



# Better Regulation

## Equity beta issues paper

October 2013

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## Shortened forms

Shortened term	Full title
ACCC	Australian Competition and Consumer Commission
ACG	Allen Consulting Group
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
APIA	Australian Pipeline Industry Association
CAPM	Capital asset pricing model
CEG	Competition Economists Group
regulatory determination	In this document, the term 'regulatory determination' generally refers both to regulatory determinations under the NER and access arrangement determinations under the NGR.
ENA	Energy Networks Association
ERA	Economic Regulation Authority
Frontier	Frontier Economics
NER	National Electricity Rules
NERA	NERA Economic Consulting
NGR	National Gas Rules
SFG	Strategic Finance Group Consulting
WACC	Weighted average cost of capital
2009 WACC review	AER's review of the weighted average cost of capital (WACC) parameters for electricity transmission and distribution network service providers (final decision published in May 2009).

## Request for submissions

This report is part of the Australian Energy Regulator's (AER) Better Regulation program of work, which follows from changes to the National Electricity and Gas Rules announced in November 2012 by the Australian Energy Market Commission (AEMC). The AER's approach to regulation under the new framework will be set out in a series of guidelines, most of which will be published by the end of November 2013. The rate of return guideline will be published in mid-December 2013<sup>1</sup>

This issues paper is published after the AER's explanatory statement on the draft rate of return guideline, which was released on 30 August 2013. This issues paper adds further information on our approach to the determination of the equity beta input parameter.

Interested parties are invited to make written submissions to the AER regarding this issues paper by close of business, 28 October 2013. This timeline extends past the date for submissions on the draft guideline (11 October 2013), and applies only for submissions that relate specifically to equity beta issues arising directly from this issues paper. While we would normally allow a longer consultation period, we are unfortunately unable to do so in this instance. This is because there is little time left before the publication of the final rate of return guideline.

Submissions should be sent electronically to: [rateofreturn@aer.gov.au](mailto:rateofreturn@aer.gov.au). The AER prefers that all submissions sent in an electronic format are in Microsoft Word or other text readable document form.

Alternatively, submissions can be sent to:

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The AER prefers that all submissions be publicly available to facilitate an informed and transparent consultative process. Submissions will be treated as public documents unless otherwise requested. Parties wishing to submit confidential information are requested to:

- clearly identify the information that is the subject of the confidentiality claim
- provide a non-confidential version of the submission in a form suitable for publication.

We will place all non-confidential submissions on our website at [www.aer.gov.au](http://www.aer.gov.au). For further information regarding the AER's use and disclosure of information provided to it, see the ACCC/AER Information Policy, October 2008 available on the AER website.

Please direct enquiries about this paper, or about lodging a submission to the Network Regulation Branch of the AER on (02) 6243 1233 or [rateofreturn@aer.gov.au](mailto:rateofreturn@aer.gov.au).

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<sup>1</sup> Further details on the consultation processes and other guidelines are available at <http://www.aer.gov.au/node/18824>.

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## Executive summary

Under the return on equity approach set out in our draft rate of return guideline, we need to determine a point estimate and range for the equity beta of a benchmark efficient entity. The equity beta is a key input parameter to our foundation model, the capital asset pricing model (CAPM).

After considering the evidence currently before us, we propose to adopt an equity beta point estimate of 0.7 for a benchmark efficient entity, chosen from within a range of 0.4 to 0.7. We propose to adopt this equity beta point estimate and range across each of the energy sectors we regulate (electricity transmission, electricity distribution, gas transmission and gas distribution). The equity beta for an 'average' firm in the market across all industries is 1.0. We consider the point estimate and range for the equity beta of a benchmark efficient entity providing regulated electricity or gas network services is less than 1.0. This position is informed by two primary sources of evidence:

- Conceptual analysis—in preparation for the draft guideline we commissioned Frontier Economics (Frontier) and Professor McKenzie and Associate Professor Partington to review the risks facing regulated energy networks in Australia. We consulted with stakeholders on the terms of reference for these studies and on the draft reports. Professor McKenzie and Associate Professor Partington recommend that the equity beta of the benchmark efficient entity would be very low, though it is difficult to determine a specific value based on conceptual analysis.
- Empirical estimates for Australian energy networks—these studies present a consistent pattern. This pattern is robust to the use of different econometric techniques, different comparator sets and different time periods. These consistent results extend from our analysis in the 2009 WACC review through updates by other stakeholders using more recent data. Table 1 shows the pattern of empirical estimates at a high level.

**Table 1 Average equity beta point estimates for Australian energy networks**

Source	Estimation period	Individual firm averages	Fixed portfolios	Varying portfolios	Summary of analysis permutations
Henry 2009	2002–2008	0.45–0.71	0.49–0.66	0.43–0.78	Monthly/weekly intervals, 2002/2003 start, OLS/LAD regressions, value/equal weighted fixed portfolios, average/median varying portfolios
ERA 2011	2002–2011	0.44–0.60	–	–	Monthly/weekly intervals, OLS/LAD regressions
ERA 2013	2002–2013	0.49–0.52	0.47–0.53	–	OLS/LAD/MM/TS regressions, value/equal weighted portfolios
SFG 2013	2002–2013	0.60	–	0.55	Four weekly repeat sampling

Source: Henry, *Estimating  $\beta$* , 23 April 2009; ERA, *Draft decision: Western Power access arrangement*, March 2012, pp. 195–205; ERA, *Explanatory statement for the draft rate of return guidelines*, 6 August 2013, pp. 168–181; and SFG, *Regression-based estimates of risk parameters for the benchmark firm*, 24 June 2013, pp. 12–15. Note some averages are calculated by the AER.

Our range for the equity beta for the benchmark efficient entity is established by reference to empirical estimates for Australian energy networks. While the conceptual analysis indicates the equity beta is less than 1.0, because of the nature of that analysis, it does not indicate how far below 1.0. The

empirical estimates span a range of values and we have drawn on this dispersion to inform our choice of the range.

Our choice of the range for the equity beta is informed by empirical estimates for Australian energy networks in preference to empirical estimates for overseas energy networks. This is because the firms used for the Australian empirical estimates better reflect our definition of the benchmark efficient entity.

During both the 2009 WACC review and now we considered the empirical estimates support a range of 0.4 to 0.7. In the 2009 WACC review, we adopted a point estimate of 0.8 (slightly above the range of empirical estimates). In this issues paper, we propose to lower our point estimate from 0.8 to 0.7 because we now have greater confidence in the reliability of the empirical estimates—In 2009, there were fewer empirical estimates available. The data spanned a shorter time period and we were facing uncertainty due to the global financial crisis. Four years on, we now have more studies, spanning a longer time period and a diversity of market conditions. The results from these studies demonstrate a consistent pattern over time.

Our choice of 0.7 as the point estimate for the equity beta, which is at the upper end of the range of empirical estimates, has been informed by:

- Cross checks from overseas energy networks—we consider overseas energy networks can be used as a cross check of the Australian estimates, though not as the primary source of empirical estimates. The pattern of overseas results is not consistent. The majority of recent updates include point estimates between 0.5 and 0.9 (although, some estimates exceed 1.0). Nonetheless, given the inherent uncertainties when relating foreign estimates to Australian conditions, these empirical estimates are not incompatible with our proposed range. These results are consistent with our choice of a point estimate in the upper end of our range.
- Theoretical principles underpinning the Black CAPM—this alternative model suggests that the standard CAPM may underestimate the return on equity for firms with equity betas below 1.0. Though it is difficult to ascertain the magnitude (or materiality) of this effect, selection of a point estimate at the higher end of the range appears compatible with the theoretical predictions of the Black CAPM.
- Cross checks from the water sector—expert analysis indicates that water networks have similar systematic risk exposure to energy networks and are the closest available comparators outside the energy sector. Recent decisions by regulators of Australian water networks have adopted equity beta point estimates that tend to be around 0.7, and have been between 0.55 and 0.8. The ENA's consultant on equity beta, SFG, recently produced empirical estimates for an Australian water utility where the mean equity beta estimate was 0.55. These results are consistent with our choice of a point estimate in the upper end of our range.

When we receive the new empirical estimates we have commissioned we will review our findings set out in this issues paper and publish the results with our final guideline.

# 1 Introduction

The equity beta is a key parameter within the Sharpe–Lintner CAPM (the standard CAPM).

The equity beta measures the 'riskiness' of a firm's returns compared with that of the market. Specifically, the equity beta measures the standardised correlation between the returns on an individual risky asset or firm with that of the overall market.<sup>2</sup>

In this context, the word "risk" has a specific meaning.<sup>3</sup> Risk results from the possibility that actual returns will differ from expected returns—the greater the uncertainty around the returns of a firm, the greater its level of risk.

Generally, investors can diversify away non-systematic (or business-specific risk). Therefore investors do not require compensation for business-specific risk.<sup>4</sup> Compensation is only required for bearing systematic risk. Sources of systematic risk include changes in real GDP growth, inflation, currency prices, commodity prices and real long term interest rates. A firm's sensitivity or exposure to these risks will depend on its business activities and its level of financial leverage.<sup>5</sup>

Under the rules, our task is to determine a rate of return for each service provider that is commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of regulated services.<sup>6</sup> Accordingly, it is the business activities and level of financial leverage of a benchmark efficient entity, rather than the individual circumstances of any specific service provider, which is relevant to our estimates of beta.

In the explanatory statement to our draft rate of return guideline, we outlined our proposed approach of using the CAPM as our foundation model to estimate a range and a starting point for the final return on equity.<sup>7</sup> We also outlined information that we would have regard to, in addition to the CAPM, in reaching our final return on equity estimate. We explained how we expected these changes to our approach to lead to a more stable return on equity over time. In particular, we now give consideration to the Wright approach (and other information that provides relatively stable estimates of the return on equity) when we evaluate the information set and distil a return on equity estimate.<sup>8</sup> Further, estimates of the return on debt that are determined using a trailing average will better align with actual interest costs for the businesses, and so reduce the volatility of cash flows to equity holders.<sup>9</sup>

While the equity beta we adopt is not expected to affect the stability of the return on equity we consider over time, it is expected to affect the average level of the return on equity in those determinations.

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<sup>2</sup> R. Brealey, S. Myers, G. Partington and D. Robinson, *Principles of corporate finance*, McGraw–Hill: First Australian edition, 2000, pp. 186–188 (Brealey et al, *Principles of corporate finance*, 2000).

<sup>3</sup> Brealey et al, *Principles of corporate finance*, 2000, pp. 186–188.

<sup>4</sup> G. Pierson, R. Brown, S. Easton and P. Howard, *Business Finance*, 8th Edition, p. 214.

<sup>5</sup> M. McKenzie and G. Partington, *Report to the AER: Estimation of the equity beta (conceptual and econometric issues) for a gas regulatory process in 2012*, 3 April 2012, p. 5 (McKenzie and Partington, *Estimation of equity beta*, April 2012). This report is available on the AER website at:

[http://www.aer.gov.au/sites/default/files/RBP%20gas%20transmission%202012%20-%20Equity%20Beta%20report%20-%20McKenzie%20and%20Partington%20\(Public\)%20-%203%20April%202012\\_0.pdf](http://www.aer.gov.au/sites/default/files/RBP%20gas%20transmission%202012%20-%20Equity%20Beta%20report%20-%20McKenzie%20and%20Partington%20(Public)%20-%203%20April%202012_0.pdf)

<sup>6</sup> NER, cls 6.5.2(c) and 6A.6.2(c); NGR, r. 87(3).

<sup>7</sup> AER, *Better regulation: Explanatory statement, Draft rate of return guideline*, 30 August 2013, pp. 58–72, 194–208 (AER, *Explanatory statement: Draft rate of return guideline*, August 2013).

<sup>8</sup> AER, *Explanatory Statement: Draft rate of return guideline*, August 2013, pp. 68–69.

<sup>9</sup> AER, *Explanatory Statement: Draft rate of return guideline*, August 2013, pp. 82–86.



The rate of return guideline process is a consultation process which involves all relevant stakeholders, and which we expect will occur only once every three years. Accordingly, it provides a broad forum to consider and consult on important changes, such as a change in the equity beta. This current guideline development process allows us to consult on our intended approach in advance of the first determination under these guidelines.

We propose figures for equity beta: a range of 0.4–0.7 and a point estimate of 0.7. These estimates arise from our proposed approach, which was set out in the draft guideline.<sup>10</sup> This proposed approach incorporates both conceptual (theoretical) and empirical analysis.

- The conceptual analysis provides context for the empirical analysis. The core conceptual analysis is in section 2 of this issues paper. This includes consideration of the differences between energy sectors (electricity and gas; transmission and distribution) and consideration of the potential impact of changes in the regulatory regime. It also includes analysis comparing the underlying risk characteristics of the benchmark efficient entity against the market average firm. There is further conceptual analysis comparing the energy and water sectors in the Technical Appendix (section A.1).
- The empirical estimates are generated using a number of different comparator sets and a range of econometric techniques. Section 3 of this issues paper discusses the composition of the comparator set using Australian energy networks, as well as selection of the time period for analysis. Section 4 presents the available empirical estimates for Australian energy networks, beginning with a brief summary of key econometric techniques endorsed by the AER. It then presents empirical estimates from a number of different studies. There is supporting material on the methodological choices for two key econometric issues (gearing and portfolio construction) in the Technical Appendix (section A.2).
- We then compare the empirical estimates from the best available comparator set (Australian energy networks) against other possible comparators. Our consideration of empirical estimates for international energy networks is in section 5. There is supporting material drawing from the water sector in the Technical Appendix (section A.1.1, noting that this material is closely linked to the conceptual analysis of the relative risks for Australian water networks).
- The different sources of information are then interpreted with regard to their strengths and weaknesses. We propose to determine both a range (with proposed reasoning in section 6.1) and a point estimate within this range (with proposed reasoning in section 6.2). In these considerations, we also have regard to the implications of an alternative model, the Black CAPM (presented in the Technical Appendix, section A.3).

Under this approach, empirical estimates of equity beta are a key determinant. We have commissioned a new independent expert report on empirical estimates for Australian energy networks, but this report is not yet complete. The key aspects of the terms of reference for this report are included in section 4.4. However, there are a number of other recent empirical estimates for Australian energy networks, including those prepared by the Economic Regulation Authority of Western Australia (ERA) and by Strategic Finance Group Consulting (SFG) for the Energy Networks Association (ENA). We have considered these estimates in reaching our proposed equity beta position.

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<sup>10</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, pp. 214–218.

When we reviewed the available evidence, we applied the criteria set out in our draft guideline to help us form a view on the merits of each piece of evidence and where each piece of evidence should be applied. Our review of the evidence against the criteria can be found in the Technical Appendix (section A.4).

## 2 Conceptual analysis

In the explanatory note accompanying the draft guideline, we stated that our intended approach would commence with examination of the conceptual risk factors relevant to equity beta for the benchmark efficient entity.<sup>11</sup> This section includes conceptual analysis comparing the relative riskiness of the different energy network sectors, the potential impact of regulatory changes on energy network service providers, and compares the benchmark efficient energy network entity relative to the market average firm. In Technical Appendix A, we compare the relative riskiness of the energy and water network sectors.

Based on conceptual analysis, we consider that:

- The different energy network sectors we regulate (electricity transmission, electricity distribution, gas transmission, and gas distribution) face comparable levels of systematic risk, such that we propose to adopt the same equity beta for the benchmark efficient entity across each sector.
- The systematic risk exposure of energy networks going forward is likely to be comparable to their systematic risk exposure in the past. Therefore, it is reasonable to rely on the Australian empirical estimates of energy networks (which are historical) as the key determinant of our equity beta point estimate and range. In forming this view, we have taken into account the changes that we are proposing across the Better Regulation program.
- Conceptual analysis suggests that the benchmark efficient energy network entity will have lower overall systematic risk exposure than the average firm in the market. Expert advice supports the conceptual position that for regulated energy networks, their lower business risk more than offsets their higher financial risk. It is difficult to ascertain the magnitude of this difference, and therefore the empirical estimates are the key determinant of our proposed equity beta point estimate and range. But the range and point estimate we propose are compatible with this conceptual expectation.

### 2.1 Comparative risks of different energy networks

We consider that systematic risks between gas, electricity, transmission and distribution networks are sufficiently similar as to justify one benchmark.<sup>12</sup> Most submissions to our consultation paper either supported or did not object to this view.<sup>13</sup> Consequently, we have adopted a single benchmark efficient entity, defined as 'a pure play, regulated energy network business operating within Australia'. Our reference to 'energy network' refers to a gas distribution, gas transmission, electricity distribution or electricity transmission service provider.

#### 2.1.1 Systematic risks between gas transmission and other energy networks

The systematic risk exposure of the gas and electricity networks we regulate is sufficiently similar to warrant the use of one benchmark. Stakeholders have indicated two main areas where there might be differences in the risk exposure between gas and electricity businesses—demand risk and

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<sup>11</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, p. 214.

<sup>12</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, pp. 42-46.

<sup>13</sup> For a supportive submission, see Citipower, Powercor and SA Power Networks, *Response to the AER's rate of return guidelines consultation paper*, 28 June 2013. Only one submission strongly disagreed, see Envestra, *Response to AER rate of return consultation Paper*, 28 June 2013 (Envestra, *Response to the consultation paper*, June 2013).

competition risk.<sup>14</sup> In our view, these should not lead to material differences in the net risk exposure for the following reasons.

