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Setting a New Course: Strategies to Overcoming Barriers to Energy Efficiency and Demand Response Integration into California's DER Markets

A Council White Paper on the Road Ahead

February 4, 2021

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Section 1: Executive Summary

The purpose of this California Efficiency + Demand Management Council (The Council or CEDMC) White Paper is to raise key issues and facilitate discussion among California energy industry stakeholders on the need for rapid and urgent action to move forward to identify and assess the barriers that stand in the way of California meeting its Climate Change (SB 350, etc.) and Renewable Grid goals (SB 100, etc.). In particular, the White Paper addresses areas of current industry structure and benefit-cost approaches that The Council believes can be successfully addressed through collaborative stakeholder efforts to remove barriers and facilitate broad-scale integration and deployment of behind-the-meter resources – including fully integrated EE and DR -- to put the state on a path toward a meeting our Clean Energy goals.

California, along with the rest of the county's energy industry, is in the midst of a major transformation in utility and other Program Administrator's (PA) business models that impacts many of the traditional ways our industry has acquired and delivered energy services in the past. These changes are broad and affect the industry at every level of service provision, including impacting customer roles and relationships, engagement approaches, and related modes of energy delivery and services. The transition is driven by the need to take rapid action to address climate change and related technological innovations and advancements. In California, the passage of legislation that identifies key timeframes for meeting both GHG emissions reduction and renewable energy grid goals (e.g., SB 350, SB 100) provides both an urgency to address these energy mandates and a framework-for-action that requires industry participants to work together to create innovative solutions to meeting and supporting state goals.

In this regard, the White Paper addresses key barriers and issues related to a proposed approach that California may take to clearly delineate the role integrated energy efficiency and demand response should play in the broader landscape of wide scale DER deployment. The paper is structured to provide a context and background for the energy industry transformation taking place in California and associated technological and policy drivers, and then proposes a potential solution to the questions being considered by the California Public Utilities

Commission (CPUC) in determining how best to move forward with the Energy Efficiency (EE) Potential and Goals (P&G) Study approaches and issues raised in the *CPUC Staff Proposal for Incorporating EE into the SB 350 Integrated Resource Planning Process.*[1] Specifically, the paper addresses issues related to the CPUC Guidehouse P&G team's recent past focus on how best to integrate P&G economic and methodological study approaches used in previous year P&G studies, into integrated resource planning (IRP) approaches that evaluate energy efficiency along with other resources on a theoretical levelized economic analysis basis.[2] The White Paper posits an approach to the dilemma that EE may not fare as well in IRP economic analyses approaches as it does in P&G study traditional cost-effectiveness approaches; and related concern that overall EE's traditional role may be diminished in a IRP full-resource grid focused assessment.[3] The White Paper proposes a win-win solution that has the potential to enliven the traditional EE "load-modifying" portfolio and role towards meeting SB 350 doubling of EE goals, while at the same time moving forward in identifying flexible demand "EE supply resources" that have the ability to support grid temporal and locational needs. Finally, the White Paper begins a process of identifying key barriers to EE, DR, and Behind-the-Meter (BTM) DER portfolio harmonization with grid planning and processes and identifies high-level strategies and solutions to positively address and overcome the barriers identified.

[1] We reference some of the discussion and comments from presenters in the recent (November 24, 2020) Joint Agency *Capacity Valuation for BTM Hybrid Resources Workshop.*

[2] Past proposals by Commission staff to work to create a ***Common Resource Valuation Methodology (CVRM)***, first proposed in 2017 and mentions in several workshops since that time, have not yet been acted upon. Hence, issues related to Council's and other party's comments on the current Commission EE cost-benefit analysis approach on the P&G study methodology that challenge the use of current cost-benefit assessment approaches are relevant here.

[3] See a discussion of this issue in Chapter III of the CPUC Staff EE-IRP White Paper (filed by CPUC under 2021 Potential and Goals): https://www.cpuc.ca.gov/General.aspx?id=6442464362

Section 2: Integration of EE, DR, and DER into California Energy Planning Processes and Proceedings

The Context

The California Efficiency and Demand Management Council (CEDMC or "Council") through this White Paper is pleased to propose what it believes are effective approaches to overcoming barriers to integration of energy efficiency (EE) and demand response (DR) into California's overall distributed energy resource (DER) markets. Our goal is to facilitate industry stakeholder dialogue, collaboration, and agreement on ways to rapidly move forward to meet the state's Clean Energy goals. We offer these thoughts –and at the same time begin a listing of barriers and potential opportunities to overcome these barriers to the effective and efficient integration of all DER resources into the state's power supply system– with the understanding that the energy industry in the United States and in California is undergoing a significant and important transformation. A transformation that is requiring serious re-examination of old (and very effective in the past) ways of thinking and related industry processes and procedures developed to support those approaches.

In particular, over the past forty-years or more,[4] California has been a leader in strategic planning, program design, and implementation of a very broad and successful EE resource portfolio. As a leader, California has set the model for low per-capita energy use[5] and has over the years consistently been at the top of all US states in this prestigious metric. Equally, the state's two energy agencies – the California Public Utilities Commission (CPUC) and California Energy Commission (CEC) – have led innovative processes to assess energy efficiency, demand response, and other resources, set or facilitated efficiency goals for the investor owned utilities (IOUs), Publicly Owned Utilities (POUs) and other program administrators, and again provided national models in creation of the first Database of Energy Efficiency Resources (DEER) database, the California Standard Practice Manual (CSPM), the California Solar Initiative (CSI) market transformation effort, the California Evaluation Framework for EE, and many other leading-edge analytic and day-to-day useful processes required to manage and grow the state's EE and DR demand-side-management (DSM) resources.

While California's record in this area is laudable, in this time of transition many of the existing analytic tools and approaches to meeting the state's growing energy needs are coming under review as a means to help guide California's future energy direction. Indeed, many of the state's lead energy organizations are actively engaged in reviewing, for example, past approaches to EE potentials and goals (P&G) studies (CPUC); approaches to demand response inclusion in wholesale markets run by the California Independent System Operator (CAISO), as well as DR's role in supporting emergency grid needs through CPUC authorized IOU DR program offerings. Resource Adequacy (RA) and Integrated Resource Planning (IRP) are also front and center, being examined for ways to streamline California planning process to meet its current and future resource needs and goals.

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[4] California efficiency efforts trace back to the early 1970s during the time Ronald Reagan was Governor.

[5] The term "Rosenfeld effect" was coined to explain why California's per capita electricity usage has remained flat since the mid-1970s while U.S. usage has climbed steadily and is now 50 percent higher than it was 40 years ago.

Driven by key factors such as: a) lower-cost solar energy production and combined solar-storage advantages -- priced below market costs for traditional non-renewable resource; b) advances in data analytics, day-to-day market analysis, and use of customer advanced meter infrastructure (AMI) data for program and market design; c) related technological improvements to product and system communications, integrated platforms for energy management, and advanced processes for auto-demand response; and d) the advent of in-front of the meter (IFM) and Behind-the-Meter (BTM) Program Administrator (PA) and customer DER systems, California has embraced the energy industry transition.

