A Conduct of the inquiry

Table A.1 **List of submissions**

Individual or organisation	*Submission number*[a]
Alcoa World Alumina Australia	65
Alinta/Multinet	36, DR91
Allgas Energy	25, 69, DR77
AusCID	1, DR90
Australian Competition and Consumer Commission	48, 67, 72, DR101, DR119
Australian Gas Light Company	32, DR84
Australian Petroleum Production and Exploration Association	6, DR86
Australian Pipeline Industry Association	44, 60, 74, DR100
Australian Pipeline Trust	55
BHP Billiton	26, 62, 75, DR96
Chamber of Commerce and Industry of WA	39, DR122
CMS Energy Gas Transmission Australia	19
Code Registrar	DR103
CS Energy	59
CSBP	33
Department of Infrastructure	71, DR104
Deutsche Asset Management (Australia)	66
Duke Energy International	21, 61
Economic Regulation Authority (Office of Gas Access Regulation*****)	40, DR116
Electricity Consumers Coalition of SA & Energy User Coalition of VIC	49
Energy Action Group	27
Energy Markets Reform Forum	30, 42, DR94, DR107
Energy Networks Association (Australian Gas Association)	13, 68, DR85
Energy Retailers Association of Australia	9
Energy User Coalition of VIC & Electricity Consumers Coalition of SA	49
Enertrade#	14, DR98
Envestra	22, 35, DR82, DR111
Epic Energy	37, DR109
Ergon Energy Gas	7
Essential Services Commission of South Australia	3, 51, DR112
EWN Publishing	54
ExxonMobil	8, DR78
FRH	12
GasNet Australia	47

(Continued next page)

Table A.1 **(Continued)**

Individual or organisation	*Submission number*[a]
Goldfields Gas Transmission	16, 17, 18, DR88, DR118, DR123
Harvey, Greg	15, DR93, DR105
Hunter Gas Users Group#	4
in tempore Advisory	DR87
Infrastructure Access Services	76
Institute of Public Affairs	2, 73, DR89
KPMG Consulting	20
Littlechild, Stephen C	24
M J Kimber Consultants	DR80
Menezes, Flavio	DR81
Multinet Gas Distribution Partnership	25
Murrumbidgee Shire Council	10
National Competition Council	57, DR92, DR117
National Gas Pipelines Advisory Committee	34
Network Economics Consulting Group	56, DR97, DR124
Newmont Australia	50
Northern Territory Government	41, DR126
NT Gas	64
Orica	28
Origin Energy	52, DR83
Pacific Economics Group, LLC	DR113
Project Consultancy Services	DR102
Queensland Government	63
Queensland Major Gas Users Group	38
Riverina Eastern Regional Organisation of Councils	46
Santos	29
SEA Gas	DR125
Shell Development (Aust)	31, DR95
Sleeman Consulting	DR79
South Australian Government*	58, DR108
Tasmanian Government	45
TXU Australia	11
Victorian Energy Networks Corporation	23, 53, DR106
Western Australian Government	70, DR114
Western Power	DR115
WMC Resources	43, DR99
Worsley Alumina	5, DR110

[a] An asterisk (*) indicates that the submission contains confidential material not available to the public. A hash (#) indicates that the submission includes attachments. DR indicates a submission received after preparation of the draft report.

Table A.2 **List of visits**

Interested parties
Adelaide
Department of the Premier and Cabinet
Department of Treasury and Finance
Envestra
Essential Services Commission of South Australia
National Gas Pipelines Advisory Committee
Office of the Code Registrar
Santos
Brisbane
Allgas Energy
Department of Innovation and Information Economy
Department of the Premier and Cabinet
Enertrade
Queensland Competition Authority
Queensland Major Gas Users Group
Queensland Treasury
Canberra
Australian Competition and Consumer Commission
Australian Gas Association
Australian Pipeline Industry Association
Department of Industry, Tourism and Resources
Department of the Treasury
Melbourne
Allen Consulting Group
BHP Billiton
Energy Users Association of Australia
Envestra
Epic Energy
Essential Services Commission of Victoria
GasNet Australia
Institute of Public Affairs
National Competition Council
National Gas Pipelines Advisory Committee
Utility Regulators Forum
Perth
Alcoa World Alumina Australia
Alinta/Multinet
Chamber of Commerce and Industry of WA
CMS Energy Gas Transmission Australia
Department of Industry and Resources
Department of the Premier and Cabinet

Table A.3 **Public hearings**

Participant	*Transcript page numbers*
Perth — Monday 1 September 2003	
Australian Gas Association	3–26
Alcoa World Alumina Australia	27–38
WMC Resources	39–53
Perth — Tuesday 2 September 2003	
Goldfields Gas Transmission	56–78
Office of Gas Access Regulation (Economic Regulation Authority)	79–91
Adelaide — Wednesday 3 September 2003	
National Gas Pipelines Advisory Committee	94–110
Essential Services Commission of South Australia	111–12
Envestra	123–42
Santos	143–60
Epic Energy	161–79
Melbourne — Thursday 11 September 2003	
Energy Action Group	182–94
Alinta/Multinet	195–209
Institute of Public Affairs	210–19
KPMG Consulting	220–8
Melbourne — Friday 12 September 2003	
ExxonMobil	231–45
TXU Australia	246–58
Energy Users Association of Australia	259–71
Brisbane — Tuesday 16 September 2003	
Enertrade	272–94
Energex and Allgas Energy	295–318
Sydney — Thursday 18 September 2003	
Australian Competition and Consumer Commission	320–51
Australian Petroleum Production and Exploration Association	352–64
Sydney — Friday 19 September 2003	
Australian Pipeline Industry Association	367–99
Newmont Australia	400–09
Energy Markets Reform Forum	410–25
Australian Gas Light Company	426–42
Hunter Gas Users Group	443–52
BHP Billiton	453–80

(Continued next page)

Table A.3 **(Continued)**

Participant	*Transcript page numbers*
Melbourne — Friday 19 March 2004	
Alinta/Multinet	485–500
Greg Harvey	501–12
Institute of Public Affairs	513–22
BHP Billiton	523–41
Brisbane — Wednesday 24 March 2004	
Enertrade	544–66
M J Kimber Consultants	567–75
Energy Networks Association (the former Australian Gas Association)	576–603
in tempore Advisory	604–10
Allgas Energy	611–34
Sydney — Thursday 25 March 2004	
Network Economics Consulting Group	637–53
National Competition Council	654–80
Regional Minerals Program – Study of Gas in North-Eastern NSW	681–92
Australian Competition and Consumer Commission	693–720
Project Consultancy Services	721–33
Sydney — Friday 26 March 2004	
Energy Markets Reform Forum (Transcript-in-Confidence)	735–46
Energy Markets Reform Forum	748–75
Australian Gas Light Company	776–98
Australian Pipeline Industry Association	799–829
Adelaide — Wednesday 31 March 2004	
Envestra	832–51
Electricity Consumers Coalition of SA, Energy Users Coalition of Victoria	852–88
Kimberley-Clark Australia	
Perth — Thursday 1 April 2004	
Epic Energy	891–921
WMC Resources	922–39
Alinta/Multinet	940–57
Goldfields Gas Transmission	958–79
Economic Regulation Authority	980–1000

B Risk and regulatory truncation

B.1 Introduction

In this appendix, issues resulting from rate of return (ROR) truncation, which can arise from the application of cost-based price regulation in the Gas Access Regime, are discussed. There is a particular focus on different types of truncation that can occur where the building block and incentive form of price regulation (price caps and various benefit sharing schemes)[1] are applied to set and reset reference tariffs at certain points in time over the life of a pipeline investment. The model used here to examine the impacts of regulatory truncation is the capital asset pricing model (CAPM).

B.2 Capital asset pricing model and risk

Regulators often use the CAPM to determine the allowed *expected* ROR that regulated pipeline businesses can earn from their investments.

The CAPM is used here only for the purpose of discussing regulatory truncation. Matters relating to the application of the CAPM to determine the regulated value of ROR are not discussed. The CAPM is discussed extensively in textbooks on corporate finance (such as Brealey and Myers 1996; Copeland and Weston 1988; Peirson et al. 1995). It was developed, and has been applied principally, to determine the value or price of assets traded in competitive markets. There are a number of important, and often restrictive assumptions, underlying the CAPM, such as no transaction costs, assets are infinitely divisible, each investor can invest into every asset without restriction, prices are competitive, and the model is static (only one time period).

The expected value of the ROR on investment is expected in a statistical sense — it is the expected ROR commensurate for the risk. The realised ROR after the investment is made might be above or below the expected value. The measure of risk in the CAPM is the beta (defined below in equation B.2) of the asset or

[1] See Vogelsang (2002) for a summary of what is meant by incentive regulation.

portfolio of assets (Copeland and Weston 1988, p. 198). For the CAPM model, total risk associated with an investment is disaggregated into systematic risk (sometimes referred to as nondiversifiable or market risk) and unsystematic risk (sometimes referred to as unique risk or diversifiable risk). Investors need only be compensated for the systematic risk they face because unsystematic risk can be diversified away by investing in a portfolio of assets. The asset beta determines the level of systematic risk attributed to an asset or a portfolio of assets.

Expected value of ROR for a pipeline investment

In this appendix, an *ex ante* specification of the market model is used. The market model is the empirical form of the CAPM, which is estimated using ordinary least squares regression techniques (Copeland and Weston 1988, p. 213; Pierson et al. 1995, p. 158). The market model is used to demonstrate, empirically, the effects of regulatory truncation, presented later.