On demand risk:

- The regulatory regime mitigates demand risk through the form of control. In particular, under revenue caps, the price is adjusted to enable the service provider to receive the approved revenue where forecast demand differs from actual demand. Under a price cap, service providers may mitigate the risk of forecast error by restructuring tariffs to offset demand volatility.
- To the extent that there are genuine risks of extreme changes in demand for specific service providers which present the potential for stranding of an asset, the regulatory regime for gas and electricity can mitigate this risk by providing prudent discount and accelerated depreciation provisions.<sup>15</sup>

On competition risk:

- Both gas and electricity service providers face very limited competition risk by virtue of being regulated natural monopolies. Generally, competition risks for regulated networks are very low. In fact, such networks are usually regulated in the first instance because they are natural monopolies. Although competition in unregulated industries may emerge naturally, this is unlikely to occur in regulated industries.<sup>16</sup>
- Material competition between gas and electricity may arise with changes in the relative efficiency of consumers' technology. However, gas and electricity production technology is relatively mature and technological advances that have meaningful impacts on prices have been relatively slow to commercialise.<sup>17</sup> Material competition between gas and electricity could also arise if there is a significant longer term, stable change in the relative prices. However, because demand for gas and electricity is relatively inelastic, prices would have to change significantly for consumers to change their demand gas or electricity.<sup>18</sup>
- APIA and Envestra have submitted that gas service providers face greater risk than electricity service providers because gas faces greater competition.<sup>19</sup> However, gas service providers mitigate competition from other pipelines through long term contracts with consumers - typically between 10 to 15 years.<sup>20</sup> In particular, transmission service providers typically enter into contracts which underwrite their revenue requirements. These contracts typically assign a portion

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<sup>14</sup> Envestra, *Response to the consultation paper*, June 2013, p. 10; APIA, *Response to Issues Paper: The Australian Energy Regulator's development of Rate of Return Guidelines*, 20 February 2013, Schedule 3, p. 1 (APIA, *Response to the issues paper*, February 2013); APA Group, *Submission responding to AER Rate of Return Guidelines Consultation Paper*, 21 June 2013, p. 5.

<sup>15</sup> For prudent discounts, see NER, cl. 6A.26, NGR r. 96; for accelerated depreciation provisions see NER, cls. 6.5.5(b)(1), 6A.6.3(b)(1), NGR, r.89(1).

<sup>16</sup> Frontier, *Assessing risk when determining the appropriate rate of return for regulated energy networks in Australia: A report prepared for the AER*, July 2013, pp. 14–15 (Frontier, *Assessing risk for regulated energy networks*, July 2013). This report is available at the AER website on: <http://www.aer.gov.au/sites/default/files/Frontier%20Economics%20-%20Assessing%20risk%20when%20determining%20the%20appropriate%20rate%20of%20return%20-%20July%202013%20-%20Draft%20rate%20of%20return%20guideline.pdf>

<sup>17</sup> Bureau of Resource and Energy Economics, *Australian energy projections to 2049-50*, Canberra, December 2012, pp. 42–43.

<sup>18</sup> Bureau of Resource and Energy Economics, *Gas Market Report 2012*, Canberra, May 2012, p. 47.

<sup>19</sup> APIA, *Response to the issues paper*, February 2013, Schedule 3, p. 1; Envestra, *Response to the consultation paper*, June 2013.

<sup>20</sup> Energy Quest, *ESAA Domestic Gas Study Stage 2*, 10 March 2011, p. 69.

of the risk to the end user.<sup>21</sup> Gas distribution service providers also often undertake pipeline extensions when they are underwritten by government or developer contributions.<sup>22</sup> Further, the regulatory regime and the limited scope for competition between pipelines mitigates the potential theoretical reasons for gas service providers being somewhat riskier than the average electricity service provider. This view is shared by Frontier, which stated that:<sup>23</sup>

...there are some reasons to think that regulated gas transmission pipeline networks may be somewhat riskier than other types of regulated energy networks. .... However, this is not a strongly-held view, as aspects of the incentive regulatory arrangements provide more certainty to gas networks than electricity networks. Ultimately, the question of whether gas transmission pipeline networks are riskier than other types of energy networks needs to be answered empirically.

With these considerations in mind, the risks facing gas and electricity service providers are likely to be similar. Therefore, the risks that require compensation are sufficiently similar to warrant the use of a single benchmark between electricity, gas, transmission and distribution.

## 2.2 Potential impact of other regulatory changes

In the 2009 WACC review, we considered that service providers face a lower degree of risk compared to the market due to the relatively high demand inelasticity.<sup>24</sup> Following from changes to the National Electricity and Gas Rules by the AEMC on 29 November 2011, we started developing the Better Regulation program aiming to deliver an improved regulatory framework focused on promoting the long term interests of consumers. We have made several changes to our assessment approaches through the Better Regulation program. These changes, once implemented, have some potential to impact on the service providers' risk profile. It is unclear to what extent these changes will reflect changes in the systematic risk, compared with changes to the benchmark efficient entity's exposure to non-systematic risk. As noted above, it is only systematic risk that is of relevance to the determination of equity beta.

In the rate of return draft guideline, we proposed to move away from the current 'on-the-day' approach to a trailing average for estimating the return on debt of an efficient benchmark efficient entity. We expect the trailing average approach will more closely align with the efficient debt financing practices of the service providers. This approach will lead to less volatile cash flow for the service providers over time and allow them to manage interest rate risk without exposing themselves to substantial refinancing risk.<sup>25</sup>

In the rate of return draft guideline, we also proposed a change in our approach to the return on equity which is expected to lead to a more stable return on equity over time. For example, our proposed implementation of the CAPM will result in estimates of the return on equity that may vary over time. Alternatively, the Wright approach for implementing the CAPM will result in estimates of the return on equity that may be relatively stable over time. The informative use of these implementations of the

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<sup>21</sup> For example, in October 2011 APA entered a 10 year contract with AGL to transport gas in its Carpentaria Gas Pipeline to Diamantina Power Station at Mount Isa. The power station is underpinned by 17-year energy supply agreements with Mount Isa Mines. *APA Annual Report 2012*, p. 7. Another example, is the Stage 3 expansion of Epic Energy's South West Queensland Pipeline is underpinned by transport agreements for over 90 per cent of the increased capacity with AGL Energy and Origin Energy until 2028 and 2034. Energy Quest, *ESAA Domestic Gas Study Stage 1*, 1 September 2010, p. 42.

<sup>22</sup> For example, Victorian government contributions via the 'Energy to the Regions' program have enabled gas distribution expansion.

<sup>23</sup> Frontier, *Assessing risk for regulated energy networks*, July 2013, p. 5.

<sup>24</sup> AER, *Final decision: WACC review*, May 2009, p. 249.

<sup>25</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, p. 82

CAPM, in addition to other information, is expected to lead to more stable estimates of the return on equity than under our previous approach.

In the draft expenditure forecast assessment guideline, we proposed to complement our existing assessment techniques with two new benchmarking techniques. If the incentives are assessed as effective, we will use a business' past spending as an efficient starting point to set its future expenditure allowance. However, if we find a material and unjustified difference between revealed costs and our assessment of efficient costs, we will depart from revealed costs in favour of benchmark costs.<sup>26</sup>

The proposed approach to estimate the return on debt and return on equity are expected to decrease the volatility of service providers' cash flow. However changes to non-WACC aspects of the Better Regulation program might place less reliance on service providers' actual costs. It is unclear to what extent these changes will reflect changes in the systematic risk of a benchmark efficient entity. As noted in the draft rate of return guideline, only systematic risk should be compensated through return on equity.<sup>27</sup> Further, we note the transition into these new approaches will be gradual due to various transitional arrangements and different regulatory control periods. Accordingly, we conclude that Australian empirical estimates (which are historical) remain a reasonable basis to for determining our equity beta estimates. We will consider any new information in relation to this matter as it becomes available.

## 2.3 Systematic risk of energy networks compared with the market average firm

We now turn to the question of whether it is possible to determine an a priori expectation of the value of beta for the benchmark efficient entity we are intending to specify in the guideline. That is, where should the equity beta of the benchmark efficient entity sit relative to the average equity beta across all firms in the market, which is 1.0 by definition.<sup>28</sup> We addressed this type of conceptual analysis at length in our 2012 decision for the Roma to Brisbane pipeline, and this material remains relevant.<sup>29</sup>

Two key types of systematic risk are relevant: business risk and financial risk.

### 2.3.1 Business risk for the benchmark efficient entity

Business risk relates to the systematic risk exposure of the underlying business assets. It is generally accepted that the benchmark efficient entity has lower business risk than the market average firm.<sup>30</sup> First, there are a number of inherent characteristics for an energy transportation network that lead to low systematic risk exposure. These include:<sup>31</sup>

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<sup>26</sup> AER, *Better regulation: Explanatory statement, Draft expenditure forecast assessment guidelines for electricity transmission and distribution*, August 2013, p. vii.

<sup>27</sup> Under the assumption that investors hold fully diversified equity portfolio

<sup>28</sup> More precisely, the value weighted average across all firms in the market is 1.0. As pointed out by McKenzie and Partington, the equal weighted average may not be 1.0, since larger firms may be unevenly distributed above or below 1.0. See McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 21.

<sup>29</sup> AER, *Draft decision: APT Petroleum Pipeline Pty Ltd, Access arrangement draft decision, Roma to Brisbane pipeline, 2012–13 to 2016–17*, April 2012, pp. 149–51, 315–319 (AER, *Draft decision: APTPPL access arrangement*, April 2012). There is also relevant material in AER, *Final decision: APT Petroleum Pipeline Pty Ltd, Access arrangement final decision, Roma to Brisbane Pipeline, 2012–13 to 2016–17*, August 2012, pp. 88-89.

<sup>30</sup> See SFG, *Equity beta: Report prepared for APT Petroleum Pipelines Ltd*, 11 October 2011, p. 14 (SFG, *Equity beta for APTPPL*, October 2011); and McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 6.

<sup>31</sup> See Frontier, *Assessing risk for regulated energy networks*, July 2013, pp. 60–63; also M. McKenzie and G. Partington, *Report to the AER: Risk, asset pricing models and WACC*, 27 June 2013, p. 11 (McKenzie and Partington, *Risk, asset pricing models and WACC*, June 2013). This McKenzie and Partington report is available on the AER website at:

- Operation of a natural monopoly—the physical structure of the networks (including the substantial economies of scale and impracticality of duplicating the networks) reduces competition, which mitigates the effect of changes in aggregate demand on network revenue.<sup>32</sup>
- Provision of an essential service with low demand elasticity—across the ups and downs of the business cycle, demand does not change as dramatically for essential services such as energy, and this reduces the correlation between changes in the benchmark efficient entity's return and the market return.<sup>33</sup>

Second, the structure of the regulatory regime insulates the business from systematic risk, reflecting the following regulatory features (across electricity and gas):

- Form of pricing control—as noted above, revenue caps automatically adjust in response to changes in demand, reducing systematic risk. Even under a price cap, the ability to restructure tariffs may act to offset demand volatility.
- Tariff variation mechanisms—these include annual adjustments for inflation, which reduce exposure to inflation risk (itself a driver of systematic risk) for the benchmark efficient entity.<sup>34</sup>
- Cost pass through mechanisms—that allow for certain costs to be passed on to consumers, where expenditure was unforeseen at the commencement of the regulatory period. While in some cases cost pass throughs relate solely to business-specific risk, where these unforeseen expenses relate to market wide influences, the cost pass through would reduce systematic risk exposure.<sup>35</sup>
- Tariff structures that include fixed charges—the benchmark efficient entity can adopt pricing structures that align with their high fixed costs (for example, access charges for network connections, irrespective of gas/electricity use; or capacity charges on pipelines irrespective of gas use) and further reduce the impact of any change in aggregate demand.<sup>36</sup>

The broad category of business risk can be disaggregated into further subcategories of risk. In a 2012 report for the AER, Professor McKenzie and Associate Professor Partington disaggregated business risk into economic risk and operational risk, before assessing the overall impact.<sup>37</sup> They considered that operational risk would be above the market average, given the high proportion of fixed costs (relative to variable costs) for energy networks. However, since the benchmark efficient entity could mitigate the effect of this cost structure through the use of fixed charges (as per the comment on tariff structures above), they concluded that the overall business risk would still be very low.

The recent Frontier report went further, in that it disaggregates business risk into nine different categories. Frontier's assessment was concerned with both systematic and non-systematic risk; and only the former is relevant to the estimation of equity beta.<sup>38</sup> Nonetheless, it is relevant that the

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<http://www.aer.gov.au/sites/default/files/McKenzie%20and%20Partington%20-%20Risk,%20asset%20pricing%20models%20and%20the%20WACC%20-%20June%202013%20-%20Draft%20rate%20of%20return%20guideline.pdf>

<sup>32</sup> We note the potential for some sectoral differences in competition exposure between electricity and gas. See Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, pp. 60–61.

<sup>33</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, pp. 14–15.

<sup>34</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 6

<sup>35</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 6.

<sup>36</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 14.

<sup>37</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 5; see also M. McKenzie and G. Partington, *Report to the AER: Risk, asset pricing models and WACC*, 27 June 2013, p. 11 (McKenzie and Partington, *Risk, asset pricing models and WACC*, June 2013).

<sup>38</sup> Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, pp. 41–42, 105–106.

Frontier report assesses the total risk (systematic and non-systematic) for each subcategory of business risk as low or medium, relative to the rest of the economy.<sup>39</sup>

Having regard to this conceptual analysis, including the expert opinions from Frontier and McKenzie and Partington, we consider that business risk for the benchmark efficient entity will be very low.<sup>40</sup>

### 2.3.2 Financial risk for the benchmark efficient entity

Financial risk relates to the additional systematic risk exposure that arises from the debt holdings of the firm. The underlying principle is that since payments to debt holders take precedence over payments to equity holders, the systematic risk exposure for equity holders (i.e. the equity beta) increases as more debt is issued. It is generally accepted that the benchmark efficient entity has higher financial risk than the market average firm.<sup>41</sup> The key characteristic causing this higher financial risk is the relatively high financial leverage (gearing) for the benchmark efficient entity (60 per cent) relative to the market average firm (roughly 30–35 per cent).

However, the exact relationship between financial risk and financial leverage is not straightforward. Professor McKenzie and Associate Professor Partington discuss the limitations of various linear and nonlinear leverage formulae.<sup>42</sup> They consider that, overall, increased financial leverage increases financial risk, but caution against any claim that the exact nature of this relationship might be known. McKenzie and Partington describe one possible nonlinear relationship where, at a moderate level of debt, increases in leverage result in only a slight increase in financial risk. However, at high debt levels, increases in leverage result in a much larger increase in financial risk.<sup>43</sup> This analysis would suggest that, even where we observe financial leverage that is significantly above the market average financial leverage, we should be cautious about inferring an equivalent increase (i.e. a significant increase) in financial risk above the market average. In other words, even though the financial leverage of the benchmark efficient entity is (approximately) double the financial leverage of the market average firm, we should not infer that this means the benchmark efficient entity has (approximately) double the financial risk. We simply do not know enough about the exact nature of the relationship between financial leverage and financial risk.<sup>44</sup>

The recent Frontier report disaggregates financial risk into five different categories (again including both systematic and non-systematic risk).<sup>45</sup> Frontier assesses the level of risk relative to other businesses in the economy, for each of the subcategories that contribute to financial risk, as:<sup>46</sup>

- Low risk—default risk, financial counterparty risk, and illiquidity risk (for large networks)
- Medium risk—refinancing risk
- Medium to high risk—interest rate reset risk, and illiquidity risk (for small networks).

There are four subcategories assessed as medium or low risk (including illiquidity risk for large networks). Hence, in the Frontier analysis, only two subcategories might explain an aggregate

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<sup>39</sup> Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, p. 65.

<sup>40</sup> See McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 15.

<sup>41</sup> See SFG, *Equity beta for APTPL*, October 2011, p. 14.

<sup>42</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, pp. 7–13.

<sup>43</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 10.

<sup>44</sup> As is clear from the start of this paragraph, McKenzie and Partington would still consider that, as a result of the higher leverage, the benchmark firm had higher financial risk—the direction of the effect is reasonable, but not the magnitude.

<sup>45</sup> Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, pp. 10, 41–42, 105–106.

<sup>46</sup> Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, p. 65.



financial risk materially above the market average level (medium risk): interest rate reset risk and illiquidity risk for small networks.

Further, when the Frontier report assesses interest rate reset risk as 'medium to high', it does so on the assumption that the regulatory cost of debt would continue to be set using an 'on the day' approach.<sup>47</sup> Later in that report, Frontier acknowledges that the implementation of a trailing average approach (as we propose to do in the draft guideline) would reduce, but not eliminate, interest rate reset risk.<sup>48</sup>

Some stakeholders have argued for a long-term trailing average approach to determining the cost of debt as a way of reducing interest rate reset risk, at least on the debt side. Clearly, such an approach would result in a very smooth profile for the allowed cost of debt. However, as noted in Chapter 3, the application of such a mechanism would not eliminate interest rate reset risk altogether.

We now propose to adopt a trailing average approach, as set out in the explanatory statement to the draft guideline. We consider that the trailing average approach will reduce refinancing risk. In addition to the trailing cost of debt, there is an additional effect flowing from the new approach to the determination of the return on capital under the changed legislation. As noted above, we expect our new approach to lead to a more stable return on equity over time. This is because we now propose to consider additional sources of information that provides relatively stable estimates of the return on equity when we evaluate the information set and distil a return on equity estimate.<sup>49</sup> All else equal, this change should reduce the variability in returns to equity holders, and the more stable cash flows should reduce the default risk for the firm.<sup>50</sup> Taken together, conceptual analysis of the new approach to the determination of the return on capital should reduce the benchmark efficient entity's exposure to financial risk.

