Attachment 6.4

Incenta Expert Report – Assessment of compliance with the requirements for regulatory depreciation

Final Plan 2023/24 – 2027/28

July 2022

Assessment of compliance with the requirements for regulatory depreciation

AGN Victoria and Albury and Multinet Gas

June 2022

INCENTA

ECONOMIC CONSULTING

Contact us:

Incenta Economic Consulting
Unit 1, 19-35 Gertrude Street
Fitzroy, Victoria, 3065
Telephone: +61 3 8514 5119
Website: www.incenta.com.au

Disclaimer:

Table of Contents

Tables and figures

1. Introduction and overview

1.1 Our brief

1. We have been asked to provide an opinion on two related matters.

First, consider the approach we have taken to accelerated depreciation in the AGN Vic and Multinet cases, and provide a view as to whether this is consistent with the requirements (in terms of its economics intent) of NGR 89(1).

Secondly, at the same time as accelerating depreciation to meet what we see as our long-term threats, we are also continuing to respond to short term growth and demand from our customers, and we are also investing to support hydrogen in the future (recognising that the energy market will be quite different in future). We would like a view on whether these elements of our approach are consistent with each other, with reasoning.

1.2 Summary of conclusions

1.2.1 Depreciation

The Victorian Networks' proposals and analyses

2. AGN Victoria and Albury ("AGN") and Multinet Gas ("Multinet") (collectively the "Victorian Networks") have proposed advancing regulatory depreciation by $145 million and $76 million respectively for the next access arrangement period compared to the amount that would be derived using the previous depreciation method (straight-line depreciation on an inflation-indexed capital base). Whilst the Victorian Networks have proposed a fixed-dollar change to depreciation for the next access arrangement period, the amount is based on applying an alternative,[1] flexible depreciation method (a simplified version of the tilted-annuity method).[2]

3. The depreciation amounts, in turn, have been informed by a sophisticated modelling process that generated projections of future cost-based prices and demand (sales). Important aspects of the Victorian Networks' modelling were:

   a. the creation of simultaneous projections for cost-based prices[3] and demand across four different scenarios for the future that attempted to represent the range of

1 The Victorian Networks have not proposed applying an alternative depreciation method as such an option is not currently accommodated within the post tax revenue model (PTRM), and the Australian Energy Regulator (AER) was of the view that the PTRM could not be changed in time to accommodate the Victorian gas access arrangement review. However, as the Victorian Networks' proposals will result in the same closing capital base values at the end of the access arrangement period as if the alternative depreciation model had been applied immediately, it would be possible to switch seamlessly to the alternative depreciation method from the commencement of the subsequent access arrangement period.

2 One suggestion we make is to apply the standard version of tilted annuity depreciation in this calculation, given that it has a more intuitive underpinning and is better known: see section 3.2.3.

3 The cost-based prices during any period were a function of the choice of regulatory depreciation method.

uncertainty currently facing the gas industry, with these scenarios being derived through a consultative process,[4] and

b. a detailed modelling of customer choice between gas appliances and electricity appliances (i.e., the principal substitute energy source) under each of the scenarios.

4. From this modelling, the Victorian Networks were able to derive indicators – both before and after adjusting depreciation – for:

a. the stability of prices over time

b. the extent to which the Victorian Networks may face a risk as to whether they are able to recover their cost of providing the network services (this is signalled by demand falling away quickly and the associated cost-based price increasing abruptly), and

c. the utilisation of the gas networks in the future.

Assessment of the Victorian Networks' proposals

5. Our review of the underlying economic principles and guidance from the gas regulatory framework (comprising the national gas objective, the revenue and pricing principles and rule 89(1)) suggests that the principal outcomes sought by the choice of depreciation method are:

a. creating a reasonable opportunity to recover cost, noting that this is a central element in encouraging efficient networks and creating a fair balance of interests in relation to charges

b. encouraging the efficient use of the network, and

c. encouraging stability in prices over time.

6. Our summary of the requirements of the regulatory framework is materially the same as that presented by the AER in its recent information paper on this topic,[5] which in our view provides a material contribution to the debate on this issue.

7. Turning to the proposals, in our view,[6] the Victorian Networks' depreciation proposals better meet the requirements set out above than the depreciation generated by the previous depreciation method. A summary of our assessment against the factors noted above is as follows:

---

4 The scenarios were given the following names: "electric dreams"; "dual fuel"; "muddling through" and "hydrogen hero".

5 AER (2021), Information Paper, November: Regulating gas pipelines under uncertainty. We discuss the AER's key conclusions that are relevant to this report in section 2.4, where we also identify s small number of issues where we would place a different emphasis, or reach a different view, to the AER.

6 We note in drawing these conclusions that we have assumed as correct the modelling that the Victorian Networks have undertaken, and that our scope of work has not extended to reviewing the computational accuracy of the Victorian Networks' modelling or the reasonableness of the assumptions applied.

a. *Cost recovery* – the risk of asset stranding was projected to be material in three scenarios for AGN and in two for Multinet, but this was removed in one scenario for each business and materially reduced in the remainder.[7]

b. *Efficient utilisation of the asset* – the Victorian Networks' modelling demonstrates that the projected use of the networks over their life is materially higher under the proposed depreciation than under the alternative in all scenarios except for one for AGN,[8] which in our view is a reasonable proxy for the efficiency of use of the asset. In addition, we have used the Victorian Networks' modelling outputs to estimate (using a simplified model) the change in allocative efficiency associated with the change in depreciation. We find under conservative assumptions that the change in depreciation is projected to increase allocative efficiency.

c. *Price stability* – the proposed advancements of depreciation are found either to reduce the extent of the price increase expected in the future, or to extend to the time before prices escalate abruptly (and so signal the likelihood of asset stranding).

1.2.2 Other matters

Connection of new customers

8. It would be logical for the Victorian Networks to continue connecting customers notwithstanding the future risks to the sector, provided that the incremental cost of connecting a new customer is below the average cost of supply. Under this condition, new customers put downward pressure on prices and so act to reduce the risk of asset stranding.

9. Furthermore, we have reviewed the Victorian Networks modelling of the effect of customer connections on stranded asset risk. This modelling shows that, with even a modest gap between incremental and average cost, prices to existing customers may be lower as a consequence of connecting new customers even if a stranding event is certain. These results are reasonable and suggest the continued connection of customers now is likely to be prudent and efficient.[9]

Investment in hydrogen readiness

10. We also agree that it may be sensible to spend modest amounts now to preserve the future option for converting to hydrogen, even if a future conversion to hydrogen is not

[7] We do comment that the regulatory regime would, in our view, authorise the Victorian Networks to advance depreciation even further and so substantially eliminate this risk in all scenarios given the centrality of cost recovery for the regime.

[8] This is the "electric dreams" scenario for AGN, under which there is material stranded asset risk even after the advancement to depreciation.

[9] For customers whose incremental cost exceeds the average cost, a surcharge can be levied to cover the gap, and so connecting these customers would not necessarily increase stranded asset risk. The important point would be for the calculation of the surcharge to make an allowance for stranded asset risk.

certain or even the most likely outcome. Preserving this flexibility – depending on the cost incurred – may be of considerable benefit to customers.

11. We also note that the "real options" framework to which the Victorian Networks have referred in their materials provides important insights into how decisions should be made in the face of material uncertainty, and is an appropriate analytical framework for this type of expenditure. A key conclusion from real options theory is that it may be rational (and efficient) for a firm that is faced with material uncertainty to act in a manner that is quite different to how it would act in a more certain environment where irreversible things may occur. Some of these differences in behaviour include to:

    a. prefer projects that are modular, or to make small investments that defer a larger investment, even if the expected net present cost is greater, because the flexibility to avoid irreversible cost is valuable, and

    b. to spend money to preserve the flexibility to supply a service in the future[10] – and possibly to have several "irons in the fire" at once – even though it is not certain that any particular "iron" will be taken up.

12. The proposition that it may be efficient – and promote the long-term interest of consumers – to spend small sums to preserve the flexibility to convert to hydrogen in the future is an obvious application of the insights from real options theory.

10 An obvious example of this from the mining sector is where a mine is mothballed rather than completely closed down, which implies that material ongoing operations and maintenance expense is incurred even though there is no certainty the mine would ever operate again. The decision to mothball is taken to preserve the option to reopen the mine if prices increase to a point where production becomes viable again.

2. Requirements of the national gas regime

2.1 Introduction

13. The purpose of this chapter is to explain our understanding of the economic intent of Rule 89(1). Importantly, this requires also considering the broader regulatory framework within which the rules reside. Therefore, we also consider the guidance in the National Gas Law and what this implies for the approach to regulatory depreciation.

14. Prior to considering the specifics of the regulatory regime, we briefly describe the policy intent for regulatory depreciation as this provides context to the regulatory arrangements that exist for gas pipelines.

2.2 Policy objective for regulatory depreciation

2.2.1 Introduction

15. There are a number of outcomes for regulatory depreciation that have been accepted as desirable or applied in Australian regulatory matters, these include that:[11]

    a. there should be a high degree of confidence that costs will be recovered over the economic life of the assets such that financial capital maintenance is achieved, and

    b. subject to this first objective being achieved, the recovery of costs should be spread over time in a manner that encourages the efficient use of the assets.

16. In the remainder of this section we explain the importance of each of these objectives.

2.2.2 Cost recovery objective

17. The proposition that regulated prices should provide an expectation that they permit the recovery of costs incurred by regulated businesses, including a reasonable ("commercial", "competitive" or "normal") rate of return,[12] is a central plank of cost-based regulation as conventionally applied. There are a number of reasons for this.

    a. First, where firms do not expect to recover costs, and so earn a normal return on investment, investing in the regulated activity will yield poorer returns than available in other activities when adjusted for relative risk.[13] Consequently, the firm would no

---

11 A further factor that is influenced by the depreciation method is the timing of cash flow to a regulated business, which may affect its financeability. As the Victorian Networks' proposals do not rely upon any financeability effects, we do not discuss this issue further.