Technological changes enable transformation, but it is California's legislative policy that has led the way in charting a path ahead towards a clean and safe energy future for the residents of the state. Key legislation such as AB 32,[6] SB 350,[7] SB 100,[8] and related support legislation (SB 1477), establish the legislative mandate that drives California state agencies to move the state in environmentally safe directions.

In particular, and especially as related to the smooth integration of EE and DR with DERs and the need to harmonize with the power grid, both the SB 350 and SB 100 mandates are key forces in driving energy and related agency review of California energy approaches and procedures. Indeed, these two pieces of legislation, with targets for doubling the state's energy efficiency capture by 2030 (SB 350) and requiring renewable energy and zero-carbon resources supply 100 percent of electric retail sales by 2045 i.e., decarbonizing the grid, (SB 100) provide the oft-challenging backdrop for understanding best approaches to moving forward with EE, DR and related DER technology harmonious integration in today's power markets.

Moving EE into the DER Grid-Mod Energy Supply World

The importance of SB 350 and SB 100 cannot be overstated. Energy efficiency "lives'' in both worlds, but traditional energy efficiency portfolios, designed for the most part as a load modifying resource to capture core energy and some capacity benefits, needs now to expand its focus and move into the world of supplying grid time and locational grid needs. That is to say that while energy efficiency will always have the benefit of meeting GHG reduction requirements per SB 350, it will continually face difficult challenges of relevance in meeting the requirements of SB 100 as a grid-dispatchable resource unless reframed in a comprehensive way that allows for the EE resource to become a "grid flexible" resource.[9]

In The Council's May 22, 2020 comments on the Commission's ALJ Ruling Inviting Responses to Potential and Goals Policy Questions, along with other commenters' perspectives, CEDMC presented a four-pillar schema for

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[6] Passed in 2006, AB32 was the first comprehensive law in the country to address climate change.

[7] SB 350 also requires the state to double statewide energy efficiency savings in electricity and natural gas end uses by 2030.

[8] Senate Bill (SB)100 established a landmark policy requiring renewable energy and zero-carbon resources to supply 100 percent of electric retail sales to end-use customers by 2045; and advances SB 350's 50% mandate for clean renewable energy from 2030 to 2026.

[9] See below for further discussion of the "flexible demand" concept. We note that Arizona Public Service (APS) has and is taking significant steps towards adapting its EE portfolio towards becoming a grid resource using "flexible demand." See the November 3, 2020 APS AESP-CA DER Webinar Series Presentation: "Reimagining the Relationship Between a Utility and DERs: Planning for Scale While Bridging the Gap Between DSM and Grid Operations." *https://www.aesp.org/page/AESPCalifornia*.

how The Council believes energy efficiency should be addressed in the P&G study.[10] Here, we expand on those comments with a specific focus on transitioning those energy efficiency resources able to be transitioned from a traditional DSM load modifying resource to a new (eventual) full portfolio of energy efficiency that can help support both SB 350's GHG and doubling of EE goal by 2030, and SB 100's decarbonization and renewable grid mandate by the end of 2045.

The challenge of being able to serve both goals successfully will not be easy and will require major changes to the current portfolio conceptions and regulatory structures supporting traditional EE. But in our view, a pathway forward exists that is a "win-win" for both – with EE becoming an active supply-side DER resource, while continuing its role as a leading GHG emissions reduction provider.

Transitioning to A Portfolio of Supply-Side Energy Efficiency (SSEE)

In essence, what The Council is proposing is that the state begin a process of *transitioning the current portfolio of load-modifying EE to become an active statewide supply-side EE resource through flexible demand concepts and approaches.* We understand that some EE that currently supports "grid/duck curve" issues and needs already meets a criteria of flexible demand resources.[11] This is especially the case for those EE resources identified in NMEC analyses and Pay-for Performance (P4P) efforts, where actual market benefits of EE are measurable and able to be "settled" in a manner similar to existing supply-side resource purchases. Beyond that, we understand that much of the EE "resource portfolio" extant within traditional P&G study approaches -- and now being considered by CPUC P&G contractor, Guidehouse, as potential "optimized resource bundles" in the IRP process for evaluation and cost-effectiveness assessment (alongside other resources)[12] – for the most part, are composed of traditional load-modifying resources (i.e., "passive" DSM resources that modify demand rather than actively support grid needs).

The fact that California's best minds are challenged with approaches to integrate both SB 350 and SB 100 needs, without allowing the diminishing of the EE resource with its obvious GHG reduction and system baseload benefits, is not surprising. Energy efficiency traditionally has been designed primarily as a passive grid resource to reduce demand. To maintain the benefits of the EE infrastructure that has been built over these past four decades, however, will require a rethinking of a) how to make the best use of a most valuable EE resource and infrastructure (that is ever "decreasing" using currently flawed cost-effectiveness methodologies), and b) design a harmonized system of EE, DR, and other DERs that flows together to SUPPORT the dual policy goals established by the state to meet our Clean Energy goals.

[10] California Efficiency + Demand Management Council, "Opening Comments of The California Efficiency + Demand Management Council on Administrative Law Judge's Ruling Inviting Responses to Potential and Goals Policy Questions", May 22, 2020. https://cedmc.org/wp-content/uploads/2020/05/R.13-11-005-EE-Rolling-Portfolio-Council-Comments-on-PG-Ruling-5.22.2020.pdf.

[11] For instance, see Council Member Recurve's extensive comments touching on this subject in the company's Comments of Recurve Analytics, Inc. on Potential and Goals Analysis Ruling Questions. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M338/K650/338650728.PDF

[12] As described analytically in a Commission workshop and codified as a potential option in the Energy Division Staff Proposal for Incorporating EE into the SB 350 IRP Process CPUC Energy Division," Staff Proposal for Incorporating Energy Efficiency into the SB 350 Integrated Resource Planning Process," https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M334/K786/334786698.pdf.

It is The Council's firm belief that a much-needed collaborative process can and should be set in place (and soon begun) in California to assess our overall past successes, revalue areas that need to be modernized, and move forward in typical California innovative ways with clear sight to meet our climate and renewable goals.

Demand Flexibility -- How to Move Traditional Load Modifying EE (LMEE) to Supply-Side EE (SSEE)

A 2015 paper by the Rocky Mountain Institute[13] defines demand flexibility or what RMI called "flexiwatts" as follows:

> *Demand flexibility uses communication and control technology to shift electricity use across hours of the day while delivering end-use services (e.g., air conditioning, domestic hot water, electric vehicle charging) at the same or better quality but lower cost. It does this by applying automatic control to reshape a customer's demand profile continuously in ways that either are invisible to or minimally affect the customer, and by leveraging more-granular rate structures that monetize demand flexibility's capability to reduce costs for both customers and the grid. Importantly, demand flexibility need not complicate or compromise customer experience. Technologies and business models exist today to shift load seamlessly while maintaining or even improving the quality, simplicity, choice, and value of energy services to customers.*

The paper goes on to note that *"... customers enjoy a growing menu of increasingly cost-effective, behind-the-meter, distributed energy resource (DER) options that provide choice in how much and when to consume and even generate electricity ... Yet (current) utility and customer investments on both sides of the meter are based on the view that demand profiles are largely inflexible; flexibility must come solely from the supply side. Now, a new kind of resource makes the demand side highly flexible too."*[14]

In a limited way, California policymakers have fashioned DR programs, with their focus on supply-side demand response (SSDR),[15] as a positive means of addressing capacity shortfalls through wholesale market and Resource Adequacy (RA) structures. However, a new focus on re-fashioning EE as a supply-side "flexiwatt" resource is needed now to "break the log-jam" of past, well-fashioned-in-their-original-need, policy and implementation approaches to efficiency, to move California forward in a harmonious way.

