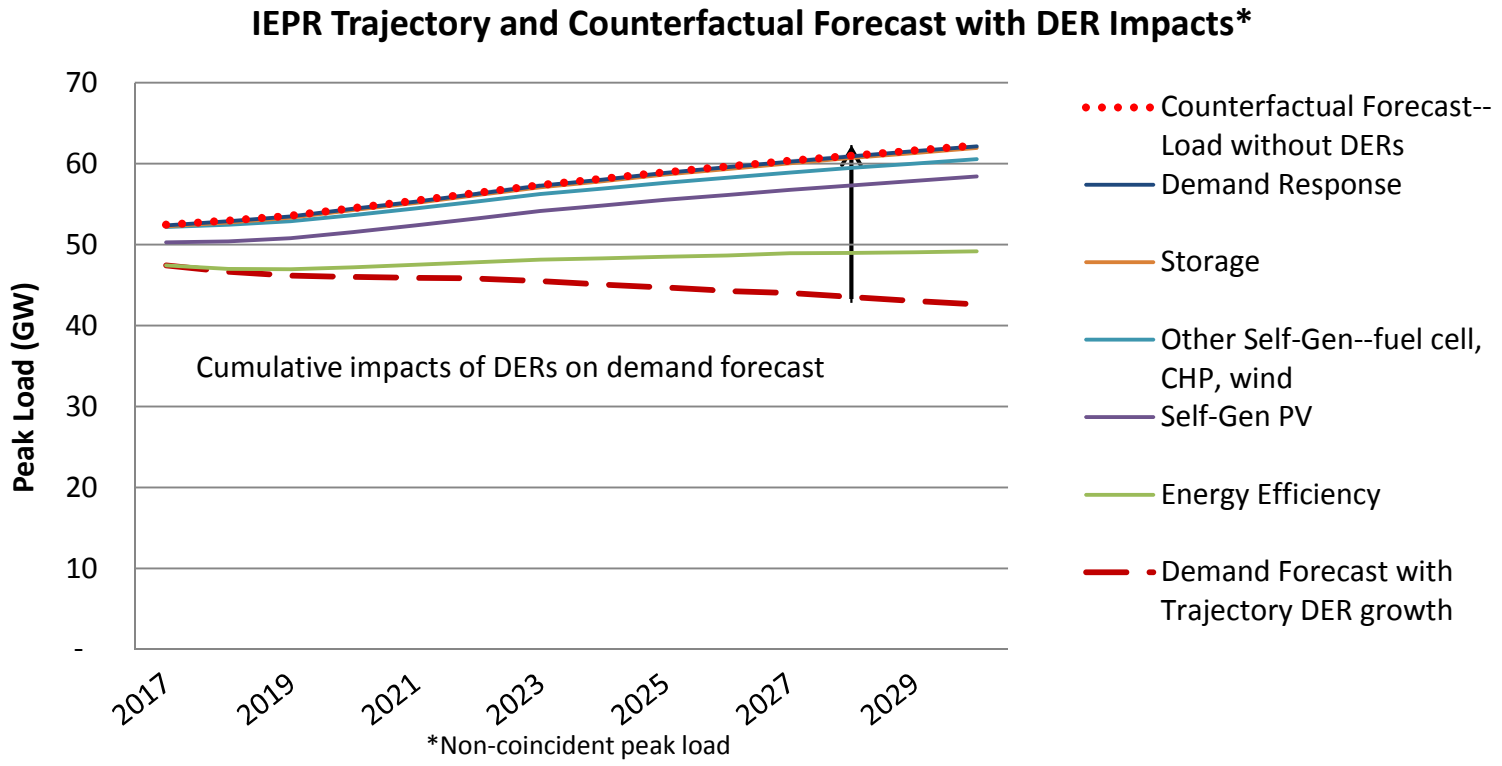
# DRP Analysis Based on Trajectory DER Growth

- Scale of potential distribution deferral impacts depend on whether there is decreasing or decline load growth
- Challenge: Distribution of high/medium/low value areas not well understood in a high EV/PV/DER future



# DRP Analysis Based on Trajectory DER Growth

- Existing DRP tools determine grid impacts based on current DER growth trajectory– IEPR forecast assumes continuing existing policies to support DERs
- IRP avoided Dx costs should be calculated in the absence of additional DER policy
  - IRP plans to remove DERs from the IEPR forecast and treat them as candidate resources
  - Only naturally occurring DER growth – growth that would occur in the absence of policy support – should be included for IRP



