AN ADAPTIVE APPROACH TO PROMOTE SYSTEM OPTIMIZATION

Michael O'Boyle[1]

Executive Summary

Starting from a clean slate, the 51st State framework calls for unencumbered thinking about electricity policy that can be adapted to any circumstance. A hypothetical state has unknown characteristics: the renewable and non-renewable resource availability, existing infrastructure, the political makeup of its constituency, and the societal values are all unknowns. This framework limits the prudence of detailed recommendations while expanding the possibilities to think big. But some basic principles of smart electricity policy transcend these uncertainties.

At America's Power Plan, we develop and curate the best thinking on system optimization around three universal goals: affordability, reliability, and environmental performance. In any state or municipality, including the 51st State, these are the primary goals of the electricity system, although the balance between each factor is unique to each jurisdiction, and there may be additional public policy priorities. The 51st State, for example, expresses a preference for promoting distributed generation (DG) and other distributed energy resources (DERs).

This paper synthesizes current thinking on system optimization by returning to first principles of rate design and market structure. The paper begins with a brief discussion of the evolution of electricity technology and regulations that call for updating the principles of rate design and market structure. Part I of the paper lays out principles for rate design in the 51st State. It builds upon James C. Bonbright's *Principles of Public Utility Rates*, adapting the best of these principles for the 51st State. The paper refines these principles, eschewing some while highlighting others as central to ensuring that rates promote an affordable, reliable, environmentally clean grid of the future. Part II proposes principles of market structure for the 51st State. It remains agnostic about whether the market structure is purely market-oriented and restructured or vertically integrated. Instead, it proposes principles and complementary policies that encourage system optimization under each market structure. Part III concludes with an assessment of the effects of the principles on various stakeholders in the 51st State. By starting from first principles, the recommendations of this paper can be widely applied across jurisdictions, including but not limited to a hypothetical 51st State.

[1] Thanks to Sonia Aggarwal, Eric Gimon, Hal Harvey, and Robbie Orvis from the Energy Innovation team for their time and effort improving this piece and providing feedback. Thanks also to Ron Lehr for his insights and feedback.

Introduction: A Brief History of Electricity Regulation and Technologies

Electricity is a good that has characterized modern development. In a recent speech at the University of Cape Town, President Obama characterized electricity as "fundamental to opportunity in this age. It's the light that children study by; the energy that allows an idea to be transformed into a real business."[2] The nature of electricity as central to modern life and comfort can hardly be disputed—and so its distribution at a reasonable cost is an essential public policy goal of any society. Whether supplied by public utilities, regulated monopolies, independent producers in restructured markets, or publicly owned utilities, there is a clear public interest in ensuring access to safe, reliable, affordable, and environmentally clean electricity.

For decades it was settled that electric utilities constituted "natural monopolies" both because of the public nature of the goods they supplied, and because operation by a single entity yielded lower overall system costs.[3] But because of relatively inelastic demand for electricity, a modern necessity, utility companies have tremendous potential to exploit customers who are captive to their service. To substitute for the efficiency and cost reductions that would arise from healthy competition, utilities had to be regulated to ensure rates remained affordable and utilities operated efficiently in accordance with other public goals for the electricity system (i.e. reliability, universal access, safety, and environmental performance).

Today, in most states not much has changed. While standards for utility efficiency are changing with the evolution of information technology and public policy objectives are as diverse as any other issue in the United States, heavily regulated investor-owned utilities are the primary providers of electricity. The consolidation of bulk system operation into independent system operators (ISOs) and regional transmission organizations (RTOs) and divestment of generation from distribution into wholesale markets constitute the most widespread deviations from the traditional, vertically integrated utility business model; but for the most part the distribution of electricity and the relationship between utility and customer remains largely intact vis-à-vis the model that emerged after World War II. But while regulatory models have remained relatively constant, technology advancement and the corresponding demand for new services have challenged the prudency of the conventional cost-of-service regulatory model.

Technological advancements offer customers more control over their energy use and challenge the notion that everyone is better off having a regulated utility be the sole provider of electricity services. In particular, the combination of distributed generation (DG), energy efficiency, and on-site storage mean that defecting (becoming entirely self-reliant for electricity services and disconnecting) from the grid is an increasingly rational choice for consumers. In less extreme cases, distributed energy resources (DERs) have made demand for electricity more elastic. Consumers now demand new services from the utility while providing new system benefits that compete against conventional, centralized generation. Energy efficiency technologies have exposed utilities to increasing competition that causes the erosion of

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[2] Tom Murphy, "Obama Puts $7 Billion Behind Increasing Electricity Access in Sub-Saharan Africa," July 1, 2013. URL:, http://www.humanosphere.org/basics/2013/07/obama-puts-7-billion-behind-increasing-electricity-access-in-sub-saharan-africa/.

[3] James C. Bonbright, *Principles of Public Utility Rates*, 2nd ed., 1988, 19. "Only a company enjoying a monopoly in the supply of service in a given area, assuming some kind of barrier to entry, can operate at maximum efficiency."

revenues from their own customers but presents a massive opportunity for cost savings and increased reliability.

But these technologies have run into outdated regulatory models that stifle innovation and maintain the status quo. Because each of these resources creates clear benefits for other ratepayers, who now have to pay for fewer kilowatt hours and system upgrades in aggregate, their development should be encouraged. But the question of how to pay for these benefits opens some of the same questions that underlie the very principles of utility regulation: how do we fairly apportion the costs of electricity service between customer and provider? To what extent can we quantify and attribute the costs and benefits caused by individual customers? And how can we optimize the system around public policy goals of affordability, reliability, and environmental performance?

To answer these questions, this paper will first turn to the fundamental principles of good public policy that underlie rate design and market structure. For example, many of the principles articulated in Bonbright's *Principles of Public Utility Rates* still hold; but new technologies challenge the need for simple rates in all cases and challenge the utility's status as a natural monopoly. Rather than treating cost recovery as one of the main goals of utility regulation, which assumed a natural monopoly and inelastic demand, a new system would focus on paying for the outcomes that consumers value most: reliable, affordable, and clean energy services. Building on the ratemaking principles of Bonbright and the successes and failures of existing market structures, a new system would be adaptive, transparent, and customer-oriented.

Part I: Rate Design

In a hypothetical 51st State, policymakers would have a chance to use rate design to hit key goals right from the start. To use rates as an effective policy tool, they must first protect vulnerable customers, and then they must take advantage of new technologies and business models to deliver a clean, reliable, and affordable power system. The particulars of the rate structure and the components of the customer bill will necessarily depend on the particular circumstances of the 51st State—its customer demographics and the mix of resources it has available. Therefore, policymakers in the 51st State will want to make decisions on the particulars of the rate structure based on solid principles that can be applied to whatever specific circumstances they face.

The investigation of first principles for rate design in the 51st State begins by examining the best thinking of the past—James C. Bonbright's preeminent text, *Principles of Public Utility Rates*—and assessing its relevance today, given the priorities in the 51st State. The spirit of Bonbright's principles still applies, though the principles require interpretation to make them fit today's technological realities.

