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Electricity Service Quality Incentives Scoping Paper

Prepared for: Queensland Competition Authority
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1. INTRODUCTION

Regulators in Australia typically collect large amounts of data from electricity utilities on reliability and service quality performance but little has been done to provide financial incentives for utilities to improve their service performance. The Queensland Competition Authority (QCA) is aiming to introduce formal incentives for utilities to improve their reliability and service quality performance in its next round of electricity distribution regulation. This is against a background of Ergon and ENERGEX both having duration and frequency of interruption indexes which are considerably higher than other Australian rural and urban distributors, respectively, and considerably higher than respective groups of similar US utilities (Tasman and PEG 2000).

The QCA's objective is to introduce reliability and service quality incentives that are simple and achievable. As part of that process it has commissioned this scoping paper to look at the characteristics of service quality incentive regimes, discuss the most important measures to target, how the incentives might interact with other parts of the regulatory regime and look at experience with these schemes elsewhere in Australia and overseas. Based on this analysis the QCA is seeking advice on whether there is a preferred model for introducing service quality incentives.

In the following section of the paper we look at why service quality issues are important for a regulated utility and at some of the characteristics of service quality. In section 3 we review the range of regulatory approaches that have been adopted to improving service quality as well as possible market based solutions. The experience with service quality incentives in Victoria and South Australia is reviewed in section 4 along with experience in the United Kingdom and the United States. In section 5 we examine the desirable properties of a service quality incentives scheme before mapping out a possible way ahead for Queensland in section 6.

2. SERVICE QUALITY PARAMETERS

Before discussing alternative service quality incentive schemes, it is necessary to first examine some of the key attributes of service quality and understand why service quality issues are important in utility regulation.

2.1 WHY IS SERVICE QUALITY IMPORTANT?

In a competitive market for the provision of goods and services there will be many different suppliers, each of whom may choose to offer a product with a particular combination of price and quality attributes. Consumers will choose the combination of price and quality that best meets their individual preferences. Suppliers will compete to improve their market share by striving to offer better quality products for the lowest price they can.

Many infrastructure industries, including electricity distribution, are natural monopolies where one supplier can supply the whole market cheaper than two or more suppliers. In these markets consumers have limited choice and limited bargaining power and are typically presented with only one quality of the product by the infrastructure provider. In the absence of economic regulation the infrastructure provider will have an incentive to exploit its monopoly power and charge a high price for the product. In electricity systems that were government owned, the service provided was often 'gold plated' as suppliers concentrated on achieving a high level of engineering excellence. The service was, thus, expensive but often of a high standard.

With reform of the infrastructure industries there has been a focus on regulation to ensure suppliers achieve efficient costs and reduce infrastructure prices to a level approaching those which would apply if the market were competitive. This has most commonly been achieved by the use of CPI–X price or revenue caps. At the same time there has been widespread application of minimum service standards to provide basic protection for customers. However, because regulation does not fully replicate a competitive market, there is an incentive for distributors to meet the price cap by reducing the quality of the product they supply. This is because distributors benefit from reduced costs, including the cost of providing better service quality. This incentive can be strengthened by the multi–year nature of most price cap plans where the impact of regulatory penalties for reductions in service quality are delayed. In other cases distributors complain that the application of onerous price controls leaves them with inadequate funds to undertake the strengthening of the system necessary to improve service quality. This has led to an increasing focus on the need to incorporate service quality incentives within the regulatory regime to ensure that consumers receive the appropriate level of quality at an efficient cost.

2.2 DEFINING SERVICE QUALITY

When consumers purchase electricity they are purchasing a service with a number of different attributes. The most obvious of these is having electricity supplied at the place and time they want to use it. However, there are many other attribute dimensions that form the 'product' purchased and make up the level of service quality received. These include the reliability of the supply available (determined by the number of interruptions suffered and the duration of any interruptions), the technical characteristics of the supply and their variability (voltage levels, frequency and harmonics) and customer service (eg the timeliness and responsiveness of the supplier to requests for telephone assistance and the accuracy of billing). In addition to these direct attributes affecting their own consumption, some consumers may also be willing to pay a contribution towards societal goals such as having a high quality electricity supply generally available, achieving environmental objectives and ensuring public safety.

Which attributes of service quality regulators concentrate on in incentive schemes should be determined by those that consumers value the most highly. For instance, it is not productive to 'incentivise' the distributor to minimise phone waiting times while ignoring the reliability of the electricity supply received when consumers are not particularly worried about phone response times but desperately need improvements in reliability. Also, consumers' priorities will change over time. As people become more affluent they are generally prepared to pay more for a reliable electricity supply. But as reliability improves, consumers will generally be prepared to pay less for additional improvements. Changes in technology have also changed consumers' demand for service quality attributes. Greater use of computers and sophisticated electrical equipment has reduced preparedness to put up with poor quality supply, particularly in rural areas. Changes in lifestyle choices have also changed service quality demand patterns. As more affluent, well educated people move to 'hobby farm' and retirement areas adjoining regional centres the demand for better quality electricity supply in these areas has increased.

Different classes of consumer will also have different preferences. For large industrial customers, for instance, supply cuts may now be relatively rare and the main priority is to eliminate voltage dips which cause electric motors to trip out which in turn causes plants to be shut down. Residential consumers, on the other hand, may not be worried about or even be aware of voltage dips and may not be unduly worried by momentary interruptions to power supply but may want to reduce both the frequency and duration of longer interruptions.

When trying to determine consumers' relative preferences and willingness to pay, the attributes nominated by the regulator should be meaningful to consumers and be measurable. They should also be under the control of the distributor to a significant extent and be relatively independent of each other.

Regulators and distributors have used a range of techniques to ascertain and attempt to quantify consumers' preferences for service quality. These have ranged from relatively informal consultation with key stakeholder groups to the application of contingent valuation and conjoint analysis techniques to representative samples of consumers. In all cases it is important to be aware of the incentive respondents face to behave strategically. That is, there may be a tendency to overstate preferences to influence the outcome in that direction when they do not have to actually commit money to the choice.

As with other areas of utility regulation, regulators need to be pragmatic when embarking on a service quality incentives program. Given the degree of uncertainty involved about both the pattern and strength of consumer preferences for different service quality attributes and the costs utilities face in improving those attributes, a cautious approach is probably in order. This may involve concentrating initially on those attributes where the best information is available and there is good chance of success (provided these attributes are likely to be important to consumers). Experience with the operation of even a basic incentive scheme will enable the regulator, distributors and consumers to develop the expertise and confidence necessary to develop and implement more sophisticated schemes in future regulatory periods.

2.3 MEASURING SERVICE QUALITY

To implement a service quality incentive scheme objective, quantifiable and verifiable performance indicators are required. Verification of the indicators is usually achieved by independent external scrutiny of the distributor's measurement and reporting systems. Kaufmann and Lowry (1999) note that service quality indicators should satisfy four criteria:

1. they should be related to the aspects of service that customers value;
2. they should focus on monopoly services;
3. utilities should be able to affect the measured quality; and
4. the indicators should not ignore pockets of service quality problems.

Indicators should, thus, concentrate on outputs directly affecting service quality rather than inputs such as distributor staff training programs. They should also be limited to direct service quality issues rather than picking up customers' views on other issues such as the perceived fairness of distribution prices – this applies particularly to customer survey based indicators. The indicators should also concentrate on those aspects of service where there is no alternative supplier as competition will reduce service quality problems in other areas. Finally, there is a need to look at the distribution of the indicator as well as its average to ensure that some 'outlier' consumers do not receive very poor and perhaps declining service while the average consumer receives good and improving service.

Considerable work has been done recently to standardise the definitions and reporting of service quality indicators across Australia (Utility Regulators' Forum 2002). There are obvious advantages in using the indicators developed as part of this process, wherever possible, to maximise the scope for performance comparisons with as wide a range of distributors as possible.

Service quality attributes are normally grouped according to reliability, technical quality and customer service categories.

Reliability indicators

The principal reliability indicators relate to the duration and frequency of interruptions. The system average interruption duration index (SAIDI) measures the total number of minutes, on average, that a customer on the distribution network is without electricity in a year. It excludes momentary interruptions of one minute or less. The system average interruption frequency index (SAIFI) measures the average number of times a customer's supply is interrupted in a year (excluding momentary interruptions). A third index, the customer average interruption duration index (CAIDI), can be obtained by dividing the SAIDI by the SAIFI to show the average duration in minutes of each interruption a customer on the network faces. Where measurement systems permit, momentary interruptions are measured by the momentary average interruption frequency index (MAIFI).

