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ACCELERATED DEPRECIATION – INCENTA REPORT

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ATCO depreciation for AA6 – Response to the ERA Draft Decision

Report for ATCO

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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 summary

1.1 Previous work and scope of this report

1. We previously prepared a report for ATCO to support its proposal in relation to regulatory depreciation for AA6.[1] The scope of that report was to advise upon:

   a. the implications of the gas regulatory regime (i.e., the National Gas Laws and Rules) for the choice of depreciation method, drawing upon regulatory economic principles, and

   b. how the results of the modelling performed by ACIL Allen could be interpreted to assist with that choice.

2. While we commented on the general nature of the ACIL Allen modelling, our scope did not extend to a review the ACIL Allen modelling.

3. The ERA engaged Frontier Economics to review ATCO's material in relation to regulatory depreciation for AA6.[2] Frontier commented on a number of aspects of the ACIL Allen modelling, and ACIL Allen has modified certain aspects of its modelling. For the current report, we have been asked to:

   a. consider and respond to the comments made by Frontier Economics and the ERA in relation to our previous advice, and

   b. advise how the updated modelling by ACIL Allen may best be interpreted to assist with the choice of regulatory depreciation method for AA6.

4. Again, aside from commenting on the general nature of ACIL Allen's modelling, and most importantly the implications of the key changes to ACIL Allen's methodology, we have not undertaken a review of the ACIL Allen modelling.[3]

1.2 Summary of findings

1.2.1 Updates to the ACIL Allen Modelling

5. Frontier Economics' principal issue with the modelling that ACIL Allen prepared in support of ATCO's depreciation proposal was that the modelling did not allow the regulated distribution price that was calculated under a given scenario to affect the

1 Incenta Economics (2023), Regulatory depreciation for AA6, Report for ATCO, August ("Earlier Report").

2 Frontier Economics (2024), ATCO MWSW GDS Accelerated Depreciation Modelling Review, February ("Frontier Economics").

3 We observe that most of Frontier's analysis was devoted to a review of detailed aspects of ACIL Allen's modelling, such as the specific inputs applied in the consumer choice modelling and the modelling of electricity price paths under the different scenarios. Please refer to ACIL Allen's materials for a consideration of these matters.

forecasts of future demand. Frontier concluded that this did not allow any insights relevant to depreciation to be drawn.

6. Whilst we think that Frontier's concerns were exaggerated and that insights could indeed be drawn, we note that ACIL Allen has revised its modelling to integrate the forecasts of future demand with the distribution price. As well as addressing Frontier's comments, this change results in modelling that is materially more informative as to the choice of depreciation method.

7. In particular, this revision by ACIL Allen means that the potential for asset stranding under the different scenarios, as well as the implication for the extent to which the efficiency of use of assets is affected, can be observed or estimated directly from the modelling. This change also means that many of Frontier's issues with our advice (such as whether the original ACIL Allen modelling suggested asset stranding was likely, or whether smoothing prices in real terms is likely to increase the efficiency of asset use) become redundant.

1.2.2 ATCO's change in approach to depreciation

8. ATCO has changed its approach from calculating depreciation as the amount that is implied by a price path that is level in real terms, to applying a depreciation method. Specifically, ATCO proposes a method that allows the degree of depreciation to be advanced or deferred (compared to straight line depreciation) by changing a single factor (the tilt factor).[4]

9. ATCO's proposed depreciation method meets the standard requirements for such methods, notably that the sum of depreciation allowances over an asset's life will equate to the original cost. In addition, as the proposed depreciation method allows the outcomes caused by advancing depreciation by differing degrees to be tested it is particularly suitable for the task.

10. If this depreciation method is adopted, then the choice becomes of:

a. whether to change from the use of the straight-line depreciation method, and

b. if so, the degree of advancement of depreciation that is appropriate, which is given effect via the value adopted for the tilt factor.

1.2.3 Factors relevant to the choice of depreciation method

11. In our previous report, we emphasised that the priority when determining the depreciation method should be to reduce stranded asset risk to a level that is not material. We say this because this is a risk for which regulated businesses are not compensated

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4 The method that ATCO has proposed is a simplification of what is referred to as the tilted annuity depreciation method (the simplification being that the discount rate input to the tilted annuity is set to zero, and the sign on the tilt factor is also reversed).

(and so leaving a material risk in place will mean that NPV=0 is not achieved), and because of the fundamental asymmetries that arise. In particular:

a. regulated businesses receive no windfall from a regulator taking action too early to remove stranded asset risk (more depreciation in AA6 will just mean lower prices thereafter), however

b. if action is deferred, the capacity for the regulated business to recover its costs may be lost – that is, even if the regulator wishes to remove stranded asset risk (as we say it should) this may not be possible given the constraints imposed by the operating environment.

