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Next-Generation Performance-Based Regulation

VOLUME 1

Introduction— Global Lessons for Success

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Next-Generation Performance-Based Regulation

Volume 1: Introduction—Global Lessons for Success

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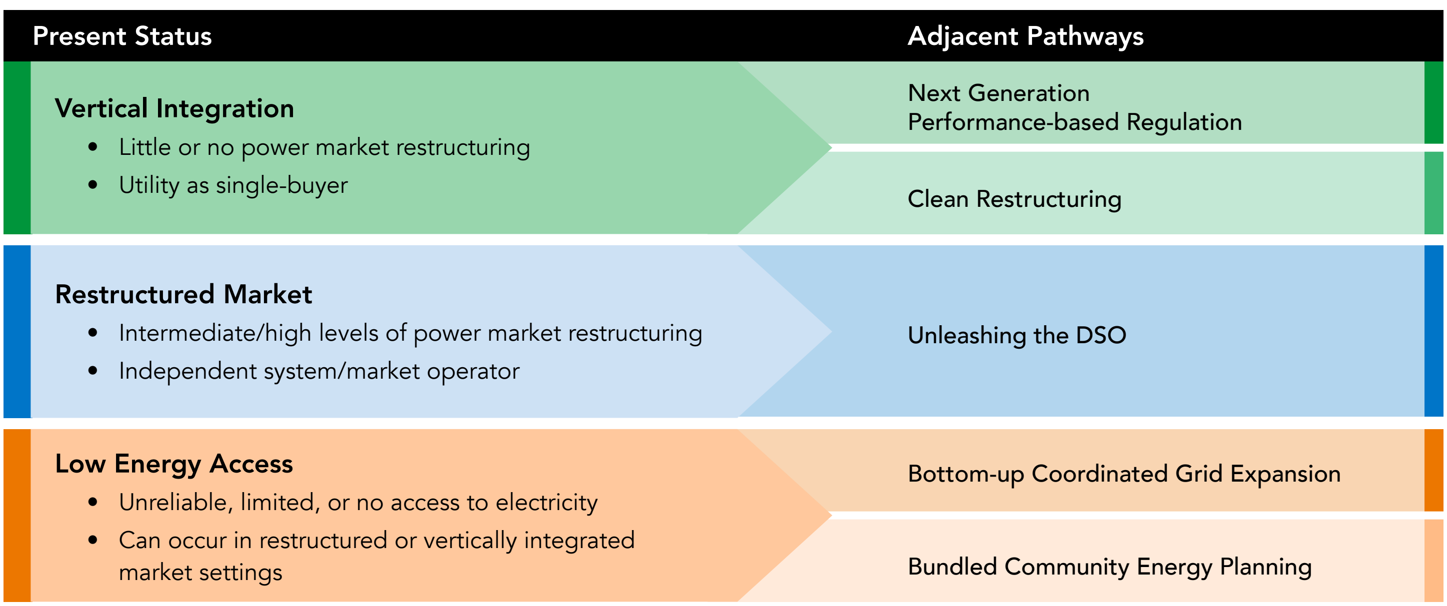
The Next-Generation Performance-Based Regulation Report in Three Volumes

This three-volume report is based on the material found in *Next-Generation Performance-Based Regulation: Emphasizing Utility Performance to Unleash Power Sector Innovation*,[1] which, like this report, was created for the 21st Century Power Partnership (21CPP). Since 2012, the 21CPP—an initiative of the Clean Energy Ministerial—has been examining critical issues facing the power sector across the globe. Under the direction of the National Renewable Energy Laboratory (NREL), 21CPP provides thought leadership to identify the best ideas, models, and innovations for the modern power sector that can be implemented by utilities and governments around the world.

An earlier 21CPP report, *Power Systems of the Future*,[2] published in 2015, summarizes the key forces driving power sector transformation around the world and identifies the viable pathways that have emerged globally for power sector transformation, organized by starting point as illustrated in Figure P-1. In 2016, the 21CPP published an in-depth report describing the Clean Restructuring pathway originally elucidated in *Power Systems of the Future*. A related pathway identified in *Power Systems of the Future* was Next-Generation Performance-Based Regulation, and this report builds on that.

Figure P-1. Present status and adjacent pathways to power system transformation



Source: Zinaman, O., Miller, M., Adil A., Arent, D., Cochran, J., Vora, R., Aggarwal, S. et al. 2015. *Power Systems of the Future: A 21st Century Power Partnership Thought Leadership Report*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-62611. http://www.nrel.gov/docs/fy15osti/62611.pdf.

[1] Littell, D., Kadoch, C., Baker, P., Bharvirkar, R., Dupuy, M., Hausauer, B., Linvill, C., et al. 2017. *Next-Generation Performance-Based Regulation: Emphasizing Utility Performance to Unleash Power Sector Innovation*. Golden, CO: National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy17osti/68512.pdf.

[2] Zinaman, O., Miller, M., Adil A., Arent, D., Cochran, J., Vora, R., Aggarwal, S. et al. 2015. *Power Systems of the Future: A 21st Century Power Partnership Thought Leadership Report*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-62611. http://www.nrel.gov/docs/fy15osti/62611.pdf.

With this report, we have divided the full *Next-Generation Performance-Based Regulation* report into three volumes:

1. *Next-Generation Performance-Based Regulation*
   Volume 1: Introduction—Global Lessons for Success
2. *Next-Generation Performance-Based Regulation*
   Volume 2: Primer—Essential Elements of Design and Implementation
3. *Next-Generation Performance-Based Regulation*
   Volume 3: Innovative Examples from Around the World.