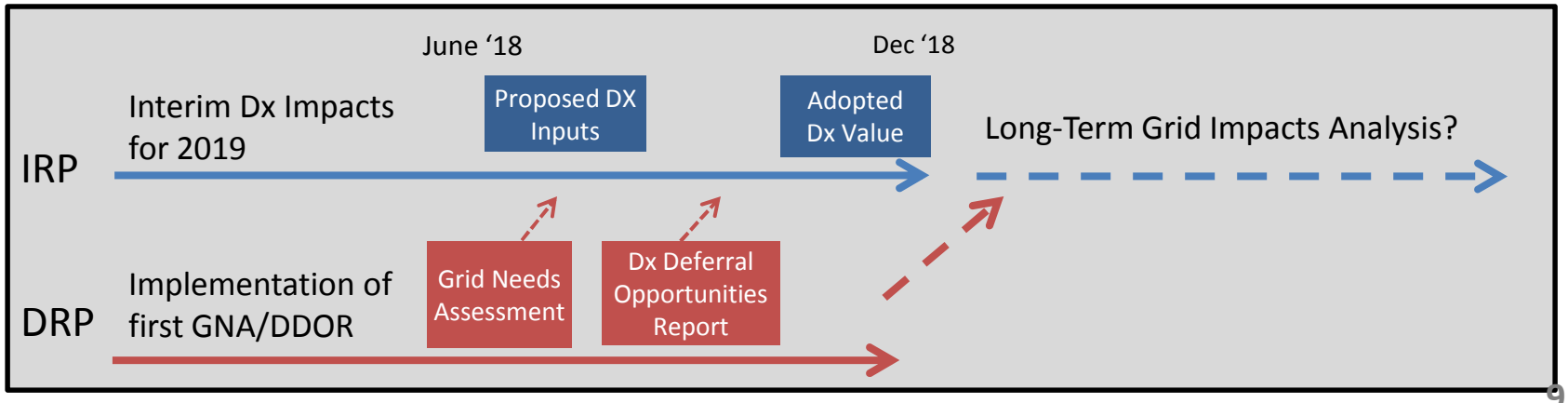



Forecast simplified for illustrative purposes. Actual counterfactual forecast must be adjusted for Codes and Standards and peak shift.

# Distribution Planning Tools Could be Used to Develop IRP Inputs

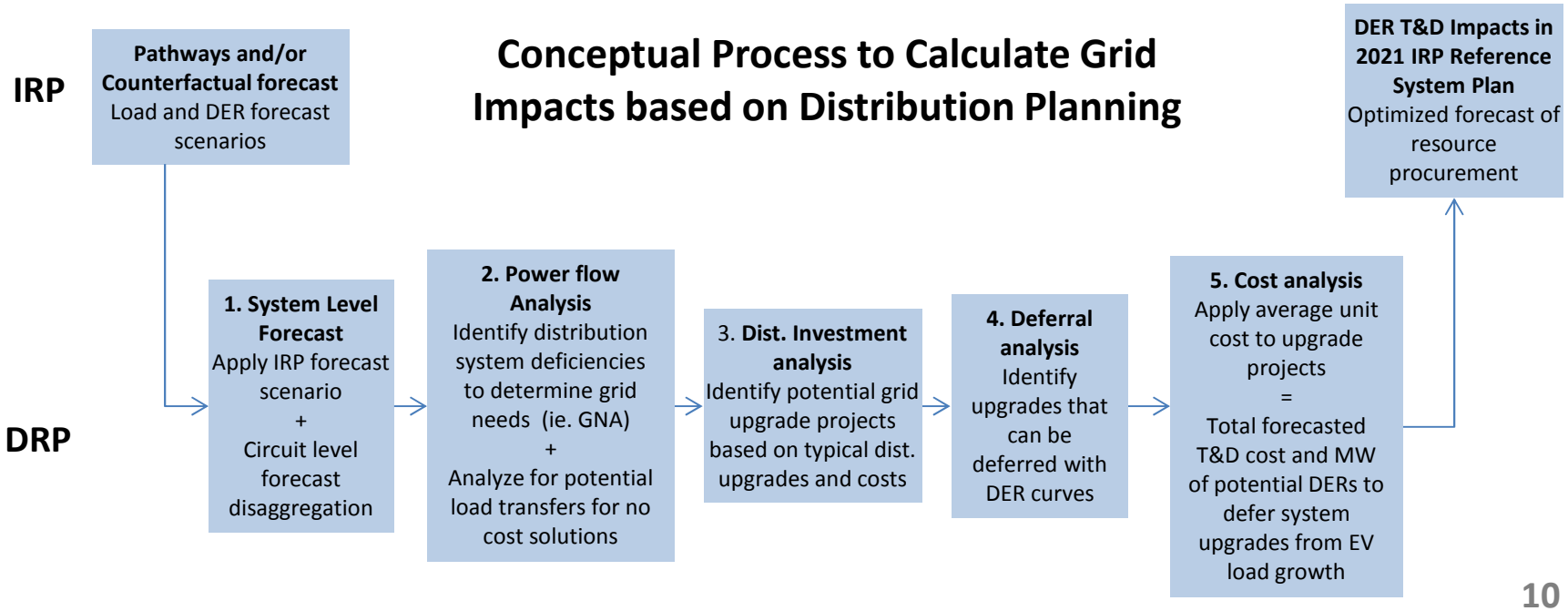
- Results from DRP planning tools could provide Dx inputs (mid 2018) for IRP (price and MW values) on an interim basis
- IRP schedule for 2019 RSP requires that Dx input methods be proposed by June 2018, with methods and values vetted and in place by end of 2018
  - Vetting via IRP MAG process and then IRP ruling requesting comments
- If 2019 RSP results highlight that avoided distribution costs materially affect the economically optimal amount of DERs, then changes to existing tools and methods may be needed to create a more granular successor to interim approach