### 2.3.3 Overall assessment of business risk and financial risk

The conceptual assessment of equity beta relative to the market average is determined by the direction and relative magnitude of these two factors: business risk and financial risk.

The expert report we commissioned from Professor McKenzie and Associate Professor Partington attempts this assessment. They undertake conceptual analysis of both business risk and financial risk, and engage with academic literature on this issue.<sup>51</sup> They also note that their conceptual findings are supported when they turn to the empirical evidence.<sup>52</sup>

Taken together, the previous conceptual discussion clearly provides evidence to suggest that the theoretical beta of the benchmark firm is very low. While it is difficult to provide a point estimate of beta, based on these considerations, it is hard to think of an industry that is more insulated from the business cycle due to inelastic demand and a fixed component to their pricing structure. In this case, one would expect the beta to be among the lowest possible and this conclusion would apply equally irrespective as to whether the benchmark firm is a regulated energy network or a regulated gas transmission pipeline.

Empirical support for this proposition may be found by looking at the industry beta tables of Damodoran (see Appendix 2). The equity betas for water, gas and electricity are the lowest in the table, while their debt to equity ratios are among the highest. Although this evidence is based on US companies, there is no reason to believe that a similar pattern would not exist in Australia.

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<sup>47</sup> Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, p. 64.

<sup>48</sup> Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, p. 74.

<sup>49</sup> AER, *Explanatory Statement: Draft rate of return guideline*, August 2013, pp. 68–69.

<sup>50</sup> Frontier Economics, *Assessing risk for regulated energy networks*, July 2013, p. 24.

<sup>51</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, pp. 5–15.

<sup>52</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 15.

This is how McKenzie and Partington conclude their report:<sup>53</sup>

This report was asked to prepare a response to three questions. The first question was whether there are conceptual or theoretical grounds to expect that the benchmark firm has an equity beta below 1.0? A close examination of the components of systematic risk clearly suggests the answer to this question is in the affirmative. In fact, one would expect the beta to be among the lowest possible and this conclusion would apply equally irrespective as to whether the benchmark firm is a regulated energy network or a regulated gas transmission pipeline.<sup>54</sup>

Based on the available evidence, including the expert reports from Frontier and McKenzie and Partington, we consider that there are reasonable conceptual grounds to expect that the equity beta of a benchmark efficient regulated energy network will be below 1.0. However, we recognise the limits of this type of approach, and use it to inform our assessment with regard to these limitations. Further, conceptual analysis does not indicate the magnitude of the difference between the benchmark efficient entity and the market average (1.0), and we propose to rely on empirical estimates for this assessment.

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<sup>53</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 23.

<sup>54</sup> This quote refers to three questions, which were set out in the terms of reference for the McKenzie and Partington report. For clarity, the other two questions did not relate to conceptual analysis of the benchmark firm against the market average firm. They related to (1) the possibility of bias in regressions with low R-squared statistics and (2) the possibility of systematic bias in the CAPM as demonstrated by Monte Carlo simulations. See McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 3.

## 3 Comparator set selection

We propose to use firms that share all or most of the key characteristics of the benchmark efficient entity when conducting our regression analysis to estimate the equity beta. These will be entities that provide regulated electricity and/or gas network services operating within Australia. Afterwards, we propose to cross check our empirical equity beta estimate with comparators less representative of, but nevertheless reasonably comparable to, the benchmark efficient entity. We propose to use water networks and international energy networks for these cross checks.

We propose to use time periods that generate reliable and relevant estimates of equity beta. Hence, we have also included in this section discussion of the alternative time periods that might be chosen for the comparator set, and the strengths of each approach.

### 3.1 Firm selection—Australian energy networks

The risk exposure of the gas, electricity, transmission and distribution networks we regulate is sufficiently similar to warrant adopting a single benchmark efficient entity for the Australian energy section.<sup>55</sup> Importantly, we do not consider systematic risks between gas, electricity, transmission and distribution networks to be materially different (see discussions in conceptual analysis section above). Therefore, we propose to estimate a single equity beta for the Australian energy sector.

We would, ideally, use firms that share all or most of the key characteristics of the benchmark efficient entity when conducting our regression analysis to estimate the equity beta. In practice, few firms closely align with the benchmark. Further, several of these firms do not have observable equity betas because they are not listed on the Australian Stock Exchange (ASX). This leaves us with a small sample of firms for our regression analysis, which could cause problems associated with statistical reliability.

A potential solution to this problem would be to relax our threshold of comparability to the benchmark efficient entity and include firms that are less similar to the benchmark efficient entity. This would allow us to increase our set of comparator firms for our regression analysis. However, while this would make our equity beta estimates more statistically reliable, it would also reduce the relevance of the results.

ENA's consultant, SFG, suggested the sample of Australian comparators was too small to produce reliable estimates. Consequently, SFG suggested expanding the comparator set to include 56 US-listed stocks.<sup>56</sup> However, we do not consider international comparators should be used as a primary determinant of the equity beta for the benchmark efficient entity. This is because international comparators are exposed to different systematic risks compared to a benchmark efficient entity (see section 5, international comparators). We recognise there are only nine reasonable Australian comparators and a larger comparator set would be desirable in an ideal world. However, since the 56 US-listed stocks in SFG's sample are less relevant comparators, including these firms simply to increase the number of our observations would not be a preferable option. While increased statistical reliability is desirable, it is not preferable if it substantially reduces the relevance of the data. Moreover, we consider the available Australian data is sufficient for us to form a reasonable equity beta estimate.<sup>57</sup> The set of nine Australian comparators generates a consistent pattern of empirical

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<sup>55</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, pp. 42–46.

<sup>56</sup> SFG, *Regression-based estimates of risk parameters*, June 2013.

<sup>57</sup> For example, although the sample is small, there is a consistent pattern of empirical estimates across different sample periods and econometric techniques, as presented in section 4.

estimates that is robust across different sample periods and econometric techniques, as presented in section 4. Further, the data set has substantially increased since the 2009 WACC review, and the statistical precision of the estimates has improved, as presented in section 6.

In response to this problem, we propose to use ASX listed firms that most closely represent benchmark efficient firms in our regression analysis. After producing an empirical equity beta estimate, we propose to use comparators which are less representative of the benchmark efficient entity to cross check the estimates from our regression. These less representative comparators must, nevertheless, still be reasonably comparable to the benchmark efficient entity. For this, we propose to use water networks and international energy networks.

The entities we will use in our regression analysis are those that provide regulated electricity and/or gas network services operating within Australia. There are nine firms that meet these criteria, which we list below in table 3.1. Three of these firms are no longer trading. Another firm, AGL Energy Limited, has changed its operations such that it no longer closely represents a benchmark efficient firm.<sup>58</sup> We propose to account for this by only including data over an applicable time period for these firms. Whereas, for the other five firms, we propose to include the most recent data.

**Table 3.1: Listed entities providing regulated electricity and gas network services operating in Australia**

Firm (symbol)	Time/trading period	Sectors
AGL Energy Limited (AGK)	January 1990 – October 2006	Electricity Gas
Alinta (AAN)	October 2000 – August 2007	Gas
APA Group (APA)	June 2000 – present	Gas Minority interest in energy
DUET Group (DUE)	August 2004 – present	Electricity Gas
Envestra Ltd. (ENV)	August 1997 – present	Gas
GasNet (GAS)	December 2001 – November 2006	Gas
Hastings Diversified Utilities Fund (HDF)	December 2004– November 2012	Gas
Spark Infrastructure Group (SKI)	March 2007 <sup>59</sup> – present	Electricity Gas
SP AusNet (SPN)	December 2005 – present	Electricity Gas

Source: AER analysis, Bloomberg, AER, *Final decision: WACC review*, May 2009, p. 255

<sup>58</sup> In October 2006, AGL sold its infrastructure and asset management business to Alinta and acquired a portion of Alinta's retail and co-generation businesses.

<sup>59</sup> Note the SKI data is available from December 2005. However, the data prior to 2/3/2007 reflects stapled securities traded as instalment receipts—that is there are additional instalments owed by equity holders, which requires further leverage adjustment and makes beta estimation difficult.

While the firms in table 3.1 closely represent a benchmark efficient entity, they also provide non-regulated electricity and/or gas services. Examples of this include:

- Approximately 25 per cent of APA Group's revenue in the 2013 financial year (excluding pass-through revenue) was subject to prices determined under full regulation. APA Group generates most of the remaining 75 per cent of its revenue from contracts which have set terms, including negotiated pricing for the life of the contract.<sup>60</sup>
- DUET Group's assets, receive some unregulated revenue - Dampier Bunbury Pipeline (7 per cent unregulated), United Energy (8 per cent unregulated) and Multinet (5 per cent unregulated).<sup>61</sup>
- SP AusNet has an unregulated corporate arm, 'Select Solutions' that provides a number of commercial services.<sup>62</sup>

Generally, with the exception of APA Group, these non-regulated activities only constitute a small portion of the revenue earned by the firms in this comparator set. Therefore, when we consider the impact of these unregulated activities, we expect the net impact would be sufficiently minor such that our equity beta estimates for the comparators are reasonable. However, we understand that the organisational structure and commercial activities of these comparator firms are subject to change. Consequently, we propose to continuously review our comparator set in case we need to make adjustments. This may entail adjusting the comparator set by excluding or adding new comparators.

Since we propose to include only nine firms in our regression analysis, we also propose to complement this by cross checking our empirical equity beta estimates using an expanded set of comparators. These additional comparators, by necessity, will be less representative of the benchmark efficient entity. We propose to use water networks and international energy networks as additional comparators.

When applying expanded comparator sets as cross checks, we propose to carefully account for their differences to the benchmark efficient entity. We have highlighted the differences we need to consider when looking at water networks (see Technical Appendix A.1.1, systematic risk of energy networks compared with water networks). Further, we have considered the differences associated with international comparators. This is because the geographical market in which a comparator business operates is a determinant of its systematic risk in that this influences the conditions in which it operates. These include conditions relating to the regulatory regime, tax laws, industry structure and broader economic environment. As most of these conditions will be different for international comparator entities, the risk profile and activities of overseas entities is likely to differ from those within Australia. Therefore, we must take this into account when using international comparators to cross check our equity beta estimates.

## 3.2 Time period selection

### 3.2.1 Length of estimation period

As we suggested in the 2009 WACC review, in determining the length of the estimation period, there is generally considered to be a trade-off. On one hand, older data might be considered less reflective of current risk assessments (which would suggest a shorter period). On the other hand, in order to obtain a robust and statistically reliable equity beta estimate we need to have sufficient number of

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<sup>60</sup> APA Group, *Australian Pipeline Trust: Annual report for the financial year ended 30 June 2013*, p. 2.

<sup>61</sup> DUET Group, *Annual Report 2012*, p. 5.

<sup>62</sup> SP AusNet, *Statutory Annual Report 2013*, p. 23.

observations (which would suggest a longer period). Given that the sample of Australian businesses that can be considered close comparators to the benchmark efficient entity is limited, one option to increase the number of observations is to consider the longest available time period. Another option is to broaden the comparator set to include businesses that do not as closely reflect the benchmark efficient entity, such as overseas comparators or businesses in other regulated industries.<sup>63</sup> We also noted that the common data series providers generally use an estimation period of five years (using monthly observations) in estimating equity beta. On balance, we considered it reasonable to use an estimation period of at least five years.

### 3.2.2 Potential outlier observations

In the 2009 WACC review we distinguished between two types of events that may create outlier observations and, thus, potentially lead to bias in the equity beta estimates: business-specific events (such as merger announcements) and events that may be 'unrepresentative' of the market (such as the 'technology bubble' or the global financial crisis, GFC). In this section we present our considerations related to treatment of 'unrepresentative' events.

### 3.2.3 'Unrepresentative' events

Events are considered 'unrepresentative' when the market conditions during this period are unlikely to be reflective of the market in the future. Accordingly, 'unrepresentative events' are generally removed from the estimation period. While removing 'unrepresentative events' might appear relatively uncontroversial in theory, identifying the events that should be treated as 'unrepresentative' and their exact time frames might not be straightforward.

During the 2009 WACC review we treated the 'technology bubble' period (also known as the 'dot-com bubble' period) as an 'unrepresentative event' and excluded it from the sample as it was consistent with previous regulatory practice. The 'technology bubble' refers to the period from the late 1990s to 2001. It was suggested that in the United States market indices were driven upwards by telecommunications, media and technology stock prices during this period. This resulted in a period where equity betas for energy businesses were at their historical lows. It has been considered that during the 'technology bubble' the prices of energy businesses were not driven by technology stock prices, unlike the market index. We consider that there is an established consensus on the start and end dates for the 'technology bubble' that affected Australian share prices (and therefore equity beta estimation) from July 1998 to December 2001.

In the 2009 WACC review we also considered that the available evidence did not conclusively indicate whether the impact of the 'commodities boom' or 'sub-prime crisis' should be considered as structural changes or 'unrepresentative events'. Our consultant, Professor Olan Henry noted that post-September 2008 events associated with the GFC would be unlikely to be consistent with the CAPM as an equilibrium pricing model and should be excluded from consideration.<sup>64</sup> However, in the 2009 WACC review we also considered the Allen Consulting Group's (ACG) updated results, provided in support of the Joint Industry Associations' (JIA) submission, which were based on an analysis of the most recent available data at the time. These results demonstrated that the GFC had minimal impact on the estimated equity beta when compared to the ACG's previous report that estimated equity betas for the sample period up until May 2008.

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<sup>63</sup> These options are further discussed in section 5 (international comparators) and the Technical Appendix, section A.1.1 (comparison against water networks).

<sup>64</sup> O. Henry, *Estimating  $\beta$* , 23 April 2009, p. 8 (Henry, *Estimating  $\beta$* , April 2009).

Re-visiting the question of whether the GFC period should be included in the data sample for the present analysis, we note that it is impossible to predict whether (or when) the financial markets would fully recover to their pre-GFC state. As such, it is unclear whether the GFC should be classified as an 'unrepresentative event', as a structural break, or as a normal part of the cycle. As the Public Interest Advocacy Centre (PIAC) submitted:<sup>65</sup>

...it is too early to suggest there has been some sort of permanent shift in the economy, a shift that would require revisiting parameters derived from historical analysis.

In addition, if the GFC data is excluded, a case could also be put ... that the period of very high interest rates in the early 1980's should also be removed. This demonstrates that it is difficult to draw the line on what is in and what is out. Excluding data from a data set is opening a Pandora's box unless there is clear evidence that the data is incorrect or corrupted.

Further, we acknowledge that the start and end date for the GFC across different economies and asset markets are matters of varying opinion and are not settled.

Regarding the exclusion of the 'technology bubble' period, we note that at the time of the 2009 WACC review the 'technology bubble' represented a larger proportion of the estimation period than it currently does. As more observations become available, the effect of this event (if it is not removed from the observation period) on the beta estimates may diminish. It is also not clear if the 'technology bubble' period should be treated differently from the GFC period.

Given the above considerations, we have requested Professor Henry, to undertake the core set of regressions using three permutations of the estimation period:

1. The longest period available
2. The period after the 'technology bubble' and before the GFC, then the period after the GFC
3. The last five years of available data

Further detail on the relevant terms of reference is provided in section 4.4.

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<sup>65</sup> PIAC, *Balancing risk and reward: Submission to the AER's consultation paper: Rate of return guidelines*, 21 June 2013, p. 27.

## 4 Empirical estimates

The historical empirical estimates are the main form of evidence to determine equity beta values. Accordingly, we propose to use empirical estimates of equity betas from a set of Australian comparable firms to guide the equity beta value we adopt. The empirical estimates will be generated using a number of different comparator sets and a range of reasonable econometric techniques. The recent relevant empirical estimates indicate the equity beta estimate falls in the range of 0.4 to 0.7:

- In the 2009 WACC review, Professor Henry estimated the equity beta empirically for the benchmark regulated energy network. He found the average equity beta for individual Australian firms ranged from 0.45 to 0.71. The average equity beta estimates for the portfolios based on these Australian firms ranged from 0.49 to 0.66.<sup>66</sup>
- The ERA has conducted two studies on equity beta after the 2009 WACC review. The ERA's 2011 study found the average equity beta for individual Australian firms ranged from 0.44–0.60. Its 2013 study found a range of 0.49–0.52 as the average equity beta for the comparable Australian firms. The 2013 ERA study also indicated the average portfolio equity beta estimates ranged from 0.47–0.53. The equity beta estimates in both studies were in line with Henry's 2009 results.<sup>67</sup>
- The ENA's consultant, SFG has also submitted recent analysis to our consultation paper that indicates a reasonable equity beta estimate of 0.60 based on the individual Australian firms and an average beta estimate of 0.55 based on the index made up of these Australian firms.<sup>68</sup>
- For this rate of return guideline, we have commissioned an update of those empirical estimates from Professor Henry, following a similar methodology. However, this report is not yet complete. Our findings will be further informed by the updated analysis.

The following sections discuss these empirical studies in detail.