12 At least where those costs pass reasonable hurdles for prudence and efficiency.

13 To be clear, firms in competitive markets would only be expected to invest only where economic costs are able to be recovered (this is the implication of the standard NPV ≥ 0 rule for investment). Where there may be a difference between regulated and unregulated activities is the level of risk of recovery that is then accepted: in competitive markets, firms often bear a lot of subsequent recovery risk, but as a consequence expect to recover their costs over a sufficiently short period (and therefore with a possibility of earning a windfall if supply continues past this point) so that there is an "upside" to

longer have a financial incentive to invest in the regulated activity. Instead, it would have the incentive to invest elsewhere and reduce its investment in regulated activities as much as possible.[14] This could lead to a number of undesirable outcomes, including:

i. Cessation or deferral of discretionary projects

ii. A substitution from capital expenditure to operating expenditure where this is possible, when where this comes at higher cost to customers

iii. A deferral of asset replacement where possible, and a possible increase in the risks of outages, and

iv. A general reduced preparedness to investigate or explore new initiatives that may require investment.

b. Secondly, providing an expectation of cost recovery represents a fair balancing of the interests between regulated businesses and their customers. That is, utility businesses agree to undertake irreversible investments for the benefit of customers, as well as submit to ongoing service obligations, and to recover the cost of those investments over an extended period. In return they are provided with a reasonable assurance that they will recover those costs. As noted in footnote 13, the period over which costs are recovered in regulated sectors is typically much longer than in competitive markets (and even in competitive markets where service provision is undertaken under a long term contract), and this longer recovery period acts to reduce prices and so is of benefit to customers.

18. In the context of depreciation, giving this objective effect requires ensuring that funds that are invested are recovered at a sufficiently fast rate so that there is an expectation that all costs will be able to be recovered in the context of possible future risks, such as from technological change in substitutes or government policy changes. By implication, where a future constraint to cost recovery is expected, confidence for cost recovery is achieved by recovering a greater proportion of cost while the capacity to recover is higher (and so the amount left to recover in the future is consistent with the expected future capacity to recover). It is relevant in this context to draw on one of the earliest applications of incentive regulation in Australia as a guide to the regulatory approach for depreciation. While consulting on its approach to regulatory depreciation as part of its first review of prices for electricity distribution networks, the Office of the

balance off the "downside" risk. However, long term contracts can also be used in a competitive market to reduce the extent of cost-recovery risk faced by an investor, which are quite common in activities that are capital-intensive and specific to a particular customer.

14 It is important to recognise that the fact a regulated firm may continue to invest even in these circumstances cannot be taken as implying that it expects to make a normal return (and by implication, that there is no stranded asset risk) given that a substantial share of investment is either compelled by various regulations or would be done even at a loss in order to minimise a much greater loss.

Regulator-General (ORG) highlighted the primacy of a cost recovery objective, and the importance of adhering, where possible, to past commitments:[15]

The regulatory asset base represents the regulator's view of the market value of the regulated business at any point in time. Accordingly, the regulator can be interpreted as making an implicit commitment to ensure that the market value of those assets does not fall below the regulatory asset base over time. The objectives of encouraging efficient investment will only be met if this remains a credible commitment.

This has important implications for the design of the regulatory depreciation profile. In particular, in order to ensure that the regulatory asset base remains at or below the market value of the assets, the regulatory regime must permit each distribution licensee to have their capital returned at a rate that keeps pace with the decline in the economic value of their assets. This in turn implies that regulatory depreciation must at least keep pace with economic depreciation. This will ensure that the value of the distribution licensee should not be placed in a position in the future where it is not able to set tariffs that are expected to recover the benchmark revenue requirement.

2.2.3 Efficient use of assets

19. As indicated above, subject to the cost recovery objective being achieved, the other key economic objective for depreciation is that the profile for cost recovery promotes the efficient use of assets.

20. An efficient price from the perspective of promoting efficient use is a price that reflects the cost of supplying an additional unit of output (i.e., the marginal cost), as this will signal to customers the societal cost of their consumption actions. However, for gas pipelines – in common with the infrastructure sector more generally, where economies of scale and scope are typical – pricing in this manner will leave a substantial share of cost unrecovered and so not achieve the cost recovery objective referred to earlier (we refer to the costs that would not be recovered under marginal cost pricing as the "residual cost"). The aim for efficient pricing, therefore, is to recover this residual cost in a way that has the least impact on the efficient use of the service at any point in time, noting that regulatory depreciation is the tool to alter how the recovery of the residual cost is spread over time.

21. The standard response in infrastructure sectors for recovering the residual cost, while minimising distortions to efficient use, is to have regard to demand sensitivity across classes of customers at a particular point in time when determining prices. The demand sensitivity of classes of customers used to guide the structure charges (noting, for example, that the demand response to a change in a fixed charge is usually much less than to a variable consumption charge) and relativities across different customer types (subject to other considerations, like equity).

22. It is apparent that these same economic principles are also relevant to how the recovery of residual cost should be spread over time (i.e., as well as how that cost should be

15 ORG, '2001 Electricity Distribution Price Review, Cost of Capital Financing, Consultation Paper No. 4', May 1999, p. 15.

recovered at any point in time), which is given effect through the choice of depreciation method. These economic principles imply that allocative efficiency would be promoted by choosing a depreciation method that spreads the recovery of the residual cost over time in a manner that least affects the pattern of usage compared to what would occur if prices were set at marginal cost.

23. When deciding how to spread cost recovery over time in order to minimise the distortions to the efficient use of an asset, the key economic principles are as follows.

a. The recovery of a residual cost in any period inevitably will cause some users to reduce their use of the regulated infrastructure even though that use would have been efficient (recognising consumption is efficient whenever it is valued by the consumer more than the marginal cost, i.e., the cost to provide those extra units). This recognises that, while techniques for minimising this inefficiency exist – such as setting fixed charges and other forms of multi-part pricing – these techniques are imperfect and thus some inefficiency (reduction of output below that which would emerge under marginal cost pricing) will remain.

b. The inefficiency that is caused in any period from the recovery, via a mark-up, of fixed costs increases more than proportionally with the extent of fixed costs that are recovered through this mark-up. In fact, it is a well-known outcome in economics that the inefficiency from pricing at a mark-up over marginal costs rises with the square of that mark-up.[16] The inefficiency that is caused in any period will also vary with the sensitivity of demand to price in that period.

c. The non-linear relationship between the inefficiency caused in any period and the increment over marginal cost means that the aggregate of inefficiencies over time will be minimised by setting prices that cause a mark-up over marginal cost that is proportional to the sensitivity of demand to price in each period. This is the inter-temporal analogue of the well-known Ramsey rule for applying mark-ups across different products/customers at a point in time.[17]

24. In terms of the implications of such an intertemporal Ramsey pricing rule for efficient pricing, the following observations could be made.

25. The simplest case for applying this intertemporal Ramsey pricing rule is one where the marginal cost is expected to be approximately constant over time,[18] and the price sensitivity of demand also is not expected to change in a material way. the same over time and If the asset was expected to remain unconstrained over its life, or only to

16 One of the seminal papers in this area is Harberger, A., The measurement of waste, American Economic Review, May 1964a, 54(3), 58-76. A paper reviewing Harberger noted, in the context of the similar issue of excise taxes: "[h]e went on to make [the] trenchant observation that the area of [the] welfare loss triangle is generally a function of the square of the tax rate." Hines, J., "Three sides of Harberger Triangles", http://www.nber.org/papers/w6852.pdf.

17 Ramsey pricing minimises demand distortions by applying mark-ups to product prices in inverse proportion to each product's demand elasticity.

18 This would occur where the asset was never expected to be constrained, or where a succession of local constraints were expected over time at approximately equally-spaced time intervals.

experience constraints locally and periodically,[19] and further that the sensitivity of demand to price changes was not expected to change over time, then choosing a depreciation method that generates a price that is approximately constant in real terms would maximise allocative efficiency. These assumptions are what has justified the choice of straight-line inflation-indexed depreciation.

26. However, if these assumptions are invalid, then a different time path of prices may be appropriate. Most relevant here, the projected decrease in the cost of electricity relative to gas for the key gas appliances would imply an increased sensitivity of gas demand to price. The implication of this increased sensitivity is that the recovery of residual costs in the future may lead to larger distortions to efficient use, assuming it is possible to even recover this cost. This, in turn, may imply that allocative efficiency would increase by recovering more of the residual cost earlier (i.e., when demand is less sensitive to price), which would be achieved by advancing depreciation.

   a. To see why the narrowing of the gap between electricity and gas prices may raise the price sensitivity of gas demand, consider an example where the gas distribution price is currently $10, and the equivalent electricity price (i.e., the electricity price net of the other gas supply chain costs) was $15 dollars.

   b. Raising the gas distribution price by $1 by allocating more residual cost would not be expected to have a material effect on demand.

   c. However, if the equivalent electricity price falls to $10 in the future, then raising the gas distribution price by $1 to $11 would be expected to have a substantial effect on demand. Indeed, if customers were indifferent between fuels and could switch instantaneously, all customers would switch to electricity, and so all of the gas demand would be lost.[20]

27. One further factor that is relevant to the efficient use of gas pipelines is the stability and predictability of pricing.[21] Like infrastructure owners, customers also make investment decisions when deciding to consume gas through the decision about whether to purchase a gas appliance, and then what type of gas appliance is purchased. When making this decision, customers would be expected to evaluate the "all-up" cost of using the energy service via gas or electricity, as well as their own preferences in relation to service potential / quality. A key input to this decision is likely to be the expected future (delivered) price of gas relative to the alternative (i.e., principally electricity). To the extent that there is substantial uncertainty over the future price of gas relative to the alternative, then customers may be expected to apply a risk premium to the choice of a gas service, thus depressing the demand for gas. Thus, to the extent that the recovery of the residual cost over time can reduce the perceived uncertainty in future gas prices, the demand for gas services – and allocative efficiency – is likely to be promoted.

---

19 These imply that marginal cost is approximately zero or approximately unchanged over time.

20 In practice, as switching involves an investment by customers, the switching is likely to occur with a lag, and may not be complete even in the longer term (for example, some customers may apply a higher value to the gas-provided energy service).

21 This argument has been set out more comprehensively by Darryl Biggar: see https://www.degruyter.com/document/doi/10.2202/1446-9022.1173/html.

2.3 Depreciation in the existing gas regulatory framework

2.3.1 Introduction

28. In this section we describe the formal guidance and requirements of the regulatory framework for gas pipelines that are relevant to regulatory depreciation. This section draws upon the discussion of the economic principles in the previous section and demonstrates where these principles are reflected in the formal guidance for the selection of depreciation.

29. We first consider the objectives and overarching principles for gas pipeline regulation in the National Gas Law. We then consider the specific requirements of the Rules.

2.3.2 National Gas Objective

30. The objective of the NGL is:[22]

to promote efficient investment in, and efficient operation and use of, natural gas services for the longer term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas

31. Three separate components of the objective can be usefully distinguished, namely:

a. the requirement to promote economic efficiency with respect to investment, operation and use

b. the reference to the long-term interests of consumers, and

c. the requirement that the above instruction be focused on the price, quality, safety, reliability and security of supply of natural gas.

