Point of View

Establishing Regulatory Incentives To Raise Service Quality in Electricity Networks

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June 2011

Cisco Internet Business Solutions Group (IBSG)

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The quality of electricity network service is of paramount importance to electricity suppliers. Actual service quality and incentives to improve quality vary dramatically from country to country. This Point of View from the Cisco Internet Business Solutions Group (IBSG) examines electricity network quality of service (QoS) and related regulation in Europe. We establish current regulatory baselines and identify trends associated with policy and the treatment of capital expenditures (CapEx) that are affecting countries in their quest for improvement. To help utilities establish a successful quality improvement strategy, we recommend best practices and provide examples of countries benefiting from these approaches.

The Need for Quality of Supply Regulation

Across Europe, we enjoy a stable and reliable electricity system. Most countries have either had a high-performing electricity network for some time or utilities have come a long way in improving outage times. As a result, quality of electricity supply has not been a focus of industry regulation. Following unbundling and the liberalization of incumbent electricity companies, regulators have been occupied with ensuring an open market and reducing system costs.

The utility industry is transitioning from a centralized electricity distribution system to a more decentralized setup with significant consumer contribution—a transformation that is part of the larger "Smart Grid" theme. Consumer contribution may happen through mass-market distributed generation in the form of photovoltaic solar technology, micro combined heat and power generation (micro-CHP), and others. Distributed generation (DG) and the respective feed-in of electricity tend to benefit from unrestricted access to the electricity network.

Deployment of small-scale DG is still in its early days, although distribution system operators (DSOs) already have to cope with the destabilizing effects of the unrestricted feed-in. Utilities have various ways to cope with those effects: they may invest in physical network capacity ("copper"), buy into the concept of Smart Grid and build out network intelligence (ICT), or simply accept a less-secure and reliable power supply.

With the prospects of a deteriorating energy supply system, it becomes obvious that regulators need to financially incentivize DSOs to invest in the utility network. The time has come for explicit QoS incentive regulation.

The Quest for Optimal Quality

Modern management literature contains a vast array of contributions focused on quality: what it is, how to manage and improve it, and so forth. Despite all of these efforts, quality remains a highly subjective experience.

In engineering terms, we are clearly capable of measuring different levels of quality. The question still remains: what are adequate quality levels? While occupants of a distant farm might live with the occasional day of service interruption during severe weather conditions, the head of operations of a manufacturing company dependent upon precision tools probably would have a very different opinion on what constitutes adequate QoS. What is acceptable in one environment might not be acceptable in others. When dealing with QoS, the first challenge regulators face is to define the appropriate QoS level for their market.

The purpose of this paper is not to comment on the optimal quality of the electricity system itself. Instead, our work focuses on providing guidance on how to structure a QoS regulation framework.

We will investigate two primary questions:

- How do incentive schemes accommodate QoS today?
- Which elements should a QoS framework contain going forward?

Policy Framework

From a systems perspective, utility networks are extremely stable. Given the scale and complexity of the power grid, the impact of any change in the overall configuration takes a long time to become noticeable. (Clearly, this refers to changes in the overall setup, not deliberate interference with the infrastructure that would result in interrupted service.) This implies that short-term changes to the overall system are not feasible on a large scale. In the case of mass-market DG, we barely notice the impact on the grid today. It has taken the better part of the past two decades to accumulate the critical mass to make the effect relevant. Now that we have reached the critical mass and even face accelerated deployment, we might see a rapid increase in the negative impact on network stability. Still, this has been a long-term reshaping of our system.