12. Frontier Economics did not challenge our discussion of the economic principles, but rather emphasised that the ERA needs to consider the outcomes under all of the scenarios (including the outcome from deferring actions). Whilst we do not disagree with the proposition that the ERA should consider all scenarios, it is essential for the ERA to ensure that the regulatory settings will generate a reasonable outcome under all of the scenarios. As noted above, a key requirement for an outcome under a particular scenario to be considered reasonable is that the regulated business would not be exposed to material stranded asset risk if that scenario came to pass.

1.2.4 Preliminary results under the different scenarios[5]

13. We were given access to the ACIL Allen model, and so have had the opportunity to generate preliminary estimates of the key outcomes flowing from the depreciation choices for AA6 and beyond. Our principal preliminary findings are as follows:

a. In relation to the risk of asset stranding (i.e., the priority when choosing the depreciation method):

i. As with our earlier report, we find that, if the current depreciation method were to continue to be applied into the future, there is a material risk of asset stranding under the "electricity dominates" scenario, although the ACIL Allen modelling suggests that the risk of asset stranding under the current depreciation method is less likely under the other scenarios.

ii. Furthermore, we find that applying a tilt factor of 2 per cent as ATCO has proposed would reduce this stranding risk, although it would not eliminate it. We also tested the effect of a 5 per cent tilt factor risk, and found that this too would fail to eliminate all of the standing risk, although the residual risk was materially reduced (a 5 per cent tilt factor, if maintained, is forecast to remove 80 per cent of the asset stranding).

iii. We also find that, if the ERA deferred its decision to change depreciation for AA6, then applying a tilt factor of around 3 per cent from AA7 would generate

5 We have not in the time that has been available been able to subject these results to a robust series of checks as we ordinarily would, and hence we describe the results as preliminary results.

a similar level of stranded asset risk to applying a tilt factor of 2 per cent from AA6.

b. in relation to the efficiency of use of the network:

   i. we find that a modest advancement of depreciation from AA6 (i.e., a tilt factor of 2 per cent or 5 per cent) is likely to increase the efficiency of use of the asset in the "natural gas retained" and "energy hybrid" scenarios, suggesting that an advancement of depreciation from AA6 would be beneficial (or at least not detrimental) in these scenarios even though material asset stranding risk is not predicted, and

   ii. in relation to the "hydrogen future" scenario – which envisages a large capital expenditure commitment to convert networks – our expectation is that the optimal depreciation strategy (in terms of encouraging efficient use) would be to advance depreciation from AA6, and then to switch to a back-ended depreciation method after the network has been converted; however, we have not been able to test this with modelling in the time we have had available.

14. We therefore conclude from the above that ATCO's proposal is justified under the requirements of the national gas regime – and indeed, it can be to be considered conservative – as it:

   a. reduces the material stranded asset risk that is predicted under the "electricity dominates" scenario (we say it is conservative because the proposed 2 per cent tilt factor would be insufficient to fully address this risk, and so would leave further action to remove stranded asset risk from AA7), and

   b. is predicted or expected to increase the efficiency of use of the assets under the remaining scenarios.

2. Analysis

2.1 Principal issues of Frontier Economics

15. Frontier Economics' principal criticism of the ACIL Allen modelling was that the projected future distribution prices and demand forecasts were not integrated, so that the effect of changes in prices on demand was not captured. Frontier considered that this absence of integration meant that the ACIL Allen modelling was not suitable for assisting with the choice of depreciation method.[6]

16. In our view, Frontier's concerns about the ability to draw implications from ACIL Allen's modelling for regulatory depreciation were exaggerated. As we discussed in our earlier report, even without demand and price being integrated, it was possible to infer whether asset stranding would be likely, as well as to draw on stylised economic propositions for how allocative efficiency may be affected. However, clearly, the absence of integration meant that more effort was required to interpret the modelling results.[7]

17. In response to Frontier Economics' comments, ACIL Allen has revised its modelling to integrate its demand forecasts with the distribution prices that are calculated under the different scenarios. The implication of this change is that key outcomes that are relevant to the choice of depreciation method – namely, whether and to what extent asset stranding occurs and whether changes to depreciation will affect the efficiency of use of pipelines – can be extracted directly from the modelling. This reduces the scope for disagreement over how the modelling results are interpretated, and so in our view is a material improvement.

18. We discuss how the outcomes that are most relevant to the selection of the depreciation method may be estimated in section 2.4 below.

2.2 Depreciation method

19. One of the ERA's concerns about ATCO's proposal was that it did not consider that a deprecation method had been proposed. ATCO originally proposed a depreciation amount in dollar terms (or, more specifically, an advanced depreciation amount, which was to be added to the amount calculated under the straight-line method), which in turn was based upon achieving a level real price.

