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21 September, 2001

Dr Tom Parry
Chairman
Independent Pricing and Regulatory Tribunal
PO Box Q290, QVB Post Office
Sydney NSW 1230

Dear Dr Parry

Discussion Paper on the Form of Economic Regulation for NSW Electricity Network Charges

Thank you for the opportunity to comment on the important matters raised in IPART's Discussion Paper on the Form of Economic Regulation for NSW Electricity Network Charges (DP 48).

The form of economic regulation is seen as a threshold issue in the ongoing development of IPART's role as the price and service regulator for electricity network services in NSW. Integral Energy recognises and supports the objectives for regulating network tariffs contained in the National Electricity Code and believes a price cap regime can be developed which supports these objectives and foster on-going investments in the distribution networks. Integral Energy also recognises and supports the combined submission of EnergyAustralia and Country Energy.

The attached submission sets out Integral's response to the issue raised in the discussion paper.

Integral Energy looks forward to participating in the ongoing development of a specific and detailed proposal on the form of economic regulation and commends a consultative approach to this task. Should you have any questions in relation to this submission, please contact Integral Energy's Regulatory & Pricing Group via David Neville on (02) 9853 6144 or Jason Ockerby (02) 9853 6631.

Sincerely,

R. Powis

Richard Powis
Chief Executive Officer

INTEGRAL energy

SUBMISSION TO IPART

RESPONSE TO THE DISCUSSION PAPER ON THE FORM OF ECONOMIC REGULATION FOR NSW ELECTRICITY NETWORK CHARGES (DP48)

21 September 2001

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Executive Summary

Integral Energy has a long-term vision that IPART will adopt a light-handed form of price control that will involve the monitoring of electricity network charges. This is seen as a natural goal for the regulatory continuum, which progresses from revenue regulation to price capping and on to price monitoring and oversight.

Integral Energy would like to move on from the current fixed revenue cap which has created perverse pricing outcomes for network services and does not support on-going prudent investment in the network businesses. Integral Energy is concerned with the continued focus on tariff reducing regimes implied in the CPI minus X dogma. It seeks a price path that is not based on a cost cutting regime, but one that recognises the real costs of maintaining and operating a network with acceptable reliability and quality of supply.

Integral Energy would like to see a national approach to regulating electricity distribution networks. The 2004-09 Determination is seen as an important step in the regulatory cycle, and the form of regulation chosen should progress the objectives of competition reform and support on-going investment in the electricity supply industry.

Integral Energy strongly supports the principles of a tariff basket or Weighted Average Price Cap (WAPC) form of economic regulation. It meets each of Integral Energy's criteria for evaluating forms of price control. These criteria are as follows:

- Sustainable commercial revenue stream to the network
- Certainty and consistency
- Equitable allocation of risk
- Incentives for efficient capital investment
- Incentives to improve operating and maintenance practices
- Incentive to maintain and improve service and reliability standards
- Stable and cost reflective end-user prices

The outcome of this first round of submissions and consultation should be a favoured form of regulation based on sound economic principles and the objectives of the National Electricity Code.

Following this, Integral Energy supports the development of a more specific proposal for the selected form of regulation addressing transitional and implementation issues. IPART must publish, in sufficient time to allow for meaningful evaluation and comment, a detailed proposal of how the selected form is to be implemented. The proposal should outline how the form of regulation will operate in practice and be administered by the Tribunal.

1 Introduction

Integral Energy has a long-term vision that IPART will move on to a price monitoring role for electricity network charges, rather than remain with an entrenched regulatory position of tariff-reducing regimes. A period of price regulation is clearly justified, but this should move gradually to a price monitoring or oversight role.

The 2004-09 Determination is seen by Integral Energy as the next step in the regulatory cycle, and the form of regulation chosen should progress the objectives of competition reform and support on-going investment in the electricity supply industry.

Integral Energy sees great merit in heading towards a national approach to regulating electricity distribution networks. The regulatory arrangements can then allow for transparent decision making on regional issues. A decision on the form of regulatory structures should also be couched in terms of the practical implications of licence requirements.

To evaluate each form of regulation in an objective manner it is necessary to first determine a framework for the evaluation. The framework summarised below is a simple list of objectives Integral Energy believes a regulator should be seeking to achieve in developing the form of regulation and making determinations.

Criteria for evaluation
One: Sustainable commercial revenue stream
Two: Certainty and consistency
Three: Equitable allocation of risk
Four: Incentives for efficient capital investment
Five: Incentives to improve operating and maintenance practices
Six: Incentive to maintain and improve service and reliability standards
Seven: Stable and cost reflective end-user prices

1.1 Sustainable commercial revenue stream

The form of regulation should:

- ensure a fair and reasonable rate of return to network owners on assets invested;
- ensure that revenue reasonably tracks changes in costs resulting from fluctuations in volume; and
- provide incentive and flexibility to increase the rate of return over time.

1.2 Certainty and consistency

A predictable and transparent regulatory approach will allow:

- certainty in terms of obtaining a reasonable return on capital investment; and
- the development of a rational regulatory strategy that is consistently applied from period to period and to each NSW (Distribution Network Service Provider (DNSP).

1.3 Equitable allocation of risk

This implies that:

- risk is allocated to parties in relation to their capacity to manage the risk; and
- higher non-diversifiable risk levels are recognised in higher rates of return.

1.4 Incentives for efficient capital investment

The form of regulation should provide:

- certainty in regards to earning a commercial rate of return on prudent capital expenditure; and
- a transparent prudence test for capital expenditure consistently applied to regulated assets.

1.5 Incentives to improve operating and maintenance practices

This should provide:

- opportunity to improve operating and maintenance towards best practice standards;
- financial incentives for demand management practices; and
- specific incentives to drive expenditure down to efficient levels, without detrimental impacts on service and reliability levels.

1.6 Incentives to maintain and improve service and reliability standards

Recognition in the form of regulation may include:

- financial rewards for consistently meeting or exceeding customer expectations; and
- financial penalties for consistently failing to meet expectations.

1.7 Stable and cost reflective end-user prices

The practical outcome of the form of regulation should:

- avoid large price changes, either up or down, both within and between regulatory periods;
- avoid price distortions created by fluctuations in sales volumes;
- avoid large price variations resulting from unders/overs account balances;
- avoid price differences between DNSPs for customers in the same vicinity
- provide the appropriate cost signals to end users and market participants; and
- allow flexibility to rationalise and implement efficient prices

2 Summary of options

In order to clarify our understanding of the specific options put forward by IPART a summary of Integral Energy's understanding of each option is set out below. Clearly, each option may have numerous permutations. Once this first round of consultation is completed and a favoured form of regulation identified, Integral Energy supports the development of a more specific proposal for the selected form of regulation.

Integral Energy believes that at this stage a specific proposal should be developed for the Weighted Average Price Cap (WAPC).

2.1 Fixed Revenue Cap

Integral Energy presently operates under a fixed revenue cap. A fixed (or pure) revenue cap directly limits the allowed revenue Integral Energy and other DNSPs can earn in any year of the determination. In general for fixed revenue caps, the revenue requirements are usually determined using the building block approach based on forecast sales volume and operating and capital expenditure requirements. This revenue is then fixed (adjusted only by CPI minus X); regardless of the actual volume of electricity distributed or network changes throughout the period of the determination.

The fixed revenue cap provides a very strong but generalised incentive to reduce costs. To the extent that underlying costs may vary with volume, there is an incentive for DNSPs to reduce sales volume in order to increase net earnings. This is viewed by some as having desirable demand management outcomes.

This form of regulation is most suited when underlying costs are largely fixed and is applied to transmission network businesses in the UK and Australia. If underlying costs vary or partially vary with volume, then DNSPs will over or under recover costs depending on the actual volume of output relative to forecast. As revenue is fixed, implicit regulated prices will also vary inversely to fluctuations in actual volumes. Therefore revenue certainty under this approach creates additional risks of pricing and earnings volatility. An error correction mechanism is also required to adjust for revenue under or over recovery resulting from sales volume fluctuations. Under the 1999 Determination[1] the unders and overs account rule serves this purpose (discussed in more detail below).

The belief that network costs are fixed for DNSPs ignores the stepped cost function that is inherent in electricity network business. While it is true that the marginal cost of carrying an additional kWh is close to zero, the cost of adding capacity to cover an incremental or infra-marginal increase in peak system capacity (or the cost of adding new connection points) is certainly greater than zero. The cost function of DNSPs is non-linear in relation to additional

[1] IPART, *Regulation of New South Wales Electricity Distribution Networks*, Determinations and Rules Under the National Electricity Code, December 1999.

maximum demand and customer numbers. It is therefore difficult to incorporate the function into the form of regulation.

The current fixed revenue cap has performed inadequately in meeting the key objectives and principles of network regulation. The perverse price path created by the side constraints and the unders and overs account rules has made it particularly difficult for DNSPs to manage volume risks. They have also served to mask errors in the building block parameters (particularly in relation to capital and operating budgets) that underlie the 1999 Determination.

The reliance on long-term forecasts and an error correction mechanism, along with the inefficient pricing incentives create serious concerns for the operation of this form of regulation. From a theoretical, practical and administrative perspective these should rule out the fixed revenue cap from further consideration.

2.2 Revenue Yield Cap

Under a revenue yield approach, a cap is placed on the average revenue per unit (ie. average price) that a DNSP is allowed to earn. Average revenue is calculated by taking the DNSP's total revenue requirements (often determined by building block approach) and dividing it by forecast sales volume (usually expressed in kWh). Average revenue is then regulated in the CPI minus X framework. The total amount of revenue earned will vary directly in proportion to sales volume. Therefore there is an inherent incentive to expand sales volume in order to maximise revenue (a common criticism of price caps in an environment which values demand management).

This form of regulation is most suited when underlying costs are largely variable. If there are significant fixed costs or if costs vary according to factors other than energy (ie. customer numbers, demand etc), then DNSPs will over or under recover costs depending on actual volume of output relative to forecast. Therefore any greater pricing certainty under this approach is at the expense of greater risk in earnings volatility.

2.3 Tariff Basket or Weighted Average Price Cap (WAPC)

Under a tariff basket approach or WAPC, Integral Energy understands that the limit on allowed price increases would be expressed in terms of a weighted average of a group or basket of tariffs, rather than on average revenue. Integral Energy and other DNSPs would faces a cap on the weighted average that increases over time on the basis of a CPI minus X formula.

The key difference between the WAPC and the revenue yield form of regulation is that the allowed revenue received for each additional unit varies according to the actual tariff for that unit, rather than an overall average price. Therefore revenue will vary in accordance with the underlying tariff structure (eg fixed charge, connectio n fee, demand and energy components) rather than solely by energy volume. Theoretically, if tariffs reflect marginal costs, then greater earnings certainty is established by revenue tracking the underlying costs of supply. This form of regulation also provides greater pricing certainty.

Under a WAPC the limit on allowed price increases is expressed in terms of a weighted average of the prices of a basket of services. A simple form of WAPC sets a formula as follows.

$$(1+CPI-X) \exists 3p_t\, q_{t-2} / 3\, p_{t-1}\, q_{t-2}$$

In order to maximise profit and minimise risks, there is a strong incentive to develop efficient prices. If previous year weights are used (as in the approach adopted by the ORG)[2], the WAPC does not rely on forecasting or require an error correction mechanism, such as the unders and overs account. Forecasting may be required for the introduction of new tariffs, but this should not warrant an error correction mechanism.

2.4 Hybrid Revenue Cap

Integral Energy's understanding of hybrid approaches is that they attempt to link regulated revenue to the fixed and variable cost elements of DNSP's businesses. In effect, a hybrid revenue cap is an average of a price cap and a revenue cap, where the underlying coefficients (ie fixed, energy, demand, customer numbers, circuit kms etc) determine the sensitivity of revenue to changes in those variables.

This form of regulation recognises that DNSPs costs are not 100% fixed nor 100% variable. It attempts to adjust regulated revenue to track the underlying costs of supply. The hybrid approach provides greater earning certainty to DNSPs, however underlying prices will still vary depending on output levels and an error correction mechanism is required to adjust for revenue under or over recovery resulting from sales volume fluctuations.