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List of Acronyms

COS	cost of service
DER	distributed energy resource
DSO	distribution system operator
EAM	earnings adjustment mechanism
NREL	National Renewable Energy Laboratory
NY REV	New York's Reforming the Energy Vision
NY-PSC	New York Public Service Commission
PBR	performance-based regulation
PIM	performance incentive mechanism
RIIO	Revenue=Incentives+Innovation+Outputs
SAIDI	system average interruption duration index
SAIFI	system average interruption frequency index

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1 Introduction

Performance-based regulation (PBR) enables regulators to reform hundred-year-old regulatory structures to unleash innovations within 21st century power systems. An old regulatory paradigm built to ensure safe and reliable electricity at reasonable prices from capital-intensive electricity monopolies is now adjusting to a new century of disruptive technological advances that change the way utilities make money and what value customers expect from their own electricity company.

Advanced technologies are driving change in power sectors around the globe. Innovative technologies are transforming the way electricity is generated, delivered, and consumed. These emerging technology drivers include renewable generation; distributed energy resources (DERs), such as distributed generation and energy storage; demand-side management measures, such as demand response, electric vehicles, and smart grid technologies; and energy efficiency.

Today, average residential customers are increasingly able to control their energy usage and even become grid resources, something not contemplated in the 20th century era of large centrally operated generating plants. There are now new energy capabilities throughout the power sector. Traditional centralized power generation and transmission are being supplemented with customer-sited generation, energy management and energy efficiency solutions, and energy storage.

The ongoing transformation to a more efficient and more complex grid means utility business models are also changing. Utilities in many advanced economies that historically have grown by building new power plants and large transmission lines are now adjusting to lower—or even flat—growth in electricity usage.[3] Some utility business models are being challenged as they face less demand for electricity sales, and all are facing increasing demands for new services and uses of their system. With this transformation, utilities worldwide are increasingly finding themselves delivering value to customers who have different needs, who want to use electricity in different ways, and who sometimes offer value back to the utilities. PBR enables regulators to recognize the value that electric utilities bring to customers by enabling these advanced technologies and integrating smart solutions into the utility grid and utility operations.

All regulation is incentive regulation.[4] Regulated entities respond to the incentives they are provided. Traditional cost of service (COS) regulation looked at performance in terms of sales, revenue, and rate (price) and often service reliability, safety, and quality. Regulated entities responded to the incentives inherent in traditional COS regulation and provided service according to the performance requirements implicit in traditional utility regulation. Changes in the electric energy system and in customer preferences mean there is an increasing interest in motivating regulated entities in areas beyond traditional COS performance. Modifications to the COS model, called PBRs, are not new. Multi-year rate plans, a first effort at PBRs, were first used in the 1980s for railroads, telecommunications, and other industries facing competition and changing demand, and they were introduced for U.S. electric utilities in the 1990s.

A PBR represents a significant modification to historical COS utility regulation paradigms, wherein performance incentives can operate as an incremental add-on to traditional regulation or state-owned models to influence management to align utility planning, investments, and operations with societal goals. This report defines PBRs and performance incentive mechanisms (PIMs) as:

- *PBRs* provide a regulatory framework to connect goals, targets, and measures to utility performance or executive compensation. For some enterprises, PBRs determine utility revenue or shareholder earnings based on specific performance metrics and other non-investment factors.

[3] However, in many advancing economies, such as Mexico, Indonesia, China, Vietnam, and Brazil, demand for electricity continues to grow between 3% and 10% annually.

[4] Bradford, P. 1989. *Incentive Regulation from a State Commission Perspective. Remarks to the Chief Executive's Forum.*

Non-investment factors can be particularly important for state-owned entities, such as by providing low-cost service and being responsive to government mandates. For utilities of all types, PBRs can strengthen the incentives of utilities to perform in desired ways.

- *PIMs* are components of PBRs that adopt specific performance metrics, targets, or incentives to affect desired utility performance and represent the priorities of the jurisdiction. PIMs can be specific performance metrics, targets, or incentives that lead to an increment or decrement of revenues or earnings around an authorized rate of return to strengthen performance in target areas. PIMs can act as an overlay on a traditional COS regulatory framework for privately owned utilities in which a return on rate base is computed in a rate case. For state-owned entities and investor-owned utilities, a PIM can take on the form of manager performance reviews (on specific criteria) that are linked to manager income or promotion.

Well-designed PBRs provide incentives for utility performance, thus benefiting consumers and utility owners alike. This report considers the role of both PBRs and more discrete PIMs in 21st century power sector transformation. Innovative technologies are transforming the way electricity is generated, delivered, and consumed. PBRs have the potential to realign utility, investor, and consumer incentives and mitigate emerging challenges to the utility business model, renewable integration, and even cyber security.

The goals of PBRs in the form of multi-year rate plans are in many respects the same in terms of providing reasonably priced and reliable service to customers. However, today's technologies have changed, and there is more emphasis on clean energy. Thus, the pathways and the potential outcomes are different than they were in the 20th century when centralized generator stations and large infrastructure additions dominated the utility landscape.

The changing power sector—including penetration of new disruptive technologies such as decentralization of supply, growth of demand-side resources, and increasing intelligence and digitalization of networks—will also change what regulation looks like in an era of disruptive technologies. Given unprecedented changes underway in the electricity sector, PBRs—by specifying expectations of utility performance and outcomes for consumers, while staying agnostic to the exact means of delivery—constitute a form of prescient regulation that harnesses disruption. PBRs are one tool in the toolbox in the transition toward flexible regulatory and market structures that rewards utilities that adapt or evolve in reaction to market and technology change.

PBRs that succeed often do so because they rely on clear goal setting, use a simple design, make clear the value of the utility service, and are transparent at each step. Alignment of incentives and benefits for customers and ratepayers tends to make the relationship of the cost of incentives and value of performance easier to understand. Metrics that are clearly identified with objective information support ease of implementation, accountability, and the transparency of the value proposition to regulators, utility management, customers, policymakers, and the public.

Depending on the PBR goals and needs of each jurisdiction, there are several proven PBR and PIM design options, including shared net benefits, program cost adders, target bonuses, base return on equity incentive payments, bonus returns on equity for capital, incentives for kilowatt-hour targets, peak reduction, and penetration measures for DERs.