For the CAPM, the expected ROR for a pipeline asset, $E(R_p)$, is equal to the risk-free ROR, R_f, plus the expected premium to compensate for systematic risk and the expected value of the error term, ε_p. The error term is assumed to be normally distributed with a mean of zero and a standard deviation of $\sigma_{\varepsilon p}$. The covariance between the market portfolio ROR and the error term is normally assumed to be zero.

The expected premium to compensate for systematic risk (ROR above the risk free ROR) is a function of the pipeline asset beta, β_p, which is multiplied by the difference between the average expected ROR for all assets (market portfolio[2]) in the economy and the risk-free ROR, typically based on the ROR for government bonds (equation B.1). For the CAPM, the measure of risk for a pipeline investment is its asset beta. The difference between the expected value of the ROR for the market portfolio and the risk-free rate is the price of risk (Copeland and Weston 1988, p. 198):

$$\begin{aligned} E\left(R_p\right) &= R_f + \beta_p\left[E\left(R_m\right) - R_f\right] + E\left(\varepsilon_p\right) \\ E\left(R_p\right) - R_f &= \beta_p\left[E\left(R_m\right) - R_f\right] + E\left(\varepsilon_p\right) \end{aligned} \qquad \text{(B.1)}$$

The asset beta of a pipeline investment is defined as the covariance of the ROR between the pipeline investment and the market portfolio divided by the variance of

2 The market portfolio is a portfolio of all assets, not just shares. It includes bonds, land, buildings and much else (Peirson et al. 1995). It is not possible to measure returns on all these assets. So the market portfolio is approximated in practice by the All Ordinaries Share Price Index, as noted by the Australian Competition and Consumer Commission (ACCC) (sub. 48, p. 41).

the ROR for the market portfolio (equation B.2). The correlation between the ROR for the pipeline investment and the market portfolio is denoted by the correlation coefficient, r_{pm}. The standard deviations of the ROR for the pipeline investment and market portfolio are denoted by σ_p and σ_m, respectively:

$$\beta_p = \frac{Cov(R_p, R_m)}{Var(R_m)} = \frac{\sigma_p r_{pm} \sigma_m}{\sigma_m^2} = \frac{\sigma_p}{\sigma_m} r_{pm} \qquad \text{(B.2)}$$

The level of systematic risk for the pipeline investment depends upon the ratio of the standard deviation of the ROR for the pipeline investment and market portfolio (relative risk) and the correlation between these two ROR variables. The higher the pipeline's relative risk and correlation of ROR with the market portfolio, the greater the beta.

Standard deviation of ROR for a pipeline investment

The standard deviation of ROR for a pipeline investment can be inferred by rearranging the terms in equation B.2:

$$\sigma_p = \frac{\beta_p \sigma_m}{r_{pm}} \qquad \text{(B.3)}$$

For a given value of beta (measure of systematic risk for the pipeline investment) and standard deviation of market ROR, the standard deviation of pipeline ROR depends on the correlation between the ROR of the pipeline investment and the market portfolio. The standard deviation of ROR for the pipeline investment equals systematic risk of the pipeline investment in the special case of a correlation coefficient value of one.

An illustration

To illustrate the concepts and issues discussed throughout this appendix, data from regulatory decisions are used (box B.1). By applying the mean and standard deviation to a specific functional form of probability distribution, it is possible to plot the implicit probability distribution of risk for a pipeline investment, such as the Moomba–Sydney pipeline.

Although different forms of the probability distribution function could be used, the normal distribution is used here for empirical convenience[3]. The issues and broad findings being discussed here are not dependent upon the functional form of the probability distribution.

Box B.1 **Data used for illustrative purposes**

Some data provided here are cited in the final decisions of the Australian Competition and Consumer Commission (ACCC) in relation to approval of access arrangements for the Australian Gas Light Company's Central West Pipeline (ACCC 2000b) and Eastern Australian Pipeline's Moomba–Sydney pipeline system (ACCC 2003b). The Productivity Commission has provided the data (standard deviation of ROR for the market portfolio, σ_m) and derived some parameters from ACCC data (debt and asset betas).

Although the data are from the above sources, no views are offered on the merit of the data. For simplicity, all figures are based on the ACCC's vanilla form of the weighted average cost of capital (WACC). No adjustments are made to incorporate the impact on shareholder cash flows arising from the tax shield effects of dividend imputation. All figures are in nominal terms.

	Symbol	*Units*	*Value*
ACCC parameters			
Nominal risk-free rate	r_f	%	5.29
Debt divided by assets ratio	D/(D+E)	%	60.00
Equity beta	β_e		1.00
Market risk premium	MRP	%	6.00
Debt margin	DM	%	0.92
Nominal cost of debt	r_d	%	6.21
Nominal vanilla WACC	W_v	%	8.24
ACCC asset betas for electricity transmission			0.35–0.50
IPART/IPARC asset betas for gas distribution[a]			0.40–0.50
ACCC asset beta for the Central West Pipeline			0.60
PC estimates			
Debt beta	β_d		0.15
Asset beta	β_p		0.49
Market risk (January 1990 to December 2002)[b]	σ_m	%	13.20
Standard deviation of systematic risk	$\beta_p\sigma_m$	%	6.49

[a] Independent Pricing and Regulatory Tribunal (NSW); Independent Pricing and Regulatory Commission (ACT), now the Independent Competition and Regulatory Commission. [b] Graham-Smith 2003.

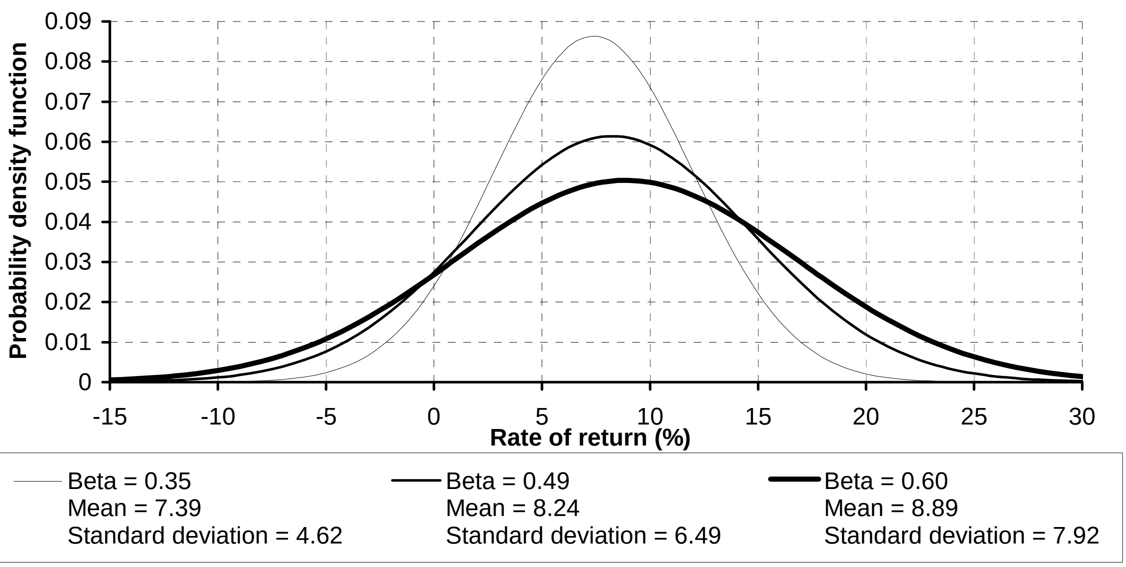
Sources: ACCC 2000b, p. 42; ACCC 2003b, p. 140; Graham-Smith 2003; PC estimates.

3 The ACCC noted that the normal distribution is generally applied to the CAPM. However, it also stated that 'according to [Bishop, S., Crapp, H., Faff, R. and Twite, G. 2000, *Corporate Finance*, 4th edn, Prentice Hall, p. 142], the issue of whether returns are normally distributed in Australia is unresolved.' (sub. 48, p. 41).

Systematic risk (measured as standard deviation) is given by $\beta_p\sigma_m$ (Copeland and Weston 1988, p. 199; and Peirson et al. 1995, p. 159).

The distributions of the ROR to compensate for systematic risk for different values of the asset beta are illustrated in figure B.1. These distributions are based on the assumed value of the standard deviation of the ROR for the market portfolio (σ_m in box B.1). The values of asset betas correspond to those that have been applied by various regulators in assessing the ROR for electricity and gas transmission and distribution assets (ACCC 2000b, p. 42). The asset beta value of 0.49 is that estimated for the Moomba–Sydney pipeline. As the value of beta (risk) increases, both the mean value of ROR and standard deviation (systematic risk) increase. Even for the low value of beta (0.35), the distribution of ROR to compensate for systematic risk is wide.