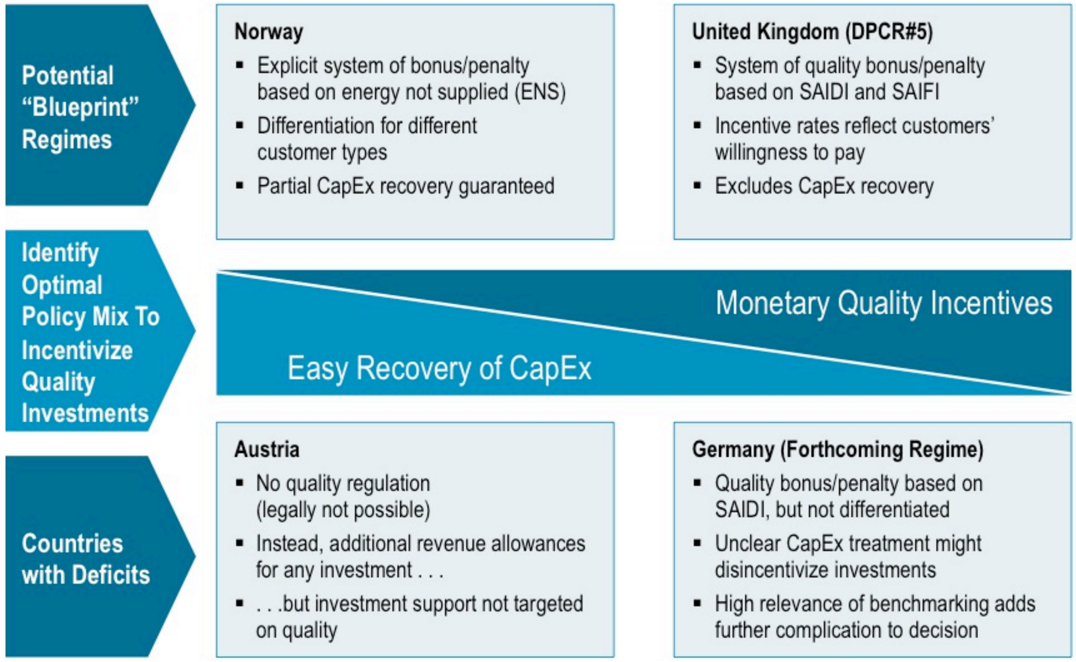
So, how can one design a QoS scheme that addresses the long-term network environment? Just as with any other regulatory scheme, in the end it all comes down to money. The most basic financial levers are CapEx and operational expenses (OpEx). In a simplistic system description, CapEx is a proxy for the quality of the network itself, and OpEx is a proxy for how fast service will be restored following an interruption. When devising schemes to manage QoS, regulators may provide for the CapEx required to design, build, and maintain the network for the envisioned level of quality. By doing so, regulators will certainly acknowledge the longevity of our utility network. Equally, regulators may provide for sufficient OpEx to allow for adequate response times.

Devising effective QoS schemes requires us first to define the appropriate measures for assessing network quality and to make prudent decisions on the desired QoS. Regulators then will provide the incentive structure to encourage the right level of investments and short-term fixes. Investments in a network may or may not enhance its quality. Equally, OpEx does not necessarily reflect effectiveness in operating and maintaining the network.

Current State of QoS Regulation

Even without explicitly addressing QoS, each regulation makes an implicit assumption about QoS as regulators grant utilities compensation for their CapEx and OpEx.

Figure 1. Current Policy Frameworks for QoS Offer a Mix of OpEx Quality Incentives and CapEx Recovery.



Source: Cisco IBSG, 2010

Explicitly addressing QoS will require regulators to become more involved. Regarding CapEx, regulators might assume effective spending by utilities and simply focus on the CapEx recovery mechanisms. Or they might choose to become more deeply involved in the investment planning process and decide upon specific projects to be included in the Regulated Asset Base. A more detached regulator might opt simply to define acceptable QoS levels (based on SAIDI[1] or SAIFI[2] levels, for example) and leave the utility to determine the most efficient approach to reach the prescribed targets.

At the time of our analysis, we found a mixed picture of the European regulatory landscape, with two extreme positions: the Austrian regulator focused on CapEx regulation, and the United Kingdom's emphasis on quality incentives. Most of the European regulatory landscape in early 2010 was somewhere in between those positions.

Policy Recommendations

What are the elements of a differentiated QoS regime? While we would not claim to have a ready-made blueprint, the framework described in Figure 2 highlights the key building blocks as a reference for future policymaking.

[1] System Average Interruption Duration Index
[2] System Average Interruption Frequency Index

Figure 2. Policy Framework: Create Differentiated Quality Targets / Incentives and Carefully Balanced CapEx Recovery Schemes.

		Recommendation	Good Practice
Quality Incentives	Level of Incentive Rate	▪ Base incentive rates on customer's cost of outage, including "energy not served" (ENS)	United Kingdom Netherlands
Quality Incentives	Differen-tiation	▪ Differentiate incentive rates based on customer's factual outage costs ▪ Value network types with different cost structure separately	Norway
Quality Incentives	Target-Setting	▪ Set targets independent of DSO's past performance ▪ Provide long-term security on target development	United Kingdom
CapEx Pass-Through		▪ Allow additional partial CapEx recovery, if quality incentives are insufficiently foreseeable	Norway
CapEx Pass-Through		▪ Limit CapEx pass-through as much as possible to attract efficient investment	United Kingdom

