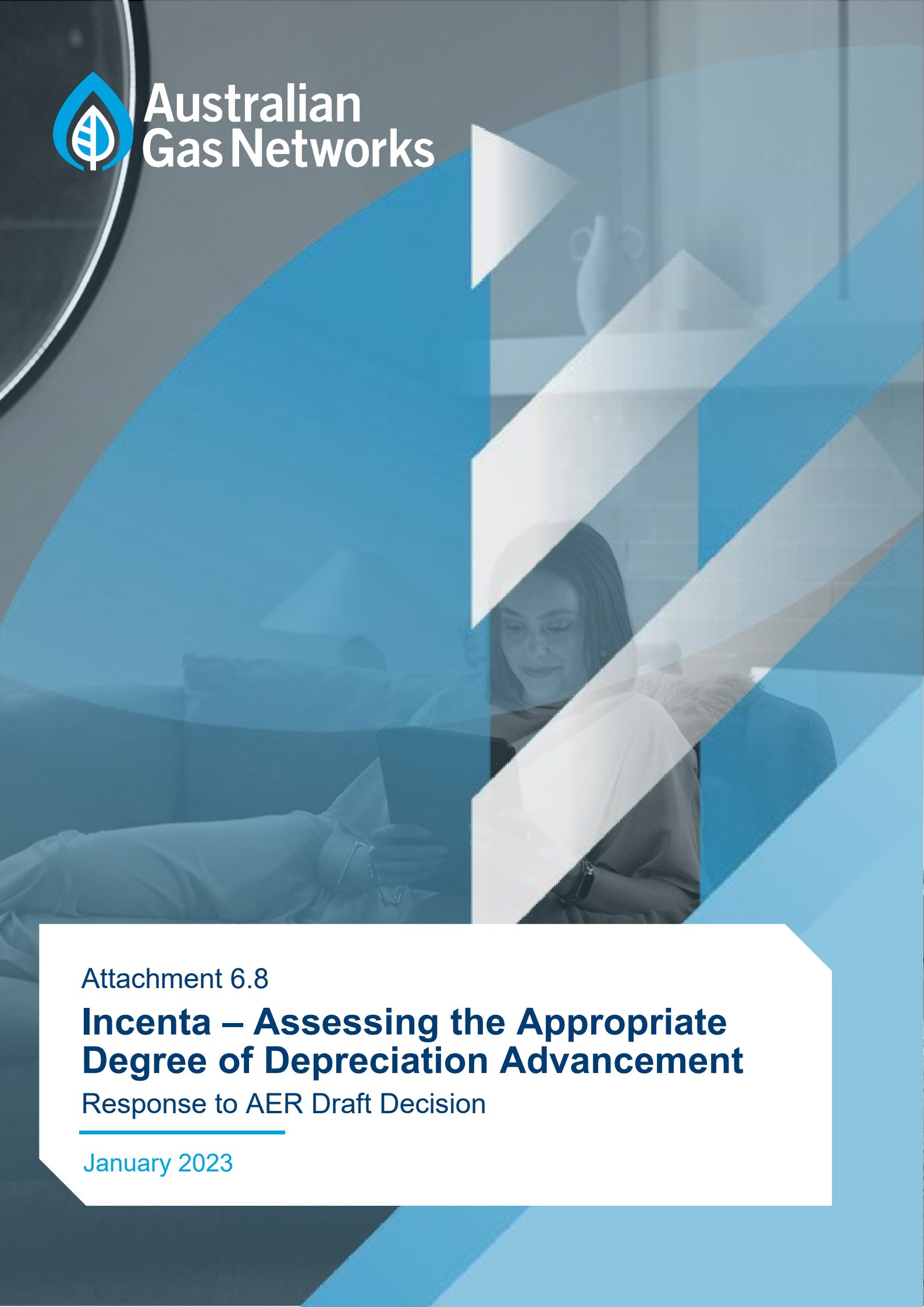

Australian Gas Networks

Attachment 6.8

Incenta – Assessing the Appropriate Degree of Depreciation Advancement

Response to AER Draft Decision

January 2023

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Australian Gas Infrastructure Group

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Assessing the appropriate degree of depreciation advancement

Introduction and summary

Purpose

You have asked me to comment on the method that Australian Gas Networks ("AGN") and Multinet Gas Networks ("MGN", and collectively the "Victorian gas distributors") proposes to determine the extent of advancement in depreciation that will promote the long-run interests of customers.[1] The background to this issue is the Australian Energy Regulator's (AER) draft decision in relation to the Victorian gas distributors, where the AER accepted an advancement of depreciation for both businesses, but only to the extent that real prices did not increase, implicitly suggesting that customers interests would only be promoted to the extent that real prices do not increase. The thrust of the Victoria gas businesses' proposal is to present an alternative framework for assessing whether a particular degree of advancement of depreciation would promote the interests of customers.