**IRP Interim Approach for 2019 Reference Plan & Possible Future Analysis**



# Distribution Impacts Analysis: Long Term Plan

- The following flow chart describes the general steps to a comprehensive analysis of grid impacts, which reflects the IOUs' distribution planning process
- Actual distribution planning process requires a year to conduct
- If 2019 RSP highlights need for more detailed Dx Impacts Analysis, then Commission will need a simplified approach to calculate grid impacts for multiple IRP scenarios and to meet the IRP's timelines



# Questions?

Contact Dina Mackin in DRP at dina.mackin@cpuc.ca.gov

or Nathan Barcic in IRP at nathan.barcic@cpuc.ca.gov

# Modeling Avoided Distribution Costs in the RESOLVE Model

**CPUC Modeling Advisory Group Webinar**

**May 30, 2018**

Presenters: Jimmy Nelson and Brian Horii, Energy and Environmental Economics, Inc.

# BACKGROUND

# Distributed resources and IRP modeling

- IRP modeling focuses on the bulk system level in order to meet multiple planning goals simultaneously:
  - Evaluate a wide range of plausible future conditions
  - Consider a long planning horizon of 10-20 years
  - Represent hourly operational conditions and constraints, including ramping and curtailment
  - Evaluate multiple candidate resources
- It is important to include both the system-level and distribution-level costs and benefits of Distributed Energy Resources (DERs) in IRP modeling
  - Incorrect representation of DER costs and benefits could lead to a suboptimal mix of supply-side and demand-side resources

