White Paper

On the Grid's Bleeding Edge: The California, New York, and Hawaii Power Market Revolution

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Shareables

- California, Hawaii, and New York power market reforms will enable dramatically increased solar and distributed energy penetration, improved reliability, lower costs, and reduced GHG emissions.
- Realizing this vision takes integrated process reform in two fundamental areas: distribution planning processes and portfolio development to understand how to optimize pricing, programs and procurement for their systems.
- These integration initiatives will usher in fundamental changes for utilities, and are the harbinger of similar transitions likely to occur across many states. Early engagement by stakeholders is key to determining if these transitions are friend or foe.

Executive Summary

California, Hawaii, and New York are in the midst of radically reforming their state regulatory processes and eventually markets to accelerate the integration of Distributed Energy Resources (DER) into the grid. Each state process fundamentally envisions the future regulated utility as an enabler of customer choice to manage energy costs through advanced distribution planning, modern integrated grids, and opportunities for DER to provide market-based grid services.

Increasingly, we see the three state reform initiatives converging toward a common set of goals, mechanisms, and shared elements. In this white paper, we take an initial look at two of these shared elements — the need for a new distribution planning process and the emerging elements of market design / portfolio development.

The new planning process for each utility envisioned in all three states must support the development of DER alternatives that meet current and future system requirements. The first step for utilities in establishing such an integrated process will be the development of a standardized planning framework, which will require enhanced use of probabilistic-based engineering analysis, scenario-based distribution planning, hosting capacity analysis, and locational net value of DER. These are challenging but achievable steps.

The development of a portfolio of new services enabled by DER using various pricing, programs and/or procurements to competitively source them requires several new processes and analytical methods. The potential types of services may include distribution capacity deferral, voltage management, power quality, reliability, and distribution line loss reduction. These services would be sourced through a combination of time varying rate designs, energy efficiency and demand response programs, and utility procurements. While also a heavy lift, ICF has worked with stakeholders to develop a framework for considering these issues.

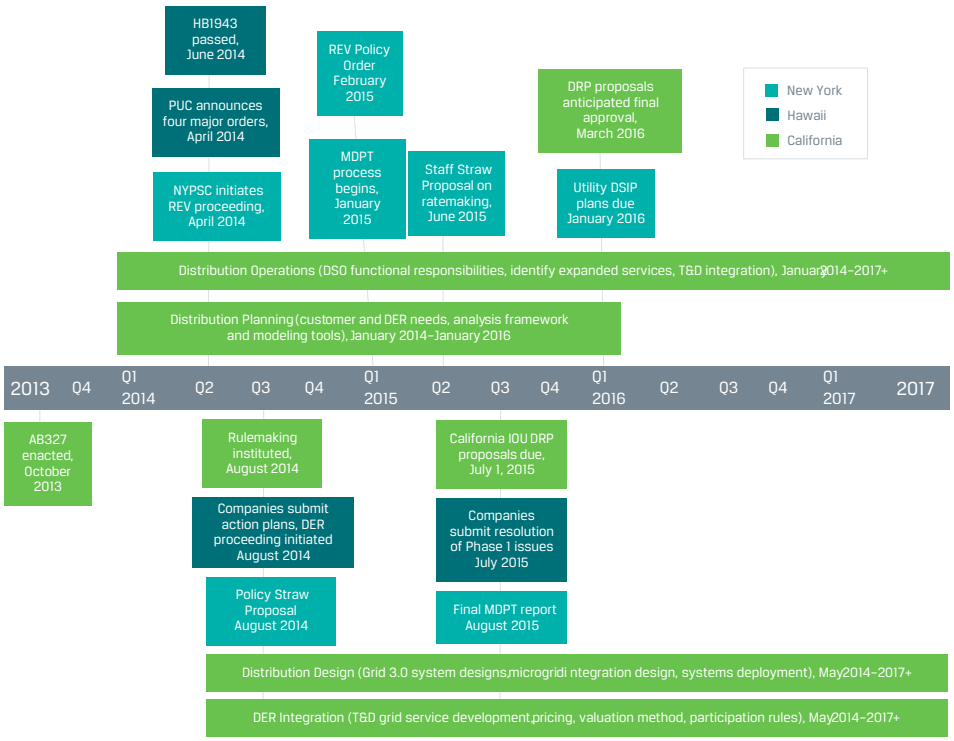
There are several other critical shared themes across the three states, such as the role of distribution system operators, the role of distribution platforms, and understanding the needs and role of customer decisions, and we expect to focus on them in future analyses. Overall, it is clear that integrating and enabling DER will require an evolution in how states and stakeholders plan, design, and implement systems and markets, and the current state initiatives offer a blueprint for stakeholders preparing to tackle these issues.