Summary of findings

The Victorian gas businesses have presented a number of indicators that are intended to provide guidance as to the degree of advancement of depreciation that will promote the long-term interests of customers. One indicator is the extent to which consumer surplus and allocative efficiency (which is the sum of consumer surplus and producer surplus) are promoted by a particular degree of depreciation advancement, across each of the modelling scenarios.[2] This proposal draws upon the work presented in my earlier report, where I set out a method for quantifying whether allocative efficiency would increase or fall as a consequence of a particular degree of depreciation advancement.[3]

Estimates of consumer surplus and the combined surplus to consumers and producers (allocative efficiency) provide useful information for choosing the extent to which depreciation should be advanced. One caveat to this, however, is that a focus on these surpluses – which are inherently short-run values – are likely to produce less advancement of depreciation than may be optimal. This is because the effects on investment are not considered.[4] I observe, however, that if the aggregated

1 I wrote an earlier report for the Victorian gas distributors that addressed the requirements of the depreciation rules in the National Gas Rules for the assessment of the Victorian gas distributors' depreciation proposals: Incenta Economic Consulting (2022), Assessment of compliance with the requirements for regulatory depreciation, June ("Earlier Report").

2 I described the Victorian gas distributors' approach to modelling the effect of advancing depreciation on future gas prices and demand – of which the application of different scenarios about the future was a key component – see Earlier Report, paras.67-68 and 71-74.

3 Earlier Report, paras.83-88 and Appendix A.

4 That is, a focus on consumer surplus or allocative efficiency does not factor in the effect of advancing depreciation for the potential for cost-recovery, and so does not consider the incentives created for future investment.

consumer surplus over time increases as a consequence of a specific advancement of depreciation, then this suggests that customers in aggregate would benefit from that advancement of depreciation *even before* considering the effect on investment and the benefit to customers from this investment.

I have reviewed the Victorian gas businesses estimates of consumer surplus and producer surplus (and hence on allocative efficiency) and have confirmed that these estimates are consistent with method I set out in this note, and so are, in my view, sound.

Guides for assessing the advancement of depreciation

Concepts of consumer surplus and producer surplus

Consumer surplus simply refers to the difference between the amount that a customer would be prepared to pay for a service,[5] and the amount that it is required to pay for that service. To the extent that the price paid is below the maximum the customer would be prepared to pay, then that customer is said to make a surplus. The preparedness to pay for a service across all customers is represented in the industry demand curve, which takes account of the aggregated customer preferences and the availability of substitutes, so that consumer surplus is given by the area under the demand curve but above the price (this is shown graphically in the appendix to this note).

The producer surplus is the parallel concept for the supplier, being the difference between the amount the supplier is prepared in the short run to supply a service, and the price that is received. The supplier's preparedness to pay for a service in the short run is given by the short run marginal cost, and so producer surplus is given by the area between the price and the short run marginal cost aggregated across the industry (this is also shown graphically in the appendix to this note for the simplified case where the short run marginal cost is constant).

The sum of consumer surplus and producer surplus is an indicator of allocative efficiency, which is a measure of the extent to which the usage of existing assets is optimised. To the extent that the price can be adjusted so that the sum of consumer and producer surplus increases, then a greater aggregate surplus from the use of the asset will result, and the efficiency with which the existing asset is used will increase.[6]

Advancing depreciation will increase prices in the short term, with lower prices than otherwise created in the longer term. The change in the trajectory of prices caused by advancing depreciation will also have a parallel effect on demand: demand will be lower than otherwise in the short term, but higher than otherwise in the longer term. These factors will have a flow on effect to consumer surplus, producer surplus and allocative efficiency:

- *Consumer surplus* – will be reduced in the short term but increase in the longer term

5 I refer here only to the case of providing "services" rather than "goods or services" for brevity (the former being the case at hand), although the concept applies to the provision of both goods and services.

