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Prepared For:

Australian Pipeline Industry Association

Energy Networks Association

Pricing Principles in the exposure draft of the National Gas Law

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DISCLAIMER

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EXECUTIVE SUMMARY

The Australian Pipeline Industry Association (APIA) and the Energy Networks Association (ENA) have asked CRA International to provide its expert opinion on Revenue and Pricing Principles (6) and (7) ("Principles 6 and 7") set out in Section 21 of the Exposure Draft of the National Gas Law (3 November 2006). In particular, we have been asked whether the terms underpinning principles 6 and 7 have an unambiguous meaning, and how those terms might be interpreted. Furthermore, we have been asked what possible regulatory outcomes might result from the application of principles 6 and 7.

The costs and risks of under- and over-investment (referenced in principle 6) have a clear economic meaning. The costs of under-investment (relative to an efficient benchmark) reflect the loss of social surplus associated with the output foregone. The costs of over-investment reflect an input mix that is too capital intensive. The risk of under-investment is greater where a regulator provides low returns thereby affecting incentives to invest, or where the regulatory environment is inherently uncertain and characterised by regulatory risk. The risk of over-investment is also affected by the level of regulatory returns. However, under most systems of incentive regulation there are a number of in-built mechanisms (such as capital expenditure prudency reviews and optimisation provisions) that mean the risk of over-investment occurring is low.

Utilisation (the focus of principle 7) can only be considered in relation the capacity of a pipeline and the throughput supplied by that pipeline. Capacity is the rate of output which a plant is built to supply. Capacity utilisation is a short run concept that reflects the relationship between the short run average total cost curve and the long run total cost curve. It is by no means clear what is meant in economic terms by the under- and over-utilisation of a pipeline. It is also unclear what the costs and risks of capacity under- or over-utilisation reflect in a long run analysis when capacity is malleable.

There is relatively wide acceptance amongst the economics profession that the social costs of under-investment are generally greater than the social costs of over-investment. This is because the costs associated with the loss of social surplus are typically much greater than the costs associated with a sub-optimal mix of capital and other inputs. However, there is a range of opinions on the significance of the risk of under-investment, reflecting the subjective nature of issues relevant to the debate. Some economists argue that regulated returns are already sufficiently high and that the risk of under-investment is low: others however, suggest that returns are relatively low and that therefore the risk of under-investment is real.

It is unclear why a regulator should consider the costs and risks associated with the over- and under-utilisation of a pipeline. Where there is spare capacity on a network a business should have appropriate commercial incentives to reduce price if demand is sufficiently elastic. If demand is inelastic reducing price may be contrary to the need to recover efficiently incurred costs in the long run. Both cases argue against regulatory intervention. In addition, over-utilisation is most likely to be a consequence of policies that do not provide appropriate incentives for long run investment.

Requiring a regulator to consider over- and under- investment and utilisation concurrently means that weight will be provided to all strands of principles 6 and 7. Even if a regulator accepts there is an asymmetry between the costs of over- and under-investment the provisions in relation to capacity utilisation still provide scope for the regulator to adjust prices (downwards) to promote capacity utilisation even though this may result in a worse outcome to society.

A pre-requisite to reducing uncertainty is to remove reference to the over- and under-utilisation of a pipeline (Principle 7). This means that debate can be focused on issues that clearly affect long run social welfare rather than on capacity utilisation, which necessarily can only be defined in the short run.

The removal of Principle 7 will reduce uncertainty associated with the interpretation of Principle 6. However, there will still be uncertainty over the costs and, in particular, the risks, of over- and under-investment. One approach to reducing regulatory uncertainty associated with over- and under-investment could be to rephrase principle 6 to ensure regulatory debate is focused on addressing the costs associated with asymmetry between under- and over-investment rather than further debating the existence of asymmetry in costs. For example, the Economic Policy Statement issued by the New Zealand Minister for Commerce requires that regulatory returns take "full account of the long-term risks to consumers of underinvestment in basic infrastructure".[1]

1 New Zealand Minister for Commerce, *Economic Policy Statement*, 7 August 2006, available at: http://www.med.govt.nz/templates/MultipageDocumentTOC____21483.aspx (accessed 13 December 2006).

1. INTRODUCTION

The Australian Pipeline Industry Association (APIA) and the Energy Networks Association (ENA) have asked CRA International ('CRA') to advise on economic and regulatory issues arising out of the Revenue and Pricing principles included in the exposure draft of the National Gas Law.[2]

The focus of this report is on Revenue and Pricing Principles (6) and (7) ("Principles 6 and 7"), which will require that:

> *(6) Regard should be had to the economic costs and risks of the potential for under and over investment by a service provider in a pipeline with which the service provider provides pipeline services.*
>
> *(7) Regard should be had to the economic costs and risks of the potential for under and over utilisation of a pipeline with which a service provider provides pipeline services.*

CRA has been asked to respond to the following economic questions:

(a) *Do the terms in principles 6 and 7 have an unambiguous ordinary or economic meaning?*

(b) *Taking account of the answer to Q (a), what is the range of interpretations that could realistically be given to principles 6 and 7 in respect of:*

(i) *Its component parts; and*

(ii) *Principles 6 and 7 in combination?*

(c) *What are the possible regulatory outcomes from the application of principles 6 and 7, taking account of: the other Revenue and Pricing principles, especially (3); and the overarching role of the objects clause?*

The remainder of this paper considers these economic questions and is followed by our concluding thoughts.

2. QUESTION (A): MEANING OF THE TERMS

> *Do the terms in principles 6 and 7 have an unambiguous ordinary or economic meaning?*

Principles 6 and 7 requires that regard should be had to the **economic costs and risks** of:

2 Exposure Draft, National Gas Law, 3 November 2006.

(i) the potential for **under** and **over- investment** by a service provider in a pipeline with which the service provider provides pipeline services; and

(ii) the potential for **under** and **over utilisation** of a pipeline with which a service provider provides pipeline services.

In economics the term "**cost**" reflects the benefits foregone, or opportunity cost, from undertaking a particular decision. Economic costs are typically referenced to an efficient benchmark. In general, the term "**risk**" [3] reflects the potential for an adverse event or a range of adverse events to arise. The use of the terms "cost" and "risk" concurrently implies that "risk" refers to the potential (or probability) for an adverse outcome to arise, while "cost" refers to the significance of that adverse outcome. This distinction is assumed in the remainder of this paper.

For the various terms in principles 6 and 7 to have an unambiguous ordinary or economic meaning it is necessary for the following conditions to hold:

- The term in question can be clearly defined;
- Factors affecting the risk of each term are well understood; and
- The costs associated with any adverse event are well understood, at least at the conceptual level.