Electricity has historically been a commodity product delivered by a monopoly service provider. Increasingly, electricity is also an enhanced value service. PBRs enable regulators to compensate utilities for the value that utilities capture for the grid, customers, and society. Although some analysts believe PBRs are only applicable to developed economies, we take a different view and hold mainly that well-designed PBRs are a valuable tool to be applied in a variety of economic and technological situations worldwide. PBRs require capable regulators but not necessarily mature economies.

PBRs and PIMs have great value for the electric industry when designed well, and they can be applied to many different situations. How exactly PBR mechanisms are most effectively enacted will vary based on the utility ownership model, institutional arrangements, and various local factors. PBRs should be tailored to the needs and goals of each jurisdiction, and perhaps each utility, to most effectively achieve the needs of a 21st century power grid in that jurisdiction. PBRs have a growing history. This report highlights the lessons learned from this history and identifies considerations for how PBRs may be best applied. PBRs will continue to evolve and the lessons learned from new applications will continue to accrue.

Electric utilities are embedded in an increasingly sophisticated technological society. The power sector often represents progress in developing countries. In all jurisdictions, utilities enable achievement of important societal goals. Performance-based regulation is regulation in which anyone can know how good utilities are at delivering on clearly stated expectations and, in its higher form, where management is strongly motivated to deliver on public goals as well as internal and fiduciary goals.

In this volume, we examine some leading examples of PBRs:

- The United Kingdom's Revenue = Incentives + Innovation + Outputs (RIIO) initiatives, which focus on outcomes and customer satisfaction
- New York's Reforming the Energy Vision (NY REV) initiative, which seeks to better integrate and harness markets for distributed resources with utility operations and create a new paradigm for utility coordination of distribution-level investments with distributed resources
- Denmark's success with benchmarking PBRs to improve distribution system reliability
- Mexico's PBR program to reduce distribution and transmission system losses
- South Africa's benchmarking PBR to set a cost of coal.

We also look at what we have learned from experience with multi-year rate plans and early forms of PBRs, particularly for energy efficiency, including that:

- Predictability and incrementalism matter for utilities to succeed with PBRs.
- Implementing PBRs without financial incentives builds experience.
- Focusing on metrics with clear measurement methods is valuable and more likely to result in success.
- PBR incentives should be sized in alignment with desired results.
- An appropriate range for PBR impact can be based on traditional COS financial limits.

Lessons in setting PBRs on what *not* to do include:

- Basing performance incentives on inputs is generally a poor practice. Inputs, and particularly spending, tell little about whether a successful outcome or savings are achieved.
- The "business-as-usual" outcomes need to be understood before incentive levels and targets are set. If incentive levels or targets are set at what business-as-usual operations would achieve anyway, additional incentive costs are incurred with no additional benefit to customers.
- Regulators learn that sometimes rewards or penalties are set too high or too low to reach the desired outcomes. Experience allows for modifications and adjustments to refine PBR programs.
- Establishing a well-designed set of performance incentives can require significant utility and regulatory resources.
- Unclear or uncertain metrics or goals create uncertainty for the utility and regulator.

Utilities and utility regulators across the world are experimenting with different business models and regulatory methods to address the technological, business, and economic challenges and opportunities that the 21st century has brought to the power sector. As context for a discussion around next-generation practices, this document and continuing documents in the series will offer some examples of what is working and why and what might work better in the world of power utility PBRs.

2 Examples of Well-Functioning PBRs

The following are examples of PBR mechanisms worldwide that have been successful at achieving their objectives. This is not an exhaustive list of successful PBR mechanisms, but rather those that are known to the authors. It is also important to note that the context and jurisdiction are important: what is successful in one jurisdiction with one set of objectives and constraints may not succeed in another jurisdiction. As a result, a wide variety of PBR applications is evident in diverse jurisdictions. The examples of PBR in this report vary from, for example, energy efficiency, system reliability, transmission system efficiency, and cost of coal management to entire power sector transformation. They highlight lessons learned about what worked in some jurisdictions to achieve PBR goals and may offer lessons for other jurisdictions.

2.1.1 The United Kingdom

The United Kingdom's RIIO offers a point of departure to articulate the characteristics of next-generation performance-based regulation. The main goal of RIIO is the "timely delivery of a sustainable energy sector at a lower cost to consumers than would be the case under the existing regimes."[5] RIIO is a framework that retains strong cost control incentives while attempting to focus on long-term performance, outputs, and outcomes, with less focus on *ex post* review of investment costs.

A review of the previous RPI-X[6] price and revenue control mechanism, instituted in the 1990s, concluded that, although there was a need for large-scale investment in low-carbon energy infrastructure and more effective engagement with customers, U.K. utilities were risk-averse, too slow to innovate, and focused on appeasing regulators rather than satisfying customers.[7] There were also concerns that the previous regulatory framework encouraged a focus on capital costs containment rather than outputs, and the RPI-X framework had been modified and had become rather complex.[8] RIIO, emplaced in 2013, was intended to begin a transition away from the traditional approach of simply rewarding investment in networks (sometimes called the "predict and provide mentality") under the prior regime to an outcome-based approach—a shift from inputs to outputs through revenue-based regulation overlaid with a system of financial rewards for achievement of specified goals (performance).[9]

U.K. regulators changed their price and revenue control mechanism to remove any bias that may normally exist between capital expenditures and operational expenses that would tend to lead utilities to prefer capital expenditures. This approach, which has been referred to as TOTEX (i.e., total expenditures),[10] means there is an incentive to deliver outputs rather than simply build new infrastructure. There was also an associated move from

[5] Ofgem. 2010. RIIO: *A New Way to Regulate Energy Networks*. https://www.ofgem.gov.uk/ofgem-publications/64031/re-wiringbritainfs.pdf.

[6] The RPI-X framework had been in place since 1991, following privatization of the energy industry. Mandel, B. 2015. "The Merits of an 'Integrated' Approach to Performance-Based Regulation." *Electricity Journal* 28(4): 4–17.

