T&D Value of Solar + Storage

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T&D Value of Solar + Storage

- The potential value of DER (incl. solar and storage) can be considered within four main categories:
  - Wholesale energy, capacity and ancillary services
    - Wholesale value derived from DERs includes components such as avoided generation ancillary services, and flexible capacity
  - **Transmission system**
    - Non-transmission alternatives (NTA), such as FERC 1000 requirement
  - **Distribution system**
    - Non-wires alternatives (NWA), such as deferred/avoided distribution capital, improved voltage management, improved reliability and resilience.
  - External (e.g., customer and societal).
    - Societal value derived from DERs include reduced emissions and customer value includes bill savings and improved resilience.
- **The focus of this presentation is on potential specified T&D Value considerations**

T&D Specified Value

T&D Specified value is based on deferring or avoiding specific T&D grid upgrades identified in a long-term planning process (e.g., 3-10 year horizon plan). The value is related to the specific avoided cost of the physical grid investment alternative that would otherwise be built to address the need.

*A **DER non-wires alternative (NWA)** is a non-traditional transmission and distribution (T&D) solutions, such as distributed generation (DG), energy storage, energy efficiency (EE), demand response (DR), and grid software and controls, to defer or avoid the need for conventional transmission and/or distribution infrastructure investments.* *Adapted from: Hawaii DPWG adapted from Navigant, DOE and SEPA definitions*

T&D Value (Specified or Unspecified) opportunities require alignment of utility engineering and economic needs and DER service capabilities and related price

T&D Value

5 Potential T&D Value categories identified by California PUC and other state commissions:

- Transmission Investment Expenditure Avoidance
- Distribution Investment Expenditure Avoidance
- Distribution Reliability Expenditure Avoidance
- Distribution Voltage Management Expenditure Avoidance
- T&D Grid Resilience Expenditure Avoidance

The potential value is the net savings that may be achieved from using DER services instead of building the T&D project. A viable DER solution should be priced equal to, or less than the cost of the grid project to provide benefit for all customers.

Key T&D Value Realization Considerations

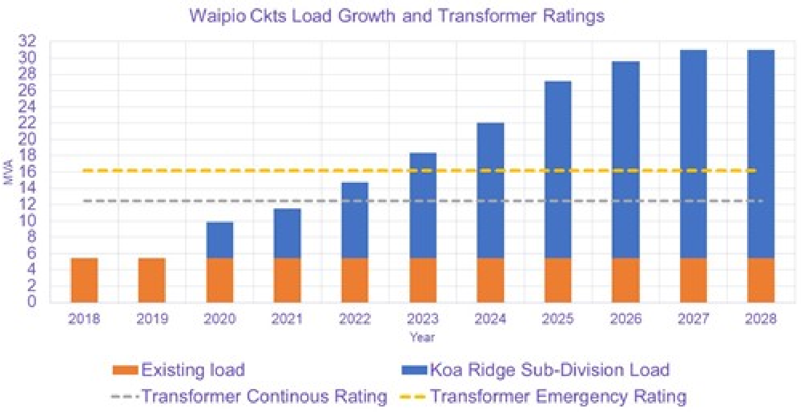
- Dependability of DER service is critical
  - Majority of potential typically involves deferring/ avoiding physical infrastructure investment – there is no alternative, aside from load shedding, if the DER doesn't perform
- Locational requirements
  - T&D value is based on specific needs identified through engineering analyses in planning
  - Needs are very specific to particular transmission line segments or distribution circuits/subsection of a circuit
- Irregular temporal requirements
  - T&D needs typically involve variations in time durations for a day, the days of the week, seasons in a year and yearly given changes in loading patterns