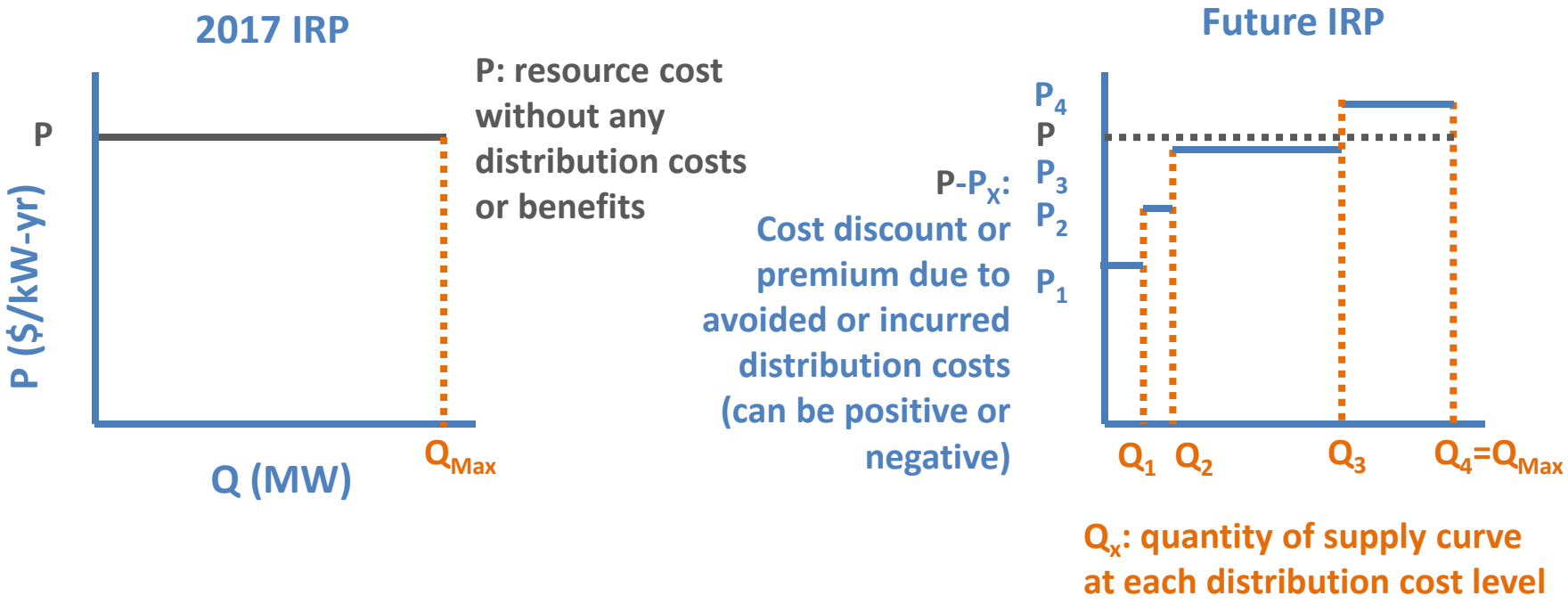
# Art of the possible in RESOLVE

- Capacity expansion models struggle with model complexity and runtime
  - Simplifications necessary to ensure acceptable model performance
- Proposed modification: add supply curve functionality in RESOLVE that ascribes DERs value based on the ability of each DER to defer distribution system upgrades
  - At a high level, DER deferral value subtracts from DER capital costs, reducing the net capital cost of the resource
  - Strategy is leave operational/dispatch representation of each resource unchanged – only investment costs are affected
  - Also possible to add distribution system integration costs if significant

# DER Supply Curves in IRP

2017 IRP did not consider distribution system costs and benefits

Capacity expansion modeling in future IRP cycles can include distribution system costs and benefits



# DER modeling in 2017 IRP

- Shed demand response
  - Existing shed programs were included in baseline
  - New shed was available for selection by RESOLVE
- Shift demand response
  - Not available for selection by RESOLVE in general
  - Made available for selection in Shift DR sensitivities
- Energy efficiency
  - Not selectable by RESOLVE, but sensitivities examined value of different levels of efficiency by varying load level
- Distributed PV
  - Selectable by RESOLVE, modeled similarity to utility-scale PV but with higher costs and a different production profile
- Storage
  - Modeled as a system resource – was not differentiated with respect to utility-scale vs. distributed
  - Some customer storage modeled as Shift DR in Shift DR sensitivities

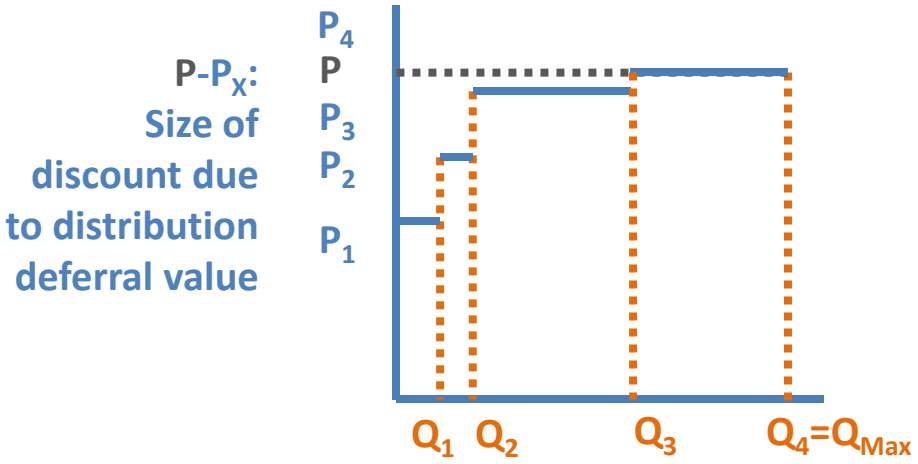
# MODELING DEFERRAL VALUE IN RESOLVE

# Deferral value considerations

- DERs should receive value based on their ability to avoid distribution capacity
- Avoided distribution value depends on:
  1. Projected evolution of distribution capacity needs (2018-2030+)
     - Needs are dependent on policy assumptions and baseline DER resources
  2. Timing of DER installation relative to upgrade needs
     - To receive value, DER must be installed *before* upgrade is triggered
  3. Coincidence of DER production and consumption (8760) with distribution system needs
  4. Other candidate DERs installed by RESOLVE
     - Competition for high value areas
  5. Ability of DER to effectively target high value areas
  6. In addition, some DERs may impose costs on the distribution system

# Quantifying deferral opportunities (1)

- Goal: Estimate value and variation of distribution avoided cost across entire CAISO system
  - Conceptually, goal is to estimate the fraction of distribution system infrastructure in need of capacity upgrades (Q), and the value of deferring upgrades (P)
- RESOLVE DERs will compete for areas with high deferral value