20. In our view, ATCO's original proposal was compliant with the gas regulatory regime, and is a valid method for calculating depreciation, it is just that the depreciation calculation was indirect (i.e., the inferred as a product of a larger calculation). We agree, however, that there are disadvantages to an indirect calculation of depreciation. In particular, as the depreciation amount was determined as part of a larger calculation, the

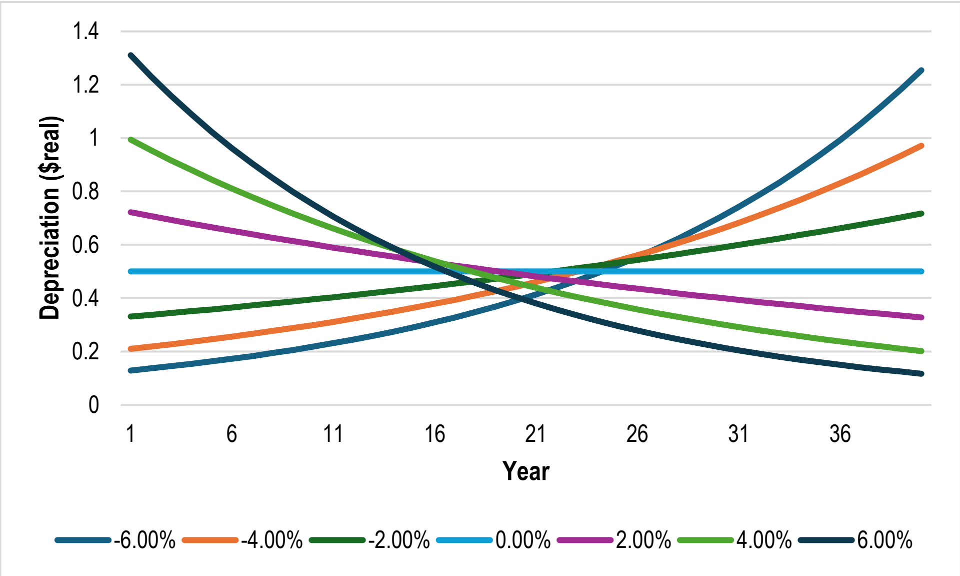
6 Frontier referred to this as a "fundamental flaw" (Frontier Economics, p.47).

7 We also commented on the desirability of integrating the demand forecasts with prices in our earlier report (Earlier Report, footnote 37).

depreciation calculation is less transparent, and would be more difficult to update (and predict how it would update) from one regulatory period to the next.

21. ATCO has responded to the ERA's views by adopting instead a direct calculation of depreciation, specifically a simplified version of what is referred to as the "tilted annuity" method.[8] Under the method proposed, the depreciation of individual assets can be advanced or deferred by simply changing a single factor (the tilt rate), so that the effect of differing degrees of advancement of depreciation may be tested, with a zero tilt rate equal to straight line depreciation.[9] We observe that the depreciation method as proposed meets the normal requirements for a depreciation method, specifically that the sum of the depreciation amounts over the life of the assets will equate precisely to the original cost.[10] We show how the depreciation amount varies with changes to the tilt rate for a simple, notional asset (original cost of $20 and life of 40 years).

Figure 1 – Simulation of the simplified tilted depreciation method



Source: Incenta analysis.

22. The remainder of the discussion assumes that the choice for the ERA is:

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8 A "tilted annuity" depreciation method determines the depreciation amount that results in the capital charge changing year by year at a predetermined rate, and so has a discount rate as an additional input. The depreciation method that ATCO has proposed is obtained by setting the discount rate to zero and reversing the sign of the tilt rate.

9 The formula in ATCO's model is undefined if the tilt rate is zero; however, the formula can be rearranged to allow a zero tilt rate and deliver straight line depreciation, and an arbitrarily small tilt rate can be applied which will also deliver an amount that materially the same as the straight line depreciation amount.

10 The formula applied in ATCO's modelling calculates depreciation as a function of the original cost, rather than as a function of the written down value. Accordingly, a check is required to ensure that the depreciation stops at the end of the asset's life (i.e., when it has been recovered). We confirmed that the ATCO model contains this check.

a. whether to change from straight line depreciation from AA6, and

b. if so, a switch to the simplified tilted annuity method is assumed, in which case a further decision is required about the tilt factor.

2.3 Decision criteria for choosing the depreciation method

23. In our earlier report, we concluded that the principal concern when choosing the depreciation method should be to ensure that potential stranded asset risk is reduced to the point where it is immaterial. We said this because there is no compensation for stranded asset risk under the gas regulatory regime,[11] and so the presence of material stranded asset risk will result in the NPV=0 outcome – and hence the conditions necessary to attract efficient investment – not being met. In addition, potential measures (or absence of measures) to address stranded asset risk are fundamentally asymmetric, that is:

a. if a regulator acts too early and it turns out that the stranded asset risk was a mirage, then the regulated business does not benefit – rather, as the RAB is more depreciated, future regulated prices are lower than otherwise, however

b. if the regulator acts too late then it may not be possible to avoid the stranded asset risk (i.e., irrespective of the regulator's actions, a recovery of cost becomes impossible).

24. We then said that a key secondary consideration (which is referenced expressly in the National Gas Rules) is to improve the efficiency of use of pipeline assets (referred to as "allocative efficiency"). We also said that economic principles suggested that creating stable prices to customers should be a further concern.