The question arises – What measures and/or processes exist in our current portfolio of EE measure and resources (i.e., in DEER or the California Electronic Technical Reference Manual (eTRM)) can "fit" under a refashioned SSEE flexiwatt portfolio and regime? And the answer is, whatever our creativity can imagine that will allow EE in its many-measure aspects to become a load shifting resource that not only captures, supports, and expands grid needs, but also provides exceptional GHG emissions goals and reductions.

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[13] Rocky Mountain Institute, "The Economics Of Demand Flexibility How "Flexiwatts" Create Quantifiable Value For Customers And The Grid," 2015. https://rmi.org/insight/the-economics-of-demand-flexibility-how-flexiwatts-create-quantifiable-value-for-customers-and-the-grid.

[14] A January 5, 2021 article in Green Tech Media discusses the possibilities and needs for demand flexibility in California. "California' Big 2021 Decision on Grid Reliability: Expand Supply or Manage Demand? ... *Google Nest and other distributed energy providers demand fast action to bolster behind-the-meter flexibility*." Jeff St. John, January 5, 2021 https://www.greentechmedia.com/articles/read/californias-big-decision-for-2021-grid-reliability-go-big-on-supply-or-expand-demand.

[15] Supply-side demand response (SSDR) as defined by the CPUC.

Will A Portfolio of SSEE Flexiwatt Resources Be "Cost-Effective"?

The Council has publicly stated on numerous occasions over the past few years that existing Standard Practice Manual (SPM) Tests, as currently applied using primarily Total Resource Cost (TRC) test, should be either modified to remove private investment as a negative impact on EE portfolios, as is currently being done in New Hampshire,[16] or replaced with the Program Administrator Cost (PAC) as an interim measure towards a more comprehensive resource value analysis.[17] Such an analysis would help facilitate the state's ability to undertake apples-to-apples resource value comparisons to enable an EE portfolio transition to grid- supporting flexible-demand approaches.

The Council's focus in this paper is on California rapidly moving forward to develop such a comprehensive resource valuation tool. Beginning in 2017 the Energy Division began scoping development of a ***Common Resource Valuation Methodology*** (CVRM) in its Workshop *on Proposed Reference System Plan for the CPUC's 2017/2018 Integrated Resource Planning (IRP) Process*.[18] A CVRM, designed to take into account ALL benefits and costs of an SSEE flexiwatt portfolio will, we believe, have definite positive impacts on the state's IRP portfolio as it allows for many new pathways for EE-rate-design-based standalone programs (e.g., TOU rates), in combination with EE-DR approaches, and as strong components of "DER BTM resource/technology packages" to meet customer preference and to address utility feeder, circuit, substation, and transmission upgrade distribution system needs.[19]

The Council envisions an innovative EE portfolio that renews itself based on:

- Technology enhancement
- Interoperability and controls refinements
- Expanding manufacturer integrated and DER ready products
- A resource base that has no "drags" on cost-effectiveness, but rather enhances opportunities for potential innovations and creativity at every level of grid and customer activity

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[16] New Hampshire adopted a "Granite State Test." It is one of the states in the nation that adopted their cost-effectiveness (C-E) approach based on use of the National Standard Practice Manual -DER, which provides a framework for determining a state's C-E test based on alignment of state policy and goals with test design. National Efficiency Screening Project (NESP), *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources, including Energy Efficiency (NSPM for DERs, including EE)* 2020, https://www.nationalenergyscreeningproject.org/wp-content/uploads/2020/08/NSPM-DERs_08-24-2020.pdf

[17] The study focuses on only a few well known "shift" resources such as Air conditioning (AC), Domestic hot water (DHW), Electric vehicle (EV) charging, Electric dryer cycle timing, Battery energy storage. However, almost any "piece of equipment" (e.g., home and business refrigerators, freezers, plug-loads, etc.), other than insulation perhaps, could have demand flexibility components incorporated into its daily operations and encouraged through TOU and other rate structures (mentioned later in this paper) and other creative incentives approaches.

[18] https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/Sept%2025-26%20CPUC%20IRP%20Workshop%20Agenda%20-%20Proposed%20Reference%20System%20Plan.pdf

[19] Staff discussion of the **CVRM** concept, mentioned in several other Commission workshops, briefly is as follows: *A) Staff to Develop CRVM staff proposal for public comment in Q1 2018; B) Resource areas: EE, DR, BTM PV, RPS, storage, EVs; C) Proceedings: IDER, DRP, RA, IRP; D) Phased approach: Resource areas to be assessed for incorporation into CRVM to be sequenced by likelihood of near-term procurement; and E) Two types of alignment:*

- Vertical: Alignment of the resource attributes valued in IRP with those valued in procurement
- Horizontal: Alignment of the attributes used for valuing resources across all procurement processes, allowing "apples to apples" comparisons from resource to resource (e.g., RPS vs. EE) (Workshop Day 2 p.56-59)

https://rmi.org/wp-content/uploads/2017/05/RMI_Document_Repository_Public-Reprts_RMI-TheEconomicsofDemandFlexibilityFullReport.pdf.

- EE, DR, Solar, Storage, EVs being able to work together harmoniously with the ability to begin to understand and assess related EM&V issues, distribution values issues, and load factor issues related to both aggregated and "typical" BTM activities

As can be seen, The Council views EE and DR combined (and SSEE as a standalone flexiwatt resource) as viable BTM DER resources that allow for the Commissions (CPUC and CEC) and other regulatory and state bodies to plan a future that not only can recognize BTM DER issues and resources but also create viable ways to assess and measure their impacts.[20]

We offer these suggestions to spur discussion on these issues and *actions*, as The Council does not believe that California has the luxury of the thirty to forty-year timeframe that was once available to build the current EE and DR portfolio approaches and evaluation systems. To meet pressing Climate goals and complementary state policy mandates, The Council believes it is imperative to begin to immediately "unwind" past structures and siloed approaches that hinder the California's progress and the pressing need to move forward on the road to meeting 2030 energy efficiency/GHG emissions reduction and 2045 decarbonization goals.

In this regard, The Council calls for a "new collaborative" not unlike the collaboratives of the past in support of efficiency, to create the innovative thrust forward needed for California to take "leaps ahead," in addressing and overcoming barriers that keep the state from smoothly meeting its policy mandates. Below in Section 3, The Council identifies what it believes to be some of the key barriers needing to be addressed to be able to successfully transform – at the rapid pace needed – our current focus on EE as a "load modifying resource" to a "supply-side EE resource, and to fully integrate SSEE and SSDR into active DER efforts statewide.[21]

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[20] For BTM DERs to flourish, much work needs to be done in re-imagining our grid system. In particular, The Council believes that we need to move forward rapidly to create a system whereby utility Distribution System Planning, Interconnect Engineering, and especially Distribution Operations can begin to not only "see" the impacts of BTM DERs at the feeder level, most likely through aggregation programs such as those requested recently in an RFP by the Los Angeles Department of Water and Power (LADWP) i.e., 28MW (4.8KV line) of DERs implemented over a long-period of time as a capacity resource in three separate LADWP customer zones – that include residential, commercial, and industrial customer.