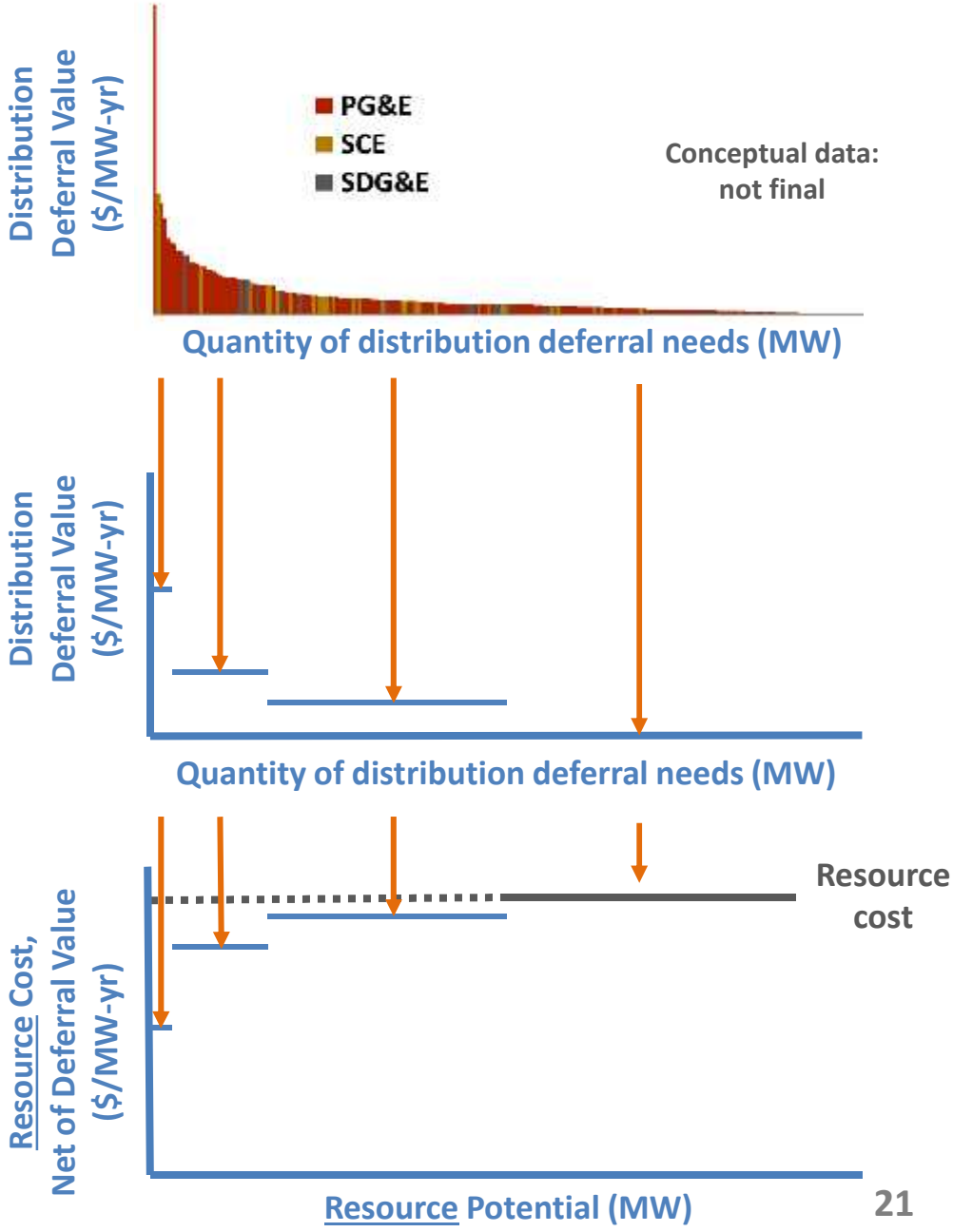

Note: Incurred distribution costs addressed in RESOLVE model section

# P-Q data flow (1)

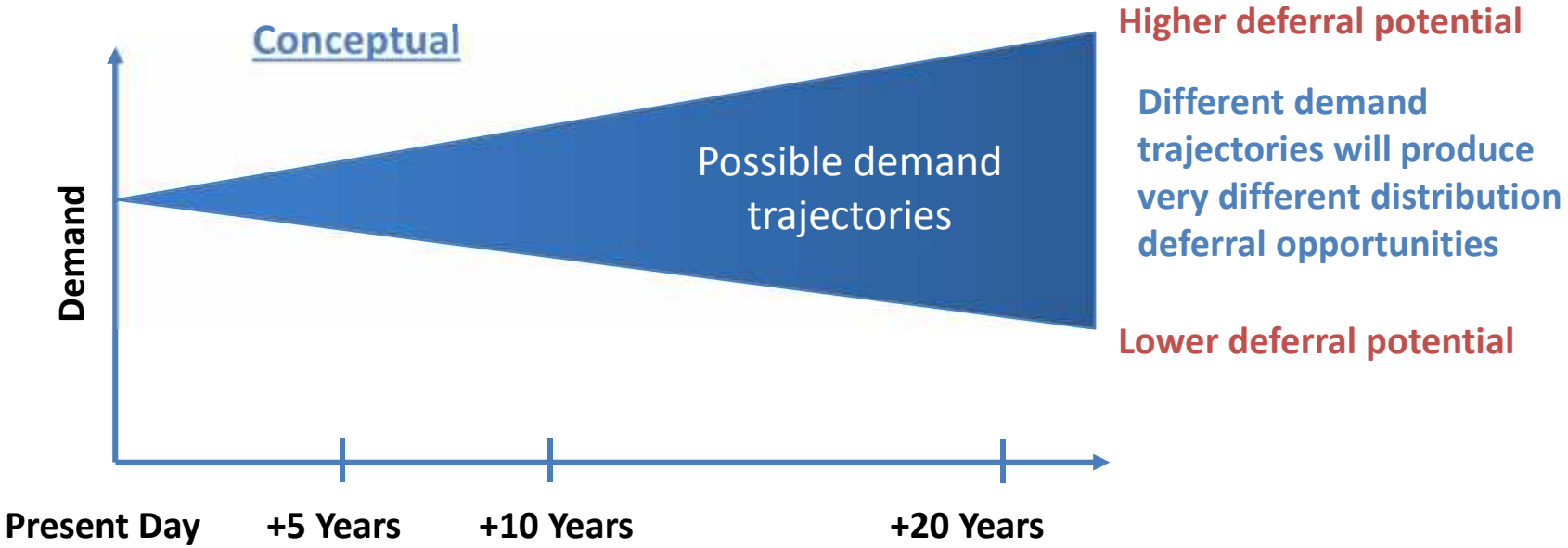
Distribution system data will be used to create detailed supply curve

Simplify detailed supply curve for RESOLVE

Relate deferral needs to resource capabilities (Consideration 3). Deferral value only captured if deferral need is not filled by other resources (Consideration 4)



# Data on deferral potential (1)




- P & Q values applied to RESOLVE candidate (selectable) DERs should be consistent with demand level and DERs included in baseline (forced in)
  - P & Q should evolve over time with baseline trajectory
- 2019-20 IRP will use intermediate approach to calculating P & Q, presented in subsequent MAG meeting