Under the Hybrid Revenue Cap, the maximum allowable revenue (MAR) is linked to one or more parameters that are observable cost drivers for the business, such as the DNSP's number of customers, network demand in kVA or energy sales in MWh. Though Integral Energy would strongly argue that sales in MWh is a poor cost driver of network services. The coefficients applying to the parameters determine the sensitivity of revenue to changes in those parameters. A simple MAR formula may take the form:

$$MAR = (a + bN + cM) * (CPI-X)$$

where :
N is the number of customers on the network
M is the peak demand on the network kVA
a is a fixed coefficient
b is the average long run marginal cost of adding an additional customer

[2] Office of the Regulator General (ORG), *Electricity Distribution Price Determination*, 2001-2005.

c is the average long run marginal cost of adding a kVA of system capacity

If the coefficients are correctly specified the result is the textbook competitive outcome - marginal revenue equals marginal costs. As is discussed in detail below, this "competitive outcome" may be an artificial construct that is not supported by efficient pricing, neutral investment incentives and competitive behaviour.

There is typically great difficulty in reaching agreement on the parameters to incorporate in the MAR equation. Fixed parameters are chosen which requires a significant amount of averaging. The other major limitation is that the coefficients for the volume parameters are set at the start of each regulatory period. They are therefore static and unresponsive to the change in the mix of costs associated with an expanding network. In reality, the cost functions of each DNSP will be a step function, where the cost of adding additional capacity to the network is not linear, it depends on the customer type, scale, location and scope of the expansion. In the past application of the Hybrid (in the 1996 IPART Determination) parameters were adjusted regularly and this reduced certainty.

Integral Energy has considered the options presented by IPART and the criteria it has put forward. A summary of the findings is included in the table below, with a tick given when it is believed the criteria is met in most circumstances. The WAPC is clearly the most favoured contender for further examination in the consultation process.

Summary of options

	Revenue Cap	Hybrid Revenue Cap	WAPC	Revenue Yield
Price efficiency	x	x	v	x
Demand management	x	x/?	v	x
Pricing strategy / flexibility	x	v	v	v
Revenue certainty (volume risk)	v	v	v	x
Forecasting risk	x	v	-	x
Investment incentive	x	- / v	v	-

3 Integral Energy proposal

Integral Energy strongly supports the principles of a tariff basket or Weighted Average Price Cap (WAPC) form of economic regulation. This form entails the regulator setting a maximum weighted average price per kWh of electricity for each 'basket' of services. The regulator would also set a CPI minus X formula for adjusting the weighted average prices in each subsequent year of the regulatory period.

To calculate the weighted average price the regulator applies a weight to each individual price category and then sums these weighted prices in order to calculate the weighted average price to be charged. The weight is usually based on estimates (forecasts or rolling historic weights) of the volume to be sold in each price category. It may also be possible to use the revenue collected from each tariff to weight the basket, rather than the volume or quantity sold under each tariff.

The ORG has adopted a form of WAPC, termed its "tariff basket approach". Integral Energy supports many of the parameters of the Victorian approach.

The following arguments are made by Integral Energy in support of the WAPC approach:

- It creates incentives over time to move towards efficient and cost reflective network prices. In order to achieve efficient prices, the weights need to be proportional to the quantities that would be sold at efficient prices. There is a direct link between revenue and tariff structure.
- It has strong incentives to reduce costs by maximising scale efficiencies, a better incentive than the blunt instrument created by revenue caps where cost reductions are encouraged that may lead to reduced reliability.
- Customers have price certainty and stability.
- It reduces volume risk as it links marginal cost and marginal revenue.
- It reduces or eliminates reliance on volume forecasts and correction mechanisms as well as the regulatory workload associated with these elements.
- It has the potential to provide incentives for demand side management by promoting efficient pricing.

3.1 Detailed proposal

It is not possible to separate out the question of the general form of price control from the specific formulation of the control. Whatever form of regulation it intends to adopt IPART must publish, in sufficient time to allow for meaningful evaluation and comment, a detailed proposal of how the approach is to be implemented. The proposal should outline how the form of regulation will operate in practice, highlighting any differences from the current price control arrangements.

The proposal must deal with all transitional issues and set out a staged transition if the change over is not to be immediate. We set out below some of the issues that should be addressed in a detailed proposal for the implementation of a WAPC.

Integral Energy would support the next round of consultation on form of economic regulation being based on developing a detailed implementation plan for a WAPC. Integral Energy is happy to work with IPART in the development of this proposal as it reduces uncertainty for the industry, the regulatory institutions and the community.

3.2 Transitional issues

Numerous transitional issues will need to be addressed in the implementation plan. Most relate to transitioning from a fixed revenue cap to a WAPC. These will need to be developed in the next stage of consultation, but Integral Energy puts forward the following issues to give a flavour to the discussions.

1. In the absence of a correction mechanism under the WAPC, The over or under recovery balances at the end of the current regulatory period will need to be factored into price paths, asset values or the revenue base implied in the X factor.
2. There are presently a large number of distribution tariffs in NSW. Pricing rules and side-constraints should allow sufficient flexibility for tariffs to be rationalised.
3. It is arguable that existing tariff structures reflect the underlying fixed and marginal costs of supply. A tariff transition process will need greater attention then in the past.
4. A change in the form of regulation may require a re-examination of underlying operating and capital expenditure requirements of DNSPs, particularly if there were insufficient allowances in the previous Determination.
5. For Integral Energy, the 1999 Determination allowed insufficient capital expenditure to adequately manage the network and maintain a prudent capital replacement program. Due to the changing age profile of the network assets, the capital expenditure requirements are under constant review. IPART should consider providing more clear guidelines for defining "prudent" investment and implement a mechanism to give certainty to DNSPs that these expenditures will be rolled into the asset base and an appropriate capital return is achieved.
6. A timetable is needed to review and revise the asset base and examine the impact on the building block parameters and prices under a new form of regulation.

3.3 Implementation issues

1 Cost reflective pricing is the primary advantage of the WAPC. Without a broadening of side constraints and other pricing rules, the incentives set up by this form of regulation will be inhibited. It is therefore essential that the proposal include specific details of side constraints and other rules affecting price changes.

2 Under a WAPC, a decision will be needed on what weights will be used in the weighted average calculation. There are broadly two options:

   - Volume forecasts – this necessarily requires some form of correction mechanism that is in principle not supported; or
   - Historic data – the ORG has adopted an approach where weights are determined based on the actual quantity of each tariff component supplied during the previous year. No correction mechanism is required.

3 A question also arises as to how new tariffs are to be incorporated into the tariff basket. It is important that new tariffs can be relatively easily introduced so as not to inhibit innovation on tariff design or stifle incentives for efficient pricing and innovative demand management products. In developing the approach for introducing new tariffs the proposal will need to address:
   - how volumes sold for the new tariff should be estimated; and
   - whether a correction mechanism for new tariffs will apply, given the need to estimate volumes.
4 The precise tariff basket formula will need to be provide in the consultation phase along with how this will be applied in the context of a CPI minus X incentive regime.
5 For comparison with other form of regulation, the maximum revenue formula which underlies the form of regulation and establishes the X factor in the adjustment formula will need to be provided.
6 Certainty is also required regarding the tariff approval process and annual compliance requirements (eg. side constraints).
7 How X factors will be calculated, including the building block components, asset values, WACC adjustments, efficiency carryovers, operating and capital expenditure budgets and approvals.
8 Options need to be put forward on the incorporation of quality of services incentives in the form of economic regulation. Specific proposals will require substantial lead times to consider, evaluate and implement.
9 The proposal should contain worked examples wherever this would add to clarifying the practical implementation.

A number of these issues may at first be considered issues for the Determination process. However, Integral Energy believes that in order to give more than "in principle" support for a particular change to the form of regulation, the detailed implementation issues outlined above will need to be developed and finalised in the consultation phase on the form of regulation – prior to 1 July 2002.

4 IPART Questions

4.1 Does the mechanism provide DNSPs with incentives to set efficient prices?

Integral Energy believes that the form of regulation should provide clear incentives to price efficiently. Integral Energy considers that the role of IPART should be that of a price and service regulator. Incentives to encourage efficient tariff structures and levels are paramount issues for the regulator.

The NSW DNSPs are corporatised entities that will have been subject to revenue cap regulation for almost 10 years at the conclusion of the 1999 Determination. This period has seen DNSPs adjust to earning commercially based revenues and achieve the bulk of cost efficiencies associated with liberalisation in the industry. In the regulatory hierarchy, the next progression is to a form of price regulation that encourages efficient pricing.

To this end Integral Energy, Energy Australia and Country Energy have engaged a consultant, National Economic Research Associates (NERA), to provide an independent economic exposition of the theoretical and practical incentives provided under the form of economic regulation options. Central to this examination is the incentives provided to DNSPs in relation to efficient network pricing, demand management and efficient network investment.

Integral Energy believes there is substantial scope to make network pricing more cost reflective and that this is generally a fertile ground in electricity distribution pricing, and it should be the central focus of regulatory oversight. This will be an area where substantial efficiency benefits can be passed on to customers.

IPART have disputed that the form of economic regulation can influence the pricing behaviour of the regulated firm. Integral Energy believes that this is not the case and that the form of economic regulation is paramount in providing such incentives. The use of alternative ad-hoc schemes such as *Pricing Principles and Methodologies* creates additional, unnecessary and insufficient regulatory intervention.[3]

IPART cite Giulietti and Waddams-Price (2000) as indicating that price caps yield little evidence that this is supported in practice.[4] A close examination of this article shows that Giuletti and Waddams Price (2000) "…find very mixed evidence of rebalancing between prices within incentive price caps. Only for two industries, telecoms and gas transmission, were these changes unambiguous and in the expected direction."

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[3] IPART, *Regulation of NSW Electricity Distribution Networks: Pricing Principles and Methodologies for Prescribed Electricity Distribution Services,* March 2001.

[4] Giulietti, M. and Waddams Price, C. (2000) "Incentive Regulation and Efficient Pricing: Empirical Evidence", Centre for Management under Regulation, University of Warwick, March 2000.

The precise form of economic regulation for the business analysed is not clearly specified in the article. However, Giuletti and Waddams-Price (2000) indicate that "the most popular form of incentive regulation has been imposition of caps on average price levels". In contrast Armstrong, Cowan and Vickers (1995) report the specific form of economic (RPI-X) regulation for some of the utilities in 1995 is as follows.[5]

UK form of economic regulation

Entity/industry	Form of economic regulation
British Telecom	Tariff basket or Weighted average price cap
British Gas	Average revenue per therm
British Airports	Average revenue per passenger
Water supply companies	Tariff basket (modified)
Electricity transmission (NGC)	Average revenue per KWh
Electricity distribution (RECs)	Average revenue per KWh
Electricity supply (retail)	Average revenue per KWh

It is clear that the specific differences (and terminology) in the form of regulation are important in this debate. While each may be adequately described as a price cap, most are more accurately described as an average revenue or revenue yield cap. British Telecom on the other hand, is regulated under a tariff basket approach, or weighted average price cap (WAPC).

Integral Energy considers that the analysis of this piece of empirical literature lends support for the WAPC as the only form of regulation that drives efficient pricing incentives. This is supported by the theoretical and practical analysis undertaken independently by NERA that is attached. Extracts from the analysis are included with comments below.

4.1.1 Fixed revenue cap

A fixed revenue cap provides the DNSP with guaranteed revenue, regardless of services provided. As a result, the DNSP has few incentives to encourage any use of the network that would result in higher network costs – irrespective of whether the benefit to the consumer is greater than the marginal cost to society of that use. This is clearly sub-optimal and arises from the fact that, in economic terms:

> *The marginal revenue to the business of providing additional services is always equal to zero and is in no way linked to the marginal benefit*

[5] Armstrong, M., Cowan, S. and Vickers, J. (1995) Regulatory reform: economic analysis and British experience., MIT Press, London, England.

to consumers of the service (or to the marginal prices charged for those services). Unless marginal cost is zero or negative, marginal revenue is always less than marginal cost.

Thus, the business has a financial incentive to minimise use of the service – even if the marginal benefit to customers is greater than the marginal cost to the business of providing the service.

4.1.2 Revenue yield approach

Under the revenue yield approach the marginal revenue to the distribution business per kWh sold is equal to the regulated average cost allowance per kWh (M_t). However, simple economics tells us that distribution is a natural monopoly so marginal cost is, by definition, below average cost. This means that:

Marginal revenue (M_t) is almost certainly greater than marginal cost. Furthermore, marginal revenue is constant and is independent of marginal prices or the marginal benefit to customers of consuming the services.

This is the opposite situation to the fixed revenue cap and provides the opposite incentives for pricing. Under the revenue yield, on each extra unit of electricity sold the DNSP receives an average revenue/cost allowance. This allowance is certainly above the marginal cost of expanding a unit of output. Therefore the business has a strong incentive to price low to promote greater throughput. DNSPs would be encouraged to divert resources into expanding output. The associated demand management implications are discussed further below.