[21] The Council reiterates its view that while a great number of existing EE measures can be seen to be eligible for supply-side EE transformation, those not able to match specific grid temporal or locational needs (e.g., wall insulation, etc.) still provide extremely valuable demand-side and GHG emission reduction resources in support of SB 350 and should be considered separately as its own portfolio.

Section 3: Addressing Barriers to EE, DR, and DER Integration & Opportunities for Overcoming Barriers

As with any successful market transforming effort, identifying and taking steps to remove barriers that stand in the way of transformation is a key step towards achieving the goals of the effort. Below, The Council identifies barriers in the following categories: Global, Regulatory, Program Administrator, Technology and Market, and Customer level barriers.

We note that this is an initial survey of such barriers and will of necessity require further refinement. Still, The Council offers these as points of further discussion in moving EE and DR towards a fully integrated and operationalized DER system in California.

Global Barriers

The Council believes that there are serious global barriers that California faces to harmonize not only EE and DR resources with DER applications in the marketplace, but also to specifically meet the stated goals of SB 350 and SB 100. These relate to:

1. ***Understanding and Moving to Replace Outdated Structures and Approaches*** – To meet the dual state goals of GHG emissions reduction AND decarbonization reductions, it is critical that roadblocks based on inertia from outmoded approaches be addressed quickly and new solutions put in place. Structures that hold budget silos, implementation silos, program analysis silos, and related issues keep the state from creatively harmonizing its effort to reach important climate goals.
2. ***Need for DER Market Transformation Initiative on the Scale of CSI*** – The state should fund multi-technology flexible demand and related DER efforts – both IFM and BTM – in the same way that California led the nation in the California Solar Initiative (CSI) market transformation. The successful CSI effort provided the impetus in California to rapidly reduce market barriers and solar costs, and to transform California's grid and customer markets into working national examples of "making solar work." An equivalent effort is now needed focus on the much-needed SSEE-supply-side energy efficiency portfolio transition and related DER's harmonization with traditional bulk power acquisitions and transmission and distribution assets.
3. ***Aligning and Funding New Behavioral and Education Support Programs Aimed at Educating California Consumers About the Pressing Environmental Need and Enlisting Their Support*** – Californians have always been willing to "step-up-to-the-plate" to address environmental needs. Both SB 350 and SB 100 are parts of a panoply of state policy in support of clean energy, clean air, with a goal of leaving the planet more environmentally sound than we found it. Now is the time, with the searing reality of the effects of climate change at our front door, to enlist Californians – as was done beginning in the 1970s – to help harmonize state Clean Energy actions with goals.
4. ***Disadvantages Communities Must Play A Key Role in the Transition –*** A key feature of a supply-side flexible demand EE portfolio is to be able to work with existing residential resources to incorporate these into SSEE portfolio efforts. Virtually every residential area of energy use is potentially eligible for creative technological demand-flexibility innovation, many of which are in nascent use currently. Disadvantaged

Communities, in particular, can benefit tremendously from such innovation. The Council urges policymakers to make a focus on these communities as a major area of benefit of early innovative SSEE approaches.[22]

Below this White Paper provides a brief survey of identified barriers – from available stakeholder input and research[23] – at the regulatory, program Administrator, technology and market, and customer levels that The Council believes will need to be considered/addressed – and overcome – to rapidly align current structures with the needs of SB 350, SB 100, and related California state policy objectives.

Regulatory Level – Barriers/Potential Solutions

Regulatory approaches to meeting state policy objectives set the framework for "best in class" approaches to key resource issues and problems. Solutions provided by regulators provide guidance not only to the program administrators of EE, DR, and related integrated DER efforts (including 3rd party providers), but also flow down to the market through manufacturers, vendors and other market actors eventually impacting consumer perspectives and choices. The barriers Identified at this level, therefore, have a great deal of influence and impact in and on the marketplace. Below, The Council notes some of the most impactful barriers that in its view will need to be addressed for a successful transformation effort.

Barriers

- Division of Program Funding (High-level) e.g., silos in funding technology sources and proceedings; Separate/distinct program budgets for EE, DR, DG, and Storage (Operational impacts at PA level)
- Division of Program Administration (High-level) e.g., diverse rules and approaches across proceedings
- Misalignment of Program Cycles (High-level) e.g., problems related to 5 different proceeding timing cycles
- Lack of effective metric for evaluating cost-effectiveness of integrated programs (Operational impacts at PA level); Inconsistent Cost-effectiveness Calculation Methods (Operational impacts at PA level)[24]
- Lack of integrated regulatory rules for EM&V (Operational impacts at PA level)

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[22] SB 350's focus on Disadvantaged Communities provides clear guidance on inclusion of this critical stakeholder group in all decision forum and approaches related to the act. Flexible demand EE and DR provide potential significant benefits to this community.

[23] Sources for information in this Chapter include multi-sourced information from many different people and vehicles. Literature review and sources are sited where possible, however, multiple industry interviews and private communications of "barriers works-in-progress" from several agencies and sources are also included, though not cited. Overall, a key resource for Chapter 2 is the Lawrence Berkeley National Laboratory study, "Barriers and Opportunities to Broader Adoption of Integrated Demand Side Management at Electric Utilities A Scoping Study," Authors: Jennifer Potter†, Elizabeth Stuart‡, and Peter Cappers‡ † Hawaii Natural Energy Institute February 2018) https://ipu.msu.edu/wp-content/uploads/2018/03/LBL-Barriers-and-Opps-for-Integrated-DSM-2018.pdf

[24] The following EE-DR integration report notes: "A fundamental challenge is the lack of effective, standard practices for evaluating integrated programs' efficiencies and benefits. Cost-effectiveness evaluations continue to operate in silos for energy efficiency and DR programs, whether they are integrated or not. Regulated utilities are often required to meet energy and demand savings targets as defined in state level energy efficiency resource standards, in other policies, or by the utility commission or utility itself. Targets for demand savings, energy savings, and other goals are typically separate from one another and have separate budgets; some are even tracked in separate utility proceedings. Integration can be a challenge for entities that have designated budgets for distinct savings goals" (Potter, Stuart, and Cappers 2018) ACEEE, Integrated Energy Efficiency and Demand Response Programs Dan York, Grace Relf, and Corri Waters September 2019 U1906 https://www.aceee.org/sites/default/files/publications/researchreports/u1906.pdf

- Separation of responsibilities across industry partner organizations for delivering different DER technologies (e.g., utility, 3rd party, other program administrator(s) ((Operational impacts at PA level)
- Telemetry requirements and functionality may be inadequate to address complex DER needs (Operational impacts at PA level)
- Challenges to align siloed funding and timing of various proceedings (Operational impacts)

Solutions

- Standardize cost-effectiveness metrics (Regulatory)
- Dedicated goals, budgets, and targets for DER (Regulatory)
- Regulatory rule change for EM&V (Regulatory)
- Regulatory or legislative mandates to implement non-traditional DER activities (Regulatory/Legislative)
- Consolidate and integrate funding for DER offerings (Regulatory)
- Consolidate and integrate regulatory oversight (i.e., integrate DER proceedings into point-of-focus proceeding

Program Administrator (PA) Level – Barriers/Potential Solutions

As noted, regulatory level issues flow down to PAs who work within their organizations and in particular with market actors and customers. Issue identified here often relate to the regulatory framework in which PAs operate. This said, much can be done – and has been initiated by some – within the current systems available in California to begin transitioning organizational, market deliver, and other customer facing and internal operational approaches to facilitate barrier removal at this level.