Bonbright's thinking relied on yesteryear's economic and technological realities. For example, for decades, larger power plants led to lower prices. Distributed generation was not an economically viable solution. Today, distributed energy resources, like rooftop solar photovoltaics (PV), energy efficiency, or demand response, are in many cases cheaper than utility-scale power plants.[4] Other distributed

[4] See Vishal Shah, et al., "2014 Outlook: Let the Second Gold Rush Begin," *Deutsche Bank Markets Research,* January 6, 2014. URL: https://www.deutschebank.nl/nl/docs/Solar_-_2014_Outlook_Let_the_Second_Gold_Rush_Begin.pdf.

technologies such as solar plus storage and home automation are emerging that will further challenge the dynamics of electricity production and consumption—and even the economics of the grid itself. Customers are now able to tolerate more complicated rate structures due to home automation or third-party demand management solutions.

Underlying the need for new "rate design" principles is a need to redefine the set of possible solutions. "Rate design" implies a "designer," or regulatory body that creates a framework for charging customers that are captive to the regulated utility. In the 51st State, no such implication exists. The baggage of existing infrastructure and utility incumbency is not present, so problems of how to recover potentially stranded assets do not enter the calculus of how to engineer a system that fairly compensates energy service providers and fairly charges energy service users. Instead, the question of how to best design rates can be answered by what rules efficiently allocate system costs and risks to those best suited to pay or mitigate them, and what rules optimize the transactions between providers and consumers around agreed upon principles for the electricity system. In this context, a "rate" is simply the price paid to cover the cost of electricity service, eschewing some of the baggage of the traditional model for rate design.

Nevertheless, the wisdom of Bonbright's principles is undeniable for its assessment of the interaction between different system goals—particularly those that require some regulatory balancing. Bonbright's thorough examination of the electricity system, though originally intended for a system in which centralized generation was the only option for customers, still lends perspective and wisdom to the principles of rate design for the 51st State.

Bonbright's Principles of Rate Design

In the original text, Bonbright has ten principles of rate design (they are summarized and reworded here in the interest of brevity and clarity). Though the principles themselves are largely applicable today, some require refinement:

1. **Rates should be made to cover system costs**
2. **Utility revenue should be stable and predictable**
3. **Customer rates and bills should be stable and predictable**
4. **Retail rates should discourage wasteful use of service while allowing all justified types and amounts of use**
5. **Rates should reflect all of the present and future private and social costs and benefits occasioned by a service's provision**
6. **Rates should promote innovation and respond economically to changing demand and supply patterns**
7. **Specific rates should be fair in the apportionment of total costs of service among the different ratepayers so as to avoid arbitrariness and capriciousness**
8. **Rates should avoid undue discrimination, subsidies and inter-customer burdens.**
9. **Rates should be simple, easy to pay and collect, and understandable, meeting customers where they are in sophistication**[5]

See also "NY PSC Approves Con Edison BQDM Program", *Enerknol Research*, December 22, 2014. URL: http://breakingenergy.com/2014/12/22/ny-psc-approves-con-edison-bqdm-program/.

[5] James C. Bonbright, *Principles of Public Utility Rates*, 2nd ed., 1988, 383–84.

10. Rates should be free from controversies to interpretation

These principles of ratemaking correspond to Bonbright's four "purposes" of rates, which are (**a) utility revenue collection and capital attraction, (b) limiting wasteful electricity consumption, (c) fair distribution of system costs, and (d) operational efficiency.** The first three purposes can be accomplished by rates directly. The last requirement of operational efficiency is a function of the underlying regulatory model, which may reward operational efficiency in any number of ways. While not the focus of this section, improved market design alongside performance-based ratemaking is a crucial next step for ensuring maximum operational efficiency.[6]

One of Bonbright's hidden but important assumptions that has changed in the modern era is that "rates" are necessarily bilateral, resulting from a captive utility-customer relationship. Today, it is more useful to think of "retail rates" simply as what customers pay (or get paid) for the electricity services they receive (or provide). Because information technology allows for real-time transmission of money and information, it is now possible for individual customers to pool or trade energy services among themselves or through the utility. For example, today energy service companies (ESCOs) handle utility bills on behalf of the customer while optimizing the rate structure with a mix of distributed energy resources on-site, usually home automation and energy efficiency. Many states also "decouple" that which is charged customers from that which is paid utilities, so the retail rate may not directly drive utility profits.

a. Revenue collection and capital attraction

Bonbright saw utility revenue collection and capital attraction as a central role of rates, but that relied on the premise that electricity distribution and system management constituted a single natural monopoly. Today, the utility does not necessarily have to be the system operator; whether the system operator is a properly-incented utility or an independent nonprofit operator is an open question. The operator's financial future should be secure for the well-being of the system, no doubt. The owner of the wires and poles also needs a fairly secure value proposition to keep its cost of capital low. But these concerns do not require a traditional captive relationship between customer and regulated utility. It may be sufficient to say that customers should cover the costs of system operation, which could be a for-profit utility under an evolved regulatory structure or a non-profit system optimizer.

Capital attraction is also important for a new class of actors—so called "prosumers" that provide net benefits to the grid driving down system costs for all users. Revenue and capital attraction are just as important for the prosumer to ensure the benefits she provides to the grid retain their value proposition to her, encouraging other prosumers to follow suit and continue driving down overall system costs.

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[6] See Ron Lehr, "Utility and Regulatory Models for the Modern Era," *America's Power Plan*, 2013. URL:http://americaspowerplan.com/wp-content/uploads/2013/10/APP-UTILITIES.pdf. See also Sonia Aggarwal & Eddie Burgess, *New Regulatory Models*, March 2014. URL: http://westernenergyboard.org/wp-content/uploads/2014/03/SPSC-CREPC_NewRegulatoryModels.pdf.

Wholesale markets[7] provide one example of how capital attraction can be achieved without a captive customer-utility relationship. PJM Interconnection is a "profit-neutral" independent system operator (ISO) that coordinates the operation of wholesale energy markets in a large swath of mid-Atlantic, Southern, and Midwestern states.[8] Rather than collecting rates from energy service purchasers or end-use customers, PJM is funded by voluntary market participants who pay their share to participate in the market in order to reap the benefits of market participation.[9] The transmission providers likewise make a profit by charging for line usage, with clear rules to ensure these prices do not discriminate between users.[10] In wholesale markets, market forces, i.e. value propositions, drive investments, rather than centrally collected rates. Thus, a system operator does not necessarily need rates to guarantee capital attraction or revenue stability to keep rates low; a market facilitator may stimulate competition that drives investment without using its own power to raise funds from captive customers.

b. Limiting wasteful electricity consumption

Retail rates can also be used to affect consumption patterns. To this end, rates would prevent consumption beyond the value that consumers place on it. Bonbright emphasized that rates should "reflect all of the present and future private and social costs and benefits occasioned by a service's provision," meaning that retail rates should reflect costs while avoiding cross-subsidies. Following this principle to its logical end, rates should prevent consumer behavior that costs more to the utility than it delivers in value to the end-users. But this assumes a captive relationship between utility and customer. So far, regulators have not prioritized cost-causative rates; revenue adequacy for the utility, simplicity, and other social policy goals won out against conflicting principles of cost causation.