The remainder of this section considers principle 6 and principle 7 in turn. We conclude that the term "costs and risks of the potential for under- and over- investment" has a reasonably unambiguous ordinary or economic meaning. However, we consider that the term "costs and risks of the potential for under- and over- utilisation" is inherently ambiguous.

2.1. COST AND RISK OF UNDER- AND OVER-INVESTMENT

The term "investment" reflects the purchase of an asset by a business or investor to provide a service. The terms "under" and "over" investment do not have a specific economic meaning. Instead they reflect the ordinary meaning of "too much" or "too little". Given that, they beg the question of "too little or too much relative to what"? The most obvious benchmark is the efficient level of investment, which results in the level of output that maximises social welfare (producer surplus plus consumer surplus).

A benchmark referencing efficient investment (for the long term interests of consumers) is included in the objects clause in the exposure draft of the National Gas Law:

3 It is unclear what is meant by the drafted term "risks of the potential". This drafting suggests some assessment is required of the risk of a risk. For the purpose of this paper we assume that the drafting is intended to imply consideration of the risk of under- and over-investment in a pipeline and the risk of under- and over-utilisation of the pipeline.

> *The objective of this law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of national gas.*

The economic **cost** of under- and over-investment reflects the benefits foregone relative to the benchmark of efficient investment from undertaking "too little" or "too much" investment. Seen against the benchmark of efficient investment:

- The cost of "too little" investment reflects the loss of social surplus (consumer and producer surplus) associated with that investment; while
- The cost of "too much" investment reflects an input mix that is too capital intensive.

The **risk** of over- or under-investment reflects the potential for adverse outcomes such as those listed above to arise. For example, if a regulator were to set regulatory returns too low (or too high) there would be a risk that a regulated business would have greater incentives to behave in a manner that may result in an adverse outcome(s). Additionally, if the regulatory environment was inherently uncertain there would be a greater risk that a business would choose not to invest.

We expect that there will be limited ambiguity over what is meant by the costs and risks of under- and over-investment. However, we expect a range of interpretations over how the various risks and costs can be quantified and/or applied in a regulatory setting.[4]

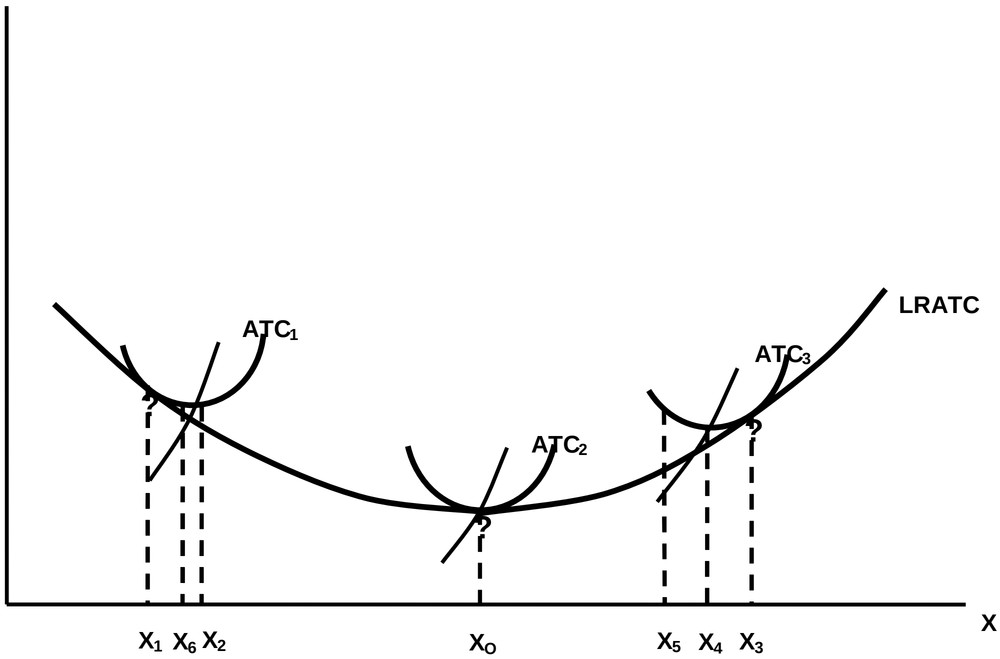
2.2. COST AND RISK OF UNDER AND OVER-UTILISATION OF A PIPELINE

The "utilisation" of a pipeline can only be considered in relation to the capacity of the pipeline and the output supplied by that pipeline. In economic and general terms, "capacity" is the rate of output which a plant is built to supply. Put somewhat more technically, in economics it is defined as the rate of output at which the plant cost function is tangent to the envelope defined by Long Run Average Total Cost ("LRATC"). This is usually illustrated by means of the curves set out in Figure 1, where ATC_i (for i=1, 2, 3) refers to short run average total cost, while the curve which envelopes them refers to long run average total cost. In the context of Figure 1:

- The *short run* cost function shows the minimum cost of producing a given output, holding fixed the size of plant; while
- The *long run* cost function shows the minimum cost of producing a given output, allowing sufficient time for all factors (including the size of plant) to be varied.

4 This is considered in section 3.1.

Figure 1: Relationship between capacity and capacity utilisation



"Capacity utilisation" is defined with respect to the **short run** cost function and refers to the relationship between actual output and the plant's capacity (defined as the output rate at the point of tangency), which is assumed to be fixed.

It is by no means clear what is meant in economic terms by "under- and over- utilisation" of a pipeline.

In Figure 1 above, there are some circumstances where under- or over-utilisation may exist. This includes points below X_1 on $ATC_{1,}$ points above X_3 on ATC_3, and points above and below X_0 on ATC_2.

However, in most cases what constitutes under- or over-utilisation is unclear. For example, if the cost function that corresponds to installed capacity is ATC_1, at any output rate below X_2, there will be short run increasing returns.[5] However, at points beyond X_1 but below $X_{2,}$ the output rate exceeds the output rate that corresponds to the point of tangency between the short run and long run cost functions. Is output rate X_6 a case of "under-utilisation" or of "over-utilisation" of "the capacity of assets"?

For most utilities, where there are economies of scale, it is feasible that the long run cost curve will be downward sloping at the current output rate. Therefore, a short run cost curve as depicted by ATC_1 is plausible. This means that it is conceivable that a point such as X_6 will arise in practice.

5 As drawn, there are obviously also long run increasing returns at these points. Note that the mere fact of short run increasing returns does not mean that we are off the envelope (i.e. are producing inefficiently), as the region of output that is less than X_2 also includes the point where ATC_1 is tangent to the envelope.

As over- and under- utilisation of a pipeline does not have a clear economic meaning, it is not clear what can be gained from considering what an “ordinary” meaning may entail. Suppose that utilisation is referenced solely off the short run average total cost envelope applicable to the firm[6] and that capacity is seen to be efficiently utilised at the minimum point of the short run average total cost curve. This may imply a clear meaning of what constitutes under- and over-utilisation. However, this would create the risk that a clear meaning is (erroneously) applied to something that is necessarily ambiguous unless the firm happens to be in a long run equilibrium on cost curve ATC_2.