25. Frontier Economics did not provide a detailed discussion of the economic principles underpinning the choice of depreciation method, rather its main point was that the ERA should observe the outcomes under all scenarios, and balance a number of considerations, rather than look closely at just a subset of the scenarios as we did.[12] Frontier also said that it was not convinced that the depreciation proposed would result in more stable price paths under all scenarios,[13] suggesting that it may support the generation of price stability as a desirable outcome of the depreciation method.

26. Turning to Frontier's comments, as an example of why the ERA should consider a wider range of information, Frontier advises that the ERA should take account of the fact that:

a. more information may exist from AA7 as to which of the scenarios are more likely, and so

b. the ERA should weigh the potential for a certain price increase in AA6 if depreciation is advanced against the possibility that a more optimistic future for the gas sector may

[11] And nor is there a capacity to provide compensation for stranded asset risk under the National Gas Rules as presently drafted.
[12] Frontier Economics, p.58.
[13] Frontier Economics, p.57.

exist in 5 years time (for example, where the "electricity dominates" scenario is deemed less likely and one of the other scenarios is deemed more likely).

27. We do not disagree with the proposition that the ERA should consider the potential outcomes under all of the scenarios when deciding upon the appropriate depreciation method for AA6. However, what is missing in Frontier's discussion is advice about the decision rule that should be applied once all of the information has been generated. As discussed above, the priority when choosing the depreciation method is to ensure that stranded asset risk is minimised (or, more specifically, immaterial), and this outcome needs to be achievable under *all* of the scenarios. This means that:

a. the depreciation method that is chosen should result in immaterial stranded asset risk under each of the scenarios, and

b. when consideration is given to deferring a change to depreciation until AA7, then the changes to depreciation that are assumed from that point forward should also ensure that there is immaterial stranded asset risk (i.e., acknowledge that a greater adjustment to depreciation will be required from AA7 onwards to avoid material stranded asset risk where the decision is deferred).

28. We observe further that the need to ensure that stranded asset risk is immaterial under all of the scenarios naturally means that a greater focus will be required on those scenarios (or scenario, as appears from the revised ACIL Allen modelling) where stranded asset risk is most present.

29. Moreover, the potential that we may know more when reviewing prices for AA7 about which scenario may prevail in the future does not advance the analysis. We do not know which scenario is more likely to prevail in the future (which is a fact that Frontier acknowledges) and so the analysis must ensure that appropriate outcomes are achievable under each of the scenarios as currently formed, including that stranded asset risk is immaterial under each.

2.4 Stranded asset risk and allocative efficiency under the different scenarios

2.4.1 Introduction and method

30. One of Frontier Economics' principal criticisms of our work is that it was not (in its view) possible to infer based on the original ACIL Allen modelling whether asset stranding was likely to occur, as well as whether changes to depreciation would improve the efficiency of use of the pipeline. As noted above, we disagree with Frontier's advice in this regard. For example:

a. under the original ACIL Allen modelling, where the regulated price under the "electricity dominates" scenario in the absence of advancing depreciation increased at a very rapid rate, it was self-evident that such a price could not be charged, and so asset stranding would occur

b. similarly, implications for allocative efficiency from changes to the time path of prices can be inferred from general economic principles, and the proposition that prices that are flatter in real terms (or declining in real terms where the price responsiveness of demand is likely to be increasing) will promote allocative efficiency is a fairly obvious outcome of economic principles that a number of regulators have drawn upon.

31. Having said that, the improvements to ACIL Allen's modelling mean that estimates of asset stranding and the efficiency of pipeline use for each scenario under different options for depreciation may be made directly, rather than inferred.

32. We have been provided with the ACIL Allen model, and have derived our own preliminary estimates of the extent to which asset stranding is expected under the different scenarios and for different depreciation choices (i.e., different tilt factors), as well as indicators of how changes to depreciation may affect the efficiency of use of the network. We discuss these below.

Indicators of asset stranding

33. In terms of asset stranding, we have derived the extent of stranded asset risk as the sum of:

a. the under-recovery of revenue against the regulated revenue (cost of service), and

b. the RAB at the start of the year from which the model suggests that no revenue is received.

34. These results have been presented both in absolute dollar terms (commencing from 2030), as well as discounted back to the commencement of AA6 (using the regulatory WACC as a discount rate).

Indicators of the efficiency of pipeline use

35. We note at the outset that the indicators of the efficiency of pipeline utilisation discussed below all assume that the pipeline infrastructure is in place, and so do not "count" the benefits to consumers from improving the environment for investment and so encouraging efficient investment to take place. Thus, the benefits from improving the efficiency of use of networks that are discussed below are additional to the benefits that may be generated from improving the investment environment through removing material stranded asset risk.

36. The simplest indicator of the efficiency of pipeline use – and how this may be affected with changes to depreciation – is the total throughput through the pipeline over its life. Where a change to time path of prices induces an increase in total throughput, this can be interpreted as an indicator of an increase in the utilisation of the asset.