The DER Promise: Lower Rates, Better Reliability, Consumer Choice, Resiliency and Environmental Salvation

The increasing role and cost-competitiveness of DER in the power sector has raised hopes that these technologies can deliver a host of benefits: reduced system costs through avoided/deferred capital expenditures; increased resiliency enabled by storage, distributed generation, and microgrids; lower costs for customers through better demand side management and low marginal cost generation; and faster attainment of environmental targets by enabling low-emitting generation sources and electric vehicles. The rise of DER, however, will also impose costs, unintended consequences, and complexities.

In an effort to quantify and realize these benefits and mitigate costs and risks, California, Hawaii, and New York have each launched initiatives aimed at integrating current or anticipated DER penetration and addressing the resulting changes to utility planning and business models. Despite some variations in emphasis and timing, in the most fundamental ways the three state processes are converging toward a common set of goals, mechanisms, and shared elements. Broadly speaking, each state is pursuing three goals: reducing customers' energy costs, improving service reliability and reaching environmental targets. While each state has tended to emphasize those goals in a somewhat different order based on state issues, they have ended up considering the same set of questions and mechanisms, driven by the shared fundamental physics and power market economics.

EXHIBIT 1. TIMELINES FOR STUDY, PLANNING, AND IMPLEMENTATION OF THREE STATE DER/ MARKET INITIATIVES



Source: ICF

California currently has largest amount of DER in absolute terms and DER penetration is growing exponentially. While the state is certainly focused on making systemic changes to create an integrated grid, it is driven first by a clear set of state policy objectives related to the environment and the role of DER. Put another way, California is looking to turn the near-term challenge posed by DER growth into a long-term opportunity for customers and for policy goals. This has led to the enactment of state law AB 327 creating Public Utilities Code §769, mandating that California investor-owned utilities (IOUs) file Distribution Resource Plans (DRP) to integrate distributed, customer-owned resources into grid investment and operational plans. In addition, there are parallel proceedings on energy storage, integrated demand side management (IDSM), energy efficiency (EE) and net energy metering (NEM) as well – and all within the backdrop of increasingly aggressive renewable targets and GHG reduction goals. Alongside these proceedings, the California stakeholder driven More Than Smart initiative has provided recommendations for distribution planning, operations, and design of California's future grid.

Hawaii is similarly introducing policy innovation in response to market trends. Unprecedented rapid rooftop solar adoption — one out of every eight homes in Hawaii now has solar — has caused distribution circuits to back-feed during times of high utilization, leading to overvoltage and utility restrictions to photovoltaic (PV) additions. In response, Hawaii's PUC issued four orders, including Order No. 32052 requiring utilities to file Distributed Generation Interconnection Plans (DGISP) to upgrade distribution and integrate more PV. Hawaii has also enacted state legislation (HB1943) that will maximize the interconnection of solar PV, require changes to distribution planning, modernization of the grid and compensation for DER provided services[1]. Hawaii's regulators have responded with a sense of urgency to adapt to market changes as part of its proceeding investigating DER policies.

On March 31, 2015, the Hawaii PUC established a requirement for utilities to submit a plan within 90 days for "a) proposed revisions to applicable interconnection-related tariffs to mitigate near-term DER technical integration challenges, expedite interconnection process, and standardize technical specifications for fast-track approval of customer self-supply systems; b) New tariff systems; and for customer self-supply c) Proposed DER 2.0 Transition Plan, including tariff for grid-supply systems[2]."

[1] The Hawaii legislature also recently passed a bill moving the state's renewable portfolio standard (RPS) up to 100 percent by 2045.

[2] http://dms.puc.hawaii.gov/dms/OpenDocServlet?RT=&document_id=91+3+ICM4+LSDB15+PC_DocketReport59+26+A1001001A15 D01A84805H5843318+A15D01A92712J302731+14+1960

By contrast, NY has very little current DER adoption, low growth rates, and no state policy targets linked to DER development. NY's "Reforming the Energy Vision" (REV) initiative is rather intended to create an overarching regulatory framework that creates market opportunities for DER to provide system and customer benefits as well as improve resilience to hurricanes like Superstorm Sandy. New York's policy innovation intends to align utility business practices and incentives with the value of DER in an integrated grid through the animation of a distribution market. The REV process is split into two tracks: track 1 examines the evolution of the distribution system to an open platform to integrated DER through market designs and defining the new operational functions for utilities, including new grid and market facilitation services; track 2 examines changes in regulatory, tariff, and incentive structures. Currently, the Market Design and Platform Technology working group is developing recommendations for commission guidance on planning, operations, market mechanisms and technology to create a DER enabling platform within the context of Track 1.