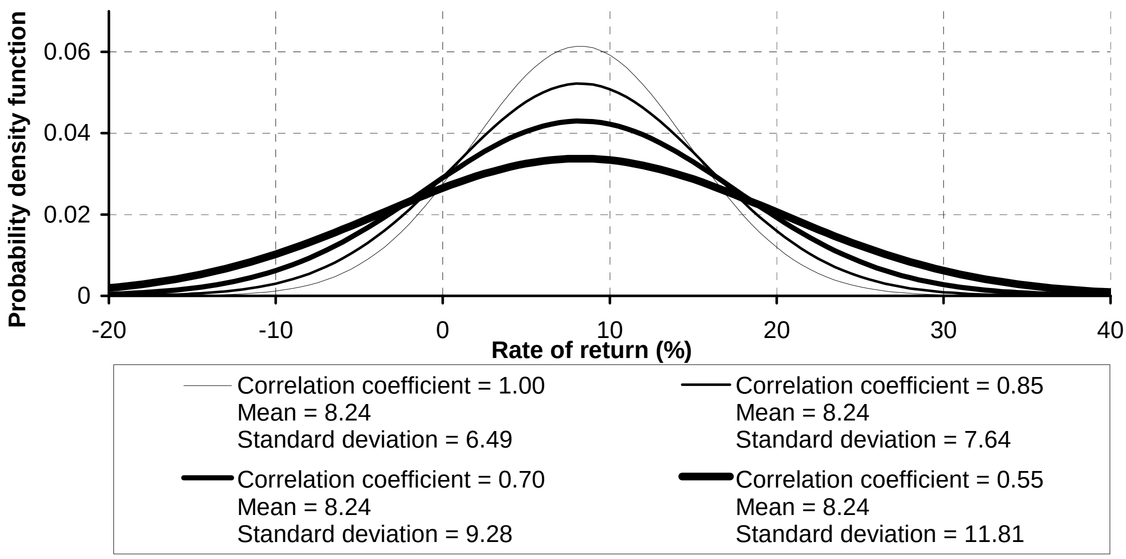
Figure B.1 **Distribution of ROR to compensate for systematic risk for alternative values of the asset beta**



Source: PC estimates.

As defined above (equation B.3), the standard deviation of pipeline ROR, σ_p, is determined by the value of beta, β_p, the standard deviation of market risk, σ_m, and the correlation between the ROR for the pipeline investment and the market portfolio, r_{pm}. The distributions of pipeline ROR are illustrated in figure B.2, based on the value of the asset beta estimated for the Moomba–Sydney pipeline (0.49). There is a distribution of pipeline ROR for each assumed value of the correlation coefficient (1, 0.85, 0.7 and 0.55). As the correlation coefficient decreases, the standard deviation of pipeline ROR increases. This is worth noting because it is the distribution of pipeline ROR (and not the distribution of ROR to compensate for systematic risk) which the regulator truncates. It is only in the special case when the correlation coefficient equals one that the standard deviation of pipeline ROR equals systematic risk and the distributions of total risk and systematic risk coincide.

Figure B.2 **Distribution of pipeline ROR for alternative values of the correlation coefficient, for a given asset beta (0.49) and market portfolio risk**



Source: PC estimates.

The fact that pipeline ROR has a probability distribution has important implications when considering the issue of regulatory truncation of ROR. As discussed below, all else equal, the application of price regulation under the Gas Access Regime (through the use of benefit sharing mechanisms, for example) has the potential to alter the mean and standard deviation of ROR for a regulated investment and the correlation of its ROR with those of the market. Applying the CAPM to ROR that have been truncated through regulatory intervention is unlikely to yield the same results as applying the CAPM to unregulated ROR, all else equal. In this way, the choice of the value of beta and adjustments for truncation are interdependent with the way price regulation is implemented.

B.3 Simulating regulatory truncation

Under the Gas Access Regime, regulators generally use the building block method to estimate the expected value of revenue required to earn the expected ROR appropriate for the degree of risk (reflected in the regulator's choice for the value of asset beta). The revenue requirement is then generally used to determine a reference tariff (and its path over time, using a CPI-X price (growth) cap).

At regular periods (typically every five years), the process of setting the revenue requirement and price cap for the next regulatory period is repeated. With the price cap fixed over the period, the actual ROR generally vary, depending on the level of sales achieved and the costs of production. Sometimes, benefit sharing mechanisms (between end users and service providers) are employed.

Some potential sources of regulatory truncation

The Australian Competition and Consumer Commission (ACCC) suggested benefit sharing in its draft greenfields guideline (ACCC 2002a). It suggested truncating revenue when the actual quantity shipped exceeds expected quantity by a specified amount, such as one standard deviation above the expected value. All else equal, an upper bound on the (allowed) ROR is implicit in this approach.

Other regulators have also expressed interest in using a range of regulatory tools. For example, the Victorian Essential Services Commission suggested:

> Given the uncertainties of designing appropriate gas access regulation and the resulting potential for regulatory 'error', there may be great value in further examining a fuller range of regulatory methods. Some of the regulatory tools that have been discussed in the theoretical literature and applied in other jurisdictions include the following:
>
> - *Earnings sharing mechanisms.* Earnings sharing mechanisms (ESMs) refer to pre-established rules for sharing earnings between companies and customers; ESMs are widely seen as devices that mitigate shareholder risk, although these lower risks are also accompanied by lower performance incentives.
> - *Revenue sharing mechanisms.* Revenue sharing mechanisms are similar to earnings sharing mechanisms, although company revenues rather than earnings are shared according to pre-established formulas.
> - *Interplan sharing provisions.* These are provisions that share the benefits of efficiency gains between different regulatory plans. Such mechanisms can strengthen incentives and create more uniform incentives to pursue efficiency gains in all years of a regulatory plan. One example is the efficiency carryover mechanism first applied by the Office of Water Regulation (Ofwat) in the United Kingdom in its 1999 review of water and sewer price controls. The ESC adopted a nearly identical efficiency carryover mechanism in its 2001 Electricity Distribution Price Review.
> - *Trigger mechanisms and 'off ramp' provisions.* Price control plans can incorporate various trigger mechanisms that lead to automatic regulatory adjustments when certain variables pass established thresholds. An example might be an automatic, up or down adjustment of rates when the cost of capital changes by a certain amount.

An 'off ramp' is a more radical trigger mechanism where a fundamental review of plan terms can take place under certain, specified conditions.

- *Menu approaches.* The tools above and others can be brought together in various combinations. It is also possible to construct 'menus' of alternative price control plans with varying terms. An example might be a menu that presents three different regulatory options, each of which has a different X factor and an associated earnings sharing mechanism. A higher X factor would be associated with a less demanding ESM, while a lower X factor would have a more demanding ESM. The company could then select its desired choice from the menu. (sub. DR112, p. 18)

In implementing such regulatory tools, the regulator will generally alter the mean and standard deviation (total risk) of ROR for a pipeline investment, as well as the correlation of its ROR with those of the market portfolio, compared to the values implicit in the regulator's initial choice of an asset beta, all else equal.

Illustration of regulatory truncation

The effect of regulatory truncation is best illustrated by applying the market model (the formulation of the CAPM used for estimation purposes) to a data set. The data set used here is generated using the Monte Carlo technique, so that application of the market model to the data set will reproduce the parameters for the Moomba–Sydney pipeline discussed in box B.1, for an assumed correlation between the ROR for the pipeline and market portfolio of 0.7. The method used to generate the data set is outlined in box B.2.

Box B.2 **Method used to generate the data set**

The data set is a sample of pairs of variables (market ROR and pipeline ROR), generated using a bivariate normal probability density function:

$$f\left(R_m, R_p\right) = \frac{1}{2\pi\sigma_m\sigma_p\sqrt{1-r_{pm}^2}} e^{-q/2}$$

$$\text{where } q = \frac{1}{1-r_{pm}^2}\left[\left(\frac{R_m - E\left(R_m\right)}{\sigma_m}\right) - 2r_{pm}\left(\frac{R_m - E\left(R_m\right)}{\sigma_m}\right)\left(\frac{R_p - E\left(R_p\right)}{\sigma_p}\right) + \left(\frac{R_p - E\left(R_p\right)}{\sigma_p}\right)^2\right] \quad \text{(B.4)}$$

and $E\left(R_m\right) = 11.286357, \sigma_m = 13.2, E\left(R_p\right) = 8.238357, \sigma_p = 9.277714, r_{pm} = 0.7$

The random value of market ROR is generated first using:

$$R_m = E\left(R_m\right) + \sigma_m \text{ RanNor}_m \quad \text{(B.5)}$$

where RanNor is random variable generated from a standard normal distribution.