Interruption measures can cover total interruptions (transmission and directed load shedding related as well as planned and unplanned distribution related) and those due to planned and unplanned distribution related causes only. Another measure called 'normalised distribution network interruptions – unplanned' excludes the impact of certain exceptional events the distributor could not have been expected to allow for.

As well as overall system figures, the Utility Regulators' Forum (2002) recommends separate reporting for four feeder categories: central business district, urban, short rural and long rural feeders.

To address the issue of the spread of reliability performance as well as the average, some jurisdictions also require information to be provided on a given number of the worst performing feeders.

Technical quality indicators

Technical quality indicators principally relate to the voltage characteristics of the electricity supplied. Voltage characteristics will be particularly important to large industrial customers. The URF (2002) recommends the collection of complaints data relating to:

- low supply voltage;

- voltage dips;
- voltage swell;
- voltage spikes;
- waveform distortion;
- TV or radio interference; and
- noise from appliances.

The causes of complaints are to be classified according to:

- network equipment faulty;
- network interference by distributor equipment;
- network interference by another customer;
- network limitation;
- customer internal problem;
- no problem identified; or
- environmental.

While the number of complaints is only a rough proxy for the number of technical quality breaches, they may provide a starting point for an incentive scheme until such times as system reporting methods capture actual technical quality breaches more accurately.

Customer service indicators

The main dimensions of distributor customer service identified by the URF (2002) relate to the timely provision of services, the timely repair of faulty streetlights, call centre performance and complaint handling. The indicators which could be derived from the information the URF recommends for collection include:

- percentage of connections not provided on or before the agreed date;
- average percentage of streetlights 'out' during each month;
- average number of days to repair a faulty streetlight;
- percentage of calls not answered within 30 seconds;
- percentage of calls abandoned;
- number of call centre overload events;
- number of reliability complaints;
- number of technical quality complaints;
- number of administrative process or customer service complaints; and,
- number of other complaints.

Other customer service indicators could be developed around safety performance, metering and billing, non–emergency on–site repairs and customer satisfaction.

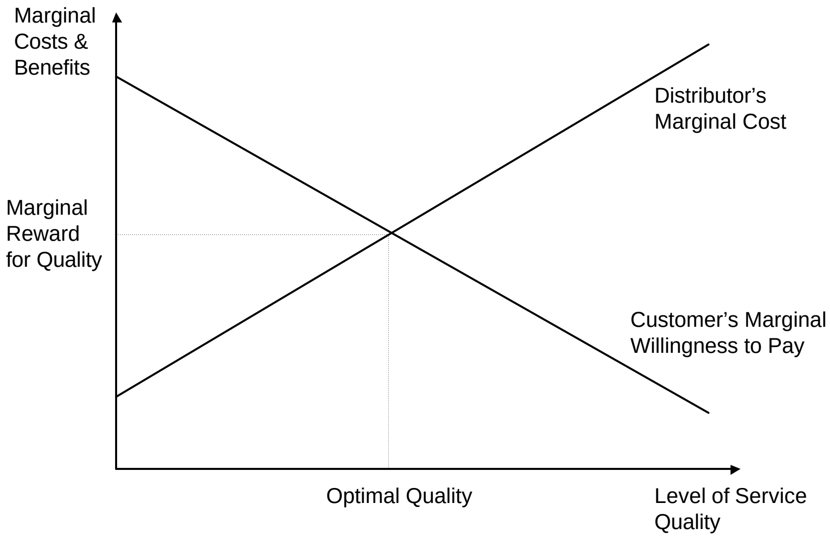
2.4 WHAT IS THE OPTIMAL AMOUNT OF QUALITY?

Customers normally prefer better quality service to inferior quality service and are prepared to pay a premium for better service. However, the size of the premium they are prepared to pay will depend on their individual preferences and the amount of quality involved. Consumers typically exhibit reduced marginal willingness to pay as the amount of quality increases. That is, as they attain higher quality levels, consumers value additional improvements in quality less so they are prepared to pay less to go from a very good service to an excellent service than they were to go from a poor service to a mediocre service.

Distributors, on the other hand, face increasing marginal costs of improving quality. For instance, improved maintenance practices and some basic strengthening of the network may improve service quality from poor to medium at modest cost. However, to go from medium to high service quality levels is likely to require major capital expenditure to strengthen and possibly duplicate parts of the network and make greater use of undergrounding which will come at a much higher cost.

The optimal level of service quality will occur where the consumer's marginal willingness to pay is equal to the distributor's marginal cost to improve service quality as shown in figure 1. This level of service quality coincides with that where the distance between the consumer's total willingness to pay and the distributor's total costs of improving quality is at a maximum. For service quality levels below the optimum, consumers value a small increase in service quality by more than it costs the distributor to produce it while for service quality levels higher than the optimum level, it costs the distributor more to produce a small increase in quality than consumers value it.

Figure 1: **The marginal benefits and costs of service quality**



Source: Williamson (2001, p.67)

Two important implications need to be borne in mind when interpreting figure 1. These are that not all consumers are the same and not all distributors have the same marginal costs of increasing service quality. As the distributor will not normally be able to provide each individual consumer with a price/service quality choice, consumers' willingness to pay will have to be averaged over the relevant group of consumers when determining the optimum service quality level. From the distributor side, it will cost a remote rural distributor with long, narrow radial feeders much more to improve quality to a given level than it will a distributor operating in a dense urban environment where there is much more interlinking of the system and scope to feed power to consumers through different feeder routes. Consequently, even if the consumers in the remote rural network and the dense urban network have identical preferences and marginal willingness to pay for quality, the optimum quality levels will differ due to the difference in distributor costs with the optimum service quality level in the remote rural network being less than that in the dense urban network.

From society's perspective, additional costs may have to be figured into the calculation when trying to identify the optimal level of service quality within a regulatory setting. These include monitoring and data collection costs, compliance costs for the distributor and increased resource requirements for the regulator. Other things being equal, the addition of these costs may tend to reduce the optimal level of service quality somewhat.

The main practical problem with identifying the optimal level of service quality is identifying what customers' marginal willingness to pay for quality and the distributor's marginal cost of providing it actually are. Both consumers and the distributor have incentives to hide this information to obtain a more favourable outcome for themselves leading to a classic asymmetric information problem. In the following sections we explore some options for addressing this situation.

3. REGULATORY APPROACHES TO SERVICE QUALITY

Most electricity industry regulators have at least some arrangements in place regarding service quality levels. These can range from minimum service quality standards to ensure distributors meet very basic standards through to penalties or compensation distributors have to pay directly to customers for not meeting specified standards through to more sophisticated forms of incentive regulation where distributors are paid rewards and charged penalties for improving or reducing reliability, respectively. There are also a number of market–based solutions ranging from allowing recourse to legal remedies to 'price/service offerings'.

3.1 LITIGATION

The South Australian Independent Industry Regulator (SAIIR 2002) notes that consumers may have recourse to a number of legal options if they suffer loss or damage as a result of the distributor supplying poor quality power. For instance, the Trade Practices Act requires that goods (including electricity) must be of 'merchentable quality' or fit for the purpose for which they were bought. Although the applicability of this provision to electricity is currently the subject of debate, it does offer scope for distributors to be liable if they supply poor quality power.

Distributors may also be liable for breach of contract provisions with customers. In reality, however, it would only be large customers who would be in a position to pursue legal remedies given the likely expense of such a course of action and they may be unwilling to go down that avenue if there is no alternative supplier available. At this stage Queensland's Standard Customer Contracts have limited requirements regarding quality of supply.

Some states also have alternative dispute resolution mechanisms available such as an Electricity Ombudsman to reduce the costs of consumers complaining about service quality if direct complaints to the distributor fail to provide a satisfactory outcome. In Queensland the Energy Consumer Protection Office carries out this role. These mechanisms attempt to reduce the imbalance in bargaining power between a small customer and a large distributor.

Legal avenues and related extended complaints mechanisms generally provide no certainty about the level of service quality provided and provide minimal incentives for the distributor to supply anything other than the most basic quality service. However, detailed contracts with inbuilt penalty provisions may be the most cost effective way of addressing the specialised service quality needs of large industrial customers.

3.2 MINIMUM STANDARDS

Minimum service standards for a range of quality attributes are often built into a distributor's license to supply. However, these provisions are more often equivalent to 'safety net' provisions which impose little pressure on the distributor to move towards an optimal level of service quality. Nevertheless, they can provide a fall–back position which provides the regulator with some bargaining power in the event of serious lapses in service quality.