[7] Mandel, B. 2014. *A Primer on Utility Regulation in the United Kingdom: Origins, Aims, and Mechanics of the RIIO Model*. http://guarinicenter.org/wp-content/uploads/2015/01/RIIO-Issue-Brief.pdf

[8] Jenkins, C. 2011 (June). *Examining the Economics Underlying Ofgem's New Regulatory Framework*. Florence School of Regulation Working Paper. http://www.city.ac.uk/__data/assets/pdf_file/0011/80939/Jenkins_RIIO-Economics_draft-paper-FINAL.pdf.

[9] By "revenue-based," we mean a method by which "target" or "allowed" revenue levels are determined by regulators and collected by means of adjustments to prices as sales vary (as they inevitably do) from expected levels. (This is what is known as decoupling in the United States.) The allowed revenues themselves may be periodically adjusted to deal with non-sales-related cost drivers, such as inflation, productivity improvements, and approved changes in investment. Such changes are often formulaic in nature and embedded in multi-year regulatory plans.

[10] The move to a total expenditure, or TOTEX, regime was first suggested by Ofgem in March 2008, when the energy regulator launched its RPI-X@20 review. From this comprehensive review of the previous regulatory regime, which had endured since privatization in 1989, emerged the RIIO model.

the previous five-year price control term to eight years as a reflection of the long-term nature of the investments necessary for a low-carbon transition. Output areas that emerged from a public process intended to distill regulatory priorities include:

1. Customer satisfaction
2. Network safety
3. Network reliability
4. New connection
5. Environmental impact
6. Social obligations.

RIIO separates goals into one-year and eight-year outputs. For each price-revenue control regime (gas, electricity distribution, electricity transmission), the regulatory authority Ofgem defines deliverables (measures of success) and units for measurement where applicable (metrics). Using the example of the price-revenue control regime for gas transmission and distribution (known as RIIO-GD1), Figure 1 shows the deliverables, incentives, and metrics for those

Electricity Distribution Networks Operators

Customer

Safety

	ENWL	NPgN	NPgY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Compliance with HSE legislation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

Environmental*

	ENWL	NPgN	NPgY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Oil leakage	■	✔	✔	✔	✔	✔	✔	✔	✔	✔	NA	■	✔	✔
Business carbon footprint	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
SFe emissions	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

Customer Service (scores out of 10)

	ENWL	NPgN	NPgY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Interruptions survey	8.08	8.68	8.69	8.88	8.97	9.14	8.86	8.52	8.63	8.88	8.79	8.86	9.06	8.39
Connections survey	7.75	8.03	7.95	8.70	8.79	8.75	8.73	8.13	8.34	8.10	8.36	8.43	8.55	7.88
General inquiries survey	8.52	8.93	8.76	9.14	9.35	9.29	9.18	8.86	9.12	9.16	8.84	9.24	8.72	8.53
Complaints metric**	7.65	8.00	7.19	1.70	1.92	3.04	2.41	5.18	6.10	5.60	3.60	3.37	4.08	4.65

Connections

	ENWL	NPgN	NPgY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Time to quote	✔	✔	✔	✔	✔	■	✔	✔	✔	✔	✔	✔	✔	✔
Time to connect	✔	✔	■	✔	✔	✔	✔	✔	✔	■	✔	✔	✔	✔

Reliability

	ENWL	NPgN	NPgY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Customer interruptions	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Length of interruptions	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

Social Obligations (scores out of 10)

	ENWL	NPgN	NPgY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Stakeholder engagement	6.90	← 6.50 →		← 8.75 →				← 7.53 →			← 6.78 →		← 5.73 →	

✔ Met target in year 1 or RIIO-ED1

■ Failed part of target in year 1 or RIIO-ED1

Customer Bill Impact

	April 2015	➡	April 2017
ENWL	£89	-11.2%	£79
NPgN	£97	-6.2%	£91
NPgY	£84	-9.5%	£76
WMID	£80	3.8%	£83
EMID	£76	0.0%	£76
SWALES	£96	6.3%	£102
SWEST	£107	5.6%	£113
LPN	£66	1.5%	£67
SPN	£86	5.8%	£91
EPN	£76	3.9%	£79
SPD	£96	-5.2%	£91
SPMW	£121	-14.0%	£104
SSEH	£122	2.5%	£125
SSES	£80	-1.3%	£81
GB	£87	-1.1%	£86

* No formal targets were set for environmental outputs. The performance score reflects the change from the previous year.

** Target score should be below 8.33.

Source: Based on graphic from RIIO

Figure 1. RIIO outputs

Ofgem. 2016. RIIO-ED1 Annual Report 2015–16. https://www.ofgem.gov.uk/system/files/docs/2017/02/riio-ed1_annual_report_2015-16_supplement.pdf.

price control regimes where applicable. Note that not all outputs are associated with incentives; this is to avoid unintended consequences (e.g., misreporting incidents), and because some outputs are governed by other government agencies and are thus outside the control of the utility.

RIIO has a notable innovation: utility benchmarking and scorecards identify utilities that excel or lag. Ofgem publishes annual reports on the performance of all network companies, including tables that compare performance output areas. Figure 1 is based on one of the tables provided. Color coding indicates the level of success achieved in the last year or forecast to be achieved over the eight-year period. The more innovative elements of RIIO are addressed in Volume 3.

2.1.2 United States

PBR programs in the United States have successfully addressed cost management, customer service, energy efficiency, and reliability.

2.1.2.1 California

California's experience with PBR has produced some successes as well as some notable failures. Perhaps the most successful performance-based program in California is a gas utility mechanism that allows gas utilities to retain part of the proceeds from effectively managing gas supply costs on behalf of ratepayers. Gas utilities in California have a proven record of effectively purchasing and hedging gas supply. The PBR mechanism deserves credit for this success, as the program consistently produces savings for ratepayers and revenue for gas utility shareholders.