4.1.3 Weighted average price cap (WAPC)

Under a WAPC, marginal revenue is not set by the regulator but is instead equal to the price of that service. As a result, the incentive for a profit maximising firm to set marginal revenue equal to marginal cost is also an incentive to set marginal prices equal to marginal cost – ie, to price efficiently.

A stylised example can illustrate this point. Imagine a business has only a single two-part tariff with a fixed charge and a kWh charge for distribution. Also imagine that there is only a single marginal cost that is 5c per kWh and that connection to the network is completely unresponsive to prices but that marginal consumption is at least partially responsive. In this case, efficient pricing requires that the tariff structure set the kWh charge at 5c and recovers the remainder of total costs from the fixed charge. Now let the business be currently charging 10c per kWh when a WAPC is introduced.

For any given set of weights in the tariff basket the business has a clear incentive to rebalance prices such that marginal prices move closer to marginal cost on the most price sensitive services. This can be seen by noting that if there is no change in consumption patterns following the rebalancing the business will maintain the same revenue as would have been achieved under the old price structure. (This condition is effectively the definition of a WAPC – ie, rebalancing with unchanged consumption patterns must maintain the same revenue.)

However, if demand increases more for the service whose price has fallen than it reduces for the service whose price has risen then total allowable revenue will rise. Not only this, but costs will have risen by less than allowable revenues provided that prices were originally above marginal cost. This means that the business will have an incentive to lower prices on all price sensitive services to close to marginal cost (and to raise prices on less price sensitive services).

The above analysis assumes that the only impact on relative rates of demand growth is via changes in pricing. However, if a business anticipates higher exogenous rates of growth in demand for particular services than for other services then it will have an incentive to raise prices on those services growing the fastest and reduces prices on the other services. This is because the WAPC allows rebalancing on the basis that revenue will be unaffected assuming no change in consumption. Thus, the best way to increase allowable revenue when consumption patterns are changing is to raise prices on the fastest growing services and reduce prices on other services.

Whether this is consistent with cost reflective pricing depends on whether marginal cost is also rising on those services that are growing faster. It is likely that this will be the case to some extent, however, there is no reason to expect marginal cost to be rising by the same amount as it will be profit maximising for the business to raise prices.

It should be noted that the incentive to adopt cost reflective network tariff structures discussed in the previous section will always be present but that it may be "overwhelmed" in the short run by changes in anticipated exogenous growth rates. However, this is only likely to be the case in the short run. In the long run there will still be an incentive to price efficiently under the WAPC.

4.1.4 Hybrid revenue cap

The hybrid revenue cap is based on the presumption that the regulator can overcome information asymmetry and parameterise the DNSP's costs and demand conditions and clearly identify the cost drivers of the business over the review period. This task requires detailed information on the technical and allocative cost structures of the business.

Even if the regulator were able to perfectly estimate the marginal parameters in the hybrid revenue cap then this form of price control would still not provide the incentive to price efficiently. This somewhat surprising result can be seen from the fact that, if the parameters in the hybrid revenue cap perfectly reflect the marginal cost of additional units sold, then business profit will be completely independent of sales volumes. As a result, there will be no financial incentive to provide the efficient level and type of service.

In other words, by setting marginal revenue equal to marginal cost, the hybrid revenue cap makes the business financially indifferent between selling more or less of the services. As a result, there is no financial incentive to set prices equal to marginal cost and hence promote efficient use of the network[6].

The above analysis assumes that the regulator is successful in setting the (marginal revenue) parameters of the hybrid regime equal to the true marginal cost. It is therefore critical to examine the implications of the regulator incorrectly estimating the hybrid (marginal revenue) parameters– either above or below marginal cost. This is relatively simple to analyse as:

- if marginal revenue is set above marginal cost the business has an artificial regulatory incentive to expand output above optimal levels – exactly as is the case with the average revenue yield form of price control. In other words, the business has an artificial incentive to price less than cost; or
- if marginal revenue is set below marginal cost the business has an artificial regulatory incentive to contract output below optimal levels – exactly as is the case with the pure revenue cap. In other words, the business has an artificial incentive to price above cost.

This suggests that, as regards incentives for pricing, the hybrid revenue cap at best creates an indifference by the business. However, in general it will create an incentive for inefficient pricing – whether this incentive is for low or high prices will depend on whether regulatory marginal revenue for each service provided is above or below marginal cost.

4.2 Is the mechanism unbiased in relation to demand management?

The appropriate role of a DNSP in relation to demand management (DM) is to provide network services in the least cost manner. This may be undertaken by network augmentation if the network is congested, shifting demand to less congested period (perhaps through pricing), or providing alternatives options to meet the demand (for example, through gas fired heating). The responsibility of the DNSP is to choose which is the least cost approach.

Efficient network pricing will allow DNSPs to invest appropriately in network augmentation and will discourage excessive investment. This is the essential role of network businesses in DM as it internalises the external cost of excessive investment in network prices.

Other aspects of DM, such as the environmental cost of electricity generation and cost of excessive investment in generation are costs associated with the retail and generation sectors. These costs need to be internalisd in the energy component of end-user tariffs, not in the network component. The reason is that the retail and generation sectors are either directly responsible or best capable of knowing and managing these costs.

[6] Ironically, there is an incentive to cut costs by abolishing any pricing strategy operations within the firm – given that profits are no longer linked to prices/sales.

In the Discussion Paper, IPART state that:

> *"The Tribunal notes that in choosing one form of regulation over another, there may be a direct trade-off between pricing efficiency and demand management, in that the options that provide incentives for pricing efficiency for network services are biased against demand management and vice versa." (p 13)*

Integral Energy strongly opposes this view. It believes that efficient network pricing is entirely consistent with the demand management role of DNSPs. Efficient network pricing will provide dynamic signals to customers regarding the cost of their network usage. It will also provide feedback to DNSPs for efficiently allocating resources in expanding or enhancing the network.

The imposition of non-network DM costs on DNSPs creates an artificial construct and will distort prices and network investment decisions. If the private cost of energy use differ from the social cost because of environmental externalities a form of tax on energy use may be considered. An extensive literature on pollution taxes exists as a means to addressing these issues. From a public policy perspective, it is considered that the form of economic regulation is an inefficient and inequitable mechanism to address these concerns. For example, a form of regulation that discourages off-peak electricity use will create perverse signals for energy consumption when the environmental cost of electricity generation does not vary with network congestion.

We also note that IPART's determined focus on tariff reduction (within the CPI minus X framework) in itself has a detrimental impact on DM outcomes. A discussion of DM by the regulator must deal with the relationship between peak and off-peak energy consumption and network congestion.

As a means to addressing DM, IPART have proposed an "E factor" which penalise revenue when sales are above forecast. Integral Energy strongly opposes the use of an "E factor" in the price/revenue cap formula. This would create an even more perverse result than does the unders and overs account. The use of an E factor would diminish the revenue link essential to a price cap and would constrain DNSPs from funding growth related capital expenditures.

Each form of economic regulation has implicit incentives in relation to DM which hinge upon the incentive each form provides in relation to efficient network pricing. As discussed above, Integral Energy considers that in the context of a network business, efficient network pricing provides the necessary and sufficient outcome in relation to DM and will discourage excessive investment in the network.

Each form of economic regulation is considered in turn.

The fixed revenue cap, which presently operates for DNSPs in NSW, is seen as creating positive (or at worst neutral) incentives in relation to demand management. Under the fixed revenue cap the network revenue received by DNSPs is fixed, profit is maximised by reducing the costs associated with running the network. If this can be achieved by reducing demand on the network then it is to the clear advantage of the DNSP.

In terms of pricing outcomes, under a fixed revenue cap the DNSP is encouraged to price inefficiently in order to reduce demand. That is to price high where demand is elastic (to reduce demand) and low where demand is inelastic. The incentives promote excessive DM and under investment in the network.

The revenue yield cap has particularly poor incentives in relation to DM. The revenue yield cap sets the marginal revenue per kWh received by the DNSP equal to the estimate of the average cost per kWh. This results in a strong incentive to maximise sales where the marginal revenue received is greater than the marginal cost of expanding output to that customer. The DNSP is encouraged to price below marginal cost in order to achieve this.

The incentives for DM surrounding the hybrid revenue cap depend on the coefficients included in the maximum allowable revenue MAR formula associated with the cap. If, as widely intended, the coefficients represent marginal cost, then the DNSP will always receive a marginal revenue equal to the marginal cost of expanding demand. Therefore, few incentives exist for the DNSP to price efficiently, and to the extent that the marginal cost coefficient accurately reflects "marginal cost", the DNSP will be neutral in relation to expanding output because it will be compensated in it's MAR allowance. The incentive form DM is potentially low.

If IPART incorrectly estimate marginal cost in the MAR coefficients, then there are strong incentives for inefficient pricing and the community will end up with either too much or too little DM:

- if estimated marginal cost is too high then there is an incentive to price inefficiently low, providing similar incentives for DM to the revenue yield; and
- if estimated marginal cost is too low then there is an incentive to price inefficiently high, providing similar incentives for DM to the fixed revenue cap.

Under the weighted average price cap, the DNSP has a strong incentive to adopt efficient pricing over time. The reason is that marginal cost pricing will maximise expected profits and minimise profit risk.

In the long run, pricing below marginal cost under this form of regulation will result in the DNSP losing money on the increased network services as clearly the marginal revenue it receives will be less than the marginal cost. The DNSP does not have an incentive to sell more electricity in peak periods because this increases capital expenditure costs, and these will need to be factored into peak period prices.

Similarly if prices are above marginal cost there is an incentive to increase output via rebalancing that reduces prices where demand is most responsive (volume charges) and increases prices where demand is least responsive (fixed charges).

It is conceded that if rolling past year quantity weights are used to weight the average price cap, there is some incentive for the DNSP to raise prices on the tariffs that have the fastest growing demand. This may or may not be efficient depending on whether marginal cost is also rising with demand. Using revenue weights rather than quantity weights may reduce this incentive. Regardless, in the long run, DNSPs will still have the incentive to return to marginal cost pricing and will be unbiased in relation to DM.

Demand management (DM) incentives

	Too little DM	Too much DM	Efficient DM
Fixed revenue cap		√	
Revenue yield	√		
Hybrid revenue cap	√	√	
Weighted average price cap			√ (long run)

Based on this analysis it is clear that any perceived DM biases with a price cap are unfounded, and that a WAPC encourages efficient DM and discourages excessive investment in the network.

4.3 Does the mechanism provide flexibility in pricing design?

Clearly it is desirable for DNSPs to have flexibility to introduce new tariffs and rationalise existing tariffs over time. A rudimentary assessment of existing tariff structures for NSW DNSPs indicates that the split between the fixed and variable component of tariffs is not aligned with fixed and marginal (forward looking) costs of the DNSP's networks.

At present the primary obstacles to tariff structure reform are the side constraints contained in the 1999 Determination.

IPART's current Determination sets out limits on price movements (otherwise known as side constraints), that the distributors are required to adhere to. The 1999 Determination states that:

- average prices across the network are not to increase by more than the Consumer Price Index (CPI); and
- increases in the standard periodic bill of any residential customer (including rural), for the same pattern and volume of demand, must not exceed the bill for the corresponding period of the preceding year by more than the greater of CPI plus 2 per cent or $30.

The second constraint, limiting the increase in the bill of *any* residential customer, represents the greatest burden. It prevents DNSPs from effectively and efficiently managing network pricing, specifically restricting their ability to:

- reform existing tariffs into charges that signal the economic cost of service provision; and
- re-balance tariffs to remove historical cross-subsidies between customer groups.

It is clear that there are significant transitional issues associated with a re-balancing of network tariffs. An overnight move to "efficient" tariffs is likely to involve substantial increases in fixed charges and a restructuring of variable charges to reflect network congestion costs. The regulator in conjunction with the government may need to consider transitional subsidies in order to smooth tariff changes and address equity concerns.

Integral Energy considers that transitional arrangements such as these will be to the long-term advantage of the electricity supply industry and the economy in general. Side constraints are diminishing the efficiency gains associated with the restructuring and liberalisation of the industry. It is strongly contended that electricity network tariffs are not the most efficient means of addressing equity concerns and that direct income subsidies are more appropriate.

Setting aside the issue of side constraints, it is true that under a fixed revenue cap or a hybrid revenue cap, it is easy (for the regulator) to incorporate new pricing structures under the cap. Under these forms of regulation, it is the DNSP who must manage the revenue risk associated with forecasting customer volumes under the alternate tariff structures.