Rate design has always affected customers' incentive to consume more or less electricity, but today they have even greater implications for optimizing customer behavior and supporting new resources behind the meter. Retail rates can incentivize distributed energy production, change demand patterns, and even encourage grid defection in areas where total bills are particularly high.[11] Because customers have access to so many new technologies for controlling their energy use, simple rate structures can lead to a mismatch between consumption patterns and bills; either too few or too many DERs are installed and cross-subsidies or higher overall system costs result. In other words, new possibilities for distributed energy resources fundamentally change the balance of compromise between rate simplicity (Principles 3 & 9) and cost causation (Principles 5, 7, & 8). With new technologies and businesses that can automate response to more complicated rate structures, there is potential to more precisely engineer retail rates to incent efficient levels of production and consumption, taking advantage of information technology and smart hardware.

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[7] As opposed to the vertically integrated utility model in which generation and distribution assets are owned, operated, and coordinated by the same company, wholesale markets are operated independently from the generators that bid into the market.

[8] *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.*, effective date January 1, 2015. URL, http://www.pjm.com/documents/agreements.aspx.

[9] Ibid at 31

[10] See U.S. Energy Information Administration, See *The Changing Structure of the Electric Power Industry 2000: An Update* (Washington, D.C.: U.S. Energy Information Administration, 2000), discussing FERC Rule 888.

[11] See Rocky Mountain Institute, "The Economics of Grid Defection," 2014. URL:, http://www.rmi.org/electricity_grid_defection.

c. **Fair distribution of system costs**

Retail rates should undoubtedly discourage wasteful consumption. It is "fair" for each customer to pay the cost of his electrical service, which should discourage inefficient consumption. But apart from cost causation, fairness also has another element—are customers paying for the services they actually use and value most? Customers have diverse needs for energy services, and this will become much more prevalent as technology advances and continues to lower system costs. The result of cost reductions for distributed energy resources is that customers may not need the grid as often or as much as they used to, or may not need parts of the grid but may still see value in connecting to the grid as an alternative to defecting entirely. For customers that only use parts of the grid, or only use the grid for backup, say, once a month, what is "fair" may be a different calculation.

Consider once again the example of the DG customer with storage on-site. This customer may rely mostly on his own generation for power but may choose to remain connected to the grid if it is be more cost-effective to use the grid as a backup service than procure additional storage and/or solar capacity. In this case, the customer's choice to remain connected is made via a comparison to the marginal cost of more on-site solar or storage, which should be compared to utility's marginal cost of serving him. What constitutes a "fair" charge for the customer to hook into the grid depends largely on what he uses, when he uses it, where he is located, and what he values.

As a whole, Bonbright's principles of rate design provide a sound basis for assessing the propriety of any rate structure, but the instances in which the principles are in conflict are growing. Because of recent innovations in technology, particularly the advent of third party energy management technologies and the falling costs distributed energy resources, the relative weight and importance of certain principles are diminished, while new concerns make other principles even more important. The following section builds on Bonbright's principles to lay out four principles of retail rates for the 51st State.

Principles of Rate Design for the 51st State

In the 51st State, the principles for rate design do not reflect a preference for competitive markets or (properly incentivized) vertically integrated utilities; instead, they are meant to apply in any market structure. Furthermore, they are not meant to imply a captive relationship between a ratepayer and a utility; rather the term "rates" refers here to the amount that a customer pays (and/or receives) for energy services. With that in mind, the following principles of retail rate design modernize Bonbright's approach to provide a foundation for the relationship between customers and the grid in the 51st State:

1. **To the extent possible, rates should reflect the real and social costs of service for each customer. Bills should vary based on customer use (time and intensity) of system services.**

While the spirit of this principle remains largely unchanged from Bonbright's time, the notion of costs and benefits changes considerably in the 51st State where customers and prosumers are increasingly diverse in the services they demand from the grid. Technological advancement has accompanied the proliferation of distributed energy resources, altering the balance between rate simplicity and cost-causation posited by Bonbright. Even if perfect cost causation was possible, it would overwhelm the consumer with information. Rates should approximate cost causation relative to other customers, with other public policy goals left to resolve the imperfections or justify certain cross subsidies over others.

Bonbright emphasized the primacy of cost causation in ensuring both fairness and efficient consumption, without, perhaps, foreseeing on-site generation:

> *"[O]ne standard of reasonable rates can fairly be said to outrank all others in the importance attached to it by experts and public opinion alike – the standard of costs of service, often qualified by the stipulation that the relevant cost is necessary, true (i.e., private and social) cost or cost reasonably or prudently incurred."*[12]

The amount a consumer pays for energy services should reflect his costs of service, including avoided system costs and quantifiable externalities. This could mean a fundamental shift in the nature of services provided by the utility, grid operator, market coordinator, competitive retailer, or other service provider.

However, the disaggregation of cost of service has limits. First, "perfect" attribution of differential/marginal costs would result in absurd consequences. One extra customer may add a single kilowatt of peak demand to the system that calls for additional capacity on the bulk transmission grid. Say for example that this requires a $1 billion substation upgrade, as was the case at the Brooklyn-Queens substation in 2014.[13] Obviously it would be unequitable to slap that customer with a $1 billion bill because she tipped the scales toward a large investment. It is likewise absurd to compensate demand response from a few customers with the same $1 billion if they defer the upgrade of the substation.

Beyond the impossibility of figuring out every cost, there is the question of how to communicate this information to consumers such that it affects their behavior, which is dealt with in more detail in Principle 4, below. There are undisputed aggregate cost-causative consumption behaviors than can be reflected in the price for electricity. The need to construct new infrastructure (centralized or distributed) correlates to growth in peak demand, a growth in geographical scope, and overall electricity use. These "system costs" are likewise deferred by the deployment of distributed energy resources like demand response (peak demand growth), energy efficiency (electricity use and peak demand growth), and energy storage (all of the above). But the granularity of this price information can overwhelm the average consumer, particularly if he is left to deal with pricing information on his own.

However, technologies have fundamentally changed the capacity for deciphering cost (and benefit) causation and responding to price information. Information and smart-grid technology has fundamentally changed the balance between rate simplicity and cost causation. Home automation products can communicate directly with the smart meter, eliminating the need for customer action, and in many cases, making price-responsive behavior invisible to the consumer. The market for these home automation products has been growing at an average of 40 percent each year since 2011, and analysts expect that growth rate to continue into 2015.[14] Together with more granular pricing, home automation technologies have the potential to provide bill savings for customers while also adding grid flexibility that lowers system costs for the 51st State.

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[12] Bonbright, *Principles of Public Utility Rates*, 1988, 109

[13] See "NY PSC Approves Con Edison BQDM Program", *Enerknol Research*, December 22, 2014. URL: http://breakingenergy.com/2014/12/22/ny-psc-approves-con-edison-bqdm-program/.

[14] "*Smart Grid Insights: Smart Appliances* (Zpryme Research & Consulting, 2010), http://www.smartgridnews.com/artman/uploads/1/2010_Smart_Appliance_Report_Zpryme_Smart_Grid_Insights.pdf.

As cost-causation continues to increase in sophistication, enabled by emerging technologies, many of the revenue adequacy and capital attraction principles diminish in importance. If consumers pay for the costs of service, costs will be covered, in theory, by the rates; prices need not be the principal focus of the system operator's financial well-being. In a market-oriented structure these revenues could be derived from either a fee or tariff to participate in the market and use the distribution infrastructure, covering the costs of market operation. For a centralized distribution utility, it may mean supplementing rate revenues with a performance incentive that ensures the utility facilitates cost and benefit causation principles.