Barriers

- Separation of responsibilities within organizations for delivery of different technologies (e.g., EE, DG, DR, storage and EVs – refer to DERIS study to show integration with Distribution system and DER programs)
- Technology controllability and Technology interoperability[25]
- Customer market confusion about program and technology offerings
- DSM technologies as competitors (e.g., reduced DR impacts with increased EE)

Solutions

- Consolidate and integrate funding for DER offerings (Internal PA/Regulatory)
- Consolidate DER delivery departments i.e., create dedicated IDER (Internal PA) administrative & program implementation activities structure
- Internal PA - Promote technological and product manufacturer advancements in interoperability and control
- Internal PA - Support new IDER market entrants with outreach, targeted request for proposals (RFPs/RFOs) and similar approaches (e.g., in ways the typical EE emerging technology departments support new EE entrants)

[25] DER implementers at Fort Collins Colorado note that they "...faced some technological challenges, mainly in the difficulty of integrating dissimilar DERs into a single, unified software platform. Ibid, ACEEE (Dan York, Grace Relf, and Corri Waters) September 2019 U1906 https://www.aceee.org/sites/default/files/publications/researchreports/u1906.pdf

- Internal PA - Develop pilot demonstration projects; advertise to public;
- Internal PA – Establish social media customer educational series and podcasts on IDER

Technology and Market Level – Barriers/Potential Solutions

Technologies and market approaches flow together to impact vendor and customer perceptions and perspectives on Clean Energy choices in the marketplace. We note below general market and policy level barriers flowing from regulatory and PA approaches. We follow with a survey of customer and vendor level barriers to *EE Flexible Demand's and DR's full integration* into an active statewide DER portfolio. In enumerating these market and technology level barriers, it becomes clear that these and related regulatory and PA provider barriers are intricately linked and that *all actors* will need to work together to obviate barrier impacts in an organized and collaborative fashion to meet California's lofty Clean Energy (SB 350 and SB 100) goals.

General Market Influencing and Policy Level – Barriers[26]

Barriers[27]

- Division of Program Administration
- Division of Program Funding
- Misalignment of Program Cycles
- Inconsistent Cost-effectiveness Calculation Methods
- DSM Technologies seen as Competitors

Barriers to Customer Adoption – Flexible Demand Barriers and Solutions[28]

Barriers

- Lack of market-ready automation technology (noted above)
- Cost and/or complexity of building automation technology
- Insufficient savings opportunities for building owners
- Insufficient supporting infrastructure (e.g., lack of Advanced Metering Infrastructure)
- Privacy and cybersecurity concerns of building customers / owners
- Lack of building customers / owners' interest or awareness
- Lack of understanding by the entities responsible for implementing load flexibility offerings (including both installers and end-users)
- Lack of financial incentives for utility to pursue load flexibility
- Program design that makes load flexibility unattractive to potential participants
- Insufficient customer incentive structure (including lack of retail rate designs that encourage load flexibility)

[26] For further detail see the discussion below addressing DR and DER Vendor/Aggregator Barriers.
[27] Information included in this section is from a Lawrence Berkeley National Laboratory/Brattle "work-in-progress" research study on flexible loads. The Council is a contributor to this research effort.

- "Status quo bias," including institutional bias against demand-side solutions among utilities as well as reluctance of building operators to alter systems
- Load flexibility not sufficiently represented in utility resource planning processes
- Wholesale market designs that do not fully compensate load flexibility for its value
- Complex or unnecessarily restrictive wholesale market participation rules
- Insufficient load flexibility performance metrics and assessments practices (i.e., EM&V)
- Inability to monetize the full "value stack" of load flexibility)i.e., combining distribution level benefits with bulk system-level benefits)

Solutions

Flexible Load Research Solutions

- Market studies, pilots, , M&V of performance etc.
- Building load flexibility technologies and systems demonstrations
- Enhanced industry training

Flexible Load Implementation Solutions

- Innovative load flexibility program designs (packaging load flexibility with other offerings
- New retail rate designs
- Enhanced customer marketing outreach
- Modernization of existing conventional DR programs

Flexible Load Government-Action (legislative and regulatory) Solutions

- Financial incentives for utilities
- Requirement that load-flexibility be represented in resource planning processes such that its full value proposition is account for
- Enablement of 3-P (aggregator) participation/competition
- Codes and standards for buildings or technologies (e.g., controls standards supporting interoperability, building and appliance standards to promote load flexibility
- Load flexibility goals and mandates
- Create or assign responsibility to organizations – or coalition of organizations – specifically to drive load flexibility progress at the state level
  Establishment of wholesale market products and participation rules that are clear and fully compensate load flexibility for its value.

Demand Response and DER Institutional Barriers and Solutions

As noted, a path within CAISO for Supply-Side Demand Response (SSDR) currently exists, however, per recent multi-agency workshop presentations, many barriers exist to harmonizing DER aggregation (DERA) resources. [29] This includes perceived barriers faced by customers currently being aggregated by DR firms operating in California (as well as nationally);[30] firms, whose efforts helped reduce the impacts of the August grid blackouts.

[29] See Multi-Agency Workshop – "Capacity Valuation for BTM Hybrid Resources Workshop" (November 24, 2020), for discussion of SSDR, load modifying demand response (LMDR) programs eligible in the CAISO wholesale market and other key information points and challenges for DER Aggregation and DR inclusion—in the CPUC and CAISO presentations.

[30] For example, firms like GridPoint, with its focus on small and medium sized business DR aggregation, and CPower, with a multi-segment DR focus both work to help customers participate in California DR programs and markets.

We note that FERC 2222 *"Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System,"* provides key guidance for the CAISO related to DER aggregation resources:

We list major features of the FERC 2222 guidance below:[31]

- Allow distributed energy resource aggregations to participate directly in RTO/ISO markets and establish DERAs as a type of market participant
- Allow DERAs to register under one or more participation models accommodating their physical and operational characteristics
- Establish a minimum size for DERAs that does not exceed 100 kW
- Address distribution factors and bidding parameters for DERAs
- Establish metering and telemetry for DERAs
- Address coordination between the RTO/ISO, the DERA, the distribution utility, and the relevant electric retail regulatory authorities
- Address modifications in a DERA
- Address market participation agreements for DERAs

The Council believes that barriers it has identified in the DR and DERA markets may be mitigated with clear rulemaking decisions and implementation of FERC 2222. Nonetheless, we identify some key issues that are current and active that should be addressed now to facilitate increased customer access to DR aggregation (and other) resources and market expansion planning for implementers.