Then use is made of the conditional probability density function of R_p, given R_m, which is also normally distributed:

$$\begin{aligned} &\text{Conditional mean} = E\left(R_p \mid R_m\right) = E\left(R_p\right) + r_{pm}\frac{\sigma_p}{\sigma_m}\left(R_m - E\left(R_m\right)\right) \\ &\text{Conditional variance} = \text{Var}\left(R_p \mid R_m\right) = \sigma_p^2\left(1-r_{pm}^2\right) \end{aligned} \quad \text{(B.6)}$$

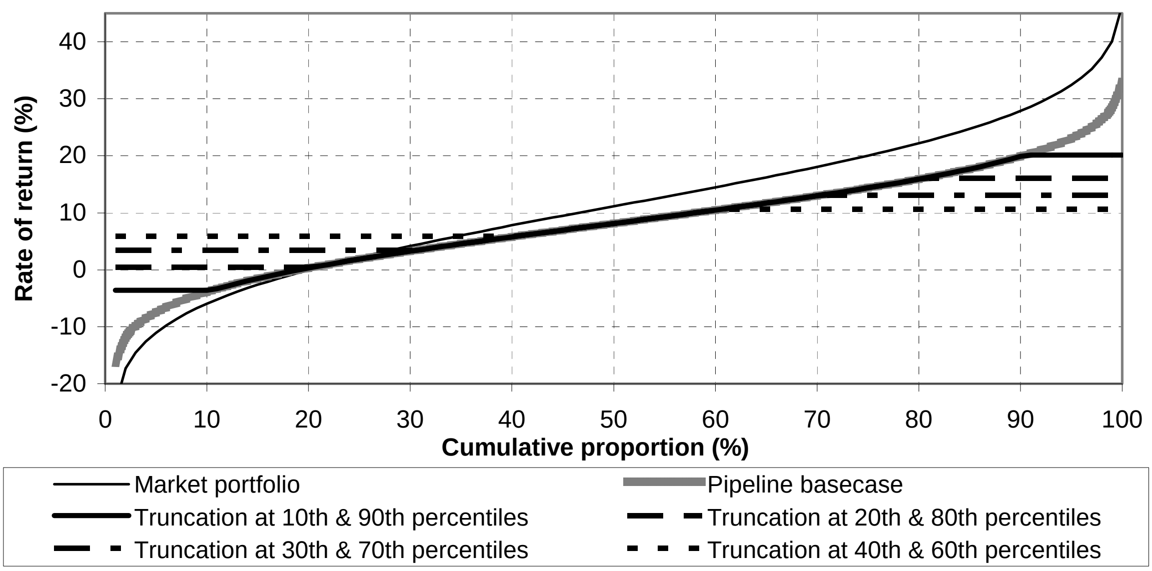
Using the above formulae, a random value of R_p is generated for each randomly generated value of R_m:

$$R_p = E\left(R_p\right) + r_{pm}\frac{\sigma_p}{\sigma_m}\left(R_m - E\left(R_m\right)\right) + \sqrt{\sigma_p^2\left(1-r_{pm}^2\right)} \text{ RanNor}_p \quad \text{(B.7)}$$

Sources: Based on Hogg and Craig (1978, pp. 117–8); and Maddala (1992, pp. 104–5).

The effect of regulatory truncation on the distribution of ROR is illustrated in figure B.3, which shows plots of the value of ROR at each percentile for both the pipeline and market portfolio. Truncation is only applied to ROR of the pipeline investment and the market portfolio ROR are assumed unaffected.

Figure B.3 **Cumulative distribution of ROR for the market portfolio and pipeline (with no truncation and four levels of truncation)**



Source: PC estimates.

For simplicity, it is assumed that ROR for the pipeline investment are capped at lower and upper bounds set to the values of ROR corresponding to the 10th and 90th percentiles, 20th and 80th percentiles, 30th and 70th percentiles, and 40th and 60th percentiles. In the case of asymmetric truncation, only the cap on the upper bound is applied.

Effect of truncation on mean, standard deviation and correlation

The effect of truncation on the mean and standard deviation of pipeline ROR and the correlation of pipeline ROR with market ROR are provided in table B.1. These statistics for the basecase (no truncation) are very close to the parameters used to generate the data set (box B.2). The small differences are due to random variations, which arise in generating a data set with a limited sample size using the Monte Carlo method described in box B.2.

Table B.1 **Analysis of regulatory truncation**

			Asymmetric truncation				*Symmetric truncation*			
Variable	*Units*	*Basecase (no truncation)*	*90th percentile*	*80th percentile*	*70th percentile*	*60th percentile*	*10th & 90th percentiles*	*20th & 80th percentiles*	*30th & 70th percentiles*	*40th & 60th percentiles*
Risk free ROR	%	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29
Mean market ROR	%	11.32	11.32	11.32	11.32	11.32	11.32	11.32	11.32	11.32
SD[a] of market ROR	%	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19
Pipeline ROR at upper truncation percentile	%	..	20.15	16.07	13.13	10.60	20.15	16.07	13.13	10.60
Pipeline ROR at lower truncation percentile	%	..	..	..	..	..	–3.61	0.48	3.40	5.90
Mean pipeline ROR	%	8.26	7.83	7.23	6.50	5.62	8.27	8.27	8.26	8.25
SD[a] of pipeline ROR	%	9.26	8.48	7.72	6.96	6.19	7.63	5.95	4.15	2.18
CC[b] of pipeline ROR with market ROR	no.	0.7005	0.6891	0.6726	0.6523	0.6278	0.6806	0.6551	0.6263	0.5945
Estimated asset beta	no.	0.4920	0.4430	0.3936	0.3441	0.2945	0.3940	0.2954	0.1970	0.0985
Estimated intercept	no.	0.0077	–0.1329	–0.4305	–0.8634	–1.4465	0.6022	1.1987	1.7859	2.3706
WACC[c] using estimated beta	%	8.25	7.96	7.66	7.36	7.06	7.66	7.07	6.47	5.88
SD[a] of systematic risk	%	6.49	5.84	5.19	4.54	3.88	5.20	3.90	2.60	1.30

a Standard deviation. **b** Correlation coefficient. **c** Weighted average cost of capital. **..** Not applicable.

Source: PC estimates.

First, consider the case of asymmetric truncation. The mean of pipeline ROR after truncation decreases (from 7.83 per cent to 5.62 per cent) compared to the basecase (8.26 per cent with no truncation) as the upper bound on ROR decreases (from 20.15 per cent to 10.60 per cent). Similarly, the standard deviation decreases (from 8.48 per cent to 6.19 per cent). The correlation coefficient of pipeline ROR with market ROR also decreases (from 0.69 to 0.63) because the values of truncated ROR are set to a constant (the relevant upper bound) and have no correlation with market ROR.

Next consider symmetric truncation. Unlike asymmetric truncation, the mean of pipeline ROR after symmetric truncation is the same as for the basecase and is unaffected by truncation (apart from small random variations discussed above). However, the standard deviation and correlation coefficient do decrease. Moreover, for symmetric truncation the decreases in standard deviation and correlation are greater than for asymmetric truncation. This is explained by the fact that twice as many observations of ROR in the data set are being fixed to constant values, albeit different constants for the upper and lower bounds.

Effect of truncation on CAPM parameters

Finally, consider the effect of truncation on the results obtained from application of the CAPM. To provide insights into this matter, comparisons are made with the results obtained from estimating the CAPM for the basecase and truncated data sets.

CAPM theory is about expectations (*ex ante*); the empirical model is specified in terms of time series (*ex post*) observations. The latter form of the model is usually estimated using equation B.8 (Copeland and Weston 1988, p. 214):

$$
\begin{aligned}
&Y_p = \alpha_p + \beta_p X_p + \varepsilon_p \\
&\text{where } Y_p = R_p - R_f,\ X_p = R_m - R_f, \qquad \text{(B.8)} \\
&\alpha_p \text{ is the intercept term and } \varepsilon_p \text{ is the error term.}
\end{aligned}
$$

The intercept term, α_p, normally would be expected to be zero. If it is significantly different from zero, then it might be an indication of an omitted variable.

The parameter estimates, obtained by fitting equation B.8 to the data set and truncated data sets using ordinary least squares, are provided in table B.1. As expected for the basecase data set, the value of the intercept is about zero and the value of beta is about 0.49.

Consider again asymmetric truncation. As the degree of truncation increases (the cap on ROR decreases from 20.15 to 10.60 per cent), the value of the intercept is increasingly negative (–0.13 to –1.45) and the value of beta decreases (from 0.44 to 0.29). The value of the intercept is negative because the mean of the variation in the pipeline ROR that is not explained by the difference between market ROR and risk free ROR is lower than the risk free rate. The value of beta decreases because of the reduction in risk (standard deviation of ROR) for the pipeline and the decrease in the correlation of pipeline ROR with those of the market.

Next consider again the case of symmetric truncation. In this case, the value of the intercept is increasingly positive (0.6 to 2.37) as the degree of truncation increases. The increasingly positive value of the intercept reflects the extent to which the mean of pipeline ROR that is not explained by variation in the difference between market ROR and risk free ROR is increasingly higher than the risk free rate. The values of beta decrease rapidly (0.39 to 0.1) as the degree of truncation increases (range of capped ROR decreases from between –3.6 per cent and 20.15 per cent to between 5.9 per cent and 10.6 per cent) and decrease more rapidly than under asymmetric truncation.

Findings about the effects of truncation

In both the asymmetric and symmetric truncation cases, the non zero value of the intercept and the changing value of beta indicate that the parameters estimated for the basecase are not valid following truncation of the ROR. The implication is that the weighted average cost of capital (WACC) for the basecase is inappropriate after truncation. Two corrections are required:

- the beta needs to be adjusted downwards (in both symmetric and asymmetric truncation)
- a truncation correction (as measured by the magnitude and sign of the intercept) should be made, with this being in the upwards direction for asymmetric truncation and downwards for symmetric truncation.

In the well behaved data set used here, the intercept for the basecase has a value of zero, and therefore, the mean value of ROR for the pipeline coincides with the estimated WACC (ignoring small random variations). In the case of asymmetric truncation, however, the mean value of pipeline ROR decreases. It is also true that some downward adjustment in the WACC is appropriate in light of the decrease in the standard deviation of ROR and the decrease in the correlation coefficient. However, the actual decrease is greater than that justified by the decrease in beta. The gap between the truncated mean ROR and that which would be determined using the revised value of beta in the CAPM equation is equal to the value of the intercept. Consequently, asymmetric truncation is biasing the mean ROR downwards too far, as measured by the negative value intercept. The absolute value of the intercept can be interpreted as a premium required to offset truncation.