37. A more direct measure of the efficiency of use of an asset are the concepts of consumer surplus, producer surplus and the sum of these (the total surplus). Changes to these surpluses that are caused by a change to the time-profile of prices provide an indication of whether the respective groups (consumers and suppliers) and their combination are made better off by the change.

a. Consumer surplus simply refers to the difference between the amount that a customer would be prepared to pay for a service, 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.

   i. Changing the time profile of prices may affect the total value to consumers where the changed time profile is able to induce a change to the total use of the asset in question.

   ii. For example, charging more when gas has a greater cost advantage relative to alternatives (i.e., electricity) and less when gas is less cost competitive may induce demand (use) that would not otherwise have occurred, and so result in an increase in the total value to consumers.

b. 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 technical paper appended to this report for the simplified case where the short run marginal cost is constant).

c. 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.

38. We previously prepared a technical paper for the Victorian gas distributors that set out how consumer and producer surplus may be calculated from the outcomes of a similar modelling exercise, and we attach that technical paper as Appendix A to this report.[14] We focus in this report on changes to consumer surplus because where this is expected to increase, then the case for advancing depreciation is the clearest (i.e., this would mean that customers would benefit from the change, even before considering the benefit from improving the investment environment).[15]

39. The key inputs to this calculation are:[16]

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14 One simplification that we have made in the current calculation is to ignore the gain in allocative efficiency that may result from changes to depreciation causing the asset to remain in service for a longer period. The ACIL Allen modelling results suggest that the potential for changes to depreciation to extend the life of the gas network is not material in the context of ATCO.

15 Our results express the present value of the changes in surpluses using the regulatory WACC as a discount rate, although we note that different views exist as to whether such surpluses should be discounted using a social rate of time preference rather than a commercial discount rate, or not discounted at all.

16 A further assumption required is the short run marginal cost associated with the use of the gas network, which we have assumed to be zero.

a. the time series of real distribution prices under the different scenarios and for different depreciation choices, and

b. the associated time series of sales quantities.

2.4.2 ACIL Allen modelling choice: Maximum price constraint

40. There is one aspect of the ACIL Allen model that deserves comment.[17] The ACIL Allen modelling of appliance choice assumes that once a consumer has made its appliance choices, it is essentially captive until those appliances are at the end of their useful lives. This assumption means that the modelling results would suggest that a gas network business could raise its prices – potentially by orders of magnitude – and (almost) always recover its RAB before its existing customer base could switch.

41. However, this assumption is unrealistic – price increases of orders of magnitude would not be politically acceptable, and would cause customers to switch immediately in any event. ACIL Allen has addressed this issue by allowing a maximum price constraint to be determined, which is specified as the distribution that causes the final (retail) price to increase by a factor of the 2029 price. The Victorian gas distributors encountered the same modelling issue in their work on regulatory depreciation for their recent access arrangement review, and responded to the issue in a very similar manner.[18]

42. For the purpose of the result reported below, we have assumed a maximum price constraint equivalent to a doubling of the 2029 retail price.[19]

2.4.3 Preliminary results[20]

Asset stranding

43. Table 1 sets out our estimates of the degree of asset stranding expected under the different scenarios for different depreciation methods

44. We observe from Table 1 that the "electricity dominates" scenario is the only scenario where material stranded asset risk is expected under the current method of depreciation (straight line). However, the risk under this scenario is material: absent any change, the stranding event is projected to cause a $1.6 billion windfall loss to the regulated business

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[17] We observe that ACIL Allen has implemented a range of changes in its revised modelling, one of which is to assume that aggressive reductions in operating and capital expenditure are possible and get implemented once customer numbers start falling materially. Please refer to the ACIL Allen report for a discussion of these.

[18] We noted this issue in a report for the Victorian gas distributors: Incenta (2022), Assessment of compliance with the requirements for regulatory depreciation, June, footnote 44 (available at: https://www.aer.gov.au/documents/agn-victoria-albury-attachment-64-incenta-expert-report-assessment-compliance-requirements-regulatory-depreciation-july-2022).

[19] This is a looser constraint than the Victorian gas distributors assumed (who assumed that real distribution prices were constrained to 1.7 times the 2022 distribution price).

[20] We have not in the time that has been available been able to subject these results to a robust series of checks as we ordinarily would, and hence we describe the results as preliminary results.

(in today's dollars) at the time it occurs, and this remains material even when discounted back to today (over $200 million).

45. This table also shows that, if a switch to tilted depreciation were to be made from the start of AA6 with a tilt rate of 2 per cent, then the asset stranding would be reduced by approximately one-third, and if a tilt rate of 5 per cent were to be applied, then the risk would be reduced by approximately 80 per cent.