There are additional practical problems in defining over- and under- utilisation of a pipeline even in the short run. Sometimes the term “capacity utilisation” is used to refer to the spare capacity embedded in a network at a particular point in time. On other occasions it is used to refer to the level of spare capacity over a period of years. However, the extent of spare capacity for any network asset will vary throughout its life by virtue of the fact that capacity is lumpy and has to be provided in advance.

It is further unclear what is meant by the “**costs** of under- and over-utilisation.” In the few cases where it can be concluded that under or over-utilisation of capacity necessarily exists, costs potentially arise because output can be readily expanded (or contracted) to the point of tangency between the short run and long run average cost curves. This suggests that any costs of under- and over-utilisation may necessarily be transitory. However, in other circumstances there is significant ambiguity over what costs exist and even if they are relevant when a long run perspective is taken.

The **risk** of capacity under- and over-utilisation is also difficult to define. A range of factors affect the potential for a regulated decision to lead to an asset having spare capacity. These include the nature of customer demand, the incentives for the firm to invest and price levels. However, for these factors to represent a “risk” per se to utilisation necessitates the potential for an adverse outcome to materialise. If the short run costs of capacity under- or over-utilisation are largely irrelevant or secondary to long run considerations then the risk of under- and over-utilisation of capacity is necessarily limited.

In summary there is no clarity in an economic sense over what is meant by the costs and risks of under- and over-utilisation of a pipeline. Capacity utilisation only has an economic meaning in the short run, yet even in this period it is unclear what constitutes under- and over-utilisation.

3. QUESTION (B): INTERPRETATION OF THE TERMS

> *Taking account of the answer to Q(a), what is the range of interpretations that could realistically be given to principles 6 and 7 in respect of:*

6 That is, the relationship between the short run and the long run cost curve is ignored.

(i) *Its component parts (i.e, (a) the costs and risks of over/under investment, and (b) the costs and risks of over/under utilisation); and*

(ii) *Principles 6 and 7 in combination?*

The range of interpretations that can be given to the various terms will reflect the clarity of any ordinary and economic meaning (considered in question (a)), and the ease of quantification of costs and risks. For example, a term may be subject to much broader interpretation where risks are inherently subjective, or the term does not have a simple meaning.

This section considers each component of principles 6 and 7 in turn and then the combination of these components. We conclude that a broad range of interpretations is possible, in large part due to uncertainty over what constitutes over- and under-utilisation of a pipeline, and the subjective nature of the risk of under-investment.

3.1. INTERPRETATION OF COSTS AND RISKS OF OVER AND UNDER INVESTMENT

We expect that a range of interpretations of under-investment and over-investment is possible, largely due to the subjective nature of what constitutes a “risk” of over- and under-investment.

3.1.1. Under-investment

Cost of under-investment

In section 2.1 we noted that there should be a fair degree of consensus amongst economists that there are costs associated with under-investment.

If a long run approach is adopted then setting prices below long run efficient costs must result in investment falling below the efficient level.

This is because firms respond to a participation constraint; that is, they supply when expected price equals or exceeds expected cost but do not do so when that inequality is not met. Therefore, if the participation constraint is not met – at least in a system based on voluntary supply (i.e. where investors are not coerced into supplying, or output is not publicly subsidised) – supply must decline.

More specifically, if the participation constraint is not met at the efficient level of output, then capacity must diminish to the point where that constraint is met, with the capital stock adjusting to equate the marginal product of capital with its rental rate or user cost (that is, the risk adjusted rate of return plus depreciation). Equally, if future returns become more risky, then the capital stock must fall, with the extent of the fall depending on the shape of the production frontier and the elasticity of demand.

As a result, if price is set below cost there **must** be a social loss in terms of output restriction. This will be the case regardless of the form of regulation in place.

Note that this conclusion is still valid even if a short run perspective is taken. In the short run any adverse impact on output or service performance from reducing investment may not be immediately apparent. This is because in many infrastructure sectors there is a time lag between investment and service performance. However, even where the firm is able to meet its performance targets by reducing investment, there may still be associated costs such as the increasing inability of the firm to meet system reliability targets, which can ultimately lead to increased risk of catastrophic system failure.

Risk of under-investment

There may be divergent interpretations of the risk of under-investment because many of the factors affecting the risk of under-investment are subjective.

One factor affecting the risk of under-investment is the potential for regulatory returns to be set too low. However, quantifying what regulatory returns are "too low" is inherently difficult. This uncertainty is reflected in the debate over the level of regulatory returns in Australia, where divergent positions have been reached using similar data. For example, by comparing the price paid for regulated assets and the regulatory asset value of these assets, the Allen Consulting Group ('ACG') concluded that:[7]

> *regulators systematically err in favour of providing regulated entities with a return that exceeds the cost of capital associated with the regulated activities.*

This view suggests that any risk of under-investment is low. However, a more circumspect position was reached by the Network Economics Consulting Group ('NECG') based on the same ACG dataset.[8] NECG concluded:[9]

> *The shortcomings in the ACG's methodology are such that the estimated q ratios from the asset sales provide no meaningful information concerning the sufficiency or otherwise of regulated rates of return for the purposes of encouraging socially desirable new investment. This is all the more so given that the uncertainties that prevail in the context of new investment (given the inherent uncertainties associated with new investment and the way that it is affected by regulatory uncertainty).*

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7 Allen Consulting Group, "Review of the Gas Code: A Commentary on Economic Issues, A report for BHP Billiton", August 2003, p.61.

8 ACG's analysis was based on a number of (implicit) assumptions including that: purchasers would not factor in tax benefits, the potential for efficiency gains, the value of unregulated assets and the wider strategic benefits in the purchase price of a regulated asset;; and the historic "average" q value was an applicable value for the forward-looking marginal q value. It also did not account for favourable tariff rulings on sale price and applied a particular set of assumptions on the value of retail businesses.. Regardless of the applicability of these assumptions, the range of assumptions employed highlights the uncertainty of the results of any such analysis.

9 Network Economics Consulting Group, "Critique of ACG Report on Tobin's q: Submission to the Productivity Commission's Review of the Gas Access Regime", May 2004, p. 10.