In the case of symmetric truncation, the mean pipeline ROR was unaffected by truncation. However, in light of the reduction in standard deviation of pipeline ROR and the reduction in its correlation with market ROR, there should be an adjustment. The gap between the mean pipeline ROR after truncation and the corrected mean value is equal to the value of the intercept.

The main finding from the analysis of regulatory truncation is that it has a potential to distort returns to pipeline investment.

Truncation and risk transfer

The ACCC (2002a) suggested in its draft greenfields guideline that symmetric truncation (using benefit sharing schemes) is one option to overcome the problem of asymmetric truncation. However, as demonstrated above, this approach appears to raise an issue of who should bare the risk — users or service providers. By passing more of the risk to users (users share risks by accepting higher prices when profits would otherwise be low and lower prices when profits would otherwise be high), the expected value of ROR for regulated assets would be lower than it would otherwise be. Myers (1972) noted in discussing the concept of a fair ROR based on an expected value of the ROR:

> There are several things that the principle does not imply. It does not specify returns *ex post*; it is solely an *ex ante* concept. The existence of competitive markets does not require that expectations be realised for any asset, or even for all assets over any given period of time. Regulators can eliminate unexpectedly high or low rates of return after the fact, but only if they are willing to make the firm a risk free investment. (Myers 1972, p. 80)

Myers went on to note:

> … for one thing, a low cost of capital is not necessarily a good thing. There is no basis for assuming that, in a competitive market, uncertainty about operating costs would be borne almost entirely by consumers, as would be the case under this rule. Consequently, this is not likely to be an optimal allocation of risk bearing. (Myers 1972, p. 80)

Further, in an increasingly deregulated environment with emerging competition, many privately-owned service providers and full retail contestability, it is increasingly unlikely that a regulator would be able to transfer risk from service provider to users This might have been possible in the past with vertically integrated public monopolies.

B.4 Further comments on price regulation and risk

Price regulation can have further impacts on risk in ways other than those described above. Recall that the asset beta depends on the standard deviation of the ROR for pipeline investment relative to that for the market portfolio, and the correlation between these two ROR (equation B.2). The way in which tariffs are structured can also affect these parameters. Greater reliance on access charges (fixed charges) and less reliance on volume charges, for example, are likely to stabilise revenue and make the variance in revenue less sensitive to variations in sales volumes. To the extent that sales volumes are correlated with the performance of the market portfolio, a greater reliance on fixed access charges is likely to reduce both standard deviation of pipeline ROR and its correlation with market ROR. As noted by Kolbe, Tye and Myers:

> The risk a pipeline faces is in part a function of rate design. Where service is 'firm', rates are generally composed of a demand charge and a commodity charge … a demand charge is basically a capacity charge that reserves the right to service during peak periods and is paid regardless of the level of service actually rendered. The commodity charge is based on the quantity of gas actually delivered to the customer. … Actual throughput will generally vary from planned throughput. The extent of these variances probably will depend partly on nondiversifiable factors (for example, general business conditions, which affect demand for gas end users) and partly on diversifiable factors (for example, the number of really cold days in December). Either way, all else equal, the pipeline is less exposed to risk of throughput variances with a higher proportion of fixed costs in the demand charge (at least to the extent that costs are in fact recovered in the demand charge). (Kolbe, Tye and Myers 1993, p. 254)

Similarly, the choice between revenue caps and price caps (and the paths over time for these caps) can influence both the variability in ROR and the correlation of ROR with market ROR.

C Gas pipelines in Australia

This appendix contains detail information on gas distribution systems and transmission pipelines in Australia, from various sources.

Table C.1 includes information on all covered and uncovered distribution networks in Australia — such as the current owner and approximate throughput of the distribution networks. Table C.2 includes similar information for transmission systems. The lists in tables C.1 and C.2 cover pipelines that were listed in schedule A of the National Third Party Access Code for Natural Gas Pipeline Systems (the Gas Code), pipelines excluded from schedule A of the Gas Code and pipelines built since the introduction of the Gas Code.

At the start of the National Third Party Access Regime for Natural Gas Pipelines (the Gas Access Regime), State and Territory Governments listed in schedule A of the access legislation all those pipelines that they considered should be covered. These pipelines became covered on the day in which the access legislation in that State or Territory came into operation. The Commission is not aware of any distribution networks in 1997 that were not included in schedule A. There are some transmission pipelines that were not included in schedule A, mainly in Western Australia.

Applications for coverage and revocation of coverage for distribution networks and transmission pipelines are listed in tables C.3 and C.4, respectively. The timing of the approvals of access arrangements for distribution networks and transmission pipelines are in tables C.5 and C.6, respectively.

Table C.1 **Distribution networks**

State	*Distribution network: component*	*Current owner*	*Schedule A*[a]	*Approx. throughput*
				TJ/annum
Uncovered distribution networks				
NSW	South West Slopes	Country Energy	No[b]	123
NSW	Temora	Country Energy	No[b]	44
NT	Centre Gas Systems: Alice Springs	Envestra	Yes	100
Qld	Dalby	Dalby Town Council	Yes	160
Qld	Roma	Roma Town Council	Yes	15
Vic	Mildura	Envestra	No[c]	250
Total uncovered distribution networks				**700**
Covered distribution networks				
NSW	AGL NSW Distribution: AGL Central West Wilton–Newcastle Wilton–Wollongong Other pipelines	AGL Gas Networks	Yes	102 600
NSW	Albury Gas Company	Envestra	Yes	2 900
NSW	Wagga Wagga (Great Southern Energy)	Country Energy	Yes	1 600
ACT	Canberra	ACTEW AGL	Yes	6 000
Qld	Allgas Energy	Allgas Energy	Yes	9 600
Qld	Envestra system	Envestra	Yes	4 700
SA	Envestra SA distribution	Envestra	Yes	41 000
Vic	Westar Energy	TXU Networks	Yes	68 400
Vic	Multinet Gas	Multinet Gas Network[d]	Yes	59 000
Vic	Envestra systems	Envestra	Yes	54 000
WA	Alinta Gas distribution	Alinta Gas Networks[e]	Yes	28 000
Total covered distribution networks				**377 800**
Total distribution networks				**378 500**

[a] If the distribution network was initially covered through being included in schedule A of the Gas Code. [b] The South West Slopes and the Temora Distribution Networks were not identified in schedule A. They were constructed as extensions of the AGL distribution network (which is covered) and were therefore covered. AGL sold these networks in 2001. [c] The distribution system became covered through a competitive tender process approved by the relevant regulator under transitional provisions of the Victorian Act (and was subsequently uncovered — table C.3). [d] Owned by Diversified Utility and Energy Trusts (majority owner) and Alinta. [e] Owned by Alinta (majority owner) and Diversified Utility and Energy Trusts.

Sources: Schedule A of the Gas Code; ACCC, sub. 48; NCC website; various access arrangement information; AGA, pers. comm., 20 November 2003.

Table C.2 **Transmission systems**

State	*Transmission system: component*	*Current owner*	*Length*	*Pipe diameter*	*Schedule A*[a]	*Approx. throughput*
			km	mm		TJ/annum
Uncovered transmission systems						
NSW	Moomba–Sydney system[b]					
	Moomba–Marsden pipeline	Australian Pipeline Trust	942	864	Yes	152 000
NSW	Hoskingstown to Canberra	ACTEW AGL	na	na	No	na
NT	Amadeus Basin–Darwin:[c]					
	Palm Valley–Alice Springs	Envestra	140	219	Yes	3 000
	City Gate–Berrimah	NT Gas Distribution	19	150	Yes	8
Qld	Moura Mine–Qld Gas Pipeline	Peabody Moura Investments and Peabody Moura Mining	23	219	Yes	3 700
Qld	Kincora–Wallumbilla	Oil Co of Aust	53	219	Yes	2 700
Qld	Dawson Valley–Qld Gas Pipeline	Oil Co of Aust	47	168	Yes	1 500
SA	South East Pipeline system	Hastings Funds Management	81	60/168	Yes	3 000
SA	Riverland Pipeline	Envestra	231	114	Yes	680
SA/Vic	South East Australia Gas (SEA Gas) Pipeline	Origin Energy, Australian National Power, TXU	680	450/700	No	na
Vic	Berri–Mildura	Envestra	148	114	No[d]	221
Vic/NSW	Longford–Sydney (Eastern Gas Pipeline)	Alinta	795	457	No	na
Vic/Tas	Longford–Bell Bay (Tasmanian Gas Pipeline)	Alinta	576	203/356	No	na
WA	Dongara–Perth/Pinjarra (Parmelia Pipeline)	CMS Gas Transmission Australia	445	114/356	Yes	10 200
WA	Karrathra–Cape Lambert Pipeline	Robe River Iron and Associates	57	250	Yes	4 745
WA	Beharra Springs–Parmelia Pipeline	Boral Energy Developments	2	168	Yes	13 000
WA	WMC Laterals:[e]					
	GGTP–Mt Keith Power Station	Southern Cross Pipelines[f]	8	219	Yes	na
	GGTP–Leinster Power Station	Southern Cross Pipelines[f]	5	219	Yes	na
WA	GGT–Kalgoorlie Power Station	Southern Cross Pipelines[f]	8	219	Yes	na

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Table C.2 (continued)