There are serious question marks over the effectiveness of minimum service standards which provide for the withdrawal of the right to supply in the event of serious breaches. This is because electricity supply is an essential service and, where there are no alternative suppliers available, such threats are unlikely to be credible. This lack of credibility is more pronounced where the distributors are government–owned enterprises. Minimum standards will have a role, however, in improving service quality but only in conjunction with other measures.

3.3 BENCHMARKING

Comparative performance reporting of service quality across distributors can play a useful role, particularly in the early stages of incentive regulation. Its rationale lies in correcting information asymmetries which exist in natural monopoly markets. Consumers who have only had experience with the one supplier who has effectively given them a 'take it or leave it' offer will not be aware of what service levels are being offered in other jurisdictions. Publication of comparative service quality performance indicators helps address this information asymmetry by making consumers more aware of how other distributors are performing relative to their own. This can in turn place pressure on the local distributor to improve its performance if it is below par. There is some evidence to suggest that benchmarking has had this effect in instances where a utility's performance has been significantly below standard. Benchmarking alone does not, however, provide distributors with great incentives to outperform their peers on service quality but rather to make sure they do not fall too far behind. One reason is that there are few rewards for outperforming peers and, therefore, companies have little prospect of being compensated for the costs they incur to improve quality.

A criticism of the benchmarking approach is that it may generate unrealistic expectations among consumers without taking account of the cost of improving service quality. If no account is taken of the different operating environments different distributors face then assuming a remote rural distributor should be able to match the reliability performance of a densely populated urban distributor will be unrealistic at any feasible cost. Although it is technically possible to undertake statistical studies to quantify and adjust for differences in operating environments, this should only be done with extreme caution because of problems with data quality in this area.

The QCA has recently developed service quality reporting requirements for the Queensland distributors and initial reports have been provided. However, at least one distributor has requested that the reports not be made public until such times as the accuracy of reporting systems is improved. This highlights the relative immaturity of this process in Queensland but also the usefulness of comparative reporting in the early stages of regulation in helping lay the ground work for the higher quality data required by formal service quality incentive schemes.

3.4 PENALTY PAYMENTS

Most regulators and in some cases the distributors themselves devise a schedule of guaranteed service level payments which are paid by the distributor directly to affected customers as compensation for specified service quality breaches. In most cases the magnitude of these payments is set somewhat arbitrarily and usually well below the true cost of the inconvenience suffered by the consumer. Verification of the breach is sometimes difficult to establish and the scheme will be less effective where a large number of customers who are potentially hard to identify are affected. This type of scheme tends to be more successful in relation to customer service issues rather than reliability or technical supply issues.

In some cases distributors are charged separate penalties by regulators for service quality breaches which affect a large number of customers such as reliability failures. These payments may be fed back to customers in general in the form of lower prices.

Penalty payments have the effect of providing relatively strong incentives to meet the specified minimum level of service quality but provide no incentive for the distributor to outperform the specified minimum. The payments are usually set without firm reference to either consumer marginal willingness to pay or the distributor's marginal service quality cost.

3.5 PERFORMANCE–BASED INCENTIVES

Performance–based service quality incentives usually modify the CPI–X price or revenue cap to include a service quality component. The price or revenue cap then becomes CPI–X+S where S is the departure of actual service quality performance from a nominated benchmark level. Performance which leads to service quality better than the target benchmark leads to S being positive and a reward being provided in the form of a less onerous price or revenue cap. Performance worse than the target benchmark leads to S being negative and a penalty being imposed in the form of a more onerous cap with subsequent loss of revenue.

Ideally, the financial impact of the S factor is set to lie between consumers' marginal willingness to pay for service quality and the distributor's marginal cost of providing it. The S factor can be either symmetric with rewards and penalties being imposed at the same rate or asymmetric. There is sometimes a 'deadband' around recent performance levels that attracts neither a reward not a penalty. The S factor can contain multiple service quality attributes either operating separately or aggregated into an overall service quality index.

Performance–based service quality incentives provide the best way of encouraging distributors to move service quality levels towards the optimum. Unlike the other instruments examined above, they encourage distributors to improve performance, so long as it is cost effective to do so relative to consumers' valuations of the benefits of improved quality, rather than just encouraging distributors to achieve specified minimum levels. Because there are many data issues to be resolved in implementing performance–based incentive schemes, it may be appropriate to operate the scheme in conjunction with some of the 'safety net' schemes identified above. However, the schemes do lend themselves to a process of gradual introduction where more attributes can be added over time and penalty/reward rates can be modified as more information is obtained.

3.6 MARKET SOLUTIONS

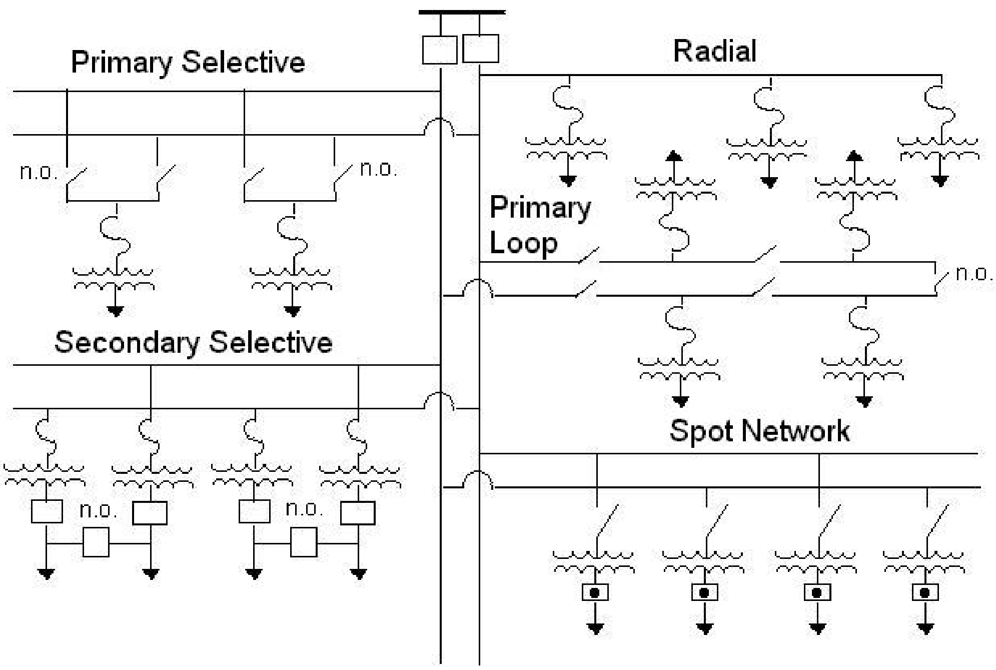
Although distribution is a natural monopoly and most customers do not have choice of supplier, there is still an active market in reliability equipment for end–users. At the home computer end, for instance, customers can purchase a 300 Watt uninterruptible power supply unit for around $100. For around $1,500 customers can purchase a 5 kiloWatt petrol generator. Industrial customers also have a range of onsite options to improve reliability such as diesel generators, ultra capacitors, transfer switches and superconducting magnetic energy storages although the cost of this equipment runs into the hundreds of thousands of dollars. Thus, although distributors determine reliability up to the customer's premises, customers can influence the ability of their electrical equipment to function in the face of interruptions.

The demand for this end–user reliability equipment can provide a guide to the demand for increased reliability levels. At this stage, the main demand for these products appears to come from industrial users rather than households. However, it does highlight that in at least some circumstances it may be cheaper to address reliability problems from the consumer end rather than the distributor end. This may be the case for remote rural consumers in particular. This has particular importance for service quality regulation where the regulatory boundary may be at the point where wires enter the customer's premises. Some flexibility may be needed to allow distributors to seek least cost solutions in these cases. This may involve allowing the distributor credit for expenditure on end–user equipment even though this would not normally be part of the regulatory cost base.

At a more general level, many distributors are keen to explore the scope for 'price/service offerings' to customers (see EnergyAustralia 1999, ENERGEX 2002). This involves giving consumers a choice between a range of options including low price with low reliability through to high price with high reliability. In a normal radial network where each customer relies on one feeder and one transformer, if the feeder fails then all customers beyond the point of failure are left without power until the feeder is repaired.

Higher reliability is usually achieved by duplicating parts of the network. The various technical possibilities are illustrated in figure 2. For instance, large industrial customers with a high demand for reliability can be given a primary selective service where they have the capacity to switch between feeders at high voltage so they are less susceptible to one feeder failing. To accommodate multiple customers this requires the two feeders to run close to each other for most of their length but each customer has only one transformer.

