Conference Proceedings

ASES National Solar Conference 2016
San Francisco, CA, USA 10 – 14 July 2016

SMUD Solar: A Roadmap For Utilities in Transition

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Abstract

There is near universal agreement that the utility sector is in the midst of a transformation. The 100-year-old model of centralized generation and one-way power flow is being disrupted by alternative energy technologies that enable customers to generate and store their own electricity.

Recent surveys of utility executives confirm the conclusion that traditional utility business models need to change as a result of these (and other) disruptive forces. New technologies, renewable portfolio standards, and federal carbon regulations have created a minefield of issues and challenges for the electric utility industry.

As incumbent utilities grapple with the daunting challenge of reinventing themselves, the pioneering work at Sacramento Municipal Utility District (SMUD) provides a credible foundation from which to construct a new-age road map for utilities going forward. Methods and strategies employed by SMUD in the 1990s and 2000s can help utilities of all types successfully navigate this disruptive transition to a clean energy future.

Keywords: *solar, clean energy, technology adoption, disruptive innovation, alternative energy, electric power, grid-connected photovoltaics, distributed generation, commercialization, dispatchable storage*

1. Introduction

With the closing of the Rancho Seco nuclear power plant acting as a catalyst, Sacramento Municipal Utility District (SMUD) established a solar program with the mandate to promote the commercialization of grid-connected PV for both utility and end-customer applications. From 1992 through 2002, SMUD's solar program had a profound effect on the development and transformation of the entire solar/PV industry and earned SMUD a worldwide reputation for its affordable, clean, renewable energy programs.

The unplanned transformation of an electric utility, caused by the loss of its principal source of power, presents a rare opportunity to study and learn about how a utility can make the transition to renewable energy. An examination of SMUD's transition strategy shows the utility focused primarily on nurturing key markets with broad potential, using its buying power to lower the cost of photovoltaic panels, a technique referred to as Sustained Orderly Development and Commercialization (SODC). SMUD's transition plan also included offering a complete, standardized solar system "package" to residential homeowners in order to reduce the perceived risk of using a new technology.

The ability to field and interconnect large volumes of small-to-large PV systems on a utility's grid in a

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Selection and/or peer review under responsibility of Scientific Committee
doi:10.18086/solar.2016.01.22 Available at http://proceedings.ises.org

simplified fashion and without adverse effects was proven. The willingness of mainstream customers to employ PV on a large scale – going well beyond early adopters – was demonstrated.

This paper describes the technical, economic and cultural techniques used by SMUD during a time when it was forced to replace nuclear power with renewable energy. Based on the experience and results achieved at SMUD, our goal is to provide valuable insight and a roadmap for all utilities in transition, looking to navigate their way to a clean energy future.

2. An Unplanned Transition

The Sacramento Municipal Utility District (SMUD) is one of the ten largest publicly owned utilities in the United States and serves approximately 1.4 million people in a 900 square mile service area in the Sacramento, California metropolitan area.

On June 6, 1989, Sacramento became the first, and only, community in the world to shutter a nuclear power plant by public vote. The plant was closed during an era of enormous concern about nuclear safety and economics. Closing the Rancho Seco Nuclear Plant initially forced SMUD to buy more than half its power from neighboring utilities. SMUD needed to replace the power generated at Rancho Seco and management explored a variety of options, with and without SMUD-owned resources, ultimately deciding to pursue a diversified portfolio of power sources, including wind and solar, along with a strong emphasis on conservation and energy efficiency.

3. Transition Strategy

The Solar Program at the SMUD was established with a mandate to promote the commercialization of grid-connected PV for both utility and end-customer applications. SMUD's transition to solar was focused on distributed generation at both customer and SMUD sites. While the utility put more effort into their residential solar applications than into any other single area, SMUD also developed a comprehensive set of "non-residential" grid-connected applications of PV that included: commercial building rooftop systems, distribution support at substations and electric vehicle recharging stations. But the efforts at SMUD that ignited the current solar industry revolution were based on the residential market through the SMUD's "PV Pioneer Program."

SMUD had already installed utility-scale PV arrays in 1984 (Rancho Seco I) and 1986 (Rancho Seco II). So their level of technical understanding and familiarity with solar electric systems was advanced and growing. This made the transition to renewables less of an unknown. The greatest challenge for SMUD was applying their experience to distributed generation at customer sites.