Table 1 – Estimated stranded asset risk under different depreciation scenarios ($million, real 2023)

Tilt factor	Applied from	Undiscounted			NPV		
		Unrecovered COS	*Unrecovered RAB at closure*	*Total*	*Unrecovered COS*	*Unrecovered RAB at closure*	*Total*
Natural gas retained							
Base case	n/a	0.0	0.0	**0.0**	0.0	0.0	**0.0**
2%	2025	0.0	0.0	**0.0**	0.0	0.0	**0.0**
5%	2025	0.0	0.0	**0.0**	0.0	0.0	**0.0**
2%	2030	0.0	0.0	**0.0**	0.0	0.0	**0.0**
5%	2030	0.0	0.0	**0.0**	0.0	0.0	**0.0**
Energy hybrid							
Base case	n/a	0.0	0.0	**0.0**	0.0	0.0	**0.0**
2%	2025	0.0	0.0	**0.0**	0.0	0.0	**0.0**
5%	2025	0.0	0.0	**0.0**	0.0	0.0	**0.0**
2%	2030	0.0	0.0	**0.0**	0.0	0.0	**0.0**
5%	2030	149.3	0.0	**149.3**	16.2	0.0	**16.2**
Hydrogen future							
Base case	n/a	0.0	0.0	**0.0**	0.0	0.0	**0.0**
2%	2025	0.0	0.0	**0.0**	0.0	0.0	**0.0**
5%	2025	0.0	0.0	**0.0**	0.0	0.0	**0.0**
2%	2030	0.0	0.0	**0.0**	0.0	0.0	**0.0**
5%	2030	0.0	0.0	**0.0**	0.0	0.0	**0.0**
Electricity dominates							
Base case	n/a	1,086.4	555.5	**1,641.9**	166.0	58.4	**224.4**
2%	2025	703.9	351.9	**1,055.8**	104.3	37.0	**141.2**
5%	2025	259.2	155.7	**414.9**	32.6	16.4	**48.9**
2%	2030	833.3	373.2	**1,206.5**	126.9	41.1	**168.0**
5%	2030	593.0	210.1	**803.2**	90.6	26.5	**117.1**

Source: Incenta analysis of ACIL Allen modelling results

46. Whilst not shown in the results above, if the change to depreciation is deferred until AA7 then a tilt rate of 3 per cent would be required to deliver a similar level of stranding risk as a 2 per cent tilt rate applied from 2025.[21]

Indicators of efficiency of use of the network

47. Table 2 and Table 3 provide the indicators of the efficiency of asset use discussed above, namely the total throughput forecast over the period from AA6 to 2074 as well as estimates of the (short term) surpluses discussed above.[22]

21 Our application of the ACIL Allen model suggests that it may not be possible to advance depreciation from the commencement of AA7 and provide a similar level of stranded asset risk to a 5 per cent tilted annuity applied from AA6. However, in the time that has been available we have not been able to confirm this result.

22 Our estimates of the changes in throughput and allocative efficiency suggested that, whilst advancing depreciation may improve the efficiency of use if implemented from AA6, the reverse was suggested if the same changes were delayed until AA7. If correct, this would provide a further reason to advance

Table 2 – Total lifetime throughput, domestic (B3) consumers (TJ)

	Base case	2% from 2025	5% from 2025
Natural gas retained	487,610	494,294	495,846
Energy hybrid	354,663	371,372	385,764
Hydrogen future	359,240	366,368	379,508
Electricity dominates	195,902	193,854	194,613

Source: Incenta analysis of ACIL Allen modelling results

Table 3 – Estimates of the changes in consumer surplus, producer surplus and allocative efficiency, domestic (B3) customers ($'000, real 2023)

Tilt factor	Applied from	Consumer surplus	Producer surplus	Allocative efficiency
Natural gas retained				
2%	2025	-8,008	38,945	30,937
5%	2025	3,440	15,652	19,092
Energy hybrid				
2%	2025	26,578	38,002	64,581
5%	2025	21,549	66,482	88,032
Hydrogen future				
2%	2025	-15,701	59,717	44,016
5%	2025	-21,157	139,363	118,206
Electricity dominates				
2%	2025	-81,203	52,148	-29,055
5%	2025	-154,050	133,642	-20,408

Source: Incenta analysis of ACIL Allen modelling results

48. The obvious feature of these results is that the measures of the efficiency of use of the assets under the "electricity dominates" scenarios is lower under the options where depreciation is advanced. This outcome is to be expected:

a. advancing depreciation in the "electricity dominates" scenario leads to the pipeline operator recovering a greater amount of its cost over the life of the asset (i.e., asset stranding is reduced)

b. this increased cost recovery will necessarily deter usage, and hence the efficiency with which the asset is used, however

c. securing cost recovery is an essential part of creating the environment conducive to the asset being in place and maintained so that it is able to be used.

depreciation from AA6. However, in the time available, we have not been able to understand why deferring the advancement to depreciation may reduce the efficiency of asset use (and hence whether this result may be an error or an artefact), and so we do not report or rely upon these results in this report.

49. For the “natural gas retained” and “energy hybrid” scenarios, these results suggest that advancing depreciation is likely to increase the total lifetime throughput on the asset, and also increase consumer surplus in the energy hybrid scenario (the effect on consumer surplus depends on the size of the advancement in the “natural gas retained” scenario and is small in any event). This suggests for these scenarios that advancing depreciation may be beneficial (at least not materially costly in terms of consumer surplus) even if material asset stranding risk is not present.