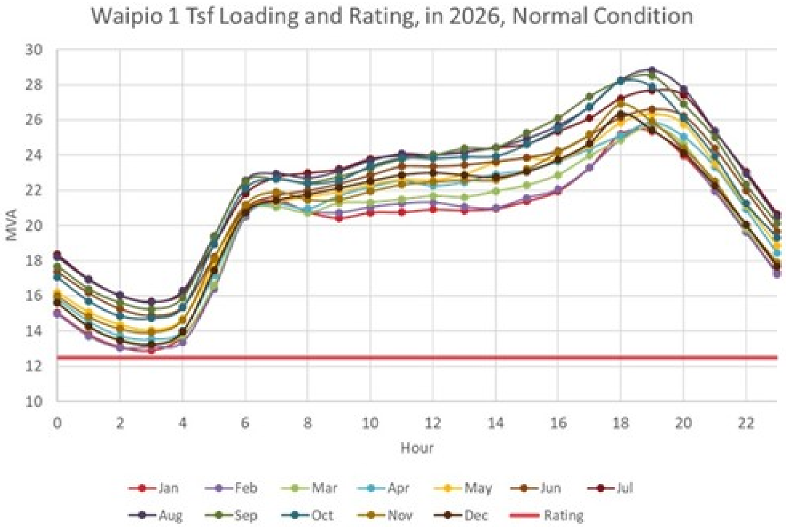
T&D Capital Deferral Value

- Use of DER to reduce localized flow of electricity to within normal operating limits on a specific transmission line or distribution feeder to defer or avoid a physical upgrade
- Primary T&D value being successfully pursued in North America
- Can be accomplished by reducing customer loads at the meter (e.g., EE, Demand Response or Self Generation)
- Can also be accomplished on distribution through reverse electricity flow from distributed generation or batteries

Distribution Capital Deferral Example

Koa Ridge Development includes 3,500 new homes, medical center, commercial and light industrial, parks and schools. The developer's estimated ultimate load is 43 MW with an initial load of 450 kVA (residential) in 2020. Additional distribution capacity needed by 2022/2023 to address new development growth. This load growth will result in an overload of substation transformers under normal. An example representing the transformer that will see the largest overload under normal conditions is shown



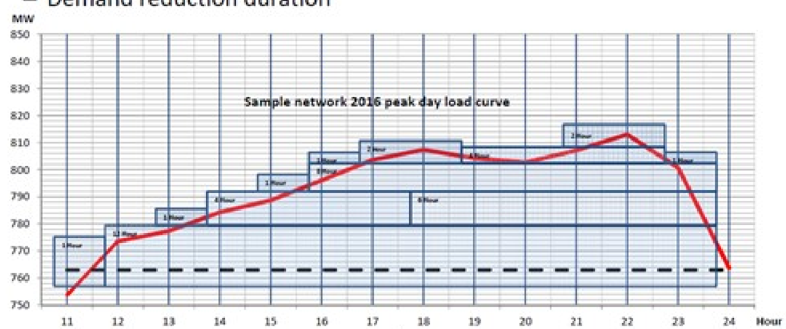


DER Solution Portfolio Approach is Often Needed

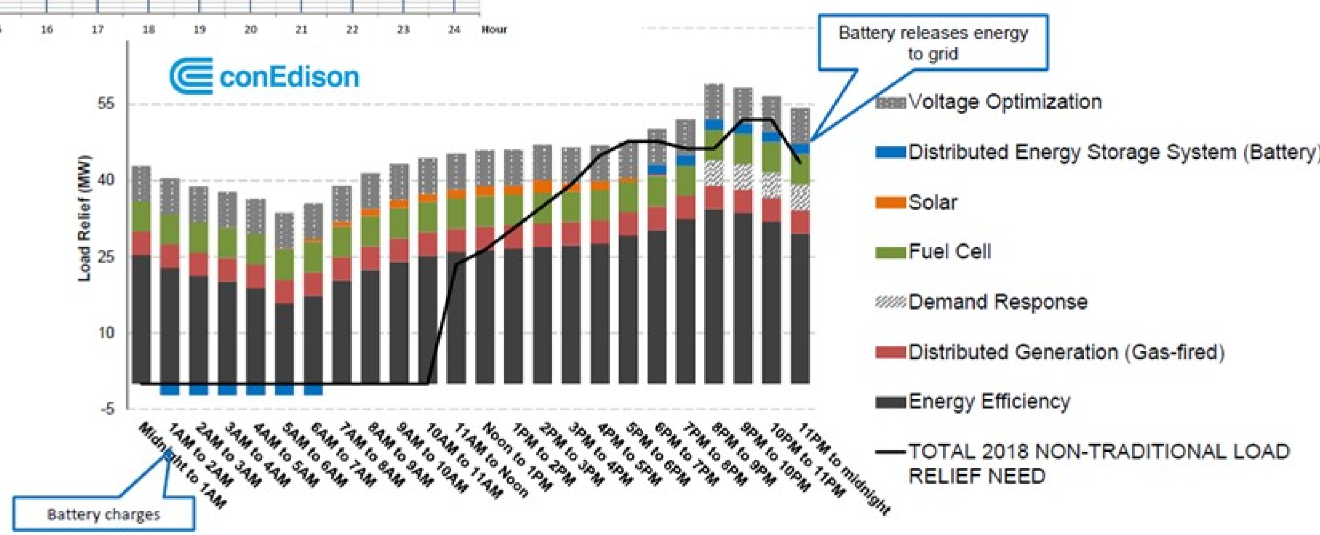
ConEdison example that combines multiple types of DER solutions and sourcing options