The SMUD Solar Program, running from 1992 to 2002, was established to implement a broad range of grid-connected PV applications on both sides of the utility meter and as a compliment to SMUD's extensive energy efficiency program. At the time the grid-connected PV market was virtually non-existent, consisting of only a few demonstration projects, so the high cost of PV was recognized as a barrier to widespread adoption.

There were two main facets of SMUD's transition strategy. The first was to use the utility's buying power to lower the cost of photovoltaic panels through a sustained multi-year commitment to purchase a substantial volume of PV each year with prices declining with each yearly block of purchases. This annual commitment to purchase was nearly one megawatt of PV at a time when the entire grid-connected PV market was measured in kilowatts. The second was an initiative to develop and improve solar business practices. This included creating a compelling whole product for mainstream customers by offering a complete, standardized solar-panel package while simplifying both interconnection and permitting.

As a result SMUD saw substantial reductions in PV project costs and began the process of transitioning PV from a 'public goods,' subsidized resource to a self-sustaining, commercialized resource for domestic, grid-connected applications. Through these market transformation activities SMUD was able to dramatically lower the cost of PV for its customers, stimulate local economic development, and begin the building a long-term market for grid-connected PV in the US.

Bulk purchase commitments provide PV manufacturers with the assurance of a future market that they need to expand their manufacturing capabilities and achieve cost reductions. This mitigation of risk and stimulation of new production, plus the effect of technology improvements associated with new production processes, combine to create structural changes that lead to lasting benefits. Production increases result in price reductions

that are permanent and provide a lasting stream of benefits, unlike demonstration projects or large one-time purchases.

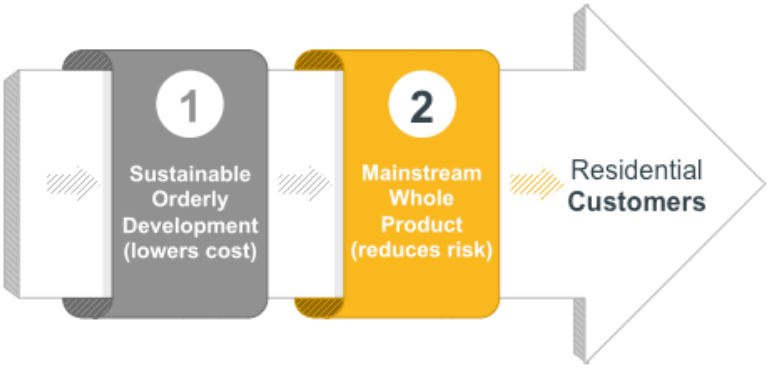

Fig. 1: SMUD's two-part strategy to encourage the adoption of solar power

The SMUD Solar Program included the first multi-year, large volume, broad based, customer sited, PV applications through its "PV Pioneer" Program. Through the sustained, multi-year, high volume purchase and fielding of PV systems, significant cost reductions and improved system performance results were achieved. The ability to field and interconnect large volumes of small-to-large PV systems on a utility's grid in a simplified fashion and without adverse effects was proven. The willingness of utility customers to adopt PV on a large scale – going well beyond early adopters – was also demonstrated.

During the first years of the PV Pioneer Program the homeowner simply lent his roof -- plus paid a small green energy surcharge to SMUD -- with the PV connected to the utility side of the meter. This gave SMUD experience in the application of distributed PV resources within its system, and provided the opportunity to gain the confidence of ratepayers for having PV on their homes.

Fig. 2 : Early SMUD PV Pioneer I System with SMUD's D. Osborn and D. Collier

This evolved into the "PV Pioneer II" program, in which the homeowner purchased their system for a subsidized amount and realized the benefit of power generation on their side of the meter, in a "net metered" configuration with the grid. This transition had the additional benefit that as the PV Pioneer I installations were "utility owned power plant," SMUD acted as the "permitting agency" avoiding the complications of permitting process not familiar with PV. This created an experience base for permitting agencies to benefit from once the PV Pioneer II (customer owned) program began and the traditional permitting agencies were then responsible. This also helped to develop the market infrastructure in the private sector needed to respond to the growing customer demand for PV systems in Sacramento.

It is important to note that when SMUD started its PV Pioneer I Program, there was no pre-existing, grid-connected market in place so SMUD was not using its monopoly status in unfair competition in an existing, viable market. Indeed, SMUD developed the grid-connected market and then nurtured the transition from the utility as the service provider to one of supporting a new and developing marketplace of private suppliers through the PV Pioneer II Program.