2. **Rates should provide transparent, stable value propositions for all participants that provide energy services, including the system operator or facilitator, energy service companies, and customers.**

This principle integrates and builds upon almost all of Bonbright's Principles, including those that deal with revenue collection and adequacy. Instead of applying them *only* to a central distribution utility, however, rates should provide value propositions to *all* providers of energy services—including generators, DER customers, distribution companies, third-party aggregators, and ESCOs. Existing wholesale markets and vertically-integrated procurement systems provide a model for transparency that has been applied to bulk generation successfully with increasing success with distributed energy resources in limited contexts as well. But in the 51st State, transparency will be a central principle to ensure proper investment signals reach all potential energy service providers. These value propositions should be sufficiently transparent and predictable to permit customers or aggregators to determine with great confidence what the payments for service will be if they equip their homes or factories with new technologies.

Ireland provides a model for price transparency in practice for bulk generators in a market-based system, but also highlights the lack of needed transparency on the distribution system in some cases. The Irish electricity system (encompassing both Ireland and Northern Ireland) is fully market-based, meaning the distributed system operator (DSO), transmission system operator (TSO), retailers ("Suppliers"), generators, and other aggregators are all separate entities.[15] Generators bid their services into a market, add the price of transmitting power on both the bulk and local systems, and ultimately bids are selected by competitive suppliers that manage the billing relationship with customers.[16] These generators compete against "demand side units" (DSUs) that aggregate distributed energy resources including dispatchable demand and distributed generation and bid those into the resource pool. Each resource can furthermore bid into energy, capacity, and "constraint" markets (reflecting a willingness to *not* generate, an ancillary service). The bidding process is blind, resulting in a single clearing price for which low-bidding DSUs and generators are compensated. Bids over the clearing price get nothing. Because the bidding process in Ireland is public, there are clear market price signals that incentivize investments.

But even this very transparent, market-based system lacks a clear value proposition for distributed generators, or "embedded micro-generators," as they are called in Ireland. Individual customers that want to connect to the grid must negotiate individual contracts to export their power on to the distribution system. These contracts are not public information, meaning that suppliers can make their own decisions about whether to allow interconnections, despite strict technical system-wide

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[15] Anthony Schoofs, "The Electricity Market in Ireland," *wattics.com*, December 19, 2014, last visited February 24, 2015. URL: http://www.wattics.com/the-electricity-market-in-ireland/#distribution.
[16] Ibid.

interconnection requirements set by the DSO that safeguard against reliability concerns.[17] As a result, the value propositions for residential distributed generators is not clear, and in some cases they may not be permitted to export power to the grid, despite the benefits it could provide.[18] To the extent possible, even these sorts of small-scale transactions require more price transparency (rather than individual bilateral contracts) that expose truer cost or value causation, and encourage investment in cost-effective energy services. Of course, to build on this transparent structure in the 51st State, regulators must set prices associated with both positive (e.g. avoided fixed costs) and negative externalities (e.g. a carbon tax) if they are otherwise missing, in order to promote the resource mix that optimizes the grid and meets policy goals.

But there are disadvantages to the market-based approach to setting transparent prices. First of all, markets that rely on economic dispatch have a difficult time pricing avoided system costs into longer-term procurement decisions, obscuring the value that some energy service suppliers provide to the grid. In order to compensate for this potential failure. Because real-time market prices fluctuate based on an evolving resource mix, they do not lend themselves well to providing long-term investment signals, and do not provide support for emerging technologies that have long-term potential to bring down system costs. These market failures could be compensated through a "staircase capabilities market," that awards long-term contracts to small tranches of emerging technologies.[19]

In a vertically integrated distribution utility, transparent value propositions would be reflected in rate structures, not a market clearing price. In such cases, a customer should be able to understand her energy profile based on how her consumption data interacts with all available rate structures. This would allow customers, or more likely third-party ESCOs, to make rational decisions about whether to invest in distributed energy resources and home automation technologies that enable price-responsive behavior. Making this data available to customers is crucial to ensuring transparency, particularly when it comes to allowing energy service companies to find savings on customers' behalf.

The legislature in the 51st State should require utilities to share customer data while maintaining appropriate privacy. At a bare minimum, the 51st State should adopt the Green Button data disclosure protocol created by the U.S. Department of Energy that is now in use in California.[20] The Green Button initiative gives utility customers easy access to their electricity consumption data in a standard data file that can be shared with third party developers. This, in turn, can be used to determine what mix of distributed energy resources and enabling technologies would be cost-effective for the customer, which in turn *should* create net benefits for the grid if the rates reflect cost causation. So long as it is possible to lock in a rate over the lifetime of distributed energy resource investments, this would provide an extremely transparent and clear value proposition to potential prosumers while minimizing cross-subsidies.

The vertically integrated utility has some disadvantages for transparency. Beyond the market structure concerns addressed later on in this paper, utilities will have difficulty adjusting prices between

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[17] ESB Networks, "How to Connect a Micro-Generator," last visited February 24, 2015. URL:, http://www.esb.ie/esbnetworks/en/generator-connections/micro_gen_connections.jsp. See also *ESB Networks Distribution Code*, DCC9.9 (Additional Requirements for Dispatchable Demand Customers).
[18] Ibid.
[19] See Part II, Principle (c) below.
[20] See https://www.data.gov/energy/welcome-green-button.

different customers without relying on a market. Whereas a market price can reflect time, usage, and locational prices, rate structures are less apt to respond to idiosyncrasies of each customer. Because retail programs like real-time or locational pricing have not been tested, the 51st state should adopt an adaptive approach to rate setting that answers the question of what is the appropriate balance between cost-causation and price simplicity given the evolution of enabling technologies. The granularity of the rates should be increased as customer sophistication and enabling technologies allow more real-time price-responsive behavior.

3. **The retail rate structure should be adaptive, quickly responding to new social demands, new value opportunities, and new technologies.**

While retail rates today often do a poor job of adapting to changing technologies due to a desire to err on the side of simplicity, Bonbright also envisioned a system that was much more adaptive and encouraged innovation (Principle 6). However, as a principle for the 51st State, adaptive rate structures should become structural, rather than merely aspirational.

One way to accomplish this where the market structure remains a centrally operated, regulated distribution utility is through mandatory pilot programs to demonstrate new rate designs enabled by technology. Time-of-use or critical peak pricing pilot programs have demonstrated customer savings and grid benefits by testing small groups measured against control groups, with a preordained process for assessing and implementing the findings of the pilot.[21] Cutting edge rate design ideas such as real-time pricing could be tested using the latest home automation technologies, and implemented across a service territory if found to be a proper balance between customer sophistication and cost causation. This is the only way that rate structures will adapt to unforeseeable changing technologies in the 51st State.

Market pricing has an inherent advantage of being adaptive to the least-cost technology that provides energy services, but depends on proper service definitions that promote competition. On the other hand, markets do not provide inherent testing for pilot programs, or for deployment of smart-grid technologies that provide system benefits. To the extent these value propositions exist for the system as a whole, regulators should step in and promote pilot programs, smart-grid infrastructure investments, and consumer engagement.