A second performance-based program that may have produced a beneficial outcome is the cost recovery mechanism established for the Diablo Canyon nuclear power plant. Cost overruns and project delays led to significant consumer discontent with the costs of Diablo Canyon. As a result, a standard rate base-focused cost recovery mechanism was rejected in favor of a performance-based mechanism that made investor-owned utility Pacific Gas and Electric's revenue recovery contingent on the availability of the units. Diablo Canyon enjoyed a very high availability rate and operated with a very high capacity factor for much of its service life. One can reasonably infer that the performance-based mechanism was at least partly responsible for this positive track record.[11] The mechanism is not without its critics, however. Some consumer advocates felt the mechanism was too generous, and Pacific Gas and Electric was not really held accountable for its relatively poor management of the construction of the facility.[12] Pacific Gas and Electric avoided billions of dollars of potential disallowed costs by accepting the mechanism, but it also was held accountable for its performance. Valid points are expressed on opposite sides of this debate and resolving them here is beyond the scope of this brief report. However, it is worth noting that this experience with "performance ratemaking" created some negative feelings toward PBR by consumer advocates that affected their receptivity to the PBR proposals that followed.

2.1.2.2 New York's Reforming the Energy Vision

The State of New York has undertaken an ambitious effort to transform its regulatory system. New York's effort aims to construct a regulatory system that rewards distribution utilities for high levels of customer satisfaction, facilitates power sector transformation to cleaner and more distributed resources, and increasingly focuses on outcomes rather than inputs (which is similar to the U.K.'s RIIO approach). This comprehensive effort, still in its infancy in terms of implementation, is referred to as Reforming the Energy Vision (NY REV) and is led by the New York Public Service Commission (NY-PSC).

[11] Whited, M., Woolf, T., and Napoleon, A. 2015. *Utility Performance Mechanisms: A Handbook for Regulators*. Synapse Energy Economics. http://www.synapse-energy.com/sites/default/files/Utility%20Performance%20Incentive%20Mechanisms%2014-098_0.pdf, pp. 63-64.

[12] Ibid.

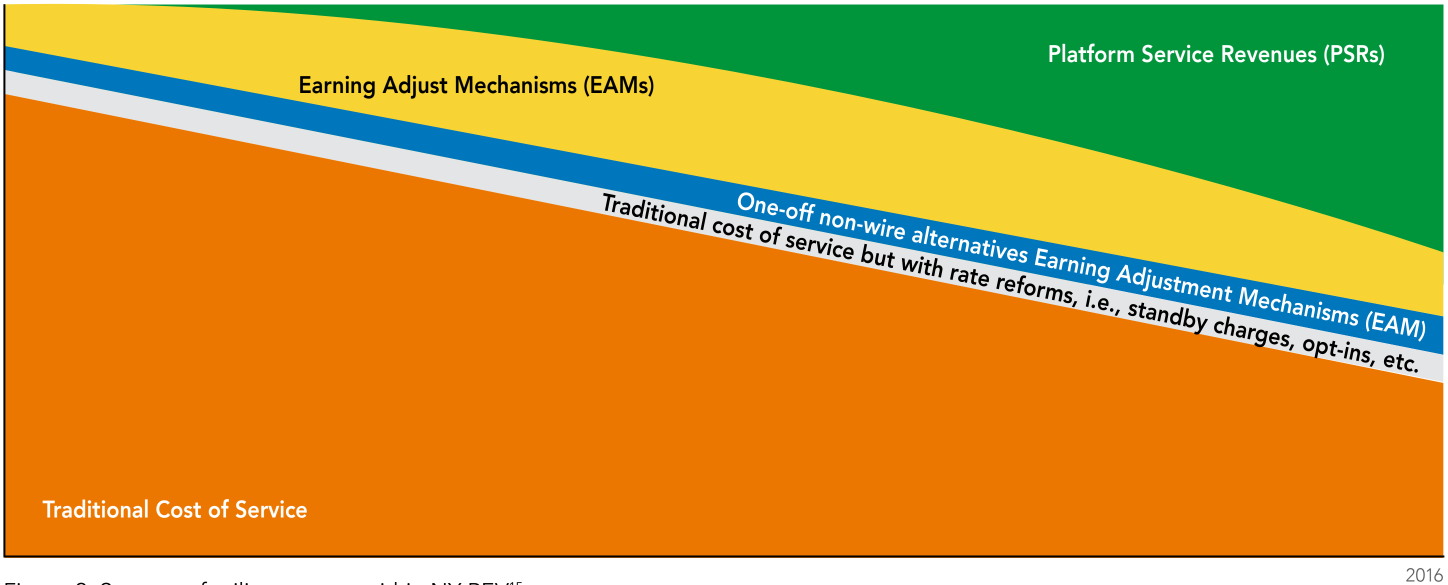


Figure 2. Sources of utility revenue within NY REV[15]

To incubate power sector transformation, NY REV is using a form of PBR that provides for several outcome-based incentives to be implemented, called earnings adjustment mechanisms (EAMs).[13] The purpose of EAMs is to "encourage achievement of new policy objectives and counter the implicit negative incentives that the current ratemaking model provides against REV objectives." They are intended to play a bridge role until other forms of market-based revenues are available at scale to become a meaningful contributor to distribution utilities' revenue requirements. The NY-PSC believes the need for EAMs will diminish over time, as utilities' opportunities to earn from platform service revenues increase.[14] However, the NY-PSC does not intend to place a time limit of the intended bridge role on any particular EAM, and it expects that some EAMs will supplement the contributions of platform service revenues for the foreseeable future. Figure 2 illustrates this bridge for utility revenues as envisioned. The specific portfolio of EAMs offered to utilities by the regulator may also change over time to reflect advancing technologies with new and different capacities, such as energy storage installed at a distribution substation or at consumer premises, which would offer complementary but different capacity to grid operators and consumers. Because of the unique situation of each distribution utility, the financial details of the EAMs are developed in rate proceedings.