Demand-Side Resource Portfolio

- Effective MW of resources calculated based on:
  - Technology, customer, and load curve characteristics
  - Demand reduction duration



Brooklyn Queens Demand Management (BQDM) project has a goal to avoid a unique T&D Capital investment



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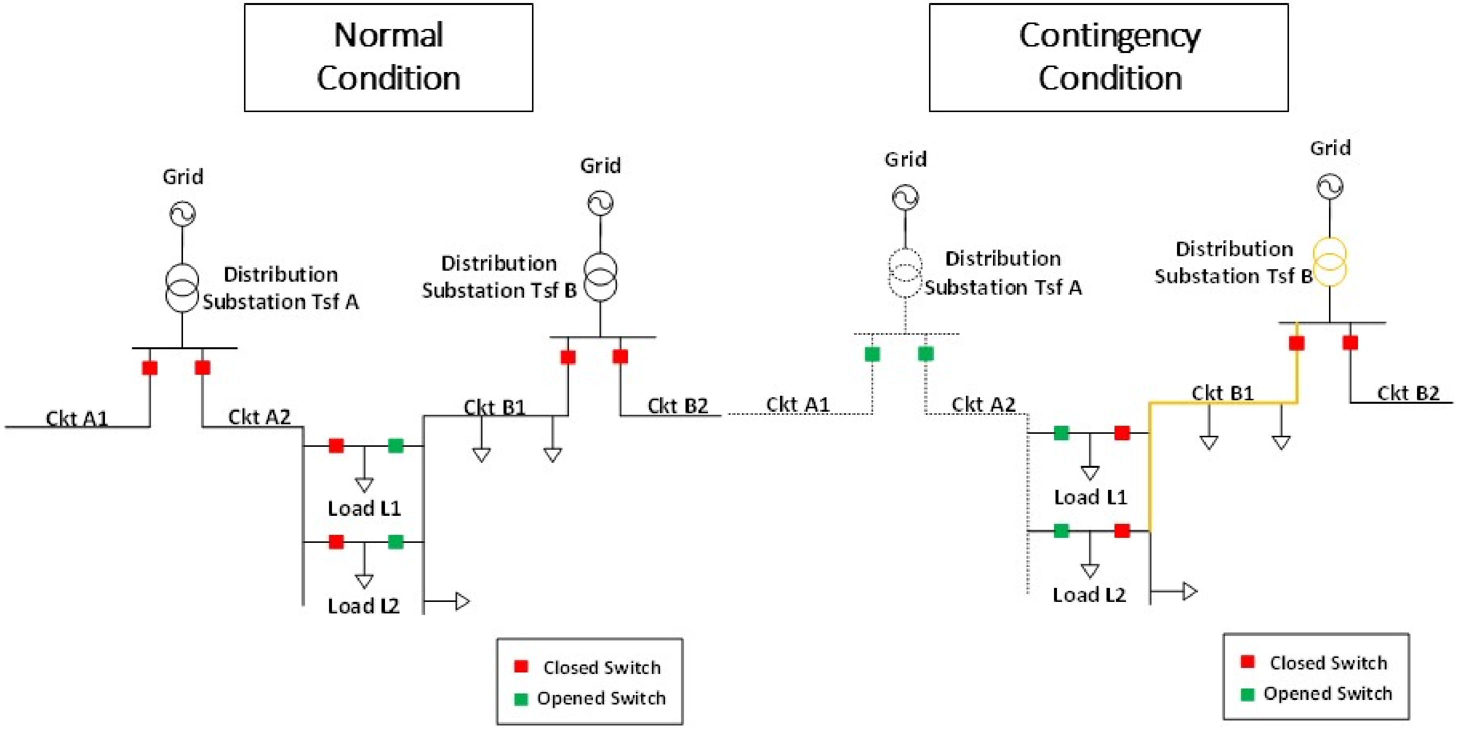
Distribution Reliability Value