Figure 2: **Distribution delivery options with differing reliability levels**



Source: Brown and Marshall (2001, p.16)

A secondary selective service is another variant of the duplication theme. In this case the customer has two transformers which normally each source power from different feeders and each provide power to different parts of the customer's plant. A switch between the low voltage sides of the two transformers which is 'normally open' and switches on the low voltage side of each transformer can be reconfigured to direct power from one feeder and its transformer into part or all of the circuits normally powered by the other transformer in the event of the other transformer's feeder failing. Unless each of the transformers have the capacity to supply the plant's entire power needs, the secondary selective network will only support the most important functions of the plant in the event of one of the feeders failing.

Spot networks provide another duplication option for maintaining greater reliability. In this case a low voltage network with multiple users is connected to a series of transformers each of which source their high voltage power from different feeders. In the event of one feeder failing, a series of switches enable power to be sourced solely from the other feeder. To support full consumption levels if one feeder fails, there must be full duplication of transformer capacity as well as of the feeders.

Primary and secondary selective and spot network services are typically limited to high density urban areas and are not available to residential or small commercial customers. Feeder automation on primary loops does offer an option for these customers. In this case two feeders can service separate geographic areas but come close to each at one point allowing a switch which is normally open to be placed between them. Combined with a series of switches on each feeder, this allows a failure in one of the feeders to be isolated and the customers on the remainder of the sections on that feeder to be fed from the other feeder once the switch between the two feeders is closed. This type of arrangement is not uncommon in Australian networks now but the switches tend to be manually rather than automatically operated. However, full customer choice is problematic in a primary loop, as all customers on a switchable feeder section will experience the same reliability.

Enhancing transformers to include power quality equipment is another way of providing options to small consumers. With this technology customers with a low demand for reliability would retain essentially their existing service. Customers with a medium demand for reliability could be supplied at a higher price from a different part of the transformer equipped with a power storage device capable of maintaining power for up to a minute and thus eliminating momentary interruptions. Customers with a very high demand for reliability could be supplied at a much higher price from a third part of the transformer equipped with its own backup generator capable of cutting in within a minute and, thus, eliminating even sustained interruptions (Brown and Marshall 2001). However, this technology is, as yet, prohibitively expensive in most instances.

Another variant of the 'price/service offering' is reliability guarantees. Under this system distributors guarantee to compensate customers demanding higher reliability in the event of interruptions in excess of the guaranteed level but in exchange for a higher price. In theory, if one area has many customers demanding high reliability but experiences relatively low reliability then the compensation payments will provide a signal to the distributor to strengthen the network in that area. Conversely, in areas where there are few high reliability demanding customers but the system is very secure, the lack of compensation payments will provide a signal to the distributor to cut back on expenditure in that area.

A major problem with the price/service offering concept is the free rider problem. This arises particularly for small customers where many customers will be on the one feeder section. Customers will have an incentive to nominate a preference for a low cost/low reliability option in the hope that their neighbours will nominate a preference for a high reliability/high price option. This way they will be able to 'free ride' on the high reliability that would be given to the feeder section without paying the associated price if each customer is able to choose their plan. If all customers are given the average price and reliability level chosen by the group then those that did not value reliability highly would resent paying for their neighbours' preferences. Either way, this is likely to lead to the resulting level of service quality being lower than the optimum level.

While the price/service offering concept is attractive and represents a desirable goal as a means of addressing service quality problems, particularly given the information asymmetries and uncertainties involved, it is unlikely to be a practical proposition in the short term. Much of the required technology is still prohibitively expensive for the large majority of customers and distributor information and management systems would require substantial upgrade. Until such times as price/service offerings become a practical alternative, performance–based service quality regulation remains the best option for moving service quality closer to its optimal level.

A variant of the price/service offering may, however, have a role to play in performance–based regulation. In the presence of information asymmetries, there may be scope for the regulator to adopt a menu approach where, for example, a variety of X factors and service quality standards are offered to the distributor and it is allowed to choose which option is best for it. This approach provides an incentive for the distributor to reveal its true costs by the choice it makes. This type of menu approach is gaining increasing currency as a welfare–enhancing response to information asymmetries (see Laffont and Tirole 2000).

4. WHAT HAS BEEN DONE ELSEWHERE?

Service quality issues are receiving increasing attention in most electricity markets. The United States has the longest history with providing performance–based incentives to improve service quality. A variety of approaches have been used across the US state systems and service quality regulation is still evolving. The United Kingdom has also moved recently to introduce limited service quality incentives and plans to extend this at the time of its next price review.

In Australia, South Australia was the first state to introduce a form of service quality incentives although these are now being reviewed in the lead up to its next regulatory period commencing in 2005. In its current regulatory period which commenced in 2001, Victoria is introducing a relatively advanced form of price control adjustment to provide its distributors with an incentive to improve reliability.

In this section we review experience with performance–based service quality regulation in Victoria, South Australia, the UK and the US.

4.1 VICTORIA

Commencing in 1996, Victoria set minimum reliability standards for its distributors differentiating between short and long feeders. The Office of the Regulator General (ORG) has also published detailed reports on service quality for each distributor covering average performance and identifying problem feeders. While the minimum standards were generally considered to be too low, publication of service quality performance served to put pressure on poor performing distributors to improve their performance and increased public awareness.

In its electricity determination for 2001–2005 the ORG has significantly expanded its regulation of service quality introducing a new incentive scheme within the price cap in addition to compensation payments to customers affected by poor reliability. Distributors are required to make guaranteed service level payments of $80 to urban customers who experience more than 9 supply interruptions in a year and to rural customers who experience more than 15 interruptions. Urban and rural customers both also receive payments of $80 if their power is off for more than 12 hours at any one time. These payments are not based on the estimated inconvenience cost to customers but are intended to be significant from the customer's perspective while providing the distributors with an incentive to improve service levels to problem areas.

The modification of the price cap formula to include an 'S' factor for service quality performance has been a more innovative move. In simplified terms the price cap now becomes (1+CPI)(1–X)(1+S) where S is the product of an incentive rate and the gap between target and actual performance levels for a series of reliability indicators. The number of unplanned interruptions, average unplanned interruption duration and total planned minutes off supply are included for CBD, urban and rural customers. The details of the price control formula are reproduced in appendix A. The scheme will be phased in from 2003.

The incentive is symmetric with performance above the target being rewarded at the same rate as penalties are imposed for performance below the target. The incentive rate is based on estimates of the distributor's marginal cost of improving reliability. This rate was considerably lower than available evidence on the valuation consumers place on improved reliability. If distributors can exceed the reliability target at less cost than implied by the incentive rate, they can keep the resulting benefit for the remainder of the current regulatory period and for part of the following regulatory period under the ORG's efficiency carryover mechanism. This provides them with an incentive to exceed the target.

Momentary interruptions are currently excluded from the incentive scheme due to system difficulties with measurement and monitoring. However, the ORG plans to include momentary interruptions in the next regulatory period. The ORG is also moving to improve its monitoring and benchmarking of the distributors' telephone response times.

Distributors have to apply to the ORG to have exceptional events excluded from the incentive scheme. The ORG (2000, p.24) indicated it would consider exclusion of the following events:

- 'supply interruptions made at the request of the customer affected;
- load shedding due to a shortfall in generation;
- supply interruptions caused by a failure of the shared transmission network; and
- supply interruptions caused by a failure of transmission connection assets, to the extent that the interruptions were not due to inadequate planning of transmission connections.'

4.2 SOUTH AUSTRALIA

The South Australian Distribution Code establishes a symmetric performance incentive scheme for the distributor, ETSA utilities. The maximum average distribution revenue allowed to ETSA Utilities is increased or decreased depending on actual performance relative to targets across five indicators: SAIDI, SAIFI, CAIDI, time to restore supply to not less than 80 per cent of affected customers and operating cost per customer. For the first four measures, the points score is averaged across the Adelaide Central, Metropolitan, Rural and Remote areas and a category which has been specified by the SAIIR as the forty worst feeders in South Australia based on the number of interruptions per consumer.

ETSA Utilities receives points for its performance relative to the specified targets and revenue adjustments are made at the rate of $300,000 per point. The first revenue adjustment was made for the 2001–02 year based on performance for the year ending 31 March 2001. In this case ETSA Utilities' allowed revenue was reduced by $900,000 mainly due to average operating costs per customer exceeding their target and reliability measures falling short of targets in rural and remote areas. While the calculation of reward points is symmetric, the timing of rewards and penalties is not with revenue reductions being passed on to customers immediately but any increases in prices being delayed until the following year and then capped at a maximum of 1.5 per cent per annum. The calculation of the initial performance incentive is detailed in appendix B.