4. **Rates should meet customers at their level of sophistication and services required. Rate volatility may be justified if volatility risk is accompanied by potential reward and more precise cost causation.**

This principle recognizes the wisdom of Bonbright's Principle 9: "Rates should be simple, easy to pay and collect, and understandable, meeting customers where they are in sophistication," understanding that this requires give and take with other principles, particularly cost and benefit causation. Bonbright recognized this conflict, even as technology to manage more dynamic pricing was not available:

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[21] Oklahoma Gas and Electric's "Smart Hours" pilot found that consumers saved money on their energy bills while providing net benefits to the system on peak pricing plans when also provided with smart appliances that respond to demand. See Robert Walton, ", Is the Promise of OG&E's Dynamic Pricing Program Starting to Fade?,"?, *Utility Dive*, August 29, 2014. URL: http://www.utilitydive.com/news/is-the-promise-of-oges-dynamic-pricing-program-starting-to-fade/303455/.

"[I]f, through the miracles of high speed megacomputers and of techniques of econometrics, all significant cost differentials could be measured without inordinate expense, they would then be found far too numerous, too complex, and too volatile to be embodied in rate differentials. Stability and especially predictability of the charges for public utility services are desirable attributes; and up to a certain point – or rather, up to an indeterminate point – they are worth attaining even at the sacrifice of nice attempts to bring rates into accord with current production costs."[22]

It is not so much that Mr. Bonbright's statement is any less correct today than it was forty years ago, but the "indeterminate point" at which it no longer makes sense to attribute costs and benefits between customers has shifted significantly because of the advances of metering and information technologies. Furthermore, disruptive technologies such as distributed energy storage require a new examination of what services customers demand in the 51st State.

Customers should be offered a wide range of rate structures in a centrally operated distribution utility, or a wide range of market products in a market-oriented structure. In the former situation, customers should be able to assess, with ease, the costs and benefits of adopting new rate structures. Third parties should be allowed to use customer data to figure out the rate structure that best reflects their cost-causation/efficient use of the grid, and take on the volatility risk that may come with, for example, real-time pricing or demand charges. More sophisticated customers, particularly large industrial or commercial ones, may take the time to assess this on their own. In a market-based approach, intermediaries providing energy services to customers would likely provide information on which services customers would most benefit from procuring and providing. In both cases, customers could this information to inform their investments in distributed energy resources.

Customers, aggregators, or third-party energy service companies could take on the risks, and commensurate rewards associated with more granular rates or participation in wholesale markets. The risks of more granular rates, e.g. real-time pricing, come from the volatility of the rates between days, and even between hours. A customer who does not understand the relationship between her energy use and her monthly bill would struggle to see the benefits of participation. But third parties could help to interpret transparent pricing and data in order to maximize customer benefits under any rate structure, including by adding distributed energy resources to the customer mix. This may be a more efficient outcome for the system as a whole, if the arbitrage costs of involving a third party were smaller than the value to the customer derived from access to lower cost financing and sophisticated energy management.

As for new kinds of energy services, the solar-plus-storage "prosumer" provides an illustrative example of how rates should adopt to changing technologies and consumer demands. A network facilitator/distribution utility can provide at least two services that that kind of prosumer needs: a banking or marketing platform service and an insurance or backup service. The banking service is the ability to store locally generated electricity off-site and get it back later when it is needed (daily/seasonally/etc.), while the market service allows the prosumer to sell her kilowatts (or "negawatts") to others whether they are close or far from the prosumer. An insurance service would be characterized by the probabilistic nature of a prosumer's energy adequacy, providing backup based on how likely that customer is to need power. Power needs will fluctuate based on the availability of the on-site resource, so a DG-plus-storage

[22] Bonbright, *Principles of Public Utility Rates*, 1988, 392.

customer may occasionally need more electricity than the system can provide. This could be once a week or once a year, depending on system characteristics. But in order to encourage participation of this increasing class of prosumers, new compensation structures and retail products should provide incentives for prosumer grid participation.

Part II: Market Structure

The most appropriate market structure for the 51st state depends on many factors, but it starts from a central question: to what extent, if any, is electricity distribution a natural monopoly? Few would argue that it would be more efficient if electricity wires and poles and their operation and maintenance were not regulated monopolies. No potential benefit would manifest from two overlapping systems of redundant infrastructure, given the costs. Centralized operation of the system, the active balancing of supply and demand, is rightly characterized as a natural monopoly, as significant efficiencies result from a concentration of system management and technological understanding—not to mention that the grid system is a giant synchronous machine that must be kept in delicate balance to avoid blackouts and keep people safe.

On the other hand, electricity generation is not a natural monopoly. Even before the advent of distributed energy resources, wholesale markets managed by independent system operators (ISOs) have proven that competitive generation keeps the lights on without driving up costs.[23] Wholesale markets have made significant progress encouraging competition and taking advantage of least-cost energy services from both demand- and supply-side resources, particularly in PJM Interconnection.[24] But these entities fail to capture many of the local benefits of distributed generation or other externalities, because their jurisdiction limits their concern to bulk system reliability. Continued improvements that reduce barriers to competition and improve the pricing of externalities and local system benefits have the potential to unlock market forces to optimize the system.

The proliferation of DERs has further increased the potential for competitive generation, and even challenged the necessity for one regulated distribution utility that owns the poles and wires, optimizes the system, and holds an exclusive relationship with customers. While system efficiencies result from central planning of the resource mix, individual customers can now compete with the vertically integrated utility to provide energy services to the grid.

The advent of three technologies in particular challenge the "natural monopoly" status of one distribution utility that owns the wires and poles, optimizes the resources on the system, and holds an exclusive relationship with customers: information technology and networks that allow for multilateral energy transactions in real time; advances in DER technologies like demand response and distributed generation that increase customer control over energy consumption; and energy storage technology that reduces the need for an interconnected system with an aggregated load profile. Because of these

[23] For example, studies show that when PJM incorporated Midwest utilities, it immediately led to a boost in inter-regional trading, suggesting that the larger trading area allowed for more cost-effective transactions. Erin T. Mansur and Matthew W. White, "Market Organization and Efficiency in Electricity Markets," 2012, 56.

[24] In PJM Interconnection, demand response and energy efficiency compete against traditional generation in the forward capacity market. Demand response won as the least-cost option for 47.5 percent of additional capacity in 2017-2018, displacing the most expensive would-be generators in the process. Similarly, demand response regularly bids into the day-ahead energy markets in PJM at well below the average cost of generation.

technologies, the provision of energy services themselves will inevitably encounter competition in the 51st State, with the best of both centralized and distributed resources playing roles in overall system optimization.

But should this distribution system operator (DSO) also own the wires and poles, or should different bodies own and operate the distribution system? The system needs a central coordinator for procurement to ensure that demand and supply are balanced in real time to deliver safe, reliable power. There are some benefits to having one entity own the physical system and operate the resources—it can streamline decision-making about where to expand or improve the distribution network to help optimize the system and avoid unnecessary infrastructure investments. On the other hand, having one entity own the wires and operate the system may create incentives for overinvestment in distribution infrastructure, and could create a bias against customer-owned distributed energy resources even where they can alleviate congestion—especially when the utility is compensated based on a rate of return on prudent capital expenditures.