- Use of DER to reduce a local overload that may occur during an emergency due to an outage on an adjacent circuit or other abnormal condition
- Similar to T&D Capital Deferral, except that the objective is to reduce the overload to within acceptable emergency ratings for transformers and wires
- Given that the system will already exceed emergency ratings when the DER is needed – this involves very stringent performance requirements
- Not yet widely pursued, Hawaiian Electric has the first procurement underway

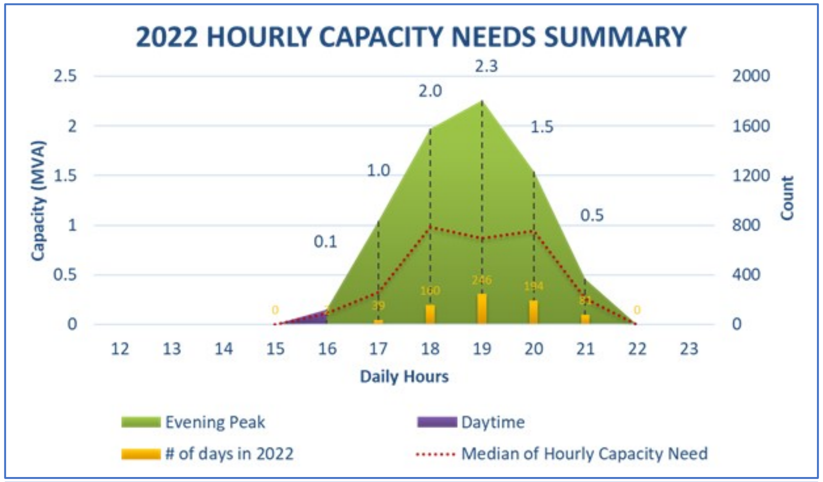
Distribution Reliability Value

Value is based on when a distribution system is reconfigured to minimize an outage

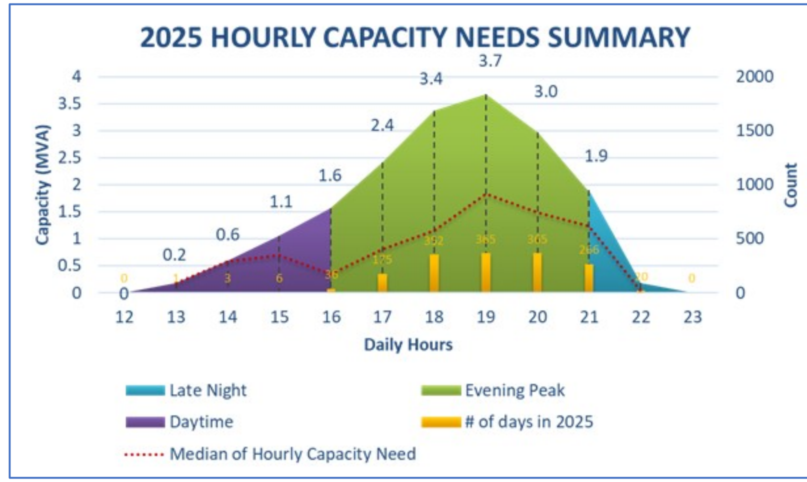


Distribution Reliability Example

Contingency overload changes over time with underlying load growth



Zone	Capacity (MVA)	Energy (MWH)	Delivery Months	Delivery Hours	# of days per year
Daytime	0.1	0.1	Oct.	3PM - 4PM	2
Evening Peak	2.3	7.3	Apr. - Dec.	4PM - 10PM	246



Zone	Capacity (MVA)	Energy (MWH)	Delivery Months	Delivery Hours	# of days per year
Daytime	1.6	3.7	Jul. - Dec.	13PM - 4PM	36
Evening Peak	3.7	14.3	Jan. - Dec.	4PM - 9PM	365
Late Night	0.2	0.2	Sep.	9PM-10PM	20

Distribution Volt-var Value

- Distribution Volt-var involves potentially 2 values:
  - Voltage quality for customers, particularly for customers' electronic/computer based equipment
  - Potential line loss reduction through managing voltage
- Distribution Volt-var value may involve different locations on a distribution circuit
  - Substation level
  - Primary Feeder level
  - Secondary Feeder level
- Key factors driving need
  - High adoption of rooftop solar without smart inverter capabilities enabled can cause non-compliant secondary voltage fluctuations
  - Longer distribution circuits (>5 miles) have inherent voltage management and line loss challenges toward the end of the circuit as the wire sizes get smaller (shorter distribution circuits typically do not)