### 4.1 2009 Henry estimates

In the 2009 WACC review, we found the empirical evidence indicated an equity beta point estimate of between 0.4 and 0.7. This equity beta range was informed by the average of individual equity beta point estimates and a number of portfolios of different compositions and lengths.<sup>69</sup> It did not represent the total range of individual equity beta estimates or the confidence interval around the equity beta estimate.

We considered the most relevant empirical estimates:<sup>70</sup>

- use listed Australian gas and electricity networks as the set of comparable firms (consider both individual and portfolio equity beta estimates)

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<sup>66</sup> Henry, *Estimating  $\beta$* , April 2009.

<sup>67</sup> ERA, *Draft decision on proposed revisions to the access arrangement for the Western Power network*, Submitted by Western Power, 29 March 2012, pp. 195–205 (ERA, *Draft decision: Western Power access arrangement*, March 2012). ERA, *Explanatory statement for the draft rate of return guidelines: Meeting the requirements of the National Gas Rules*, 6 August 2013, pp. 168–181 (ERA, *Explanatory statement: Draft rate of return guidelines*, August 2013).

<sup>68</sup> SFG, *Regression-based estimates of risk parameters for the benchmark firm*, 24 June 2013, p. 6 (SFG, *Regression-based estimates of risk parameters*, June 2013).

<sup>69</sup> Henry, *Estimating  $\beta$* , April 2009, p. 49.

<sup>70</sup> AER, *Final decision: Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, 1 May 2009, pp. 260–277 (AER, *Final decision: WACC review*, May 2009).



- commence after the technology boom (2002 onwards) but end just before the start of the GFC, exclude business-specific events
- implement two types of regression equations – ordinary least squares (OLS) and least absolute deviation (LAD)
- use both weekly and monthly estimation intervals
- calculate based on continuous returns
- do not apply a Blume or Vasicek adjustment.

While it is usual to employ continuously compounded returns, the 2008 Henry report estimated equity beta used both discrete and continuous returns and found the beta estimates obtained from discretely compounded data are not manifestly different.<sup>71</sup> Henry's report examined data sampled at weekly and monthly frequency over the period 1 January 2002 to 1 September 2008 to avoid potential issues associated with the technology bubble and the GFC. The Brealey and Myers formula was used to de-lever and re-lever the equity beta of a business to reflect the equity beta of a benchmark efficient entity. Henry applied the Dimson approach for testing for the presence of thin trading and concluded there was no convincing evidence of thin trading in both the individual firm data and the portfolio data.<sup>72</sup>

We considered foreign businesses are subject to different regulatory regimes and market conditions, therefore the equity beta estimates derived from foreign data should be treated as a cross check only.

Table 4.1 presents the Henry's re-levered equity beta estimates for the individual comparator businesses (averaged by sample period/sampling frequency/regression technique) in his 2009 report. This produced equity beta point estimates of 0.45 to 0.71 as the average of individual firms.

**Table 4.1 Average re-levered equity beta estimates from Henry's 2009 analysis**

	2002-2008 - monthly	2002-2008 - weekly	2003-2008 - monthly	2003-2008 - weekly
OLS	0.57	0.59	0.65	0.71
LAD	0.45	0.45	0.64	0.59

Source: AER, *Final decision: WACC review*, May 2009, p. 318.

Henry also produced portfolio equity beta estimates. As presented in tables 4.2 and 4.3 below, the individual portfolio equity beta estimates ranged from 0.35 to 0.94 and the average equity beta estimates for the portfolios ranged from 0.49 to 0.66.

In addition, Henry estimated portfolio beta estimates with time varying weights, although he considered time-varying portfolios are likely to be affected by measurement errors:

- The time-varying portfolio equity beta estimates using average returns:
  - range from 0.55 to 0.57 using the post technology bubble period ending September 2008

<sup>71</sup> O. Henry, *Econometric advice and beta estimation*, 28 November 2008, p. 20 (Henry, *Econometric advice and beta estimation*, November 2008). Note this report was released with the AER's proposed statement (transmission) and proposed statement of regulatory intent (distribution) on the revised WACC parameters in December 2008.

<sup>72</sup> Thin trading refers to the situation when the stock does not trade regularly. In this case, the OLS estimate of beta tends to be biased towards zero. Henry, *Estimating  $\beta$* , April 2009, pp. 17–19, 28–32.

- range from 0.64 to 0.78 using the five years ending September 2008.
- The time-varying portfolio equity beta estimates using median returns:
  - range from 0.43 to 0.68 using the post technology bubble period ending September 2008
  - range from 0.52 to 0.68 using the five years ending September 2008.

Overall, the empirical evidence indicated an equity beta point estimate of between 0.4 and 0.7 for the electricity and gas service providers. However, in the 2009 WACC review final decision, we adopted a conservative approach to set the equity beta just above this range.<sup>73</sup> This was seen as a step towards moving the businesses to the range from previous decisions, which set equity betas of 0.9-1.0. Since the 2009 WACC review, we have adopted a consistent approach to estimate equity beta in each of our regulatory decisions, which has resulted in the consistent adoption of an equity beta of 0.8 across all of these decisions (for electricity and gas; distribution and transmission).<sup>74</sup>

**Table 4.2 Henry's re-levered portfolio equity beta estimates - monthly observations**

	P1'	P1	P2	P3	P4	P5	Avg (P1-5)	Avg (P1'-5)
Estimation period	Jan 2002 - Sep 2008	Oct 2003 - Sep 2008	Aug 2004 - Sep 2008	Dec 2004 - Sep 2008	Dec 2005 - Sep 2008	Mar 2007 - Sep 2008	Jan 2002 - Sep 2008	Jan 2002 - Sep 2008
Businesses	ENV, APA	ENV, APA	ENV, APA, DUE	ENV, APA, DUE, HDF	ENV, APA, DUE, HDF, SPN	ENV, APA, DUE, HDF, SPN, SKI	ENV, APA, DUE, HDF, SPN, SKI	ENV, APA, DUE, HDF, SPN, SKI
<i>Equal weighted</i>								
<b>OLS</b>	0.44	0.55	0.50	0.59	0.59	0.62	0.57	0.55
<b>LAD</b>	0.45	0.60	0.70	0.57	0.62	0.81	0.66	0.63
<i>Value weighted</i>								
OLS	0.47	0.58	0.52	0.61	0.55	0.60	0.57	0.55
LAD	0.57	0.75	0.52	0.55	0.49	0.94	0.61	0.65

Source: AER, *Final decision: WACC review*, May 2009, p. 322.

<sup>73</sup> AER, *Final decision: WACC review*, May 2009, pp. 343–344.

<sup>74</sup> However, the 2009 regulatory determinations for the NSW electricity networks and the Tasmanian electricity transmission network implemented an equity beta of 1.0, as mandated under the relevant transitional legislation. These determinations were released before the final decision for the 2009 WACC review (1 May 2009) See AER, *Final decision: New South Wales distribution determination, 2009–10 to 2013–14*, 28 April 2009, p. 237.

**Table 4.3 Henry's re-levered portfolio equity beta estimates - weekly observations**

	P1'	P1	P2	P3	P4	P5	Avg (P1-5)	Avg (P1'-5)
Estimation period	Jan 2002 - Sep 2008	Oct 2003 - Sep 2008	Aug 2004 - Sep 2008	Dec 2004 - Sep 2008	Dec 2005 - Sep 2008	Mar 2007 - Sep 2008	Jan 2002 - Sep 2008	Jan 2002 - Sep 2008
Businesses	ENV, APA	ENV, APA	ENV, APA, DUE	ENV, APA, DUE, HDF	ENV, APA, DUE, HDF, SPN	ENV, APA, DUE, HDF, SPN, SKI	ENV, APA, DUE, HDF, SPN, SKI	ENV, APA, DUE, HDF, SPN, SKI
<i>Equal weighted</i>								
<b>OLS</b>	0.45	0.51	0.46	0.58	0.59	0.62	0.54	0.54
<b>LAD</b>	0.35	0.42	0.42	0.51	0.54	0.64	0.51	0.49
<i>Value weighted</i>								
OLS	0.51	0.57	0.49	0.60	0.52	0.56	0.55	0.54
LAD	0.45	0.51	0.51	0.53	0.57	0.61	0.55	0.53

Source: AER, *Final decision: WACC review*, May 2009, p. 323.

## 4.2 2011 and 2013 ERA estimates

We note the ERA has conducted two studies on equity beta after the 2009 WACC review. In 2011, the ERA replicated Henry's study with a dataset updated to October 2011. In 2013, the ERA developed two new econometric techniques for equity beta estimation in its draft rate of return guideline. In addition, the dataset was updated to April 2013. We note the ERA's studies adopted the same approach as applied by Professor Henry in his 2009 equity beta analysis. The equity beta estimates in both ERA's 2011 and 2013 studies are in line with Henry's 2009 results.

The ERA's 2011 study sourced data from Bloomberg and used both monthly and weekly measurement intervals. It only estimated equity beta estimates for the individual comparator businesses and applied both OLS and LAD methods to the data.<sup>75</sup> As presented in table 4.4, using a monthly estimation interval, the ERA's equity beta estimates range from 0.07 to 0.97, with a mean of 0.46 and a median of 0.43. In table 4.5, using a weekly estimation interval, its equity beta estimates range from 0.22 to 1.34 with a mean of 0.52 and a median of 0.43.

**Table 4.4 The ERA's 2011 re-levered equity beta estimates for individual businesses, sampled monthly**

	AGL	ENV	APA	GAS	DUE	HDF	SPN	SKI	AAN	Ave
OLS	0.70	0.46	0.67	0.26	0.38	0.07	0.26	0.42	0.81	0.45
LAD	0.50	0.37	0.70	0.24	0.27	0.47	0.26	0.44	0.97	0.47

Source: ERA, *Draft decision: Western Power access arrangement*, March 2012, p. 202. Averages are calculated by the AER.

<sup>75</sup> ERA, *Draft decision: Western Power access arrangement*, March 2012, pp. 195–205.

**Table 4.5 The ERA's 2011 re-levered equity beta estimates for individual businesses, sampled weekly**

	AGL	ENV	APA	GAS	DUE	HDF	SPN	SKI	AAN	Avg
OLS	0.75	0.36	0.61	0.33	0.32	1.34	0.22	0.49	0.96	0.60
LAD	0.53	0.31	0.60	0.26	0.26	0.84	0.22	0.34	0.62	0.44

Source: ERA, *Draft decision: Western Power access arrangement*, March 2012, p. 204. Averages are calculated by the AER.

Overall, the ERA considered the results supported an equity beta range of between 0.5 and 0.8. It determined an equity beta point estimate of 0.65 being reasonable for Western Power's Access Arrangement.<sup>76</sup>

In the ERA's draft rate of return guidelines released in August 2013, it introduced two additional econometric methods—MM and Theil-Sen to the existing OLS and LAD methods. In this study, the ERA adopted the same sample of nine companies used in its 2011 study and Henry's 2009 analysis, but excluded three of the nine companies (GAS, AAN and AGL) as they do not have data available until 2013.<sup>77</sup> Its re-levered equity beta estimates for the individual firms with data up to 2013 range from 0.17 to 1.20, with a mean of 0.50. These results are shown in table 4.6.

**Table 4.6 The ERA's 2013 re-levered equity beta estimates for individual businesses**

	APA	DUE	ENV	HDF	SKI	SPN	Ave
OLS	0.59	0.17	0.44	1.20	0.54	0.05	0.50
LAD	0.55	0.23	0.44	1.11	0.37	0.26	0.49
Robust MM	0.63	0.25	0.45	1.00	0.48	0.30	0.52
Thiel Sen	0.56	0.27	0.45	1.00	0.39	0.22	0.48
Average	0.59	0.23	0.45	1.08	0.45	0.21	0.50

Source: ERA, *Explanatory statement: Draft rate of return guidelines*, August 2013, p. 171.

The ERA's 2013 study also examined portfolio beta estimates. It studied the same portfolios as those analysed by Henry in his 2009 report. As the Bloomberg data for both SPN and SKI became available in the same week, there was no need for the ERA to study Henry's last portfolio, which reflected the later data availability of SKI on Datastream. As shown in table 4.7, its re-levered portfolio equity beta estimates range from 0.39 to 0.59 with a mean of 0.50.

<sup>76</sup> ERA, *Draft decision: Western Power access arrangement*, March 2012, p. 205.

<sup>77</sup> ERA, *Explanatory statement: Draft rate of return guidelines*, August 2013, pp. 168–181.

**Table 4.7 The ERA's 2013 re-levered portfolio equity beta estimates**

	P0	P1	P2	P3	P4	Avg
Estimation period	Jan 2002 - Apr 2013	Sep 2003 - Apr 2013	Aug 2004 - Apr 2013	Dec 2004 - Apr 2013	Dec 2005 - Apr 2013	
Businesses	ENV, APA	ENV, APA	ENV, DUE, APA,	ENV, DUE, HDF, APA,	ENV, DUE, HDF, SPN, SKI	ENV, DUE, HDF, SPN, SKI
<i>Equal weighted</i>						
OLS	0.49	0.49	0.39	0.55	0.49	0.48
LAD	0.53	0.54	0.41	0.58	0.59	0.53
MM	0.49	0.50	0.41	0.58	0.56	0.51
Theil-Sen	0.44	0.46	0.40	0.55	0.53	0.47
Ave	0.49	0.50	0.40	0.56	0.54	0.50
<i>Value weighted</i>						
OLS	0.53	0.53	0.40	0.47	0.40	0.47
LAD	0.56	0.55	0.44	0.52	0.51	0.51
MM	0.53	0.53	0.43	0.51	0.49	0.50
Theil-Sen	0.47	0.49	0.41	0.49	0.45	0.46
Ave	0.52	0.52	0.42	0.50	0.46	0.49

Source: ERA, *Explanatory statement: Draft rate of return guidelines*, August 2013, p. 173.

### 4.3 2013 SFG estimates

In its submission to the rate of return consultation paper, the ENA submitted several reports prepared by SFG in relation to equity beta estimates. SFG presented its equity beta estimates for both the CAPM and the Fama-French three factor model (FFM) using historical stock returns on the relevant Australian and US stocks. From the SFG analysis, we consider only the estimates based on the CAPM are of relevance. Further, the Australian estimates are more relevant than the US estimates.<sup>78</sup> While we are still considering its methodology, the SFG's equity beta estimates based on comparable Australian firms support the equity beta range of 0.4 to 0.7 for the benchmark efficient entity.

<sup>78</sup> We discuss the US estimates in section 5.

SFG's analysis of nine comparable Australian stocks for the CAPM was similar to that conducted by Henry in his 2009 report, except it:<sup>79</sup>

- used data up to 19 February 2013 based on four-weekly returns
- only examined OLS estimates as it considered LAD estimates exhibit a downward bias
- made a Vasicek adjustment to the OLS estimates, which increased OLS beta estimates by an average of 0.03.

It estimated a mean re-levered CAPM equity beta estimate of 0.60 for the Australian firms, with a confidence interval of 0.37 to 0.83. It also derived an equal weighted index based on these Australian firms. The average re-levered beta estimate for this index is 0.55, with a 95 per cent confidence interval of 0.41 to 0.68.<sup>80</sup>

#### 4.4 2013 Henry estimates

We have engaged an external expert to produce updated empirical estimates of equity beta. This expert advice builds on the approach taken in the 2009 WACC review.<sup>81</sup> It also reflects the ongoing evolution of arguments and counter-arguments around equity beta in the regulatory determinations since this time. We consider that obtaining our own empirical estimates (rather than only relying on the estimates submitted by stakeholders such as the ENA) aids transparency and is good regulatory practice. In addition, we have provided the terms of reference for this new report to the ENA.

We have commissioned Professor Olan Henry, now based at the University of Liverpool, to provide this advice. Professor Henry provided two key reports on equity beta to the 2009 WACC review.<sup>82</sup> Unfortunately, the new empirical estimates are not yet complete. Our assessment of equity beta will be further informed by the results of the updated analysis. To provide further guidance to all stakeholders on the approach that the AER intends to take in this area, we summarise below the terms of reference issued to Professor Henry.

The key aspect of the new terms of reference is that, where there are alternative econometric approaches underlying the generation of the empirical estimates, and these alternatives each have merit, we have asked Professor Henry to undertake each of them. This generates a large number of permutations across the different combinations of plausible econometric approaches, which reveals any interaction effects. It also allows us to ascertain which decisions on econometric technique are material to the empirical outcomes.

The core set of regression permutations includes:

- Two different forms of the regression calculation; using both Ordinary Least Squares (OLS) and Least Absolute Deviation (LAD).
- Three different estimation periods; using (1) the longest period available, (2) a period after the technology bubble and before the GFC, then after the GFC, and (3) the last five years.
- Two different approaches to leverage; using the Brealey–Myers formula to de-lever and re-lever to the benchmark, but also reporting 'raw' equity betas unadjusted for leverage.

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<sup>79</sup> SFG, *Regression-based estimates of risk parameters*, June 2013, p.6.

<sup>80</sup> SFG, *Regression-based estimates of risk parameters*, June 2013, pp. 12–15.

<sup>81</sup> AER, *Final decision: WACC review*, May 2009, pp. 239–344.

<sup>82</sup> Henry, *Econometric advice and beta estimation*, November 2008 and Henry, *Estimating  $\beta$* , April 2009.

- Three different units of analysis; using individual firms, portfolios with constant weights, and portfolios with time varying weights.
- Two different constructions for the constant weight portfolios; using equal weighting and value weighting.