The 51st State would be wise to consider the advantages of either structure. There is no clear better option, and concerns can be addressed with complementary policies. Instead, policymakers in the 51st State should focus on first principles of system optimization that can be applied to either market-based or vertically integrated distribution utilities. Different circumstances, not the least of which is whether the 51st state is located adjacent to a large, well-functioning wholesale market (largely outside its control), will require different regulatory solutions. Because the existence or willingness of other states to join a wholesale market with the 51st State is unknowable, this paper will not directly address interactions with a broader wholesale market, but we note that bulk generation is not a natural monopoly, and a well-designed market compares centralized generation on equal footing with distributed energy resources. First principles of market design will elucidate the pros and cons of each system, shedding light on necessary complementary policies that can make each structure work.

Principles of Market Structure in the 51st State

We start with the following principles of market structure extracted from America's Power Plan,[25] a platform for smart thinking on electricity policy, market design, and utility regulation. A modern market structure for electricity should accomplish the following goals:

a. **Create a level playing field for competition between all resources, regardless of their type, technology, size, location, ownership and whether or how they're regulated, allowing supply and demand resources to compete head-to-head.**[26]
b. **Ensure the stability and health of the grid and incentivize integration of cost-effective centralized and distributed resources.**[27] **Allow infrastructure owners and grid operators to capture a fair portion of the value of optimizing new technologies to deliver an affordable, reliable, environmentally clean electricity system.**

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[25] www.americaspowerplan.com
[26] Michael Hogan, "Power Markets: Aligning Power Markets to Deliver Value," *America's Power Plan*, 2013. URL: http://americaspowerplan.com/wp-content/uploads/2014/01/APP-Markets-Paper.pdf
[27] James Newcomb, et al., "Distributed Energy Resources: Policy Implications of Decentralization," *America's Power Plan*, 2013, 32. URL: http://americaspowerplan.com/power-transformation-solutions/ratemaking-and-utility-business-models/.

c. **Foster innovation in energy services delivery by allowing procurement to adapt quickly to technological innovation. Allow any resource—single or aggregated—to compete to provide energy services (energy, capacity, and ancillary services).**
d. **Maximize the transparency of energy procurement and markets.**

These principles apply to vertically integrated, partially restructured, and fully restructured markets. Any of these market structures can work, if these principles are applied and the right set of complementary polices are put in place. Although a hybrid approach could be best for the 51st State, the following sections discuss the method for complying with each principle in purely market-based and in more vertically integrated market structures. Some definitional groundwork will help differentiate the two:

A market-based approach separates a system and market operator role from the ownership of the poles, wires, DERs, and other generation. The most ambitious adoption of market-based procurement to optimize the distribution grid is under development in New York under the Reforming the Energy Vision (REV) proceeding.[28] The REV proposes a distributed system platform provider (DSPP) that provides a market for distributed energy resources and serves as an intermediary between customers and the wholesale market. The DSPP uses open markets to procure resources from both the bulk and local systems, in theory driving down the costs of energy services and fostering competition across all available system resources. Prices and value propositions, in conjunction with procurement obligations, drive investments in energy resources. While in New York the DSPP is also the distribution utility owner of the poles and wires, it need not be. An independent system optimizer that does not own the system of wires and poles could also direct investments in distribution infrastructure that are determined by price signals long-term planning studies.[29] For the rest of this paper, "market-based" distribution system operators refers to the latter—an entity that ensures system optimization but remains separate from the wires and poles company.

By contrast, a vertically integrated utility is the system operator, the owner of infrastructure, and may also own some generation and bulk transmission assets. The utility projects system need and uses the rate structure to procure distributed energy resources alongside conventional generation to meet system need at least cost. Resource procurement in this system is driven by utility planning and regulatory oversight of those planning decisions. The distribution utility determines system need and procures it either by building it directly, or buying it though an auction that results in bilateral contract(s) for energy services. Under either market structure, the following principles guide the policy choices:

a. **Create a level playing field for competition between all resources, regardless of their type, technology, size, location, ownership and whether or how they're regulated, allowing supply and demand resources to compete head-to-head.**

In a market-based distribution system, the most crucial part of creating a level playing field for all resources is defining tradable energy services in a way that will enable all resources to compete to provide them. These tradable services include energy, capacity, and ancillary services such as frequency

[28] *Reforming the Energy Vision: NYS Department of Public Service Staff Report and Proposal*, Case No. 14-M-0101, 2014.

[29] For a thorough description of the independent distributed system operator model, see *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, Case No. 14-M-0101, Comments of Jon Wellinghoff, Stoel Rives, LLC, and Katherine Hamilton and Jeffrey Cramer, 38 North Solutions, LLC, July 18, 2014.

regulation, voltage stability, and upward or downward ramping services. Once a given resource, such as distributed energy resources like demand response, storage, energy efficiency or distributed generation, has proven its ability to provide one or more of these services, it should be permitted to provide energy services through a distributed marketplace.[30] By refining the definitions of tradable services to expose the value of all services needed by the system, the market can approach true competitive pricing. This, in turn, should drive down the overall cost of electricity distribution and increase the adoption of cost-effective distributed energy resources.

Of critical importance is both allowing smaller resources to compete, and allowing aggregation of small resources to participate for the same profile of services as conventional generation. Minimum quantities of service (e.g. a 1MW minimum capacity bid) do not have particular significance, and mostly serve to limit the amount of players in the market. While aggregation can solve this problem in many cases, an intermediary is not necessary for sophisticated customers that hope to provide services to the grid directly. In the past, small resources have not been allowed to participate in wholesale markets for these services. If individual products are unable to provide the services identified as critical needs in long-term planning, aggregation can package disparate services to compete with conventional generation. For example, modern inverter technologies now combine with renewable resources to become better citizens of the grid that provide reliability resources in conjunction with energy.[31] Add storage to the equation and one could possibly simulate conventional generation in a marketplace. Adjusting market product definitions to maximize bidder flexibility in this way will lead to more efficient competition.

But where markets excel at finding accurate prices, they struggle to integrate public policy directives and long-term planning needs. Pricing of carbon and other environmental externalities should complement any market-based procurement structure to ensure that zero- or low-carbon energy resources are receiving full consideration for the benefits they provide. Prices should also provide full accounting of the avoided system costs associated with distributed energy resources.[32] There are other public policy directives to consider as well, depending on the political priorities of the 51st State.

To ensure system optimization and correct for the failures of a purely market-based procurement strategy, regulators must also require long-term planning by the system operator that guides procurement decisions. Market prices do a poor job communicating long-term or avoided costs because identification of future energy, capacity, or even ancillary service needs requires an integrated assessment. To address this failure, regulators should complement system optimizers with powers to develop integrated distribution plans (IDPs) and broader integrated resource plans (IRPs) that ensure long term procurement matches up with system need under an evolving resource mix, subject to regulatory oversight. The IDP and IRP would be used to determine the volume of tradable services the system will need in the long-term, but the market would be used to procure and dispatch those services up to the level needed. Overall IRPs should be designed to optimize the mix between distributed and centralized

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[30] See, e.g., N.W. Miller, et al., GE Energy Management & National Renewable Energy Laboratory, *Western Wind and Solar Integration Study Phase 3 – Frequency Response and Transient Stability*, December 2014.

[31] See, e.g., Y.C. Zhang, et al., “Role of Wind Power in Primary Frequency Response of an Interconnection,” *National Renewable Energy Laboratory*, October 2013.