The fact that Sacramento could shutter its biggest energy source overnight and continue growing on a mix of conservation and renewable power suggests there are many options and alternatives for utilities going forward. The key to guiding any transition is an understanding of the dynamics of technology adoption and market

transformation, which are described in the following section.

4. A Framework for Technology Adoption

Mainstream technology marketing, as it is widely practiced today, is fundamentally a combination of models and techniques that are adaptations of earlier work. The technology adoption lifecycle for example is an extension of an earlier model called *the diffusion process*, which was originally published in 1957 by Joe M. Bohlen, George M. Beal and Everett M. Rogers at Iowa State University[1].

Everett Rogers extended this popular theory about how, why, and at what rate new ideas and technology spread in his book *Diffusion of Innovations* in 1962[2].

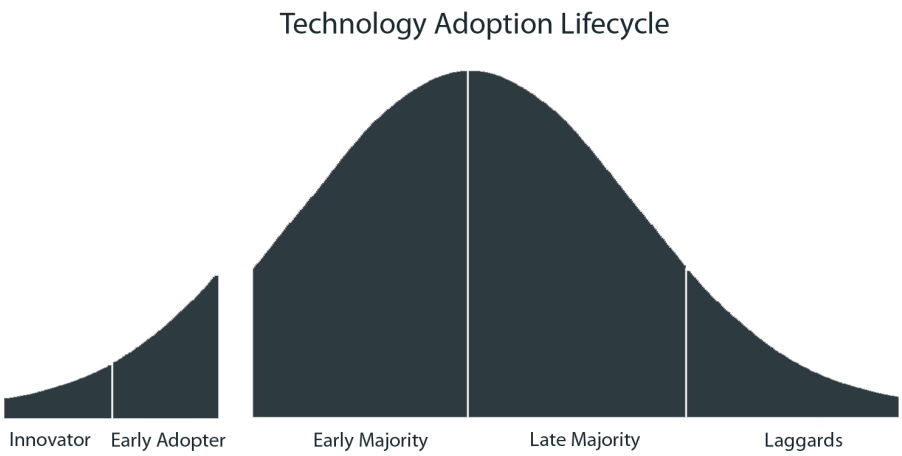

Fig. 3: The technology adoption lifecycle model

In 1989 diffusion theory was updated again, this time by Lee James and Regis McKenna while working with technology companies in Silicon Valley and the Pacific Northwest[5]. The updated model was called the "Technology Adoption Lifecycle," which in turn lead to development of the "Marketing Chasm" adoption model that later became the subject of a book by the same name, written in 1989.

Other modern day marketing models include Ted Levitt's "Total Product Concept[3]" (1980) that was adapted for technology products by Regis McKenna in his book *The Regis Touch* (1985) [4]. McKenna's book emphasizes the process of diffusing technology across various classes of users ranging from innovators to early adopters to late adopters and laggards and the corresponding evolution of the "Whole Product."

Despite their relative age, several of these books are still required reading in entrepreneurship courses at Stanford, UC Berkeley, Harvard, and MIT. Technology adoption theory is taught in all business schools worldwide.

5. A Model for Mainstream Market Adoption

The most common technology adoption framework in use today -- The Marketing Chasm -- is a seven-element program designed to accelerate adoption of an emerging technology by a mainstream audience causing it to be accepted and put into practice. According to the framework, any program designed to encourage mainstream market acceptance must contain the following seven elements:

1. Select a Target Customer -- Select an identifiable economic group of buyers and focus your efforts on satisfying that specific segment of the mainstream market
2. Understand the Compelling Reason To Buy -- Ensure that the target market has a compelling reason to buy the new product or technology, as soon as possible
3. Define the Whole Product -- Determine what makes the product "complete" in the eyes of your initial target customer. The whole product is the complete set of products and services required by the target customer to achieve his or her compelling reason to buy. This often means the core product/technology must be augmented with a variety of services and ancillary products to become complete.