State	Transmission system: component	Current owner	Length	Pipe diameter	Schedule A[a]	Approx. throughput
WA	Burrup extension pipeline	Epic Energy[g]	24	600	No	31 000[h]
WA	Pilbara extension pipeline	Hastings Funds Management	220	450	No	[h]
WA	Wodgina Lateral	Epic Energy[g]	80	150	No	na
WA	Geraldton to Windimurra (Midwest Pipeline)	Australian Pipeline Trust and Western Power	365	na	No	na
WA	Westlime Lateral (Dampier–Bunbury pipeline–Dongara)	Australian Pipeline Trust	16	na	No	na
WA	GGP–Murrin Murrin	Origin Energy	85	na	No	na
WA	GGP–Wiluna	Newmont	8	na	No	na
WA	GGP–Jundee	Newmont	45	na	No	na
WA	GGP–Plutonic	Barrick Gold	19	na	No	na
WA	GGP–Cawse Nickel	OMG	35	na	No	na
WA	GGP–Leonara	State West Power	17	na	No	na
WA	Kambalda Lateral–Esperance	BRW, Worley and ANZ	340	na	No	na
Total uncovered transmission systems			**5 500**			**194 800**
Covered transmission systems						
NSW	Moomba–Sydney system[b, i]					
	All pipelines except Moomba–Marsden	Australian Pipeline Trust	1 071	864	Yes	152 000
NSW	Marsden–Dubbo (Central West Pipeline)	Australian Pipeline Trust	251	168	Yes	3 700
NT	Amadeus Basin–Darwin:[c]					
	Amadeus Basin–Darwin	NT Gas	1 656	114/356	Yes	15 000
Qld	Ballera–Wallumbilla	Hastings Funds Management	756	406	Yes	28 000
Qld	Ballera–Mount Isa (Carpentaria Gas Pipeline)	Australian Pipeline Trust /SWQ Producers	840	324	Yes	30 000
Qld	Roma (Wallumbilla)–Brisbane	Australian Pipeline Trust	440	273/406	Yes	28 000

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Table C.2 (continued)

State	Transmission system: component	Current owner	Length	Pipe diameter	Schedule A[a]	Approx. throughput
			km	mm		TJ/annum
Qld	Wallumbilla–Rockhampton (Queensland Gas Pipeline):					
	Wallumbilla–Gladstone	Alinta	532	324	Yes	27 000
	Gladstone–Rockhampton	Alinta	97	219	Yes	na
SA	Moomba–Adelaide	Hastings Funds Management	1 102	89/600	Yes	104 000
Vic	Victorian transmission system[i]	GasNet Australia	1 930	168/762	Yes	211 000
WA	Dampier–Bunbury	Epic Energy[g]	1 845	150/660	Yes	221 000
WA	Goldfields Gas Pipeline	Goldfields Gas Transmission (owned by Southern Cross Pipelines[f] and Alinta)	1 427	219/400	Yes	30 300
WA	Tubridgi	Sagasco SE Inc	175	168/273	Yes	8 400
WA	WMC Laterals:[e]					
	Kalgoorlie–Kambalda	Southern Cross Pipelines[f]	44	219	Yes	na
Total covered transmission systems			**12 200**			**831 400**
Total transmission systems			**17 700**			**1 026 200**

[a] If the transmission system was initially covered through being included in schedule A of the Gas Code. [b] The Moomba–Sydney pipeline system is treated as one pipeline system. [c] The Amadeus Basin–Darwin is treated as one pipeline system. [d] The transmission system became covered through a competitive tender process and was subsequently uncovered — table C.4. [e] The WMC laterals are treated as one pipeline system. [f] Southern Cross Pipelines owned by CMS (45 per cent), AGL (45 per cent) and TransAlta (10 per cent). [g] The references in this table to Epic Energy relate to various entities within the Epic Energy group of companies. Different pipelines are beneficially owned by different entities within the group. [h] This throughput measure is the total of the throughput for the Burrup and Pilbara extension pipelines. [i] Includes the Interconnect pipeline between Wagga Wagga and Albury/Wodonga. The section between Wagga Wagga and Culcairn is owned by Australian Pipeline Trust and the section between Culcairn and Barnawartha is owned by GasNet. **na** Not available.

Sources: Schedule A of the Gas Code; ACCC, sub. 48; NCC website; Alinta 2004; Epic Energy 2004b; various access arrangement information.

Table C.3 Distribution networks — applications for revocation of coverage[a]

State	Distribution network	Applicant	Application date	NCC final recom-mendation date	Minister's decision date
Coverage revoked[b]					
NSW	South West Slopes[c]	Country Energy	Jul 2003	Sep 2003	Oct 2003
NSW	Temora[c]	Country Energy	Jul 2003	Sep 2003	Oct 2003
NT	Alice Springs[d]	Envestra	Apr 2000	Jul 2000	Jul 2000
Qld	Dalby[d]	Dalby Town Council	Aug 2000	Oct 2000	Nov 2000
Qld	Roma[d]	Roma Town Council	Feb 2002	Apr 2002	May 2002
Vic	Mildura[e]	Envestra	Sep 2002	Dec 2002	Dec 2002

[a] There have been no applications for coverage of distribution networks. [b] All applications resulted in revocation. [c] Original coverage through being extensions of existing covered networks. [d] Original coverage through being included in schedule A. [e] Original coverage through a competitive tender process approved by the relevant regulator under transitional provisions of the Victorian Act.

Source: NCC website; AGA, pers. comm., 20 November 2003.

Table C.4 Transmission pipelines — applications for coverage and revocation of coverage

State	Transmission system: component	Applicant	Application date	NCC final recom-mendation date	Minister's decision date
Applications for coverage					
Vic/ NSW	Longford–Sydney (Eastern Gas Pipeline)	AGL Sales and Marketing	Jan 2000	Jun 2000	Oct 2000[a]
Applications for revocation					
Coverage maintained					
NSW	Moomba–Sydney system[b, c]	East Australian Pipeline[d]	Jun 2001	Nov 2002	Nov 2003
WA	Tubridgi Pipeline[b]	SAGASCO South East	May 1999	Jul 1999	Aug 1999
WA	WMC Laterals: Kalgoorlie–Kambalda[b, e]	Southern Cross Pipelines	Mar 1999	Jun 1999	Jul 1999
Coverage revoked					
NSW	Moomba–Sydney system[b, c]	East Australian Pipeline[d]	Jun 2001	Nov 2002	Nov 2003

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Table C.4 (continued)

State	Transmission system: component	Applicant	Application date	NCC final recommendation date	Minister's decision date
Coverage revoked (continued)					
NT	Amadeus Basin–Darwin System:				
	Palm Valley–Alice Springs[b]	Envestra	Apr 2000	Jul 2000	Jul 2000
	City Gate–Berrimah[b]	NT Gas Distribution	Jan 2003	Apr 2003	May 2003
Qld	Moura Mine–Qld Gas Pipeline[b]	Peabody Moura Mining	Aug 2000	Oct 2000	Nov 2000
Qld	Kincora–Wallumbilla[b]	Oil Co. of Australia	Aug 2000	Oct 2000	Nov 2000
Qld	Dawson Valley–Qld Gas Pipeline[b]	Oil Co. of Australia	Aug 2000	Oct 2000	Nov 2000
SA	South East Pipeline[b]	Epic Energy[f, g]	Dec 1999	Mar 2000	Apr 2000
SA	Riverland Pipeline System[b]	Envestra	May 2001	Aug 2001	Sep 2001
Vic	Berri–Mildura pipeline[h]	Envestra	May 2001	Aug 2001	Sep 2001
WA	Dongara–Perth/Pinjarra (Parmelia Pipeline)[b]	CMS Gas Transmission Australia	Oct 2001	Feb 2002	Mar 2002
WA	Karrathra–Cape Lambert Pipeline[b]	Robe River Mining Co.	Jun 1999	Sep 1999	Sep 1999
WA	Beharra Springs–Parmelia Pipeline[b]	Boral Energy Resources	May 1999	Jul 1999	Aug 1999
WA	WMC Laterals:				
	GGTP–Mt Keith Power Station[b, e]	Southern Cross Pipelines	Mar 1999	Jun 1999	Jul 1999
	GGTP–Leinster Power Station[b, e]	Southern Cross Pipelines	Mar 1999	Jun 1999	Jul 1999
WA	GGT–Kalgoorlie Power Station[b]	Southern Cross Pipelines	Mar 1999	Jun 1999	Jul 1999
Minister's decision pending					
WA	Goldfields Gas Pipeline[b]	Goldfields Gas Transmission	Mar 2003	Nov 2003[i]	

[a] The NCC recommended coverage (which the Minister agreed to). However, this decision was subsequently overturned by the Australian Competition Tribunal in *Duke Eastern Gas Pipeline Pty Ltd [2001] ACompT 2* in May 2001 (ACT 2001). [b] Original coverage through being included in schedule A. [c] The application related to the Moomba–Sydney pipeline and the Dalton–Canberra Lateral. The NCC recommended coverage be maintained. The Minister decided to revoke coverage for the Moomba–Marsden main trunk but not for other parts of the pipeline system. (East Australia Pipeline previously applied for revocation Moomba–Sydney Pipeline, Young–Culcairn lateral and Dalton–Canberra lateral on 1 April 2000. The NCC recommended it remain covered in September 2000 and the Minister decided not to revoke in October 2000.) [d] Now trading as Australian Pipeline Trust. [e] The WMC laterals are treated as one pipeline system. [f] The reference in this table to Epic Energy relates to an entity within the Epic Energy group of companies. [g] This pipeline is now owned by Hastings Funds Management. [h] Original coverage through a competitive tender process. [i] The NCC recommended coverage be maintained.

Source: National Competition Council website.