32. The objective makes an explicit reference to efficient investment. In the discussion above we identified that the capacity and incentive for efficient investment is influenced by the extent that a service provider can expect to recover at least the efficient costs of supply, and so earn a normal return on investment. The implication being that the objective for efficient investment is maintained through a commitment to the recovery of cost for past investments, such that there is an expectation that this commitment will be upheld for any future investments, to the extent it is reasonable to do so.[23] Consequently, in circumstances where there is a future threat to cost recovery, the profile of depreciation should be one that supports the recovery of cost.

33. Similarly, the objective also refers to promoting the efficient use of gas, which was also discussed above. This aspect of the objective would suggest that depreciation be applied in a way that spreads out the recovery of residual costs (i.e., those costs that would not be recovered under efficient marginal cost pricing) in a manner that least distorts the pattern consumption. It was observed that, where the price sensitivity of demand for gas is

22 Section 23 of the National Gas Law.
23 We discuss the concept of 'reasonable' in section 2.4.2 below.

expected to increase (as may be expected in view of the projected narrowing of the gap between electricity and gas prices) then recovering a greater share of residual costs earlier may be justified.

34. In terms of the long-term interests of consumers, whilst this is not an economic concept, it is observed that consumers have an interest in both minimising price / maximising the service offering, but also ensuring that the service is offered – the discussion earlier concluded that this trade-off is optimised by setting prices based upon cost (i.e., the minimum price that is also able to attract investment). Furthermore, the goal of encouraging the efficient use of the asset is quite tangible for customers – the intention is to spread the recovery of fixed cost over time in a manner that increases the total use of the asset. If achieved, this would imply a reduction in the average price for the regulated services over the life of the asset, and also lead to additional customers being served by the network over the network's life. These outcomes should be consistent with the long-term interests of customers.

2.3.3 Revenue and pricing principles

35. The Revenue and Pricing Principles (RPP) are set out for gas networks in section 24 of the NGL. The RPP provide additional guidance to the AER (and AEMC) when considering matters relating to economic regulation and pricing.

36. The RPP are particularly relevant to the approach taken to depreciation and the management of future cost recovery risks. This is because they provide a direct instruction that regulated businesses be provided with a reasonable opportunity for cost recovery. We interpret this as meaning that action should be taken to provide a reasonable assurance that costs are returned to investors sufficiently fast that this principle can be met.

37. The other provisions in the RPP that are particularly relevant to the considering how to act where there is a future prospect of asset stranding are summarised as follows:

a. A price or charge for the provision of services should allow "*for a return commensurate with the regulatory and commercial risk involved".*[24] If the regulatory approach does not permit that capital invested is returned to investors, it is clearly not possible for a service provider to earn a return commensurate with the regulatory and commercial risks involved. This would also be true where the business is required to retain stranded asset risk but without explicit compensation being provided.

b. *"Regard should be had to the economic costs and risks of the potential for under and over investment"* by the regulated service provider.[25] Returning capital to a service provider earlier than otherwise does not mean that it earns a higher return. The reason for this is that altering depreciation is NPV neutral. Therefore, there is limited reason to be concerned that returning capital earlier than first expected would lead to over-investment by a service provider. Conversely, as identified above, if recovery is

24 Section 24(5) of the NGL.
25 Section 24(6) of the NGL.

sufficiently delayed that asset stranding is expected this is likely to harm the incentive for investment and so increase the prospects of under-investment.

2.3.4 National Gas Rules

38. The Rules for gas pipelines related to depreciation are drafted in a way that provides flexibility to the service provider to propose, and the regulator accept, a change to depreciation where necessary to ensure cost recovery and to generate efficient prices.

39. Rule 89(1) is as follows:

The depreciation schedule should be designed:

(a) so that reference tariffs will vary, over time, in a way that promotes efficient growth in the market for reference services; and

(b) so that each asset or group of assets is depreciated over the economic life of that asset or group of assets; and

(c) so as to allow, as far as reasonably practicable, for adjustment reflecting changes in the expected economic life of a particular asset, or a particular group of assets; and

(d) so that (subject to the rules about capital redundancy), and asset is depreciated only once (i.e., that the amount by which the asset is depreciated over its economic life does not exceed the value of the asset at the time of its inclusion in the capital base (adjusted, if the accounting method approved by the AER permits, for inflation); and

(e) so as to allow for the service provider's reasonable needs for cash flow to meet financing, non-capital and other costs.

40. The rules most relevant to this matter are Rules 89(1)(a), (b) and (c) and so are the focus of the discussion here.

41. Rule 89(1)(a), which directs that a depreciation method be designed to encourage a time-path for reference tariffs that are consistent with the efficient growth in the market for services, has two interlinked objectives:

a. First, it guides the regulator to use depreciation to target a time-path for prices that are expected to result in an (allocatively) efficient price over time, and in particular, the efficient spreading of what we referred to as "residual costs".

b. Secondly, a key contributor to the efficient growth for the market for services is that the incentive exists for regulated businesses to make the investments that are necessary to support growth. Therefore, this is again related to the cost recovery objective given an expectation for cost recovery is needed to motivate efficient investment.

42. We note that these two objectives need not work in opposite directions.

a. First, there may be a circumstance where asset stranding is possible and so the "cost recovery" objective may necessitate advancing depreciation. However, allocative efficiency may also be improved by bringing forward the recovery of capital. If the stranding risk was caused by the increased competitiveness of electricity relative to gas, then it would also be the case that there would be an increase in the degree of price sensitivity of gas demand in the future. Advancing depreciation may also improve allocative efficiency in this case.[26]

b. Secondly, in circumstances where an alternative use of the pipeline for hydrogen is possible, a key contributor to efficient growth will be to maintain an incentive for investment related to the conversion to proceed. Providing a fair treatment of existing investment is more likely to create an environment within which this investment is able to occur.

43. Rule 89(1)(b) and (c) work in tandem. Rule 89(1)(b) requires assets to be depreciated over their economic lives, and Rule 89(1)(c) then envisages that the remaining lives of the assets would be adjusted over time so that they continue to track their economic lives as new information becomes available. As such, these rules require a holistic assessment of the factors that are likely to affect an asset's economic life and the associated depreciation method. Given our view that the cost recovery objective should have priority, it is our view that the economic life applied should reflect the minimum life over which there is substantial confidence (or, stated alternatively, no material risk) that the asset will remain in useful service, given the information available at that point in time.

2.4 AER's information paper regarding emerging uncertainty

2.4.1 Overview of AER's issues paper

44. The AER has recently released an Information Paper about regulating gas networks under the emerging uncertainties for sector in light of technological change and local and international efforts to pursue net zero carbon emissions.[27] In our view, that paper makes a very important contribution to understanding the challenges posed by these emerging risks, and how best that regulation may respond. Whilst the scope of the AER paper is much wider than this report – addressing matters like the contribution of regulatory tools other than regulatory depreciation to manage stranded asset risk, as well as whether aspects of the current regime should be refined – there is substantial commonality between the views expressed by the AER and those presented herein.

45. In particular, we note the following views of the AER:

---

26 We note, however, that in cases where there is an expectation of increased price sensitivity in the future, regulated businesses will be motivated to ensure that bringing forward cost recovery does not lead to prices that motivate early departure by customers. This is because early departure of customers would make cost recovery more challenging.

27 AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November.

a. The recognition of the importance of providing a reasonable expectation of cost-recovery for efficient investment to be encouraged, mimicking how investment incentives are created in competitive markets, including the following comment:[28]

In competitive markets, firms take on the risk of the price and quantity of sales. Where there is a material stranded asset risk, firms would defer entry into the market until prices have risen to a level that provides an acceptable rate of return after accounting for the stranded asset risk (i.e. a risk premium). Alternatively, firms mitigate stranding risk by entering into long-term contracts with customers.

Economic regulation is designed to provide a functional proxy for competitive markets. The regulatory settings are designed to provide appropriate incentives for regulated businesses to invest by preserving the expectation of recovering the efficient costs of their investments, including a normal return.

If stranded asset risk is demonstrated to be material, there are two primary ways to restore a reasonable expectation of cost recovery:

1. remove, or substantially reduce, the prospect of under-recovery of costs, or

2. compensate the regulated business for carrying this risk.

The AER proceeded to discuss[29] the merits (in incentive terms) of leaving some stranded asset risk with regulated businesses. However, this discussion was conducted in the context where the AER had already concluded that if material stranded asset risk was left with a regulated business then this would need to be accompanied with compensation.

b. That there is the potential for (allocative) efficiency to be increased from advancing the recovery of capital if this produces prices in the future that are lower in view of the effect of technological change on substitutes for the price sensitivity of customers, commenting as follows:[30]

When gas consumption per customer is declining and the competitiveness of electricity as a substitute for gas is increasing, a price path that declines rather than increase could promote efficient use of the pipeline assets. The increasing price sensitivity of gas over time would suggest that a front loaded profile, which allows a higher portion of costs to be recovered earlier (while price sensitivity is lower compared to later), would mitigate the potential price increased in the future, thereby encouraging fewer customers to leave the gas networks overall.

c. That stability in gas prices is important to encouraging the efficient use of gas networks, as this will affect the confidence of customers to make investments in gas appliances.[31]

---

28 AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, p.28.
29 AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, p.28.
30 AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, p.31.
31 AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, p.26.

Gas appliances typically last for 10-15 years. Consumer expectations of gas prices over that 10-15 year period are a factor in their investment decision. If future gas demand is expected to fall substantially or is highly uncertain, with corresponding expectations of price increases or price uncertainty, consumers may perceive a higher risk or cost associated with their investment in gas appliances.

d. That advancing regulatory depreciation is the most appropriate regulatory tool for responding to emerging stranded asset risks (subject to being supported by appropriate evidence),[32] and that it is preferable to act earlier in response to an emerging issue – when greater options exist to respond to an issue – which included the following observations:[33]

We have not provided any compensation to regulated businesses for stranded asset risk via the return on capital. This is because stranded asset risk is generally considered non-systematic. In addition, it has not been considered material to date. We consider that adjusting regulatory depreciation (return of capital), one of the building blocks we use to determine gas access prices, would be more appropriate to manage stranded asset risk under the regulatory regime.

…

Regulatory depreciation can be reviewed at each access arrangement review and it can be adjusted as circumstances change in the future. It can be calibrated at later time intervals to address any material estimation errors made previously. Apart from the risk of discouraging gas consumption with a price increase (or lack of price reduction), which depends on how much accelerated depreciation we consider reasonable with respect to price affordability, there is little downside in accelerating depreciation to effectively create a price buffer for the future.

It may be an opportune time to accelerate depreciation now given interest rates (and rate of return) are relatively low, which may offset some price impact of accelerated depreciation. Also, with an expectation that interest rates may increase in the future, there is an argument that accelerating depreciation would help smooth prices across access arrangement periods and result in greater price stability.

