DISRUPTIVE TECHNOLOGIES IN THE CABLE TV AND ELECTRIC UTILITY INDUSTRIES

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Contents
History of Cable and Electric Utilities ................................................................. 3
New and Emerging Technologies ................................................................. 5
Industry Impact and Response ................................................................. 13
Can these Technologies Disrupt the Current System? ..................................... 14
Cost Effectiveness of New Technologies ......................................................... 16
Revenue Generation .................................................................................. 19
Industry Response and Adaptation – Past, Present and Future ......................... 20
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ABSTRACT

This paper highlights the parallels between the introduction and impact of potentially disruptive technologies in the cable television and electric utilities industries. Both the cable television and electric utility industries are facing increasing competition in the form of new technologies. The advent of DVR and internet streaming provided individuals with new ways to consume television programs and altered the way television shows are created. Consumers can now watch a large number of programs online without a cable subscription through paid and free streaming services. While first designed to stream content that had previously aired on television, streaming services like Netflix, Hulu and Amazon have further bypassed the cable system by creating original internet-only content. Similarly, advancements in photovoltaic distributed generation, battery storage and micro grid technologies have given customers more energy choices and the ability produce and consume energy independent of the utility’s transmission and distribution infrastructure. As with streaming services that require a cable subscription, these new technologies often work in tandem with the existing utility systems. Most rooftop PV customers remain connected to the utility grid and sell excess energy to the grid in periods of peak PV output and consume energy from the grid when PV output is low. However, experimental homes and neighborhoods utilizing battery storage and have completely bypassed the utility system. While, relatively new and with only a small portion of “early adopter” customers currently abandoning the cable TV and electric utility system in favor of these technologies, they have the potential act as disruptive market forces. If more customers choose to forgo cable subscriptions or install PV, revenues in the form of cable subscription fees and electricity rate payments will decline, and cable and electric utilities will have to learn to adapt to accommodate these new technologies or risk becoming obsolete.
DISRUPTIVE TECHNOLOGIES IN THE CABLE TV AND ELECTRIC UTILITY INDUSTRIES

The cable television and electric utility industries face increasing competition in the form of new technologies, such as online video streaming and distributed generation resources. These emerging technologies have the potential to disrupt the status quo of these industries and shape the television and energy systems of the future. This report explores these new technologies, their impact on the dominant players in both industries, namely electric utilities and cable-TV providers, and the potential of those players to adapt and coexist with these new technologies in the future.

History of Cable and Electric Utilities

Today's transmission lines can carry power thousands of miles, but this was unheard of in the early 1900s when transferring power a mile away was no small feat. Instead, small power plants littered cities and generated electricity for customers in their immediate vicinity. The advent of scalable steam turbines and alternating current (AC) transformers made it possible for utilities to generate large amounts of electric power at a central location and send that power to faraway customers using AC transmission lines. Soon, the old system of distributed generation resources gave way to the large-scale electric system we see today due to declining marginal costs and increasing economies of scale. Under this system, an array of small firms providing electricity to the same area was deemed inefficient, both because market entry called for extensive capital investment in generation and distribution equipment and because the existence of multiple distribution systems in the same area was duplicative and unnecessary. As such, territories were outlined and electric utilities were allowed to operate as government-regulated monopolies.

Prior to electric restructuring, electric utilities in California were largely vertically integrated, with utilities exuding monopolistic control of generation, transmission, and distribution of power in their service territories. The Public Utility Regulatory Policies Act (PURPA) of 1978 designated cogeneration as a form of energy efficiency and introduced competition into the generation sector. Enacted in response to the 1973 energy crisis, it created a market for non-utility generation and required corporate utilities to purchase power from these qualifying facilities (QFs). Spurred by the ability of non-utility generators to produce power at costs comparable to power generated by electric utilities, government regulation further challenges to the utilities’ natural monopoly status. The 1992 Energy Policy Act (EPACT) allowed non-utility generators to access transmission networks. Finally, California passed the Electric Utility Industry Restructuring Act (AB 1890) in 1996, establishing Direct Access (DA), which granted customers the option to choose their electricity supplier. California suspended DA in 2001 but reopened it in 2010 for select non-residential customers. Additionally, it required the investor-

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1 PBS
owned utilities (IOUs) to divest at least half of their generation assets.\(^2\) With this, the transmission and distribution systems continued to operate as regulated natural monopolies, but the IOUs divested much of their generation and primarily became deliverers of generation, a system that remains in place today.\(^3\)

Like electric utilities, cable companies have largely operated as natural monopolies, but unlike the electric utility industry, vertical integration in the cable television market was absent at the onset but has increased over time. Prior to the advent of cable television, television signals were broadcast directly from stations to consumers. These signals were subject to distance constraints and easily impeded by large natural objects or man-made structures (e.g. hills, tall buildings, etc.), making it impossible for many individuals to watch television. Cable television was created in 1948 to serve communities that were unable to receive broadcast TV signals. Cable providers aggregated signals and distributed those using coaxial cables, amplifiers and antennas. It wasn’t until later that cable providers moved from simply distributing content created by networks to creating their own content.

Cable television systems were largely unregulated until the 1960s when the Federal Communications Commission (FCC) established the first rules for all cable systems, and the Supreme Court established the FCC’s authority over cable systems in order to preserve local broadcast service and ensure equal distribution of broadcast services across the country. A number of rules were enacted in the early 1970s pertaining to franchise standards, syndication exclusivity, and a host of other areas, but they were soon repealed. As a result, Congress approved the Cable Communications Policy Act of 1984 that established policies on issues such as ownership, channel usage, franchise provisions and renewals, subscriber rates and privacy, and obscenity. This led to an increase in the number of channels that could be offered and the number of cable subscribers but did nothing to increase competition in the industry. The Telecommunications Act of 1996 largely deregulated the cable industry as a means of increasing competition and innovation. Before this act, cable providers were allowed to enact exclusive regional franchises in exchange for building cable infrastructure to the region. The bill ended this practice and also allowed phone companies to offer TV service and cable operators to deliver phone service and internet. Subsequent FCC rulings approved mergers and allowed ownership of multiple media outlets in the same market by a single company, potentially leading to an increase in market power for large cable companies.\(^4\)

Today, cable companies face increasing competition in the form of telecommunications and satellite companies that also offer pay-TV services as an alternative to cable. Conversely, many cable companies have expanded their service territories through mergers, and some now own not just the infrastructure to distribute cable television across the country but also the networks that produce the content that airs on TV. In fact, six companies (Disney, Viacom, CBS, News

\(^2\) World Nuclear Association, 2014
\(^3\) IEPA
\(^4\) FCC, 2012
Corp, Comcast and Time Warner), two of which are cable companies, own most of the largest broadcast and cable networks and now movie studios in the country.