6 Note that the demand curve for gas that has been produced by the Victorian gas distributors' "future of gas" modelling incorporates the effect on gas demand of the modelled future electricity prices. Accordingly, the modelling of the effects on price and demand of advancing depreciation – and the estimated surpluses that flow from this – already factors in the capacity for customers to switch fuels.

- *Producer surplus* – except for a special case, the effect of the change in prices will be ambiguous (and so an empirical matter) because:
  - higher (lower) prices will tend to increase (decrease) the surplus earned from pre-existing customers, but
  - also deter (attract) customers and so cause a loss (gain) in surplus associated with this change in customers.

As substantial changes to the sector will take place with the trajectory to net zero – which is expected to cause a material change in the relative price of substitutes – there is no reason to expect that, for example, a short-term reduction in consumer surplus will be offset exactly with an increase in consumer surplus in the longer term. Rather, it is plausible that the loss of consumer surplus caused by raising prices in the short-term will be more than offset by the increase in consumer surplus in future periods, or vice versa.

It follows that assessing how a particular advancement of depreciation is expected to affect the aggregated consumer surplus over time,[7] and the combined surplus of consumers and producers, can be a useful guide to the calibration of depreciation. In particular, it could be inferred that:

- if the aggregated consumer surplus increases with the advancement of depreciation, then customers in aggregate would be better off from the advancement of depreciation, as the short-term detriment from the price increase would be more than offset by the benefits from lower prices in the future and (where relevant) gas services continuing to be provided for a longer period, and
- similarly, if the aggregated combined surplus to consumers and producers increases as a consequence of a particular advancement of depreciation, then the aggregate surplus extracted from an existing asset would increase, and allocative efficiency would improve (i.e., the deadweight loss caused by pricing above marginal cost would fall).

The aggregated changes in these surpluses can be broken down to allow greater visibility as to the drivers of the change, of which three periods could be identified:

- *Period 1* – being where the price is higher as a consequence of advancing depreciation, with consumer surplus lower (and producer surplus potentially being higher or lower)
- *Period 2* – being where the price is lower as a consequence of advancing depreciation, with consumer surplus higher (and producer surplus potentially being higher or lower)
- *Period 3* – being where supply would have already ceased if depreciation had not been advanced, and both consumer surplus and producer surplus being higher.

As I noted in my earlier report, the Victorian gas distributors' "future of gas" modelling contains the key inputs that are required to estimate how a particular advancement of depreciation would affect

[7] By "aggregated", I mean summed over time, with a suitable discount rate applied.

consumer surplus, producer surplus and hence allocative efficiency. I address how these values may be estimated below.

Cautionary note: the effect on investment

Whilst I note that an assessment of how depreciation affects the surpluses discussed above is relevant to the choice of depreciation methods, it does not provide the complete picture. In particular, this analysis focusses on the creation of surpluses on the assumption that assets are in place. Thus, focussing on these measures:[8]

- need not ensure that the conditions are in place to ensure that incentives will exist for continued, efficient investment in the gas sector,[9] and
- ignore the potential for the perceived fairness of treatment of asset owners in one sector (i.e., the gas sector) to have flow on effects for investment in other sectors (e.g., the electricity sector).

Encouraging efficient investment in both the gas sector and in other sectors would advance the long-run interests of customers.[10] Accordingly, focussing only on the short-term surpluses has the potential to exclude consideration of other sources of benefit to consumers from advancing depreciation.

In the context of the energy sector – including the real risk of asset stranding for gas distribution businesses, and need for substantial investment in electricity networks – these additional considerations provide a further rationale for the advancement of depreciation. It follows that if a particular advancement of depreciation is found to be justified from an analysis of consumer surplus, producer surplus and allocative efficiency, then the rationale for that advancement would likely be even stronger once the full effect on investment is considered.

Measuring consumer surplus and producer surplus

Overall method

As I noted above and discussed at length in my earlier report, the "future of gas" modelling that the Victorian gas distributors have undertaken provides the key inputs (aside from those I discuss below) required to estimate the changes in consumer surplus, producer surplus and hence the combined surplus (i.e., allocative efficiency). The principal outcomes of this modelling that are relevant for estimating these surpluses are:

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8 My earlier report addressed in a number of places how the choice of depreciation may influence the incentives for investment and the importance of this criterion (as well the potential for incentives for efficient investment to require the foregoing of some efficiency of use): see Earlier Report, paras.17-18, 32, 34, 41-43, 45, 48-51, 57-59 and 81-82.