Increasing regulatory depreciation to recover more of the sunk costs when there are more customers to share the costs can help maintain intergenerational equity by ensuring future customers are not subject to unreasonably high gas access prices if demand does fall substantially. As such, accelerating depreciation may not only

[32] We agree with the AER that it will or may be appropriate to apply other regulatory tools in tandem – or to refine existing regulatory tools – in parallel with adjusting regulatory depreciation as a means of responding to emerging risks. For example, these risks may imply that more sophistication is required when assessing the relative merits of new investment, and that reviewing other measures – like the level of customer (capital) contributions from new connections may be warranted. Moreover, if it becomes likely that a network may have a finite (and short) remaining life, then existing incentive schemes may need to be recalibrated or restructured to reflect the changed period over which benefits may flow from an improvement in efficiency.

[33] AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, pp.28, 31, 40.

> *increase certainty in cost recovery for regulated businesses, but also in future price paths for consumers.*
>
> *Another scenario for consideration is where incurring expenditure to make regulated gas pipelines capable of carrying hydrogen is assessed as efficient under the regulatory framework. In this instance, increasing regulatory depreciation now may provide for reduced price impacts associated with a transition to hydrogen.*
>
> …
>
> *Our ability to adjust prices as a means to reduce price uncertainty and stranded asset risk will diminish over time and there is a window of opportunity, ie. a period of time, within which we can make decisions that will produce a desired outcome.*

46. However, there were several areas where the AER's discussion differed (and, in most cases, in emphasis) or where other materials were referenced, to which it is appropriate to respond. These areas relate to:

    a. the appropriate interpretation of the "reasonable opportunity to recover … efficient cost" criterion in the revenue and pricing principles

    b. the extent to which changing the timing of recovery of capital costs is likely to affect the long-term interests of consumers

    c. the reference to comments by the Energy Regulation Authority of Western Australia (ERA) about whether the opportunity to recover sunk costs would be consistent with advancing the long-term interests of consumers

    d. a technical issue of whether the advancement of depreciation may dissuade – rather than advance – the conditions for investment, and

    e. the potential for applying a "capital redundancy" policy as a possible mechanism for addressing stranded asset risks (although this was not something the AER identified as its preferred tool).

47. We address these in turn.

2.4.2 Reasonable opportunity to recover efficient cost

48. One difference between the AER and us relates to the how the "reasonable" element in "reasonable opportunity to recover … efficient cost" that is the first of the revenue pricing principles should be applied. In the discussion above, we argued that this clause required prices to be set such that there was an opportunity to recover cost, and that the use of "reasonable" was merely a recognition that events beyond the regulator's control may prevent cost recovery occurring, despite the regulator's intention for it to occur. The AER's discussion on the other hand, suggested that the term "reasonable" meant that

prices need only be designed to provide the opportunity to recover cost where this was "reasonable". The AER's principal statement was as follows:[34]

> *In our view, the NGL guiding revenue and pricing principle that regulated businesses should be provided with a reasonable opportunity to recover at least the efficient costs they incurred in providing services does not mean gas consumers must guarantee that the regulated businesses recover their costs under any circumstances. That is, regulatory depreciation or risk compensation <u>cannot be adjusted without constraint to guarantee cost recovery for the regulated businesses</u>. We must have regard to consumers' interest in having affordable and stable or reasonably predictable gas access prices to encourage their use of the gas infrastructure. Having said that, it is fair to note that regulated businesses also have an interest to maintain price affordability to avoid further decline in gas customer numbers.*
>
> *We must carefully consider what regulatory actions may be appropriate to promote the efficient investment in, operation and use of the gas networks while maintaining reasonably affordable and predictable gas access prices, both of which are in the long-term interests of gas consumers, in light of the uncertainty in future gas demand we face now. <u>We will do so with regard to the specific circumstances of the regulated business and the scale of price adjustments that can be reasonably made without creating price shocks.</u> We discuss the potential options in this section. These are not mutually exclusive (i.e. we may use a combination of these options) and not all of them would be warranted at the same time or now. [Emphasis added]*

49. The extent to which this difference in interpretation is material in practice, however, depends on how the "reasonable" qualifier should be interpreted and, in the context of the passage quoted above, the change in prices that would be defined as a "price shock".

50. In our previous discussion we identified that the concept that investors should be provided with an opportunity to recover costs as fundamental to the incentive for investment. This reflects the reality that most investment in gas pipelines is irreversible and so will not proceed unless there is confidence that an opportunity will be provided for costs to be recovered (or there is compensation for any downside risks that are held). Moreover, as we discuss further in paragraph 58.c below, the decisions in relation to gas networks are likely to affect investment incentives in other regulated sectors. It follows that it would be inconsistent with the underlying economic principles for the "reasonable" qualifier to permit the opportunity for cost recovery only in limited circumstances, including for example, only if price increases are not the result. However, it is clear from the AER's discussion that this is not its intent, and that a more substantial effect on prices would be required before it was deemed unreasonable. We also agree with the AER's observation (present in the quoted passage above) that where stranding risk arises from emerging competition, then this competition itself will provide a strong degree of protection to many customers.[35]

---

[34] AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, p.29.

[35] We observe that some customers could not switch energy supply (or do this in the most efficient way), such as renters.

51. As we discussed in section 2.3.4, it is clear that consideration must be given to the implications that a price path implied by a deprecation profile has for the efficient utilisation of assets. However, it is our view that this is a consideration that is made subject to first achieving the cost recovery objective. That is, it is a matter of how best to achieve the cost recovery objective given the constraints that are faced by the operator.

2.4.3 Timing of recovery of fixed costs and the long-term interests of consumers

52. Putting aside the effect on investment incentives (which I consider separately below), the AER's overall view appeared to be that the concept of long-term interests of consumers are largely indifferent to how the recovery of fixed costs is to be spread over time. Its two statements relevant to this matter also noting for example:[36]

> *Because of the intergenerational nature of gas customers, the net present value of the total costs that consumers need to pay for gas network services over time may change if regulatory depreciation is adjusted. For long-term customers, bringing forward depreciation means they pay more today but less in the future. Overall, they pay the same amount of costs. However, for short term customers who intend to leave the gas network soon, accelerating depreciation would mean paying more than they otherwise would have. This is because raising prices now – implying that prices will therefore be lower than otherwise in the future – would be detrimental to customers that consume now and expect to leave the network, beneficial to customers who expect to join the network in the future, and neutral for customers that expect to consume throughout.*

53. However, what is missing from this analysis is that how the recovery of fixed costs is spread over time may also affect:

   a. the incentive for investment, and hence for the quality of the service (and indeed whether a particular service is provided) – which I discuss further in the following section, and

   b. the total use of the service over time.

54. In terms of this second factor, as noted in paragraph 34 above, an outcome of encouraging the efficient use of an asset is to increase the total use of the asset. Achieving this outcome, in turn, would lead to a reduction in the average price for the regulated services over the life of the asset, and also lead to additional customers being served by the network over the network's life. These outcomes should promote the long-term interests of customers.

55. Alternatively, the AER may have intended to say that:

   a. *if* altering the time-path of fixed cost recovery was not expected to affect investment incentives or the efficiency of use of an asset,

36 AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, pp.32.

b. *then* the long-term interests of consumers would be unaffected (i.e., that there is no further effect to be considered).

56. If this is the AER's position, then we would not offer a contrary view. However, this just means that the assessment of a depreciation method must focus on the effect on incentives for investment and upon the efficiency of use, which we would also agree with.

2.4.4 ERA's comments about the long-term interests of consumers

57. On the question of promoting the long-term interests of consumers, I note that the AER referenced comments by the ERA on this matter. These comments questioned whether advancing the recovery of capital is something that would be in the long-term interests of customers if all that this did was to permit the recovery of sunk costs (i.e., assets that could not be redeployed elsewhere). The ERA framed the application of the long-term interests test as being one that is applied at a point in time, and so without regard to history, including commitments or understandings that may have underpinned the investment.

58. In our view, there are three reasons as to why providing an opportunity to recover sunk costs may advance the long-term interests of consumers.

a. First, even where reticulated gas was expected to cease as a consequence of measures to reach net zero, material capital expenditure may nonetheless be required to ensure that consumers receive the services they seek over the intervening period. Whether commitments are maintained in relation to the recovery of *existing* sunk costs is likely to condition the risks that investors perceive over the recovery of new investment that will also be sunk once committed, and hence their incentive to invest.

b. Secondly, where a transition to reticulated hydrogen is a possibility, material expenditure may be required to ensure that this option is retained (I discuss the merits of this optionality-expenditure in section 4.2below). Similarly, whether commitments are maintained in relation to the recovery of *existing* sunk costs is likely to affect the incentives for this new investment.

c. Thirdly, the treatment of sunk costs in the gas sector is also likely to condition how investors perceive the risks to the recovery of sunk investments in other sectors – such as electricity – and hence the incentive for investment in those other sectors.[37] We note here that the AER has stated that the consideration of the long-term interests of consumers as required by the objective of the regime should extend to a consideration of consumers across the energy sector more generally.[38] To this end, it is noted that the less important that new investment in gas infrastructure becomes, the more important that investment in electricity infrastructure is likely to become.

[37] Noting in particular that the "revenue and pricing principles" are materially the same between the gas and electricity sectors.

[38] AER (2021), Information Paper: Regulating gas pipelines under uncertainty, November, pp.58-59.

59. Lastly, we note more generally that in relation to gas pipeline assets, no arguments have been raised that the investments made in the past would not have been made even if there had been perfect foresight about the current risks facing the sector. Rather, if regulators in the past had had perfect foresight, the only change would have been that assets would have been depreciated more quickly and prices in the last would have been higher. This context is relevant to the broader question about whether the long-term interests of consumers have been promoted over time, and how best the overall balance of interests between the parties could be achieved from this point forward.

2.4.5 Technical issue: advancing depreciation and incentives for investment

60. The AER observed that there is a potential that the advancement of depreciation may reduce the incentive for investment (and, more specifically, deter investment), rather than raise the incentive for investment as we argued above. Specifically, it commented as follows:[39]

Specifying shorter asset lives for new pipeline assets could preserve the effective incentives required for regulated businesses to make new investments. On the other hand, shortening the remaining asset lives of existing assets (i.e. the RAB) could potentially limit the incentive for the regulated businesses to make new investments. This is because they may prefer to prioritise cost recovery of the existing RAB over adding new capital expenditure to the RAB while avoiding price increases that may encourage further customer disconnections. [emphasis added]

61. The AER's comment that advancing the recovery of the existing RAB may dissuade investment would appear to reflect the following chain of logic:

a. the distribution business is assumed at present to be close to a binding price constraint (e.g., due to a competing energy source), and

b. it is further assumed that there is discretionary investment that could be made that, if undertaken, would raise prices (and without creating an additional offsetting additional value to consumers), so that

c. if prices were raised closer to the binding price constraint, additional investment may not be recoverable (irrespective of the wishes of the regulator), and so not undertaken.