This would not necessarily be the case under the WAPC. To some extent the regulator would need to be involved in the introduction of new tariffs. The informational requirements are however, unlikely to be greater than what is presently applied by IPART in relation to 1 July tariff changes and demand forecasts.

Integral Energy considers that the ORG have adequately addressed the role of volume forecasting in the introduction of new tariffs in the WAPC or tariff basket regime[7]. Integral Energy agrees with IPART that the use of fixed weights in a price cap makes price structures rigid, but we contend that the use of rolling historic weights in a price cap, combined with volume forecast for new tariffs, represents a workable solution in the use of the WAPC.

Moreover, constraints on price flexibility create unnecessary earnings risk for the DNSP, particularly under the WAPC form of economic regulation.

In the past, ORG utilised a revenue yield cap that involved updating volume forecast on an annual basis. Because forecasts were to apply over the entire revenue base of the Victorian DNSPs, an error correction mechanism was applied to handle forecasting error. Largely because volume forecasts were addressed on an annual basis (rather than on 5 yearly

[7] Office of the Regulator General, *Electricity Distribution Price Determination 2001-05*, September 2000.

determination basis) Victoria did not end up with an unders and overs account problem which presently exists in NSW.

One of the distinct advantages of a WAPC that is based on rolling historic weights (say quantities one or two years prior), is that it does not require an error correction mechanism. As has been demonstrated, an error correction mechanism is often introduced to rebalance risks or deter gaming in forecasts. The difficulty is that it creates perverse incentives and can result in an uneconomic price path. Under the WAPC, the forecasting risk would only apply to new tariffs and would therefore be significantly reduced.

If a structured forecasting arrangement can be established between IPART and the NSW DNSPs it is believed that complexities associated with the introduction of new tariffs can be significantly reduced. In this context, contention over forecasting errors or gaming are likely to be minimal compared with those which are inevitably addressed by IPART in setting the building block parameters which underlie each form of regulation.

A proposal for the WAPC form of price control would have to very specifically set out how new tariffs will be incorporated and how, and what, side constraints will be applied. Rules that inhibit price flexibility are the greatest threat to the efficient operation of WAPC mechanisms.

4.4 Do customers or the DNSPs bear the volume risk?

The appropriate sharing of volume risk is of considerable concern to DNSPs and to customers of the network businesses. It is important however, to delineate between two aspects of volume risk – regulatory “volume” risk and commercial volume risk.

4.4.1 Regulatory “volume” risk (or capital expenditure risk)

In the CPI minus X regulatory environment, IPART makes a judgement about the use (both quantity and quality aspects) of the network over the Determination period. This judgement is embedded in the cap and reflected in the X factor. In this environment, it is contended by Integral Energy that the DNSP will always bear this aspect of “volume” risk. If the regulator incorrectly forecasts the capital and operating requirements of meeting the total demand on the network, the risk of windfall gains or losses is imposed on the DNSP.

This type of volume risk is not associated with marginal changes in network demand or demand for new connections. Regulatory volume risk arises because of information asymmetry between the regulator and the DNSP in not allowing sufficient costs to be included in the building block revenue to adequately manage and update the network. Integral Energy’s present situation in which it has “over spent” its capital expenditure allowance in the 1999 Determination is clear example of regulatory volume risk.

Regardless of which form of regulation is adopted this risk will always be imposed by the regulator on the DNSP. It highlights one of the critical aspects of regulatory risk under a CPI minus X regime that must be carefully managed during the development of the Determination.

None of the alternative forms of regulation currently under consideration would give DNSPs absolute assurance that actual capital expenditure incurred would be included in allowed revenue during the regulatory period where this expenditure exceeds forecasts made at the time of the Determination. Both Integral Energy and Energy Australia are experiencing this problem under the current Determination.

There are two approaches to eliminating this risk.

Reopening of the determination during the regulatory period

A mechanism that would trigger a reopening of the determination (regardless of the form of regulation) if actual expenditure differs from the forecasts expenditures which go to making up the underlying building block components of the Determination by more than an allowable margin.

Integral Energy believes that the building blocks in the 1999 Determination were insufficient in its allowance for capital expenditure. Given the age profile of existing assets and the capital replacement program, we believe there is a substantial risk that this situation could arise in the next Determination. Hence the suggestion that narrowly defined mid-term review of capital replacement expenditures could be adopted.

There is considerable regulatory risk attached to this approach and it is generally inconsistent with an incentive-based form of regulation. The mechanism would have to be symmetrically applied, that is, actual expenditure less than forecast would also trigger a reopening of the determination. Under current arrangements a reopening puts at risk all elements of the determination. For example, the regulator may use the opportunity to revise downward the rate of return if market parameters have changed since the determination was made.

A process to confine a mid-term review (or reopening) of the Determination to capital expenditure that incorporates a prudence test would facilitate the reduction of this risk.

A hybrid form of regulation that incorporates actual capital expenditure in a hybrid equation (rather than a surrogate driver)

This approach would essentially remove capital expenditure from the CPI minus X regulatory regime. Up until now economic regulation has been developed in an environment of cost cutting and productivity improvement. The regulator's approach has been driven by the need to remove 'gold plating' from capital investment.

It may be time to consider whether this period is nearing its end, whether most of the cost reductions have been achieved and whether considerations such as service, reliability and the environment are becoming more important than further cost reductions. There is a clear conflict between further cost reductions on the one hand and service, reliability and environmental considerations on the other that cannot easily be resolved through a CPI minus X form of incentive regulation.

This conflict would be largely removed under a hybrid approach that allows actual capital expenditure.

Instead of being subject to the CPI minus X regime, capital expenditure would be subjected to a separate prudence test. This approach would be consistent with work being done by IPART to develop a prudence test as part of its demand management code. Once it has passed the prudence test capital expenditure should be included in allowed revenue and not subjected to a further efficiency regime.

Whilst this is a sound and supportable argument, the removal of capital expenditure from CPI minus X regulation may be contrary to current Code requirements. Whilst this approach may be 'ahead of its time' for the current review it will ultimately re-emerge and it is worth considering how best to progress the debate. At this stage Integral Energy supports the first option, that of defining a mid term reopening of the determination to address capital expenditure forecast to address this risk.

4.4.2 Commercial volume risk

Commercial volume risk arises where marginal revenue to the DNSP is different from marginal cost. This type of volume risk can be influenced by the form of economic regulation – any pricing control formula that links marginal revenue and marginal cost reduces volume risk to the DNSP.

Month-on-month and year-on-year changes in demand for network services are difficult to forecast 5 years out. Therefore, a form of regulation that allows the DNSP to manage this risk is preferred.

Fixed revenue cap regulation can place significant volume risks on the DNSP, as its marginal revenue from a change in volume is equal to zero. If the total revenue allowed is inadequate, the lack of an automatic price/revenue adjustment formula means that the DNSP is exposed to all cost changes related to increased demands for network services, particularly with the impact of the unders and overs account on network prices.

Under the revenue yield approach, the DNSP receives an average revenue allowance. In most circumstances this will be different from marginal cost. It will therefore impose significant volume risk on the DNSP and encourage inefficient (and perverse) pricing outcomes, discussed above.

Both the hybrid revenue cap and the WAPC achieve a situation where marginal revenue will equal marginal cost in the long run. However, this will only be achieved under the hybrid revenue cap if the regulator sets the parameters correctly. Experience in the past suggests that there is much contention with the choice and level of the parameters. Over time, with adequate allowances for rebalancing tariffs, only the WAPC gives DNSPs the means and the incentives to minimise volume risk. This will be achieved by efficient pricing (reflecting forward looking marginal costs in variable tariffs).

It is clear however, that volume risk is a not a cost under the CAPM because it is diversifiable and that a changing allocation of risk should not be associated with a WACC adjustment.

As a general rule risk should be allocated to parties in relation to their ability to manage that risk. Risk allocation under the various forms of regulation is as follows.

Risk sharing under each form of regulation

Form of regulation	Who bears the volume risk?	The DNSP has certainty of:
Revenue cap	Customers	Revenue
Revenue Yield	DNSP	Price
WAPC	Shared	Price and Earnings *
Hybrid	Shared	Earnings

* Assuming tariffs reasonably reflect marginal costs. Otherwise earnings certainty is reduced.

Regarding the allocation of risk it is worth noting that under revenue yield and WAPC approaches both DNSPs and customers have reasonable price certainty. Customers are better placed to manage risks attached to the cost of electricity supply where they have certainty of price.

Uncontrollable cost changes need to be addressed at the time of regulatory resets, when imbalances can be corrected and efficiency gains passed on to customers to achieve or mirror a competitive market. DNSPs should be allowed to retain efficiency gains for a period in order to reward effort before competition is allowed to compete away the gains. The period over which gains are maintained is a point for further discussion.

Most price cap regimes in the UK, allow for certain uncontrollable cost elements to be passed on to customers. There is obvious merit in allowing a pass through of uncontrollable cost changes, but if it is carried out in an asymmetric manner the DNSP may be exposed to more, rather than less risk. The regulator may use discretion in order to extract perceived super normal profits in good economic cycles, but not allow the pass through of unavoidable cost changes (such as full retail contestability).

Any pass through formula would therefore need to be formalised in the Determination.

4.5 How critical are accurate forecasts?

Generally, accurate forecasts are important regardless of the form of regulation. The following points deserve consideration:

- It is preferable to avoid mechanisms that require the regulator to determine volume forecasts. Regulators do not have sufficient information to develop accurate forecasts and will tend to err on the side of conservatism, often to the detriment of the DNSP.
- The nature of forecasts is that they will always vary from actual results. By implication, a mechanism that relies on volume forecasts will require some form of correction mechanism, such as under/over recovery accounts. Much of the difficulty being experienced with the current revenue cap can be ascribed to the correction mechanism.
- On the other hand, a mechanism that relies on forecasts presents opportunities for DNSPs to exploit the information asymmetry that exists with the regulator. The opportunities to use forecasts as a strategic tool is lost under forms of regulation that rely on historic data. There are obvious risks attached to strategic forecasting and IPART has flagged the possibility of introducing penalties for inaccurate forecasts in the style of the UK regulators. This is opposed by Integral Energy due to the inherent uncertainty associated with forecasting.

The ORG's tariff basket approach reduces the reliance on forecasts by adopting rolling historic data as a surrogate for volume forecasts. In essence the adoption of a WAPC allows the regulator to review the accuracy of cost forecasts and efficiency gain issues at the time of regulatory resets.

In the Discussion Paper, IPART state that:

> *"There are reasons why hybrid revenue cap may prove to be complicated at the time of the regulatory reset. Issues arise at to which parameters to use, or the precise definition to adopt. For example, is a customer measured by the number of electricity accounts, persons or households? Further, marginal cost is difficult to specify and the coefficients will inevitably include a measure of guesswork. In the Tribunal's experience, it has been difficult to obtain agreement on the construction of the MAR formula." (p 15)*

Under the hybrid cap, mixed parameters are calculated that require a significant amount of forecasting and averaging. In reality, the cost functions of each DNSP will be a step function which is difficult to forecast and impossible to implement in a regulatory formula. A workable hybrid would have the parameters adjusting regularly, which creates regulatory burdens and uncertainty.

This situation is contrasted to the WAPC, where utilities have control (and the associated risks) of commercial forecasting. In order to reduce risk they aim to reflect the stepped cost function in network tariffs. This creates less regulatory burden, but price flexibility is required in order to increase certainty.

4.6 Is there an effective mechanism for reconciling forecasts and actual volumes?

An approach that seeks to use network prices as a means to reconciling forecasting error can create perverse price paths for network services. Network pricing becomes an output of the regulatory parameters, rather than based on the cost of service provision. Under the current Determination the unders and overs account is used to penalise DNSPs for at best, poor forecasting, or at worst, lack of perfect foresight. It has created the present distortions in network prices that are not based on cost or productivity differentials between DNSPs, but are a function of IPART's regulatory scheme.

Apart from the WAPC, each form of regulation proposed would require an error correction mechanism similar to the unders and overs account that operates under the present fixed revenue cap. As has been demonstrated, particularly by Energy Australia, the rules of the unders and overs account, rather than those under the Determination drive the price path generated under the fixed revenue cap.

DNSPs are now seeking more incentive-based regulation that is based on fixed parameters and formula. Mechanisms that seek to *ex post* reconcile forecasting errors add to regulatory uncertainty. When it comes to sharing efficiency gains or passing on uncontrollable costs, ex ante mechanisms combined with 5 year regulatory resets should provide adequate opportunities to ensure any benefits are shared between DNSPs and customers.