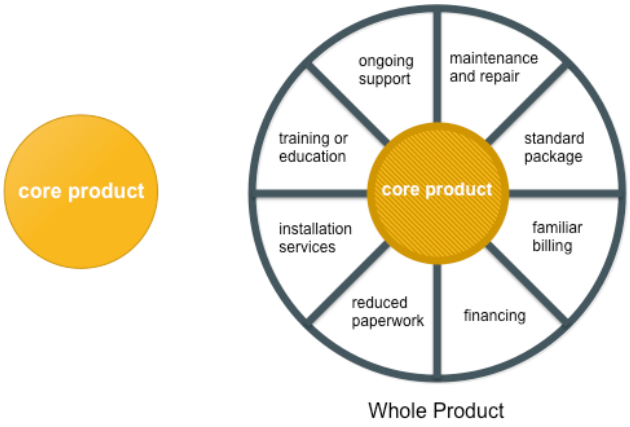

Fig. 4: The Whole Product Concept as applied to SMUD's PV Pioneer Program

4. Recruit Partners and Allies -- It is rare for a single organization to be able to deliver every piece of a whole product. So the only way to satisfy the whole product requirement is to an organization must recruit the necessary partners and allies
5. Use Appropriate Pricing -- Price must be appropriate for the category of product being offered, and the financial transaction needs to make it is easy for the customer to buy.
6. Select Familiar Channels of Distribution -- Mainstream customers have very strong preferences regarding who they buy from and they especially like to buy from people and channels they already know. You must present your new product via a familiar channel
7. Communicate the Right Messages -- Position the organization and the offering in a way that reduces risk in the eyes of the buyer. The organization must be seen as a credible provider of products and services to the target market.

6. SMUD's Technology Adoption Scorecard

The SMUD Solar Program met or exceeded the requirements in ***all seven*** of the areas of the Marketing Chasm technology-adoption framework. This achievement indicates SMUD was able to fully understand the personal needs, requirements and motivations of a mainstream audience. SMUD recognized the pragmatic and risk-averse nature of the mainstream buyer and designed a complete offering that leveraged all of the inherent advantages of a utility.

✓ Select a Target Customer -- SMUD selected homeowners as their principal target market and launched a two-phase program (PV Pioneer I and II) designed to place solar on residential rooftops. This emphasis on homeowners along with small businesses complimented the sustainable orderly development initiative by allowing SMUD to purchase PV modules by bid in substantial quantities, which progressively reduced the cost of their installed PV systems.

✓ Understand the Compelling Reason To Buy -- It is interesting to note that the event that forced a transition to renewables at SMUD, also became the compelling reason for residential homeowners to adopt solar power. At the time there was enormous concern about nuclear safety both locally and around the world. The Rancho Seco Nuclear Power Plant was nearly identical to the Three Mile Island reactor. Rancho Seco also had a very checkered operational history leading to substantial rate increases. The concern about the safety of nuclear power caused SMUD ratepayers to demand an alternative.

✓ Define the Whole Product -- It is in this area where SMUD absolutely excelled. SMUD augmented a standardized 4-killowatt solar system with a long list of intangible product attributes – streamlined permitting, educational materials and programs, installation services, ongoing support, convenient billing, etc. The result was a complete offering for mainstream homeowners.

✓ Recruit Partners and Allies -- SMUD obviously recruited the necessary installers, contractors and equipment

suppliers needed to create a whole product. However SMUD's list of partners and allies included local governmental agencies that helped streamline the permitting process. In many cases, this meant empowering a local jurisdiction so that administrative processes could be expedited.

- ✓ Use Appropriate Pricing -- Initially SMUD asked customers to pay a $4 per month premium to host a SMUD-owned solar array on their rooftop. With PV Pioneer II the customer could purchase a 2 kW solar array for $6,000. These prices were appropriate for the category at the time each program was active.
- ✓ Select Familiar Channels of Distribution -- At the start of the SMUD PV Pioneer Program, there was no pre-existing, grid-connected PV market. As a result SMUD could use its well established relationship with customers already familiar with their local utility as a provider of electric power providing an important level of confidence with what was perceived as a new, untested technology without the profound issues of unfair competition in an established marketplace. SMUD, under PV Pioneer I, first solicited participating customers to provide their roofs for a SMUD owned PV "power plant," building market awareness, experience, and confidence while beginning to build the capabilities of marketplace providers. Then SMUD transitioned to the PV Pioneer II program, where customers were buying the PV systems through SMUD incentives and guidance from a growing body of providers. Throughout, the SMUD customer had the assurance of "going solar" with the confidence of SMUD's involvement.
- ✓ Communicate the Right Messages -- SMUD recognized a critical characteristic of the mainstream audience they were targeting, that people could "go solar" safely and with ease. People have never had to evaluate multiple energy vendors before selecting a supplier let alone evaluate a new technology mix. So SMUD used their position as a known provider of electric power and communicated from the position of a trusted advisor to the homeowners in Sacramento. This was a very powerful positioning strategy.