**New and Emerging Technologies**

A multitude of technologies have emerged in recent years and altered the electric utility landscape, most notably photovoltaic (PV) distributed generation (DG), battery storage, and micro grid technologies. Distributed solar PV is the most prominent of these technologies. Non-utility PV installations in the U.S. increased from 3 MW in 2000 to 1,904 MW in 2013.\(^5\) In 2011, there were 200,000 distributed solar customers in the US with roughly 2,400 MW installed between them, 70 percent of which is concentrated within 10 utilities.\(^6\) For the first time ever, the utility, commercial and residential market sectors each installed more than a gigawatt (GW) of PV in 2014.\(^7\) While the utility and commercial sectors had installed over a GW each in prior years, this was the first year the residential sector passed the 1 GW mark. Despite lagging behind the other sectors, distributed residential PV is the fastest growing of the three market segments, experiencing three consecutive years of greater than 50 percent annual growth.\(^8\)

**Figure 1: U.S. PV Installations 2000-2014**

Source: SEIA, 2015

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\(^5\) SEIA, 2013  
\(^6\) SEIA, 2014  
\(^7\) SEIA, 2015b  
\(^8\) SEIA, 2015a
These trends are expected to continue because of the policy push towards a greater reliance on renewable energy in the United States. Renewables are a tool to achieving national carbon reductions under the EPA’s Clean Power Plan, but no formal national mandate for increased renewable energy generation exists in the U.S. Individual states, however, have enacted renewable portfolio standards (RPS), regulatory mandates that require a certain amount of the energy generated or sold by utilities, depending on the state, be from renewable resources such as wind, solar, or hydropower, as well as similar but non-binding renewable portfolio goals (RPG). 29 states, Washington DC and two U.S. territories have adopted an RPS, and an additional 8 states and 2 territories have adopted RPS goals. Of those, 21 states have an RPS with solar or distributed generation provisions. Distributed solar generation does not count toward California’s RPS because the RPS is set a percentage of utility sales, but separate from the state’s RPS, Jerry Brown issued an executive order that sets a target of 12,000 MW of DG by 2020 in California. Distributed systems smaller than 20 MW will be counted toward the target, so it is unclear how much of 12,000 MW will be customer located, but even larger DG systems are less reliant on the utilities’ distribution and transmission systems than centralized power plants.

While increasing distributed PV penetration will displace large amounts of utility distribution and allow consumer greater control over their energy supply, distributed solar PV typically exists within the framework of today’s electric utility structure. This can be attributed to the variable nature of PV generation, which keeps PV customers not content to forgo electricity when the sun isn’t shining tethered to the grid. These customers sell generation back to the grid under net metering contracts during periods of excess generation and buy electricity from the grid when their usage outpaces PV output.

By storing excess energy for later use and automatically deploying it when and where it’s necessary, battery storage and smart technologies (micro-grid, meter and inverter) could help consumers manage PV variability and achieve energy independence. Current battery storage and smart technologies, however, have not yet made it possible or economically viable for all customers with DG PV to disconnect from the utility grid. As is, smart inverters are not yet widely available in the U.S., and economically feasible battery storage systems that in theory provide DG customers with control over their reliability needs, reduce demand charges, and allow customers to take advantage of TOU rates by shifting grid-consumption to off-peak periods or selling energy back to the grid when prices are high are new to the market.

Tesla, a major player in the electric vehicle market, introduced the company’s first home rechargeable lithium ion battery, the Powerwall in April 2015. Coming in two sizes, 10 kWh for backup applications and 7 kWh for daily cycle applications, the units cost $3,000 and $3,500, respectively, without installation or inverters. Musk noted that no comparable systems exist for anything close to those prices, and analysts say that the price per kWh of the smaller unit is nearly half that Iron Edison’s lithium-ion residential storage battery the LiyfePO4. Tesla also

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9 SEIA
10 Shahan, 2015
introduced a $250/kWh commercial version named the PowerPack that is “infinitely scalable” and consists of 100 kWh blocks that can be combined to create systems of any and all sizes.\textsuperscript{11}

Musk referred to Powerwall as “a fundamental transformation of how the world works, how energy is delivered across the earth.”\textsuperscript{12} This speaks to Tesla’s larger strategy of changing the way we produce and use energy. The company has had its eyes set on the energy industry, most notably the energy storage market, for years. In a 2014 interview, the company’s chief technology officer and cofounder, Jeffry Straubel said that he sees Tesla more as an energy-innovation company. Straubel highlighted the importance of affordable energy storage in increasing its vehicle sales, noting, “If we can reduce energy-storage prices, it’s the most important thing we can do to make electric vehicles more prevalent,” however; increased vehicle sales were not the company’s only goal. Straubel outlined plans for a total disruption of the current energy industry when storage is paired with renewables. “Add in renewable power, and I have a direct line of sight towards an entire economy that doesn’t need fossil fuels and doesn’t need to pay more to do it.”\textsuperscript{13}

Even before the introduction of Powerwall, Tesla provided SolarCity with batteries for its commercial and residential PV storage systems. Since 2013, SolarCity has offered DemandLogic, a smart energy storage system for commercial PV customers that uses Tesla’s lithium-ion batteries and is designed to protect customers against rising utility demand charges and costly outages.\textsuperscript{14} In theory, the system helps to reduce the demand charge businesses pay to utilities using software that automatically discharges stored energy when demand spikes to reduce peak demand.\textsuperscript{15} Figure 2 details this process. Further, the system provides backup power during outages, helping customers avoid potential losses in revenues associated with their businesses losing power.