The SAIIR is currently reviewing whether the incentive scheme should be modified or replaced in the next regulatory period commencing in 2005.

4.3 UNITED KINGDOM

The UK electricity distributors have been subject to financial penalties for breach of licence conditions and failure to meet relevant requirements under the Utilities Act 2000. Guaranteed Standards of Performance have also involved compensation payments for customers receiving poor service. In addition the Office of Gas and Electricity Markets' (OFGEM) price determination of 1999 set price caps for the period 2000–2005 assuming certain service quality targets. To reinforce incentives to achieve these service quality targets OFGEM initiated a two year review known as the Information and Incentives Project to come up with an interim incentive scheme to apply from April 2002 for the remainder of the current regulatory period. The interim scheme was intended to inject a more competitive relative assessment of performance and move away from the setting of a single target at the start of each five year regulatory period.

OFGEM (2001) announced that interim incentive scheme would be made up of four main components:

- 'a mechanism that penalises companies annually, up to 1.75 per cent of revenue, for not meeting their quality of supply targets (as measured by the number and duration of interruptions to supply);
- a mechanism for rewarding companies who exceed their quality of supply targets for 2004/05 based on their rate of improvement in performance up to that date;
- a commitment to rewarding frontier performance in the next price control period; and
- a mechanism for rewarding or penalising companies annually, up to a maximum of 0.125 per cent of revenue, for the quality of their telephone response provided to consumers and a commitment to introduce targets for the speed of telephone response in April 2003.'

OFGEM has put considerable effort into developing consistent data definition and collection methods to support future incentive schemes. Momentary interruptions are currently monitored but excluded from the interim incentive scheme due to insufficient information.

OFGEM will review experience with the interim scheme as part of its next major price determination in 2004 for the period 2005–2010 and develop its ideas for rewarding service quality performance based on a distributor's distance from a cost–quality frontier. This idea extends OFGEM's previous method for rewarding efficiency performance on the basis of the distance from an efficiency frontier determined by average actual operating cost performance.

The OFGEM interim scheme has been criticised for not taking any account of customers' willingness to pay (Williamson 2002). The ideas of a cost–quality frontier and rewarding relative performance in future schemes have also been criticised. It has been argued that a cost–quality frontier is a meaningless concept as the optimal service quality level for each distributor should be determined by balancing its marginal customer benefits and unique distributor costs rather than by attempting to normalise costs across distributors for differences in operating environments. Relative performance rewards run the risk of encouraging distributors to increase service quality levels above the optimum as determined by the balancing of marginal customer benefits and unique distributor costs. It has also been argued that attempts to base rewards on relative performance will provide incentives for distributors to 'game' the scheme by progressively 'leapfrogging' each other rather than converging on an optimal level, thus, introducing instability to service quality levels.

4.4 UNITED STATES

Service quality issues have become increasingly important in utility regulation in the US. Kaufmann and Lowry (1999, p.40) indicate that a number of recent events have illustrated the increased attention given to service quality issues:

- 'the Wisconsin PSC sued Ameritech-Wisconsin, which was operating under price caps, charging the company with declining service quality;
- a price cap plan for US West–Oregon was terminated because of quality problems; and
- service quality complaints led to lower allowed returns for Missouri Gas Energy.'

Structural reforms of the US electricity sector were the main focus of initial deregulation starting around a decade ago. Service quality issues were of less concern under traditional rate of return regulation but have become increasingly important as deregulation has progressed. Regulators initially thought they would be able to rely on their existing rules and investigatory powers to address any problems that arose but this proved to be insufficient (Alexander 1996).

Many US regulators have been keen to address service quality issues as part of a package of incentives known as 'performance–based ratemaking' (PBR). The underlying rationale of PBR is that financial incentives and disincentives should be used to influence utility behaviour in the desired direction. Good performance should be rewarded by an increase in the profits the utility is allowed to make while poor performance should be penalised by a reduction in the level of allowable profits. This was summarised by a report for the National Association of Regulatory Utility Commissioners (NARUC 1997, p.37) as follows:

> 'in order to "beat" the moving baseline and cream rewards from the sharing mechanism, the utility may be tempted to achieve false cost savings by deferring necessary maintenance, reducing service personnel, or engaging in some other type of cost cutting that reduces some measure of performance. The equally obvious solution to this problem is to devise a system that penalizes utilities in such a way as to directly link the sharing of cost savings to the maintenance of quality standards.'

US regulators have developed incentive schemes for a range of service quality issues including customer contact, customer satisfaction, outages and employee safety. Based on the report for NARUC, the SAIIR (2002, p.35) summarised the US experience as follows:

- ‘few, broad measures are favoured over many, detailed measures;
- an incentive approach is more popular than minimum standards;
- there has been debate about the difficulty of measuring customer satisfaction;
- outage measures appear to be standard measures and well understood;
- power quality measures are increasingly important and have been found to require a good monitoring regime; and
- the appropriate quantum of penalties/incentives has been debated.’

The current service quality PBR mechanism for San Diego Gas and Electric (SDG&E) is widely viewed as one of the most advanced in the US and serves to illustrate many of the PBR features adopted by US regulators. The main features of the scheme are listed in table 1.

Table 1: **SDG&E’s Service Quality Incentives, 1999–2002**

Performance area	*Indicator*	*Benchmark*	*Dead-band*	*Live-band*	*Unit of change*	*Incentive per unit $’000*	*Maximum incentive $m*
Safety	OSHA[1]	8.80	±0.20	±1.20	0.01	25	±3
Reliability	SAIDI	52 mins	0	±15	1.00	250	±3.75
	SAIFI	0.90 outages/yr	0	±0.15	0.01	250	±3.75
	MAIFI	1.28 outages/yr	0	±0.30	0.015	50	±1
Customer satisfaction	Very satisfied	92.5%	±0.5%	±2.0%	0.1%	75	±1.5
Call centre response	Answered in 60 secs	80%	0	±15%	0.1%	10	±1.5

[1] Occupational Safety and Health Administration Frequency standard.
Source: CPUC (1999)

The scheme is symmetric with performance in excess of the benchmarks or targets attracting rewards at the same rate as penalties are applied to performance below the benchmarks. Symmetric incentives are more popular with utilities and generally, but not always, with customers. Symmetric schemes have been widely used in California and, at times, in New York. Two of the indicators have a ‘deadband’ area where a small variation in performance around the benchmarks attracts neither a reward nor a penalty. There is a cap on the maximum rewards or penalties received for performance in each area. This approach is often adopted where regulators have imperfect knowledge of the magnitude of utility costs and customer valuations to ensure that the scheme does not overwhelm other aspects of the price cap mechanism and to contain the risk faced by both the regulator and the utility. Finally, the scheme is based on 6 indicators covering 3 broad service quality areas: safety, reliability and customer service. Around 60 per cent of the maximum rewards/penalties available are allocated to reliability and 20 per cent to each of safety and customer service.

5. DESIGN ISSUES FOR SERVICE QUALITY INCENTIVES

In designing a service quality incentive scheme the first issue to be resolved is the underlying objective of the scheme. In this report we assume that the objective is to move service quality towards its economically optimal level, that is to the point where the marginal benefits to consumers of further improving service quality are equal to the marginal costs to the distributor. It should be noted that this objective would lead to different groups of customers having different service quality levels and paying different prices for those service quality levels depending on the customers' characteristics, preferences and expectations and the operating conditions faced by the distributor in supplying those customers. It would typically not be consistent with objectives such as providing a common level of service quality at a common price to all customers, regardless of where they are located and whether they value a higher quality service or not.

Another objective may be to ensure that least cost service quality solutions are provided to meet customers' needs and preferences. Achieving this objective may require some flexible and innovative solutions if the least cost solution lies outside the traditional boundary of the regulatory regime such as on the customer's premises rather than in the distribution network itself.

Once the objectives of the service quality regime are determined, Kaufmann and Lowry (2002, p.41) note that there are four basic elements around which choices have to be made:

- 'a series of indicators of the company's quality of service;
- a list of related service quality benchmarks;
- a means of assigning values to different aspects of service quality; and
- a method for translating a utility's quality performance into a change in utility rates via rewards or penalties.'

5.1 CHOOSING SERVICE QUALITY INDICATORS AND THEIR COVERAGE

As discussed in section 2.3, the service quality indicators chosen should satisfy four basic criteria: they should be related to the aspects of service that customers value; they should focus on monopoly services; utilities should be able to affect the measured quality; and the indicators should not ignore pockets of service quality problems. It was also noted that there would be advantages from adopting a set of indicators which were consistent with a subset of those being promulgated by the Utility Regulators' Forum (2002). The URF indicators cover reliability, technical quality and customer service aspects.