9 Indeed, the general case for natural monopoly sectors is that prices need to be set at a mark-up over marginal cost to allow costs to be recovered (and hence provide an incentive for investment). This means that some allocative efficiency is consciously sacrificed in order to ensure continued service provision.

10 My reference here to encouraging *efficient* investment is intended to refer to only those projects that are expected to generate sufficient benefits to be justified in the specific context of the sector at the time of the investment.

- the cost-based gas distribution prices for the default depreciation and with advanced depreciation[11]
- the quantities sold under each of these scenarios, and
- with both of these outcomes projected out over a long-term period.

The Victorian gas business have applied substantially the same method as I did in my earlier report to estimate the change in consumer surplus and producer surplus associated with a particular advancement of depreciation, the sum of which is the change in allocative efficiency. The key features of this calculation include:

- the assumption of a linear demand curve for delivered gas
- the assumption that the marginal cost of gas distribution is zero, and
- the assumption that price is equal to marginal cost for the other levels of the supply chain (the majority of which is the gas commodity).

I discuss one further issue with this estimation below.

In terms of the mechanics of the calculation, I explained the estimation of overall allocative efficiency in my previous report. I have refined and expanded that discussion in the Appendix to this note, where I also set out how to derive consumer and producer surplus separately.

Whilst the assumptions summarised above imply a substantial simplification to reality, they are reasonable in my view for an initial assessment of the likely effect of changes in depreciation method on consumer and producer surpluses. However, it would be appropriate for a future refinement of this calculation to explore more complex treatments of these matters.

Further issue: Determining the zero-demand price

One issue that I highlighted in my earlier report was regarding how to estimate the change in allocative efficiency where the change in depreciation causes the gas supply to continue for longer than would otherwise have been the case. The difficulty here is that there is no observable price for the counterfactual case (i.e., where depreciation is not advanced), which is required to identify the surplus to customers. The unobservable input that is required is the price that would see the quantity just fall to zero, i.e., the price at which the demand curve would cross the vertical axis (referred to below as the zero-demand price).[12]

The surpluses the Victorian gas networks have estimated assume apply the maximum price constraint used in its "future of gas" modelling as the assumed zero-demand price. As I discussed in my earlier report, a maximum price was applied in the "future of gas" model to prevent outcomes whereby all costs would be recovered before existing customers could switch (which was deemed both unrealistic and unacceptable),[13] and so was applied as akin to the zero-demand price. There are, therefore, good

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11 Whilst I refer here to undertaking the calculation of consumer and producer surpluses based on gas distribution prices, the same outcomes would be achieved by applying retail gas prices instead.

12 Earlier Report, para.104.

13 Earlier Report, footnote 44.

consistency arguments to apply the same price when estimating the consumer and producer surpluses.[14]

I observed above that the changes in consumer and producer surplus can be disaggregated into three time periods, with the third of these periods corresponding to where advancing depreciation extends to period of time for which has services are provided. Disaggregating the results in this manner provides visibility about the importance of the extension of the period over which gas supply continues for the effects of advancing depreciation, and for the importance of the zero-demand price as a driver of this.