\textsuperscript{11} Randall, 2015
\textsuperscript{12} Justice, 2015
\textsuperscript{13} Business Insider, 2014
\textsuperscript{14} Wang, 2013
\textsuperscript{15} SolarCity
SolarCity also offers a residential storage system to provide backup power that now includes the Powerwall. It uses software to monitor energy use so the SolarCity can make recommendations on when it’s cheapest to consume energy and the best rate plans for customers. In theory, such a system could be used by residential TOU-customers to reduce costs by automatically discharging power during expensive on-peak periods and charging using power purchased from the grid during cheaper off-peak periods, but net metering policies make these costs savings improbable. Elon Musk stated that the smaller Powerwall system, which is designed for daily use, does not make financial sense for U.S. solar customers with net metering agreements because solar used to charge the systems could instead be sold back to the grid. If the difference between on- and off-peak TOU rates widens substantially and/or net metering policies disappear or become less favorable to PV customers, this may change. Until then, SolarCity’s residential storage offering will continue to be marketed as a backup power provider, offering protection from outages and natural disasters, and include only the 10 kWh Powerwall. SolarCity hopes the system serve as a substitute for natural gas or liquid propane stationary backup generators. Unlike a generator that requires manual start-up, SolarCity’s battery storage system turns on automatically when an outage occurs and relies on the sun as opposed to fossil fuels to operate.

Like Tesla, SolarCity has made no secret of its desire to shape the future of the energy industry with these battery storage systems. In 2013, CEO Lyndon Rive told The Atlantic, “Our business model is to become the energy company of the 21st century.” Whether that business model will
supplant the existing utility system entirely remains to be seen, but Rive leaves room for the two systems to coexist to an extent. “You’re still connected to the grid, but the grid would be your secondary provider and the primary provider would be your solar system and your storage device.”

While SolarCity and Tesla develop and distribute new energy systems, corporations and researchers have been combining a variety of emerging energy technologies in experimental homes and communities that demonstrate new models for electricity generation in order to analyze both how these technologies shape customer behavior and how to best implement these technologies on a large scale. Honda partnered with UC Davis to create the Honda Smart Home. The home, completed in early 2014, is outfitted with energy efficient materials and design features, solar PV and energy storage and produces enough energy to power the home and charge an electric vehicle. The heart of the home is Honda’s home energy management system (HEMS). Honda’s HEMS is a hardware and software system monitors and optimizes energy consumption across the home’s micro-grid. UC Davis faculty or staff members will live in the house for three years, and Honda will collect data on the home during this period. Along with the blueprints and a list of materials used to build the home, Honda will make this data available to the public for analysis in order to spur further innovation and understanding of how people use energy.

Perhaps the largest example of consumers using energy in ways that subvert the utility business model is Pecan Street Inc., a $30 million initiative developed by the City of Austin, Environmental Defense Fund, municipal utility Austin Energy and the University of Texas. Billed as a testing ground for a smart grid and the largest residential energy research network, the Texas-based initiative is centered on Mueller, an experimental neighborhood in Austin, but has recently expanded to neighborhoods in California and Colorado. Over 200 Mueller homes have rooftop solar, 50 have electric vehicles, and smart grid technologies in the neighborhood include automated meter information, Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) smart meters, HEMS, distributed generation systems, intelligent load control, and advanced billing platforms.

Like UC Davis and Honda, Pecan Street hopes data from its project will help to advance these technologies. It is collecting terabytes of customer data using its Dataport technology and making it available to researchers across the globe. With 200 billion data points, Dataport is the largest source of disaggregated customer data for university researchers in the world and allowed Pecan St. to evaluate over 30 smart technologies. In analyzing this data, Pecan Street found the following:

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18 Woody, 2013
19 We toured the home in 2014 with Michael Koenig, the Project Leader for Honda Smart Home US. When asked, Michael said the house could island but that was not the intention.
20 Koenig, 2014
21 Pecan Street Inc., 2015, p. 5
22 Pecan Street Inc., 2015
Households who were able to view their energy consumption data did not experience statistically significant reductions in energy use.

Households with the mobile app, smart thermostat and portal access practiced greater energy conservation behaviors than households without these technologies.

Generic recommendations like “how to save money on your electric bill” do not cause long-term behavioral changes. Data that is analyzed through software to produce recommendations that are highly tailored to specific situations are more useful in creating long-term behavioral changes.

- Recommendations with specific actions have an impact on energy usage even without monetary incentives.

South-facing PV panels may produce more overall energy, but production from west-facing panels most closely matches with peak demand.

- Utilities may want to provide higher rebates for west-facing systems.

Electric vehicle charging mostly occurs during peak demand hours but not at the level assumed in previous research models. This means that negative impacts to the distribution system from EVs likely begin to occur at higher penetration levels than previously assumed.

As these homes move from testing grounds to actual communities throughout the U.S., insights from experiments such as Mueller and the Honda Smart Home will help individuals and communities gain more autonomy over their energy systems.

People are becoming more independent with regard to electricity generation and reliability, and by the same token, individuals are becoming more independent about their television viewing habits thanks to a number of new technologies and content generators, many of which are further along than their energy-industry counterparts. In January of 1999, TiVo introduced the world’s first digital video recorder (DVR) at the Consumer Electronics Show. The following March, TiVo DVRs were available for consumers to purchase. Soon after, Dish created its own DVR, and other cable providers followed suit, making DVRs readily available to all cable customers for a small monthly fee. Though TV viewers had previously been able to record live television programs to watch at a later date using a VCR, the advent of the DVR marked the first time viewers could pause live TV and record entire seasons of a show on a single device equipped with a hard drive. Later advancements in DVR technology made it possible to record multiple shows at once, watch one program live while recording content on another channel or channels, and record programs on one device and watch them on another. During this same period, cable companies introduced on-demand viewing to customers with set-top boxes that allowed customers access to a bevy of previously aired programs. As result, television viewers were gained previously unheard of levels of autonomy over their viewing habits and were no longer entirely beholden to network programming schedules. Time-shifted viewing became the norm for many viewers, as they could watch programs when it was convenient for them, be it 30 minutes or 30 days after the program originally aired.

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23 TiVo
DVRs set the stage for today’s digital television revolution by granting viewers unprecedented autonomy over their viewing habits, but like today’s PV and storage systems, they are still largely tied to current cable system and infrastructure. To record a program, one must have a television, and if that program is on a cable network, one must also have a cable or satellite subscription. By contrast, online video distribution software and hardware simultaneously work in tandem with the current system, and completely circumvent it, all the while granting viewers autonomy over not only when they watch television but where.