> *Indeed, if regulated rates of return were as attractive as is suggested by the ACG report, one must ask why is it that virtually all investment in gas transmission infrastructure has been directed towards assets which the investor expects will never be subject to regulation. This is hardly an outcome one would expect in an environment in which regulated charges were overcompensating owners of regulated infrastructure.*

Uncertainty over the risk of under-investment is also evident from debate over international comparisons of regulatory returns. The Productivity Commission highlighted this uncertainty in its inquiry into the Gas Access Regime:[10]

> *There is disagreement among technical experts about how regulatory rates of return (WACC) in Australia compare to those in other countries. This illustrates the inevitable imprecision and subjectivity that occurs when regulators are required to approve reference tariffs.*

The risk of under-investment will also be affected by regulatory risk. However, there is also uncertainty over the quantification of this risk. The Productivity Commission stated:[11]

> *If regulatory risk, asymmetric truncation or regulatory error reduce expected profits and/or increase risk, then some riskier projects might no longer have an expected profit that investors consider is sufficient to compensate for the associated risk. Investors could respond by abandoning such projects. Alternatively, investors could modify projects so they are unlikely to be regulated (enabling a higher expected rate of return than allowed by regulators) or are lower risk (to match the low expected rate of return allowed by regulators). Relative to the intended outcome under cost-based price regulation, this might involve greater emphasis on:*
>
> - *building capacity that is essentially fully contracted — pipelines are smaller in diameter than otherwise because capacity is essentially built exclusively for clients that enter a long-term contract before construction*
> - *incremental expansion — greater reliance than otherwise on expanding capacity incrementally to meet demand growth as it arises, rather than building a larger pipeline initially based on forecasts of realisable demand*
> - *delaying investment — new projects are delayed for longer than otherwise while investors wait until demand is more certain.*

10 Productivity Commission 2004, Review of the Gas Access Regime, Report no. 31, Canberra, p.302.

11 Ibid., p.107.

In summary we expect that both the risks and costs of under-investment are significant. The main area of debate revolves around the significance of the risks of under-investment. The fact that assessing risk is inherently subjective creates the likelihood that economists and regulators will reach differing conclusions on the risk of under-investment.

3.1.2. Costs and risks of over-investment

We expect reasonable uniformity of opinion amongst economists that there can be costs associated with over-investment. However, we do not believe that the risk of over-investment is significant in practice. Furthermore, we are not aware of any economist who suggests there is a significant risk of over-investment. However, the fact that principle 6 explicitly requires consideration of the risk of over-investment means that greater attention will be paid to this possibility in future.

Costs of over-investment

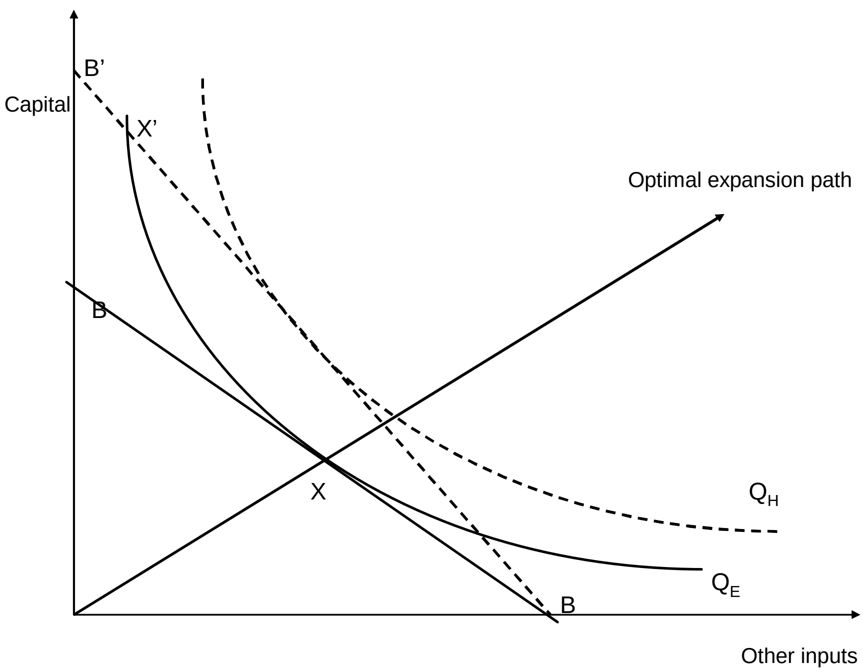
The main mechanism by which over-investment can arise is the Averch-Johnson effect, which is the best-known mechanism by which regulation may result in "over-investment".[12]

The Averch-Johnson effect refers to the impact on the input choices of a monopolist of a regulatory constraint that continuously (that is, without any lag) limits the monopolist's rate of return to an amount that is *less than* the unconstrained monopoly rate of return but *more than* the competitive rate of return. The monopolist is assumed to face a production function (that is, a function defining the level of output it secures from each combination of factor inputs) that allows it to substitute capital for other factors and to select the combination which allows it to maximise its total profits subject to the rate of return constraint. It is also generally assumed that once the firm has selected an input mix (that is, determined a capital stock), it operates that capital stock to a given and fixed level of utilisation. Given those assumptions, the rate of return constraint effectively lowers the cost to the firm of increasing its capital intensity (since the decreased marginal product of capital is partly offset by the higher-than-competitive return on the added capital stock), with the result that the firm chooses an input mix that is too capital intensive.

12 Harvey Averch and Leland L. Johnson "Behaviour of the Firm under Regulatory Constraint." American Economic Review, vol. 52 (1962) pp. 1053-1069. There is a vast literature on Averch-Johnson effects, with important contributions including: Elisabeth, E. Bailey and Coleman, R.D., "The Effect of Lagged Regulation in the Averch-Johnson Model." Bell Journal of Economics and Management Science, vol 2 (1971) pp. 278-92; David P. Baron, and Taggart, Robert A., "A Model of Regulation Under Uncertainty and a Test of Regulatory Bias." Bell Journal of Economics and Management Science, vol 8 (1977), pp. 151-67; William S. Baumol, and Klevorick, Albert K., "Input Choices and Rate of Return Regulation: An Overview of the Discussion." Bell Journal of Economics and Management Science, vol 1 (1970) pp. 162-190; Davis W. Dechert "Has the Averch-Johnson Effect been Theoretically Justified?" Journal of Economic Dynamics and Control, vol 8 (1984) pp. 1-17; Robert Spann "Rate of Return Regulation and Efficiency in Production: An Empirical Test of the Averch-Johnson Thesis." Bell Journal of Economics and Management Science, vol 5 (1974) pp. 38-52; and Akira Takayama "Behavior of the Firm under Regulatory Constraint." American Economic Review, vol 59 (1969) pp. 255-260.

This impact of the Averch-Johnson effect is illustrated through a stylised example. Figure 2 sets out the combination of capital and other inputs that can be used to produce a given output (an isoquant). The line BB represents the firm's budget constraint, which sets out the quantities of capital and other inputs that the firm is able to purchase. The point of tangency between the firm's budget constraint (BB) and the isoquant at point X reflects the efficient or cost-minimising combination of capital and other inputs. In this framework the Averch-Johnson effect is manifest by it becoming cheaper *for the firm* to employ more capital. This is seen in an upward shift in the firm's budget constraint to B'B. If the firm does not increase output overall it will subsequently operate at different point on isoquant Q_E, namely X'. This is productively inefficient as the firm could produce a higher output for the same cost (Q_H), or the same output at lower cost (as was the case at X). Even if the firm expands output (to Q_H) it is unlikely to be operating on the optimal expansion path given the incentives to employ additional capital created.