[32] TimT Woolf, et al., “Benefit-Cost Analysis for Distributed Energy Resources,” *Synapse Energy Economics,* prepared for the Advanced Energy Economy Institute, September 22, 2014. URL: , http://info.aee.net/hs-fs/hub/211732/file-1683401630-pdf/REV/Synapse-AEEI-NY-REV-DER-BCA-2014.pdf.

resources, and across demand and supply. They may even incorporate the "staircase capabilities market" proposed in Principle 3, below.

Centrally planned or vertically integrated distribution utilities, on the other hand, require careful regulation to ensure they are taking advantage of all available resources to optimize the system across affordability, reliability, and environmental performance. These utilities should use market-based procurement such as reverse auction mechanisms and a loading order that reflects system needs and priorities ascertained through an IRP process. A reverse auction mechanism specifies the resource need and type, then solicits bids from third-party participants to meet system need. These procurements would be multi-year contracts, providing stable value propositions for both supply- and demand-side resources. Coupling this IRP process with reverse auctions streamlines the process of integrating public policy goals and externalities into consideration, particularly if there is a clear policy signal such as a renewable portfolio standard to guide procurement decisions.

But in the vertically integrated case, customers would rely heavily on regulators to ensure that utilities were properly motivated to consider all resources when recommending a mix of energy resources to meet the system needs they identify. While centralized procurement is excellent at integrating these social directives, it is not as great at cost containment or system optimization. For example, IRPs allow utilities the first bite at determining which resources would most cost-effectively meet system need. Regulators then scramble to ensure that these decisions are prudent under the traditional utility compact. If the resource type is already specified—even implicitly—in the reverse auction, it limits the ability for all cost effective resources to compete. Instead, the *characteristics* of resources, i.e. which services they provide, should be specified, leaving the specific type of resource up to the results of the reverse auction.

Another problem is utility bias toward procuring utility-owned assets. Performance-based regulation can correct this failure by aligning utility incentives with customer value. Regulators can set clear incentives for utilities to meet key goals, enabling utilities to meet them by unleashing competition. In particular, the utility should be given clear, quantitative goals for (1) reliability, (2) affordability, and (3) environmental performance, set five to seven years out. If the utility meets those goals it gets a reasonable profit; if it beats them, it makes real money; if it misses them, it faces financial repercussions.[33] Along the way utilities can be judged by how close they are to the proper trend line, and be rewarded or penalized accordingly.[34]

b. **Ensure the stability and health of the grid and incentivize integration of cost-effective centralized and distributed resources. Allow infrastructure owners and/or grid operators to capture a fair portion of the value of optimizing new technologies that deliver an affordable, reliable, environmentally clean electricity system.**

In both market-based and vertically integrated systems, a central coordinator is needed to oversee the distribution system to ensure the lights stay on and there are no safety issues. In order to achieve this goal, the system requires sufficient reliability resources, which fall into two categories: flexibility and ancillary services. Of course, the two are not entirely distinct, but separation is useful for

[33] Hal Harvey, "The Great Reinvention of the Electric Utility," *Energy Innovation*, August 2014. URL:, http://energyinnovation.org/wp-content/uploads/2015/01/Reinventing-the-Electric-Utility.pdf.
[34] Ibid. See also Ron Lehr, "Utility and Regulatory Models for the Modern Era," *America's Power Plan*, 2013, available at http://americaspowerplan.com/wp-content/uploads/2013/10/APP-UTILITIES.pdf.

explanation. Flexibility consists of resources that can respond to sudden changes in supply or demand, e.g. conventional plant tripping or solar cloud cover, by adjusting power output rapidly enough to accommodate that kind of variability. Ancillary services are provided by resources that can maintain system stability on a much shorter timescale, including frequency response, voltage stability, and system inertia. Regardless of the market structure, the central operator needs clear guidance on what the appropriate level of reliability resources is on the system to satisfy public policy goals of reliable power delivery.

The system operator is the best entity to conduct a study to determine the ongoing needs of the system for flexibility and reliability services because the system operator has access to data about operational needs, constraints, and thus value opportunities. The reliability assessment would have two parts: an integrated distribution plan (IDP) and an integrated resource plan (IRP). In order to determine the capacity for existing feeders and lines to accommodate additional distributed generation (or needed load reductions from other DERs), the system operator should begin by conducting an integrated distribution plan (IDP), to inform the system wide reliability procurement process. According to a concept paper from the Interstate Renewable Energy Council, the IDP proceeds in five steps: (1) forecast DG (or DER) growth on the circuit; (2) establish the hosting capacity and allowable penetration level; (3) determine available capacity on the distribution circuit; (4) plan upgrades and expedite interconnection procedures based on the IDP; and (5) publish the results for public knowledge.[35] Once the system operator figures out the capacity for reliable distributed generation on each circuit, and the coincident potential for other DERs to relieve that capacity, it can proceed to system-wide planning.

In either market context, guidance on reliability resource adequacy should come in the form of an IRP that is logically informed by the IDP. The integrated resource plan is "a utility plan for meeting forecasted annual peak and energy demand, plus some established reserve margin, through a combination of supply-side and demand-side resources over a specified future period."[36] For example, if significant load growth is projected in an area of the distribution system, an IRP would assess the need to add energy, capacity, and ancillary services to support that new demand. An IRP should also provide opportunities for stakeholder engagement and regulatory oversight to ensure that all options are considered, building on best practices in other states.[37] Procurement would then take place according to the principle of competition under Principle (a), above.

c. **Foster innovation in energy services delivery by allowing procurement to adapt quickly to technological innovation. Allow any resource—single or aggregated—to compete to provide energy services (energy, capacity, and ancillary services).**

Under both market structures, some regulation that promotes innovation and integration of new technologies will be needed as a complement to cost-effective procurement. Both procurement systems

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[35] Tim Lindl, et al., "Integrated Distribution Planning Concept Paper: A Proactive Approach for Accommodating High Penetrations of Distributed Generation Resources," *Interstate Renewable Energy Council*, May 2013, 10. URL: http://www.cpuc.ca.gov/NR/rdonlyres/2EC6B7F3-DAAC-4F47-8DDA-EB3374977797/0/IREC.pdf. This planning process is already under way in California under SB 327 (2013).
[36] Rachel Wilson & Bruce Biewald, "Best Practices in Electric Utility Integrated Resource Planning," *Synapse Energy Economics*, June 2013, 4.
[37] Ibid, at p.26–27

should fund pilot programs to demonstrate the viability of new technologies to provide reliable electricity services, particularly ancillary services.

Market-based systems could adjust product definitions as necessary to make room for these new resources to provide the same services as existing resources. But the market-based system may fall short in promoting nascent technologies if it relies on today's prices alone. In order to foster new technologies that may have the potential to create savings in the long run but cannot yet compete on price alone, regulators could impose minimum procurement requirements for "innovative" resources on the system operator. These will be small parts of the total electricity business, but crucial for cultivating future options. In the long run however, the potential for profitable deployment of new technologies in a fair market should provide enough incentive to invest in improving the cost of new technologies.