In the early days of online video distribution, there were few if any viable legal methods of watching television programs online. Millions of tech-savvy individuals streamed or downloaded pirated copies of movies and television shows online for free with only rare instances of legal consequences for viewers. Beginning in the mid-2000s, a number of legal internet-video services were introduced, and customers concerned about breaking the law by illegally downloading or streaming videos or those sick of the inconsistency in quality found in illegal internet-video offerings, flocked to these services. They can be paid, free or some combination of the two and generally fall into the following four categories.24

- **Transactional (Electronic sell-through):** customers pay a one-time fee to download a video to their device(s). The customer can authorize one or a small number of devices on which to download and store the video (e.g. iTunes, Amazon, Vudu).
- **Transactional (Rental):** Customers pay a fee to access a video for a specified amount of time. Perhaps due to the low cost of purchasing an episode of television, this is typically limited to movies (e.g. iTunes, Amazon, Vudu).
- **Subscription video-on-demand:** Under these services, consumers pay a monthly or annual fee that grants them access to a collection of television shows and films that they can then stream over the internet. Often times, there are no ads present on videos viewed using these services, but this is not always the case (e.g. Hulu Plus, Netflix, Amazon Prime).
- **Ad-supported video-on-demand:** These distributors are free to anyone with an internet connection and allow viewers to watch a program online with limited interruption by advertisements (e.g. Hulu, broadcast network websites, YouTube, Vimeo).

Most major cable networks make their programs available to stream online for those with cable subscriptions, but we will focus on services that do not require a cable subscription. Using these services, viewers can watch both backlogs of old shows and currently airing programs without cable. The initial offerings of Netflix, Hulu, etc. were not expansive enough to allow avid TV fans to cut the cord without forgoing access to many of their favorite programs, but this is no longer the case. Currently, these transactional and video-on-demand providers’ libraries offer at least 226 of IMDB’s top 250 shows. Netflix, alone offers nearly half of the top 250 shows.25

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24 KPMG, 2015, p. 2
25 Ravenscraft, 2014
In April 2014, HBO made most of its shows (old and new) available to stream online for Amazon prime subscribers. Though those with a cable subscription could already view these programs on HBO’s original streaming service HBOGo, accessing HBO shows through Prime does not require a subscription to HBO. This marked the first time HBO programming was legally available without a traditional pay-TV subscription. A year later, HBO launched its own standalone streaming service, HBO Now, to further target cord cutters. Access to the service is currently restricted to Cablevision broadband customers or those iPhone, iPad, and Apple TV owners but is expected to expand to other platforms in the future.

In addition to previously aired programs, consumers can now stream live TV channels online without a cable/satellite TV subscription with Sling TV. Subscribers to Sling TV, a subsidiary of Dish Network, can watch 16 channels, including AMC, ESPN, and HGTV, under its “The Best of Live TV (core)” package for $20 per month. Subscribers to the core package can add additional channel packs $5 each, making this somewhat of an online a la carte television subscription.

Not everyone is able to or wants to watch television shows on their computers or phones. Outdated equipment may make it difficult or impossible to stream high definition video, and computer and phone screen sizes are not ideal for prolonged solo viewing, let alone gathering an entire family or group of friends together to watch a program. In response to this, a new market of hardware designed to enhance online viewing and replicate the traditional TV experience has emerged. Apple TV, Roku, Chromecast, smart TVs, and other such devices allow consumers to stream video content from the internet directly to their television sets, which they are doing at impressive rates. On average Americans stream 37 million, 15 million, 12 million, and 6 million hours of video per week using Roku, Apple TV, Chromecast, and Amazon Fire TV devices, respectively.

These software and hardware technologies allow customers to watch TV shows whenever and wherever is most convenient for them and have changed the pace at which we consume television series, ushering in the age of binge watching. Once used sparingly in the 90s to describe watching two to three episodes of a show in one sitting, the term ‘binge watch’ is now synonymous with streaming large portions of a series online in one extended viewing session, a feat made possible by Netflix and other internet-TV providers. Viewers are no longer limited to watching a television program in weekly installments spread out over six months of the year. They now have entire seasons of shows at their fingertips via the internet, allowing them to consume multiple episodes in rapid succession. Over 75% of Americans have binge watched a show, and 61 percent admit to regular binge watching. Binging has become so prevalent that the term ‘binge watch’ received a spot as a finalist for Oxford’s 2013 word of the year.

Finally, the internet has changed the way TV shows are created and distributed. Streaming services like Netflix, Hulu and Amazon Prime originally started as content aggregators. They purchased streaming rights to shows previously aired by television networks and made them

26 Horn, 2014
27 Wallenstein, 2015
28 Reisinger, 2013
available to subscribers, tying them to the prevalent content generation system controlled by networks and cable companies. Though they still serve as aggregators, a number of streaming services have bypassed that system by creating and distributing their own original content. First pioneered by Netflix in 2013 with the introduction of the wildly popular House of Cards, a myriad of internet-only original programs now exist, and in accordance with the internet binge-watching era, Netflix and Amazon Prime release all episodes of a season at once instead of in weekly installments. Though some industry experts were skeptical of this new model, online-only original programs quickly gained legitimacy. House of Cards received nine Emmy nominations for its first season in 2013, the first ever Primetime Emmy Award nominations for an online-only show, and won three awards. The following year original Netflix shows garnered 31 Emmy Nominations, and in 2014, Amazon’s original program Transparent won the Golden Glove for best TV series, musical or comedy, making it the first online program to win a best series award at a major awards show.

This new system consisting of independent online entities creating and distributing original content harkens back to the early days of television when individual networks would create and broadcast programs to consumers, absent a middleman. Similarly, the so-called energy systems of the future are reminiscent of the microgrids of the past, so much so that FERC Commissioner Phil Moeller said that we are going back to the future with microgrids. It may be, then, that both of these industries are poised to go back to the future moving forward.

Industry Impact and Response

New technologies are beginning to chip away at the existing pay-tv industry. Since the advent of the DVR, live-TV viewership has drastically declined and shows no signs of stopping. Most recently the majority of shows experienced lower ratings in the important 18-49 demo during the 2013-2014 television season than those same shows did the prior season. Following the decade-long decline in linear-TV (i.e. TV service where the viewer has to watch a program at its scheduled time and on its schedule channel) viewership, the number of pay-tv subscriptions fell for the first time in 2013, declining by over 250,000 from the peak in 2012. Conversely, the number of subscribers to online streaming services has increased in recent years, such that there are now 62 million Netflix subscribers.