7. Commercialization Strategy

In considering the commercialization strategy to pursue, many have looked at the solar programs in Japan and concluded that substantial "buy-down" incentives were the key to success of commercializing grid-connected PV. Others concluded from programs in Germany that a high "feed-in" tariff was the key success factor. However, it was not the specific incentive chosen that made these programs succeed. Rather, it was how each program was implemented and sustained over time.

In order to accelerate the long-term cost reductions required for full commercialization, the solar industry needed reliable, substantial, growing and sustained market volume. And manufacturers need long-term, reliable programs in order to invest the capital required to ramp up production to meet that demand. Therefore, to be effective, any renewable energy commercialization program, whether national or local, must include the following attributes:

Sustained: sustained over a period sufficient to result in market and manufacturing changes – typically at least a decade. Gaps in incentive funding can quickly gut its effectiveness.

Orderly: policies that have sensible consistency over time, and are not revisited, or turned on or off, in each year.

Substantial: substantial enough to affect market changes – resulting in a series of doublings of the market, perhaps in concert with other initiatives. Sufficient incentive funding for long-term success must be assured, but too large incentives are counterproductive.

Predictable: predictable over the initiative period so investors, manufacturers, and suppliers know what the details and ground rules are for the entire period, including the multiyear program plan.

Credible: credible with the investors, manufacturers, and dealers so they are confident in making the needed investments to significantly expand supply. If the investor does not believe the multiyear program is credible, if funding is uncertain or may have significant funding gaps, the incentive will be ineffective in expanding supply.

Ramped: ramped down over time to exert constant downward price signals and avoid an "incentive cliff" at the end of the incentive period. This also stretches out the incentive funds and yields increasingly greater returns for the incentive program.

The lack of any of these factors will result in an incentive policy that is ineffective or even counter-productive.

The problems experienced in many early statewide California programs were almost exclusively due to funding gaps and start/stop cycles. This lack of consistency reduced the investment in the PV delivery infrastructure and lowered the program's impact on cost reductions. Once these issues were corrected, programs such as the California Solar Initiative began to grow explosively.

Any public policy aimed at accelerating the commercialization of a discontinuous innovation must itself be sustainable and lead to permanent changes. It must expand the market, stimulate new production and lower costs in ways that becomes embedded and structural. What are needed are sustained incentives and processes that will expand supply, help reduce transactional costs, and lower installed costs over time.

A successful transition to a new energy strategy also depends on human factors. To be successful it must have:

1. **The proactive support at the highest management levels**. Market transformation requies a long-term commitment and is disruptive to many traditional business plans. At SMUD, the General Manager (S. David Freeman) and the Board (led by Board President Ed Smeloff) made the solar program a very high priority and also provided high-level support.

2. **A dedicated, knowledgeable, and committed program team**. The manager of SMUD's Solar Program (co-author Donald Osborn) had extensive experience in solar that allowed him to develop, lead, and manage a dedicated team (including Dave Collier who was the lead engineer on Rancho Seco I & II) that was given ownership and "cradle to grave" responsibility for the entire duration of the program.

3. **A commitment for the long run**. A successful transitional strategy is a multi-year effort that is by its very nature, disruptive, and contrary to conventional business practices. Through the support of SMUD's General Manager and Board, the solar program had the flexibility and time to implement a strategy that looked far beyond the next quarter or annual budget cycle.

4. **Builds on previous work and forms a basis for follow-on action**. The SMUD Solar Program built upon key development and demonstration efforts of the 1980s; including the Solar Design Associates/New England Electric PV neighborhood in Massachusetts (led by co-author Steven Strong) and PGE PV Demonstration and Analysis Programs including Howard Wenger and Tom Hoff who provided the economic analysis showing the "stacked benefits" of the SMUD PV deployments. In turn, the SMUD Solar Program spearheaded efforts to broaden its impact through collaborative efforts with other utilities to gain broad acceptance of grid-connected, distributed generation. This included PVUSA, the solar test facility established by the US Department of Energy and a consortium of utilities, plus the formation of the Utility PV Group, which became the Solar Electric Power Association. The SMUD Solar Program incorporated the principles of SODC that were originally developed by Donald Aitken (co-author) for the California Energy Commission in 1991. Each of these outside experts were active, key collaborators in the development and implementation of the SMUD Solar Program and a key to its success.