Figure 2: Relationship between capital and other inputs



Under the Averch-Johnson effect any given output will be produced at higher cost. This means that customers will face a higher price for a given output than would otherwise be the case. This can create a reduction in consumer surplus as the difference between the price a customer is willing to pay and the actual price of a good is reduced. There can also be a deadweight loss created as some demand may be foregone by the resulting increase in price.

Additional costs can potentially arise in a Greenfield setting where a firm invests early or undertakes unproductive expenditure (as may other firms) to capture the perceived rents associated with access prices being set "too high". This type of behaviour is similar to that under a patent race where innovators expend resources in search of capturing the rent associated with an innovation, thereby dissipating the rent in advance. The Productivity Commission recognised these costs in its Inquiry into the National Access Regime.[13] However, an important feature of models of entry based on pre-emption (which is the concern the Productivity Commission has expressed) is that while inefficient resources may be expended in securing the patent the firm that supplies the market is the efficient supplier. Moreover, even when there is inefficient entry, the duration of that inefficient entry is limited and inefficient entrants are displaced by more efficient rivals.[14]

Risk of over-investment

The risk of over-investment is influenced by many of the factors that affect the risk of under-investment. This includes the level of regulatory returns and regulatory risk. However, the risk that setting returns too high or that a benign regulatory regime will result in over-investment requires the Averch-Johnson effect to occur or the effects associated with the patent race noted above to be manifest (in a Greenfield setting) through premature investment.

As with any other model, whether the Averch-Johnson effect occurs depends on the degree to which the model's assumptions hold.

Some of these assumptions are technical in nature: for example, the assumption of a long run production function that is smooth and continuous, while the capital stock is operated at a fixed level in the short run. Whether these technical assumptions hold for most conventionally regulated industries is questionable.

Other important assumptions affecting the risk of over-investment involve the regulatory context. More specifically, the model assumes a very particular form of regulation, in which the regulated firm faces an especially "low powered" set of incentives – in other words, has few disciplines on it to be efficient. Thus, the regulated firm in the Averch-Johnson model is exposed neither to the conventional regulatory "sticks" nor to the conventional regulatory "carrots":

- The regulator is assumed to simply accept the regulated entity's asset base, rather than testing it (ex ante or ex post) for any form of efficiency; and

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13 Productivity Commission 2001, Review of the National Access Regime, Report no. 17, AusInfo, Canberra, p.73.

14 See generally, Ponssard, J.P, 1991 "Forward Induction and Sunk Costs Give Average Cost Pricing", *Games and Economic Behaviour* Vol 3, pp.221-236; and Gromb Denis, Jean-Pierre Ponssard and David Sevy 1997, 'Selection in Dynamic Entry Games', *Games and Economic Behavior*, vol. 21, no. 1-2, pp. 62-84.

- The assumption of zero regulatory lag (so that any cost savings the firm makes are immediately passed on to consumers) eliminates the incentive the firm might otherwise have to cut its costs.

In contrast, if the regulatory regime is of an 'incentive regulation' type, then the Averch-Johnson effect is muted or indeed (for suitable specifications of the dynamics) reversed. The muting of the Averch-Johnson effect can occur where the firm has incentives to reduce costs (including capital costs) or the regulator has the ability to either optimise "gold plated" assets or undertake ex-ante approval of capital expenditure proposals. Therefore, the *risks* of over-investment are significantly reduced (if not eliminated) under most forms of incentive regulation.

Given this dependence of the Averch-Johnson effect on the model's assumptions, it is unsurprising that empirical studies, even of US regulation at its most conventional "cost of service/rate of return" form, have been very mixed in finding any evidence of the effect at work. There is therefore no certainty that such effects occur, or if they do occur, whether such effects are material.

The risk that the patent-race effect will arise through the workings of price regulation is very limited in the gas sector. First, as the patent-race effect arises where there is competition for the market, it is only applicable in Greenfield settings, rather than in cases where an existing gas network is being augmented or extended. Second, in a Greenfield setting, timing effects on investment are largely swamped by demand uncertainty (which makes it attractive to delay incurring costs that once expended, are sunk) so that the net strength of any patent race effects is likely to be very slight. Third, the fact that commitments never to regulate have low credibility, and the resulting risk of eventual regulatory truncation, are also likely to induce delays in the timing of Greenfield investment relative to the social optimal, further limiting any distortion that patent race effects (which at best will offset these investment dampening impacts) could give rise to.

The above considerations mean that most economists will argue that the risk of over-investment is low. Credibly arguing a contrary case requires evidence of the Averch-Johnson effect applying under incentive regulation or that there are strong and adverse patent-race effects occurring in pipeline investment. As yet, we are not aware of compelling evidence to this effect.

3.1.3. Net effect of over- and under- investment

There is a strong argument that an asymmetry exists between both the *risk* of over- and under-investment and the *cost* of over- and under-investment.

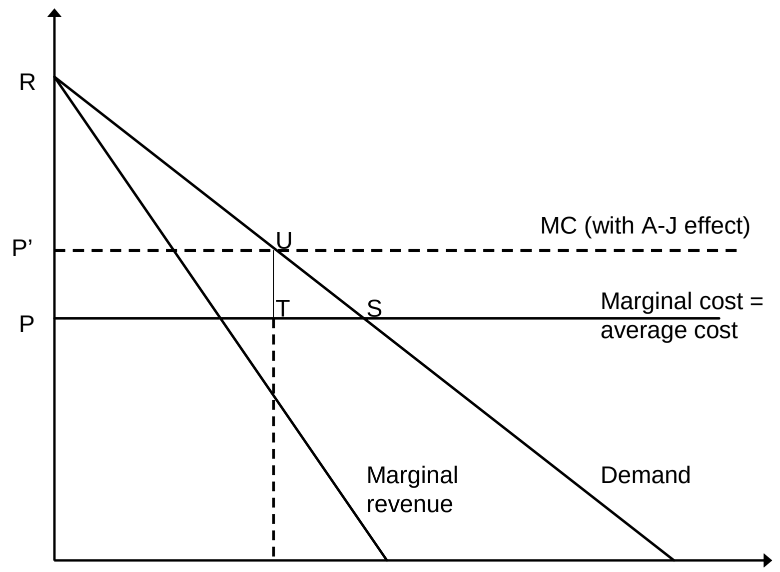
We have noted that under systems of incentive regulation the risk of over-investment is reduced where a regulator has the ability to disallow capital expenditure that it considers is not prudent and/or optimise out assets that may be “gold plated” or otherwise inefficient. These checks exist even if the regulated rate of return is set too high. By contrast there are no checks against the risk of under-investment. If the regulated rate of return is set too low investment will fall in the long run. This means that even if regulated returns are designed to reflect efficient prices there is a greater risk of under-investment rather than over-investment.