4.7 Is the mechanism (and any formula it involves) easy to understand?

It is difficult to assess the options against a simplicity criterion without knowing the detail of how the mechanism will be applied. All of the approaches could be made complex and clumsy in implementation. Complexity should not be seen as a disadvantage in itself. The economic regulation of network businesses is a complex area and it may be naive to seek a simplistic solution. Any methodology, no matter how complex, can be broken down into logical steps.

It is important, particularly where a complex approach is adopted, that IPART develop the approach in sufficient detail in advance of it being adopted so that its application can be understood and all transitional and practical issues can be identified.

4.8 Does the mechanism require the cap to be reset each year?

This discussion again boils down to a price, revenue and earnings risk. Integral Energy and Energy Australia, by incurring capital expenditure in excess of those forecast at the last Determination, are experiencing the adverse effects of a cap set for the duration of the regulatory period.

Under a hybrid approach it may have been possible to recover some of this additional expenditure during the revenue period. Whether revenue would have increased in proportion to the additional expenditure would have depended on whether the drivers adopted in the hybrid MAR equation accurately reflected capital expenditure. This was not the case under the previous hybrid approach used by IPART.

5 Integral Energy questions

Beyond the issues raised by IPART, Integral Energy would like to put forward its own questions to promote discussion and consultation on the issues it sees as key in this debate.

5.1 Does the mechanism provide adequate funding for the DNSP to invest in the network?

Investment in the network is required to address a number of issues, including:

- growth in system demand and connections
- reliability maintenance
- reliability improvement
- capital replacement program

Under the various forms of economic regulation these are (or should be) treated in different ways. This in itself creates difficulties because capital expenditure may serve multiple objectives and can be difficult to allocate.

In this context, it is worth considering the current position of each NSW DNSP in relation to their capital expenditure allowance under the 1999 Determination. Note that the capital expenditure allowance under the existing fixed revenue cap does not seek to delineate expenditures based on their purpose. The current situation sees:

1. Energy Australia (EA) having significantly over-spent its capital expenditure allowable under the 1999 Determination. It is understood that a significant portion of this expenditure is growth related.
2. Integral Energy has also significantly over-spent its capital expenditure allowance. This is in part growth related, but is primarily related to the essential capital replacement program required to maintain the network. This allowance for this program was clearly insufficient in the 1999 Determination.
3. Country Energy has significantly under-spent its capital allowance. The likely cause of this situation was an overly generous forecast of capital expenditure in the 1999 Determination.

By adopting a fixed revenue cap, IPART has imposed considerable risks on the DNSPs. EA and Integral Energy have had to over-spend on their capital allowance in order to satisfy growth-related demand. The current over recovery by EA and its recent network price movements serve to illustrate the problems with the fixed revenue cap, but what is more concerning is that the need to fund capital investment associated with demand fluctuation has not been allowed for under the Determination. This has created the potential for a deterioration of shareholder value.

Integral Energy believes that each of the other options for the form of regulation would, in part serve to address this issue. Under the revenue yield approach the DNSP would fund capital requirements via the average cost allowance provided under the cap. The coefficients on the growth parameters in the hybrid revenue cap should cover the incremental cost of investing. Under the WAPC, the funding comes from the marginal revenue collected (based on the network tariffs) from the unexpected increase in demand.

Integral Energy also believes that the WAPC offers the best mechanism for funding necessary (growth related) investment, because it is based on the revenue collected on the network tariffs. It will allow DNSPs to structure tariffs to collect enough revenue to fund capital expenditure when the customer signals that their willingness to pay is greater than the incremental cost of investing in the network (efficient pricing signals is discussed in more detail above). The revenue yield approach offers only an "average" allowance and will send a weaker signal on efficient network investment. Similarly, the hybrid revenue cap puts the investment funding decision largely in the hands of the regulator who is likely to face information asymmetry. Moreover, the fixed nature of the coefficients in a hybrid is likely to stifle innovation and the pursuit of the least cost investment alternative.

What none of the forms of economic regulation will provide is a correction mechanism where the capital expenditure allowance under the Determination is insufficient (or surplus) to fund investment in reliability improvements and the capital expenditure replacement programs of the network. These are issues which need to be addressed in establishing the building block revenue (or X factor) which underlies each form of regulation option.

For Integral Energy, the 1999 Determination allowed insufficient capital expenditure to adequately manage the network and maintain a prudent capital replacement program. Due to the changing age profile of the network assets, the capital expenditure requirements are under constant review. IPART should consider providing more clear guidelines for defining "prudent" investment and implement a mechanism to give certainty to DNSPs that these expenditures will be rolled into the asset base and an appropriate capital return is achieved. At present the rules are unclear, and the five year period between regulatory resets creates considerable uncertainty. IPART might also consider a mid-determination capital expenditure prudence test to reward capital expenditure needed to maintain the integrity and reliability of the network.

5.2 Does the mechanism provide incentives to improve operating and maintenance expenditure?

Under a fixed revenue cap there is a strong incentive to reduce cost within the current volume sold, but there is no incentive to pursue efficiencies related to the expansion of volumes.

Under price cap approaches there is a strong incentive to maximise scale efficiencies. This would ultimately lead to lower prices to customers and would represent more desirable behaviour from the point of view of retaining system reliability and quality of supply.
As discussed further below, the regulatory cycle appears to be moving on from a single-minded focus on cost cutting. The community, regulators and the industry are becoming more aware of

the links between service and cost. The level of service demanded by the public requires further examination, and benchmarks need to be set.

Using those as a starting point, the industry and the regulator should seek to agree on operating and capital expenditure plans to meet those benchmarks. The level of the debate has moved on from blunt incentives to reduce costs and broad service/cost relationships. Integral Energy would support the development of a process to incorporate greater linkages and regulator support for service level and operating and capital expenditure level relationships in the form of regulation consultation.

5.3 Does the mechanism allow for the recognition of service and reliability standards?

It is perhaps cause for concern that the linking of prices and quality of service is not addressed in IPART's discussion paper. IPART's main focus to date has been on cost and price reduction. If the link between price and service is not recognised, there is no incentive to enhance the level of customer service. In the long run this can lead to inefficient investment and deterioration in network quality.

All of the forms of regulation under consideration would allow for a link between price and service to be established. IPART is encouraged to address this as part of its review.

Integral Energy is presently participating in a number of internal and external forums on service and reliability. As discussed, this is believed to fundamental to IPART's role as a price and service regulator. Integral Energy believes there are strong linkages between price, cost and service levels, and that the form of regulation may be a viable mechanism to provide incentives to DNSPs in this regard.

5.4 Is there still merit in a CPI minus X form of economic regulation?

The electricity supply industry seeks to promote the operation of its networks in the most efficient and commercial manner possible. Pricing is fundamental to the efficient use of electricity distribution infrastructure. It is in the interests of network users in particular, and the national economy in general, that commercially driven decisions be made about maintaining existing infrastructure, and building new infrastructure.

Another objective is the protection of customers. The form of economic regulation arrangements should aim to protect network users from any potential abuse of market power by DNSPs.

Because of the inherent monopoly characteristics of electricity networks a more involved regulatory arrangement is required for electricity distribution then elsewhere in the economy. Distribution networks have clear natural monopoly characteristics. Though the tendency towards natural monopoly arises from efficiency benefits (one network can provide services more efficiently than two can), it inevitably reduces potential competitive pressures. However, the extent of market power of a particular network in practice will depend on a range of factors including:

- the price responsiveness of customers;
- the mobility of network users;
- the cost structures of suppliers to the network business;
- the share of network charges in the total electricity bill; and
- network substitution possibilities (eg. embedded generation and alternative forms of energy such as gas).

Over time these factors change and should be monitored by IPART with a view to less intrusive forms of regulation.

DNSP's electricity network charges are presently subject to a CPI minus X revenue cap. Embodied in the CPI minus X structure are implied productivity improvements, a building block of "efficient" operating and capital expenditures and a risk adjusted return.

The current framework involves substantial economic regulation and a major regulatory influence on the operations of the DNSPs. Integral Energy believes the arrangements have encourage IPART to move on from being a price regulator (as envisaged by the Code and the IPART Act) to attempt becoming an operational or functional regulator.

CPI minus X is at the heart of this problem. Littlechild (1983) "tariff reduction scheme" as it was originally termed, focussed regulators on achieving the efficiencies associated with liberalisation and privatisation of utilities through the form of regulation.[8] It is highly questionable whether tariff reduction should remain as the most prominent focus for the regulation of network charges as most efficiency gains have been achieved. In addition the CPI minus X regime combined with a fixed revenue cap has led to under investment in the network that will need to be addressed by the industry in future years and factored in to regulatory decisions.

Integral Energy is seeking a more light-handed regulatory regime from IPART, which offers the business commercial latitude. It seeks a price path which is not based on a cost cutting regime, but one with attention to the real costs of maintaining and operating a network with acceptable reliability and supply qualities.

While it is argued that the DNSPs costs are largely fixed and therefore their revenue should be fixed, this misconception can result in very heavy-handed regulation to the detriment of innovation. Almost all infrastructure business (including listed Australian companies) would have the majority of costs fixed in the short run. A move to a WAPC is seen as the first important step toward price regulation.

[8] Littlechild, S. (1983) Regulation of British Telecommunications Profitability, London, HMSO.

Integral Energy has a long-term vision that IPART will move on to a price monitoring role for electricity network charges, rather than remain with an entrenched regulatory position of tariff-reducing regimes. A period of price regulation is clearly justified, but this should move gradually to a price monitoring or oversight role.

EFFICIENCY PROPERTIES OF THE FORM OF PRICE CONTROL

A Report for Integral Energy, EnergyAustralia and Country Energy

Prepared by NERA

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Sydney

Project Team:
Tom Hird
Greg Houston
Ann Whitfield

n/e/r/a

National Economic Research Associates
Economic Consultants

Level 6, 50 Bridge Street
Sydney NSW 2000
Australia

Tel: (+61) 2 8272 6500
Fax: (+61) 2 8272 6549
Web: http://www.nera.com

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1. INTRODUCTION

1.1. Purpose

This report analyses the incentives for efficient pricing and demand management under various forms of price control for electricity distribution businesses. This analysis is in the context of the Independent Pricing and Regulatory Tribunal of New South Wales' (IPART) August 2001 discussion paper on the Form of Economic Regulation for NSW Electricity Network Charges. In that discussion paper IPART identifies four forms of price control:

- the pure revenue cap;
- the revenue yield cap;
- the hybrid revenue cap; and
- the weighted average price cap.

In this report we analyse the impact of each of these forms of price control on the incentives for distribution businesses to:

- price their services efficiently; and
- promote appropriate levels of investment in demand management.

We also analyse the impact of each of these forms of price control on the sensitivity of regulatory profits to errors in demand forecasts used in setting the price/revenue path over the regulatory period. In addition we discuss whether any such variability imposes costs on businesses.

1.2. Structure and summary of the report

This report has the following chapter structure. Chapter 2 – defines the meaning of "efficient prices" and "efficient incentives for demand management". We conclude that:

- efficient pricing of distribution capacity requires that prices should as far as possible reflect the marginal cost of customers using the network – subject to a cost recovery requirement;
- any divergence between prices and marginal cost necessary in order to meet the cost recovery requirement should be largest for those services that are most unresponsive to price ("Ramsey" pricing);

- efficient prices for the use of distribution capacity by definition provide efficient incentives for demand management of distribution capacity as a substitute for additional network augmentation. To the extent that there are any (environmental) externalities associated with *energy* usage then it is inefficient to attempt to account for these through the form of price control associated with the sale of *distribution capacity*.

- marginal cost pricing of distribution capacity has the potential to deliver substantial economic benefits to society.

- there is no single marginal cost of distribution capacity usage. Rather, the marginal cost of distribution capacity usage depends on location, time of use, and type of use. Efficient pricing requires that, where practical, these variations be reflected in tariff structures that include: fixed charges, time of use energy/demand charges and maximum kW/kVA charges; and

- the ability to impose such tariff structures may be constrained by available metering data. In which case, efficient tariff structures require a trade off between providing too little and too great an incentive to use system capacity.

Chapter 3 – describes each form of price control and the associated incentives for efficient pricing/demand management. We conclude that:

- the pure revenue cap creates strong incentives for inefficiently high prices;

- the revenue yield cap creates strong incentives for inefficiently low prices;

- the hybrid revenue cap does not provide an incentive for efficient pricing and will often provide incentives for inefficiently high/low prices depending on the parameter estimates used; and

- the weighted average price cap provides long run incentives for efficient pricing. These incentives may be distorted by short run differentials in demand growth rates for different services.