* * *

Yours sincerely,

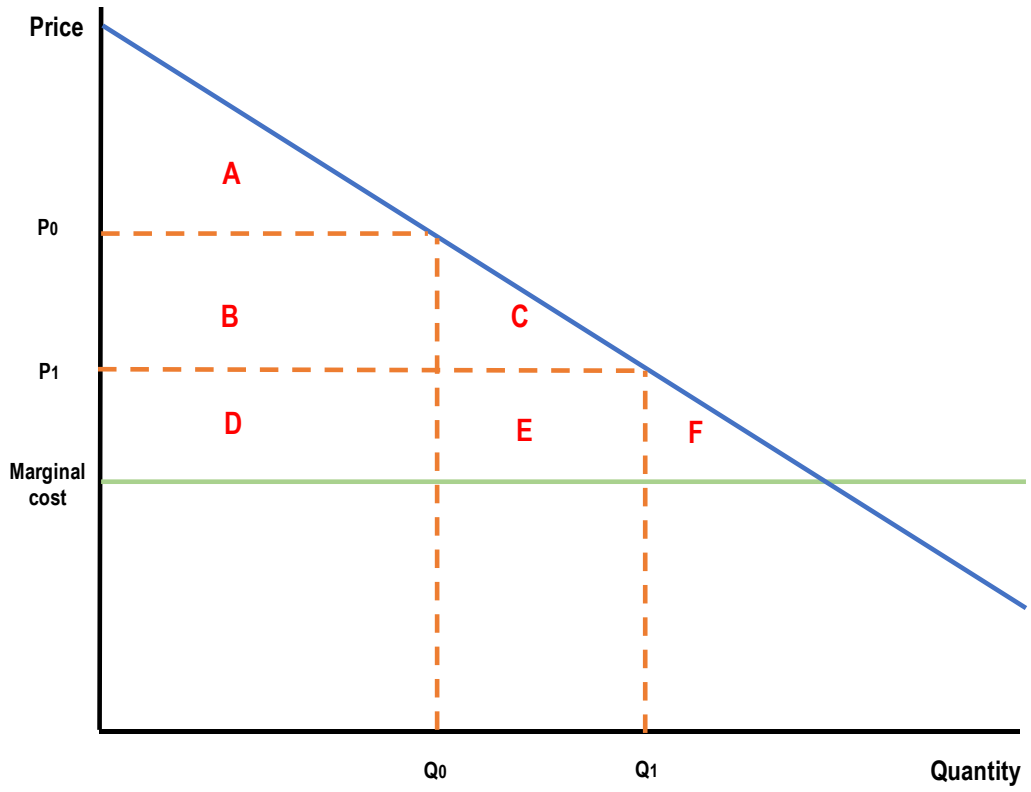
Jeff Balchin
Managing Director

[14] Using the maximum price as the zero-demand price had not occurred to me when I wrote my earlier report. In that report, I assumed an arbitrary surplus (defined in $ per GJ terms) for the extension of supply, and tested the effect of different arbitrary values, which I think is inferior to using the maximum price as the zero-demand price (Earlier Report, paras.104, 107).

Appendix – Deriving the formula for the change in producer and consumer surplus

The figures below repeat Figure 1 from my earlier report, with the price and quantity notation changed so that the "original" position has the subscript "0" and the changed position has the subscript "1".[15] The first figure shows the case of a price reduction.

Figure 1 – Consumer and producer surplus: price reduction



In this case, price reduces from P_0 to P_1, and quantity expands from Q_0 to Q_1. Focusing first on consumer surplus:

- the initial consumer surplus is given by area A, and
- the final consumer surplus is given by area A + B + C, implying
- a change in consumer surplus of B + C.

In terms of producer surplus:

- the initial producer surplus is given by area B + D, and
- the final producer surplus is given by area D + E, implying

[15] These diagrams assume for simplicity that (short run) marginal cost is constant.

- a change in producer surplus of E – B.

The overall change in efficiency is the sum of the changes in producer and consumer surplus, which is area C + E.

Note that whilst a price reduction will necessarily result in an increase in consumer surplus, the change in producer surplus is ambiguous, being the difference between the additional margin over marginal cost that is earned from the new quantity that is caused by the price reduction, and the reduction in the margin over marginal cost for the pre-existing units (i.e., the margin reduces because price reduces).

In equation form:

$$\Delta CS = -(P_1 - P_0).Q_0 - \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

$$\Delta PS = (Q_1 - Q_0).(P_1 - MC) + (P_1 - P_0).Q_0$$

$$\Delta Alloc\ Eff = (Q_1 - Q_0).(P_1 - MC) - \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

If P_1 and Q_0 are replaced with P_{low} and Q_{low} (i.e., indicating that, when price falls, the final price is the lower of the initial and final prices, and the reverse occurs in relation to quantity), then the above equations can be re-written as follows:[16]

$$\Delta CS = -(P_1 - P_0).Q_{low} - \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