Current and Active DER and DERA Barriers

Barriers

To DERA Participation at the Wholesale Market Level[32]

- Retail programs are more attractive – SGIP & NEM (no capacity limit)
- DERs that could be in DERAs generally are eligible to participate in net energy metering programs
- Stand-alone resource requirements are low – 500 kw for generators and 100 kW for storage
- Lack of an established methodology to determine an RA capacity value for DERAs
- Complexity DERAs introduce to distribution system operations and planning

To DERA Participation at the Utility Distribution Level[33]

- Distribution Interconnection process did not study DERs impact to system in aggregate
- Establish(ed) a detailed DERA review process, which included ISO NRI process integration
- ISO market systems see DER at T-D substations, have no visibility to distribution grid conditions or impacts
- Develop(ed) DERA availability (red/green) – manual process
- Distribution utility is not aware of DER bids and dispatches

[31] Ibid, CAISO presentation BTM DER Workshop.
[32] CAISO presentation a November 24 BTM workshop.
[33] Ibid.

- Identified availability to provide information using existing market reporting mechanisms High DERA participation requires enhanced Transmission/Distribution Operations coordination

To DERA Participation in CEC Demand Forecasting and DR/DER Interactions

- Regardless of pathway, as DER installations increase, CEC's ability to accurately forecast metered load will be challenged without more comprehensive data collection.
- If resource is in a supply-side program, CEC should be receiving program impacts (charge and discharge) through load impact protocol ex post analysis, but the LIP ex post data do not quantify storage charge/discharge v. load response
- Ex post impacts are also not available by LSE for any DR program
- This may be more easily solved for sub-metered DERs than for estimated behavioral impacts.
- CEC has no visibility on hourly performance of storage or PV
- More comprehensive data availability would improve valuation of distributed resources in the demand forecast

Solutions to the Institutional Barriers (noted above)

CEDMC support the efforts of each of the agencies noted above to coordinate efforts where possible to create a) the data streams CEC needs for the IEPR forecast, b) FERC 2222 rules and policy adjustments at the CAISO to facilitate enhanced DER recognition and opportunities statewide, and c) rapid direction and integration of CAISO, CPUC, and CEC informational needs and processes into distribution system planning and operations. In particular, The Council supports the CPUC taking extraordinary steps in the IDER proceeding to help rapidly overcome the barriers identified in the utility distribution system talks with CAISO.

Demand Response (DR) and DER Vendor Barriers and Solutions

Barriers - To Vendor and Developer/DRA and DERA Aggregators[34]

- *Policy/Regulatory*
  - CPUC should move rapidly to recognize DR as a component of Resource Adequacy to facilitate the counting at CAISO of DER and DR aggregation resources
  - Perceived barriers for an aggregator with thousands of small sites:
    - Minimum of 100kW per Sublap requirement (PG&E) – Capacity Bidding Program, not DRAM, or PDP
    - SDG&E does not have Sublaps
    - SCE does have Sublaps, but does not have minimum requirements per each
    - Baseline structure is not accurate, increases likelihood of "underperformance" during heat waves – baselining appears to favor utility and not customer actual performance (one model of preferred approach in AZ where a) weather sensitivity taken into account- local and global, and 3-in-10-day baseline rule
    - Incentive structure is more favorable with fewer events
    - Potential overly stringent requirements for qualifying the DR resource – 12-month load portfolio study is required before qualifying load. Other states to not required,

[34] Information provided from this part of the White Paper through the end of Chapter 2 has been gathers through interviews with industry participants and "works-in-progress," as noted previously.

only a "portfolio season test" on what resources can do, and collateral for lower MWs than projected.

- *Market*
  - ***General Barriers to DERA Customer Participation for Small Business Customers (SBM) in California***
    1. SMB customers not aware of DR programs
    2. SMB customers not equipped with OADR technology
    3. SMB customers do not qualify for DR without an aggregator

Solutions to Overcome These Barriers, Especially During Emergency Events

- Remove 100kW per sublap requirement for emergency events, and possibly all events
- Compensate emergency DR events (like what we saw in August 2020) differently than CBP/DRAM/BIP events
- Require separate "emergency response" registration
- Permit any/all OADR technology sites to participate regardless of sublap and curtailable load
- Change baselining structure: when events are called more than two days in a row, there must be a different system than using 10 days prior
  1. Consider averaging "like" days from the year prior, or six months prior, or
  2. Aggregators could submit peak and/or average demand during the event period for specific temperatures and hours of the day to use as a baseline, or
  3. Establish a global day-of-adjustment based on actual conditions during the event
- Modify compensation structure/tiered compensation for DR customers to recognize additional effort with multi-event scenario, e.g.,

  Tiers:
  1. 0-5 events, $x/kW
  2. 5-10 events, $1.5x/kW
  3. 10-15 events, $2x/kW
  4. Emergency/mandatory events: $5x/kW
- Utilities and CPUC should partner with and incentivize widespread OADR technology adoption
  1. With one specific OADR technology partner, and collaborative funding, more customers could be reached, enrolled, aggregated, and participate

<u>DER Vendor Residential Controllable Load Barriers</u>

Barriers - To Vendor Controllable Load Devices

- Customer acquisition – cost of customer acquisition can be moderately high for controllable loads sales
- Barriers to making project financials work
  - *Value stacking*
    1. While most controllable load devices make sense economically - and the need for them is often driven by replacing an old device - there are difficulties in capturing the additional value streams that can stack on top of more traditional customer-side values
    2. Traditional values:
       - Generic need for the appliance (e.g., you need to heat your home but your current water heater is not functioning properly, so you get an electric water heater)

- Bill savings through automatic managed use
3. Additional potential value streams that are more difficult to monetize:
   - Resource adequacy
   - Utility program participation revenues
   - CAISO market revenues
4. In theory, all of these value streams may be available but in practice they can be hard to capture

- *Financing*
  - Some channels through which customers purchase controllable load devices might offer financing, while others might not
  - For EVs specifically financing is highly sensitive due to the high capital outlay or long-term financial commitment.

- For CAISO participation
  - Load Impact Protocol / Net Qualifying Capacity
- M&V Methodologies and Requirements
  - Baseline comparison
    1. May not reflect DER performance
    2. May permanently shift with recurring usage pattern; may need to actively plan around a specific day that resets the baseline
- Permitting / Safety
  - Installation crews in the home might not be desired, particularly during COVID-19

DER Vendor and Project Developer Solar Photovoltaics, other Renewables and Storage Barriers

- Customer acquisition – for reasons similar to the residential controllable load market, it can take significant time and effort for vendors to close sales as vendors generally have to address the following barriers

- Making project financials work
  - Value stacking difficulties
    - To make financials work for BTM DERs, especially solar plus storage, vendors typically have to "stack" the values the DER can provide.
      - Bill savings
      - Resource adequacy
      - Utility program participation revenues
      - CAISO market revenues
    - In theory, all of these value streams may be available but in practice they can be hard to capture
  - Financing
    - Incentives running out (e.g., ITC, SGIP)
      - ITC, which has been a major enabler of renewable energy projects, is set to decline to 10% in 2021
      - Complex, time-consuming, and costly to meet requirements and provide required verifications
      - Even if overall funding for incentives is not declining (SGIP), the available funds in any given category can be exhausted