What should the coverage of the incentive scheme be?

Existing incentive schemes typically cover reliability, call centre performance, field service, billing and complaints handling, customer satisfaction and, in the case of the US, safety performance. Reliability, in turn, has several dimensions including duration and frequency of outages, sustained versus momentary interruptions and planned versus unplanned outages. Reliability can also be measured at the system–wide level, for individual feeder lines or for individual customers.

It is important to concentrate on those areas that are of most concern to customers. Provided utility complaints processes are adequately publicised, the pattern of customer complaints should provide a guide to what customers value the most. However, it is also important to cover as many aspects of service quality as possible as failure to include some aspects will provide an incentive for distributors to reduce service quality in those areas. Consequently, it may be desirable to include indicators from all three main areas – reliability, technical quality and customer service – even though some may receive a relatively low weight. Including representative indicators from the gamut of service quality attributes provides an important signal to distributors.

Given the starting point and the 'maturity' of the regulatory process in Queensland, improving system reliability is likely to be the highest priority compared to improving customer service aspects such as call centre performance. Reliability indicators are also among the most developed and work is well advanced on making the data reported across distributors consistent.

Technical quality is also of particular importance to some major customers with voltage dips having caused major plant shutdowns in the past. While these incidents have been of major concern and expense to these customers and have the potential to affect Queensland's competitiveness, they may be more effectively handled in the short term by direct negotiations and contractual arrangements between the relatively small number of major customers and the distributors rather than through a general service quality incentive scheme. This is because solutions to these problems will have to be tailored to this small group of large customers, data on technical quality in other parts of the network is not readily available and it is not clear as yet how important technical quality issues are to other customers.

Once the reliability of the system is improved the focus may then change to place more weight on different dimensions of customer service. Also, given the starting point, it may be desirable to concentrate initially on improving overall system reliability performance and/or reliability for the four main feeder types. Some weight also needs to be given to a 'worst circuit' list to ensure that the dispersion of performance does not become too great but including this from the outset may be placing too onerous a data burden on both distributors and the regulator. Once data collection mechanisms improve it would be necessary to explicitly include worst circuit performance as part of the incentive scheme. Similarly, the scheme may need to be based solely on sustained interruptions initially given data collection problems but momentary interruptions should be included as soon as possible.

How many measures should be included?

It will be important to ensure that the measures included are relatively few in number (so that they are comprehensible), are generally understood and not subject to inconsistent definitions across utilities and that the data required to support the measures is readily available. To ensure that the measures capture as much of the relevant reliability/service quality dimension as possible, they also need to be comprehensive in nature.

The trend in US service quality incentive schemes is to include a few broad measures in preference to many detailed measures. For instance, the current service quality incentive scheme for Brooklyn Union Gas contains 8 indicators while the scheme it replaced contained 21 indicators. In Australia where distributors are often covering much larger, less densely populated service areas with very diverse conditions, adequately representing service quality with a small number of indicators will be a challenge.

The incentive scheme proposed by the ORG (1999) for Victoria contains 9 indicators but focuses solely on reliability with three reliability indictors (unplanned SAIFI, unplanned CAIDI and planned SAIDI) for three regions (CBD, urban and rural). This gives good coverage of reliability while keeping the number of indicators manageable but ignores the other dimensions of service quality. The current South Australian scheme also largely focuses on reliability but contains 21 indicators with four reliability indicators (SAIDI, SAIFI, CAIDI and time to restore supplies to 80 per cent of interrupted customers) for 5 regions/groups (Central Adelaide, metropolitan, rural, remote and the 40 worst feeders) and average operating cost per customer. This also ignores the non–reliability service quality dimensions but has too many indicators to be readily tractable. This is exacerbated by the fact that only two of the trio of indicators of SAIDI, SAIFI and CAIDI are independent in any case.

The preferred number of indicators should be kept low in the initial stages of the scheme – probably not exceeding half a dozen and comprising, say, four reliability indicators, one technical quality indicator and one customer service indicator. Over time as experience with the scheme increases, the number of indicators could be expanded somewhat but should probably not exceed, say, 9 even in the long run.

5.2 CHOOSING SERVICE QUALITY BENCHMARKS

After having chosen a range of indicators to quantify the distributor's service quality performance, we next have to choose an appropriate set of benchmarks against which to compare the distributor's performance. This comparison then forms the basis for providing rewards or penalties in the incentive scheme.

The benchmarks chosen should be relatively stable in that they are not unduly influenced by random events and they should be realistic given the operating conditions faced by the distributor. An obvious starting benchmark is an average of the distributor's recent performance. This has some appeal as the prices charged by the distributor and the costs it currently faces should reflect the level of service quality currently delivered so marginal changes above or below this level can be safely rewarded or penalised in the early stages of the incentive scheme.

Problems arise, however, where the distributor's recent performance is considered to be inadequate. There may then be a need to set an external benchmark to provide larger incentives for the distributor to improve performance. Appropriate benchmarks could then be the performance of similar distributors nationally or a subset of peer distributors. Engineering best practice based benchmarks are also an option. The use of external benchmarks has some appeal as it is consistent with the concept of setting X factors in CPI–X price cap regulation on the basis of information on the firm's current performance and an external industry benchmark performance level that the firm has little direct influence over. This then lays the groundwork for incorporating an analogous 'S' factor in the price cap for service quality.

Other reasons for not using the distributor's recent performance as an ongoing benchmark are that recent periods of good performance may set an unreasonable standard if they have been due to an unusual run of favourable climatic and other conditions. There is also a concern that prolonged use of the distributor's own performance as the benchmark may actually produce perverse incentives as good performance leads to a 'ratcheting' effect and continual raising of targets. In some ways managers are then penalised for good performance by being set higher benchmarks in the next round. The report to NARUC (1997) puts forward some variations of the recent performance benchmark to help alleviate some of these problems. These include using the average performance of the worst three of the last five years and using a long term average minus one standard deviation.

Overall, it seems appropriate to start the incentive scheme off using recent service quality performance as the benchmark. This could comprise the average of, say, the last three years. This is relatively transparent and simple to implement. However, work should be undertaken during the first period of the scheme to explore creating appropriate external benchmarks to be introduced in the second period of the scheme.

5.3 SETTING APPROPRIATE REWARDS AND PENALTIES

Setting an appropriate rate for rewards and penalties is one of the most difficult elements of introducing a service quality incentives scheme. Ideally the schedule of rewards and penalties should mimic customers' marginal willingness to pay for service quality. This then allows the distributor to change its service quality up to the point where its marginal cost of improving service quality equals its reward from doing so and the optimal level of service quality is attained. However, determining what customers' marginal willingness to pay schedules really look like is notoriously difficult. Customers often have difficulty valuing a hypothetical product they have not experienced before and there are numerous incentives for customers to misrepresent their preferences. Distributors also have an incentive to overstate their true costs of improving service quality and exploit the information asymmetry the regulator faces.

Completely accurate estimates of customers' marginal willingness to pay and the distributor's marginal costs are not, however, necessary for the scheme to lead to significant steps towards the optimal level of service quality. As long as the reward and penalty schedule lies between the distributor's marginal cost schedule and the customer marginal willingness to pay schedule then improvements will result.

Different regulators have adopted different approaches to this information asymmetry. In Victoria the ORG has opted to set rewards and penalties based on its estimate of the distributors' costs of improving service quality. If the distributors can improve service quality at a lower cost than that estimated then they get to keep the difference for the remainder of the current regulatory period and into the next period using the efficiency carryover provisions. In the US, there have been more attempts to quantify customers' willingness to pay. A study of the willingness to pay of Southern California Edison's customers used a range of quantitative methods (Hagler Bailly 2000). The study was conducted by SCE at the direction of the California Public Utilities' Commission.

Attempts to quantify customers' willingness to pay use a number of survey–based techniques. These include contingent valuation where customers are asked to place a value they would be prepared to pay on a hypothetical combination of service quality attributes and conjoint analysis where customers are asked to rank their preference for alternative combinations of attributes. Some of the available survey methodologies have recently been reviewed in a report for IPART (CIE 2001). However, Kaufmann and Lowry (2002, p.46) note 'survey results reflect subjective perceptions rather than actual consumer behavior, and hypothetical valuations may not be a good guide to how consumers would actually act in markets'. Despite these limitations, well–designed surveys can still provide some useful information.