Source: Cisco IBSG, 2010

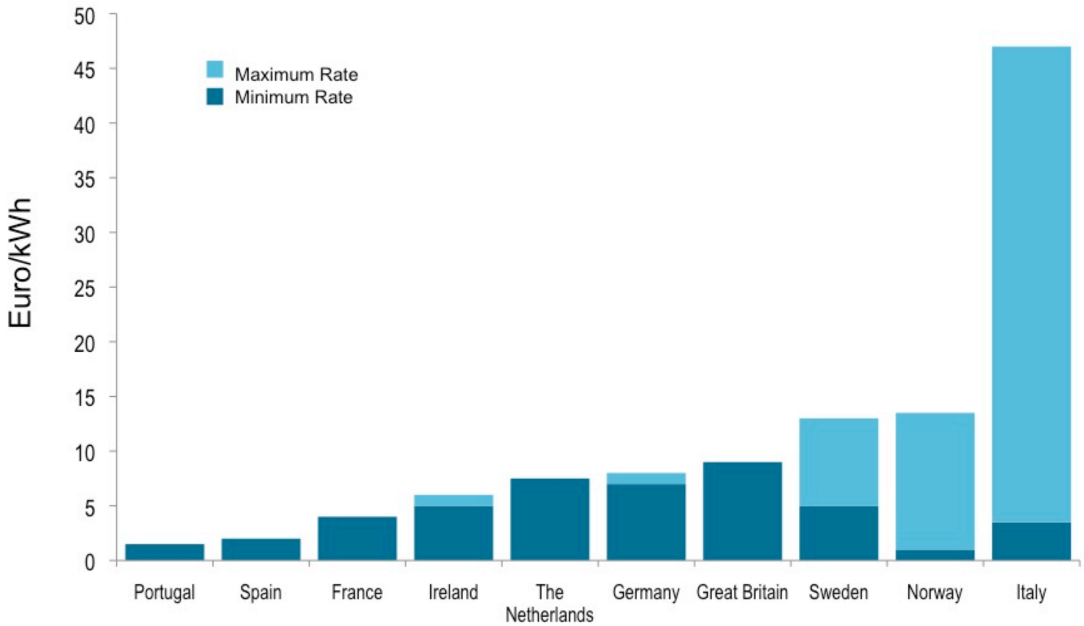
How would we structure such a blueprint? The utility industry itself—like the system it operates—is a harbor of stability. Modifying the overall system configuration will require incentives to embrace system change as well as providing for the required means to invest.

Level of Incentive Rate

The level of the incentive ultimately determines the level of QoS. Regulators need to take a macroeconomic view of the role of the electricity system and the costs and benefits of the current and desired QoS level. Assessing the benefits of an increase in QoS level should be based on customer outage costs. Incentives for the network operator should align with the costs and achievable benefits of altering QoS.

Based on that macroeconomic assessment, regulators then need to review whether incentives will be relevant for utilities in the context of overall network-related revenues. If incentives are set too low, we will not see any meaningful deployment of resources on behalf of the network operator. If they are set too high, the result will be windfall profits. Based on a survey of incentive rates in the European Union, optimal incentive rates are in the range of €5 to €10 per kilowatt-hour, as shown in Figure 3. Of course, rates will vary from country to country based on actual outage costs. The United Kingdom and the Netherlands are examples of countries that have set effective incentive rates, based on survey results. Spain and Portugal's rates are unusually low, and will be insufficient to motivate QoS investments.

Figure 3. A Survey of Incentives in the European Union Showed Rates Ranging from 5 To 10 Euros Per Kilowatt-Hour.



Source: Frontier Economics, 2010

Differentiation of Incentive Rates

Just as defining the right level of QoS is no minor task, identifying outage costs is equally challenging. An outage may simply inconvenience retail customers, or it can bring factories to a standstill and cause lost revenues for commercial and industrial customers. Likewise, an outage in an urban environment will result in more significant costs than a similar outage in a rural area. The incentive scheme should therefore account for these differences and foster appropriate quality levels for specific operating environments.

Regulators need a system to categorize each network operator's customer base and evaluate the specific economic implications of outages for each cluster. Incentive rates should be driven by factual outage costs, based on both customer type and by the type of interruption and timing. Outage costs would be higher for industrial customers than for residential customers, and a planned system interruption during off-peak hours would cost less than an unplanned outage during peak times.

Equally, regulators must judge the effort to take the network to a different QoS level based on the specific network topography. This task should be standard procedure for most regulators, as network topography is already considered in many existing schemes. So QoS regulation is not only about the right level of incentives, but also about understanding the customer and network base of the respective DSO.

Norway is an example of good practices in this area. Rather than simply counting the number of minutes of an outage, it uses "energy not supplied" (ENS) as a reference to account for time of day and impact on customers. Norway further differentiates incentives based on customer type and planned/unplanned interruptions.