- Relative value of SGIP is less for longer duration projects.
  - e.g., SGIP best for 2-hour storage, but resilience and load-shifting energy storage projects tend to have 4-or-more-hour duration per SGIP formula
- Tax-related values require tax equity partner, adding cost and complexity to contracting arrangements for relatively small projects

- For CAISO participation
  - Issues related to Load Impact Protocols and Net Qualifying Capacity
- M&V Methodologies and Requirements
  - Baseline comparison May not reflect DER performance and may permanently shift with recurring usage pattern; may need to actively plan around a specific day that resets the baseline
- Agency issues
  - Different parties own properties than occupy and pay electric bills
- Time of project development
  - Projects can take years to complete - personnel can change
- Permitting / Safety
- Interconnection
  - Time; upgrade costs; vagaries of "black box" process
  - One of the primary barriers to solar plus storage in California are the months-long interconnection delays. The CPUC's Distribution Resources Plan (DRP) updated Integration Capacity Analysis (ICA) 2.0 maps, posted online as of December 28, 2018 could help reduce interconnection barriers by releasing the most critical interconnection capacity factors at the node level on every line section of all primary distribution circuits

Customer Level – Barriers/Potential Solutions

Customers play the lead role in moving forward to adopt environmentally sound technologies and approaches. To the extent that operational and incentive policies and approaches align well with customer willing to adopt Clean Energy approaches, rapid integration takes place. Barriers identified below are some of the key considerations that policymakers, PAs, 3rd Party vendors, and technology providers might wish to consider in bring key customer classes into the transformation effort suggested in this Council White Paper.

Barriers to Customer Adoption -- Residential Solar Photovoltaics, Renewables and Storage

- Costs (money and/or time) of site and other preliminary evaluation steps
- "Where do I start?" Lack of clear process for moving forward
- Competition with other solutions, e.g., solar+storage vs. diesel generators
- "Who/what do I believe?" Concerns about the veracity of information, vendors, and whether financial claims are accurate
- "It's too complicated" Energy projects are complex and esoteric. Initial enthusiasm for the idea of DER projects can quickly wane as the complexities become more apparent.
- "It's not worth my time" Energy is still a relatively low cost and therefore low priority for many customers.
- Costs of equipment
- Concern about damage to on-site structures
  - People are concerned that installing solar on their roof may cause roof damage
- Agency issues

- Different parties own properties that occupy and pay electric bills. Particularly prevalent for residential renters and for C&I customers
- Time of project development
  - Particularly for C&I customers, projects can take years to complete. Too long relative to benefits for many customers.
  - Personnel can change. e.g., a procurement person or facility manager leaves, and it is "back to square" one with the new people in the role
- Access to credit/financing
- Age/condition of on-site structures
  - Many roof structures may not support PV equipment
- Potential renovations of other significant changes to site/structures prior to the end of DER equipment life
- Space limitations for equipment, particularly solar
- Safety concerns
  - Primarily for energy storage
- Aesthetic concerns about how the DERs will look

<u>Barriers to Customer Adoption – Residential Flexible/Controllable Loads</u>

- Costs (money and/or time)
- "Where do I start?" For some devices, lack of clear process for moving forward.
- Competition with other solutions, e.g., EVs vs ICEs
- "Who/what do I believe?" Concerns about the veracity of information, vendors, and whether financial claims are accurate
  - Some products come from names without a strong brand, while others do (e.g., GE's electric water heaters, Google's Nests)
- "It's too complicated" Energy projects are complex and esoteric. Initial enthusiasm for the idea of DER projects can quickly wane as the complexities become more apparent.
- "It's not worth my time" Energy is still a relatively low cost and therefore low priority for many customers
- Costs of equipment
- Concern about damage to on-site structures
  - e.g., people are worried about people coming in and doing a poor job installing something that they use every day
- Access to credit/financing
  - Some controllable load devices need to be financed, while others do not.
- Age/condition of on-site structures
  - e.g., electrical panel can support the addition of an electric water heater and EV
- Limitations on vehicle charging options
- Reluctance for a third party to manipulate their devices; concerns over in-home temperature as a result of controlling thermal load.

As noted previously, these barriers identified provide a "step on the road ahead." Refinement and development of action-oriented solutions to address these are a key element of this Council White Paper proposal. Because of the complex and interrelated nature of the issues identified, it will take stakeholders/market actors from many different sectors and perspectives to determine the best approaches to both effectively integrate EE and DR into the DER space, and to create the needed collaborative planning and action processes to make the transformation happen.

Section 4: Conclusion

The focus and purpose of this Council White Paper is to begin a discussion of the need for significant overhaul of systems and structures that have served California well over the past 40-years in supporting state energy efficiency, demand response and related environmental goals given the transformational industry changes underway. California has been a leader in this regard, and now at this time of change, The Council calls for a broad coalition of Clean Energy stakeholders and regulators to work together effectively and creatively to devise and support implementation of a plan for both transitioning and harmonizing the EE and DR resource with the rest of the DER portfolio (i.e., solar, storage and EV). In addition, there is a need for California to rapidly realign relevant structures, methodologies, and approaches, including cost-effectiveness methods – that stand in the way of quickly moving forward to meet the imperatives of SB 350 and SB 100 goals.

As noted, changes in market and grid forces and focus, cost-efficient new clean energy technologies, data availability, and a myriad of other advancements in utility distribution planning, DER availability, and most importantly, the pressing challenges and needs to address both climate change and customer preference and demand, have created a need to act on these key industry transformation issues in ways not conceived of in the past. It is The Council's firm belief that as a state, California needs to advance now rapidly to identify the key changes (e.g., structured revisions to silos in programs, budgets, and implementation approaches, for critically needed DER resources) and initiate a collaborative transformational effort that can successfully bring us to our SB 350, 2030 goal, and SB 100, 2045 goal.

We offer this paper in hopes of moving California's energy industry to do what it does best i.e., to marshal the state's creativity, innovation, and flexibility to meet the needs of the task ahead. The Council notes again that we do not have the same timeframes for action that the state has had in the past. A call to urgency is needed. Our proposal for a *"flexible demand" CSI-type market transformation program effort* (to transform our efficiency efforts from "passive-load modifying ones" to supply-side EE -SSEE) in The Council's view will provide the needed impetus to reach our state policy goals.[35]

The Council reaches out its hand in support of California's needed transition with our continuing offer to work closely with other stakeholders on these important issues as the state advances to successfully meet and exceed its environmental and energy goals.

[35] We note again, it is The Council's firm belief that flexible demand supply-side EE (SSEE) resources need to be fully coordinated with load modifying EE (LMEE) resources – which provide ongoing GHG reductions, energy, and some demand savings – to ensure the state has a robust Clean Energy portfolio.