Along with pilot programs, vertically integrated utilities should use a "staircase capabilities market" to provide long-term market signals for proven, but nascent technologies, as a separate procurement process from the reverse auction mechanism.[38] A Staircase Capabilities Market is an iterated sequence of long-term, but small-volume requests for proposals for new capabilities to match anticipated system needs. The period of performance would be on the order of 10–20 years to ensure a consistent investment signal. But in order to minimize cost and risk, the procurement would happen in relatively small tranches, adjusting parameters from one small procurement process to the next in order to incorporate lessons from the prior process and create room to integrate new technologies regularly. Operating as a reverse auction mechanism, the set of resources competing in each auction could either be innovative packaging of existing resources or new technologies, providing an on-ramp for innovative solutions to present and future grid challenges.[39]

In either case, integrated resource planning and market procurement processes should undergo regulatory review periodically for continuous improvement. This implies a well-funded, well-staffed public utility commission in the 51st State. Procurement processes, long-term planning processes, and rate structures should reflect the current conditions and challenges associated with providing reliable electric service at reasonable costs.

d. Maximize the transparency of energy procurement and markets.

Transparency is the final principle; and rather than standing alone, it applies to all other principles. Transparency is fundamental because it allows potential market entrants to discern the value proposition of bidding into markets for their energy services. Transparent markets expose the value of particular attributes of an energy resource, allowing technology developers to adapt their products to deliver these values, and fostering better competition between supply- and demand-side resources. Without clear signals as to what price point a potential market entrant should meet, it remains difficult to assess the risk associated with developing new technologies.

Transparency should be a natural consequence of a market-based approach. As long as there are rules for disclosing the clearing price of each of the services, there is a clear price signal to future entrants.

[38] See Sonia Aggarwal, Eric Gimon, & Hal Harvey, "A New Approach to Capabilities Markets: Seeding Solutions for the Future," *Electricity Journal*, Vol. 26, Issue 6, July 2013.
[39] Ibid 3.

The performance requirements of these definitions (the resource "capabilities") should align with identified value of DER deployment.[40]

A similar standard of transparency should apply to a vertically integrated utility's reverse auction mechanism. The prices of anonymous individual bids should be disclosed, or at least the clearing price, when the reverse auction procurement concludes. With clear rules defining the services in place for each auction or bidding process, transparency can go a long way to ensuring a virtuous cycle of investment in cost-effective centralized and distributed energy resources.

Access to data is another important consideration that fosters competition and transparency by giving industries and stakeholders the tools they need to engage effectively with and suggest improvements for an IRP and IDP. Greentech Leadership Group emphasizes that this data needs to come from both the system operators and the DER industries in *More than Smart*, a research project to explore ways to advance California's distributed energy resource integration. In order to incorporate appropriate costs into the IRP analysis, qualified access to grid asset and operational data is a must.[41] Likewise, utility planning and analysis, as well as stakeholder engagement, would benefit from information regarding system performance characteristics for distributed energy resources, potentially from DER developers and ESCOs.[42] Maximizing transparency will help to drive down system costs, maintain reliability, and promote an optimal mix of resources in the 51st State.

Part III: How Will this Affect Stakeholders?

Affected Stakeholder	Effect of New Principles for Rate Design and Market Structure
Electric Utilities (in a vertically integrated structure)	• Become system optimizers • Use reverse auction mechanisms to procure resources based on integrated resource plans and integrate distribution plans, engaging with stakeholders early and often in the process • Use more granular prices or tariffs to optimize the system around affordability, reliability, and environmental performance goals articulated by regulators • Find new opportunities to expand their businesses to include more customer-oriented service, including bill optimization and energy management services • Be proactive in generating and packaging data, adopting the Green Button protocol from U.S. Dept. of Energy and Greentech Leadership Group's *More than Smart* data access standards • Revenues become dependent on system performance • Procure new technologies via a staircase capabilities market

[40] Greentech Leadership Group, "More than Smart: A Framework to Make the Distribution Grid More Open, Efficient and Resilient," August 2014, 23. URL: http://greentechleadership.org/wp-content/uploads/2014/08/More-Than-Smart-Report-by-GTLG-and-Caltech.pdf.
[41] Ibid. at 9.
[42] Ibid.

Electric Utilities (in a market-based structure)	• Build and operate grid infrastructure based on IRPs and IDPs • Own and maintain poles and wires • Earn returns on capital expenditures • Earn volume-based payments for use of the grid network
Distribution System/Market Operator (in a market-based structure)	• Safeguard consumers by creating fair rules for compensating bilateral flow of energy services • Drive system reliability planning through IDP and IRP processes, procuring resources through a marketplace • Periodically update market rules and product definitions to accommodate new technologies and reflect needed system characteristics • Ensure transparency by disclosing prices, and to the extent possible, individual bids • Be proactive in generating and packaging data, adopting the Green Button protocol from U.S. Dept. of Energy and Greentech Leadership Group's *More than Smart* standards for data access • Ensure that the value and costs of DERs are fully reflected in market prices and definitions
Solar/DER Industry	• Access to new opportunities for creating customer value directly, or via third party aggregators of demand response, energy efficiency, DG, and storage • Increased collaboration with utilities to determine full potential of distributed energy resources to meet system needs • Growth in demand for home automation technologies • More sustainable adoption of rooftop solar, meaning a long-term boost in demand for modules and construction • Increased viability of emerging technologies through staircase capabilities market and pilot programs
Solar/DER Customers	• The ability to provide—and get paid for—an increasingly diverse set of energy services • Compensation through rate structures or market procurement • Long-term, sustainable market growth associated with becoming better citizens of the grid • Guidance from IDPs to identify opportunities for location-specific deployment of cost-effective DERs • An increasing amount of fellow "prosumers" that provide net benefits to the grid • More offers for home energy management from utilities or third parties to simplify bills and increase value
Non-solar/DER Customers	• Falling bills due to cost-effective DER integration and fewer investments in unnecessary infrastructure • More reliable electric service due to integration of DERs as reliability resources • Simple bill options alongside opportunities to for increasing sophistication, commensurate with additional risks and potential rewards for price-responsive electricity use

Regulatory & Policy-Making Bodies	• Promote pilot projects for untested, granular, and real-time cost-causative rate designs coupled with enabling home automation technologies • Provide oversight for IRP and IDP processes • Ensure that market products are updated frequently • Measure performance of the system optimizer and ensure it receives a fair portion of the value it creates for the grid • Ensure that the PUC has sufficient staffing and funding to undertake new roles overseeing complex utility and market planning processes, including capacity to interpret public data and modeling results • Set optimal interconnection rules that ensure DERs have a positive effect on system reliability

Conclusion

The 51st State should be well equipped to take advantage of new technologies now available to customers and the grid. With the right set of complementary policies, a vertically integrated or a market-based structure can work. The foregoing principles for rate design and market structure provide a foundation for the policymakers and constituents of the 51st State to make well-informed choices as to which specific policies they can try first. Choices between market structures or rate designs may reflect a political or ideological preference for more smart regulation, more market pricing or most likely some hybrid of the two. Optimizing the system around affordability, reliability, and environmental performance requires political leadership. The 51st State may also put other policy directives on par with these three, for example, customer choice, or low-income equal access. These policy priorities will elucidate which path is most appropriate for the 51st State. Most important, building transparency and adaptability into the policy structure will ensure that the policymakers can respond to changing technologies, political trends, and regulatory models as they emerge in the future.