62. However, whist we do not dispute that these concerns may have validity in some circumstances, they do not appear to be consistent with the challenges and opportunities facing the Victorian Networks.

a. First, an implication of the Victorian Networks' modelling (discussed below in section 3.1), is that there is not a binding price constraint at the present time, and so advancing depreciation would not present a barrier to current investment. Indeed, it is logical for a business to recover more of the investment cost early where there is less substitutability with other energy services. This is because it will reduce the potential of reaching the binding price constraint in the future; or at least delay when that

39 AER (2021), Information Paper, November: Regulating gas pipelines under uncertainty, p.31.

constraint is reached. As a result, the incentives for investment in future periods would improve given the cost recovery demands at that time are reduced.

b. Secondly, we would expect most discretionary investment undertaken by a pipeline owner faced with stranded asset risk to relate to the connection of new customers. As discussed in section 4.1, this investment has the potential to reduce prices and so assist with overall cost recovery, even where the risk of asset stranding is high. One type of discretionary investment that may increase cost is expenditure that is needed to preserve the option to transition to hydrogen in the future.[40] However, businesses in the position of the Victorian Networks would have strong incentive to undertake this investment in order to preserve the longevity of their networks if possible.

2.4.6 Relevance of the redundant capital provisions in the gas rules

63. The capital redundancy provisions in the National Gas Rules are an example of what may be referred to as a device for creating a hypothetical, regulator-driven asset stranding risk, in order to influence the incentives of a regulated business. That is, creating a link between the capital base and some measure of utilisation would be intended to encourage the regulated business to do things that it otherwise would not do in order to reduce the change of its capital base being reduced.

64. However, this incentive scheme – if created – would need to comply with the broader guidance of the regulatory regime, a critical feature of which is that the regulated business is provided with a reasonable expectation to recover its cost. Thus, for this scheme to be implemented in a manner that is consistent with the broader regime and economic principles, there would need to be compensation provided for the downside risk (there is no potential upside from this regime). Thus, this mechanism would have the same problems that the AER identifies with compensating for stranded asset risk, namely, the difficulties with quantifying the compensation and the potential for windfall gains or losses.

65. In addition, we would question whether there is any merit in creating a *hypothetical* regulator-driven stranding risk for gas networks at this present time, given the *real-life* standing risk that now exists as a consequence of technological change and the transition to net zero.

66. Lastly, we note that the gas redundancy provisions in the rules would appear to be a largely voluntary regime, and one that it would be unlikely for a provider and customer to agree to in view of the uncertainty that is created and the potential for windfall gains or losses. Moreover, we agree with the AER's observation that it is not obvious that the incentives created by stranding risk are necessarily perfectly aligned with the pursuit of economic efficiency.[41]

40 We understand, however, that the extent of hydrogen-readiness expenditure that is proposed for the next access arrangement period is very small.

41 AER (2021), Information Paper, November: Regulating gas pipelines under uncertainty, p.28.

3. Assessment of the Victorian Networks' depreciation proposals

3.1 The Victorian Networks' modelling

67. The Victorian Networks have conducted an extensive modelling exercises to develop their ideas and to assess the merits of different depreciation options, which can be summarised as follows.[42]

a. The Victorian Networks commenced with four scenarios to represent possible "futures" for energy supply and use in Australia. These scenarios were developed through a consultative process. The scenarios differed on such matters as: the trajectories of electricity prices; the price and scale of hydrogen production; the price of natural gas; consumer preferences for gas; and the extent of measures taken to achieve "net zero".

b. The Victorian Networks then forecast the "cost of service" for the relevant gas distribution networks (AGN and Multinet were modelled separately) spanning the period from 2023 to 2100. One of the inputs into the calculation was the depreciation method, for which a flexible version was applied that allowed the annual depreciation to be varied and compared to the standard straight-line method.[43]

c. For each of the scenarios, an annual price and demand (quantity) level were calculated to be consistent with the "cost of service" derived above. This calculation included a module that generated the quantity from a model of consumer choice between gas supply (natural gas initially, and then a conversion to hydrogen under some scenarios) and substitutes energy forms.

   i. The customer choice module assumes that customers make a decision between consuming gas or an alternative energy source at the time that major appliances need to be installed or replaced. Demand is not assumed to respond materially to price changes between appliance replacement decisions (that is, whilst gas consumption is forecast to respond to price changes, the decision to remain connected to gas is not).[44] A 15 year appliance life was assumed, implying that approximately 1/15th of customers are able to switch in each year.

   ii. The customer choice module models a range of factors that affect appliance choice, including the price of appliances, the (variable) price of delivered electricity, the non-distribution components of the delivered price of gas. In addition, some stickiness of customer choice is assumed, whereby some customers may remain on gas even as gas is relatively more expensive (and with an increasing proportion then switching as the price-gap increases).

---

42 A summary is provided here only, a more detailed explanation and justification for the different components is included in the Victorian Networks' proposal documents.

43 More specifically, the Victorian Networks' modelling involved only varying the depreciation for existing assets, although it noted that this could be extended to new assets in the future.

44 Clearly, customers will respond to very large price changes even between appliance replacements. For this reason, the Victorian Networks applied a limit to the extent to which gas distribution prices are allowed to increase (which it set at a factor of 1.7 times the 2022 price, in real terms).

Customers are assumed to make appliance decisions based on the lifecycle cost with current-year prices applied as their forecast over the life of the appliance.

d. From the "cost of service" calculations and price / quantity pairs described above, the Victorian Networks were able to observe for each of the scenarios and for the chosen settings in their flexible depreciation methods:

i. The trajectory of the annual cost-based prices, commencing with those in the next access arrangement period[45]

ii. Gas demand – and hence utilisation of the infrastructure – over the analysis period, and

iii. Whether – under the assumptions applied – the capital base would be fully recoverable over the analysis period, or whether some economic stranding of assets would occur and when this would commence occurring.[46]

e. The Victorian Networks then tested alternative settings in their flexible depreciation methods, and observed how the outcomes summarised above would change.

68. The Victorian Networks' key findings from their modelling are summarised in the following section. The Victorian Networks' proposals are to increase depreciation by $145 million and $76 million for AGN and Multinet respectively for the next access arrangement period compared to the amount that would have been derived under the previous depreciation method. This amount has been designed to not raise prices materially in the next access arrangement period compared to 2022 (in real terms).

3.2 Assessment of the Victorian Networks' depreciation proposals

3.2.1 Introduction

69. In the discussion in chapter 2, we summarised the requirements of the gas regulatory framework for the choice of depreciation, the principal of which were to:

a. provide a reasonable opportunity to recover efficient cost, and

b. deliver a time-path of prices that encourages the efficient use of the network, of which we also identified stability in prices as an important component.

---

45 The cost-based prices generated in the model are not those that the Victorian Networks necessarily would be expected to charge because lowering charges in some circumstances would be expected to raise profits (i.e., where the cost-based prices encouraged substantial switching to alternative energy sources, and lowering prices would raise revenue whilst still covering forward-looking costs). However, it is correct to focus on the effects of cost-based prices given that this is the focus of the regulatory regime.

46 The remaining RAB at the time that asset stranding occurs is expected to provide a strong indicator of the degree of stranded asset risk, although it would be expected to overstate the extent of asset stranding that would actually occur. This is because a business in this situation would lower prices – and so raise demand and revenue – and recover some of the capital base provided that revenue is sufficient to recover forward-looking costs.

70. In the discussion below, we address in turn:

a. the Victorian Networks' modelling technique

b. the form of depreciation method that the Victorian Networks chose to represent a more flexible approach to depreciation, and

c. the outcomes of its modelling, and how they relate to the requirements summarised above.

3.2.2 Modelling technique

71. In terms of the Victorian Networks' modelling technique, in our view this provides a very useful framework for predicting the effect of changes in the approach to depreciation, and then evaluating this against the requirements of the gas regulatory framework. The central object of their modelling is to project the likely future price and demand for gas network services – both under a business-as-usual depreciation method and with depreciation advanced by a particular amount – which is a key to understanding the implications of the choice of depreciation method for the requirements of the regulatory framework. That is:

a. the projected demand for network services will shed light on how changing depreciation will affect the utilisation of the infrastructure

b. the projected (cost based) price will show how stable that price is expected to be over time, and

c. whether there is a demand for network services at the price required to allow the recovery of cost will be implicit in the price and quantity pair – to the extent that the existence of substitutes means that cost cannot be recovered, a sharply escalating (and ultimately infinite) cost-based price is generated (at which point the calculation in the Victorian Networks' models stops).

72. There are two aspects of the Victorian Networks' modelling to which we would draw attention in particular.

73. First, representing the range of possible futures via scenarios that were developed through a consultative process provides, in our view, the best means of attempting to reduce the complexity of the future into something that can be subject to analysis.

a. Indeed, the Victorian Networks' analyses of the future risks facing the gas distribution sector modelling highlight the challenges with deriving what may be seen as a "perfect" depreciation method today.

b. A direct implication of the Victorian Networks' modelling is that the assessment of a proposed approach to depreciation requires a judgement to be exercised, after considering the outcomes that are observed across the range of scenarios.

74. Secondly, the Victorian Networks' modelling of consumer choice is, in our view, the most robust method for accounting for the response of customers to changing relative

prices in the future. The alternative would have been to assume elasticities of demand (with differing elasticities applying at the point in time where customers make a choice of appliances than applies between appliance decisions), but this alternative would have been much less reliable and informative than the Victorian Networks' approach of modelling the key drivers of long-term gas consumption.[47]

3.2.3 Form of alternative depreciation applied by the Victorian Networks

75. The Victorian Networks have proposed advancing depreciation by a stated dollar amount for the next regulatory period, rather than moving to an alternative depreciation method. However, the Victorian Networks have developed their proposals by testing different specifications of an alternative depreciation method, which is a simplified version of the tilted annuity depreciation method. We understand that the Victorian Networks are open to implementing a different depreciation method from the commencement of the next access arrangement period. However, the AER has indicated that implementing tilted annuity depreciation would require a change to the PTRM, which the AER does not think would be practicable in time for the next access arrangement period.