Other methods are also available for attempting to value consumers' willingness to pay for service quality. One approach is to use proxy data related to service quality attributes. This could involve calculating the opportunity cost of a customer's time spent waiting for an appointment which has not been kept on time or for being without power for a specified period. Another approach attempts to use market information on the value of service quality. For instance, the difference in rates charged for non–interruptible and interruptible services provides some basis for valuing reliability. However, obtaining such data in the Australian market is likely to be problematic. These sorts of approaches provide only a very indicative estimate of customer willingness to pay but may be a useful starting point. For larger customers the value of expenditure on equipment to reduce the effects of power interruptions and the preparedness to contribute towards the cost of distributor capital works to improve quality also provides useful information but this is unlikely to be relevant for residential and commercial customers.

Other considerations may also impinge on the regulator's setting of reward and penalty rates. For instance, given Queensland's relatively poor performance on reliability, there may be a desire that the scheme implemented provide sufficient incentive for distributors to remove as much of the gap relative to the other states as quickly possible. Consequently, the size of rewards provided to the distributors for improved performance should be of sufficient size to matter to them. But at the same time the incentive scheme should not swamp the main regulatory regime and, given the uncertainties and information asymmetries involved, there are risks to both the regulator and the distributor if rates are set inappropriately. The regulator could face large increases in allowable rates if the rewards are set too high and the distributor could face financial distress if penalties are set too high. To counter this, particularly in the early stages of the scheme, other regulators have imposed caps on the total value of the scheme. In the case of SDG&E cited in section 4, the amount was capped by a dollar amount and in the case of the current interim OFGEM scheme in the UK the impact is capped at two per cent of distributor revenue.

The current Victorian scheme has adopted a conservative approach of setting rewards and penalties based on estimated distributor cost. While large scale, survey based approaches to estimating customer willingness to pay are of arguable value, attempts should be made to approximate customer willingness to pay using available information. Given Queensland's relatively low ranking in service quality comparisons there seems to be a strong case for structuring rewards and penalties to be somewhat higher than estimated distributor marginal costs although it may be prudent to cap the value of the scheme initially.

5.4 CHOOSING THE APPROPRIATE INCENTIVE MECHANISM

Having chosen the relevant indicators to measure service quality, established the appropriate benchmarks to assess performance against and the reward and penalty rates to be applied for performance above or below the benchmarks, respectively, it now remains to establish the mechanism for delivering the rewards and penalties.

At the simplest level, the regulator could simply make payments of the relevant amount direct to the distributor if rewards were due or fine them the appropriate amount if penalties were due. However, this simplistic scheme has both implementational and design problems. From the implementation side, it would require establishing a separate fund to finance payments to and receive payments from the distributor. If the scheme started off in a reward situation then a source of finance would have to be arranged to fund the payments. However, the design problems with this approach are much more significant. There is no direct link between payments to and from the distributor under the scheme and the price customers pay. In fact, the likely price impacts work in the wrong direction with the distributor needing to increase prices to fund fines and being able to reduce prices if in receipt of payments for good performance. This lack of a link between payments under the scheme and customer prices means that customers are not fully aware of the costs associated with changing levels of service quality. There is also a risk of divergence between this scheme and other parts of the regulatory structure given the scheme's lack of integration.

The most effective means of ensuring customers see higher prices for better service quality levels and receive lower prices for poorer service quality is to incorporate the service quality incentive in the price or revenue cap mechanism so that the CPI–X regime now becomes a CPI–X+S regime. This has the added benefit of directly integrating the various components of performance–based regulation. As mentioned earlier, there may also be scope to offer the distributor a menu of choices of alternative combinations of X and S factors as a means of overcoming information asymmetries faced by the regulator.

An alternative way of incorporating an incentive to improve reliability would be to incorporate a reliability measure such as SAIDI as a negative output in a comprehensive output index as used by Tasman Asia Pacific in the last Queensland price determination (Tasman and PEG 2000). An improvement in reliability then is equivalent to a reduction in the negative part of the output index which leads to an increase in measured output. If the allowable change in costs is equivalent to the change in the CPI less the X factor plus the change in measured output, the distributor is rewarded for an improvement in reliability by being allowed more costs. Conversely, a worsening of reliability leads to the distributor being allowed a lower level of costs. While this method could be designed to have the same impact as the CPI–X+S approach, it is less transparent and, therefore, less preferable than the CPI–X+S approach.

A number of design issues surrounding the implementation of a CPI–X+S approach remain to be addressed.

Deadbands

Some incentive schemes have a 'deadband' around the benchmark where small variations in performance attract neither a reward nor a penalty. The SDG&E scheme illustrated in section 4 had this feature for two indicators. The main rationale for having deadbands in symmetric incentive schemes appears to be to prevent volatility in the distributor's allowed revenue from small and probably insignificant fluctuations in performance. However, deadbands effectively remove the operation of the incentive scheme from some performance levels and may, hence, dull the distributor's focus on achieving service quality improvements. If instability is thought to be a problem, a preferable solution is to base payments on a multi–year moving average of performance rather than a single year figure.

Deadbands may have some value if the incentive scheme is penalty–only, the idea being that the distributor should only be penalised for demonstrably bad quality and not random fluctuations due to factors such as weather. However, the case for deadbands declines significantly if the plan is symmetric because then random fluctuations can lead to both penalties and rewards, and if they are truly random the expected value of the net penalty or reward will be zero over a multi–year incentive plan.

Index versus separate indicators

As noted in section 5.1, it will be desirable to have a range of indicators covering most broad aspects of service quality although the number of indicators will typically be less than, say, nine and may be six or fewer in the initial stages of the scheme. An important issue is how do we incorporate multiple indicators in the scheme? Do we have several 'S's', one for each indicator or do we combine them all into one large 'S' using an indexing procedure which is what the ORG has done in Victoria? Having several separate S factors has the advantage of transparency and enabling customers and other interested parties to see whether the distributor has exceeded or fallen short of the benchmark for each indicator. Combining the indicators into an index of service quality has the advantage of simpler presentation but provided the weights used in forming the index reflect relative customer valuation of the various attributes, the outcome should be the same as separately including multiple S factors.

A variant of the multiple S factor approach is used in some parts of the US with the payment of penalties being directed back to affected customers. These are known as 'performance guarantees' and are appropriate for service quality lapses where affected customers can be readily identified but will be less suitable for reliability measures that affect many customers at the one time.

It is sometimes argued that using the index approach allows distributors more flexibility to substitute their service quality efforts between attributes to maximise the overall level of service quality as measured by the index. However, provided the weights used in forming the index reflect customer valuations in a similar manner to the reward coefficients applied to the individual S factors, the outcome will be the same – the difference will only be in the pressures placed on the distributor by the relatively greater transparency of the separate S factor approach.

Symmetry

Some incentive schemes in the US impose penalties on poor performance but do not reward improved performance. The rationale for this appeared to be that the schemes were designed to prevent service quality from falling below current levels. It was argued that distributors already received sufficient incentives for efficiency improvements under other parts of the regulatory regime that they should not be given an extra return for improving service quality. However, logic suggests that since improving service quality is a costly process then if we are to approach the optimal level of service quality, rewards must not only apply but also apply at the same rate as penalties. That is, the scheme should be symmetric. The schemes that are widely viewed as being best practice in the US, such as that applying to SDG&E, are symmetric.

A symmetric scheme also approximates the operation of a competitive market more closely where consumers are generally prepared to pay more for a higher quality product or, conversely, are generally prepared to consider lower quality products provided the price is sufficiently cheaper to compensate for the lower quality.

Some schemes, such as those currently applying in South Australia and the UK, are not really symmetric despite offering rewards and penalties at the same face value rate. This is because penalties are passed through to customers as lower prices immediately while rewards to the distributor in the form of higher prices are delayed for a number of years and subject to other restrictions such as capping in any one year. This clearly reduces the incentive for the distributor to improve service quality levels and also fails to transmit the appropriate information to the customer on the true cost of quality.

Exclusions

Exceptional events, which should be excluded from the incentive scheme, are the subject of much debate. Distributors would like to see as many unusual events as possible excluded to maximise their measured performance. These include outages caused by other parts of the electricity system (generation and transmission), outages requested by the customer and unusual storms, snowfalls, and other climatic extremes. At the other end of the spectrum some argue that nothing should be excluded other than outages requested by the customer and outages caused by generation and transmission as it is the distributor's responsibility to plan for all other conceivable exceptional events. The appropriate treatment probably lies somewhere between these two extremes. It may be appropriate to exclude certain climatic extremes such as one in one hundred year floods as it would not be economic for either the community or the distributor to strengthen the system to withstand such rare events. Exceptional events may be best examined on a case–by–case basis and exclusion on the basis of application to and investigation by the regulator.