Furthermore, the costs associated with under-investment are typically much greater than the costs associated with over-investment (assuming they do, in fact, arise in the first place). In the case of under-investment, the long run effect is to reduce incentives to continue to invest in the facility, which risks losing the total social surplus associated with the service. By contrast, in the case of over-investment – or an overly capital intensive input mix for a given output – society suffers only from a sub-optimal input mix relative to the first-best world. Put another way, customers still receive benefits from the presence of the service where the Averch-Johnson effect arises.

In conventional welfare analysis the cost of the Averch-Johnson effect is the change in consumer and producer surplus associated with producing output at a higher cost. There will be two effects: a) a deadweight loss triangle arising from the reduction in demand caused by the increase in final price to consumers; and b) changes in producer and consumer surplus on output that is still consumed.

This is illustrated below under a simple example, where we assume constant marginal and average cost and a competitive (and regulated) price of P.

Figure 3: Averch Johnson effect under constant marginal cost



In this example there is no producer surplus and hence the loss in social welfare equals the loss in consumer surplus for at the new output level (PP'UT) plus the deadweight loss associated with the reduction in demand (UTS).

In this case, a risk of under-investment exists where there is potential for the price to be reduced below marginal cost (which by definition equals average cost). Where price is below marginal cost the firm will prefer not to operate. The deadweight loss will be given by the triangle RPS. This effect will necessarily dominate the potential cost associated with the Averch-Johnson effect.

As this example is simple, it raises the question as to whether there may be an intermediate step or more generalised position where under-investment results in a loss of some (but not all) investment, but which leaves open the possibility that the costs of over-investment may be greater than the costs of under-investment.

Suppose sunk and fixed costs are included in the analysis. If the price is set such that the firm is able to recover marginal costs and costs that are fixed to that period but not recover sunk costs, the firm may not exit the market in the short run. Any loss in output (for example arising from the firm not undertaking any new investment) will create a deadweight loss. Whether this deadweight loss in the short run is greater or less than the welfare loss due to the Averch-Johnson effect is an empirical question. However, if the firm cannot recover its investment in the long run then output will contract further. If the firm exits the market the deadweight loss will necessarily be greater than the deadweight loss associated with the Averch-Johnson effect given all surplus associated with supply of the product is lost.

The fact that the risk of under-investment is significantly higher than the risk of over-investment means that the costs of under-investment are of much greater concern.

A number of parties have accepted that there is an asymmetry in costs (and risks). For example, in its Inquiry into the National Access Regime the Productivity Commission stated:[15]

> *Nonetheless, the Commission accepts that there is a potential asymmetry in effects:*
>
> - *Over-compensation may sometimes result in inefficiencies in the timing of new investment in essential infrastructure (with flow-ons to investment in related markets), and occasionally lead to inefficient investment to by-pass parts of a network. However, it will never preclude socially worthwhile investments from proceeding.*
> - *On the other hand, if the truncation of balancing upside profits is expected to be substantial, major investments of considerable benefit to the community could be forgone, again with flow-on effects for investment in related markets.*
>
> *In the Commission's view, the latter is likely to be a worse outcome. Accordingly, it concurs with the argument that access regulators should be circumspect in their attempts to remove monopoly rents perceived to attach to successful infrastructure projects.*

The existence of asymmetries has gained some regulatory support since the Commission's Inquiries. For example, the Queensland Competition Authority stated:[16]

> *The Authority has considered whether, in the public interest, it should increase the recommended beta estimates for the DNSPs. In this regard, the Authority is aware of recent comments by the Productivity Commission and others that regulatory bodies should err on the high side on the basis that the impact on the economy of under-investment exceeds the impact on the economy of higher than warranted prices being paid by customers. In principle, the Authority sees merit in that proposition.*

Furthermore, a range of economists have accepted this asymmetry. In a report for ETSA Utilities, NERA stated:[17]

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15 Productivity Commission 2001, Review of the National Access Regime, Report no. 17, AusInfo, Canberra, p.83.

16 Queensland Competition Authority, Final Determination, Regulation of Electricity Distribution, April 2005, p.119.

17 NERA, "Review of ESCOSA decision on ETSA Utilities Equity Beta: A report for Johnson, Winter & Slattery", April 2005, pp.48-49.

> *Providing equity investors with the minimum compensation for risk will not ensure that sufficient investment occurs. This level of compensation only ensures that the business is indifferent between investing and not investing. In order for there to be a positive incentive to invest (rather than indifference) the regulator must set the rate of return above the minimum rate of return necessary to compensate for the risks of that investment.*
>
> *If the equity beta is set too high a company may undertake greater than optimal levels of investment in order to benefit from the higher regulated cost of capital. However, as recognised by the Productivity Commission, the potential costs of over investment are dwarfed by the potential costs of service unavailability as a result of under investment.*

In a report critiquing the advice of NERA (above), Associate Professor Martin Lally stated:[18]

> *NERA's fourth argument is that regulators should err on the side of caution in estimating equity betas (i.e., err on the high side) due to the asymmetric consequences of estimation error (ibid, section 3.8). I agree that regulators should err on the high side but this adjustment should be made at the level of WACC rather than at the level of each individual parameter. By doing so at the WACC level, the regulator can choose WACC so as to control the probability (at some specified level such as 10%) of choosing a WACC value that is too low. By contrast, if that control level were applied to each individual parameter, the resulting control level at the WACC level is liable to be considerably less.*

We see no logical basis to credibly argue that there is any "reverse asymmetry" in relation to investment, such that the risk and cost of under-investment is dwarfed by the risk and cost of over-investment. However, the fact that there is no simple way of estimating the risk of under-investment or estimating the costs associated with a reduction in investment means there will be different empirical interpretations over the significance of any asymmetry.

3.2. Interpretation of costs and risks of over and under utilisation

The costs (and risks) of over- and under-utilisation are difficult to define and in many cases inherently ambiguous. Furthermore, it is not clear they have any relevance to the promotion of long term welfare. This suggests that regulators should not focus on these factors in making regulatory decisions.

3.2.1. Costs and risks of under-utilisation

Costs of under-utilisation

In section 2.2 we noted that there is no clear economic meaning as to what constitutes the under-utilisation of a pipeline and that only in some clearly defined cases could there be costs associated with under-utilisation.

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18 Lally, M, "The Equity Beta for ETSA Utilities", May 2005, p.22.