50. The results for the remaining scenario – “hydrogen future” – the two indicators of efficiency of use provide contradictory advice, with advancing depreciation predicted to increase lifetime throughput but reduce consumer surplus. In our view, this most likely means that the optimal depreciation approach is itself more complex. Under this scenario, there is a large capital expenditure requirement to convert networks to hydrogen. In this case, it is ordinarily the case that efficiency of use is increased by:

a. advancing depreciation (relative to straight line) of existing assets prior to the new capital expenditure being undertaken, and

b. then applying a more back-ended depreciation method (relative to straight line) after the new capital expenditure has been undertaken.

51. Accordingly, we expect that advancing depreciation from AA6, and then reverting to a back-ended method after the conversion to hydrogen has been undertaken, would lead to an increase in consumer surplus. However, we have not been able to confirm this with modelling in the time available.

A. Methodology for calculating consumer and producer surplus (Report prepared for Australian Gas Networks and Multinet, 2023)

Available at: https://www.aer.gov.au/documents/agn-revised-final-plan-access-arrangement-2023-28-attachment-68-incenta-expert-report-future-gas

INCENTA
ECONOMIC CONSULTING

Nick Wills-Johnson
Head of Economics
Australian Gas Infrastructure Group

24 January 2023

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.

A: Unit 1, 19-35 Gertrude St, Fitzroy, Victoria, 3065 | P: +61 3 8514 5119

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

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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

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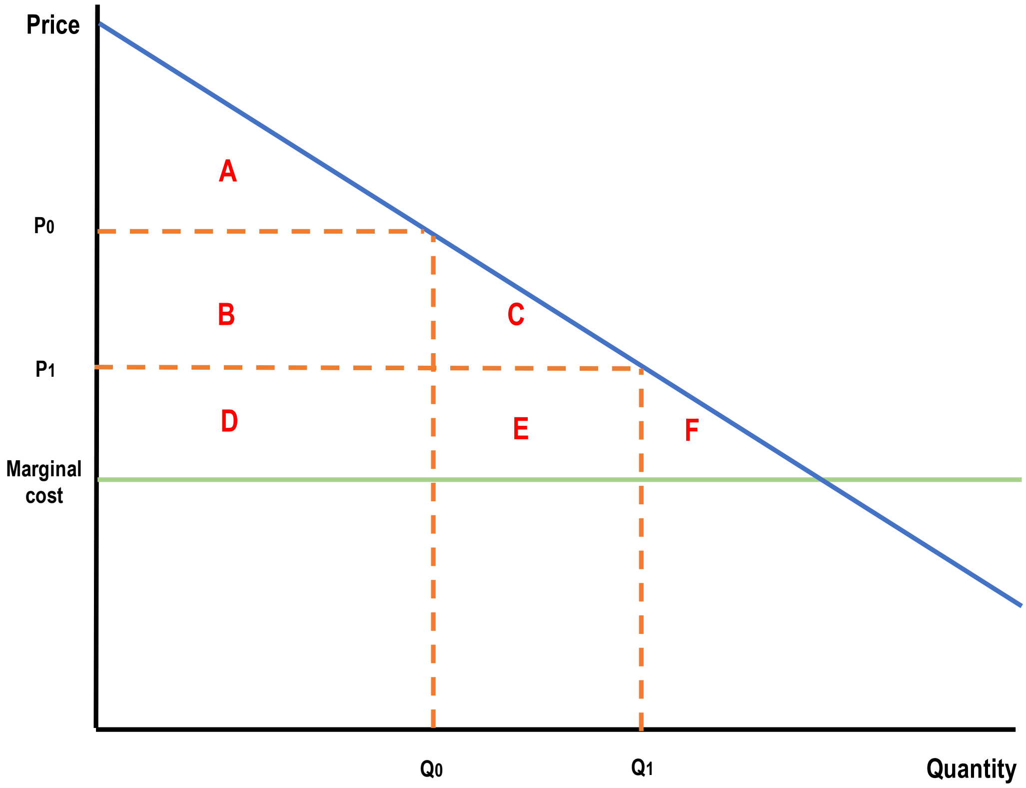
14 Using the maximum price as the zero-demand price had not occurred to me when I wrote my earlier report. In that report, I assumed an arbitrary surplus (defined in $ per GJ terms) for the extension of supply, and tested the effect of different arbitrary values, which I think is inferior to using the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