8. Policy and its Impact on Market Development

The market creation potential of SODC should not be underestimated. Through its transformational initiatives, SMUD became the leader in utility grid-connected applications of PV with the world's largest, single utility, distributed PV power system. By 2002, nearly 10 MW of PV systems were installed in Sacramento distributed over some 1000 installations. These installations included residential rooftops, commercial buildings, parking lots, and substation power plants. While very small by today's standards, this 10 MW represented over half of the grid-connected PV in the US at the time and led directly to the California Emerging Renewables PV Program. Today, due to the success of the statewide program, California has over 12 GW of grid-connected PV.

The goal of a transformational energy policy should be to demonstrate the value and importance of a long-term commitment that assures solar energy will grow in the utility's district along a sustainable and assured path. As SMUD first demonstrated, this led to a reduction in the cost of solar for the utility and the industry, with a resulting reduction in costs for the installers and buyers. A real world market was established for all to see.

However it became clear that if the industry and the market were to grow only within the confines of a few individual utilities, it would not generate the scale or scope for an ultimate national conversion to clean energy. A new policy instrument was needed based on government mandate that included long-term goals (20+ years) and encapsulated widespread areas. One such policy instrument that is based on SODC is the Renewable Portfolio Standard (RPS), which wasfirst introduced in 1995 by one of the authors of this paper (DWA).

In complying with the RPS rules for their territories, individual utilities are following many of the program particulars set forth by SMUD and its use of SODC. As a result, the growth of solar and other renewables (both distributed generation and utility scale generation) has now risen to unimaginable global scope when compared to the 1990's. SODC has proven a viable policy to go beyond the results of standard diffusion models and accelerate commercialization much as seed crystals can accelerate a crystallization process.

The SMUD PV Pioneer Program was the first commercialization effort for grid-connected PV in the US and showed there was a real market there with no technical problems preventing it. It showed the power of SODC. The SMUD Solar Program set the stage for acceptance by other utilities (perhaps grudgingly) and regulators of distributed generation. Through its efforts, SMUD jump-started the California and national solar electric (PV) grid connected marketplaces through its PV Pioneer Program and broad but strategic commercialization efforts based on SODC. What SMUD did was the model for and directly led to the California Solar Initiative program that created a booming market. That set off the explosive growth of the PV market in California and thus in the US. This series of successful efforts and developing markets played a key role in the Paris Worldwide Climate Change Agreement. It also showed that what one does in one's community can indeed help to change the world!

So SODC is not an obsolete policy, nor are the lessons learned at SMUD. SMUD, in many ways, kicked-started the solar energy revolution in the United States, and demonstrated the techniques others can follow.

9. A Roadmap for Utilities in Transition

Utilities today are faced with substantial challenges to their century-old business model and are looking for new ways to adapt. Based on the lessons learned at SMUD, a utility might consider investigating new, distributed technologies with significant potential to serve target customers who have a compelling reason to buy, given there is the ability to assemble a whole product that meets that compelling need. The utility would also need to leverage their natural advantages in distribution and program financing, as well as use their position as a familiar supplier to make their program more acceptable to the target audience.

Many utilities have limited options to meet increasing demand for electric power: energy efficiency (consume less power), build expensive new generating facilities, or embrace clean energy through renewable sources. In addition, intermittency and peak load shifting (leading to so-called “duck curves”) raise additional challenges with increasing penetration levels.

During the first half of 2016, several utilities have launched pilot programs that integrate rooftop solar with dispatchable, distributed electrical storage (DDES), creating what is known as a “virtual power plant.” The goal of a virtual power plant is to transform distributed renewables into a single source of electricity and smooth out peaks and steep ramps in generation. These “grid assets” provide the added benefit of supplying backup power, while making a grid more flexible and reliable.

In many ways, DDES is in much the same market state that distributed solar was in the early 1990s. There are a few manufacturers, a number of early demonstration projects, no real or viable market, and tremendous but unfulfilled promise.

Using the technology adoption lifecycle as a roadmap, a utility wanting to encourage the adoption of DDES and virtual-power-plant technology must determine the customer’s compelling reason to buy, recruit the necessary partners and allies, and assemble a whole product or package to meet the customer’s need.