Like RIIO, the NY REV process focuses on outcomes, because the NY-PSC believes this focus will be the "most effective approach to address the mismatch between

[13] NY-PSC. 2016 (May 19). Case No. 14-M-0101. *Order Adopting a Ratemaking and Utility Revenue Model Policy Framework.*

[14] Platform service revenues are new forms of revenues utilities will earn from displacing traditional infrastructure projects with non-wires alternatives. They include (1) services that the NY-PSC will require the utility to provide as part of market development, (2) voluntary value-added services that are provided through the distribution system provider function that have an operational nexus with core utility offerings, and (3) competitive new services that can be readily performed by third parties, including non-regulated utility affiliates, and should not be offered by regulated utilities.

[15] Mitchell, C. 2016. "U.S. Regulatory Reform: NY Utility Transformation." *U.S. Regulatory Reform Series.* http://projects.exeter.ac.uk/igov/us-regulatory-reform-ny-utility-transformation/.

traditional revenue methods and modern electric system needs."[16] The NY-PSC supports an outcome-based model for the following reasons:

1. NY REV seeks to integrate the activities of markets, including customers and third-party DER developers. Although utilities do not have control over customer or third-party actions, this approach recognizes that their activities in the aggregate, along with utilities' activities, are critical to the optimal performance of the new system. This opens the door to including metrics to encourage utilities to motivate third-party activity where doing so provides efficient system outcomes. For example, metrics could reflect third-party market activity for DER providers. Utilities also could solve distribution-level issues uncovered by their operation of the distribution system platform if a metric were established to measure private DER activity.

2. Outcome-based incentives encourage innovation by utilities, allowing utilities to determine the most effective strategy to achieve policy objectives, including cooperation with third parties and development of new business concepts that would not be considered under narrow program-based incentives.

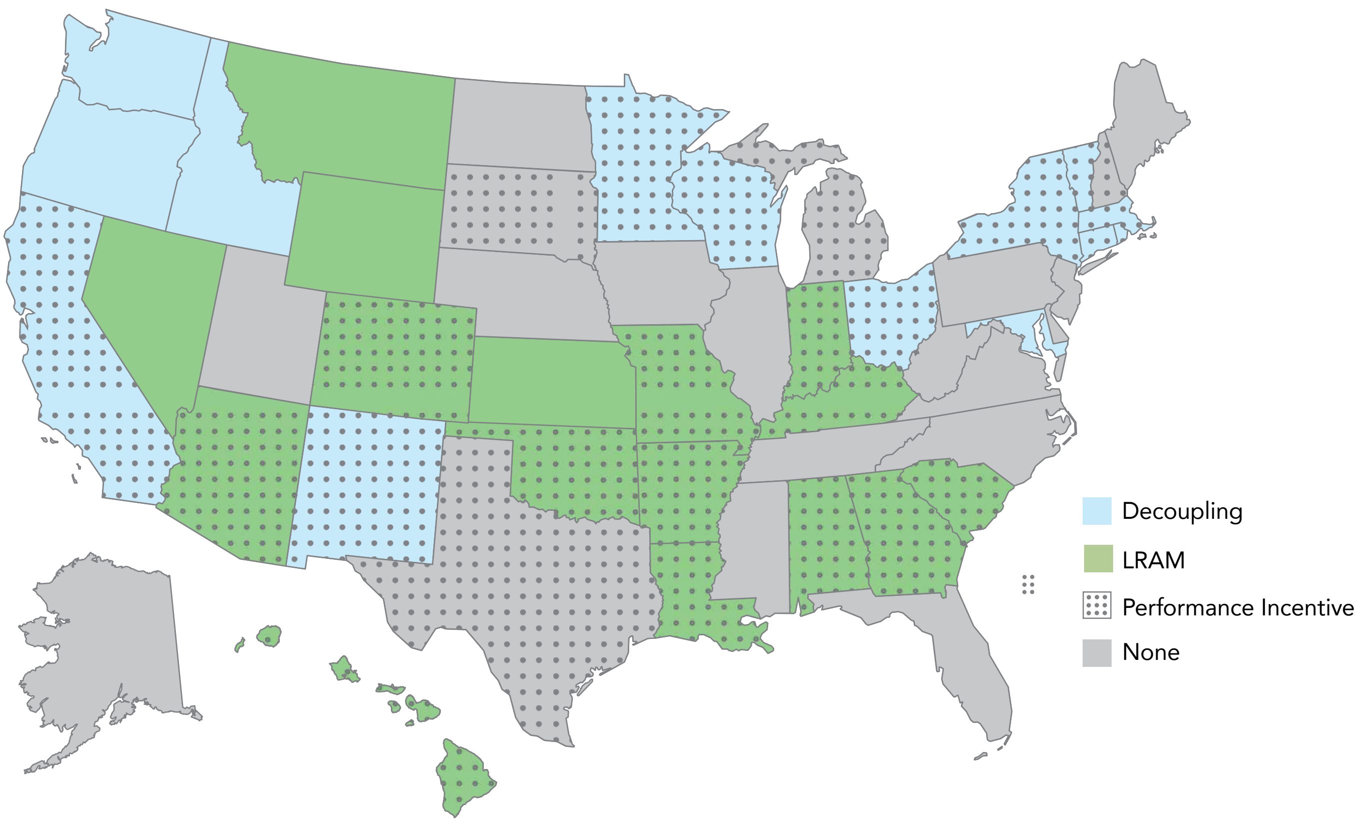


Figure 3. Different state approaches to energy efficiency

The figure also illustrates states that have adopted revenue decoupling and lost-revenue adjust mechanisms (LRAMs), which allow utilities to recover for revenue lost if utility sales decrease because of energy efficiency program savings. Revenue decoupling and LRAMs are well established to ensure adequate utility revenue recovery and are sometimes associated with PBRs, even though they operate differently to adjust utility revenue. U.S. Department of Energy (DOE 2015, April). Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure. https://energy.gov/sites/prod/files/2015/04/f22/QER-ALL%20FINAL_0.pdf.