Despite the differences in emphasis and approach, California, New York, and Hawaii share a focus on two major reform areas: distribution planning process and portfolio development. Other states looking at enabling DER will clearly have to address these areas as well.

Integrated Process Reforms: A New Distribution Planning Process...

As distribution systems experience increasing levels of DER interconnection, the three state processes all envision, if not require (California, Hawaii), an evolution in the integrated grid planning process. This integrated planning approach involves a wider and more complex range of engineering and economic valuation issues in an integrated and multi-disciplinary fashion, with the participation of relevant stakeholders.

In all three states, for example, the utility will continue to have responsibility for distribution system planning and construction. However, the new planning process must support the development of DER alternatives that meet current and future system requirements, and must meet and balance a variety of policy objectives, including system reliability and resiliency, customer empowerment, emission reduction, consumer protection, system efficiencies, cost-effectiveness, competitive markets, energy efficiency, power quality, and fuel diversity. This is undoubtedly a tall order.

The first step for utilities in establishing an integrated process is the development of a standardized planning framework, which could involve significant changes to traditional distribution planning, as outlined in Table 1. This framework has effectively been adopted in all three states and provides the basic elements of a standardized approach that can be used by others.

EXHIBIT 2. ELEMENTS OF A STANDARDIZED PLANNING FRAMEWORK	
Probabilistic-based engineering analysis	As customer DER adoption grows, the distribution system will increasingly exhibit variability of loading, voltage and other aspects that affect the reliability and quality of power delivery. Traditional distribution engineering analysis based on deterministic methods will need to evolve to include probabilistic methods.
Scenario based distribution planning	The uncertainty of the types, amount and pace of DER make singular forecasts ineffective: a better approach is to use at least 3 scenarios to assess current system capabilities, identify incremental infrastructure requirements and enable analysis of the locational value of DER.
Hosting capacity	Hosting capacity is the maximum DER penetration for which a distribution grid can operate safely and reliably. Specific methods are used to quantify the engineering factors that increasing DER introduces on the grid within three principal constraints: thermal, voltage/power quality and relay protection limits.
Locational value of DER	There may be incremental infrastructure or operational requirements that may be met by sourcing services from DER and/or better locational adoption of DER. The value this creates may be associated with a distribution substation, individual feeder, and/or section of a feeder. Net values may include avoided distribution utility capital and operational expenses as well as external environmental and customer benefits based on a specific location, but are not always a net positive.
Integrated T&D planning	At high DER adoption, net load characteristics have material impacts on transmission system / bulk power system operation. This creates a need for analysis of transmission-distribution (T-D) interaction through an iterative approach, since tools to perform a truly integrated engineering analysis don't exist yet. An important consideration is relative cost-effectiveness of managing DER-related variability locally within the local distribution area (LDA) versus exporting it to the transmission grid.

...is Not an Easy Lift

Each of the elements of this new planning framework is achievable, but will require the development of new methods and an integrated set of processes that individual utilities may not employ today. EPRI's Integrated Grid Benefit-Cost Framework[3] is an effective starting point for development of a standardized methodology for distribution planning, but it is not sufficient in practice to address the specifics of each utility's system and state regulatory rules, based on ICF's experience working with utilities to implement these new methods.

[3] Staff, Integrated Grid: Benefit-Cost Analysis Framework, EPRI, January 2015 http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002004878

Moreover, it is important for utilities to test these methods and models within their own systems as they are developing their distribution plans, not after. As EPRI says about their own framework: "Creating a robust grid modeling framework is essential, but it is not enough—it's just the first step. The technologies developed and operating procedures formulated must be subjected to rigorous, in situ field testing to ensure that they perform as intended." We agree, based on ICF's experience across the U.S. in helping utilities implement these upgraded planning elements.

In short, in order for utilities to understand the opportunities and risks in an accelerated DER adoption environment, they need to be addressing their planning framework and performing analyses, at least on a pilot basis, well in advance of any required DER integration-focused distribution plan.

Market Design and Portfolio Development…

Today, distributed resources have a number of opportunities to provide wholesale services including energy, generation capacity, transmission capacity deferral, and ancillary services necessary to operate the power system[4]. Additionally, changes underway in CA, NY and HI will create new distribution level opportunities for DER to be considered as alternatives to utility capital investment or operational expense. The New York PSC has stated explicitly that "REV will establish markets so that customers and third parties can be active participants…" and, "…distributed energy resources will become integral tools in the planning, management and operation of the electric system." California's DRP order also requires the creation of new services and using various pricing, programs and/or procurements to competitively source DER services (what NY calls "animating markets").