Grid Resiliency

- Value that DER, particularly in a microgrid configuration, may provide to all customers by providing electric power during local and/or system outages that may involve critical facilities and essential services
- Microgrid Services Tariffs/regulation is emerging in Puerto Rico, District of Columbia, Illinois, Hawaii and California
- Regulation and tariffs focused on roles and responsibilities, operational coordination and process issues, not value determination (specified or unspecified)
- Value is focused on societal benefits, but very situational – no jurisdiction has placed a specific value as yet

T&D NWA Services

Service	Description	Performance Requirements	Locational	System-wide	In-use Nationally
Transmission Capacity Deferral	Load-modifying or supply services that DER provide via dispatch of output (MW) or reduction in load that is capable of reliably and consistently reduce loading on identified transmission infrastructure.*	High Service Level Requirements	✓		Yes
Distribution Capacity Deferral	Load-modifying or supply services that DER provide via dispatch of output (MW) or reduction in load that is capable of reliably and consistently reduce loading on identified distribution infrastructure.*	High Service Level Requirements	✓		Yes
Distribution Reliability	A supply and/or load modifying service capable of improving local distribution reliability under abnormal conditions. Specifically, this service reduces contingent loading of grid infrastructure to enable operational flexibility to safely and reliably reconfigure the distribution system to restore customers.**	High Service Level Requirements	✓		Yes (Current HI RFP)
Distribution Voltage-var Support	Incremental steady-state and dynamic voltage management services beyond interconnection requirements to avoid incremental related grid investment.*	High Service Level Requirements	✓		No
Resiliency	Load-modifying and/or supply based services, including microgrids, capable of improving system or local resiliency to the benefit of all customers.*	High Service Level Requirements	✓	✓	No

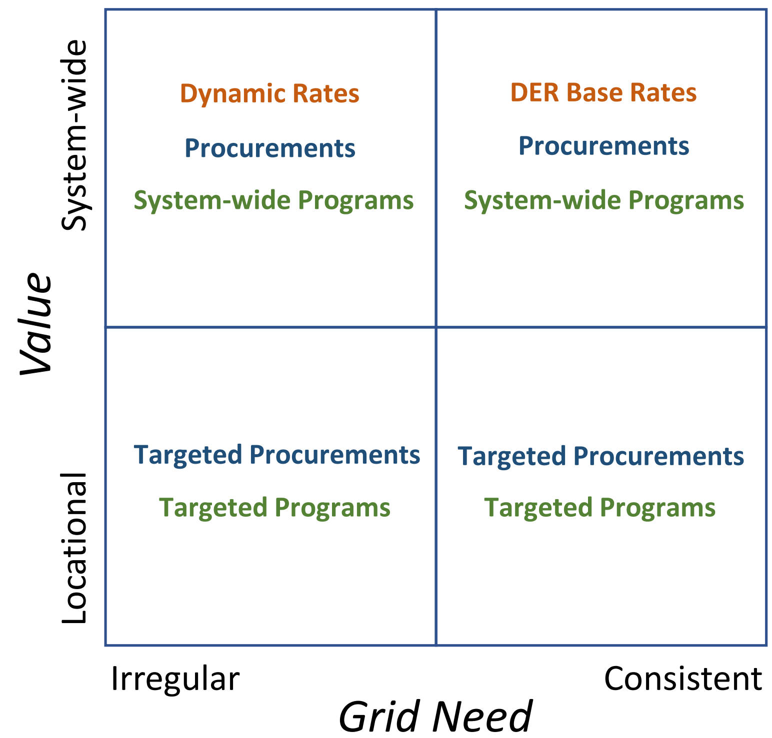
* Adapted from CPUC defined NWA services
** Hawaii NWA service definition

T&D Value Realization Options

Targeted programs appear most effective at realizing T&D value of DER to-date

3 Options to Realize Potential T&D Value of DER:

- Procurements
  - Procurements have involved consistent system needs for energy services or ancillary services for irregular system needs
  - Procurements used for T&D locational NWA services, but often with limitations
- Programs
  - For example, Legacy EE programs used to address consistent system needs & Legacy DR programs to address irregular system needs
  - Targeted DSM programs have been used to address both consistent and irregular locational needs
- Pricing (Alternative Rate Designs)
  - Rate designs typically used to address system-wide benefits
  - DER Base rates (e.g., TOU) used to address consistent system needs
  - Dynamic rates (e.g., CPP, RTP) used to address irregular system needs