76. In our view, the Victorian Networks' proposals to apply a fixed change to depreciation for the next access arrangement period is an appropriate compromise in view of the time constraints to changing the PTRM. We note further that:

a. the aggregate depreciation allowances that the Victorian Networks have derived, and the closing capital base values, will be the same as those that would have resulted if it had switched now to the simplified tilted annuity depreciation method, and so

b. if the Victorian Networks were to switch to the simplified tilted annuity method from the commencement of the subsequent access arrangement period, and applied the same tilt factor, then the same outcomes would result as if the Victorian Networks had applied the new method from now. Similarly, if the Victorian Networks sought to change aspects of the depreciation method (such as the simplified tilt factor), then that change could be a focus for consultation.

77. One improvement that could be made to the Victorian Networks' proposals would be to implement the full version (rather than the simplified version) of the tilted annuity depreciation method when deriving the proposed change to depreciation for the next access arrangement period. In our view, in the longer run, the tilted annuity depreciation method is likely to be an appropriate method for addressing the challenges facing the regulated gas sector, for the following reasons.

a. The method is flexible in that different degrees of advancement of depreciation can be specified by varying a single parameter (the "tilt" factor).

b. In addition, the method – and the tilt factor – has a very simple interpretation: the method generates a capital charge (being the sum of the return on assets and

[47] The future responsiveness of demand to changes in gas network charges will depend on a range of future factors that are likely to differ across the scenarios that the Victorian Networks modelled, and also to differ across time. It would be difficult (if not impossible) to employ existing estimates of demand elasticity in a manner that reliably reflects these scenario-dependent and time-varying factors.

depreciation allowances) that changes over time at a rate equal to the tilt factor. Thus, in a simple, single-asset case, if demand is expected to decline by 2 per cent per annum, then selecting a tilt factor of -2 per cent would generate a capital charge that declines by 2 per cent and so creates a constant capital charge per unit.[48]

c. There is also precedent for the use of the tilted annuity depreciation method both in cases where depreciation is being advanced relative to straight line depreciation, and also in cases where depreciation is being back-ended (i.e., in cases where demand is growing and existing assets have material spare capacity).[49]

d. Lastly, whilst the tilted annuity depreciation method is often applied to derive the annual capital charge directly (i.e., not separating out depreciation), simple equations exist for deriving the depreciation component in isolation. These equations, in turn, could simply be inserted into the PTRM without any need to change the structure of the PTRM. We set out these equations in Appendix B.[50]

78. While the simplified depreciation method the Victorian Networks applied is as flexible as the fully specified tilted annuity method, the method and tilt factor do not have the same logical interpretation.

3.2.4 Outcomes of the Victorian Networks' modelling

79. In our view, the outcomes of the Victorian Networks modelling provide a firm basis for accepting that their proposed advancements of depreciation would better meet the requirements of the gas regulatory regime than the current depreciation method (straight line depreciation with an inflation-indexed capital base).

Price stability

80. The most difficult issue to form a firm view on is the relative stability of prices under the previous and proposed depreciation methods, which the Victorian Networks have

---

48 Note that this outcome would apply for a single asset business. Where depreciation is applied to individual assets with differing remaining lives and capital expenditure is taking place, there will not be as clear a link between the selected tilt rate, expected demand growth and the time profile of the capital charge, and it will be necessary to test the overall effect of a tilt factor and refine it.

49 As the AER pointed out, tilted annuity was the standard depreciation method for determining telecommunications access charges where the "total service long run incremental cost" (TSLRIC) method was applied. In addition, it has been used in the context of the building block approach by Christchurch International Airport Limited to set its regulated aeronautical charges (CIAL, 2017, Disclosure relating to the reset of aeronautical prices for the period 1 July 2017 to 30 June 2022, section G3, available at: https://www.christchurchairport.co.nz/about-us/who-we-are/financial-reports/regulatory-disclosures/), by Chorus NZ for certain assets as part of its fibre access charge calculations (Commerce Commission, Fibre Price-Quality Path Determination 2021, p.14), and is being contemplated by the Port of Melbourne in relation to its regulated port usage charges (this is set out in a report that we prepared for the port: Incenta (2021), Options for structuring the return of capital for the Port of Melbourne, May, available at: https://www.esc.vic.gov.au/transport/port-melbourne/port-melbourne-compliance-pricing-regulations#tabs-container2).

50 We set out two equations for completeness: the first equation expresses deprecation as a function of the original cost and the original life of the asset by year, and the second expresses depreciation as a function of the written down value and remaining life of the asset by year.

analysed via a visual representation of the projected cost-based price paths. We would observe from the figures that they have generated that, in the majority of the cases:

a. their proposed advancements of depreciation either reduce the extent of the price increase expected in the future, or

b. where the price is expected to signal asset stranding at some time in the future, this point is reached much later than if depreciation was not advanced.

Stranded asset risk

81. In terms of the opportunity to recover cost, the potential for asset stranding under the previous depreciation method is present under the "electric dreams", "dual fuel" and "muddling through" scenarios for AGN and the first two of these scenarios for Multinet.[51] The proposed advancements of depreciation are projected to:

a. remove stranded asset risk for AGN under the "muddling through" scenario and for Multinet under the "dual fuel scenario", and

b. materially reduce the stranded asset risk of AGN and Multinet under the other scenarios.

82. Indeed, whilst the Victorian Networks' proposals reduce stranded asset risk materially for both AGN and Multinet as noted above, material stranded asset risk nonetheless remains under the "electric dreams" scenario for both networks. Moreover, the Victorian Networks' analyses suggest that there would be scope to advance depreciation to the extent that stranded asset risk is substantially eliminated for both networks.[52] In our view, the Victorian Networks' proposals arguably contain less of an advancement of depreciation than the regulatory regime would authorise. That is, in our view, it would have been open for the Victorian Networks to advance depreciation to a degree that would have retained the flexibility for stranded asset risk to be substantially eliminated under all scenarios, even if this required a more significant increase to near-term prices. We say this in view of the importance of providing a reasonable expectation of cost recovery for the necessary capital to be attracted to the broader energy sector, and because the flexibility exists to refine depreciation over time as new information on the nature of the gas sector future emerges.

---

51 We understand that much of the difference in stranded asset risk between AGN and Multinet stems from the fact that electricity network charges are higher in the area served by Multinet than for AGN. This would stem from the fact that much of Multinet's service area would coincide with the United Energy electricity distribution network, which serves both the Melbourne metropolitan area and the Mornington Peninsula, which is semi-rural and rural.

52 The Victorian Networks' analysis shows that, if maximum depreciation is applied – in which prices are capped at a multiple of approximately 1.7 times their current levels – then the capital base at the stranding date is reduced to approximately 3 per cent and 4-8 per cent (depending on the scenario) of the current capital base for AGN and Multinet, respectively.

Efficient utilisation of the asset

83. Lastly, in our view a very important contribution of the Victorian Networks' depreciation proposals is to generate time paths in prices that would be expected to improve the efficient utilisation of the assets.

84. A strength of the Victorian Networks' modelling is that these generate a direct estimate of the extent to which the changes in depreciation are expected to alter the utilisation of the assets over time, and in total. As the Victorian Networks have summarised in their own documentation, their proposed changes to depreciation are projected to increase the total use of the networks over their lives in all scenarios for Multinet, and in all scenarios except one for AGN, with this last scenario being the "electric dreams" scenario where material stranded asset risk remains. Thus, one outcome of the Victorian Networks' modelling is a demonstration that the goals of both improving the efficient use of the network, and reducing stranded asset risk, can be promoted simultaneously by advancing depreciation.

85. In our view, the Victorian Networks' observations that the total use of the networks increases in all instances except the one identified is sufficient to form a strong presumption that the efficiency of use of the networks – allocative efficiency – would also improve from their proposed advancements of depreciation. However, we have also confirmed this presumption with an approximate estimate of the gain in allocative efficiency expected from advancing depreciation.

86. Our method for estimating this change in allocative efficiency is set out in Appendix A, but in broad terms involves estimating the standard change in economic welfare from a change in the mark-up over marginal cost under the simplified assumption of a linear demand curve.

    a. One complexity with this estimation, however, is that the greatest contribution of advancing depreciation under some scenarios (notably "dual fuel" for both networks) is to extend the life of the network, and hence the duration for which the service is available to customers.

    b. We have estimated this gain in allocative efficiency by assuming the increase in use generated by advancing depreciation creates a fixed per unit increase in allocative efficiency, for which we assume a fixed per unit gain of $2 per GJ.

        i. As discussed more fully in Appendix A, this is equivalent to assuming a gap between the price and marginal cost of distribution services of $2 per GJ, which we believe to be conservative.

        ii. However, we also report below the estimate of the allocative efficiency gain if this benefit from the extension of supply is ignored.[53]

53 The importance of the extension of supply for allocative is most apparent in the "dual fuel" scenario for AGN. The table below shows that advancing depreciation under this scenario for AGN results in a very large increase in the total volume of gas delivered (a 51.4 per cent increase), but an allocative

87. The resulting estimates of the change in allocative efficiency are set out in the table below.[54] The results shown are the simple sum of the annual changes in allocative efficiency over the life of supply. This table shows that the Victorian Networks' proposed advancements of depreciation are estimated to increase allocative efficiency:

a. in all cases except "electric dreams" and "dual fuel" for AGN if the allocative efficiency benefit from extending supply is ignored, and

b. in all cases except "electric dreams" for AGN if a conservative estimate of the benefit of the extension of supply is considered.

Table 1 – Effect of advancing depreciation on allocative efficiency

Distributor	Scenario	Change in quantities (%)	Efficiency gain - ignoring benefit of extending supply ($m)	Efficiency gain - $2/GJ benefit from extending supply ($m)
AGN	Electric Dreams	-3.0%	-107	-107
AGN	Dual Fuel	51.4%	-131	718
AGN	Muddling Through	19.8%	1,164	1,561
AGN	Hydrogen Hero	6.6%	1,117	1,117
Multinet	Electric Dreams	3.4%	6	68
Multinet	Dual Fuel	45.5%	34	897
Multinet	Muddling Through	4.5%	645	645
Multinet	Hydrogen Hero	1.9%	298	298

88. Moreover, we have also tested plausible sensitivities to the key inputs, and find that the results remain qualitatively unchanged.

efficiency loss if the benefit of the extension in supply is ignored. However, under this scenario, advancing depreciation is projected to reduce the volumes sold during the period when gas supply would exist irrespective of advancing depreciation, but to allow supply to be extended under cost-based prices for a further 29 years compared to the case if the depreciation method and settings remained unchanged. A similar pattern is also observed for Multinet under the "dual fuel" scenario.

54 The changes in allocative efficiency presented here reflect the sum of the annual allocative efficiency effects over the life of the relevant network under the indicated scenario.; however, we also tested the effect of discounting the annual efficiency changes (using a real discount rate of 3 per cent), and found no change to the qualitative conclusions.

4. Related issues – prudence of new investment and investment for hydrogen readiness

4.1 New investment

89. We were asked to comment, as a matter of principle, whether the continued connection of new customers could be a prudent activity for a gas network in view of the future risks facing the sector.