New energy technologies lag behind their television-industry counterparts in terms of market penetration, economic feasibility and availability, so they are not yet having a comparable impact on the energy industry. Still, the number residential PV installations and storage systems is on the rise. As of the first week of May 2015, Tesla had received over 38,000 reservations for the Powerwall and roughly 25,000 for the Powerpack (2,500 reservations at an average of 10 Powerpacks per reservation). Further, the number of net metering customers increased 56

29 Sottek, 2013
30 Riley, 2015
31 October 2014 CAISO Stakeholder Symposium
32 Sharf, 2015
33 Welch, 2015
percent per year between 2003 and 2010. Currently, there are at least 219,000 solar net-metering customers in the U.S.\(^{34}\)

Despite these changes, both electric utilities and cable operators remain dominant in their industries. PV and internet TV are relatively new to the market; those installing PV are first movers and represent a small fraction of total customers, as are those canceling their cable subscriptions in favor of online streaming services. To put it in perspective, the number of solar net metering customers is only 0.5 percent of total utility customers in Arizona, Colorado, New Jersey, Nevada and Pennsylvania, 0.77 percent in solar-friendly California, and 2.06 percent in Hawaii.\(^{35}\) Distributed PV is approximately 0.2 percent of the U.S. electricity supply.\(^{36}\)

The fact that there are still 100 million pay-tv subscribers means those cutting the cord represent a small fraction of the total customer base.\(^{37}\) Of these 100 million subscriptions, cable has long been and still is the dominant provider of pay-tv. With more than 56 million video subscribers as of 2013, cable has more subscribers than satellite (34 million) and telecommunications companies (10 million) combined. Further, the number of cord cutters is a small fraction of the number of streaming service subscribers, as many consumers have both cable and streaming subscriptions. A 2014 survey, found that 65 percent of pay-TV subscribers have access to Netflix, 32 percent Amazon Prime, and 11 percent Hulu Plus, indicating, that for the time being, at least, these services may be serving as compliments to cable rather than competitors. Similarly, PV serves as a compliment to the utility grid system, as most PV customers remain connected to the grid and use solar to offset a portion of but not entirely replace grid purchases.

**Can these Technologies Disrupt the Current System?**

What will happen if trends continue, however, and these technologies move beyond early adopters, causing large portions of the population to install PV or disconnect from utility and cable systems? In the worst-case scenario, such a situation could lead to a cycle of declining revenues and customers.

The theory behind this for the electric utility industry is illustrated in Figure 2 and described as follows: As DG penetration increases, utilities may experience a decline in sales. Since utility revenue requirements are based on the cost of service, but actual revenues collected are dependent on sales, utilities will collect fewer dollars in revenue as sales decline. To compensate for this, utilities may be forced to increase rates to recover their revenue requirements. This will make alternative generation technologies more cost effective in comparison and, in turn, cause additional customers to adopt DER technologies. Sales and revenues will once again decrease,

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34 EIA, 2012  
35 SEIA, 2012  
36 LaMonica, 2014  
37 Lee, 2014
and so on until a small number of remaining customers are responsible for generating revenues to cover operating costs.\textsuperscript{38}

Figure 3: Disruptive Technology Revenue Cycle

![Disruptive Technology Revenue Cycle Diagram]

Source: Edison Electric Institute

The cycle is similar for cable providers. As more customers cut the cord, cable companies will experience a decrease in revenues and raise rates to cover costs. Increased rates will cause more customers to forego cable in favor of internet streaming and lead to yet another decrease in revenues. This will continue until only a small number of customers remain or until companies can no longer collect sufficient revenues from remaining customers to stay afloat.

Is such a cycle inevitable or avoidable for either or both of these industries? Can the existing business models be modified to incorporate and take advantage of these new technologies? Do protections exist that will shield the existing business models from the potential negative effects of these technologies? To understand how these new technologies may affect the prevalent business models in these industries, we first examine the cost effectiveness of these technologies and how electric utilities and cable providers currently generate revenues.

\textsuperscript{38} Kind, 2013
Cost Effectiveness of New Technologies

The ability of these new technologies to challenge the existing electric utility and cable TV systems rests on their ability to compete economically with the existing system and technologies. Very few people will ditch cable in favor of Netflix if Netflix costs $150 per month. Similarly, even the most fervent of DER supporters will be unlikely to go off the grid if the combined cost of PV, battery storage and a smart inverter far exceeds the cost at which one can buy electricity from the grid.

The average monthly price of basic cable, which consists only of local broadcast stations, is $22.63. Expanded basic service includes the broadcast channels plus a large number of cable networks and costs $64.41 per month on average. The next tier (We will refer to this as Tier 2) adds at least seven cable channels to basic extended and has an average monthly cost of $77.05. 86 percent of cable customers subscribe to expanded basic service or higher, so we will focus on expanded basic and tier 2 prices. These do not include the cost of premium channels like HBO and Showtime, which typically cost around $15 per month each. For comparison, we estimated the cost of two options for cutting the cord, the results of which can be seen in Table 1.

Table 1: Costs of Cutting the Cord per Household

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<thead>
<tr>
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<th>Option A</th>
<th>Option B</th>
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<tbody>
<tr>
<td>Netflix</td>
<td>$8.99/mo</td>
<td>$8.99/mo</td>
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<tr>
<td>Amazon Prime</td>
<td>$99/yr</td>
<td>$99/yr ($8.25/mo)</td>
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<tr>
<td>Hulu Plus</td>
<td>$7.99/mo</td>
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<tr>
<td>Sling TV</td>
<td>$20.00/mo</td>
<td>$20.00/mo</td>
</tr>
<tr>
<td>HBO Now</td>
<td>$14.99/mo</td>
<td></td>
</tr>
<tr>
<td>Roku</td>
<td>$49.00</td>
<td>$49.00</td>
</tr>
<tr>
<td>Apple TV</td>
<td>$69.00</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$60.22/mo + $118</strong></td>
<td><strong>$45.23/mo + $49</strong></td>
</tr>
<tr>
<td><strong>TOTAL (3-yr capital amortization)</strong></td>
<td><strong>$63.50/mo</strong></td>
<td><strong>$46.59/mo</strong></td>
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</table>

Option A has a monthly fee of $60.22 and includes every streaming service currently available, making it the high cost scenario. Since Amazon Prime offers most HBO shows, most people will not subscribe to both Prime and HBO Now. Without the HBO Now subscription, the monthly price drops to $45.23 per month in Option B.