[16] The early New York experience with one utility is that in order to ensure the EAMs are outcome-oriented, there should be a strong stakeholder group and process to help define the metric outputs (the individual measurable activities undertaken by the utility, such as "X number of calls answered in less than 20 seconds"). If a stakeholder group does not exist, the utility may be more likely to propose metrics based on program targets rather than on outcomes. This tendency may change over time as experience with New York's EAMs grows and also as a function of strong utility leadership.

3. Outcome-based incentives encourage an enterprise-wide approach to achieving results; they are appropriate where there are many program inputs to the system. Good outcomes are created by a range of utility activities that are planned to jointly and perhaps synergistically modify program inputs to influence the outcome along with private market activities of customers and third parties.
4. Regulation should seek outcomes that simulate competitive market behavior where possible and beneficial.
5. Having utility earnings affected by market outcomes over which they have limited influence is not a new principle. For example, under traditional ratemaking before decoupling, utilities had a general incentive to promote growth in sales, whereas many other market and customer factors also influenced this outcome.

Such an "outcome orientation" can also better align utility activity and performance with public policy and societal objectives of the regulators and jurisdiction authorities. The more innovative elements of NY REV are addressed in Volume 3 of this report.

2.1.2.3 U.S. Jurisdictions with Energy Efficiency PBRs

Numerous U.S. jurisdictions have used PBR to motivate adoption of energy efficiency goals and satisfaction of targets and metrics (Figure 3). For example, at least 26 U.S. states have used performance incentives to encourage energy efficiency deployments. These incentives include allowing a utility to earn (1) a percentage of program costs for achieving a savings target (eight states), (2) a share of achieved savings (13 states), (3) a share of the net-present-value of avoided costs (four states), and (4) an altered rate of return for achieving savings targets (one state). Over time, energy efficiency program performance improved markedly in states offering these incentives.[17]

2.1.3 Denmark

Denmark has used PBR to improve system reliability by imposing metrics on the Danish distribution system operators (DSOs). The DSOs are subject to an "outage" or quality of supply benchmarking model, which is applied annually. The goals of the quality of supply benchmarking model are to disincentivize utility outages and to improve network reliability, as measured by the system average interruption frequency index (SAIFI) and the system average interruption duration index (SAIDI). SAIFI and SAIDI are internationally recognized metrics commonly defined (even as precise definitions vary) and easily measured.

Danish DSOs are penalized if they have a higher weighted SAIDI or SAIFI than a benchmark set by higher-performing DSOs. The "outage" methodology applies to DSOs rather than the transmission system operator. The transmission system operator reports SAIDI and SAIFI but is not included in the DSO PBR scheme. This Danish application of reliability metrics illustrates how PBR can improve system reliability through some versions of SAIFI and SAIDI, and other common reliability metrics. As illustrated in Figure 4 (next page), reliability PBR schemes often rely on negative incentives.[18]

2.1.4 Mexico

Mexico has implemented PBR for its transmission and distribution system. It also has developed some metrics for distributed generation and interconnection that could form the basis of a PBR mechanism. Since the beginning of the energy reform in Mexico in 2015, the Energy Regulatory Commission has put in place performance-based compensation. Performance-based compensation is offered for minimizing transmission system losses and system losses. The transmission system has a performance-based compensation system for reducing line losses, but the targeted quantity of line loss reductions is quite small.

[17] State and Local Energy Efficiency Action Network. 2016. *SEE Action Guide for States: Energy Efficiency as a Least Cost Strategy to Reduce Greenhouse Gases and Air Pollution and Meet Energy Needs in the Power Sector*. Prepared by Schwartz, L., Leventis, G., Schiller, S., and Fadrhonc, E. of Lawrence Berkeley National Laboratory, with assistance by Shenot, J., Colburn, K., and James, C. of The Regulatory Assistance Project and Zetterberg, J. and Roy, M. of the U.S. Department of Energy. https://www4.eere.energy.gov/seeaction/system/files/documents/pathways-guide-states-final0415.pdf, pp. 12–13 citing numerous sources.

[18] NordReg. 2011. *Economic Regulation of Electricity Grids in Nordic Countries*. http://www.nordicenergyregulators.org/wp-content/uploads/2013/02/Economic_regulation_of_electricity_grids_in_Nordic_countries.pdf.

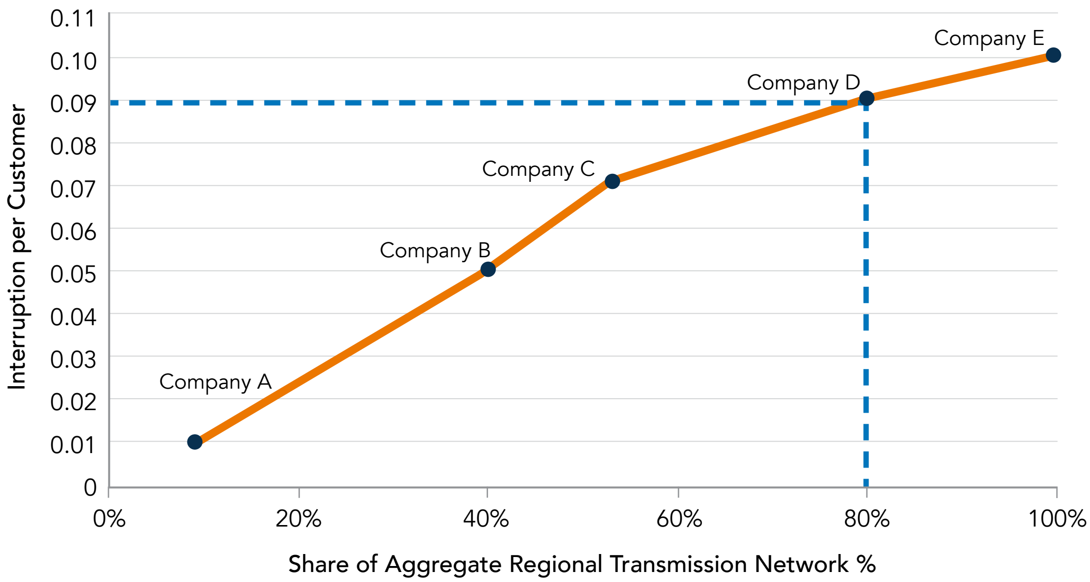
In contrast, technical and non-technical line losses in the distribution system tend to be quite high in Mexico, so the targeted distribution line loss reductions are far higher. Each of the Comisión Federal de Electricidad's 16 distribution service areas has its own distribution system loss reduction targets. The loss reduction schedules are linear three-year pathways toward a third-year ultimate target. CFE Distribution Company has the targeted amounts of losses incorporated within its revenue requirement. If the losses exceed the target, CFE Distribution Company pays. If the losses are less than the target, CFE Distribution Company keeps the money.