Through its whole product approach, SMUD made it “easy to go solar” by taking the risk out of the purchase decision -- while making everything easy to understand, to permit, and to interconnect. This included simplifying and standardizing the solar array, the intertie equipment, streamlining the interconnection process, and providing non-stop educational initiatives. This exact model would need to be followed and implemented for a virtual power plant program to be successful.

The challenge presented with the recently announced closure of the PG&E Diablo Canyon Nuclear Plant and the planned replacement of that capacity with a combination of solar, wind, electric storage, and energy efficiency presents an ideal opportunity to apply transformational programs to encourage and commercialize the application of virtual power plants. The Diablo closure presents much the same challenge as well as opportunity as the Rancho Seco closure decades earlier. The frameworks presented in this paper can be used to accelerate the commercialization of DDES power resources, which offer the most effective way to successfully

respond to this challenge.

Key stakeholders – state and local governments, the utility, equipment suppliers, other regional utilities – might implement a technology commercialization program specifically aimed at reducing the cost of distributed electric storage and associated controls while increasing its market acceptance. The combination of the SODC process with the whole product approach to mainstream adoption would lower risk, develop a sustainable market, and offer a cost effective way to respond to the Diablo closure.

The goal of every energy provider today should be to implement creative solutions that ensure customer choice while contributing to grid efficiency, reliability, resilience and security. And utilities will need to accept the realities of mainstream technology adoption for many of their transitional programs to succeed.

10. The Seven Deadly Sins of Utility Transformation

To make a successful transition to a clean energy future based on renewables and distributed storage, utilities must avoid seven specific pitfalls and errors. The "seven deadly sins" to avoid are:

- ⊗ **Favoring specific technologies:** it is imperative for a utility to take an "application" approach when defining the technical core of a whole product or complete package. Market transformation initiatives are much more effective when applied to a specific application (such as rooftop, grid-connected PV) rather than one specific technology such as thin film PV for example. Maintain a broad technology focus!

- ⊗ **Competing with the private sector**: it is also imperative for a utility to avoid using its monopoly power to compete in established markets against the private sector. SODC is a transformational technique that requires planned changes to both incentives and the product delivery mechanism. The private sector must be nurtured and supported as it undertakes product delivery that was initially managed by the utility.

- ⊗ **Placing convenience over customer need**: the catalyst for driving adoption by mainstream customers is to understand the target customer's compelling reason to buy, which may not match a utility's idea of what is easy to implement. The preferences of the mainstream customer must out-rank the needs of the utility.

- ⊗ **Target customer confusion**: it can be tempting to observe the natural interest early customers have in a new technology and accidentally build your distributed energy resources based on the preferences of early adopters. Don't target early adopters. The complete package needed to attract mainstream customers is radically different.

- ⊗ **Clinging to old relationships**: both SODC and mainstream technology adoption rely on two-way, mutually beneficial relationships with customers. The old philosophy of treating your customer as "a meter" in a one-way world of centralized generation will not fly. Customers are now partners.

- ⊗ **Process management fragmentation**: the effectiveness of a transformation program can be radically diluted when a utility uses process management teams in which different groups are responsible for different phases of the program. The SODC effort is most effective with a dedicated, knowledgeable, and committed Program Team with cradle to grave responsibility.

- ⊗ **Waiting for a commercial market to form**: time is not always on your side when making a transition to distributed/renewable energy and its new business model (see Rancho Seco example above). Sometimes the utility must actually create the commercial market needed to successfully re-invent itself. Use the powerful framework of SODC to create new markets if none exist.

11 A Word of Caution

When SMUD designed the PV Pioneer Program there was little or no data about solar-technology adoption upon which to base critical decisions. And solar market development over the past 30 years has been a venture into the unknown.

When experience-based data are not available, market development frameworks such as SODC and the technology adoption lifecycle are often the only choice because they predict what an outcome will be, even

though a specific situation is unprecedented.

The technology adoption lifecycle and the whole product concept were created to serve the needs and circumstances of commercial companies. And the objective function of a company is best expressed in terms of earnings before interest, taxes, depreciation and amortization (EBITDA). Mainstream technology marketing has a meaning in that context. However, an entity such as a university, a hospital or a public utility has an objective function that is very different from EBITDA and net margins.

Market development models are not universal truths. Models enable a discussion within organizations and provide organizations with a framework that encourages them to reflect on their strategy. All models and frameworks have weaknesses and incompatibilities. Reality is always more complex. Despite their potential shortcomings these models were proven at SMUD to be very useful.

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