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

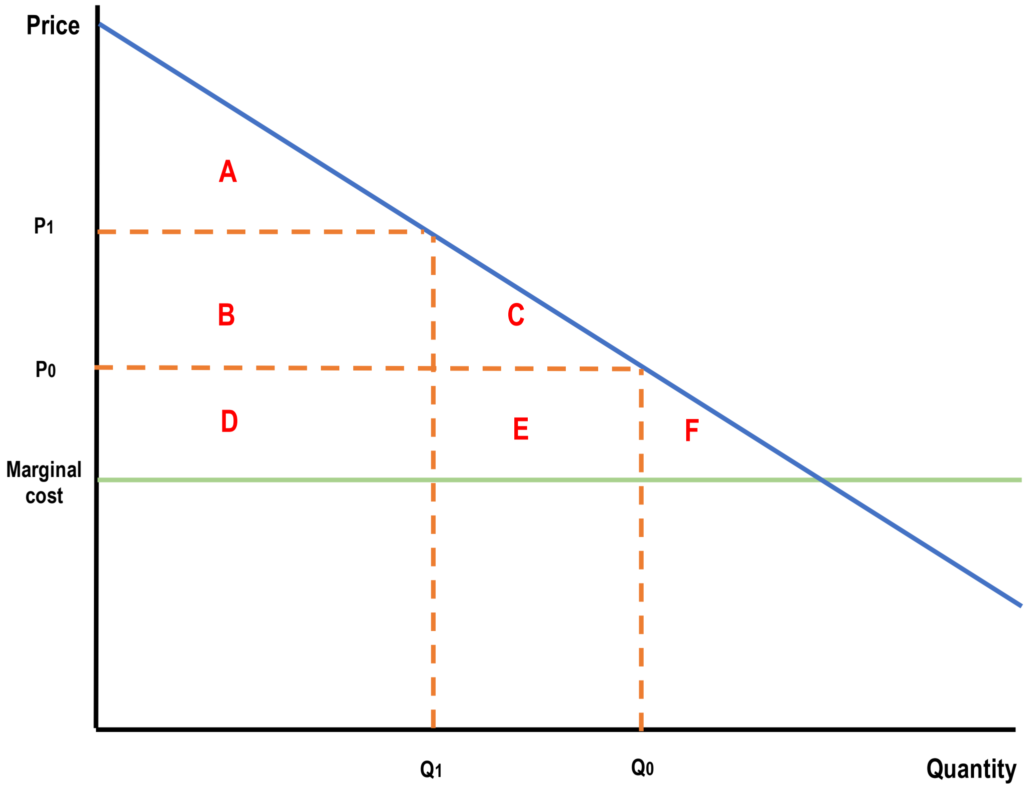
$$\Delta PS = (Q_1 - Q_0).(P_{low} - MC) + (P_1 - P_0).Q_{low}$$

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

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:

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

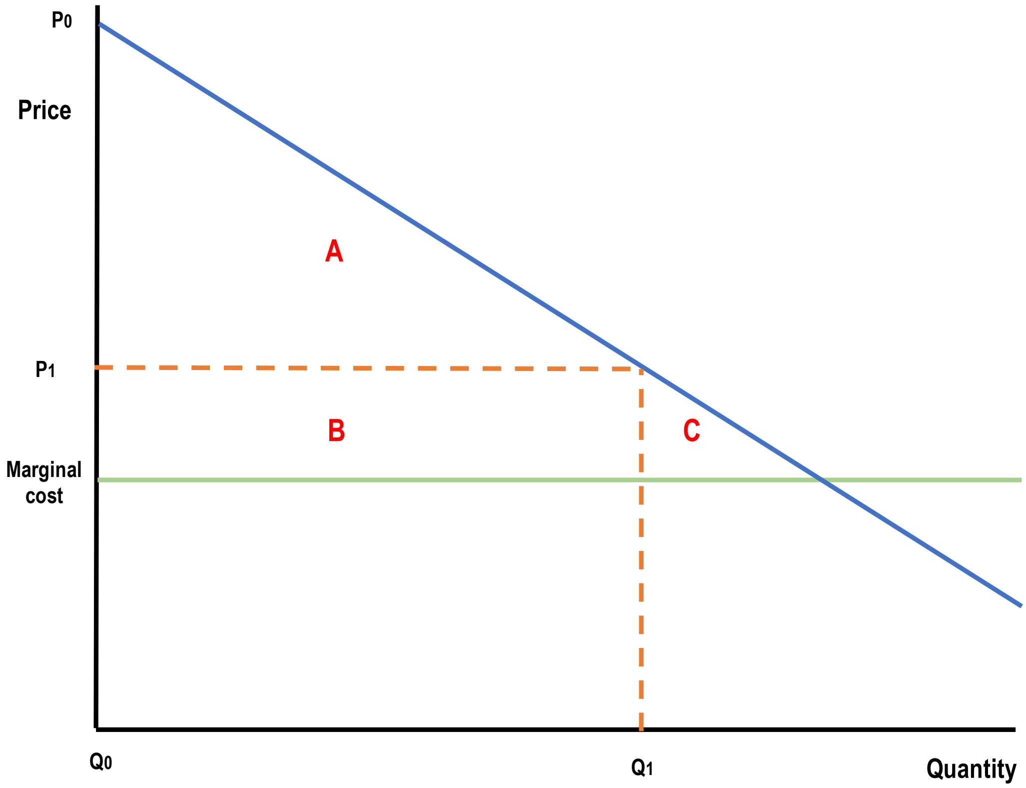
$$\Delta PS = (Q_1 - Q_0).(P_{low} - MC) + (P_1 - P_0).Q_{low}$$

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

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.