Likewise, Hawaii recognizes the value of distributed resources requiring compensation for "…electric grid services and other benefits provided by distributed generation customers and other non- utility service providers."[5] The potential types of services may include distribution capacity deferral, voltage management, power quality, reliability, and distribution line loss reduction. These services would be sourced through a combination of time varying rate designs, energy efficiency and demand response programs, and utility procurements.

As these state processes proceed and converge toward similar opportunities for DER to provide distribution grid services there is a growing recognition that a mix of time-varying rates, demand side programs, and procurements will be needed. Such a portfolio requires several new processes and analytical methods.

[4] Jurisdictional challenges to FERC Order 745 are noted.

[5] HB1943 p.5 – section 2 b.4. http://www.capitol.hawaii.gov/session2014/bills/HB1943_CD1_.pdf

First, existing demand side management (DSM) valuation techniques are not well suited for distribution grid services and require re-evaluation to address specific locational value for DSM resources. Second, a portfolio of distributed resources will need to be developed – however, unlike an integrated resource plan, this portfolio will potentially need to address a nested set of locational needs across individual feeders, substations and related local distribution area, rather than systemic needs. Development of such a portfolio, including the allocation of the sources of services, will need to address the operational firmness of the various resources as well as timing of when the distribution upgrade is needed. Further, this DER services portfolio will need to be dispatched in real-time, and so a dispatch priority protocol will need to be developed.

EXHIBIT 3. CONCEPTUAL PROCESS FOR DEVELOPMENT AND IMPLEMENTATION OF DER SERVICES AND PORTFOLIO

Source: De Martini

...Requires New Approaches

Policy makers across the three states are increasingly considering how to leverage the value of DER to reduce costs across the power system. The focus is increasingly on potential utility avoided costs that are identified in the new distribution planning process. These locational values linked to specific operational services will require a portfolio of distributed resources sourced through a variety of means to realize net benefits and reliable operations. But determining the portfolio and sourcing process, as well as dispatch, is far from easy: existing methods are deficient and new approaches are required to ensure that plans and DER service portfolios actually deliver value in operation.

ICF has been working with utilities, drawing on its expertise in DSM programs and grid planning and operations to develop new valuation methods to address some of these gaps. We have developed an integrated framework for considering these issues from planning through portfolio development and operational implementation as conceptually illustrated above. As with initiating an upgraded distribution planning process to enable greater DER penetration, ICF has found in working with regulators, utilities and stakeholders in the initial states that it is critical to get ahead of the curve in developing methods tailored to the specific needs of a particular locale.

The creation of pricing, programs and procurement processes has been iterative and involves heavy stakeholder engagement, so understanding elements of operational performance and locational needs and value can help stakeholders and especially utilities to work with regulators on designs that work both financially and from a reliability standpoint.

Conclusion

As much as the implementation of a new distribution planning process and the consideration of market design and portfolio development each require new thinking and new types of analysis on their own, one of the greatest challenges that we have seen across the three states is that this is an integrated process that impacts several previously disparate utility and regulatory processes. For example, the analytical inputs to the distribution planning process very much determine a utility's desired DER portfolio development. This means that successful consideration and implementation of these processes requires a synthesis of people and activities across departments: a level of internal integration that utilities and regulators were not previously required to achieve.

This is one of the many reasons that the California, Hawaii, and New York state initiatives and the others that are sure to follow will require a systemic change in the way that utilities, and perhaps all stakeholders, do business. A central aspect is the role of the customer decisions regarding adoption of DER and potential for leveraging these resources for the benefit of all customers. Customer insights and engagement are becoming a critical success factor in a more distributed electric system.

That is why we recommend that utilities with increasing DER adoption or in states considering initiatives in this area get as early a jump as possible in developing customer insights, adapting new distribution planning and related processes, identifying new enabling system capabilities, and considering what outcomes will best position them for the future.

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Steve Fine is a Vice President with ICF's Energy Advisory and Services practice, and leads the Distributed Energy Resources Team. Steve has expertise in evaluating the economics of conventional and renewable energy resources—both central station and distributed generation—within the context of developing technologies, market design and environmental regulations. He works with many of the major US power companies and developers in evaluating the impact of distributed energy resources (DER) on their system and the implications for their business models and their distribution system planning and operations. He has published numerous whitepapers on the Value of Solar and Distributed Resources and is actively working with the DER team to develop innovative analytical frameworks that can be used by utilities and third parties to more accurately assess the value of these resources in the context of system planning.

Matt Robison leads client projects focusing on distributed energy grid integration and associated regulatory proceedings on the evolution of distribution system planning, operations, and markets. He has helped develop ICF views and perspectives for utility clients on a diverse array of power sector issues including wholesale market design and transmission, but focuses primarily on the implications of distributed energy.

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