We requested advice from the expert consultant on the interpretation of many of these alternatives, and also on the form of the regression equation itself (using total returns or excess returns). We requested additional regressions looking at the choice of estimation interval (weekly or monthly), though these were not included in the core set of permutations.

The specification of three alternative estimation periods arises from the analysis in section 3.2 on the strengths and weaknesses of different estimation periods. We requested that the consultant should provide advice on which of these estimation period is preferable, including whether market conditions across each period provide a reasonable basis for generating an equity beta estimate that is relevant to our return on capital framework. The terms of reference also acknowledged that other dates may be influenced by data availability. In particular, the consultant's assessment of the 'longest period available' might be influenced by whether it is possible to obtain reliable data from the 1990s. We asked for brief reasoning on the choice of these dates.

To maintain a workable scope for this new work, in several areas we directed the external consultant to implement a particular approach. This includes areas where there we settled on the use of an econometric technique at the time of the 2009 review. It also includes areas where, though a particular econometric decision has been contested in regulatory processes since 2009, the AER has not been convinced by these arguments (and has publicly stated its reasons for its position in the relevant decision documents).

We instructed the consultant to:

- use a stated set of nine Australian firms that operate (or operated) gas and electricity networks
- use the ASX300 Accumulation index as the market proxy
- use continuous returns (rather than discrete returns)
- use the Dimson approach to thin trading
- not use the Blume or Vasicek adjustments
- report standard errors, 95 per cent confidence intervals, and R-squared statistics.

There were several areas where the terms of reference left an issue to the consultant's discretion. We asked the expert to provide advice on the suitable tests for stability and sensitivity (such as recursive least squares and the Hansen test), and then to implement their recommended approach. The selection of a proxy for the risk free rate (should this be required) was left to the expert.

## 5 International comparators

In this section we discuss whether we consider the use of international comparators to inform our decision on the equity beta estimate for the benchmark efficient entity is warranted and, if so, what role such evidence should play in our decision. Our conclusion is that it is reasonable to use the equity beta estimates based on international comparators as a cross check of domestic beta estimates and not as the primary determinant of the equity beta for the benchmark efficient entity. This material is included in section 5.1

Section 5.2 presents empirical estimates for a number of international energy networks across the US, UK and Europe, prepared by a number of different entities. The pattern of overseas results is not consistent. The majority of recent updates include point estimates between 0.5 and 0.9 (although, some estimates exceed 1.0). However, in view of the assessment in section 5.1 of the limitations on this source of information and the difficulty of adjusting for differing operating environments, we consider that the data nonetheless provides support to our estimate of an equity beta range for the benchmark efficient entity of 0.4 to 0.7. We also consider that this evidence is more supportive of the point estimate of equity beta located closer to the upper end of this range.

### 5.1 Role for international comparators

Several Australian and international regulators use evidence derived from analysis of international comparators to inform their decisions on equity beta.<sup>83</sup> Such use of international comparators is often motivated by the lack of relevant domestic comparator businesses, for example, due to the fact that the domestic regulated businesses are not publicly listed or due to a small number of relevant comparator businesses in domestic markets.<sup>84</sup> In the recent report commissioned by the ENA as a part of the ENA submission to our consultation paper, SFG suggested that 'the Australian sample is too small to produce reliable estimates' of the equity beta and therefore 'it would be wrong to give no weight to the large and statistically reliable US data sample and to give 100% weight to the handful of Australian data points'.<sup>85</sup>

The ENA submitted material suggesting that the equity beta should be higher than 0.7.<sup>86</sup> Core to the ENA position was evidence prepared by SFG and Competition Economists Group (CEG) on the equity beta of a set of US integrated energy companies (involved in energy generation, transmission, distribution, retail, and other regulated activities). This is a larger data set than the data set comprising Australian energy networks. We do not consider that the ENA's material should be used as the primary determinant of equity beta for the benchmark efficient entity. There are significant differences between the firms used by the ENA and the benchmark efficient entity used for our purposes. For example, the firms included in the ENA's study have different characteristics including integrated firms that undertake generation and retail activities, amongst other differences. Moreover, the data proposed by the ENA is drawn from a different jurisdiction (the USA) with different economic, geographic, and market conditions.

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<sup>83</sup> NZ Commerce Commission, *Input methodologies (electricity distribution and gas pipeline services), Reasons paper*, December 2010, pp. 157–161, 508–552; Commission for Energy Regulation, *Decision on 2011 to 2015 distribution revenue for ESB Networks Ltd*, 19 November 2010, pp. 125–133; Europe Economics, *Europe Economics report for the Commission for Energy Regulation (CER), Cost of capital for Transmission Asset Owner (TAO), Transmission System Operator (TSO), Distribution System Operator (DSO)*, 16 June 2010, pp.74–94; IPART, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services*, June 2012; IPART, *Review of water prices for Sydney Desalination Plant Pty*, December 2011; QCA, *Final report: SunWater, Irrigation price review: 2012-17*, vol. 1; May 2012.

<sup>84</sup> For example, this is the case for New Zealand and Ireland.

<sup>85</sup> SFG, *Regression-based estimates of risk parameters*, June 2013, p. 4.

<sup>86</sup> ENA, *Response to AER rate of return guideline consultation paper*, 28 June 2013, pp. 57–64.



Conceptually, we define the benchmark efficient entity as 'a pure play, regulated energy network business operating within Australia'.<sup>87</sup> We consider it is unreasonable to use the equity beta estimates based on overseas comparators as the primary determinant of the equity beta, because it is not possible to correctly adjust for the differing environment across countries.

In particular, in the 2009 WACC review we noted the difference in the regulation of businesses, the regulation of domestic economy, geography, business cycles, weather and a number of different factors are likely to result in differences between equity beta estimates for similar businesses between countries.<sup>88</sup> It is difficult to assign quantitative impacts to each of these qualitative factors and as such the use of Australian securities data for equity beta estimation seeks to encompass all of the factors within the CAPM framework in a first-best approach. The use of a foreign proxy is a suboptimal outcome that can only be justified where there is evidence that this will produce more reliable estimates of the domestic equity beta than the Australian estimates.<sup>89</sup>

As we detail below, we do not consider that the most recent empirical analysis submitted by the ENA in response to our consultation paper present us with such evidence. For this reason and consistent with our previous practice, we consider it is reasonable to use foreign estimates of equity beta only as a cross check of domestic beta estimates.<sup>90</sup>

In response to our consultation paper the ENA submitted two interlinked reports addressing the use of US comparators to arrive to the equity beta estimate. The two reports are: the aforementioned SFG report and a report by CEG that suggested a set of US comparators that was then used by both CEG and SFG to produce beta estimates.<sup>91</sup> As discussed below, we consider that CEG and SFG did not produce satisfactory evidence that the suggested sample of US businesses represent close comparators to the benchmark efficient entity and, therefore, that analysis based on such a sample would produce more reliable estimates of its equity beta.

CEG started with a broad sample of 78 listed companies classified by SNL Financial as being in the 'Power' or 'Gas Utility' industries based in the US. The sample was then narrowed down to 56 firms based on availability of financial information, liquidity considerations, and the proportion of regulated assets. Further, CEG concluded that 'there is no basis for assuming that firms subject to different regulatory environments have different predicted risk - under either the CAPM or of the FFM'.<sup>92</sup> This then appeared to suggest that the US businesses in the identified sample 'have a similar degree of risk to regulated Australian energy networks'.<sup>93</sup>

However, CEG also stated the following:<sup>94</sup>

It should be noted that 'regulated' in this instance does not necessarily mean regulated distribution or transmission. For vertically integrated companies (which are common among our sample), regulated activities could also include generation and/or retail sales (i.e. activities which are not regulated in Australia). Further, it is not always possible to determine the exact extent to which a company engages in regulated versus non-regulated electric/gas utility activities (with metering a potential example of unregulated utility activities), although several companies do report an explicit split between regulated and non-regulated utility assets.

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<sup>87</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, p. 10.

<sup>88</sup> AER, *Final decision: WACC review*, May 2009, pp. 261–264.

<sup>89</sup> AER, *Final decision: WACC review*, May 2009, pp. 260–264; 311–332.

<sup>90</sup> AER, *Final decision: WACC review*, May 2009, pp. 260–264; 311–332; AER, *Draft decision: APTPL access arrangement*, April 2012, pp. 331–336.

<sup>91</sup> SFG, *Regression-based estimates of risk parameters*, June 2013; CEG, *Information on equity beta from US companies*, June 2013 (CEG, *Equity beta from US companies*, June 2013).

<sup>92</sup> CEG, *Equity beta from US companies*, June 2013, p. 7.

<sup>93</sup> CEG, *Equity beta from US companies*, June 2013, p. 5.

<sup>94</sup> CEG, *Equity beta from US companies*, June 2013, p. 20.

We examined the table provided by CEG in appendix A that contains description of comparator companies.<sup>95</sup> The description of individual businesses included in the table confirm that a number of comparator businesses with a high proportion of regulated assets are indeed vertically integrated and engage in energy generation, wholesale and retail of energy, as well as other regulated activities distinct from energy distribution and transmission. The CEG sample of US comparators has a significant overlap with the sample previously examined by the Allen Consulting Group (ACG) in its report to ENA, Grid Australia and the Australian Pipeline Industry Association (APIA).<sup>96</sup> However, the ACG included 'only those businesses that are almost exclusively electricity and/or gas distribution and transmission businesses' in its US comparator set.<sup>97</sup> Further, according to the classification presented by the ACG, more than half of the CEG comparator businesses were classified as 'integrated regulated' or 'integrated', and, therefore, excluded from the ACG sample.

We consider that CEG did not provide satisfactory evidence to demonstrate that vertically-integrated US energy businesses (engaged in regulated activities other than energy transmission and distribution) present close comparators to 'a pure play, regulated energy network business operating in Australia'. Such vertically-integrated businesses engaged in a spectrum of regulated activities are likely to be exposed to different risks than businesses that are not vertically-integrated or businesses that are engaged in predominantly energy transmission or distribution. This could result in different beta estimates for those types of businesses. In addition, as stated earlier in this section, countries (and Australia and the US in particular) differ along a number of dimensions that can result in differences in the equity beta estimates for similar businesses. The CEG discusses only one of those factors, i.e., differences in regulatory environments. Therefore, we consider that empirical estimates of the equity beta produced by CEG and SFG should be interpreted with caution.

This does not imply that the empirical evidence based on overseas comparators should be discarded completely. Rather, we consider that such evidence can be used as a cross check of domestic beta estimates — provided the choice of overseas comparators is based on solid reasoning. Further, while we recognise the trade-off between the sample size of the comparator set and the relevance of potential comparator businesses to our conceptual benchmark, we consider it desirable to examine evidence on all available international comparators, rather than only those based in the US.

## 5.2 International empirical estimates

We consider that the analysis of overseas energy networks in the 2009 WACC review remains relevant as a cross check of domestic beta estimates. This includes equity beta estimates for a set of US electricity networks (but not gas networks) as prepared by Henry. For the period 1990 to 2008 (but excluding the technology bubble), the average point estimates are:<sup>98</sup>

- 0.54 to 0.71 for simple averages of individual firms' betas (monthly/weekly by Henry)
- 0.47 to 0.71 for fixed-weight portfolios (weekly/monthly by Henry).

ACG also calculated equity beta estimates, using a comparator set that included electricity and gas networks. For the same period, these point estimates are:<sup>99</sup>

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<sup>95</sup> CEG, *Equity beta from US companies*, June 2013, pp. 47–68.

<sup>96</sup> ACG, *Beta for regulated electricity transmission and distribution, Report to Energy Network Association, Grid Australia and APIA*, 17 September 2008, pp. 16–57 (ACG, *Beta for regulated electricity networks*, September 2008).

<sup>97</sup> ACG, *Beta for regulated electricity networks*, September 2008, p. 18.

<sup>98</sup> Henry, *Estimating  $\beta$* , April 2009, pp. 40–46; AER, *Final decision: WACC review*, May 2009, p. 330.

<sup>99</sup> ACG, *Beta for regulated electricity networks*, September 2008, p. 48; AER, *Final decision: WACC review*, May 2009, pp. 329–331.

- 0.65 to 0.73 as the average of individual firms (OLS, re-weighted OLS and LAD by ACG)
- 0.54 to 0.68 as the average/median of portfolios (OLS, re-weighted OLS and LAD by ACG).

Recognising the inherent uncertainty caused by the inability to quantify differences between the United States and Australia, we consider that these estimates are compatible with an equity beta of 0.4 to 0.7.

Separate from the 2009 WACC review, but still considering the same data window (that ends with the GFC), other evidence on overseas equity betas includes the following:

- Analysis by the ESC in 2008 presented equity beta estimates for United States energy networks together with analysis for equivalent Australian networks. The ESC's key conclusion is that US estimates are slightly above the Australian estimates and that 'the US evidence suggests that the beta is between 0.6 and 0.8'.<sup>100</sup>
- PricewaterhouseCoopers (PwC) produced international equity beta estimates for Ofgem in 2009.<sup>101</sup> These estimates include five years of data up until the onset of the GFC. The sample included gas and electricity distribution and transmission firms in the USA, UK and Europe. The average equity beta is 0.64 (to December 2007) or 0.78 (to September 2008).<sup>102</sup>
- The 2012 McKenzie and Partington report referred to estimates of equity beta by Professor Damodaran of the Stern School of Business at New York University.<sup>103</sup> Damodaran has calculated equity beta estimates for the various United States industry sectors each year since 1999, using a five year data window.<sup>104</sup> The pattern across this analysis is that the electricity and gas network equity beta estimates are amongst the lowest observed.<sup>105</sup> The results that are most comparable to the 2009 WACC review analysis are those ending in January 2007 and January 2008. The point estimates are:<sup>106</sup>
  - 0.86 in January 2007 (average gearing 61 per cent)
  - 0.85 in January 2008 (average gearing 62 per cent)

New estimates of equity beta for overseas electricity and gas networks—that is, estimates that consider data after the onset of the GFC—have been relatively sparse. The following reports provide empirical evidence based on such a broader sample:

- The CEG report prepared as a part of the ENA submission to our consultation paper (discussed above) suggested a sample of 56 US-listed energy network companies to be used as comparators for the Australian regulated energy networks.<sup>107</sup> Based on the comparator sample

<sup>100</sup> ESC, *Final decision: Gas access arrangement review 2008–2012*, 7 March 2008, p. 476.

<sup>101</sup> PricewaterhouseCoopers, *Final report: Office of the Gas and Electricity Markets, Advice on the cost of capital analysis for DPCR5*, 1 December 2009, pp. 37–45 (figures 13, 16–19).

<sup>102</sup> The average equity betas were computed by us based on visual inspection of figures 13, 16-19 and the methodology description provided in the PwC report. We adjusted for vertical integration for both UK and non-UK businesses in a manner consistent with the PwC methodology.

<sup>103</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, pp. 15, 29–32.

<sup>104</sup> This data is available at <http://pages.stern.nyu.edu/~adomodar/> and then clicking on the link 'Updated Data' at top left, accessed 24 September 2013.

<sup>105</sup> Specifically, the relevant industry sectors are Natural Gas (Distribution) which becomes Natural Gas Utility in 2008, Electric Utility (East), Electric Utility (West) and Electric Util. (Central).

<sup>106</sup> These averages are calculated as the average of the four relevant categories listed above, each weighted by the number of firms in that category. The equity beta for each firm is unadjusted for leverage. That is, it has not been de-levered and re-levered to the benchmark gearing (60 per cent), though there is minimal difference between the average leverage (61 or 62 per cent) and the benchmark in this case.

<sup>107</sup> CEG, *Equity beta from US companies*, June 2013.

provided by CEG, SFG computed equity beta estimates over an 11 year period from 2 January 2002 to 19 November 2012.<sup>108</sup> The resulting estimates of re-gearred equity beta are as follows:<sup>109</sup>

- 0.88 for the average re-gearred equity beta of individual firms
- 0.91 for the average re-gearred equity beta of equal-weighted index.
- The Damodoran equity beta estimates for United States industry groups have been updated across this time:<sup>110</sup>
  - 0.74 in January 2010 (average gearing 87 per cent)
  - 0.72 in January 2011 (average gearing 79 per cent)
  - 0.71 in January 2012 (average gearing 75 per cent)
  - 0.50 in January 2013 (average gearing 74 per cent).
- The NERA report for the QCA included equity beta estimates for UK and US energy networks for two different estimation periods ending in March 2011.<sup>111</sup> NERA implemented two leverage adjustments, and used both equal-weighted and value-weighted portfolios to produce point estimates of:
  - 0.52 to 1.09 for UK firms
  - 0.70 to 0.96 for US firms
- For its Input Methodologies (electricity distribution and gas pipeline services) reasons paper New Zealand Commerce Commission estimated asset and equity betas for a set of comparator businesses, classified as either electricity utility or gas utility by Bloomberg.<sup>112</sup> The sample of comparators included two NZ businesses (Horizon Energy and Vector), six Australian businesses (DUET, Spark Infrastructure, SP AusNet, APA, Envestra, and Hastings Diversified Utilities), one UK National Grid, and 70 US businesses. The sample periods included five-year intervals up to 31 May 1995, 31 May 2000, 31 May 2005, 31 May 2006, 31 May 2007, 31 May 2008, 31 May 2009, and 31 May 2010. The average estimates (over all sampling periods and all businesses in the sample) of the asset betas for the sample were as follows:
  - overall: 0.28, gas: 0.23, electricity: 0.30 using monthly data (correspond to the equity betas of 0.70, 0.58, 0.75, respectively, assuming 60% gearing zero debt beta)
  - overall: 0.32, gas: 0.31, electricity: 0.32 using weekly data (correspond to the equity betas of 0.80, 0.78, 0.80, respectively, assuming 60% gearing zero debt beta).