Chapter 4 analyses the impact of each form of price control on variability of return on capital with respect to forecasting errors. We conclude that the sensitivity of ex ante return on capital to forecasts of demand growth at the beginning of the regulatory period:

- is low under the pure revenue cap to the extent marginal costs of meeting demand growth are close to zero;

- is likely to be highest under the average revenue yield cap;

- is reduced under the hybrid form of price control provided the hybrid parameters are estimated accurately; and

- is under the control of businesses under the weighted average price cap (and is lowest to the extent that businesses set marginal prices close to marginal cost).

Chapter 5 provides a summary of our analysis.

2. EFFICIENT PRICING OF DISTRIBUTION CAPACITY

In any analysis of the incentives for efficient pricing it is important to be rigorous in the definition of what constitutes efficient pricing. This is particularly so in the case of electricity distribution where the service being sold is access to distribution capacity – the cost of which can vary in quite complicated ways with the time, location and type of use.

2.1. Marginal Cost Pricing

Economic efficiency is maximised if customers are charged the marginal social cost of using a service. This provides an economic signal to customers to only use the service if, and only if, the benefits to them of doing so are greater than the costs they impose on society. Customers will rationally consume the service until the benefit they receive from an additional unit is equal to the price they are charged for that unit. Therefore, unless prices reflect the marginal cost to society of the service, customers will not have the right incentive to consume up to the socially desirable level. If prices are set below marginal cost, resources will be wasted in meeting customers' demands which cost more than the benefits customers derive. If prices are set above marginal cost, then they will discourage purchases by customers which would have been valued at more than the cost to society of supplying them.

It is important to be clear about what drives marginal cost in the supply of electricity distribution, namely:

i. the quality of services being purchased. For example, is the customer purchasing an uninterruptible or interruptible capacity? Alternatively, is the customer purchasing a controlled or uncontrolled access to capacity? At what voltage is the capacity being utilised?

ii. the time that services are purchased. For example, is the customer purchasing off peak, peak and/or super peak access to distribution capacity?

iii. the type of capacity utilisation being purchased. For example, is the customer purchasing a steady level of capacity over time or is the customer purchasing highly variable ("peaky") access to distribution capacity?

iv. the location that services are sought. For example, is the customer located in a capacity constrained part of the network (which will require capacity augmentation in the near future), or an 'older' part of the network (which requires higher maintenance), etc.

Clearly, efficient pricing requires an intimate knowledge of how the marginal cost of providing the network is affected by each of these four characteristics, and requires that marginal prices reflect these characteristics. Furthermore, this intimate knowledge is only likely to reside within the distribution business[1]. Efficient tariffs may require:

- the provision of lower prices for low marginal cost services – such as interruptible/controlled load tariffs;
- differentiation between different voltage levels;
- a time of use element – including potentially seasonal charges as well as time of day charges;
- maximum capacity usage charges (commonly referred to as maximum “demand” charges) as well as average capacity usage charges (commonly proxied by kWh charges); and
- locational charges.

Of course, administration and other barriers to marginal cost pricing may mean that it is impractical to achieve a pure marginal cost pricing structure. In this situation, truly efficient prices will strike a trade off between accurately reflecting marginal cost and minimising other costs – such as administration and billing costs. Furthermore, marginal cost is a forward-looking concept and therefore, significantly, relies as much on probability and expectation as on fact. This poses particular practical challenges for electricity distribution, where forecasts of demand, especially in the short term, are subject to considerable potential variation, and where it is necessary to build climate and weather variability into forecasts of supply. Therefore, given probability distributions over all possible and relevant eventualities, setting efficient prices can be most accurately characterised as one of setting price *in such a way as to minimise expected inefficiency*.

An important example of such a trade off is that between pricing on the basis of short run marginal cost and long run marginal cost. In the absence of any administration costs economic efficiency is maximised if services are priced on the basis of short run marginal cost. This is because the ideal is for every individual consumption decision, at every instant, to reflect the marginal cost to society at that time.

The short run refers to a situation in which the investment in plant and equipment is fixed. Capacity can be neither added nor removed, although it can be used to a greater or lesser extent. The short run marginal cost of electricity distribution is the cost to society of a customer using existing capacity in the network at any point in time. This cost is often very

1 Of course, the business will have no incentive to gather and use this information unless they have an incentive to also price at marginal cost. Under what circumstance this incentive exists is discussed in the next chapter.

low but increases rapidly as the probability that the system will be capacity constrained increases.[2] [3]

However, this would require that network prices at different points in the network would have to vary on a minute by minute basis according to a complex set of algorithms that calculated the probability of system constraints developing. In addition much more sophisticated billing and metering systems would have to be put in place than currently exist. Furthermore, customers would also have to devote greater energy to price monitoring than they do now and would have to deal with greater uncertainty concerning the individual prices they face.

It is likely that pricing equal to long run marginal cost is likely to be the most efficient outcome given these constraints. That is, long run marginal cost pricing is likely to be a "second best" approximation to short run marginal cost. The long run refers to a situation in which the investment in plant and equipment is variable. Long-run marginal cost therefore indicates how cost changes with respect to output or capacity when all factors of production including plant and equipment are variable. The long run marginal cost then will relate broadly to the annualised cost of augmenting capacity (again, at a particular voltage, at a particular location etc), generally, per unit of additional capacity provided (ie, kW or kVA).

The long run cost to society of customers using the network is, unlike the short run cost, not congestion costs. Rather it is the long run cost of expanding the network to avoid congestion given that customer's use of the network. Put another way, it is the savings in the net present value of future capital and operating expenditure that would be available if that customer were to cease using the network.

2.2. Efficient Pricing Subject to Full Cost Recovery – Ramsey Pricing

An additional constraint on efficient pricing is the need to recover the total costs of providing the service. Electricity distribution is a natural monopoly characterised by large fixed costs and, by definition, the short run marginal cost of services is less than the average cost. As a result, perfectly efficient (marginal cost) pricing will not recover total costs. This means that

2 This abstracts from variable (demand related) operating and maintenance costs and, most significantly, the cost of electricity losses on the distribution system. The level of electricity losses imposed by a customer on the distribution system will also vary with the location of that customer in the network, the level of energy use by the customer and the level of capacity utilisation at the time of that energy use.

3 It should be noted that these costs do not generally reflect increased costs to the network service provider but rather reflect the costs to society of "customer A" using the network and thereby preventing "customer B" from using the network. That is, when the system is constrained the costs of one customer using the network are equal to the benefits foregone by other customers who are unable to use the network. These benefits foregone are generally measured as the maximum amount a customer who is constrained would have been willing to pay for the last available unit of capacity. By definition, this is equal to the market-clearing price for existing capacity. That is, the price at which existing capacity is rationed amongst potential users. When capacity is not constrained, as noted above, the market-clearing price is zero and therefore the short run marginal cost of congestion is also zero.

inevitably some economic efficiency must be sacrificed by pricing above marginal cost in order to recover total costs (unless provision of the service is subsidised by some means).

However, the deviation from economic efficiency will be minimised if fixed cost recovery is focused on services that are the least price sensitive. That is, if prices are raised above marginal cost on the least price sensitive services. Such an approach will have the smallest impact in terms of causing customers to consume less than the efficient level of services. This form of pricing is referred to in the economic literature as Ramsey pricing.

For example, in the case of electricity networks it may be the case that:

- fixed annual charges (within the relevant range) have little or no impact on customers' decisions to connect to the network;

- pricing of peak average capacity (say, proxied by kWh charges) does have some impact on long run peak usage; and

- all other capacity usage is more highly price sensitive (eg, interruptible tariffs, controlled tariffs, peak maximum demand tariffs etc.).

If this scenario were accurate then it would be most efficient if fixed cost recovery were concentrated on pricing above the marginal cost of annual connection and peak average capacity use, while keeping prices as close as possible to marginal cost for peak maximum demand charges and off peak charges etc.

For electricity distribution it is more likely that the above is true than the reverse (that is, people will almost always connect to the network within the relevant range of possible fixed charges). This suggests that efficiency will be maximised when costs above marginal cost are recovered primarily through fixed charges.

2.3. Efficient Incentives for Demand Management

Demand management requires that network businesses avoid the costs of network augmentation when it is socially less costly for customers to change their network usage patterns. It is important to note that electricity distributors are not selling energy but rather access to capacity for the distribution of energy. As such, it is within the scope of the businesses' core activities to manage demand for network capacity. However, it is not within the scope of the distribution business's core activities to manage demand for energy.

2.3.1. Efficient management of demand for network capacity

The single most important way that distribution businesses can manage the demand for network capacity is through efficient (marginal cost) pricing. This gives customers the appropriate incentive to:

- reduce total demand for network capacity;
- shift demand for network capacity to off peak period; or
- change the nature of demand for service quality/type (eg, move to interruptible tariffs).

There may also be some public good aspects to demand management. For example, customers may lack information on the prices they are currently paying and the options available for reducing the cost of their network usage. In this regard, there may be secondary role for businesses to ensure that customers are aware of the prices they face and of options for reducing their distribution costs (and hence the costs they impose on the distribution network). This may involve a communication campaign to customers to make them aware of the various tariff options available to them.

2.3.2. Efficient management of demand for energy

As with efficient management of demand for capacity, efficient levels of demand management for energy requires that customers face the full marginal social cost of consuming energy. To the extent that the full marginal social cost of energy is consistently greater than the electricity pool price in NSW (say, due to environmental externalities) then it may be appropriate to attempt to correct for this divergence between social and private costs ("externality").

However, it is unlikely that this is an appropriate objective for state based regulators of network industries (that do not produce energy). The first best way of attempting to correct any externality is to ensure that the externality is internalised at its source. For example, if greenhouse gas emissions are the source of the externality then the ideal solution is to tax the activity that produces greenhouse gases in proportion to the cost to society of those gas emissions (or, equivalently, to sell the right to produce those emissions at a price equal to the marginal cost to society).

However, it would be a much worse solution to attempt to account for this externality through restrictions on the efficient pricing of network capacity. In fact, such an approach is highly likely to cause losses in efficiency of network use that exceed any benefits in terms of accounting for environmental externalities. This is because:

- reducing incentives for efficient and innovative pricing of network capacity is likely to have considerable costs in terms of efficient use of the existing network and efficient development of that network;
- trading off the achievement of environmental objectives with efficient pricing of network capacity is an unnecessary trade off. Environmental policy objectives can be met through other means without the need to distort network pricing decisions (eg,

ideally a carbon tax for greenhouse gas emissions but failing this a tax on all energy usage and/or a taxpayer subsidy of energy efficient appliances). There is no obvious reason to sacrifice efficient use of network capacity in achieving these objectives.

- moreover, many incentives for efficient pricing are also likely to reduce demand for energy (eg., peak period prices give incentives for using more energy efficient appliances). As a result, it is possible that sacrificing incentives for efficient network pricing may actually make environmental outcomes worse (a "lose lose" situation).

- attempting to tackle environmental externalities through distribution capacity pricing is inevitably a "piecemeal" approach and is likely to suffer from many other problems. For example:

  - such an approach cannot distinguish between high and low externality sources of electricity. Thus customers will have an equal incentive to cut back on gas, wind and hydro sources of electricity as they do for coal – even if coal is by far the greatest source of greenhouse gas emissions per kWh;

  - most environmental externalities relating to energy are either on a local or a national/global scale (eg, local pollution and greenhouse gas emissions). As such, there is likely to be a failure to appropriately coordinate policies that are ideally administered at a federal or local level;

- a significant focus of management of demand for network capacity is focused on shifting demand from peak to off peak periods and thereby reducing the need to invest in costly new capacity. This has a real benefit to society but a zero impact on energy usage and would potentially be sacrificed should environmental externalities be attempted to be accounted for in network capacity pricing.

2.4. Potential Benefits from Efficient Pricing

The benefits from efficient pricing depend on the responsiveness of demand to changes in prices. Elasticity is a measure of demand responsiveness. The (own) price elasticity of demand for electricity provides an estimate for how much a customer's demand for electricity is likely to change as a result of a change in the electricity price.[4]

[4] Estimates are measured in terms of the percentage change in demand with respect to a 1 per cent change in price. Hence, an elasticity coefficient of -2, for example, shows that consumers respond a great deal to a change in price. If, on the other hand, the price elasticity of demand was -0.1 - which means that a 10% increase in price causes a 1% decrease in demand – the customer's demand would be considered to be relatively unresponsive to price. Demand is generally said to be "inelastic" (or unresponsive to price) whenever the absolute elasticity coefficient is less than one. When it is greater than one however, demand is generally deemed to be "elastic".