Appendix: DER Definition and Technology Overview

A 2017 article from Advanced Energy Economy (AEE), the Smart Energy Power Alliance (SEPA), and the Rocky Mountain Institute (RMI) defines DERs as "…physical and virtual assets that are deployed across the distribution grid, typically close to load, and usually behind the meter, which can be used individually or in aggregate to provide value to the grid, individual customers, or both."[36] This encompasses a broad suite of resources including, but not limited to:

- Energy efficiency – reduces and streamlines energy consumption
- Demand response – reduces energy consumption during peak times
- Demand management tools – shifts, shapes, and at times increases loads to maximize value to the grid
- Distributed Generation/Solar – generates energy through photovoltaics
- Storage – stores energy generated from a range of measures to dispatch at a more opportune time
- Electric vehicles – transportation without tailpipe emissions
- Rate designs that can support and facilitate DER adoption

These integral energy tools represent a significant shift from – and improvement to – more traditional resources such as natural gas-fired power plants.

Despite some resources seeing a greater share of the energy "spotlight" than others, the relative advantages and disadvantages of each resource mean each has a particular role to play in meeting California's energy needs. EE and DR represent a critical resource to California's future as least-cost, first in the loading order resources that can not only provide significant benefits on their own, but also complement and enrich the value of other DERs.

Below is a brief description of each of the DER offerings:[37]

- ***Energy Efficiency (EE):*** Programs that incentivize deployment of EE technologies and behaviors. These can include upstream, midstream, or downstream20 rebates/incentives for equipment (e.g., HVAC, lighting, appliances, and other measures) and other energy efficiency programs such as custom rebates, behavior-based programs, retro-commissioning and new construction. Utilities often market EE rebates through appliance retailers and more recently, have set up online marketplaces that make recommendations for efficient consumer products like appliances, light bulbs, and smart power strips. Furthermore, utilities partner with trade allies (e.g., architects, engineers, certified contractors) that perform weatherization upgrades or conduct audits and make efficiency improvements to customers' homes or businesses. EE program activities also include education and awareness campaigns to end-users and trade allies.

[36] Smart Electric Power Alliance; Tanuj Deora, Lisa Frantzis, Advanced Energy Economy; and Jamie Mandel; Rocky Mountain Institute, "Distributed Energy Resources 101: Required Reading for a Modern Grid"
[37] Modified - Lawrence Berkeley National Laboratory, "Barriers and Opportunities to Broader Adoption of Integrated Demand Side Management at Electric Utilities; A Scoping Study." Authors: Jennifer Potter†, Elizabeth Stuart‡, and Peter Cappers‡ † Hawaii Natural Energy Institute February 2018) https://ipu.msu.edu/wp-content/uploads/2018/03/LBL-Barriers-and-Opps-for-Integrated-DSM-2018.pdf

- ***Demand Response (DR):*** A mechanism through which an end-use's load profile is changed (by the user, a third party, or a utility) in response to system needs, often in return for economic compensation (e.g., payments or a different rate structure) (Potter and Cappers, 2017). For example, programs that utilize control technologies, such as smart thermostats, direct load control switches, plug load controls, or automated demand response (ADR) technologies, and/or behavior- based DR programs. The majority of DR programs offered target heating and cooling measures; however, several utilities offer custom rebates to commercial customers that install other measures that are enabled with Automated Demand Response (ADR) and agree to participate in DR programs. Offerings can also include behavior-based programs.

- ***Demand management tools:*** Work to control supply and demand within a building. Services offered by a growing number of software companies specializing in automated building management are helping commercial and industrial companies to reduce energy costs and curtail electricity usage when kilowatt demand tariffs are extremely high or when utilities are facing emergencies.[38]

- ***Distributed Generation (DG)/Solar PV***: Programs that offer rebates, incentives, and grants to utility and other Program Administrator customers that install DG technologies on site, such as photovoltaic (PV) solar, fuel cells, combined heat and power (CHP), and small wind turbines.

- ***Electric Vehicle (EV):*** Programs that provide incentives or rebates for deployment of EVs, EV chargers, grid integrated EV smart chargers or offer special time-based rates (TBR) to 20 Upstream, midstream, and downstream EE incentive payments refer to the three categories of rebate participants. Upstream refers to incentive payments made to manufacturers for manufacturing specific models that meet high efficiency standards. Midstream refers to incentives paid to retailers that carry and co-brand (with the program administrator) the highest EE tier rating end-uses. Downstream incentives are paid to the customer, often as a rebate after the purchase of the qualifying equipment has been made. 21 A "measure" refers to any type of demand side management project (e.g., upgraded insulation), technology (e.g., programmable communicating thermostats or energy management control systems), appliance (e.g., HVAC or lighting upgrades), or other end-use (e.g., battery or vehicle charging unit) that once installed, can reduce and/or optimize energy consumption at a premise.[39]

- ***Storage (ST)***: Programs that incentivize customer deployment of storage technologies, such as Li-ion and other types of batteries, grid-integrated electric water heaters, commercial and residential thermal energy storage (TES), and, in some cases, grid-integrated EV smart chargers. Storage functions like a battery as it can be used to provide power to the customer or the grid during times of critical need and can absorb power from the grid when prices are lower, providing market arbitrage. Some storage technologies can also respond to price signals. Storage options range from voluntary behavioral response by owners, to planned, event-based dispatch to meet critical grid needs. Notably, storage may also provide other high-value services to the grid similar to those that fast-responding DR systems can provide.

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[38] Demand Management, Distributed Energy magazine, Lyn Corum, Sep 25th, 2017
https://www.distributedenergy.com/home/article/13031531/demand-management
[39] See for example Con Edison's Marketplace at https://marketplace.coned.com/ Barriers and Opportunities to Broader Adoption of IDSM at Electric Utilities: A Scoping Study.

- ***Time-Based Rates (TBR):*** Electricity rates paid by customers in which rates vary for different days, times of the day, or events (such as days with extremely high loads). The electric utility alters the price level charged to retail customers for electric commodity purchases in order to elicit a change in electricity consumption. While TBRs are not universally considered DSM programs per se, many utilities consider TBR to be the cost-benefit foundation for DSM and IDSM program adoption. At present, there are four general types of time-based rates:
    - *Time of use pricing (TOU)* rates provide different but predetermined prices over specific time periods (e.g., summer weekdays between 4 PM and 9 PM).
    - *Critical peak pricing (CPP)* rates institute a single or variable predetermined price for electricity during a narrowly defined period (e.g., summer weekday between 4 PM and 9 PM) that is only applied during specific system operating or market conditions and generally limited in the number of times it can be dispatched (e.g., twelve times per year).
    - *Variable peak pricing* (VPP)[40] rates provide different prices over specific time periods (e.g., summer weekdays between 4 PM and 9 PM) that vary daily based on system operating and/or market conditions. Often times the dispatch of the highest priced level is limited, as is the case with CPP.
    - *Real-time pricing (RTP)* applies a rate schedule where the price can differ by hour of the day. There are two common forms of RTP: one that provides the twenty-four-hour price schedule a day in advance (DA-RTP) and another that provides the hourly price within 60 minutes after consumption has already occurred (RT-RTP).

[40] VPP in this context is not to be mistaken for another "VPP" acronym that has come into use -Virtual Power Plant - A virtual power plant (VPP) is a cloud-based distributed power plant that aggregates the capacities of heterogeneous distributed energy resources (DER) for the purposes of enhancing power generation, as well as trading or selling power on the electricity market.