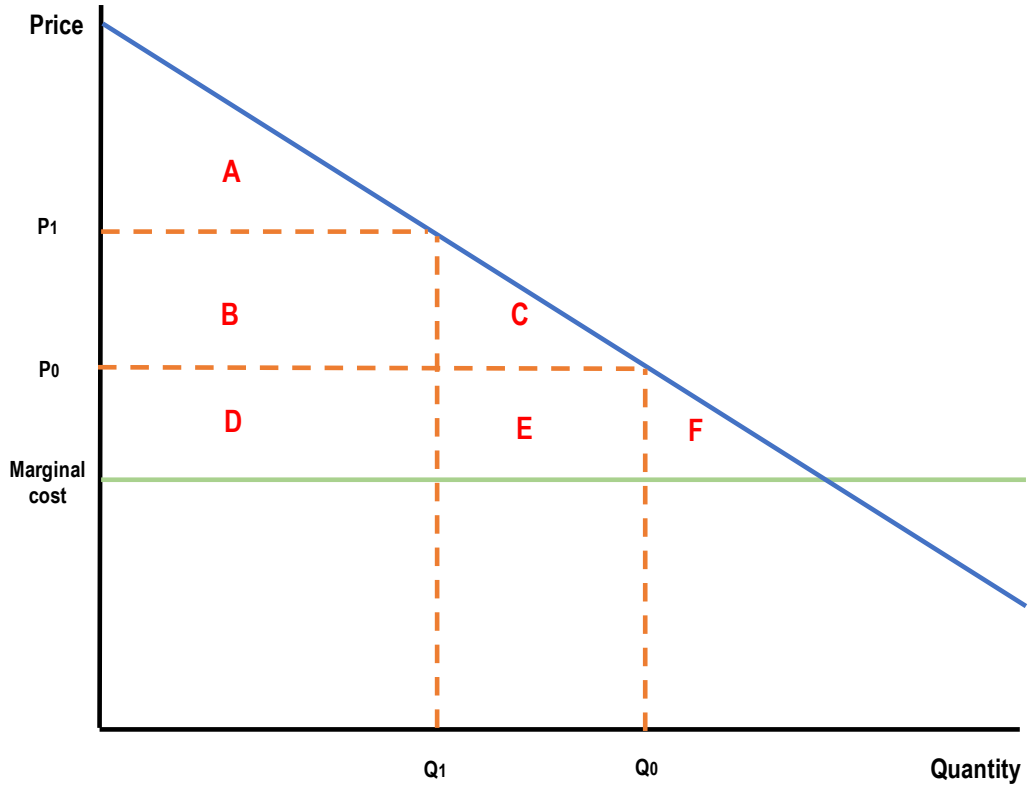
$$\Delta PS = (Q_1 - Q_0).(P_{low} - MC) + (P_1 - P_0).Q_{low}$$

$$\Delta Alloc\ Eff = (Q_1 - Q_0).(P_{low} - MC) - \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

The figure below shows the effects of a price increase.

[16] This additional step is undertaken to produce a set of equations that work for both a price decrease and price increase, which will become more obvious below.

Figure 2 – Consumer and producer surplus: price increase



In this case, price increases from P_0 to P_1, and quantity falls from Q_0 to Q_1. Focusing first on consumer surplus:

- the initial consumer surplus is given by area A + B + C, and
- the final consumer surplus is given by area A, implying
- a change in consumer surplus of – (B + C).

In terms of producer surplus:

- the initial producer surplus is given by area D + E, and
- the final producer surplus is given by area B + D, implying
- a change in producer surplus of B – E.

The overall change in efficiency is the sum of the changes in producer and consumer surplus, which is area – (C + E).

In equation form:

$$\Delta CS = -(P_1 - P_0).Q_1 + \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

$$\Delta PS = (Q_1 - Q_0).(P_0 - MC) + (P_1 - P_0).Q_1$$

$$\Delta Alloc\ Eff = (Q_1 - Q_0).(P_0 - MC) + \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

If P_0 and Q_1 are replaced with P_{low} and Q_{low} (i.e., indicating that, when price increases, the initial price is the lower of the initial and final prices, and the reverse occurs in relation to quantity), then the above equations can be re-written as follows:[17]

$$\Delta CS = -(P_1 - P_0).Q_{low} + \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

$$\Delta PS = (Q_1 - Q_0).(P_{low} - MC) + (P_1 - P_0).Q_{low}$$

$$\Delta Alloc\ Eff = (Q_1 - Q_0).(P_{low} - MC) + \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}$$

These are identical to the equations that were derived for the case of the price reduction, except for the second component of the consumer surplus term, which has the opposite sign, with this also flowing through to the corresponding term in the change in allocative efficiency. A universal equation for the changes in consumer surplus, producer surplus and allocative efficiency that reflects the change in sign of this term is as follows:

$$\Delta CS = -(P_1 - P_0).Q_{low} - \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}, if\ P_1 < P_0 + \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}, if\ P_1 > P_0$$