The new regulatory framework for distributed generation includes very specific performance requirements for the application and interconnection process, but there is no penalty or compensation mechanism associated with these requirements so far. For example, there is a schedule for interconnection with well-defined steps and associated mandatory timelines for distributed generation interconnection, as depicted in Table 1 (next page).

In addition, the regulation established a timeframe of 365 days for the distribution utility to develop a web-based platform for the management of the interconnection process, making it possible to make an interconnection request via the web. The same platform must be able to show statistics about the integration of distributed generation, including the hosting capacity of distribution circuits and the actual amount of installed capacity. Once available, the platform must be updated every three months.[19] With time, these performance requirements could support a traditional discretionary penalty structure or a PBR construct in Mexico on interconnection.

Illustrative Example of Danish Quality of Supply Benchmark

The example includes five DSOs: A, B, C, D and E. Company A has the lowest weighted SAIFI while Company B has the second lowest and so forth. Together, Company A, Company B, Company C, and Company D have precisely 80 percent of the aggregate transmission network.



Company D has a weighted SAIFI of 0.09. Thus, companies that have a weighted SAIFI higher than 0.09 are penalized with an up to one-percent reduction in their allowed operational costs. In this example, Company E is penalized.

Source: DERA, 2009.

Figure 4. Identification of regional Danish DSOs with poor quality of supply

[19] SEGOB. 2017. Section 3.1, http://www.dof.gob.mx/nota_detalle.php?codigo=5474790&fecha=07/03/2017.

2.1.5 South Africa

Basic system efficiency is pursued by the National Energy Regulator of South Africa to ensure the cost of coal is managed by its utilities to benchmark standards. The National Energy Regulator of South Africa has adopted a PBR formula to assess the utilities' cost of coal management by comparing actual costs of coal to a benchmark for costs using a PBR formula.[20] Other performance expectations are related to pricing, such as maintaining adequate coal reserves for various contingencies including labor strikes that are unique to the South African context.

Table 1. Mandated Timeframe for Distributed Generation Interconnection Application Processing[21]

Activity	Responsible Entity	Maximum Working Days for Response
Registry of the request	Retail provider	1
Verification of information	Distribution utility	2
Letter of acceptance when no study or infrastructure is required	Distribution utility	4
Letter with study or infrastructure budget	Distribution utility	10
Documentation review	Retail provider	1
Modification of the interconnection infrastructure	Applicant or distribution utility	TBD*
Relocation of meter	Distribution utility	5
Assignment of agreement	Retailer	2
Integration to the commercial scheme	Retailer	1
Total time without study or infrastructure modification	13	
Total time with study or infrastructure modification*	18	

* These times do not include the construction of specific upgrades or the response times of the activities that correspond to the Applicant. In Mexico, either the applicant or the distribution utility can make the required grid upgrades.

[20] The allowed coal cost for regulatory control account purposes will be determined by comparing the coal benchmark costs with Eskom's actual costs of coal (R/ton cost) using a PBR formula per contract type. The allowed actual total cost is calculated by applying the following formula on a contract type basis:

$$Allowed\ actual\ cost\ (Rand) = [\mathrm{Alpha}\ x\ Actual\ Unit\ Cost\ of\ Coal\ Burn + (1 - Alpha)\ x\ Benchmark\ Unit\ Cost\ of\ Coal\ Burn]\ x\ Actual\ Coal\ Burn\ Volume$$

where: $Actual\ Unit\ Cost$ = Actual unit cost of coal burn in a financial year (R/ton), $Benchmark\ Cost$ = Allowed coal burn unit cost for the contract type for the year considered (R/ton), $Actual\ Coal\ Burn\ Volume$ = Actual tonnage of coal burn in the financial year considered, $Alpha$ = the factor that determines the ratio in which risks in coal burn expenditure are divided, that is, those that are passed through to the customers, and those that must be carried by Eskom; any number of the alpha between 0 and 1, set to share the risk of the coal cost variance between licensees and its customers. (National Energy Regulator of South Africa, Annexure 1, Multi-Year Price Determination (MYPD) Methodology, 17.2.8, pp. 34-35.)

[21] SEGOB. 2016. Section 5.2, http://www.dof.gob.mx/nota_detalle.php?codigo=5465576&fecha=15/12/2016.

3 Conclusion

This introduction to PBRs employed successfully worldwide is meant to encourage readers to explore the next two volumes in this report on essential design elements for PBRs (Volume 2) and innovative examples of PBRs (Volume 3). Well-designed PBRs provide both incentives for utility performance and benefits for consumers and utility owners. PBRs and more discrete PIMs will be important tools in 21st century power sector transformation. PBRs have the potential to realign utility, investor, and consumer incentives; mitigate emerging challenges to the utility business model; alleviate the challenges of and accelerate renewable integration; and even address cyber security concerns.

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