90. In our view, the continued connection of new customers could, if undertaken appropriately, have two effects that would be consistent with prudent investment.

    a. First, where the incremental cost to the network of connecting new customers is below the average cost of supply, then connecting those customers will *reduce* the cost-based price compared to the situation where those connections were not made. This reduction in the price would be expected to reduce the risk of future asset stranding, and also promote the efficient use of the networks.

    b. Secondly, connecting more new customers now will also increase the scale and geographic reach of the gas network at the time that a conversion to hydrogen may take place,[55] and so may also raise the viability of a shift to hydrogen by increasing the scale at which hydrogen could be supplied. This increased scale is likely to raise the likelihood that a conversion to hydrogen is commercially viable, and so act to preserve this option for customers.

91. In terms of the connection of new customers, we note that the Victorian Networks have created a simple model to assess the effects on prices under assumptions about asset stranding for stylised cases. In that model, the Victorian Networks have shown that, even if there was a known stranding event within the technical life of the existing and new assets, connecting new customers would reduce the cost-based charge to existing customers provided that the incremental cost of new customers is lower than the average cost. With a sufficiently small incremental cost of connection, the Victorian Networks found that it could be in the interests of existing customers for new customers to continue to be connected until reasonably close to the stranding event.[56] We have reviewed this model, and agree with its stylised conclusions.

92. An important question, therefore, is how the (annualised) cost of a new connection to the network relates to the average cost of service. We understand that the incremental cost for many new connections is well below the average cost of service, and so this outcome

55 Importantly, it is far cheaper to install gas networks at the time that new subdivisions are created than to attempt to back-fit networks to already developed areas. Thus, it is likely that if gas networks are not installed in a new subdivision at the same time as other utilities, then reticulated hydrogen will not be available in the area if a reticulated hydrogen service subsequently develops.

56 More specifically, what matters is whether the annualised connection cost per customer is lower than the current embedded cost per customer. As the stranding date nears, the annualised cost of a connection (i.e., assuming the same capital cost) will increase as the period of recovery shortens, and so – all else constant – there will be a point at which connecting new customers will no longer be beneficial to existing customers.

is achieved in these cases. For the remainder of connections, networks are permitted to levy an upfront customer contribution (or capital contribution) to bridge the difference between the incremental revenue and cost projected from a new connection, subject to the guidance for the calculation. In this regard, we observe that it will be important to review the guidance on how surcharges are to be calculated in the future as the uncertainty facing the gas sector gets resolved.

a. For example, if it becomes more likely that reticulated gas supply will cease around a particular date (and a switch to reticulated hydrogen is unlikely), then this information should be applied when calculating upfront contributions.

b. Failing to do this may imply that the connection of new customers causes the prices to existing customers to increase and stranded asset risk also to increase.[57] We would also expect regulated businesses to be very cautious about connecting new customers in this scenario if the assumptions applied to calculate upfront contributions do not change. This is because connecting new customers in a circumstance where this would require cost-based prices to increase may increase the risk of asset stranding.

4.2 Investment for hydrogen readiness

93. Some of the scenarios for the future that the Victorian Networks have modelled assume a conversion of reticulated natural gas supply to a reticulated hydrogen supply at some time in the future. We understand that one possibility (noting that uncertainty remains) is that the conversion to hydrogen occurs via hydrogen production close to the source of consumption, so that the current interconnected gas distribution networks would evolve into a series of networks around hydrogen production locations. In this situation, depending on how the relative costs hydrogen supply evolve, parts of the current network may convert to hydrogen supply and parts may not, with the areas that are closer to viable sites of hydrogen production being more likely to convert.

94. We further understand that the costs to the Victorian Networks of preparing their networks for conversion to hydrogen are relatively modest. This is because much of its networks are constructed of polyethylene pipe, which is able to carry hydrogen, and because hydrogen-ready meters are currently available at of a similar cost to conventional natural gas meters. This means that, at the time that the installation of a new meter or replacement of an existing meter is required, this can be done with a hydrogen-ready unit with little difference in cost, so that little accelerated replacement of meters would be required at the time of conversion.

95. In our view, expenditure that retains the option to customers of converting natural gas networks to reticulated hydrogen could be of obvious net benefit to customers. Under some of the scenarios that the Victorian Networks have modelled, reticulated hydrogen is likely to be competitive with alternatives, and so preserving this option would generate a

57 The tendency for the connection of new customers to become a burden on existing customers as the stranding date becomes closer in time as implied in the previous footnote would be offset if the upfront customer contribution also increased to reflect the reduced connection life as the stranding date neared. If these upfront charges were calculated correctly – and so increased as the stranding date neared – then the preparedness of customers to pay the upfront charges would provide a natural brake on connection activity.

benefit if that scenario came to pass. Whether expenditure to preserve the option to customers of a future conversion to hydrogen would depend upon:

a. the future benefit to customers from a reticulated hydrogen service, which may vary across a range of scenarios

b. the likelihood of the scenario in question, and

c. the cost of the investments required to preserve hydrogen readiness.

96. We note that the Victorian Networks have referred in their materials to "real options" theory when discussing the merits of hydrogen-readiness expenditure. In our view, real options theory provides important insights that are very relevant to the assessment of expenditures of this sort. A key insight from real options theory is that, where firms face material uncertainty and also are required to make decisions that are irreversible, then behaviours may become prudent and efficient that not would be in a world of perfect certainty. For example, the following behaviours may be prudent and efficient:

a. Incurring small amounts of expenditure to defer a large project (such as an augmentation or replacement) in circumstances where further information about the need or required timing of the project may arrive over time. Importantly, it may be prudent to incur a greater total cost than would have been incurred under the "most likely" forecast of the future in order to create the flexibility to respond to different possible futures.

b. Following the same logic as above, a firm may choose to augment capacity in stages via smaller increments – even though the total cost may be higher than under a single, large augmentation – as the "modular" option provides the flexibility to respond to new information over time (including the potential for the large increment not to be required).

c. Incurring small amounts of expenditure to provide the flexibility to produce in the future where that right to produce may otherwise be lost. Whilst this is the obvious situation of hydrogen-readiness expenditure, it is the same decision a mining company makes when deciding to purchase exploration rights, or when deciding whether to close a mining operation entirely or to mothball it (i.e., spend money on maintaining the relevant plant so that a restart is possible).

97. This latter point may imply that it is prudent and efficient for a firm to spend small amounts of money so that it has several "irons in the fire", even though it is not certain that any particular "iron" will be taken up.

98. We would expect that it would be straightforward to justify at this stage small investments to preserve or enhance the option of hydrogen conversion (such as installing or replacing meters with hydrogen-ready meters when installations or replacements are required). However, as the uncertainty over the future of the sector is resolved, and if material investments are required, then a careful analysis may be required to judge whether further investment is justified. That said, gas networks are likely to face

increasing stranded asset risk if the likelihood of a hydrogen conversion falls, which will put a natural brake on inefficient investment.

A. Approximation for the change in allocative efficiency

99. Figure 1 shows how an approximation for the change in allocative efficiency can be estimated. The values derived are an approximation because a simple, linear demand function is used; notwithstanding, the approximation described here is frequently employed in applied economics.

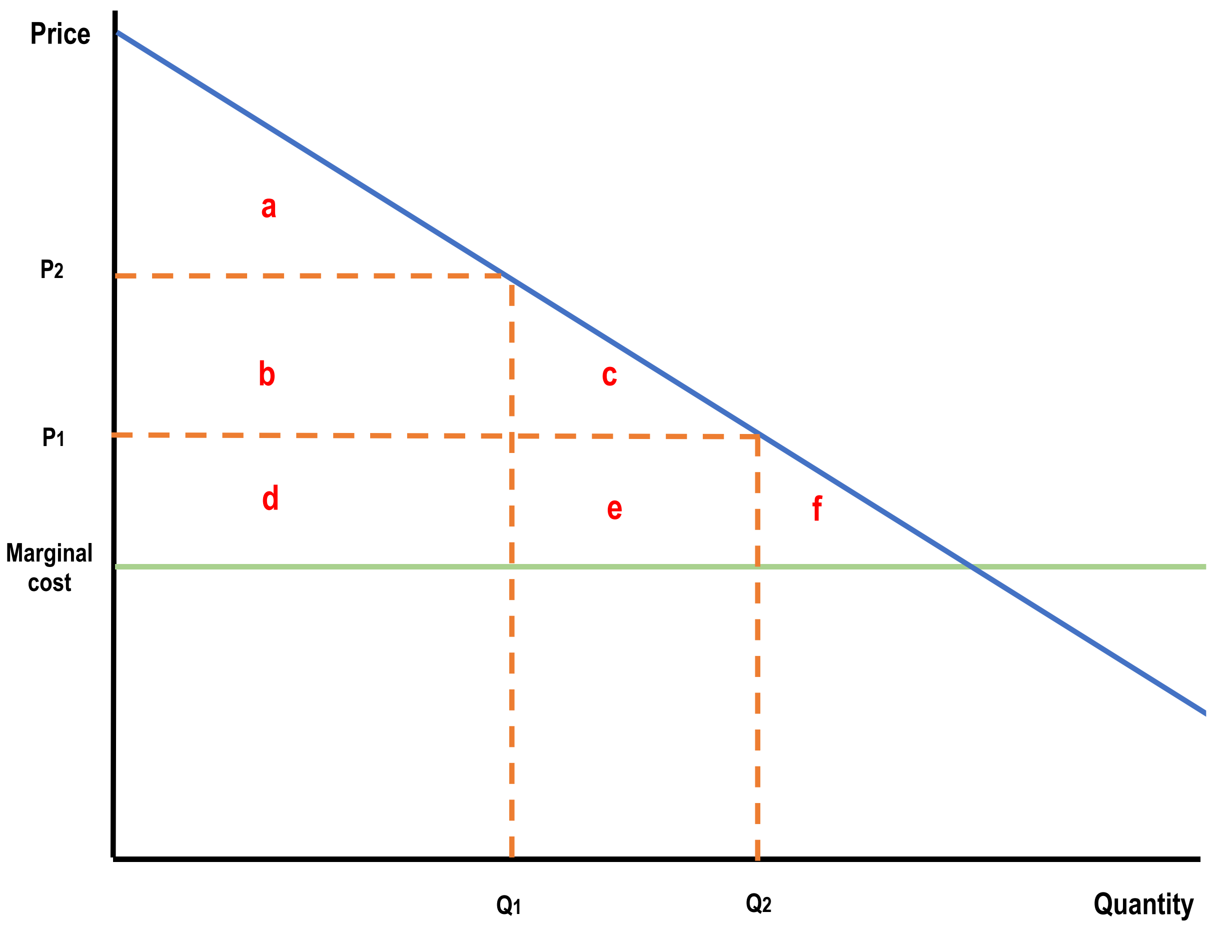
100. If the price commences at P_1 – which assumes there is a mark-up over marginal cost to recover fixed costs – then the economic welfare effects of this compared to pricing at marginal cost are that:

a. Consumer surplus decrease by the area: *d* + *e* + *f*

b. Producer surplus increases by the area: *d* + *e*, and so

c. The change in allocative efficiency (the deadweight loss) is the difference in these changes, i.e., area: *f*.