Table C.5 **Distribution networks — access arrangements**

State	Distribution network	Initial access arrangements: Applicant	Date	Draft decision	Final decision	Final approval	Length (years)	Review of access arrangements: Applicant	Date	Draft decision	Final decision	Final approval	Length (years)
NSW	AGL NSW Distribution	AGLGN	Sep 1996	May 1997	Jul 1997	Jul 1997[a]	2	AGLGN	Jan 1999	Oct 1999	Jul 2000	Sep 2000[a]	4
								AGLGN	Feb 2004				
NSW	Albury Gas Company	Envestra Albury	Jun 1998	Jul 1999	Dec 1999	Jan 2000[a]	2.5	Envestra Albury	Apr 2002	Jul 2002	Oct 2002	Dec 2002[b]	5
NSW	Wagga Wagga	Great Southern Energy	Mar 1998	Sep 1998	Mar 1999	Sep 1999[a, c]	4	Country Energy[d]	Mar 2004				
ACT	Canberra	ACTEW AGL	Jan 1999	Mar 2000	Nov 2000	Jan 2001[e]	5	ACTEW AGL	Dec 2003				
Qld	Allgas Energy	Allgas Energy	Oct 2000	Mar 2001	Oct 2001	Dec 2001[f]	5						
Qld	Envestra system	Envestra	Oct 2000	Mar 2001	Oct 2001	Dec 2001[f]	5						
SA	Envestra SA	Envestra	Feb 1999	Apr 2000	Dec 2001	Apr 2003[g]	3.5						
Vic	Westar Energy	DTF[h]	Nov 1997	May 1998	Oct 1998	Dec 1998[b]	3.5	TXU Networks	Apr 2002	Jul 2002	Oct 2002	Dec 2002[b]	5
Vic	Multinet Gas	DTF[h]	Nov 1997	May 1998	Oct 1998	Dec 1998[b]	3.5	United Energy	Apr 2002	Jul 2002	Oct 2002	Dec 2002[b]	5
Vic	Envestra systems	DTF[h]	Nov 1997	May 1998	Oct 1998	Dec 1998[b]	3.5	Envestra	Apr 2002	Jul 2002	Oct 2002	Dec 2002[b]	5
WA	Alinta Gas Distribution	Alinta Gas	Jun 1999	Mar 2000	Jun 2000	Jul 2000[i]	5	Alinta Gas	April 2004				

[a] By the Independent Pricing and Access Regulation Tribunal. [b] By the Victorian Essential Services Commission. [c] Access arrangement drafted by the regulator. [d] Country Energy Gas is a wholly owned subsidiary of Country Energy (formed by the merger of Great Southern Energy, NorthPower and Advance Energy). [e] By the Independent Competition and Regulation Commission. [f] By the Queensland Competition Authority. [g] By the South Australian Independent Pricing and Access Regulator. The Essential Services Commission of South Australia now undertakes this role. [h] The Victorian Department of Treasury and Finance (DTF) made the application on behalf of the pipeline owners. [i] By the Office of Gas Access Regulation.

Sources: Essential Services Commission (Victoria), Essential Services Commission of South Australia, Independent Pricing and Access Regulation Tribunal (NSW), Independent Competition and Regulation Commission (ACT), Queensland Competition Authority and Code Registrar websites; OffGAR, sub. 40, p. 23; AGA, pers. comm., 20 November 2003.

Table C.6 **Transmission systems — access arrangements**

		Initial access arrangements						*Review of access arrangements*					
State	*Transmission system: component*	*Applicant*	*Date*	*Draft decision*	*Final decision*	*Final approval*	*Duration (years)*	*Applicant*	*Date*	*Draft decision*	*Final decision*	*Final approval*	*Duration (years)*
NSW	Moomba–Sydney system	Australian Pipeline Trust	May 1999	Dec 2000	Oct 2003	Dec 2003[a]	5.5						
NSW	Marsden–Dubbo (Central West Pipeline)	Australian Pipeline Trust	Dec 1998	Sep 1999	Jun 2000	Sep 2000[a]	9.5						
NT	Amadeus Basin–Darwin	NT Gas	Jun 1999	May 2001	Dec 2002	Mar 2003[a]	10						
Qld	Ballera–Wallumbilla	Epic Energy[b, c]	Aug 2000	Jun 2001	Nov 2001	Jun 2002[a, d]	2/14.5[e]						
Qld	Ballera–Mount Isa (Carpentaria Gas Pipeline)	CGP Joint Venture	Nov 2000	Aug 2001	Jan 2002	Sep 2002[a]	20.5						
Qld	Roma (Wallumbilla)–Brisbane	Australian Pipeline Trust	Nov 2000	Aug 2001	Jan 2002	Sep 2002[a]	4						
Qld	Wallumbilla–Rockhampton (Queensland Gas Pipeline)	Duke Energy International[f]	Aug 2000	Apr 2001	Aug 2001	Nov 2001[a, d]	15						
SA	Moomba–Adelaide	Epic Energy[b, c]	Apr 1999	Aug 2000	Sep 2001	Jul 2002[a, d]	3.5						
Vic	Victorian transmission system	DTF[g]	Nov 1997	May 1998	Oct 1998	Dec 1998[a, d]	4	GasNet	Mar 2002	Aug 2002	Nov 2002	Jan 2003[a]	5
WA	Dampier–Bunbury	Epic Energy[b]	Dec 1999	Jun 2001	May 2003	Dec 2003[d, h]	1						

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Table C.6 (continued)

		Initial access arrangements						Review of access arrangements					
State	*Transmission system: component*	*Applicant*	*Date*	*Draft decision*	*Final decision*	*Final approval*	*Duration (years)*	*Applicant*	*Date*	*Draft decision*	*Final decision*	*Final approval*	*Duration (years)*
WA	Goldfields Gas Pipeline	Goldfields Gas Transmission	Dec 1999	Apr 2001[h]									
WA	Tubridgi Pipeline	SAGASCO SE	Oct 1999	Aug 2000	Oct 2001	Oct 2001[h]	4.5						
WA	WMC Laterals: Kalgoorlie–Kambalda[i]												
WA	Parmelia Pipeline[j]	CMS	May 1999	Oct 1999	Oct 2000	Dec 2000[h]							

[a] By the Australian Competition and Consumer Commission. [b] The references in this table to Epic Energy relate to various entities within the Epic Energy group of companies. Different pipelines are beneficially owned by different entities within the group. [c] This pipeline is now owned by Hastings Funds Management. [d] Access arrangement drafted by the regulator. [e] Epic Energy is required to lodge a revised access arrangement in two years. Revision of some reference tariff aspects of the access arrangement are deferred until 2016. [f] This pipeline is now owned by Alinta. [g] The Victorian Department of Treasury and Finance (DTF) on behalf of VENCorp and GasNet. [h] By Office of Gas Access Regulation (whose responsibilities have now been assumed by the Economic Regulation Authority). [i] Access arrangement deferred subject to any potential user requesting third party access. [j] Parmelia Pipeline coverage was revoked following approval of the access arrangements.

Source: ACCC, OffGAR and Code Registrar websites; OffGAR, sub. 40, p. 23.

D Issues regarding quantification of the net economic benefits of the Gas Access Regime

D.1 Modelling difficulties

General equilibrium (GE) models are designed to capture the economywide effects (impacts on all other sectors of the economy) arising from changes (policy shocks) to specific sectors (such as the natural gas transmission and distribution sectors). Although GE models can be a useful technique to estimate economywide effects of a policy change, they need to be well-specified theoretically and have sufficient detail and sources of data to enable meaningful calibration of key behavioural relationships and parameters relevant to the policy being evaluated.

As noted in chapter 4, the Commission decided not to undertake GE modelling, or any other type of modelling, to estimate the magnitude of the net economic benefits arising from the existing National Third Party Access Regime for Natural Gas Pipelines (the Gas Access Regime), the regime recommended by the Commission, or the difference between the two. The principal reason is inadequate data are available to specify quantitatively what would have happened, or would happen, in the absence of the Gas Access Regime, all else equal. The Commission concluded that if it were to undertake modelling, the estimates of the net economic benefits would be imprecise and subject to questionable reliability. There would be considerable doubt about the conclusions that could reasonably be drawn regarding the magnitude of the net economic benefits of the Gas Access Regime.

In commenting on the absence of quantitative estimates of the benefits of access regulation in the Commission's draft report, the Australian Competition and Consumer Commission (ACCC) noted:

> The draft report did not attempt to estimate the magnitude of the benefits of the current regime, but rather illustrated the benefits and costs with qualitative and anecdotal evidence from the inquiry participants. The ACCC considers that additional insight can be gained by weighting of the costs and benefits of the current regime through reference to a quantitative cost–benefit analysis. (sub. DR101, p. 27)

The ACCC attached a report to their submission (sub. DR101, appendix H), which it had commissioned ACIL Tasman to prepare previously. In that report, ACIL Tasman presented their estimates of the benefits of access regulation under the national Gas Code and the National Electricity Code.

There is considerable uncertainty about the results of ACIL Tasman's modelling. The uncertainty arises largely from the practical difficulties in applying GE and other models to estimate the costs and benefits of the Gas Access Regime in the absence of reliable information.