# Timing of deferral opportunity (2)

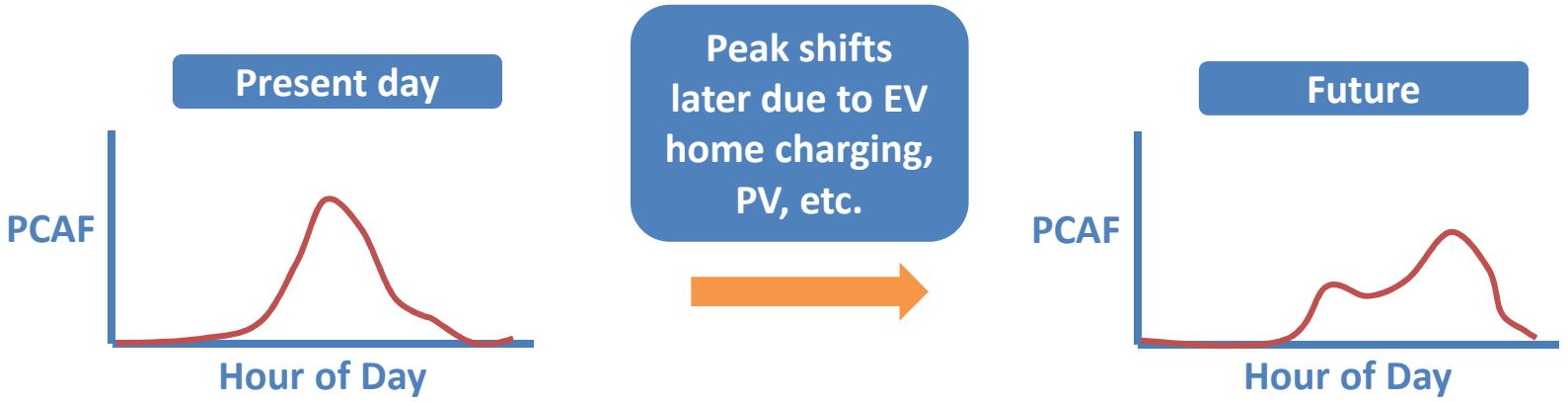
- Deferral value only available for DERs that are installed *before* distribution capacity upgrades are need
- In each RESOLVE investment period, specify the quantity (Q) of deferrals available in that period, and the counterfactual distribution system upgrade cost (P) that will be incurred if DERs do not defer the upgrade
- *Incremental* DER installations made in an investment period can contribute to deferral needs in that period
- Additional functionality could allow resources installed in one period to provide deferral credit in subsequent periods using resource capacity not allocated to deferral in the installation period
  - When installing DERs before a deferral need appears, it may not be possible to effectively target areas of future need