It is also not clear how significant any costs of under-utilisation may be. Where price is set at a level above the point of tangency between the LRATC and SRATC curves (and the LRATC curve is not upward sloping at the current capacity level) there may be allocative efficiency losses from prices being set too high. Furthermore, there may also be costs in downstream sectors using the regulated product as an input. This suggests that it may be welfare enhancing to reduce price.

However, for many plausible output rates, whether there is such a thing as costs of capacity under-utilisation is unclear. Similarly the appropriate policy response is unclear. What inference, if any, is the regulator intended to draw in respect of prices given by some (unspecified) definition of "under-utilisation and over-utilisation of the capacity of assets"? For example, at output rate X_6 in Figure 1 marginal costs are below short run average costs. Is the regulator intended to infer from this that price should be reduced so that those units that are valued at more than marginal cost, but less than existing price, are consumed? But if so, how is that reconciled with full cost recovery? Equally, at output rate $X_{5,}$ where there are also short run increasing returns (but long run decreasing returns), should output be increased? But if so, how does that reconcile with the fact that long term plant capacity is too high, and ought to diminish for long run cost minimisation to occur?

The fact that capacity utilisation only has an economic meaning in the short run means that considering it as a relevant factor in the context of promoting long run social welfare may have unintended consequences: it may actually reduce social welfare. Put another way it implies that the costs of under-utilisation is something a regulator should not involve itself with except where there is a clear case that customers should not pay for an asset – for example where it is redundant.

Risks of under-utilisation

Any infrastructure operator will need to recover the cost of any investment over the life of the relevant asset. If this does not occur the firms participation constraint will be breached. Therefore, an important factor affecting the risk of under-utilisation is whether (and if so why) it can be in the firm's interest to allow capacity to be "under-utilised" in any economic or ordinary sense of the term.

For example, suppose that demand is relatively elastic at current output, which is well below the output rate at the point of tangency. It is highly plausible that the firm may wish to reduce price to stimulate demand (thereby increasing capacity utilisation) if by doing so the firm is able to increase profit, while not jeopardising the long run recovery of investment costs. By contrast if demand is inelastic, reducing price to stimulate demand may reduce short run profits while simultaneously jeopardising long run recovery of investment costs. In the former case it would be incorrect to refer to a risk of capacity under-utilisation as the firm has no incentives to allow it to happen. In the latter case the most significant risk from regulatory intervention is the risk of under-investment not under-utilisation.

The implication is that regulatory intervention can itself be costly:

- Where demand is sufficiently elastic the regulated firm may have the appropriate incentives to reduce price and expand output so regulatory intervention is unwarranted; while

- Where demand is inelastic requiring a reduction in price to promote short run utilisation may compromise long run investment.

The firm's interest in expanding output, including by differential pricing (or forms of price discrimination), is likely to be especially great if incentive regulation is in place. As Australian regulators are committed, at least in principle, to providing regulated firms with appropriate incentives to enhance efficiency (including by adopting efficient price discrimination), it is unclear why firms would not do so were the regulatory settings correct. Moreover, if firms are not doing so, then that is not an excuse for further heavy-handed regulation, but rather should trigger a move to more incentive-compatible regulatory arrangements.

Some parties may argue that requiring a short run reduction in price may not jeopardise the long run viability of the regulated service if the reduction in price is facilitated through adjustments to the depreciation schedule (back-end loading of the regulatory depreciation schedule). In any event, a business would have an incentive to vary its depreciation profile to one most likely to recover its capital over the life of the asset. However, a current regulator may not be able to commit a future regulator to take account of changes made to depreciation schedules in an earlier period. In any case it is not certain the firm will subsequently be able to recover the additional back-end loaded costs in future periods, for example, if there are changes to customer demand.

In summary, it is not clear that the costs associated with capacity under-utilisation are significant or even ones that a regulator should concern itself with. In many case the risks of capacity utilisation are reduced by virtue of the regulated firm having correct incentives to expand output. In other cases, it is unclear how regulatory intervention can promote efficient behaviour if that intervention compromises the long run viability of the firm.

3.2.2. Costs and risks of over-utilisation

Costs of over-utilisation

In section 2.2 we noted that in many cases defining what constitutes "over-utilisation" or "under-utilisation" of a pipeline is unclear and that only in some clearly defined cases could there necessarily be costs associated with over-utilisation.

Costs associated with over-utilisation (however defined) may arise where performance of the network is adversely affected by high loads or where customers that are willing to pay the efficient costs of production are precluded from receiving a supply due to capacity constraints.

However, the costs noted above can equally be considered costs associated with under-investment. This raises the question of whether over-utilisation is a symptom of policies that do not provide incentives for long run investment, or a distinct phenomenon.

Risk of over-utilisation

The over-utilisation of the capacity of assets may arise for a range of reasons. These may include that regulated prices are too low, there are poor signals to promote new investment; and/or previous investment decisions have been made factoring in insufficient increases in capacity (say due to regulatory risk)

Therefore, as with the costs of over-utilisation, the risks of over-utilisation may equally arise when there are poor incentives to undertake long run investment. This casts doubt on the relevance of even considering over-utilisation as a distinct issue.

3.2.3. Net effect of under- and over-utilisation

In the earlier sub-sections we have noted that there is limited economic rationale to consider short run capacity under- or over-utilisation. Providing the firm has appropriate incentives to expand output and/or undertake efficient investment many of the concerns associated with capacity utilisation are at best transitory.

However, where economists and/or regulators are required to consider the two factors we expect that much greater weight will be given to supposed capacity under-utilisation for various reasons:

- It is difficult to assess what the optimal path for capacity is for a long lived infrastructure asset throughout its economic life.[19] Therefore, there is a high risk that a regulator may conclude there is "excess capacity" when the plant is operating on a long run optimal path;
- There will be time lags before any adverse impacts (on business viability) from attempting to promote capacity utilisation are apparent, even if there are immediate costs; and
- Regulators are likely to be more reluctant to increase price in the face of supposed "over-utilisation" than they are to reduce price in the face of supposed "under-utilisation."

3.3. INTERPRETATION OF PRINCIPLES 6 AND 7 IN COMBINATION

The above discussion has suggested it is likely that divergent positions will be reached on the costs and risks of over- and under-investment and costs and risks of over- and under-utilisation of a pipeline.

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19 This can arise for a range of reasons including: a): the nature of fixed and sunk costs means that it will be efficient to provide investment ahead of demand, which necessitates spare capacity existing for a large part of an asset life; and b) the optimal extent of this "excess capacity" depends on a range of factors including economies of scale in capacity provisioning, the relevant discount rate, the degree of uncertainty and the extent to which firms have discretion over setting prices for services after demand has been realised.

Many economists accept the presence of an asymmetry between the costs of under- and over-investment. However, there is a range of views on the risk of under- and over-investment. Furthermore, while capacity utilisation has limited relevance to long term efficiency, some economists believe that social welfare can be enhanced through policies that are intended to promote capacity utilisation in the short run.