In the Commission's view, the ACIL Tasman modelling in fact illustrates many of the practical difficulties encountered when attempting to estimate the net economic benefits of the Gas Access Regime. In order to do the modelling, ACIL Tasman had to make many debatable assumptions. Consequently, the estimates of the magnitude of net economic benefits are also debatable. ACIL Tasman acknowledged some of the limitations of its study:

> Defining the alternative set of assumptions for the counterfactual scenario has posed a number of difficult problems. … The development of the counterfactual scenarios has involved the application of theory to particular cases and the exercise of judgments about the restraints that would have been applied to the owners and operators of energy networks. (ACCC, sub. DR101, appendix H, p. 2)

The fact that the Productivity Commission decided not to undertake modelling does not imply that the Commission concluded there are no net economic benefits generated by the existing Gas Access Regime. Rather, the Commission considers that undertaking modelling would bring little clarity to deciding on whether and how the existing regime might be improved, and in doing so, lead to greater net economic benefits than under the existing regime.

D.2 Relevance of ACIL Tasman's modelling

Before discussing some specific issues regarding the practicality of estimating the net economic benefits of the Gas Access Regime (section D.3), there are two general comments regarding the relevance of the ACIL Tasman study to the Commission's review.

First, ACIL Tasman estimated the combined aggregate benefits of the gas and electricity access regimes, rather than estimate separately the benefits attributable to the electricity and gas access regimes:

> Because the results for electricity and gas are closely interrelated in the general equilibrium modelling, we have not attempted to detail the impacts of access regulation accruing to the electricity or gas industries individually. However, ACIL Tasman

would expect around 90 per cent of the aggregate benefits to be attributable to electricity access regulation, due to the relative sizes of the industries. (ACCC, sub. DR101, appendix H, p. xi)

This approach to estimation of the net benefits of the existing Gas Access Regime seems somewhat arbitrary and imprecise, particularly given:

- the inherent differences between the two sectors and the ways in which electricity and gas are used as intermediate inputs by different industries
- important differences in the modelling assumptions ACIL Tasman applied to electricity and gas, as noted by the ACCC:

  The price and volume effects noted in the ACIL Tasman report must be interpreted with care owing to the different methods employed in GasMark and PowerMark. PowerMark is constrained so that no volume reductions are permitted in response to increased prices, while GasMark does permit volume reductions in response to tariff increases. (sub. DR101, p. 31)

Second, ACIL Tasman did not estimate the net economic benefits that would accrue from implementation of the Commission's recommended regime. Therefore, the ACIL Tasman modelling cannot be used to draw conclusions about the relative net economic benefits that would accrue from the Commission's recommended regime compared with those from the existing regime.

D.3 Specific issues in applying GE models to estimate the costs and benefits of the Gas Access Regime

Some specific modelling issues are discussed in this section. The focus of the discussion is issue based rather than about specific details and assumptions embedded in the models. There is insufficient information and model documentation in the ACIL Tasman report to have a detailed discussion about matters, such as the specification of equations that determine economic behaviour and the values of parameters used to calibrate such equations.

Some of the key elements needing careful consideration when assessing the net economic benefits of the Gas Access Regime using GE models are discussed below.

Industry aggregation

The unit costs of producing goods and services by industries using natural gas as an intermediate input are likely to be affected differently by changes in the transport price of natural gas. One reason for this is that the industries have different cost structures. The share of natural gas in the unit cost of production is likely to vary between sectors (as discussed in chapter 2). Similarly, the share of transmission and distribution costs in the unit cost (price) of natural gas is likely to vary between sectors.

Another reason is that industries are likely to exhibit different elasticities of substitution between natural gas and other energy or even nonenergy intermediate inputs (also discussed in chapter 2). Where industries have different cost structures and substitution possibilities, the higher the level of aggregation, the greater the level of aggregation bias and the greater the error in measuring the true impact of a change the price of gas transportation.

The appropriate level of disaggregation is particularly important in considering the impact of the Gas Access Regime. As noted in chapter 2, around 80 per cent of natural gas consumption is used as an intermediate input into production of commodities including metals, electricity, chemicals and fertilisers. When an industry, such as the fertiliser industry, is aggregated into a large heterogeneous sector (for example, chemicals, rubber and plastics sector, as is the case in the standard GTAP[1] general equilibrium model), the gas demand elasticity for chemicals, rubber and plastics is a share-weighted average across all industries within that sector. All else equal, the greater the variability in cost structures and demand elasticities among industries within a GE model sector, the greater the error in estimation of the economywide effects of the policy change (shock).

The economywide effects depend heavily on the responses of selected key industries to the assumed reductions in gas transportation charges directly attributable to the Gas Access Regime. ACIL Tasman has used a GE model with 57 sectors. However, it has not published sectoral results. This makes it difficult to understand the extent (magnitude) to which industries benefit or lose from the economywide effect of lower prices for natural gas transportation. The absence of sectoral results makes it difficult to draw conclusions about the plausibility of the magnitude of the reported benefits.

[1] The ACIL Tasman model (Tasman–Global) is based on GTAP:

> Tasman–Global is a large-scale, applied general equilibrium model that has been designed to undertake projections, scenario and policy analysis of issues in an international context. … The model is an extension of the Global Trade Analysis Project (GTAP) model constructed at the Centre for Global Trade Analysis at Purdue University in the United States … Tasman–Global builds on this model's equation structure and database by adding three important features: detail for the States and Territories of Australia, dynamics and international capital mobility. (ACCC, sub. DR101, appendix H, appendix B, p. 6)

Market power and demand for natural gas by end users

GE models generally assume perfect competition for all sectors of the economy — in equilibrium, prices are equal to the unit cost of production for all sectors. This makes examining issues of market power difficult. To get around this problem, the effect of the regime on the price for transportation of natural gas is not determined endogenously in the GE model.

Instead, ACIL Tasman estimates the effects on price using other sources of information and models. For example, ACIL Tasman assumed that removal of the regime would ultimately lead to a 25 per cent increase in transmission and distribution charges for all gas transported, even for that currently under contract, once the existing contracts expire and new contracts are negotiated. These estimates were based upon case studies of the Moomba–Sydney pipeline and Dampier–Bunbury pipeline using the ACIL Tasman GasMark model to simulate profit levels of pipelines for different levels of the transmission price. In commenting on the Dampier–Bunbury simulations, ACIL Tasman noted:

> … this result is dependent upon the elasticity assumptions used for the loads serviced by the [Dampier–Bunbury pipeline]. (ACCC, sub. DR101, appendix H, p. 21)

However, there is a lack of recent data on the price elasticities of demand for natural gas, as noted by ACIL Tasman:

> Long-run price elasticities of demand for electricity are low: –0.25 for residential users, –0.35 and –0.38 for commercial and industrial users respectively. There is a lack of recent, reliable data on the elasticity of demand for natural gas but the available information suggests similar elasticities apply in the gas sector. (ACCC, sub. DR101, appendix H, p. 17)

The economywide (GE) impact of the price changes attributed to the Gas Access Regime also depend heavily on the price and substitution elasticities for sectors using natural gas as an intermediate input.

GE models generally have an implied price elasticity of demand for natural gas used as an intermediate input by industries. The price elasticity of gas demand is embedded within a nested input demand structure. The price elasticity of demand depends on the elasticity of substitution between gas and other intermediate inputs (including other forms of energy), the share of gas in the unit cost of production, the share of transmission and distribution in the unit cost (price) of gas, and the price elasticity of demand for the commodity being produced. It should be noted that the technical specification for energy substitution varies between GE models.

Price elasticity of demand for gas consumed by households is typically more straightforward. Generally, demand for gas is represented as part of a household consumption bundle. All else being equal, a change in the price of gas to households leads to a substitution between gas and other goods within the household consumption bundle. There are also income effects, whereby a decrease in the price of gas (savings) will increase the purchasing power of consumers, depending upon the share of gas in household expenditure, and the share of transmission and distribution in the unit cost (price) of natural gas.

The recent developments in the gas market mean that natural gas is moving into new markets where it faces greater competitive pressures. This means the price elasticity of demand for gas is likely to have increased over time. Consequently, the earlier estimates of the price elasticity of demand might be more inelastic than the price elasticity of demand today.

Regulatory costs

As noted in chapter 4, regulatory costs might be significant, but are not typically captured by GE models. Potential efficiency costs of regulation could significantly reduce the estimated benefits of an access regime and have not been included in the study. This was acknowledged by ACIL Tasman:

> The potential impact of disincentives to investment should not, however, be lightly dismissed. Any loss or deferral of investment brought about through inappropriate implementation of access regulation could potentially have significant economic impacts and act counter to the basic objective of access regulation, which is to encourage in increased competition within the relevant market area. There is scope in the medium to longer term for the scaling back of regulation of transmission networks if, through the development of new greenfield pipelines, competitive alternatives become more widely available to consumers. To the extent that access regulation creates disincentives for investment, this would delay the development of genuine competitive markets, and extend the period during which imperfect regulatory mechanisms need to be applied in an attempt to mimic competitive market outcomes.
>
> One element which has not been quantified in this analysis is the potential for disincentives relating to greenfield investment. (ACCC, sub. DR101, appendix H, p. 34)

Overall assessment

The estimated efficiency benefits of the Gas Access Regime in the ACIL Tasman work are subject to a great deal of uncertainty, arising from uncertainties about the counterfactual scenario, aggregation error, the price elasticity of demand for gas and the strategic behaviour of agents along the supply chain. As well, the analysis does not capture all of the benefits from greater competition in related markets and does not fully account for all of the regulatory costs, which might be significant.

In the Commission’s view, although the results suggest there is a net economic benefit, the magnitude of the benefit of the Gas Access Regime is uncertain.

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