State of T&D Non-wires Alternatives

- Regulatory Requirements:
  - Transmission NTAs are explicitly required in FERC jurisdictional transmission planning processes since 2013 (FERC 1000). Non-FERC jurisdictional areas, such as Hawaii, include as well.
  - Distribution NWAs are required in about 10 regulatory jurisdictions. Number is growing with the 20+ states actively implementing integrated distribution planning.
- NTA/NWA Sourcing Experience:
  - Procurements and targeted programs are growing but experience is limited.[1,2]
  - NTA/NWA pricing options are largely untested.
    - Related alternative rate designs are under consideration in CA, HI, NY and a few other states. HI has the most experience with post-NEM tariffs - (https://www.hawaiianelectric.com/documents/clean_energy_hawaii/grid_modernization/dkt_2018_0141_20190925_cos_ARDS.pdf)

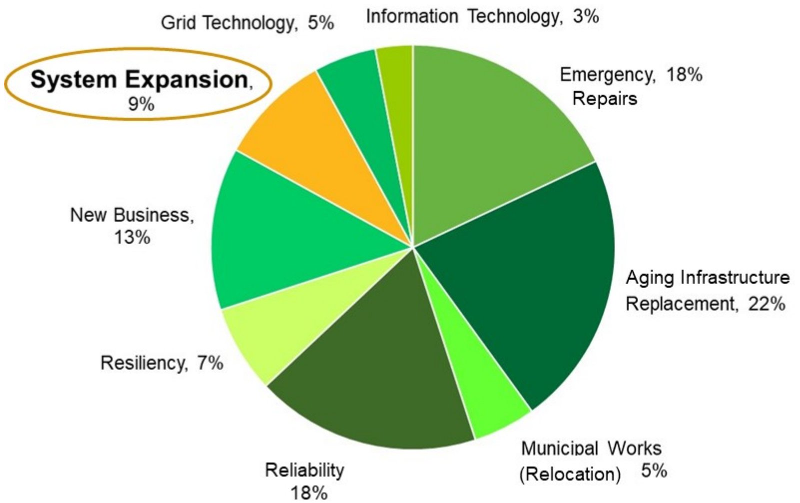
[1] The Non-Wires Solutions Implementation Playbook, Rocky Mountain Institute, 2018

[2] SEPA, PLMA and E4The Future, Non-Wires Alternatives: Case Studies From Leading U.S. Projects, November 2018

Initial NWA Lessons Learned

*To-date NWAs nationally have primarily focused on **System Expansion** projects driven by load growth and/or increasing hosting capacity*