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<sup>108</sup> SFG, *Regression-based estimates of risk parameters*, June 2013.

<sup>109</sup> The SFG results incorporate Vasicek adjustment to the beta estimates. Consistent with the 2009 WACC review, we have not applied Vasicek adjustment in our past decisions.

<sup>110</sup> As with the previous Damodoran results, these averages are weighted across firms in the four categories that contain electricity and gas networks. The equity beta for each firm is unadjusted for leverage. That is, it has not been de-levered and re-levered to the benchmark (60 per cent). In this instance, the average gearing levels are above the benchmark. Conventional finance theory states that greater leverage increases financial risk which in turn increases systematic risk, although the exact relationship is contentious. To the extent that this relationship holds, the equity beta for the benchmark firm (with 60 per cent gearing) would be below the estimates given here.

<sup>111</sup> NERA, *Cost of capital for water infrastructure company: Report for the Queensland Competition Authority*, 28 March 2011, pp. 36–37, 60.

<sup>112</sup> New Zealand Commerce Commission, *Input methodologies (electricity distribution and gas pipeline services), Reasons paper*, December 2010, pp. 508–552.

We have reviewed the studies referenced above which use international data sets. After taking into account the difficulty of adjusting for differing operating environments, we consider that the data nonetheless provides support to our estimate of an equity beta range for the benchmark efficient entity of 0.4 to 0.7. We also consider that this evidence is more supportive of a point estimate of equity beta that is located closer to the upper end of this range.

## 6 Selection of a range and point estimate

This section explains how we select the equity beta range and an equity beta point estimate given the available evidence. Overall, we consider the equity beta of a benchmark efficient entity is in the proposed range of 0.4 to 0.7 based on conceptual analysis and Australian empirical estimates. We propose an equity beta point estimate of 0.7 after taking into account other relevant evidence.

Under the rules, we are required to set out in our rate of return guideline our proposed methodologies to estimating the rate of return. We are also required to set out the estimation methods, financial models, market data and other evidence we propose to take into account in estimating the rate of return.<sup>113</sup> We are not required to set out the specific parameter values (or ranges) we determine after applying our proposed methodologies and taking into account our proposed estimation methods and other information. Despite this, we have endeavoured to set out proposed parameter values in a number of areas in order to promote regulatory certainty (e.g. return on equity term, return on debt term, credit rating, gearing, and gamma). Stakeholders have supported the inclusion of point estimates and ranges in the guideline.<sup>114</sup>

### 6.1 Selection of a range

In the draft rate of return guideline, we have set out criteria that we propose to use to assess the merits of information. We also defined the benchmark efficient entity as 'a pure play, regulated energy network business operating within Australia'. Section A.4 assesses equity beta information sources against the rate of return criteria. Accordingly, our equity beta range is based on conceptual analysis and Australian empirical estimates as they better reflect our definition of the benchmark efficient entity. We consider the equity beta of a benchmark efficient entity is in the proposed range of 0.4 to 0.7, as:

- conceptual analysis supports the equity beta of a benchmark efficient entity would be low and below 1.0. This view is supported by Professor McKenzie and Associate Professor Partington.
- the empirical evidence supports an equity beta of between 0.4 and 0.7 for the benchmark efficient entity. The empirical evidence primarily relates to Australian electricity and gas networks.

We consider it is more reasonable to use other information sources—such as empirical estimates of overseas energy networks, theoretical principles underpinning the Black CAPM and equity beta determined for the water sector—as a cross check of Australian equity beta estimates, rather than in a more determinative way. This is discussed in more detail in the Technical Appendix (section A.4).

On the empirical evidence currently before us, we propose a range of 0.4 to 0.7. We now have greater confidence in the reliability of this equity beta range than we did in 2009. Recent empirical studies based on Australian energy firms present a consistent and robust pattern. This pattern is robust to the use of different econometric techniques, different comparator sets and different time periods:

- Henry's 2009 analysis examined data sampled at monthly and the weekly frequencies over the period 1 January 2002 to 1 September 2008 for the nine comparable Australian-listed energy

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<sup>113</sup> NER, cls 6.5.2(n) and 6A.6.2(n); NGR, r. 87(14).

<sup>114</sup> PIAC, *Balancing risk and reward: Submission the AER's consultation paper: Rate of return guideline*, 21 June 2013, p. 15; and Major Energy Users Inc., *Australian Energy Regulator, Better regulation: Rate of return guidelines, Comments on the consultation paper*, June 2013, pp.19–20. See also ENA, *Response to AER rate of return guideline consultation paper*, 28 June 2013, p. 10; AER, *Questions and answers: rate of return draft guideline information session*, 30 August 2013, p. 1.

firms. He implemented two types of regression calculations (OLS and LAD) and examined equity beta estimates for the individual firms, the portfolios with constant weights, and the portfolios with time varying weights. He also analysed different estimation periods—including a long estimation period from after the technology bubble to before the GFC, and the last five years. He found the average equity beta for individual Australian firms ranged from 0.45 to 0.71. The average equity beta estimates for the constant weighted portfolios based on these Australian firms ranged from 0.49 to 0.66. The time-varying portfolio equity beta estimates ranged from 0.43 to 0.78.

- The ERA's 2011 study replicated Henry's approach and updated the analysis to October 2011. It found the average equity beta for individual Australian firms ranged from 0.44-0.60. The ERA introduced two further regression techniques to the analysis in its 2013 study—MM and Theil-Sen. It also updated the data to April 2013. Adding two new regression techniques did not change the results, the ERA's 2013 analysis indicated the average equity beta for individual Australian firms ranged from 0.49-0.52 and the average portfolio equity beta estimates ranged from 0.47-0.53.
- The ENA's consultant, SFG presented equity beta estimates in its June 2013 report. Its analysis of Australian data was based on the same nine comparable energy firms adopted by Henry and sampled over an 11 year period from 2 January 2002 to 19 February 2013. It computed total returns over a four-weekly period for each firm and repeated the analysis 20 times using different start points within this four-weekly period. SFG applied OLS regression to the data and incorporated the Vasicek adjustment.<sup>115</sup> Its analysis indicated a reasonable equity beta estimate of 0.60 based on the individual Australian-listed firms and an average beta estimate of 0.55 based on the index made up of these Australian firms.

In the 2009 WACC review, while we estimated an equity beta range of 0.4 to 0.7, we noted there were relatively few empirical estimates available. Henry analysed a relatively short period of data and we were facing uncertainties due to the GFC. As the more recent studies examining longer time periods and more diverse market conditions provided results in line with Henry's 2009 study, we now have greater confidence that the equity beta for the benchmark efficient entity is in the range of 0.4 to 0.7. This is further elaborated on in the next section.

This equity beta range of 0.4 to 0.7 was informed by the average of individual equity beta point estimates for the comparable Australian-listed firms and various portfolios estimates based on these Australian-listed firms. It does not represent the total range of individual equity beta estimates. This is because the individual equity beta estimates vary from one firm to another. It is difficult to select an estimate from a particular comparable firm over a completely different equity beta estimate of another firm. It also does not represent the confidence interval around the beta estimate as Henry noted the confidence interval is not a particularly useful method of comparison across equity beta estimates.<sup>116</sup>

In addition, we considered whether evidence from other sources of information—particularly international comparators and the Black CAPM—was sufficient to justify an adjustment to our range. However, after taking account of these sources of information, including their strengths and weaknesses, we considered that they did not warrant an adjustment to the range:

- International comparators—as set out in section 5, there are considerable differences between these firms and the benchmark efficient entity, and it is difficult to adjust for these differences. In

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<sup>115</sup> SFG, *Regression-based estimates of risk parameters for the benchmark firm*, June 2013, pp. 5-6.

<sup>116</sup> Henry, *Estimating  $\beta$* , April 2009, p. 50.

view of these differences, we do not consider that the overseas estimates are incompatible with our equity beta range.

- Black CAPM—as set out in section A.3, there are major problems deriving a reasonable empirical estimate using this model, and theoretical analysis does not lead to a clear indication of the magnitude of the difference between the Black CAPM and the standard CAPM. Further, while the Black CAPM removes one of the more unrealistic assumptions underlying the standard CAPM, it replaces it with another unrealistic assumption. From this basis, we consider that it is reasonable to maintain the observed empirical range for equity beta.

However, both of these sources of information have affected the selection of a point estimate, as discussed in section 6.2 below.

## 6.2 Selection of a point estimate

During both the 2009 WACC review and now we considered the empirical estimates support a range of 0.4 to 0.7. In the 2009 WACC review, we adopted a point estimate of 0.8 (slightly above the range of empirical estimates). In this issues paper, we propose to lower our point estimate from 0.8 to 0.7 because we now have greater confidence in the reliability of the empirical estimates. In 2009, there were fewer empirical estimates available. The data spanned a shorter time period and we were facing uncertainty due to the global financial crisis. Four years on, we now have more studies, spanning a longer time period and a diversity of market conditions. The results from these studies demonstrate a consistent pattern over time and the measures of statistical dispersion (standard errors) have reduced.

In this section, we explain why we have greater confidence in the empirical evidence compared with during the 2009 WACC review. The empirical estimates are not exact. As we have emphasised through this issues paper, the true value for the forward looking equity beta cannot be known. The 2009 WACC review identified this imprecision as one of the factors leading to an equity beta of 0.8.<sup>117</sup>

Rather, while the central estimates of the empirical estimates suggested a beta in the range of 0.44 to 0.68 for the 2009 WACC review, taking into account the likely precision of these estimates (along with other relevant considerations) we adopted an equity beta of 0.8 in the 2009 WACC review.

However, relative to the situation in 2009, we now have greater confidence in the empirical estimates. At one level, this reflects the substantial increase in the available data set. The core regressions in the 2009 WACC review were based on the periods from January 2002 to September 2008 (six years and eight months) and September 2003 to September 2008 (five years).<sup>118</sup> Extending the data set to 2013 allows (up to) an additional five years of data.<sup>119</sup> A larger data set allows the generation of estimates with lower standard errors, which provides a more reliable basis for our assessment of equity beta.

The increase in reliability is shown through the reduction in the standard errors around the point estimates discussed in section 4. This can be illustrated by comparing empirical estimates generated using the same econometric techniques but different data sets. The best available example compares the 2009 Henry estimates for fixed weight portfolios against the 2013 ERA analysis of the same

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<sup>117</sup> AER, *Final decision: WACC review*, May 2009, p. 307.

<sup>118</sup> For clarity, the 2009 WACC review also considered other periods, including longer periods submitted by ACG for the Joint Industry Association.

<sup>119</sup> The Henry report we have commissioned will use data up to the end of June 2013, an increase of four years and nine months.



type.<sup>120</sup> The ERA adopted the same regression permutations as Henry, using both equal weighted and value weighted portfolios, and both OLS and LAD regressions calculations. The key difference is that the ERA extended the data set from September 2008 through to April 2013. Table 6.1 shows the standard errors around the point estimates from this set of regressions.

**Table 6.1 Comparison of standard errors in Henry (2009) and ERA (2013)—regressions using fixed weight portfolios and weekly sampling frequency.**

Portfolio (firms)	Henry or ERA (time period)	No. of weeks	Standard error from equal-weighted portfolios		Standard error from value-weighted portfolios	
			OLS	LAD	OLS	LAD
P1' (ENV, APA)	Henry (2002–2008)	349	0.06	0.06	0.06	0.06
	ERA (2002–2013)	589	0.04	0.03	0.05	0.04
P1 (ENV, APA)	Henry (2003–2008)	262	0.07	0.07	0.08	0.08
	ERA (2003–2013)	503	0.04	0.03	0.05	0.04
P2 (ENV, APA, DUE)	Henry (2004–2008)	211	0.06	0.06	0.06	0.06
	ERA (2004–2013)	453	0.04	0.03	0.05	0.03
P3 (ENV, APA, DUE, HDF)	Henry (2004–2008)	193	0.07	0.07	0.07	0.07
	ERA (2004–2013)	415	0.06	0.04	0.05	0.03
P5 (ENV, APA, DUE, HDF, SPN, SKI)	Henry (2007–2008)	78	0.10	0.10	0.10	0.10
	ERA (2005–2013)	362	0.06	0.04	0.06	0.03
<b>P1–P5 Average</b>	<b>Henry (X–2008)</b>	<b>219</b>	<b>0.07</b>	<b>0.07</b>	<b>0.07</b>	<b>0.07</b>
	<b>ERA (X–2013)</b>	<b>464</b>	<b>0.05</b>	<b>0.03</b>	<b>0.05</b>	<b>0.03</b>

Note: Portfolio labelling follows Henry 2009. Portfolio P4 was omitted because it did not have consistent firm composition between the two analyses. Portfolio P5 has a different start date because of different data availability for SKI using Bloomberg (ERA) or Datastream (Henry) for the 2005–2007 period when this firm traded as an instalment receipt.

Source: AER, *Final decision: WACC review*, May 2009, p. 323; Henry, *Estimating  $\beta$* , April 2009, pp. 23–24, and ERA, *Explanatory statement: Draft rate of return guidelines*, August 2013, pp. 173–177.

As is evident in table 6.1, the standard errors decrease once the data is extended to 2013, with the average change across the table representing a reduction from 0.07 to 0.04. The equity beta estimates from the longer data series are more reliable.

Further, we now have empirical estimates generated from a broader set of different market conditions. The consistency of these results from markedly different environments also gives us increased confidence that the observed empirical range is reasonable. The empirical estimates from relatively stable period 2002–2008 (that is, after the tech boom but before the GFC) are consistent with recent analysis using the period 2008–2013, a period encompassing the GFC and its aftermath.<sup>121</sup> This suggests that the equity beta for the benchmark efficient entity is relatively stable across time, even

<sup>120</sup> This is the best available comparison because it is the longest data set available to us (until the completion of the new Henry report) which is transparent and comparable to the Henry analysis. The individual estimates in the 2013 ERA report are not presented with standard errors, so we were unable to repeat this analysis with them.

<sup>121</sup> This does not mean that we consider a short data period centred on the GFC would be a reasonable basis for equity beta estimation. We consider a period of (at least) five years is appropriate for equity beta estimation and see no conceptual problem with incorporating GFC data within such a data period.

when there are major fluctuations in the business cycle. This increases our confidence in the observed equity beta range.

As also noted previously, our choice of 0.7 as the proposed point estimate for the equity beta, which is at the upper end of the range of empirical estimates, has been informed by:

- Cross checks from overseas energy networks—we consider overseas energy networks can be used as a cross check of the Australian estimates, though not as the primary source of empirical estimates. The pattern of overseas results is not consistent. The majority of recent updates include point estimates between 0.5 and 0.9 (although, some estimates exceed 1.0). Nonetheless, given the inherent uncertainties when relating foreign estimates to Australian conditions, these empirical estimates are not incompatible with our proposed range. These results support the choice of a point estimate in the upper end of our range.
- Theoretical principles underpinning the Black CAPM—this alternative model suggests that the standard CAPM may underestimate the return on equity for firms with equity betas below 1.0. Though it is difficult to ascertain the magnitude (or materiality) of this effect, selection of a point estimate at the higher end of the range appears compatible with the theoretical predictions of the Black CAPM.
- Cross checks from the water sector—expert analysis indicates that water networks have similar systematic risk exposure to energy networks and are the closest available comparators outside the energy sector. Recent decisions by regulators of Australian water networks have adopted equity beta point estimates that tend to be around 0.7, and have been between 0.55 and 0.8. The ENA's consultant on equity beta, SFG, recently produced empirical estimates for an Australian water utility where the mean equity beta estimate was 0.55. These results are consistent with our choice of a point estimate in the upper end of our range.

We elaborate further on each of these points in section 5, section A.3, and section A.1.1, respectively.

# A Technical appendix

## A.1 Conceptual issues

### A.1.1 Systematic risk of energy networks compared with water networks

It is possible to use equity betas from regulated Australian water networks to cross check our estimate for the benchmark efficient entity. While Australian water and energy networks are likely to share many key characteristics and have similar levels of systematic risk, the value of this information is limited in that no Australian water networks are listed on the Australian Stock Exchange. Because of this, we would need to use determinations made by Australian water regulators to cross check our equity beta estimate for the benchmark efficient entity. This information supports an equity beta estimate within a 0.55–0.8 range. However, this data may contain limited new information as Australian water regulators often base their equity beta estimates on the energy sector. Further, we must also be wary that this data may contain international data as some Australian water regulators base their equity beta estimates on international water networks. While it is reasonable to use equity beta estimates based on international comparators as a cross check, it would not be reasonable to use these estimates as the primary determinant of the equity beta because it is not possible to correctly adjust for the differing environments across countries (see section 5.1, international comparators).