# Coincidence with deferral needs (3)

- A DER can defer distribution capacity upgrades to the extent that its production profile coincides with distribution system peaks
- Peak Capacity Allocation Factors (PCAFs) represent the timing of distribution deferral opportunities over a year
  - PCAFs are used in CEC building standards and CPUC Avoided Cost Calculator (ACC)
- PCAF 8760 profiles are differentiated by utility and/or climate zone
  - Depending on scope and timing, geographic differentiation may or may not be included in the 2019-20 IRP
    - RESOLVE DERs unlikely to be differentiated by location within CAISO in 2019-20 IRP

# Evolution of timing (3)

- The hours and months in which distribution deferral opportunities occur will evolve over time with changes in load and DER capacity
- PCAF 8760 shape can be re-shaped over time (2018-2030+) using growth assumptions for load and baseline DERs
  - EV load shapes, energy efficiency, baseline (forced in) BTM PV, baseline BTM storage, etc.
  - RESOLVE cannot update PCAFs endogenously – assumption is that PCAFs do not change significantly when RESOLVE invests in distributed resources



# PCAF example (3)

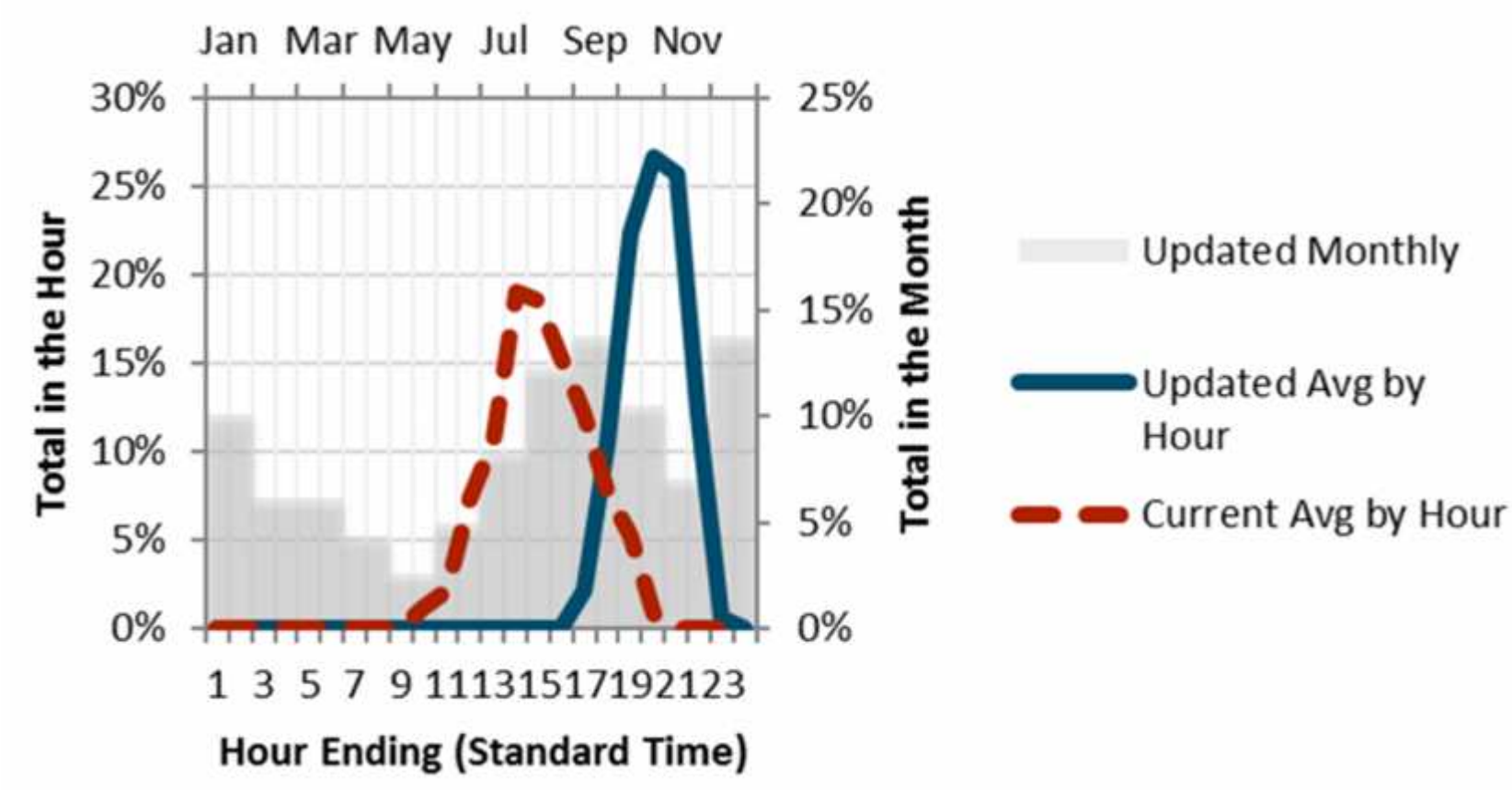



Figure from Avoided Costs 2017 Interim Update, Climate Zone 3 with 20.2% PV

# Calculating resource-PCAF coincidence (3)

- For each RESOLVE candidate DER, intersect PCAF shape with normalized resource profile
  - *Potential* RESOLVE candidate DER examples: BTM PV, BTM storage, demand response, residential lighting efficiency, commercial HVAC efficiency, etc.
    - Assume a dispatch shape for dispatchable DER resources like storage and demand response
    - Note: set of candidate DER resources in 2019-20 IRP has not been finalized and is subject to change
- Result is the PCAF overlap fraction, differentiated by:
    - RESOLVE candidate DER
    - Year / RESOLVE investment period (2018-2030+)
  - Represents overlap between timing of greatest needs and resource production profile
    - Relates MW of installed DER capacity to MW of avoided distribution capacity

# Competition for high deferral values (4)

- RESOLVE formulation for capturing deferral value would have one deferral supply curve in each investment period
- All DERs would compete for high value deferral areas