A case can also be made for having hard and fast rules for exclusion, since that creates more certaintly and may aid distributors in what they should be planning for. Most US plans do have such rules for exclusion, but this is probably more important for US than Australian distributors because of the greater prevalence of severe winter weather and the fact that Australian service territories are more diverse, which makes it harder to set rules that are appropriate system–wide.

5.5 THE PREFERRED MODEL

On the basis of the above discussion we can now define some of the characteristics of a preferred service quality incentive scheme as follows:

- the objective of the service quality incentive scheme should be to move service quality towards the point where the customers' marginal willingness to pay for additional quality is equal to the distributor's marginal cost of providing it;

- the objective should also be to provide incentives to deliver least cost solutions to improve quality to customers irrespective of regulatory boundaries;
- the scheme should concentrate on those aspects of quality customers value the most highly but it should also cover all broad quality attributes (ie reliability, technical quality and customer service);
- the scheme should start off with no more than 6 performance indicators with, say, four focussing on reliability, one on technical quality and one on customer service;
- wherever possible the indicators used should be consistent with the measurement of indicators contained in the recent Utility Regulators' Forum (2002) publication;
- the number of indicators could be expanded in the longer term but should not exceed, say, nine;
- measures of worst circuit reliability should be developed for inclusion in the second period of the scheme;
- the benchmarks or targets used to evaluate performance should initially be based on an average of the distributor's performance in at least the last three years but should explore moving to external benchmarks in the scheme's second period of operation;
- rewards and penalties should be based on proxy estimates of customers' marginal willingness to pay for improved quality and exceed the distributor's marginal costs of improving quality;
- caps should be placed on the maximum rewards and penalties available under the scheme in the first period of operation;
- the incentive should be included in the revenue cap using an S factor along the lines of CPI–X+S;
- there may be scope to design menus of X and S factors to present to distributors – this can allow them to choose the cost–quality tradeoffs that are most appropriate for their circumstances and help overcome the information asymmetries the regulator faces given uncertainties regarding estimates of marginal costs of improving quality and customer willingness to pay;
- there should likely be no service quality performance deadbands, ie rewards and penalties should apply over the whole range of performance if the plan is symmetric – if not, deadbands may be appropriate;
- the indicators and benchmarks should be aggregated into an index of service quality initially to simplify presentation;
- the weights used in forming the index should reflect customer valuation of the respective service quality attributes;
- rewards and penalties should be symmetric with rewards being paid for good performance at the same rate and time as penalties are imposed for poor performance; and

- exclusion of events from the scheme should be on the basis of outages at customer request and due to the actions of generators and transmitters – other exceptional events such as extreme weather conditions should be on the basis of application to and review by the regulator.

6. THE WAY AHEAD

Before the preferred model, or a variant of it, can be implemented, further work will be required on a range of issues. These include:

- What should be the precise objective of a service quality incentive scheme?
- How can least cost solutions to improving reliability that lie outside the regulatory boundary (eg within the customer's premises) be incorporated in a regulatory service quality incentive scheme?
- What are the service quality attributes that different classes of customer value the most highly?
- What are the key performance indicators that should be included in the scheme initially? Should these cover all of the major aspects of service quality (ie reliability, technical quality and customer service)?
- Should the number of indicators be expanded in the second period of the scheme's operation? If so, which indicators should be included? What additional data collection efforts would be necessary to support these additional indicators?
- What benchmarks should be used to assess service quality performance? If internal, how many years' data should they be based on? Is a simple average of past years' performance appropriate? If external, which groups of distributors would make appropriate comparators for the two Queensland distributors? Is there a case for using international as well as national data? Are engineering based benchmarks more appropriate than observed performance?
- Is a general service quality incentive scheme the best way of dealing with the technical quality concerns of major industrial customers?
- What are customers' approximate willingness to pay for improvements in the different service quality attributes?
- What are the efficient marginal costs for the two Queensland distributors in improving the major service quality attributes?
- At what rate(s) should rewards and penalties be allowed?
- Given the uncertainties of estimating marginal costs and values precisely, is it desirable to design menus of X and S factors from which companies are allowed to choose? If so, how should such menus be designed?

- Should caps be placed on the total amount of rewards and penalties in the initial scheme? If so, what should the maximum amounts be?
- How should the service quality incentive be incorporated in the revenue cap regulation?
- Is there a case for having a performance 'deadband' in the scheme? What other means are available to reduce any resulting instability in the distributors' revenue?
- Should the individual service quality indicators be aggregated into an overall service quality index? If so, how should the index be formed?
- Should rewards and penalties be symmetric? If not, what differential rates should apply?
- What exceptional events should be excluded from the scheme? What process should be used to determine whether or not the impact of unusual situations should be excluded?

Once these issues are resolved, implementation of a service quality incentive scheme should make a valuable contribution to improving the service quality performance of the two Queensland distributors in line with customers' expectations and willingness to pay.

APPENDIX A: VICTORIAN PRICE CONTROL ADJUSTMENT

In its 2000 Electricity Price Determination for the period 2001–2005, the ORG added an *S* term to the price control formula giving it the form:

$$\frac{(1+CPI_t)(1-X_t)(1+S_t)}{(1+S_{t-6})}$$

The service adjustment, S_t, that will apply in year t for a particular distributor is calculated as a percentage according to the following formula:

$$S_t = \sum_{r,n} s_{r,n}(GAP_{t-2}^{r,n} - GAP_{t-3}^{r,n})$$

where:

r refers to the following indicators:

- Unplanned interruption frequency (SAIFI)
- Unplanned interruption duration (CAIDI)
- Planned minutes off supply (SAIDI)

n refers to the following customer categories:

- CBD
- Urban
- Rural

$s_{r,n}$ is the incentive rate for indicator *r* and customer category *n*.

$GAP_{t-2}^{r,n}$ is the performance gap for indicator *r* and customer category *n* in calendar year *t-2*; that is the difference in performance between target and actual performance ($GAP_{t-2}^{r,n} = TAR_{t-2}^{r,n} - ACT_{t-2}^{r,n}$).

$TAR_{t-2}^{r,n}$ is the distributor's performance target for indicator *r* and customer category *n* in calendar year *t-2*.

$ACT_{t-2}^{r,n}$ is the distributor's actual performance for indicator *r* and customer category *n* in calendar year *t-2*, not including the impact of excluded events.

$GAP_{t-3}^{r,n}$ is the performance gap for indicator *r* and customer category *n* in calendar year *t-3*; that is the difference in performance between target and actual performance ($GAP_{t-3}^{r,n} = TAR_{t-3}^{r,n} - ACT_{t-3}^{r,n}$).

$TAR_{t-3}^{r,n}$ is the distributor's performance target for indicator *r* and customer category *n* in calendar year *t-3*.

$ACT_{t-3}^{r,n}$ is the distributor's actual performance for indicator *r* and customer category *n* in calendar year *t-3*, not including the impact of excluded events.

APPENDIX B: SOUTH AUSTRALIAN 2001 PERFORMANCE ASSESSMENT

Measure	*Actual Y.E. March 2001*	*Baseline Target and Margin*	*Score from PI Scheme*
SAIDI (Mins)			
Adelaide Central	20.15	20±5	0
Metropolitan area	97.6	90±10	0
Rural area	276.8	150±15	–2
Remote area	252.8	200±20	–2
Worst 40 feeders	264.5	425±40	3
	Average over 5 categories =		–0.2
SAIFI (No.)			
Adelaide Central	0.23	0.2±0.05	0
Metropolitan area	1.26	1.1±0.1	–1
Rural area	2.52	1.2±0.1	–2
Remote area	1.11	1.2±0.1	0
Worst 40 feeders	2.41	4.5±0.5	3
	Average over 5 categories =		0
CAIDI (Mins)			
Adelaide Central	89.2	60±10	–2
Metropolitan area	77.4	85±10	0
Rural area	109.7	120±10	1
Remote area	226.7	185±20	–2
Worst 40 feeders	109.9	95±10	–1
	Average over 5 categories =		–0.8
Time to restore supply to not less than 80% of interrupted customers (Mins)			
Adelaide Central	123	120±10	0
Metropolitan area	118	120±10	0
Rural area	174	180±20	0
Remote area	306	300±30	0
Worst 40 feeders	154	140±15	0
	Average over 5 categories =		0
Average operating cost per customer ($/customer)			
Distribution business	122.3	110±4	–2
	Total Score		**–3.0**

Source: SAIIR (2002, p.10)

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