Time plays an important role in determining the sensitivity of customer demand. The longer people have to make adjustments, the more adjustments they are likely to make. The price elasticity is therefore often measured with respect to both short term sensitivity (whereby the use of capital, such as hot water heaters/insulation, is fixed) and long term sensitivity (whereby capital stock can be changed). Estimates can also be disaggregated by customer type, times of electricity use (for example, to gain insights on the responsiveness of demand to peak charges relative to off-peak), and other parameters which may impact on the responsiveness of demand.

2.4.1.1. Empirical Estimates

There are a range of empirical estimates in the literature for price elasticities of demand for energy as opposed to demand for network capacity[5]. These include the following estimates of short run (a year or so) impacts of price changes:

- for residential customers:
  - the price elasticity is somewhere between –0.15 and –0.6;
  - the cross price elasticity of demand for electricity with the price of gas[6] is around 0.15.
- for industrial customers:
  - the price elasticity of demand is between –0.15 and –1.0;
  - the cross price elasticity of demand for natural gas is around 0.3; and
  - the cross price elasticity of demand for electricity is around 0.3.

There are suggestions in the literature that long-term estimates[7] of the price elasticity of demand are generally double these short-run estimates.[8]

It is important to note that demand will be more elastic the smaller the time period being examined. Most of the studies cited above focus on aggregate *energy* demand across all time periods. This means that consumers do not have the option of switching demand from one period to another in the face of price increases. However, studies of the price elasticity in particular periods show a higher level of responsiveness. Fillipini suggests that price

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5 See for example, Garcia-Cerrutti (2000), Silk and Joutz (1997), Elkhafif (1992), Filippini (1995).

6 That is, a ten percent increase in the price of natural gas, all other prices constant, results in a 1.5 percent increase in the demand for electricity.

7 Long term estimates generally imply demand responses over a 10-15 year period.

8 See, for example, Silk and Joutz (1997).

elasticity in particular time periods may be as high as –2.0[9]. This suggests that a ten percent increase in electricity price could result in a 20 percent reduction in consumption.

> *It is this price elasticity within periods that is of most interest when examining the potential benefits of efficient network pricing (such as peak period pricing or the introduction of interruptible tariffs).*

2.4.2. Implications

We note that the estimates vary widely in the literature and care needs to be taken in the interpretation of econometric models used in empirical studies and their results as well as the applicability of the location of the study to Australian conditions. Nevertheless, the information suggests that there is evidence to suggest that price influences demand patterns and that it can do this quite strongly within particular time periods. As a result, there are potentially significant benefits that can be achieved from efficient pricing.

9 Filippini estimates that the *final* price elasticity of demand is around –2.0 at off peak times.

3. INCENTIVES FOR EFFICIENT PRICING

Each form of price control has a dramatically different impact on the incentives for efficient pricing. The following sections describe each form of price control and analyse the incentives for efficient pricing under each.

3.1. Pure Revenue Cap

3.1.1. Description

The pure revenue cap is a direct limit on the allowed revenue a business may earn in any one year. Under a pure revenue cap, the maximum revenue that can be earned in any time period, t, is equal to M_t. M_t is set in absolute monetary terms at the outset of the price control, and is adjusted in subsequent years by a CPI-X formula.

A pure revenue cap provides the distribution company with a guaranteed income, regardless of the quantity of various services supplied (peak capacity, connections, controlled loads etc). Expected volumes each year determine prices required to achieve M_t. If the volume of units distributed is greater or less than expected, the additional revenue is returned to consumers, through some form of correction mechanism. Similarly, if the volume distributed falls below that expected, the regulated business receives the shortfall in revenue in the following period. Allowed revenue received by the licensee is therefore always exactly equal to expected revenue at the time the price control is set.

3.1.2. Incentives for efficient pricing

A pure revenue cap provides the distribution business with a guaranteed income, regardless of services provided. As a result, the distributor has no incentive to encourage any use of the network that would result in higher network costs – irrespective of whether the benefit to the consumer is greater than the marginal cost to society of that use. This is clearly inefficient and arises from the fact that:

> *The marginal revenue to the business of providing additional services is always equal to zero and is in no way linked to the marginal benefit to consumers of the service (or to the marginal prices charged for those services). Unless marginal cost is zero or negative, marginal revenue is always less than marginal cost.*

Thus, the business has a financial incentive to minimise use of the service to the extent that lowers costs – even if the marginal benefit to customers is greater than the marginal cost to the business of providing the service.

Examples of the sort of inefficient pricing, and other, behaviour this may induce include:

- precisely the opposite of efficient Ramsey pricing – namely pricing as high above marginal cost on the services where demand is most responsive to price. This strategy maximises the reduction in demand for services. For example:
  - inefficiently low fixed charges will enable the business to charge higher prices at the margin and remain within its revenue cap; and
  - insufficiently high subsidisation of services such as interruptible load services that are provided at less than marginal cost[10]; and
- pricing well above the marginal cost to society on all services with high marginal costs (generally peak period average capacity use and variable maximum demand use). This strategy is aimed at reducing the demand for the services that are most costly for the business to supply;

3.2. Revenue Yield Cap

3.2.1. Description

Under a revenue yield constraint, a cap is placed on the *average revenue* per unit of "output" the licensee is permitted to earn in any period t (M_t). M_t is then allowed to vary per year on the basis of a CPI-X formula. The operation of the control therefore requires the identification of a homogenous unit of output, in order for a measure of "total output" to be established. For electricity distribution businesses this unit of output has generally been each kWh of electricity distributed.[11] (The IPART discussion paper also assumes that total output would be measured in terms of kWhs distributed.)

In order to comply with the control, the average revenue per unit, calculated on the basis of total revenue divided by total "output", must be less than or equal to the maximum allowed average revenue, M_t. The amount of revenue earned on each individual unit (as opposed the average revenue per unit) is not regulated. The firm therefore has flexibility in setting individual tariffs. This flexibility encompasses both the split between the elements of any one tariff category and the rebalancing of tariffs between different tariff categories.

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[10] For example, it may be profitable to provide large cross subsidies to these tariffs as the distributor receives the savings on capital expenditure but does not bear the cost of the subsidy in the form of lower revenues. This means that the distributor has an incentive to provide a subsidy that exceeds the marginal social benefit in terms of saved network costs.

[11] In some cases different dimensions of output are weighted together in order to arrive at a single measure, eg, kWh of electricity distributed by different voltages may be weighted together to arrive at a single kWh total.

The level of the revenue yield control, M_t, is set on the basis of the target revenue established by the regulator, together with a forecast of the expected volume of output. If the volume of output turns out as expected, the regulated licensee will receive 100% of its expected revenue. Where licensees sell in excess of the volume expected, their allowed revenue will be in excess of the expected revenue. Conversely, if they sell less than the expected volume their allowed revenue falls below the level anticipated when the price control was set.

3.2.2. Incentives for efficient pricing

Under a revenue yield constraint the marginal revenue to the distribution business per kWh is equal to the regulator’s best estimate of the average cost per kWh (assuming that allowed revenue is set on the basis of forecast total costs). However, because distribution is a natural monopoly marginal cost is, by definition, below average cost. This means that:

> *Marginal revenue (M_t) is almost certainly greater than marginal cost. Furthermore, marginal revenue is constant and is independent of marginal prices or the marginal benefit to customers of consuming the services.*

This is the opposite situation to the pure revenue cap and provides the opposite incentives for efficient pricing. In the case of a pure revenue cap, marginal revenue is always below marginal cost and so the business has an incentive to price inefficiently high to reduce consumption. With the revenue yield, marginal revenue is above marginal cost and the business has an incentive to price inefficiently low to promote greater throughput – even if the marginal benefit to customers is below the marginal cost to society.

The important point to note here is that, unlike in a competitive market, lower marginal prices do not result in lower marginal revenue under a revenue yield cap. For example, the distribution business can lower marginal prices to zero but any additional kWh distributed at this price still allow it to increase its revenue by M_t – via higher infra marginal prices (say higher fixed connection charges). In fact, if volumes sold at negative prices were included in the calculation of the average price per kWh, the business will have an incentive to pay customers to take distribution provided that the business could ensure it reached its allowable average price per kWh by increasing fixed charges (by more than enough to compensate for the payments to customers).

Of course, it is likely that such explicit gaming of the regime would not be seen in practice. More subtle (inefficient) pricing and other behaviours are likely to involve:

- subsidised appliances as a “hidden” way of providing negative prices for distribution of kWhs;

- setting marginal (kWh distribution) prices below marginal cost for all price sensitive services – and thereby encouraging consumption of the service even if the marginal benefit to customers is less than the marginal cost of providing the service;

- failure to provide interruptible tariffs and other capacity management initiatives as lost distribution may cost more in terms of marginal revenue than it saves in terms of marginal costs. Again, this is likely to be true even though the benefits to customers of the additional units sold are less than the costs of providing them[12]; and/or

- building additional capacity inefficiently early as the marginal cost of doing so is less than the marginal revenue gained as a result of selling the additional capacity.

3.3. The Hybrid Revenue Cap

3.3.1. Description

The hybrid revenue cap can be regarded as a generalisation of the pure revenue cap and the average revenue yield cap by including both fixed and variable revenue elements. In the IPART discussion paper a hybrid revenue cap is described where there is a fixed component of revenue (as per the pure revenue cap) and a variable component of revenue (as per the average revenue yield cap) that increases linearly with: customer numbers, MWh sales and circuit kilometres (for rural distributors only). Unlike the average revenue yield cap, the regulator sets marginal revenue parameters as close as possible to marginal cost rather than average cost. Also, instead of purely basing marginal revenue on MWhs distributed the hybrid revenue cap also links marginal revenue to customer numbers connected (and potentially to other variables as well).

3.3.2. Incentives for efficient pricing

If the regulator were able to perfectly estimate the marginal parameters in the hybrid revenue cap then this form of price control would provide no incentive to price efficiently. This somewhat surprising result can be seen from the fact that, if the parameters in the hybrid revenue cap perfectly reflect the marginal cost of additional units sold, then business profitability will be completely independent of sales volumes. As a result, there will be no financial incentive to provide the efficient level and type of service.

12 By definition, rational customers will consume up to the point that marginal benefit is equal to marginal price. As a result, if marginal prices are less than marginal cost then so will marginal benefits be less than marginal cost.

> *In other words, by setting marginal revenue equal to marginal cost, the hybrid revenue cap makes the business financially indifferent between selling more or less of the services. As a result, there is no financial incentive to set prices equal to marginal cost and hence promote efficient use of the network*[13].

The above analysis assumes that the regulator is successful in setting the (marginal revenue) parameters of the hybrid regime equal to the true marginal cost. However, it is highly unlikely that this will be the case for a number of reasons, including:

- there is no single simple variable that drives marginal cost. For example, MWh distributed is often a poor proxy for the drivers of marginal cost of network distribution discussed in chapter 2 (quality, time, type and location of network capacity demanded);

- even if the regulator could accurately identify all marginal cost drivers, the relative importance of these would be constantly changing (eg, the gradual move from winter to summer peaks in NSW) and data on them almost impossible for the regulator to independently assess; and

- the drivers of marginal cost will not be linear (as appears to be envisaged in the IPART discussion paper). As a result, even if the hybrid parameters were estimated accurately for a given level of service they would not be true for other levels of service.

It is therefore critical to examine the efficiency implications of the regulator incorrectly estimating the hybrid (marginal revenue) parameters– either above or below marginal cost. This is relatively simple to analyse as:

- if marginal revenue is set above marginal cost the business has an artificial regulatory incentive to expand output above optimal levels – exactly as is the case with the average revenue yield form of price control. In other words, the business has an artificial incentive to price below marginal cost; or

- if marginal revenue is set below marginal cost the business has an artificial regulatory incentive to contract output below optimal levels – exactly as is the case with the pure revenue cap. In other words, the business has an artificial incentive to price above marginal cost.