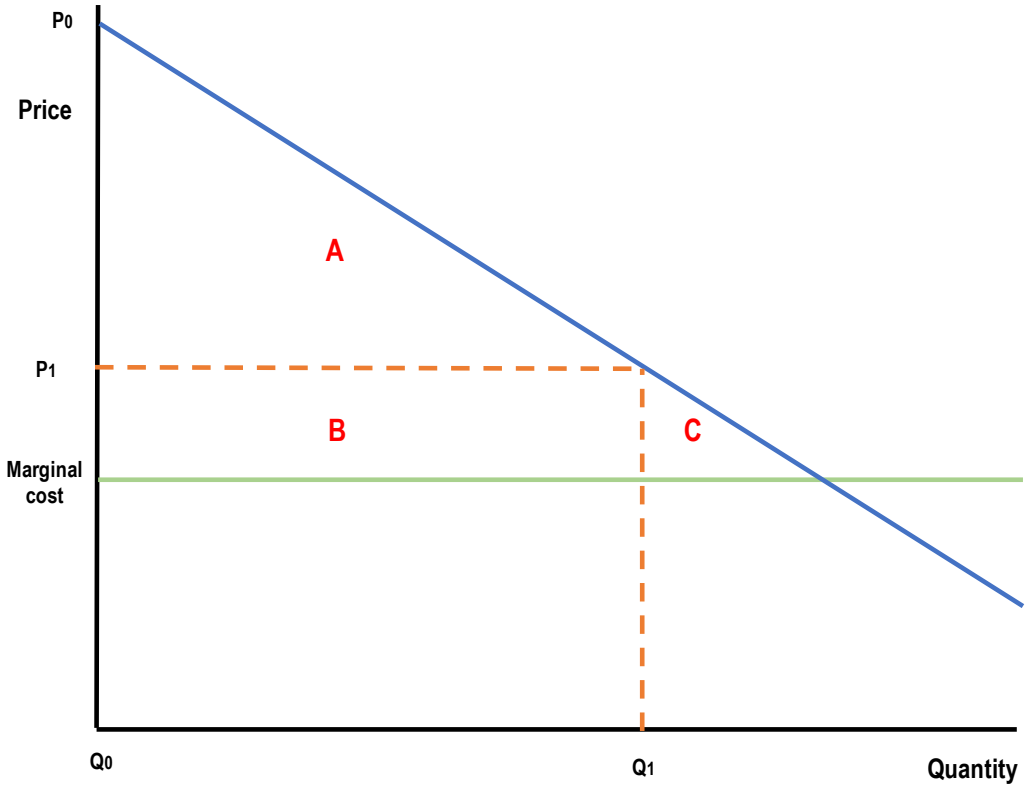
$$\Delta PS = (Q_1 - Q_0).(P_{low} - MC) + (P_1 - P_0).Q_{low}$$

$$\Delta Alloc\ Eff = (Q_1 - Q_0).(P_{low} - MC) - \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}, if\ P_1 < P_0 + \frac{(P_1 - P_0).(Q_1 - Q_0)}{2}, if\ P_1 > P_0$$

The figure below shows the result of a special case, whereby the price would have been sufficiently high in the base case to dissuade any use of gas, but then after advancing depreciation the price in the future would have decreased to a level that encourages usage of gas to continue.

[17] This additional step is undertaken to produce a set of equations that work for both a price decrease and price increase, which will become more obvious below.

Figure 3 – Consumer and producer surplus: price reduction from zero-quantity price



In this case, both consumer and producer surplus from gas consumption / production is initially zero because price is so high that all consumers switch to electricity (or other fuels). After the price reduction, consumer surplus is given by area A and producer surplus is given by area B. Two points are notable about this special case.

- First, both consumer surplus and producer surplus will increase from a price reduction where the quantity previously was zero.
  - In the earlier case, the change in producer surplus from a price reduction was ambiguous because the price reduction would increase quantity and so permit a margin over marginal cost to be earned on these new units (a positive for producer surplus), but also implies a reduced margin on the pre-existing sales (a negative for producer surplus).
  - However, where there is no pre-existing quantity (as is assumed in this special case), then only the former of these two effects (i.e., the margin earned on the increase in quantity) remains.
- Secondly, one of the more difficult issues for this case – as discussed earlier in the text – is to establish the level of the price at which the quantity will fall to zero. This assumption will only affect the level of consumer surplus (and overall allocative efficiency) and not affect the level of producer surplus.