All of these streaming services can be accessed online with a computer, so no additional hardware purchases are required for those with computers capable of streaming high-definition videos. Those who wish to access these services on their televisions can purchase a streaming device.

39 FCC, 2014, p. 7
device such as a Roku or Apple TV. Unfortunately, no one streaming device offers all of these streaming services. For example, Roku, the cheapest of which is $49, offers the greatest number of streaming services and is the only one to offer Sling TV, but it does not include access to HBO Now. HBO Now can only be viewed on the $69 Apple TV, so while a Roku is sufficient for Option B, both devices are required for Option A. As such, we will add a one-time capital cost of $118 and $49 to Option A and Option B, respectively. Assuming a lifespan of three years, which is generous considering the slow upgrade cycle of these products, we amortized the upfront capital cost into 36 monthly installments and arrived at a monthly cost of $63.50 for Option A and $46.59 for Option B for the first three years. In both cases, this is less than the average price of expanded basic and Tier 2 subscriptions with or without an HBO subscription.

Our estimates are conservative and represent the highest cost an individual could incur for these online services and hardware. There are a number of reasons the real cost of cutting the cord is less than what we outlined above. First, we assumed that each household pays for a subscription to every streaming service they access. In reality, many people share subscriptions amongst across households. For instance, one of the authors has access to four of the five streaming services listed above but only subscribes to one of them. Most streaming services actually encourage this by allowing multiple devices to access one account and stream video at the simultaneously and by allowing users to create multiple user profiles, sometimes with separate login info, all under one account. Netflix, for example, allows each subscriber to authorize up to 6 devices simultaneously for streaming video content. If we spread the cost of each subscription account over three households, the monthly subscription cost estimates drop from $60.22 to $20.07 for the high-cost option and from $46.59 to $15.53 for the low-cost option. This is cheaper than even a cable subscription for basic service and significantly cheaper than an expanded basic cable subscription. Further, we included the hardware costs of cutting the cord for those who wish to stream content to their televisions, and we did not include the monthly hardware rental fees for cable boxes and DVRs. Including the latter fees would increase the monthly cost of cable and further stack the deck in favor of cord cutting when comparing monthly costs.

Alternatively, some individuals may not want access to hundreds of shows, preferring instead to keep up with a just a few favorites. iTunes, Amazon, Google Play, and others allow viewers to purchase an episode soon after it has aired on TV, usually within 24 hours, for $1.99-2.99 per episode or at a discounted rate if the viewer purchases the entire season in advance. This makes it cost effective for those who watch only a small number of series on cable networks (e.g. AMC, FX, etc.) to forgo cable subscriptions and instead purchase just the shows they want to watch online.

Are today’s new energy technologies as economically feasible as emerging cable TV alternatives? Is it currently or will it in the future be cost-effective for customers to adopt these new technologies and move away from the utility grid? Unlike in the television industry, the answers to these questions are largely dependent on location and government policies. According to an October 2014 Deutsche Bank report, PV-scale solar power has reached grid
parity in the ten U.S. states responsible for 90 percent of US solar electricity production. That means the levelized cost of energy (LCOE) produced by solar is less than or equal to the price of purchasing power from the utility grid in these ten states. The report goes on to predict that in 2016 PV will reach grid parity in nearly all of the U.S., or 47 states. While the bank’s estimate is dependent on federal solar tax credit persisting at current levels, and certainly fewer states will reach this feat in the absence of the tax credit, PV is still expected to achieve grid parity in a large number of states if the credit is drastically reduced. If the tax credit drops from 30 percent of system costs to 10 percent in 2016, Deutsche Bank expect PV to achieve grid parity in 36 states.

PV grid parity alone will not cause customers to break from the utility system. For that to occur, smart micro-grid technologies and battery storage must be affordable and easily accessible. The introduction of the Powerwall makes battery storage available to the masses, but is it cost effective? When discussing the cost of battery storage, what really matters is the round trip cost of energy over the life of the device. That is the cost per kWh of energy put into the battery and retrieved later, or the LCOE. There are two models of the Powerwall, a 7kWh version for daily cycle applications and a 10 kWh system for backup applications. The former is intended for daily use and the latter is only intended for backup power during outage and is designed to go through fewer than 50 charge cycles per year. Because the larger unit is intended only as a replacement for backup generators and not as a source of daily power, this analysis is limited to the smaller unit.

The 7 kWh unit costs $3,000. This does not include tax, inverter and installation fees, as these costs are unavailable. Likewise, the LCOE estimates presented here do not include these items. The LCOE depends on the lifespan of the unit. A simple way to estimate costs is to assume that Powerwall has a lifespan of 1,000 complete charge cycles. This results in an LCOE $0.43 per kWh for the smaller unit. Another method is to set lifespan equal to a number of years instead of a fixed number of charged cycles. The Powerwall is covered by a 10-year warranty. Using this as the lifespan, we assume the smaller Powerwall will be used daily and go through a full charging cycle every other day. That amounts to a LCOE of $0.23 per kWh.

Table 2: Powerwall LCOE by Unit Size and Estimation Method without Installation and Inverter Costs

<table>
<thead>
<tr>
<th>Unit</th>
<th>1000 Charge Cycle Lifespan</th>
<th>10-year Lifespan*</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 kWh</td>
<td>$0.43</td>
<td>$0.23</td>
</tr>
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</table>

*assumes full charge cycle each day for smaller unit and 50 charge cycles per year for the larger unit

Both methods return LCOEs that are greater than the average retail price of electricity for residential customers in the U.S. ($0.12/kWh). The difference between PG&E’s current peak and

40 Shah & Booream-Phelps, 2015, p. 64
41 Shah & Booream-Phelps, 2015, p. 60
off-peak residential TOU rates is $0.24 during summer and $0.03 during winter.\textsuperscript{42} The LCOE using the 10-year lifespan method is slightly less than PG&E’s summer peak-to-off-peak TOU rate differential. The actual costs will be higher than these estimates, as they do not include installation costs, so the LCOE may end up being higher than this differential, making it unlikely that typical consumers will find them cost-effective at current sizes and prices.