This suggests that, as regards incentives for efficient pricing, the hybrid revenue cap at best creates an indifference by the business as to whether it prices efficiently or not. However, in general it will create an incentive for inefficient pricing – whether this incentive is for inefficiently low or high prices will depend on whether regulatory marginal revenue for each

13 Ironically, there is an incentive to cut costs by abolishing any pricing strategy operations within the firm – given that profits are no longer linked to prices/sales.

service provided is above or below marginal cost. Examples of the type of inefficient pricing likely to be associated with the hybrid revenue cap include:

- inefficiently high prices for peak period distribution and inefficiently low prices for off peak distribution. This will tend to be the case where the MWh marginal revenue parameter is set as an average of marginal cost of peak and off peak distribution of energy;

- inefficiently high charges that penalise variable ("peaky") demand (eg, higher than efficient maximum kVA/MW charges). This is because the hybrid revenue formula does not provide additional revenue for servicing customers with more "peaky" demand despite the fact that they place greater costs on the distribution business. That is, the marginal revenue associated with variability in load is set equal to zero – below the marginal cost. As a result, businesses will have a financial incentive to discourage this type of capacity usage even if the benefits to customers of maintaining peaky load is less than the marginal cost it imposes on the business; and

- inefficiently low prices for interruptible and controlled load charges. This is also a result of having marginal revenue per kWh set less than marginal cost in peak periods as, under this scenario, a business has an incentive to induce customers not to use peak period capacity – even if the benefit to them of using peak period capacity is less than the social cost.

3.4. The Weighted Average Price Cap

3.4.1. Description

Under a weighted average price cap, the limit on allowed price increases is expressed in terms of a weighted average of the prices of a basket of services, rather than on an average revenue yield.[14] The regulated business faces a cap on this weighted average price, M_t, which increases over time on the basis of a CPI-X formula. Regulated businesses are free to rebalance tariffs within the basket, increasing some more than others, provided that the ceiling on the overall weighted average price, M_t, is met[15].

In deriving the weighted average price, the weights chosen may be based on a range of factors. The weights will generally reflect actual quantities/revenues with a lag, eg, the weight attached to the price of service i reflects the quantity/revenue of service *i* distributed in the previous year.

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14 In the case where the weights are chosen to reflect current quantities of each product, i, and the tariff structure is entirely kWh based, the tariff basket control then equates to the revenue yield control.

15 Note, however, that it is also possible to impose separate constraints on the extent to which the weighted price for any individual customer class may change in any year.

The key difference between the tariff basket mechanism and all other forms of price control discussed is that the *marginal revenue* received for each additional unit varies according to the *marginal price* charged for that unit, rather than according to a variable set by the regulator. It also allows for marginal revenue to reflect the myriad of cost drivers the business considers it is feasible to reflect in pricing.

3.4.2. Incentives for efficient pricing

3.4.2.1. Incentives given endogenous relative demand growth

The above is a critical difference when it comes to determining the incentives for efficient pricing as it creates a link between marginal revenue (equal to marginal price) and marginal benefit to the consumer of the service (which is, by definition, also equal to the marginal price faced by a rational consumer).

As discussed in chapter 2, efficient pricing requires that marginal prices are set equal to marginal cost. However, a profit maximising firm does not necessarily have an incentive to set prices equal to marginal cost. Rather, it has an incentive to set prices such that the marginal revenue from an additional unit sold is equal to the marginal cost of an additional unit sold. This will only result in efficient pricing if marginal revenue and marginal price are the same!

Under all the previously analysed forms of price control, marginal revenues are set by the regulator and are completely independent of prices. As a result, the best such forms of regulation can possibly hope for is indifference on the part of the business with regards to its prices. However, if the regulatory marginal revenue is set above/below marginal cost then this creates an automatic incentive for the business to price below/above marginal cost.

In the case of a weighted average price cap, marginal revenue is not set by the regulator but is instead equal to the marginal price of that service. As a result, the incentive for a profit maximising firm to set marginal revenue equal to marginal cost is also an incentive to set marginal prices equal to marginal cost – ie, to price efficiently.

A stylised example can illustrate this point. Imagine a pure revenue cap is used to regulate a monopolist providing a single customer with fixed connection and energy distribution services and that the marginal cost of fixed connection is zero (existing infrastructure) and the marginal cost of energy distribution is 5 cents per kWh. Now let, the monopolist be charging $10 per annum for fixed connection and 10c per kWh for distribution of 100 kWh per annum. This gives a total revenue of $20 which is equal to the cost of providing the service ($15 in fixed costs and $5 in variable costs). Also assume that fixed connection is completely unresponsive to price (in the relevant range) but that energy distribution is somewhat responsive.

Now, let a weighted average price cap be introduced using the existing consumption levels as weights. If the business reduces the energy distribution charge by 1 cent per kWh then it can increase its fixed charge under the weighted average price cap by $1. If there is no resulting change in consumption then the business is indifferent as it collects the same revenue and incurs the same costs. However, if the customer does not disconnect and energy distributed increases in volume and the business improves revenues by 9 cents multiplied by the increase in energy distributed. Costs only increase by 5 cents multiplied by the increase in volumes. As a result, net revenue increases and the business is in a financially superior position.[16] If weights are updated the next year to reflect current consumption then the business will once again have the same incentive to reduce energy prices and increase fixed connection costs.

This suggests that a weighted average price cap with the weights reflecting past consumption levels[17] provides an incentive for the business to reduce prices towards marginal cost on the most price sensitive services and increase prices on the other services. This is precisely the incentives required for Ramsey pricing which is the most efficient form of pricing in the presence of a cost recovery constraint – as was discussed in chapter 2. The tendency for prices to converge to Ramsey prices under a weighted average price cap is well established in the economic literature.[18]

In the above example, the business achieves revenues greater than $20 (ie, greater than the total cost of providing the service). This is essentially a sharing of the efficiency dividend between businesses and customers. The proportion that is actually shared by customers can be increased over time at each regulatory reset. Alternatively, an "efficiency pricing dividend" can be anticipated in the X factor at the beginning of the regulatory reset.

3.4.2.2. Incentives given exogenous relative demand growth

The above analysis assumes that the only impact on relative rates of demand growth is via changes in pricing. However, if a business anticipates higher exogenous rates of growth in demand for particular services than for other services then it will have an incentive to raise prices on those services growing the fastest and reduce prices on the other services. This is because the weighted average price cap allows rebalancing on the basis that revenue will be

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16 This reflects the fact that, under the WAPC, changes in prices do not have any infra marginal impact on revenues. In other words, any reduction in revenue on existing volumes of one service as a result of a price decrease can be recovered by increasing prices on existing volumes of another service. Therefore, the only impact on revenues is the marginal impact which is equal to the new price structure multiplied by the *change* in volumes associated with the move to that new price structure.

17 Ideally, weights would be set equal to the efficient levels of consumption and would never be updated (unless the efficient levels of consumption changed). That is, quantity weights would be set equal to the quantities that would be consumed if prices were already set at Ramsey levels. However, it is not possible to observe these levels ex ante and it is not possible to know a priori how they will change over time (as this depends on variations in demand elasticities and marginal costs). An approach where weights are updated over time to reflect past consumption levels will ensure that, as prices approach Ramsey prices, the weights will also approach optimal weights.

18 See for example, Vogeslang I. and Finsinger J., "A regulatory Adjustment Process for Optimal Pricing by Multiproduct Monopoly Firms", *Bell Journal of Economics*, 1979. Brennan T., "Regulating by Capping Prices", *Journal of Regulatory Economics*, 1989.

unaffected assuming no change in consumption. Thus, the best way to increase allowable revenue when consumption patterns are changing is to raise prices on the fastest growing services and reduce prices on other services.

Whether this is consistent with efficient pricing depends on whether marginal cost is also rising on those services that are growing faster. It is likely that this will be the case to some extent, however, there is no reason to expect marginal cost to be rising by the same amount as it will be profit maximising for the business to raise prices.

It should be noted that the incentive to Ramsey prices discussed in the previous section will always be present but that it may be counteracted in some periods by short run changes in anticipated exogenous growth rates. However, in the long run there will always be an incentive to Ramsey price under the weighted average price cap.

3.4.3. Businesses assess marginal cost – not regulator

It is difficult to stress too greatly the fact that there are a complex set of cost drivers for electricity distribution and that, in general, MWhs distributed is often a poor proxy for these. Electricity distributors sell access to network capacity not energy flows and the cost of providing network capacity depends on a range of customer attributes unrelated to energy actually consumed. As a result, efficient pricing involves much more than simply charging for energy consumption. In fact, ideally, efficient tariff structures would probably all be in terms of maximum and average kVA rather than kWh and would also include a range of different values depending on time of use, interuptibility etc. A weighted average price cap gives the business an incentive to reflect all of these marginal cost drivers in marginal prices and the flexibility to adapt them overtime as is appropriate. This reduces the need for the regulator to do this for each business as may be required under the hybrid form of price control.

4. SENSITIVITY OF PROFITS TO ACCURACY OF FORECASTS

This chapter analyses the impact of each form of price control on the sensitivity of the ex ante rate of return on capital ("profit") with respect to the accuracy of demand forecasts at the beginning of the regulatory period. We also address the issue as to whether profit variability should be regarded as imposing a cost on businesses that should be avoided.

Ex ante profits will always be sensitive to forecasting error at the beginning of the regulatory period unless X factors and starting values are independent of forecast volumes. In other words, as long as forecast volumes enter into regulatory revenue/price path modelling prices and profits will depend on the accuracy of these forecasts. In order to eliminate the need for forecasts in setting price/revenue paths it is necessary that the form of price control delivers automatic alignment between costs and revenues over the regulatory period. While this is theoretically possible it is highly unlikely in practice.

Under the pure revenue cap the revenue path tends to be set highest when demand forecasts are highest. This means that if actual volumes are less than forecast volumes the distribution businesses have revenues set on the basis of higher than actual costs and therefore higher profits (and vice versa). The magnitude of this depends on the extent to which costs vary with demand and the extent to which they were assumed to do so in the cost modelling exercise.

Under the average revenue yield price cap the allowable price path (and marginal revenue) is based on forecast average cost given the forecast demand growth. The fact that marginal cost is lower than average cost means that if forecast volumes higher than actual volumes then actual profits will be lower than forecast profits (and vice versa). The magnitude of this depends on the divergence between average and marginal cost.

Under the hybrid revenue cap it is conceivable that, if the variable parameters perfectly matched true marginal cost, then both revenues and costs would move in line with each other as volumes change. In the extreme, it would be unnecessary to forecast volumes at the beginning of the regulatory period as the hybrid revenue cap would automatically adjust revenues to volumes in line with changes in marginal cost. In practice, it is unlikely that the hybrid parameters can exactly reflect marginal cost. In this case, the sensitivity of profits to errors in the initial demand forecasts will depend on how well the hybrid variable parameter estimates reflect marginal cost.

Under the weighted average price cap, the sensitivity of profits to demand forecasts will depend on how closely marginal prices reflect marginal cost. To the extent that they reflect marginal cost, then there will be low sensitivity to variations in actual volumes. The higher above marginal cost are prices the higher is profit sensitivity to the accuracy of demand forecasts.

It should be noted that profit instability should only be regarded as a cost to businesses under the capital asset pricing model (CAPM) to the extent that it is correlated with general movements in profitability in the economy. If this is not the case then, provided the expected level of profitability is unaffected, variations around that average do not impose a cost on investors in that business. This is because it is assumed that investors are able to diversify non systemic risks away.

In general, it is likely that output related profit instability is driven by factors such as weather that are only weakly correlated to the general level of profitability in the economy. As such, it is not clear that profit instability should be considered a cost to businesses under the CAPM model. As a result, treating this as an issue influencing the appropriate form of price control may be viewed as inconsistent with applying the CAPM elsewhere in the regulatory regime.

However, it should be noted that if the NSW businesses do consider that profit instability imposes costs on them not recognised under the CAPM model (say, due to the Government ownership structure) then they can still achieve a desired level of profit stability under the weighted average price cap by setting marginal prices close to marginal cost.

5. CONCLUSIONS

In conclusion we note that efficient “Ramsey” pricing of network capacity is a quite complicated endeavour and will in general require a range of tariffs and tariff elements. However, there is empirical evidence that demand responsiveness to network tariffs (as opposed to energy prices) may be significant enough to deliver significant benefits from efficient pricing.

The form of price control can have an important influence on how closely businesses have an incentive to set prices efficiently. Of the forms of price control under considered, only the weighted average price cap can deliver incentives for efficient pricing - although this can be counteracted in the short term by exogenous differential rates of growth in demand for services. At best, the other forms of price control considered give a neutral incentive for efficient pricing and, at worst, an incentive to price inefficiently.

We have also argued that efficient prices for the use of distribution capacity by definition provide efficient incentives for demand management of distribution capacity as a substitute for additional network augmentation. To the extent that there are any (environmental) externalities associated with *energy* usage then we consider that ist is unlikely to be efficient to attempt to account for these through the form of price control associated with the sale of *distribution capacity.*

Finally, we have argued that the impact of forecasting errors on ex ante profitability of businesses may be different under the different forms of price control but that it is not clear that this imposes an additional cost on businesses (at least under the assumptions in the CAPM model used in regulatory decisions).