  - Goal is to avoid double counting of deferral opportunities
- Similar to supply-side renewable resource competition for CREZ transmission capacity

# If targeted deferral is not available (5)

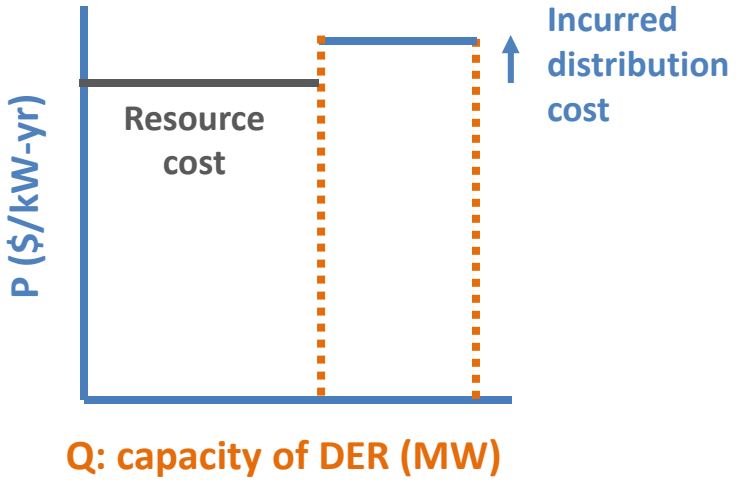
- Modeling avoided distribution costs as a supply curve *assumes* that overloaded distribution infrastructure can be effectively targeted by DERs.
  - Any resource for which this is not true should receive a system-average avoided cost
- In RESOLVE, this could be accomplished by an additional constraint.
  - For any DER that can't be effectively targeted, force RESOLVE to locate capacity in each Q bin *in proportion to bin size.*

# Limits to targeting high value areas (5)

- Limitations may exist to targeting DER installations to specific areas
  - Example: Only a fraction of BTM PV potential overlaps with high value deferral areas
- Constraints could be added to RESOLVE that reflect the ability of specific DERs to avoid distribution capacity in specific Q bins

# DER integration costs (6)

- Some DERs may impose costs on the distribution system at high penetrations
- Integration costs tend to be resource-specific
  - Example: BTM PV voltage issues




- To represent a DER that incurs distribution costs above a certain penetration, split resource into two.
  - One resource has zero incremental capital cost
  - One resource has adder to capital cost representing the cost to integrate the DER on a $/kW-yr basis
    - Data needed on threshold capacity and incurred cost
  - Both resources would still contribute capacity to system-wide avoided cost bins, so each could still avoid some distribution capacity upgrades

# Next Steps

- Informal Review of Distribution Impacts in 2019
  - Options for the development of interim inputs for Dx impacts for 2019 IRP will be presented in the June 2018 MAG meeting
- Formal schedule for development of Interim Approach for 2019 IRP
  - Release of 2019-2020 IRP Assumptions via Ruling (anticipated in Q3 2018)
  - Formal party comment
- Distribution Impacts Analysis for 2020 or 2021
  - If more detailed analysis is determined to be necessary, additional methodology development and vetting may be available in time to inform the 2020 preferred system portfolios