Setting Quality Targets

Setting the right QoS target is probably the most delicate task. It requires regulators to define the QoS that will be desired in the distant future. As stated before, changing the performance of the electricity network is not an easy undertaking. Having an impact will require consistency and perseverance. Regulators need to inform DSOs of the long-term vision and assure them of a stable regulatory environment. Utilities need to understand whether it will be financially viable to undertake any major change in the network. If it is not a sound investment, they may decide just to pay the penalty and not change the overall setup.

It is important to understand that quality targets may define the net-cash position of DSOs ("do I get a bonus or a penalty?") but have little actual impact on incentives. The value of quality is defined through the incentive rate, not the target. Regulators should set quality targets based on national performance averages, rather than on the performance of each individual DSO, because operators are not likely to invest in quality improvements if they fear even higher targets at the next review.

Figure 4. Regulators Should Set Clear Long-Term Quality Targets, Based on Overall Industry Performance.

Relevance	▪ Quality targets have little actual impact on incentives ▪ Quality targets nevertheless define who is profiting from quality incentive—customer or DSO
Recommen-dation	▪ Quality target should be independent of DSO's own performance; "rewarding" high quality with even higher targets could discourage quality investment ▪ Base targets on national averages ▪ Long-term targets promote investments since they provide certainty about the DSO's future cash position ▪ Some readjustment over time nevertheless useful to redistribute quality gains to customers
Countries	**Good Practice: United Kingdom** ▪ Clearly defined long-term trend of targets ▪ Nevertheless, readjustment ensures that expected quality improvements will not increase network tariffs forever

Source: Cisco IBSG, 2010

CapEx Treatment

In an ideal world, additional CapEx provisions would not be necessary, because QoS incentives would be sufficient to motivate appropriate investments. Nonetheless, one might consider adding specific CapEx elements to the QoS regulations. Reasons could be a lack of confidence in the stability of the QoS incentive scheme, as well as uncertainty about the effects of significant changes in the overall system design.

Figure 5. CapEx Treatment Should Be Simple, Targeted, and Balanced To Motivate Investments in Quality.

Relevance	▪ In an ideal model, quality bonus/penalties should cover all costs of quality investment, including CapEx ▪ Additional partial CapEx recovery could foster quality investments	
Recommen-dation	▪ Where quality incentives aren't sufficiently reliable/foreseeable to stimulate investment, additional CapEx allowances should be considered ▪ CapEx allowances should: Be simple and straightforward Target efficient investment to avoid "leakage" Be balanced with quality incentives	
Countries	**Good Practice: Norway** ▪ Clear rule of 40% guaranteed recovery of total expenses Simple and foreseeable regime with clear limits	**Good Practice: United Kingdom** ▪ Exclusion of any additional CapEx pass-through Instead, incentive rates raised to cover all costs

Source: Cisco IBSG, 2010

Utilities are unfortunately accustomed to the woes of political environments and the corresponding challenges of making long-term investment decisions (as impressively demonstrated with the swaying German government regarding its position on nuclear power). With depreciation times of 20 or more years, utilities will require short-term CapEx recovery as part of the QoS scheme to justify investments. To avoid free-rider effects, regulators will need to become involved in utilities' investment plans and assess the impact of specific investments on QoS.

Uncertainty over fundamental change in the system design takes us back to the beginning of this paper. Utilities face a significant alteration of how our distribution system works. DSOs need to research the impact of change on their system, and how to prepare most effectively for that change. Regulators might want to consider that effort as part of the CapEx incentive structure to drive innovation and enable continued stability of our electricity system.

A View on Innovation

Throughout this paper, we have stressed the stability and longevity of our utility system. Now, we want to return to our starting point: the ongoing transformation of the current electricity system to the Smart Grid of the future. For the first time since its initial build-out, we see a fundamental change in the system. While the laws of physics still hold, this transition bears a high degree of uncertainty:

- What will the system look like in 30 years?
- Which Smart Grid technologies will regulators prescribe?
- How will customers react to the system changes?
- How much will it cost to deliver a secure energy supply in the future, and what kind of value will it provide?

The list of questions is almost endless. Coping with system changes will require utilities to change and innovate. Innovation is about the successful transition to a different—and, we hope, better—system. Innovation is also about accepting failures. As utilities rebuild our energy system based on innovation, regulators should ask themselves how to use QoS regulation to foster innovation. It would be unfortunate if a rigid regulatory approach forced utilities to focus on running the well-oiled machine we have inherited *until it breaks*. Forward-thinking regulators and utilities must work together to create a roadmap that includes small-scale distributed generation, a more sophisticated energy distribution network, and a stable regulatory framework for continually higher levels of service quality.

For more information about establishing regulatory incentives to raise the quality of electrical service, please contact:

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