How these views are resolved is uncertain.

The fact that an economist or regulator interpreting the two provisions simultaneously is to have regard for the potential for capacity under-utilisation – and that some economists believe capacity under-utilisation has a material cost – means that weight will be given to this provision. In turn prices may be adjusted to a lower level than would be the case absent the provision.

Arguing for a reduction in price to promote capacity utilisation is more credible where there appears to be significant spare capacity. In such cases the risks associated with under-investment may be less critical (though they may still be significant). However, where there is spare capacity on a network there may already be strong commercial drivers to reduce price (if demand is price-elastic) which invalidates the case for regulatory intervention in the first place.

However, the provisions still provide scope for a regulator to reduce price to promote capacity utilisation even if it is accepted that there is an asymmetry associated with the costs of over- and under-investment. As there is limited, if any, rationale to develop policy based on short run capacity utilisation, this is likely to result in a worse outcome from an economic perspective than if provisions related to capacity utilisation were excluded.

4. QUESTION (C): REGULATORY OUTCOMES

> *What are the possible regulatory outcomes from the application of principles 6 and 7 taking into account the other Revenue and Pricing principles (especially (3)) and the overarching role of the objects clause?*

The answer to the previous questions have highlighted that a broad range of interpretations may apply to the terms in principles 6 and 7. However, this need not result in a wider range of potential regulatory outcomes. In some circumstances, other regulatory requirements will necessarily focus a regulator into considering a narrower sub-set of potential outcomes. However, it is our view that such a restriction does not arise in the present case.

Our assessment (below) of other regulatory instruments – namely the objects clause and Revenue and Pricing principle (3) – is that while they provide some constraint on possible outcomes they still leave significant discretion in the hands of a regulator. Therefore, a broad range of regulatory outcomes is still possible.

4.1. Objects clause and Revenue and Pricing principle (3)

The existence of the objects clause requires consideration to be given to “efficient investment” in the context of the promotion of the “long term interest of consumers”. The ‘long term” does not have any economic meaning unlike the use of “long run”. This creates the potential that a regulator may interpret “long term” to mean a “reasonable length of time” or multiple regulatory periods such as 10-15 years, rather than the life of the assets.

The presence of Revenue and Pricing principle (3) requires consideration to be given to various factors including incentives for the “efficient use of a pipeline (3(c))” as well as “efficient investment in a pipeline with which the service provider provides reference services (3(a)).

We have shown in this paper that there is no economic rationale to consider the utilisation of a pipeline in a long run analysis. To the extent that the “long term” is interpreted as a relatively short period in economic terms (say 10-15 years), the regulator has scope to consider the incentives for the efficient use of a pipeline under Revenue and Pricing principle (3) anyway. This suggests that at best principle 7 is redundant.

4.2. Implications

Where a regulator considers that it is to look at capacity utilisation over a sub-set of an asset life, a risk is created that policy will be developed with an aim to enhance short run resource allocation that at best may only provide transitory benefits and at worst may reduce incentives for efficient long run investment. The potential for a regulator to focus unduly on capacity utilisation will be stronger where there is no immediate need for new investment. A case would have to be made that promoting short run capacity utilisation is consistent with the interest of customers over a longer time period - for example, through an increase in consumer surplus and enhanced downstream competition. We do not believe this case is strong. Furthermore, there is an element of second guessing efficient behaviour inherent in this approach which makes such a policy dangerous: where there is spare capacity there is nothing to preclude a business from reducing tariffs if it is profitable to do so.

The fact that regulators are necessarily required to consider capacity utilisation means that policies that adversely affect long run economic efficiency are a distinct possibility.

The potential for a wide range of outcomes is evident from experience of the Long Term Interest of End User ('LTIE') test applied under Part XIC of the *Trade Practices Act* 1974, where the "long term" interests of end users objective is combined with sub-objectives of (potentially) shorter time duration, most notably the consideration of competition in related markets. In its interpretation of the LTIE test the ACCC takes significant regard on the sub-objectives:[20]

> *In a broad sense, the ACCC considers that terms and conditions in an undertaking might promote the long-term interests of end-users if they are likely to contribute towards the provision of services at lower prices and/or higher quality, or contribute to a greater diversity of services being available to end-users.*

In rejecting Telstra's Undertaking on its Unbundled Loop Services, one reason forwarded by the ACCC was that it failed to "encourage efficient use of investment in infrastructure":[21]

> *In relation to the finding on the reasonableness of the terms and conditions, the ACCC has concluded on an overall basis that the proposed price and non-price terms and conditions contained in the undertakings:*
>
> - *are unlikely to promote the LTIE, as they will not promote competition and will not encourage the economically efficient use of, and investment in infrastructure*
> - *result in Telstra recovering more than is necessary to promote Telstra's legitimate business interests*
> - *would harm the interest of access seekers and the persons who have rights to use the service*
> - *exceed the direct costs of providing access*
> - *do not have a material effect on the operational and technical requirements necessary for the safe and reliable operation of telecommunications services*
> - *are not likely to facilitate the economically efficient operation of the ULLS.*

20 Australian Competition & Consumer Commission, "Assessment of Telstra's ULLS monthly charge undertaking: Final Decision", August 2006, p.21.

21 Ibid., p.34.

5. CONCLUSIONS

Asking regulators to take the risks and costs of over- and under-investment and over- and under-utilisation into account may seem reasonable enough. However, the formulation underpinning the Exposure Draft of the National Gas Law provides no guidance as to how any such assessment should be made and invites a considerable degree of confusion. The main reason is that it conflates a long run factor (the level of investment) with a short run factor (capacity utilisation).

This creates material risks of regulatory error.

A pre-requisite to reducing uncertainty is to remove reference to the over- and under-utilisation of a pipeline (Principle 7). This means that debate can be focused on issues that clearly affect long run social welfare rather than on capacity utilisation, which necessarily can only be defined in the short run.

The removal of Principle 7 will reduce uncertainty associated with the interpretation of Principle 6. However, there may still be uncertainty over the costs and, in particular, the risks of over- and under-investment. One approach to reducing regulatory uncertainty associated with over- and under-investment could be to rephrase principle 6 to ensure regulatory debate is focused on addressing the costs associated with asymmetry between under- and over-investment rather than further debating the existence of asymmetry in costs. For example, the Economic Policy Statement issued by the New Zealand Minister for Commerce requires that regulatory returns take "full account of the long-term risks to consumers of underinvestment in basic infrastructure".[22]

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22 New Zealand Minister for Commerce, *Economic Policy Statement*, 7 August 2006, available at: http://www.med.govt.nz/templates/MultipageDocumentTOC____21483.aspx (accessed 13 December 2006).