**Revenue Generation**

Electric utilities’ revenue generating-mechanism is somewhat complicated than that of a typical business. At the state level, public utility commissions (PUCs) set rates through rate case proceedings. The adopted rates are designed to meet each utility’s revenue requirement, which is the amount needed to recover the utility’s cost of service plus a rate of return on equity. The cost of service includes capital and O&M expenses, and the rate of return compensates the utilities fairly for risk when investing in costly capital projects.

It is commonly held that regulators are obligated to set rates to fully recover costs based on an agreement between utilities and regulators, known as the regulatory compact. Under this agreement, regulators set rates in exchange for utilities accepting the obligation to serve customers within their territories. However, it may be problematic for utilities treat this as a binding agreement; Kenneth Rose of the National Regulatory Research Institute argues that “an examination of the origins and content of the regulatory compact finds little basis for the claim that utilities are always entitled to cost recovery and a return on their investments.”\textsuperscript{43} Further, it is not clear, as this market evolves, what services should and should not be subject to regulated rate of return.

Cable television providers have traditionally generated revenue in the form of monthly subscription fees for bundled channels and rented hardware such as cable boxes and DVRs. In contrast to electric utilities, cable rates are for the most part not subject to government regulation. In the absence of competition, cities, counties and other government organizations are authorized by the state to regulate cable television service and may regulate rates cable companies charge for the basic service tier. This tier must include local broadcast, public, educational and government channels. If a local cable company faces "effective competition" under federal law, however, these government entities cannot regulate rates for the basic tier. Rates for any tiers of service beyond the basic services tier do not fall under government regulation. Cable companies are, thus, free to increase rates at will and set rates conducive to generating large profits, but they do lack the security of a guaranteed rate of return on capital investments that electric utilities enjoy for the time being.

Cable providers that also own television networks like Comcast have additional revenue streams. Some of these, like the fees pay-tv providers pay to networks to include the network in their cable packages are dependent on the number of pay-tv subscribers. Others are more adaptable to and reliant on new technologies. These come in the form of commercial

\textsuperscript{42} PG&E, 2015

\textsuperscript{43} Rose, Kenneth, p. 5
advertisements, streaming subscription fees for streaming services owned and operated by networks, streaming and syndication rights to third party distributors, sales of television programs both online and on DVDs, and the myriad of other ways television networks generate revenues. It is unclear, however, if cable companies can generate enough under these revenue streams to offset declining pay-tv subscription revenues.

**Industry Response and Adaptation – Past, Present and Future**

Some electric utilities do not appear to have wholeheartedly embraced these new technologies. Instead, they try to reduce incentives to or impose new or increased fees or charges on DG customers. Currently, utility customers pay a number of non-bypassable charges (NBCs). These charges apply to electricity purchased from the utility, but customers who install DG still pay stand-by charges (SBCs) and, in California, certain NBCs, referred to as departing load charges (DLCs), for the electricity they generate onsite. Ostensibly, if DG customers only pay NBCs for utility purchases, NBCs for all customers will have to increase to keep revenues steady. The increase in NBC rates in the absence of DLCs represents a cost-shift to customers without DG. Conversely, some say that this rationale does not take into account the cost savings to the utility provided by customer DG. If this is the case, and these cost savings are large enough to offset the loss in NBC revenues associated with increased penetrations of DG, the existence of DLCs might discourage customers from installing DG by increasing its payback period. In other instances, the way the utilities have dealt with this issue, especially in California, is to impose transition costs on DG customers to recover costs and get a rate of return on prior capital investments made in good faith.

**Figure 4: DG Customer Payback**

![Graph showing DG Customer Payback](image)

Source: Simpson, 2014 (California Energy Commission Docket 14-CHP-1)

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44 Simpson, 2014
Many utilities have made failed attempts to get state regulators to reduce net metering or impose charges on rooftop PV customers. Others are having more success. On February 26th, 2015, Arizona Utility Salt River Project (SRP) approved a rate increase for all customers and new charges for future rooftop PV customers. These charges, estimated to add up to roughly $50 per month by some outlets, include a demand charge based on customers’ peak monthly peak power demand. Since the charge was approved, SolarCity rooftop solar applications in the region dropped by roughly 96 percent. It comes not as a surprise, then, that SolarCity quickly filed a lawsuit against SRP, stating that the new rates make a competitive rooftop solar business impossible within SRP territory. In response to what it referred to as anti-competitive and discriminatory behavior by the utility, Solar City is requesting an injunction and money damages.45

In a less drastic approach, some utilities have chosen instead to alter their rate structures for all residential customers to help ensure steady revenue streams in the future. Utility bills consist of variable rates charged on a dollars-per-kWh basis and a monthly fixed charge. Currently, fixed charges for residential customers are typically between $5 and $10 per month. Recognizing that these fixed charges are a good way to smooth out revenue generation in the face of increasing DG installations by making a smaller portion of the bill dependent on customers’ electricity use, a number of utilities are proposing increasing the fixed charge. The three Wisconsin IOUs recently increased their fixed charges by between 78 and 82 percent.46 California municipal utility SMUD is proposing to its fixed charge annually from $12 in 2013 to $20 in 2017.47 Most recently, Arizona Public Service (APS), Arizona’s largest IOU, proposed increasing the fixed charge for solar customers from $5 to $21. Figure 4 shows the status of these requests by state as of January 2015.48 This does not include APS’s proposal, as that was introduced in April 2015.

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45 SolarCity, 2015
46 Roberts, 2015
47 SMUD, 2013, p. 15
48 Bade, 2015
Likewise, some pay-TV providers are reluctant to embrace the new TV model. This is particularly true for the parts of it that they do not directly control and/or profit from, such third-party providers of these new technologies like Netflix. Unlike electric utilities, cable/broadband companies have not altered their rate structures to protect their revenue streams against emerging technologies, but some cable providers are making use of the fact that they are also internet service providers (ISPs) to undermine certain streaming services and extract revenue from them. Comcast allegedly cut bandwidth speeds to Netflix unless Netflix agreed to pay a fee for direct access to the company’s broadband system. Figure 3 shows Netflix download speeds by ISP. Download speeds on Comcast’s network decreased dramatically before the fee was paid and started to increase in January 2014 once negotiations between Netflix and Comcast started up again.