Figure 1 – Approximation for change in allocative efficiency



101. If the price is now increased to P_2, then:

a. Consumer surplus falls further by the area: $b + c$

b. Producer surplus increases by area: $b – e$,[58] and so

c. The change in allocative efficiency from prices increasing from P_1 to P_2 is given by area: $(b + c – (b – e)) = c + e$.

102. Expressing these areas in terms of the changes in prices and quantities implies that the approximation for the change in allocative efficiency from an increase in price from P_1 to P_2 (where P_1 is above marginal cost) is given by:

$$\mathit{Change\ in\ allocative\ efficiency} = -\left(\frac{(P_2 - P_1)(Q_2 - Q_1)}{2} + (P_1 - MC)(Q_2 - Q_1)\right)$$

103. The same change in allocative efficiency would arise for a reduction in price from P_2 to P_1, except that the sign would be positive (i.e., signifying an increase in allocative efficiency).

104. The one shortcoming to this calculation is that it assumes that in all cases there would be a quantity demanded at both P_1 and P_2, which need not be the case. Indeed, one of the major benefits of the Victorian Networks' proposed advancement of depreciation in the "dual fuel" scenario for both networks is that the supply of reticulated gas is allowed to continue for longer under regulated prices than would have been the case without the advancement of depreciation. Estimating the allocative efficiency benefit of extending supply is much more difficult and sensitive to assumptions and so we have not attempted to estimate this directly. Instead, we have assumed that there is an arbitrary but small, fixed, per unit gain in allocative efficiency from the expansion in supply, and quantified the resulting gain in allocative efficiency.

a. We have assumed an increase in allocative efficiency of $2 /GJ as the arbitrary but small, fixed per unit gain for this calculation.

b. We note that allocative efficiency will increase whenever output expands and price exceeds marginal cost, as this reflects a situation whereby the societal benefit from consumption exceeds the marginal societal cost – this is equivalent to area e in the above diagram. Therefore, the assumption of a fixed, per unit gain in allocative efficiency of $2 per GJ can be interpreted as an assumption that:

i. There is a gap between the price of distribution services and the marginal cost of distribution services of $2 per GJ (which is likely very conservative, given that marginal cost in distribution is low and the distribution price rises above $10 per GJ in the most relevant scenario, and

ii. That the additional benefit from the gain in consumer surplus (the area of the triangle denoted by c in the figure above) is ignored.

58 Noting that the increase refers to the direction in which the change has expressed – producer surplus may increase by a negative amount, in which it would be a reduction in producer surplus.

105. In terms of the application of the formulae above to the Victorian Networks, we have applied the following simplifying assumptions:

a. We have applied the total price for gas distribution services converted to a per GJ rate – rather than applying the volumetric component only – because the main decision that consumers are assumed to make in the Victorian Networks' consumer choice models is between purchasing gas appliances and continuing to be connected, or to disconnect, and so the fixed charge will also influence behaviour.

b. In the period during which supply would be projected to continue at cost-based prices even if depreciation is not advanced, we have assumed that the marginal cost of gas distribution is zero, so that all of the price for distribution is a mark-up over marginal cost, and

c. We have assumed that, for the remainder of the supply chain, the charge for the element of the supply chain is equal to the marginal cost (as this remainder is dominated by the gas commodity component, we view this as reasonable). This permits us to focus solely on the gas distribution element of the supply chain when estimating allocative efficiency changes.

106. The resulting approximate estimates of the change in allocative efficiency from applying the method and assumptions above – together with the relevant price and quantity output of the Victorian Networks' models – are set out in the table below (this is a repeat of Table 1 above). The estimated changes in allocative efficiency are the simple sum of the annual changes in allocative efficiency over the period of supply.

Table 2 – Effect of advancing depreciation on allocative efficiency

Distributor	Scenario	Change in quantities (%)	Efficiency gain - ignoring benefit of extending supply ($m)	Efficiency gain - $2/GJ benefit from extending supply ($m)
AGN	Electric Dreams	-3.0%	-107	-107
AGN	Dual Fuel	51.4%	-131	718
AGN	Muddling Through	19.8%	1,164	1,561
AGN	Hydrogen Hero	6.6%	1,117	1,117
Multinet	Electric Dreams	3.4%	6	68
Multinet	Dual Fuel	45.5%	34	897
Multinet	Muddling Through	4.5%	645	645
Multinet	Hydrogen Hero	1.9%	298	298

107. We have also tested the sensitivity of these estimates to:

a. using only the volumetric component of the gas distribution prices in the calculations

b. plausible changes in the assumed marginal cost of gas supply as referred to in paragraph 105.b (namely an upper bound of $4 per GJ)

c. assuming only a very small fixed, per unit benefit from the extension of supply permitted by advancing depreciation (a value of $0.50 per GJ has been assumed), and

d. discounting the allocative efficiency benefits (applying a real discount rate of 3 per cent).

108. We find that the results are qualitatively unchanged after applying these changes individually or in combination.

B. Tilted annuity depreciation formulae

109. The outcome of tilted annuity depreciation is that the depreciation allowance is derived such that the sum of the return on assets and depreciation component for each asset grows over time at a pre-set rate. The pre-set rate can then be derived in order to target a particular objective, for example, to target a smooth time path pf prices.

110. The tilted annuity formula is often stated as one that generates a total capital charge (i.e., ROA plus depreciation); however, it is straightforward to derive the formula for the depreciation component as a separate item, and so apply the formula in a standard building block application. In the examples below, it is assumed that depreciation is calculated in real terms, so that the depreciation allowance that is generated is specified in constant prices. There are two variations possible.

111. The first variation derives depreciation by applying a rate to the *written down value* of an asset and that is based upon the *remaining life of the asset*. The formula for depreciation in year *i* under the tilted annuity method is as follows:

$$Dep_i = \left(1 - \left(\frac{(1+r)^{L-1} - (1+t)^{L-1}}{(1+r)^L - (1+t)^L}\right) \times (1+r) \times (1+t)\right) \times WDV$$

where *t* is the selected real tilt-rate, *r* is the real discount rate, *L* is the remaining life of the asset as at the beginning of year *i* and *WDV* is the written down regulatory value of the asset (i.e., the original cost less accumulated depreciation).

112. The second variation derives depreciation by applying a rate to the *original cost* of an asset and that is based upon the *original life of the asset*. The formula for depreciation in year *i* under the tilted annuity method is as follows:[59]

$$Dep_i = \frac{(1+r)^{OL}}{(1+r)^{OL} - (1+t)^{OL}}\left(\frac{r(1+t)^{OL}}{(1+r)^{OL-i+1}} - t(1+t)^{i-1}\right) \times Original\ Cost$$

where *OL* is the original life of the asset, *Original Cost* is the value recorded for the asset when it first entered the (regulatory) capital base, and the remaining terms are as defined above.

113. The Victorian Networks' simplified version of tilted annuity was derived by dropping the discount rate terms, and reversing the sign of the "tilt" factor,[60] and is as follows:

$$Dep_{i_i}^{Simplified} = \frac{t(1-t)^{i-1}}{1-(1-t)^{OL}} \times Original\ Cost$$

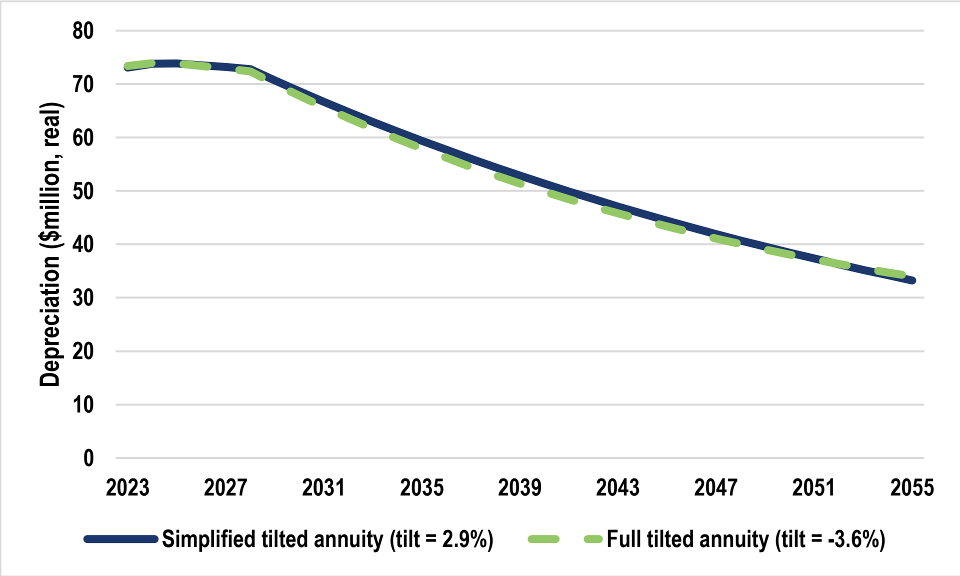
59 We normally use the first variation of the tilted annuity formulae shown here, and have derived this second variation to match the form of the depreciation calculations in the AER's PTRM. Whilst we have confirmed that this formula is correct, it may be possible to make further simplifications to the formula.

60 The tilt factor is normally specified as the growth rate of the annuity, and so a positive value implies a growing annuity and a negative value specifies a declining annuity.

114. We have derived the full tilted annuity equivalent to the Victorian Networks' proposals, and find that a tilt factor of -3.6 per cent and -3.2 per cent generates approximately the same depreciation for AGN and Multinet respectively for the next access arrangement period as the proposed tilt factors of 2.9 per cent 2.1 per cent under the simplified method. Moreover, we also find that there is quite a close correspondence between the annual depreciation amounts generated by the two methods, even many periods into the future. This is illustrated in the figure below. We conclude from this that it would be possible to apply the simplified tilted annuity method to derive the dollar-value advancement of depreciation for the next access arrangement period, and either continue using the simplified method, or switch to the full tilted annuity method from the commencement of the next access arrangement period, in a reasonable seamless manner.

Figure 2 – Annual depreciation for AGN and Multinet: simplified vs. full tilted annuity

AGN



Multinet