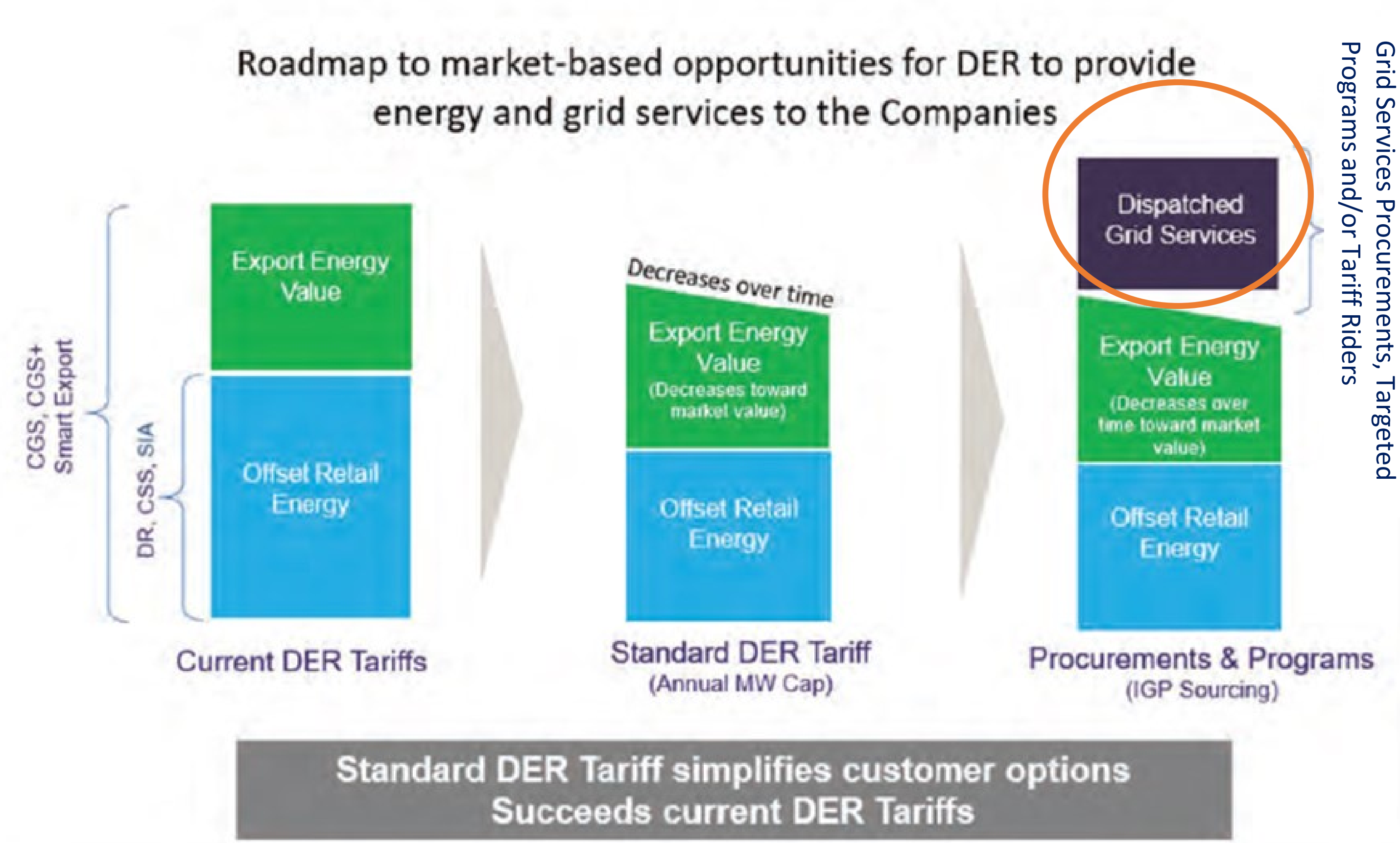
- NWA opportunities are specific to a need identified through a longer-term (3-10 yr) T&D planning process.
- Needs are locational in nature and have stringent performance requirements necessary to defer the “wires” alternative.
- NWA opportunities require alignment of utility needs and DER service capabilities, costs and financing considerations to be successful
- Lessons from initial NWAs across the US are that not all T&D projects are suited for cost-effective DER deferral.



Typical Utility Distribution Capital Budget

Alternative DER Rate Design

Hawaiian Electric example using base rate to address system value and programs/procurements to address locational value



Source: Hawaiian Electric

T&D Value Potential

Customer-centric approach is essential to ensure all customers tangibly benefit

- What are the desired outcomes?
  - Optimize utility T&D expenditures?
  - Enable greater value for customer/developer DER investments?
  - Enable greater adoption of DER to meet renewable/customer choice goals?
- What are specified and unspecified T&D values?
  - What values can be definitively identified and measured in practice?
  - Is unspecified T&D value the counterfactual to specified value?
  - How would this be evaluated in practice as part of a planning process and rate design to achieve acceptable results?
- What are the range of potential solutions?
  - Procurements, Programs & Pricing (3P's)
- What is the role of customers, DER developers, utility, aggregators and other stakeholders?

Thank you

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Paul De Martini is a leading expert on the business, policy and technology dimensions of a more distributed power system. His extensive writings and consulting work have influenced industry transformation efforts in Australia, Canada, and across the US. Paul provides advisory support to utilities, US DOE and state regulatory commissions on issues involving integrated system planning, distributed markets and grid investment planning and evaluation.

Paul was previously the Chief Technology & Strategy Officer, Energy Internet of Things at Cisco Systems and Vice President, Advanced Technology at Southern California Edison. Paul earlier led North American market development for two of the largest competitive integrated energy services firms.

Currently, he is a visiting scholar at Caltech and adjunct professor at the University of San Francisco. Paul was the 2016 Cazier Practitioner-in-Residence at the Pardee RAND Graduate School and a Fellow at Wharton, University of Pennsylvania. He holds an MBA from the University of Southern California, BS, Applied Economics from the University of San Francisco, and Certificate in Technology Management from Caltech.