49 Campbell-Dollaghan, 2014
Absent successful intervention to halt or roll back the progress of these new technologies and industries, it is likely that they will continue to advance and grow. Their growth and need not spell doom for electric utilities and pay-TV providers, though, as it may be possible for them to successfully adapt to these emerging industries long-term. This could mean further adjusting rate structures to safeguard revenue streams so that they are not negatively affected by the growth of new technologies, becoming an active participant in these new industries or something else entirely.

Cable companies are in interesting position in that they are also internet providers. They own the infrastructure for and sell subscriptions to cable internet, the very thing that is providing many customers with the option to cancel their cable TV subscriptions. As more and more customers consume television content online at the expense of cable TV subscriptions, one strategy for maintaining current revenue levels would be for companies to find a way to monetize the high levels of bandwidth used to watch online videos. Cable companies currently charge higher rates for faster internet speeds, so that customers not content to wait hours, or even minutes, for online videos to buffer or download, will pay premium rates, but they do not charge based on the amount of bandwidth used. Cable companies could adopt a rate structure for internet similar to that employed by electric utilities and charge variable rates for each gigabyte (GB) of bandwidth used on top of a monthly fixed charge.

Consumers have long advocated for the demise of bundled channels and the ability to purchase channels a la carte. Cable companies have thus far been reluctant to offer this model of pricing for linear TV, but offering it in the future may help retain existing customers and attract new
customers to generate additional revenue. Cable companies could sell individual channels or even small bundles of channels, similar to what Dish is offering online with its Sling TV service, for a small monthly fee alongside their traditional cable packages. In doing so, they would potentially attract individuals who currently do not have cable but want access to a few networks. Additionally, they would likely retain both customers who would likely never cut the cord because they enjoy having access to a large number of channels and customers who wished to cut the cord because they only watch a few channels but instead purchase just the channels they watch.

To a certain extent, pay-TV companies have taken the “if you can’t beat them, join them” approach and become participants in these new markets. For over a decade, cable and satellite companies have provided DVRs to customers for a fixed monthly fee. Additionally, they have all created video-on-demand systems that allow customers to watch reruns of programs, complete with non-bypassable commercial interruption to maintain ad revenues, using the pay-tv set top box. Some even offer live online streaming of certain networks to subscribers. More importantly, they are not only offering these technologies but also improving upon them in some instances. Dish Network’s Hopper with Sling DVR includes features not found on the latest Tivos, such as PrimeTime Anytime (PTA). This allows customers to view everything that aired on NBC, Fox, CBS, and ABC in the past eight days, regardless of whether or not they set their DVRs to record those networks during that time. In its review of the device, Laptop Mag noted that, “The Hopper is so good, you may want to ditch cable or DirecTV just to get it.”

To what extent, if any, this particular piece of hardware has helped pay-TV providers retain and attract customers remains to be seen, but the praise and media attention received by it exemplify how pay-TV providers can remain relevant by creating innovative and enticing products in these new markets.

Unlike the cable industry, electric utilities do not own or provide the substitutes to its services, i.e. distributed solar PV and other DER systems, home battery storage devices, and generators, but it may make sense for them to do so. Just as cable companies now provide their own DVRs and video-on-demand services, investor-owned electric utilities could, if regulation permitted, become purveyors of distributed solar and resources and storage devices. This could mean selling these items directly to customers for use in their homes and businesses or owning and operating their own community-based renewable systems and selling power from those systems to customers, similar to SMUD’s SolarShares program. Under this program, SMUD operates a small solar farm in Sacramento County and allows customers to purchase solar power from this farm for a fixed monthly price based on their electricity usage. This community-based solar would appeal to customers who desire renewable generation but do not want to or are unable to install DG at their homes.

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50 Prospero, 2013
51 SMUD
SMUD is also running a PV and smart grid pilot study to better understand how customers respond to these new technologies and gain insight on the following technical issues associated with high penetrations of PV:

- Grid-connected PV systems cannot be fully integrated into the Smart Grid until there is sufficient two-way communication and control capability between the utility and PV inverters.
- The production characteristics of distributed PV in a high penetration scenario have not been sufficiently tested, and utilities have not been able to develop adequate models and forecasting techniques with which to consider distributed PV as a grid resource.
- While energy storage is seen as a potential solution for “firming” the variable output of PV, there is a lack of experimental data to show how effective storage might be for overcoming these problems.\(^{52}\)

The testing ground for the study is the Anatolia SolarSmart Community in Rancho Cordova, CA, which consists of over 270 homes with rooftop solar integrated with the smart grid and both residential and community grid connected energy storage.\(^{53}\) SMUD has not yet published findings from the pilot program, but the results could prove useful in helping electric utilities determine ways to successfully incorporate these new technologies into their systems. Further, like SMUD’s community-based solar systems, the community-based storage installed at Anatolia may appeal to customers who want PV battery storage systems but do not want to or are unable to install them at their homes.

Some electric utilities have found ways to embrace the rooftop PV industry without directly entering that market. New Jersey’s largest investor-owned utility Public Service Electric and Gas Company (PSE&G) provides loans to residential customers to install solar systems on their homes through its Solar Loan program.\(^{54}\) PSE&G expanded the program along with its “Solar 4 All” program in 2013 with the intention of adding 150 MW of solar to its portfolio in the next five years including 97.5 MW from commercial and residential PV.\(^{55}\) Encouraging rooftop PV uptake does not have to be detrimental to utilities bottom lines. If they can do so while still ensuring that their wires are being used and that they are being compensated for their use, such a system will be financially sustainable for the utilities.

No matter how they go about it, change takes time for large, established industries. The electric utility industry has an advantage over the cable industry on this front, as advancements in technical development, economic feasibility, and customer adoption rates for emerging energy technologies lag behind and are moving at a slower pace than for new television technologies. Still, the fact that cable-TV providers and electric utilities are dominant in their respective industries and likely will be for some time means that both entities have time to determine the

\(^{52}\) SMUD, 2011  
\(^{53}\) Rawson, 2011  
\(^{54}\) PSE&G  
\(^{55}\) Cusick, 2013
best methods for making changes. Be it something highlighted above or something else entirely, it would be wise for cable providers and electric utilities to find ways to be wholehearted enablers of these new technologies while still staying relevant or ways that being a wholehearted enabler makes them relevant.
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