Evidence suggests Australian water and energy networks are likely to have similar levels of systematic risk. In 2010, the ACCC commissioned Frontier to examine the possibility of using energy-based empirical estimates of equity betas as a proxy for the water sector. Frontier also advised on how any observable differences between the sectors would affect the equity beta.<sup>122</sup> Frontier concluded that many of the factors affecting systematic risk were similar between the two sectors. Frontier found that water and energy networks shared similar exposure to systematic risk in their respective regulatory frameworks, ownership, industry structure, diversity of operations and operating leverage. Frontier noted two factors, the customer base and competition, would affect systematic risk differently between the two sectors. However, Frontier considered these differences were sufficiently immaterial such that equity betas in water networks would still be reasonable proxies for energy networks. Overall, Frontier recommended that energy based equity betas could reasonably be applied to rural water businesses as a default.<sup>123</sup>

A recent report we commissioned from Frontier suggested that, similarly, water based equity betas could reasonably be applied to energy networks.<sup>124</sup>

Regulated water networks in Australia are probably the closest comparators available to regulated Australian energy networks. Given the similarity of their activities and characteristics, water networks and energy networks are, in principle, reasonable comparators to one another.

Unlike the previous report, this report focused on risk generally, as opposed to focussing specifically on systematic risk. This report found there were two principal differences between the two sectors—greater supply-driven volume risk and political/regulatory risk in the water sector.<sup>125</sup> Regarding supply-driven volume risk, Frontier had previously noted that while rural water utilities have greater exposure to and dependence on weather patterns, this risk is diversifiable and is therefore independent to the

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<sup>122</sup> Frontier, *The cross sectoral application of equity betas: energy to water, A report prepared for the Australian Competition and Consumer Commission*, April 2010 (Frontier, *Cross sectoral equity betas: Energy to water*, April 2010).

<sup>123</sup> Frontier, *Cross sectoral equity betas: Energy to water*, April 2010, p. 31.

<sup>124</sup> Frontier, *Assessing risk for regulated energy networks*, July 2013, p. 92.

<sup>125</sup> Frontier, *Cross sectoral equity betas: Energy to water*, April 2010, p. 4.

equity beta.<sup>126</sup> Regarding political/regulatory risk, Frontier attributes this to governments' relatively large role in the water sector compared to energy. However, the previous Frontier report concluded that:<sup>127</sup>

While ownership may affect the actual betas associated with a business it should not have an effect on the estimate of beta for regulatory purposes. This is because regulators seek to estimate an appropriate commercial return as though the business was owned by commercial investors.

The report also noted that while there are some differences in the regulatory frameworks of water and energy, these differences should have an immaterial impact on equity betas because both sectors have a common regulatory approach and instruments to address regulatory risk.

Further, the ENA's consultant on beta, SFG, recently produced a report on the equity beta for an Australian water utility, Sydney Desalination Plant.<sup>128</sup> Even though this analysis does not have specific regard to energy, it indicates that the systematic risk exposure of water infrastructure utilities is in a similar ballpark to energy networks. SFG's ordinary least squares regression on 16 listed water utilities derived a mean beta estimate of 0.55, within a 90 per cent confidence interval of 0.40–0.70.<sup>129</sup> This is consistent with Frontier's findings that water networks are comparable to energy networks, which, as we have indicated, are consistent with an equity beta point estimate of 0.7 from a 0.4–0.7 range.

Table A.1 outlines state regulators' recent equity beta determinations for water utilities. These values have ranged between 0.55–0.8.

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<sup>126</sup> Frontier, *Cross sectoral equity betas: Energy to water*, April 2010, pp. 11–12.

<sup>127</sup> Frontier, *Cross sectoral equity betas: Energy to water*, April 2010, p. 19.

<sup>128</sup> SFG, *Cost of capital parameters for Sydney Desalination Plant*, 10 August 2011, p. 38 (SFG, *Cost of capital for SDP*, August 2011).

<sup>129</sup> SFG, *Cost of capital for SDP*, August 2011, p. 5.

**Table A.1 Final decisions on equity betas for Australian regulated water networks**

Regulator <sup>130</sup>	Regulated entity	Date	Equity beta
ESC	Greater metropolitan water businesses	June 2013	0.65
ESC	Regional urban water businesses	June 2013	0.65
ESC	Rural water businesses	June 2013	0.65 or 0.7 <sup>131</sup>
IPART	Hunter Water Corporation	June 2013	0.6 – 0.8 (20 basis points above upper end of WACC range under current market conditions)
ESCOSA	SA Water	May 2013	0.8
IPART	Gosford City Council and Wyong Shire Council	May 2013	0.6 – 0.8 (20 basis points above upper end of WACC range under current market conditions)
QCA	Seqwater's water supply schemes	April 2013	0.55
ERA	Water Corporation, Aqwest and Busselton Water	March 2013	0.65
IPART	Sydney Catchment Authority	June 2012	0.6 – 0.8 (midpoint for the WACC)
IPART	Sydney Water Corporation	June 2012	0.6 – 0.8 (midpoint for the WACC)
QCA	SunWater's water supply schemes	May 2012	0.55
IPART	Sydney Desalination Plant Pty Ltd	December 2011	0.6 – 0.8 (midpoint for the WACC)
QCA	Gladstone Area Water Board	June 2010	0.65

Source: ESC, *Price review 2013: Greater metropolitan water businesses - Final decision*, June 2013; ESC, *Price review: Regional urban water businesses - Final decision*, June 2013; ESC, *Price review 2013: Rural water businesses - Final decision*, June 2013; IPART, *Hunter Water Corporation: Final report*, June 2013; ESCOSA, *SA Water's water and sewerage revenues 2013/14-2015/16: Final determination - Statement of reasons*, May 2013; IPART, *Gosford City Council and Wyong Shire Council, Water - Final Report*, June 2013; QCA, *Final report: Seqwater irrigation price review 2013-17*, vol. 1, April 2013; ERA, *Inquiry into the efficient costs and tariffs of the Water Corporation, Aqwest and the Busselton Water Board: Revised final report*, March 2013; IPART, *Review of prices for the Sydney Catchment Authority*, June 2012; IPART, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services*, June 2012; QCA, *Final report: SunWater, Irrigation price review: 2012-17*, vol. 1; May 2012; IPART, *Review of water prices for SDP*, December 2011; QCA, *Gladstone Area Water Board: Investigation of pricing practices: Final report*, June 2010.

<sup>130</sup> We have excluded the Independent Competition and Regulatory Commission's (ICRC) and QCA's latest decisions for ACTEW and South East Queensland from this table because they did not specify a value for equity beta. See ICRC, *Final report: Regulated water and sewerage services*, June 2013; QCA, *Final report, SEQ price monitoring for 2012-13: Part B - Detailed assessment*, March 2013.

<sup>131</sup> ESC is required to use an equity beta of 0.7 for water networks operating in the Murray Darling Basin as it is subject to the ACCC's pricing principles for price approvals and determinations under the *Water Charge (Infrastructure) Charge Rules*.

Out of the equity beta estimates in table A.1, the Queensland Competition Authority (QCA), ERA and the Essential Services Commission of South Australia (ESCOSA) have made determinations that considered the energy sector. This suggests that, given the comparability of water and energy networks, it is reasonable for water regulators to make their determinations with regard to the energy sector (and vice versa). However, it also suggests this data may contain limited new information on the equity beta for Australian energy networks.

Further, of the equity beta estimates in table A.1, the Independent Pricing and Regulatory Tribunal (IPART), QCA and ESCOSA have considered information concerning international water networks. We consider it reasonable to use equity beta estimates based on international comparators as a cross check. However, we need to be wary of the limitations associated with international data (see section five, international comparators). We should also note that some regulators have already attempted to account for this in their decisions. For example, in its latest determination, ESCOSA drew heavily on the report to IPART for the Sydney Desalination Plant,<sup>132</sup> which considered international water utilities. However, it carefully considered problems associated with using overseas data. It also considered regulatory decisions applying to water, rail and electricity networks.<sup>133</sup>

While we may consider equity betas from regulated Australian water networks to inform our equity beta estimate for the benchmark efficient entity, we propose to only use this information as a cross check. Further, to conduct our cross checks accurately, we will continue carefully considering how equity betas from the water sector proxy the systematic risks of energy networks. This will prevent us from potentially misinterpreting the true risks of different business activities, which is a concern that ActewAGL has flagged.<sup>134</sup>

## A.2 Methodological choices

The equity beta is not directly observable. As a result, it must be estimated by reference to proxies and cannot be determined with certainty. During the 2009 WACC review we developed an estimate of the equity beta for the benchmark efficient service provider. We justified our position with respect to a number of empirical considerations, including data issues, methodological issues, and interpretation of empirical estimates. Methodological issues, that are the focus of this section, include:

- use of discrete or continuous returns
- method used to de-lever the equity beta from the actual level of gearing of the comparator firm and re-lever to the benchmark gearing ratio
- time period selection
- frequency of observations
- testing of estimation results
- calculation of portfolio or average equity betas
- application of Blume or Vasicek adjustments.

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<sup>132</sup> SFG, *Cost of capital for SDP*, August 2011.

<sup>133</sup> ESCOSA, *SA Water's water and sewerage revenues 2013/14-2015/16: Final determination - Statement of reasons*, May 2013.

<sup>134</sup> ActewAGL, *Response to Rate of Return guidelines consultation paper*, 21 June 2013.

In this section, we consider some of those issues in more detail. Specifically, the method used to account for leverage and the use of portfolio equity beta. We have discussed time period selection in section 3.2. ENA submitted three SFG reports that discuss the LAD regression technique, the Vasicek adjustment and the reliability of regression-based estimates of risk.<sup>135</sup> We have only been able to give limited regard to these consultant reports because they were submitted late and because of the complexity of those reports. We do not discuss these issues in this paper, however, we will consider them in more detail in the future.

### A.2.1 Gearing

The equity beta of a business reflects both the business risk of its assets and the financial risk from the business' level of financial leverage or gearing. Payments to debt holders are generally obligatory, independent of a business' contemporaneous revenue, and have precedence over payments to equity holders. Therefore, the higher a business' financial leverage, the greater the volatility of its free cash flows are assumed to be, leading to more volatile returns to equity holders.

The equity betas of comparator businesses will reflect varying levels of actual financial leverage between the businesses. Such equity betas can be de-levered to obtain the asset beta of the business. The result of de-levering reflects the beta of the asset if the asset was financed 100 per cent by equity, with no debt. These asset betas can then be re-levered, based on the benchmark gearing level adopted by the regulator to obtain an equity beta based on the benchmark level of gearing. We have consistently used a gearing ratio of 60 per cent in our previous regulatory determinations. In the draft rate of return guideline, we have proposed to maintain a gearing of 60 per cent for the benchmark efficient entity.<sup>136</sup>

In the 2009 WACC review, we applied the Brealey-Myers formula to de-lever and re-lever the raw equity beta estimates:

$$\beta_e = \beta_a \left(1 + \frac{D}{E}\right)$$

This approach was preferred by the ACG and adopted by Professor Henry in his 2009 report. It is also simpler than the Monkhouse formula that we have used prior to the 2009 WACC review. We propose to continue using the Brealey-Myers formula to de-lever and re-lever the comparable businesses' equity beta estimates.

In their April 2012 report on equity beta, McKenzie and Partington discussed the relationship between leverage and equity beta at length. They identified a number of limitations with de-levering and re-levering. These include:<sup>137</sup>

- the relationship between equity betas, financial leverage and financial risk is complex and uncertain;
- by making an adjustment to reflect the benchmark level of gearing, we are imposing a certain assumed relationship;

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<sup>135</sup> S. Gray, J. Hall, N. Diamond and R. Brooks, *Comparison of OLS and LAD regression techniques for estimating beta*, 26 June 2013; S. Gray, J. Hall, N. Diamond and R. Brooks, *The Vasicek adjustment to beta estimates in the Capital Asset Pricing Model*, SFG, 17 June 2013; N. Diamond, R. Brooks, S. Gray and J. Hall, *Assessing the reliability of regression-based estimates of risk*, 17 June 2013.

<sup>136</sup> AER, *Draft rate of return guideline*, August 2013, p. 11.

<sup>137</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, pp. 7–15.

- attempting to adjust for the different leverage of individual firms using an inaccurate formula and assumptions might be doing more harm than good.

McKenzie and Partington considered that the overall evidence indicates that financial leverage has relatively little impact on overall equity beta.<sup>138</sup> Therefore, they recommended that it might be more reasonable to simply estimate the equity beta without de-levering and re-levering the comparator set.

We note the choice of whether or not to de-lever and re-lever is not material on the portfolio estimates as the industry average gearing and the benchmark gearing are very similar. However, the difference for the individual comparative firm equity beta estimates will be greater because some firms have higher or lower gearing than the benchmark efficient entity.

We note there are views both for and against de-levering and re-levering equity beta estimates. On balance, we propose to have regard to both the raw and adjusted beta estimates.

## A.2.2 Portfolio estimates

Different samples of businesses will produce different equity beta estimates. In the 2009 WACC review, we identified a number of different approaches to obtain equity beta estimates that are reflective of the benchmark efficient entity. These include:<sup>139</sup>

- comparing the re-levered equity beta estimates of individual stocks
- obtaining individual re-levered equity beta estimates of the businesses that are representative of a benchmark efficient entity and calculating an estimate of the equity beta using a median or a simple average
- calculating median and average returns for a portfolio of stocks—using an equal-weighted portfolio or value-weighted portfolio—and then estimating a portfolio equity beta.

It is unlikely that an equity beta estimate for a particular comparable business will be superior to a completely different equity beta estimate of another comparable business. Therefore, in addition to estimating equity betas for individual businesses, we consider equity beta estimates generated from a portfolio of businesses would provide guidance on the equity beta for a benchmark efficient entity. This is also consistent with the ACG view put forward by the Joint Industry Associations at the 2009 WACC review.<sup>140</sup>

We propose to continue examining the portfolio estimates that use simple average and median returns to inform the equity beta for a benchmark efficient entity. These include estimates from:

- equal weighted portfolios—which consist of  $n$  businesses and each business has a weighting of  $1/n$
- value weight portfolios—where the weighting on each business is proportional to the market capitalisation of the business relative to the market capitalisation of that entire portfolio
- time varying portfolios—where the weights in the portfolios vary over time due to businesses being introduced into the portfolio as they become listed on the market and being removed when they are no longer listed.

<sup>138</sup> McKenzie and Partington, *Estimation of equity beta*, April 2012, p. 14.

<sup>139</sup> AER, *Final decision: WACC review*, May 2009, p. 307.

<sup>140</sup> ACG, *Beta for regulated electricity networks*, September 2008, pp. 34–35.



We consider a similar set of portfolios as those studied by Henry in his 2009 report. The structure of the portfolios and their sampling dates are listed in table A.2 below:

**Table A.2 Portfolios under consideration by the AER**

Portfolio	Firms	Start date <sup>141</sup>	End date
P1	APA ENV	16/06/2000	present
P2	AAN AGL APA ENV GAS	21/12/2001	06/10/2006
P3	APA DUE ENV HDF SPN	16/12/2005	23/11/2012
P4	APA DUE ENV HDF SKI SPN	02/03/2007	23/11/2012
P5	APA DUE ENV SKI SPN	02/03/2007	present

These portfolios are selected based on data availability. For example, the first portfolio contains two companies with the longest available data — ENV and APA, where data is available from 29 August 1997 and 13 June 2000 respectively. The last portfolio contains all the relevant companies that have data available currently. These are sampled from March 2007, as SKI is sampled from 2 March 2007 due to the limitation in SKI data as discussed in section 3.1. We will also examine portfolio estimates for the sampling periods listed above excluding 'abnormal events' such as the tech boom and GFC periods.

### A.3 The Black CAPM

The Black CAPM is an alternative to the standard (Sharpe–Lintner) CAPM. We set out a brief overview of the Black CAPM in our consultation paper.<sup>142</sup> As a result of slightly different starting assumptions, the Black CAPM predicts that the slope of estimated returns will be flatter than for the standard CAPM.<sup>143</sup> This means that for firms with an equity beta below 1.0, the Black CAPM predicts a higher return on equity than the standard CAPM.<sup>144</sup>

We have already set out an evaluation of the Black CAPM against the criteria in the explanatory statement accompanying the draft decision.<sup>145</sup> The AER has also provided analysis on the strengths and weaknesses of the Black CAPM in previous regulatory decisions (noting that these were under the previous rules framework).<sup>146</sup> The key point from this evaluation is that there is little prospect of resolving the implementation difficulties surrounding the Black CAPM—particularly the empirical estimation of the return on the zero-beta portfolio. Without robust parameter inputs, we have no confidence that direct estimation using this financial model will advance the rate of return objective.

<sup>141</sup> Note these dates should be read as the week ending on the stated Friday.

<sup>142</sup> AER, *Consultation paper, Rate of return guidelines*, 10 May 2013, pp. 91–93.

<sup>143</sup> This statement assumes that the representative investor can lend (but not borrow) at the risk free rate. The base form of the Black CAPM does not constrain the zero beta return to be above the risk free rate (which does not exist, by definition). In this case, the Black CAPM predicts a return on low beta equity that is below that of the standard CAPM.

<sup>144</sup> Conversely, for firms with an equity beta above 1.0, the Black CAPM predicts a lower return on equity than the standard CAPM.

<sup>145</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, pp. 189–191.

<sup>146</sup> For example, see AER, *Final decision, Envestra Ltd, Access arrangement proposal for the SA gas network, 2011–2016*, June 2011, pp. 43–46, 164–175.

However, this does not mean there is no merit to the theoretical basis for the Black CAPM, particularly when viewed alongside the standard CAPM.<sup>147</sup> In the draft guideline, we indicated that we would therefore consider the differing predictions of the Black CAPM when estimating the equity beta for use in the standard CAPM.<sup>148</sup> Hence, the proposed use of the Black CAPM reflects the particular strengths and weaknesses of this financial model.

### A.3.1 Theoretical implications

The key theoretical difference is that, where the standard CAPM assumes that investors can access unlimited borrowing and lending at the risk free rate, the Black CAPM instead assumes that investors can access unlimited short selling of stocks, with the proceeds immediately available for investment. Either of these assumptions might correctly be criticised as being unrealistic, and it is not clear whether the replacement assumption is preferable.<sup>149</sup> Of course, such simplifications are inherent in all financial models.

From these starting assumptions, the following formula for the Black CAPM can be derived:

$$r_e = r_z + \beta_e \times (r_m - r_z)$$

Where

$r_e$  is the expected return on equity

$\beta_e$  is the equity beta

$r_m$  is the expected return on the market

$r_z$  is the expected return on the zero beta portfolio

Note that this equation follows the same form as the standard CAPM, except that risk free rate ( $r_f$ ) has been replaced by the zero beta return ( $r_z$ ).

There are clear conceptual definitions for the expected return on the zero beta portfolio. It will sit between the borrowing rate (upper bound) and lending rates (lower bound) available to the representative investor.<sup>150</sup> While it is not possible to directly observe these borrowing and lending rates for the representative investor, this nonetheless provides a rough guide for any estimated return on the zero beta portfolio. Interest rates for different types of investors (including different credit ratings) are observable in the market. Previous expert advice to the AER indicated that the relevant borrowing rates may set an upper bound that is quite close to the risk free rate.<sup>151</sup>

Further, if it assumed that investors can lend (but not borrow) at the risk free rate, the expected zero beta return will sit between the risk free rate and the expected return on the market.<sup>152</sup> This provides a further check on the reasonableness of empirical estimates of the zero beta return.

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<sup>147</sup> For clarity, this statement does not imply that we consider the theoretical basis for the Black CAPM to be completely accurate (or more reliable than the standard CAPM).

<sup>148</sup> AER, *Draft rate of return guideline*, August 2013, pp. 15, 17.

<sup>149</sup> McKenzie and Partington, *Risk, asset pricing models and WACC*, June 2013, p. 25.

<sup>150</sup> See NERA, *Estimates of the zero-beta premium: A report for the Energy Networks Association*, June 2013, p. 6; or B. Grundy, *Comment on the cost of capital: A report for Envestra*, 23 March 2011, p. 8 (paragraph 21).

<sup>151</sup> The arguments and counter-arguments are contained in K. Davis, *Cost of equity issues: A report for the AER*, 16 January 2011, pp. 6, 11; B. Grundy, *Comment on the cost of capital: A report for Envestra*, 23 March 2011, pp. 8–9; and K. Davis, *Cost of equity issues: A further report for the AER*, 13 May 2011, pp. 10–11.

<sup>152</sup> Since even small investors can lend to the Commonwealth Government via purchase of CGS this seems plausible; though there are still complicating factors (e.g. inflation and the residual sovereign risk). K. Davis, *Cost of equity issues: A*

Where the zero beta return is above the risk free rate, the Black CAPM predicts that the standard CAPM will underestimate the expected return for shares with an equity beta below 1.0. That is, if the standard CAPM is used to generate an estimate of the return on equity, the conceptual prediction from the Black CAPM is that the return on equity will be above this figure (for all shares with an equity beta below 1.0). The magnitude of increase is difficult to determine conceptually, though there is some rough guidance from the observation of borrowing rates in the market.

### A.3.2 Empirical implementation of the Black CAPM

In the explanatory statement accompanying the draft decision we noted that the empirical implementation of the Black CAPM is difficult because the zero beta return is not observable and there is no reasonable method to obtain an estimate of the zero beta return. There is also an interaction effect with the return on the market, which is similarly unobservable. The standard CAPM also requires the return on the market to be estimated. However, in the Black CAPM, the inadequacy of the available proxies for the market portfolio amplifies the problems inherent in estimating the zero beta return (but do not have this effect on the risk free rate in the standard CAPM).

The latest NERA report submitted by the ENA illustrates how difficult it is to obtain a reliable empirical estimate of the return on the zero-beta portfolio.<sup>153</sup> NERA focuses on the zero beta premium, which is the return on the zero beta portfolio above the risk free rate. This calculation mirrors the calculation of the market risk premium, which is the expected market return above the risk free rate. The headline result is that the zero beta premium is around 12 per cent, with different scenarios shown in table A.3.

**Table A.3 Estimates of the zero beta premium in NERA's latest report**

Approach	Date range	Zero beta premium using portfolios (%)	Zero beta premium using securities (%)
	1974–2012	13.95	11.05
NERA preferred method	1974–1993	17.68	12.99
	1994–2012	10.03	9.00
Cross check using CEG method	1974–2012	11.23	8.74

Source: NERA, *Estimates of the zero-beta premium: A report for the Energy Networks Association*, June 2013, pp. 16, 17, 23.

Estimates of this magnitude appear implausible. Such a zero beta premium is approximately double the market risk premium of six per cent under a standard approach. The conceptual definition of the Black CAPM does not permit a zero beta return above the market return. In current conditions, with a risk free rate around four per cent, this means that the expected return on the zero beta portfolio is around 16 per cent. This is significantly above any reasonable expectation of the borrowing rate for the representative investor. Again, this is not compatible with the conceptual definition of the Black CAPM.<sup>154</sup> Professor McKenzie and Associate Professor Partington responded to an earlier report by NERA with a similar estimate of the zero beta return in this way:<sup>155</sup>

<sup>153</sup> *further report for the AER*, 13 May 2011, pp. 4–5; see also McKenzie and Partington, *Risk, asset pricing models and WACC*, June 2013, p. 25.

<sup>154</sup> NERA, *Estimates of the zero-beta premium: A report for the Energy Networks Association*, June 2013.

<sup>154</sup> See B. Grundy, *Comment on the cost of capital: A report for Envestra*, 23 March 2011, p. 8, K. Davis, *Cost of equity issues: A further report for the AER*, 13 May 2011, pp. 4–5; and McKenzie and Partington, *Risk, asset pricing models and WACC*, June 2013, p. 25.

<sup>155</sup> M. McKenzie and G. Partington, *Report to the AER: Review of NERA report on the Black CAPM*, 24 August 2012, p. 22–23.

As we illustrated earlier, the use of a portfolio which is not the market portfolio, and which is inefficient, leads to all sorts of problems when estimating the zero beta return. In this case, the result is a parameter estimate that is clearly incorrect, lying well outside the bounds prescribed by the underlying theoretical model. This hardly seems a solid basis on which to establish a cost of capital for regulatory purposes.

Further, given the linear form of the Black CAPM, these zero beta return estimates imply there is a negative price for risk. That is, as a share takes on more systematic risk exposure, the expected return declines. Greater risk means less reward. Given the market average return (for a share with an equity beta of 1.0) is around half the zero beta return, the expected return for a stock with an equity beta of 2.0 is approximately the risk free rate.

In section A.3.3 below, we set out how the selection of a higher equity beta might be one option to reflect the differing predictions of the Black CAPM relative to the standard CAPM. As a rough assessment of the reasonableness of this option, it is possible to convert a higher equity beta into an equivalent zero beta premium above the risk free rate. Consider the illustrative scenario where the risk free rate is 4.0 per cent, the market risk premium is 6.0 per cent and the total market return is therefore 10.0 per cent. Using the CAPM, a firm with an equity beta of 0.6 would therefore have an expected return of 7.6 per cent. Increasing the equity beta from 0.6 to 0.7 would increase the expected return to 8.2 per cent, an increase of 60 basis points. To obtain an equivalent overall return in the Black CAPM, the original equity beta (0.6) could have been used with a zero-beta return of 5.50 per cent. The zero beta premium above the risk free rate is therefore 150 basis points (5.50 per cent minus 4.00 per cent). A number of illustrative scenarios are shown in table A.4.

**Table A.4 Zero beta premium implied by a given uplift in the equity beta**

Risk free rate $R_f$ (%)	MRP (%)	Market return $R_m$ (%)	Change in beta	Implied zero-beta premium $R_f - R_z$ (%)
4.0	6.0	10.0	0.4 to 0.7	3.00
4.0	6.0	10.0	0.5 to 0.7	2.40
4.0	6.0	10.0	0.6 to 0.7	1.50
4.0	7.5	11.5	0.55 to 0.7	2.50
5.5	6.0	11.5	0.4 to 0.7	3.00
5.5	6.0	11.5	0.55 to 0.7	2.00

Source: AER calculations.

Table A.4 shows that, for 0.1 increase in equity beta (that is, from 0.6 to 0.7), to a 0.3 increase (that is, from 0.4 to 0.7), the size of the zero beta premium is between 150 basis points and 300 basis points (under a variety of scenarios for the risk free rate and market risk premium). This does not seem implausible, since zero beta premiums of this magnitude are below the market risk premium as required by the definition of the Black CAPM. Further, although the borrowing rates for the representative investor are not readily discernible, these magnitudes appear reasonable.

For clarity, we do not consider that the possible zero beta premiums presented in table A.4 are accurate or reliable as empirical estimates. As per our earlier analysis, we do not consider that there is any reliable empirical estimate for this parameter. However, in light of the available evidence, if the

Black CAPM captured the 'true' state of the world better than any other asset pricing model, this magnitude of adjustment appears open to us.

As an additional factor, much of the evidence on 'low beta bias' relies on studies that use a short term risk free rate (one to three months) in the regression equation. The difference between the short term risk free rate and the long term risk free rate (10 years, as used by the AER) is considerable. On a longer time period, the average difference is 70 basis points. Recently, the difference has been larger—around 150 basis points in August 2013.<sup>156</sup> The zero beta premiums presented in table A.4 should therefore be increased by this amount when considering this class of evidence on the Black CAPM.

### A.3.3 Impact on equity beta determination

While the direct difference between the Black CAPM and the standard CAPM relates to the risk free rate, we do not propose to add a zero beta premium to the risk free rate. First, this would effectively replace the standard CAPM with the Black CAPM. As set out in the draft guideline, we consider the standard CAPM is suitable as the foundation model and is the more reliable of the two models.<sup>157</sup> Second, the risk free rate is readily observable and there exists very little contention over its value. This contrasts with the equity beta where there is no readily observable estimate and the regulatory process already requires consideration of a number of non-quantifiable factors. Including the Black CAPM at this point has the advantage of allowing the consideration of offsetting and/or cumulative factors. Third, to the extent that support for the Black CAPM is driven by empirical findings of a 'low beta bias', these are often explained with reference to problems in estimating equity beta (rather than the risk free rate, which is usually not in dispute).

Our proposed approach is to consider the Black CAPM when determining equity beta for use in the standard CAPM. Relative to the standard CAPM, the theory of the Black CAPM points to the selection of a higher estimate for this parameter. However, while the direction is known, the magnitude is much more difficult to ascertain. As noted above, after the determination of empirical estimates for equity beta, there will be a range of other factors that will inform the selection of the equity beta point estimate and range. The Black CAPM adjustment will be incorporated into this decision. This might result in an increase to the range, or to the upper boundary of range, relative to the values that would have been selected absent consideration of the Black CAPM. Another potential outcome is the selection of a point estimate at the higher end of the range.

As discussed in sections 6.1 and 6.2, we do not consider evidence from the Black CAPM was sufficient to justify an adjustment to our range. However, we propose to select a point estimate at the higher end of the range considering the theoretical predictions of the Black CAPM.

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<sup>156</sup> This illustrative example compares the effective yield on CGS with three months to maturity (2.33 per cent, RBA series TB129) and ten years to maturity averaged across August 2013 (3.86 per cent, RBA series TB133). The difference is 1.54 per cent.

<sup>157</sup> AER, *Explanatory statement: Draft rate of return guideline*, August 2013, pp. 61–62, 185–193.

## A.4 Assessment of information sources against the rate of return criteria

Criterion	Conceptual analysis	Domestic empirical estimates	Empirical estimates from overseas energy networks	Theoretical principles underpinning the Black CAPM	Equity betas for the water sector
Where applicable, reflective of economic and finance principles and market information:  estimation methods and financial models are consistent with well accepted economic and finance principles and informed by sound empirical analysis and robust data	Conceptual analysis is grounded on economic and finance theory.	Australian empirical estimates are based on the available market data. Sound econometric techniques were used to derive these estimates.	Like domestic empirical estimates, overseas estimates are based on the available market data and employ sound econometric techniques. They may be more statistically robust than domestic estimates as they are generated from larger datasets.	Theoretical principles underpinning the Black CAPM are grounded on economic theory.  However, the empirical analysis is not sound, since there is an unresolved inconsistency between the zero beta return estimate and the model restrictions.	Regulators determine equity betas for Australian water networks. The rules frameworks which govern regulatory decisions typically require regulators to base their estimation methods on well-accepted economic and financial principles.
Fit for purpose  use of estimation methods, financial models, market data and other evidence should be consistent with the original purpose for which it was compiled and have regard to the limitations of that purpose  promote simple over complex approaches where appropriate	Conceptual analysis assesses the differences between the benchmark efficient entity and the market average. It is reasonable to use conceptual analysis to inform the equity beta of a benchmark efficient entity.	We define the benchmark efficient entity as 'a pure play, regulated energy network business operating within Australia'. As there are no businesses which precisely meet this benchmark, it is reasonable to use market data for domestic businesses that are considered to be close comparators to the benchmark efficient entity to inform the equity beta estimate.	International equity beta estimates do not meet the benchmark efficient entity definition. The use of a foreign proxy is a suboptimal outcome that can only be justified where there is evidence that this will produce more reliable estimates of the domestic equity beta than the Australian estimates.	We are estimating the equity beta for the Sharpe-Lintner CAPM. Given the limitations that we have identified for the Black CAPM in the draft guideline, it is unreasonable to estimate the Black CAPM equity beta equivalent. We only use its theoretical principles to help guide our selection.	The original purpose of this evidence is to proxy the systematic risk exposure of an Australian water network. While Australian water networks are inconsistent with our definition of a benchmark efficient entity, they do approximate the systematic risk exposure of a benchmark efficient entity insofar as Australian energy and water networks have comparable levels of systematic risk exposure.
Implemented in accordance with good practice  supported by robust, transparent and replicable analysis that is derived from available credible datasets	We have commissioned Frontier Economics and McKenzie and Partington to review the risks faced by regulated energy networks in Australia. In aggregate, this material	Empirical estimates for Australian energy networks are derived from robust, transparent and replicable regression analysis. Different studies with different econometric techniques and	Countries differ along a number of dimensions, such as the regulation of businesses, the regulation of domestic economy, geography, business cycles, and weather. If foreign	There is no generally accepted method to generate a reliable estimate of the zero beta return.	Broad administrative laws require regulatory analysis to be well-reasoned, transparent and publicly available. Accordingly, other regulators are likely to estimate equity betas for the water sector in accordance with good practice.

supports the position that the equity beta for the benchmark efficient entity is below the market average.

different sampling periods provide consistent results.

comparators were to be used to determine the equity beta estimate for the benchmark efficient entity, it would be reasonable to quantify the impacts of these differences and to make necessary adjustments. However, it is difficult to make such adjustments in a robust and transparent manner.

However, sometimes these estimates refer to foreign proxies. Foreign proxies are likely to be subject to different regulatory, geographic, economic conditions. Ideally, the impact of these differences should be quantified and adjusted for. However, it is difficult to make such adjustments in a robust and transparent manner.

<p>Where models of the return on equity and debt are used these are based on quantitative modelling that is sufficiently robust as to not be unduly sensitive to errors in inputs estimation</p> <p>based on quantitative modelling which avoids arbitrary filtering or adjustment of data, which does not have a sound rationale</p>	<p>Not applicable</p>	<p>OLS and LAD are commonly used regression techniques to estimate the equity beta. Further, the ERA introduced two new techniques, which produced consistent empirical estimates. There was no arbitrary adjustment to the data; instead we consider estimates from different comparator sets and different time periods.</p>	<p>OLS and LAD are commonly used regression techniques to estimate the equity beta. There was no arbitrary adjustment to the data. Instead, we consider estimates from different comparator sets and different time periods.</p>	<p>The Black CAPM is sensitive to errors in the estimation of the zero beta return.</p>	<p>Not applicable</p>
<p>Where market data and other information is used, this information is credible and verifiable comparable and timely clearly sourced</p>	<p>Not applicable</p>	<p>Market data used for domestic empirical estimation meets this criterion.</p>	<p>Market data used for international empirical estimation meets this criterion.</p>	<p>Not applicable</p>	<p>Estimates from other regulators may not always be directly comparable to our estimates due to differences in the estimation approach. In particular, other regulators do not always use a benchmark efficient entity that is consistent with our definition.</p> <p>However, water regulators will often provide robust reasoning and clearly specify the data used for estimating their equity betas. In this</p>

Sufficiently flexible as to allow changing market conditions and new information to be reflected in regulatory outcomes, as appropriate	Not applicable	We can always update the empirical estimates to take into account the latest market data.	We can always update the empirical estimates to take into account the latest market data.	While the theory of the Black CAPM should allow the model to accommodate changing market conditions, the difficulties in estimating the zero beta return are magnified when attempting to match current market conditions (instead of an average figure over many years).	<p>respect, this data is usually verifiable and clearly sourced.</p> <p>Estimates from other regulators may not always reflect prevailing market conditions, as there may be a delay between when the corresponding decisions are made. As such, these estimates may not be sufficiently flexible to allow changing market conditions to be reflected.</p>
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