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Cost benefit analysis of the Victorian Declared Wholesale Gas Market reforms

Final report

Australian Energy Market Commission

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Executive summary

The Australian Energy Market Commission (AEMC) has undertaken a review of Victoria's Declared Wholesale Gas Market (DWGM) that has recommended a number of draft reforms to improve the market's efficiency and flexibility. The AEMC has engaged PricewaterhouseCoopers Australia (PwC) to assess the expected benefits and costs of these reforms, applying an approach consistent with PwC's May 2016 analysis of the AEMC's overall east coast gas market reforms.[1] While that report covered the DWGM reforms, more time and consideration is now being given to the DWGM reforms in accordance with the Victorian Government's objectives[2] because of the greater complexities and stakeholder concerns about the detail and design of the market changes.

Stakeholder submissions on the DWGM reforms have raised concerns about the costs and benefits of the reforms and this document will help address these concerns.

Using information from stakeholder consultations and surveys, the analysis presented in this report found that, for an implementation cost of $100 million and ongoing annual costs of $14 million, the DWGM reforms are estimated to lead to higher productivity growth, household consumption, exports and investment, resulting in GDP that is higher by $0.9 billion in 2040 relative to the case without these reforms. Importantly, the change in GDP over and above the costs is estimated to be positive in each year following the reforms. The change in GDP is estimated to total $4.6 billion in present value terms over the 20 years to 2040.

On this basis, the DWGM reforms represent about 69 per cent of the costs for the entire reform package (when the revised DWGM costs are incorporated into the May 2016 total estimate) and about 53 per cent of its benefits. The costs comprise a large portion of the total package due to the complexity of the market and its changes. The benefits represent a larger share of the total package, not because the pipeline reforms and information provision reforms on their own generate smaller benefits than the DWGM reforms, but because there are synergies from implementing all three together.

It is expected that the outcomes of this analysis will input into future regulatory impact statements (RISs) that may be undertaken in 2017[3], and provide the AEMC with a robust information source from which to frame communications with key stakeholders, including the Victorian Government, other Council of Australian Governments (COAG) Energy Council members and market participants.

Context

The east coast wholesale gas market is in the midst of a major structural change. Historically, the market has been relatively-stable, with a low-cost, domestic orientation. The market is now expected to triple in size as new gas fields in Queensland are further developed and gas is exported to the international markets as liquefied natural gas (LNG) from Gladstone. This has significantly changed gas market dynamics by impacting the pattern of gas flow, increasing price volatility and affecting the operations of incumbent users, bringing to light several market inefficiencies. These factors have led to a renewed focus on market development and improvements in the fundamentals of gas trading arrangements.

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1 See http://www.aemc.gov.au/getattachment/c97c14b5-fd98-472a-a697-4df34f10629d/Cost-Benefit-Analysis-%E2%80%93-PwC.aspx Accessed 22 August 2016.

2 Hon Lily D'Ambrosio, Minister for Energy and Resources, The Victorian Government's response to the draft review of the Victorian Declared Wholesale Gas Market, 15 May 2016.

3 See http://www.coagenergycouncil.gov.au/publications/coag-energy-council-gas-market-reform-package Accessed 3 October 2016.

To guide this development, the COAG Energy Council established a set of principles referred to as the Energy Council's Vision for Australia's future gas market. A key priority of the Energy Council's Vision is the establishment of an efficient and transparent reference price for gas. An efficient reference price requires a liquid market with many parties buying and selling gas, which necessarily implies that:

- trade be focused at a point that best serves the needs of participants
- participants are able to readily move gas between trading locations.

Against this backdrop, in early 2015, the AEMC was requested to conduct a review of the design, function and roles of facilitated gas markets and gas transportation arrangements on the east coast of Australia (20 February 2015), and a review of the Victorian DWGM (4 March 2015). In August 2016, the COAG Energy Council met and agreed to, in principle, support the DWGM recommendations.[4]

The issues identified in the AEMC's reviews, the reforms recommended for the overall east coast gas market (including the DWGM), and the benefits expected to be achieved from the reform are set out in Figure 1. In summary the DWGM reforms are to develop a new "Southern Hub" for trading gas, and are focussed on two key areas:

- Exchange-based trading: transitioning from the DWGM – where trading and balancing occurs on a mandatory, operator led-basis – to a new model where trading would occur on a voluntary, continuous basis but underpinned by a mandatory residual balancing mechanism. A key feature of the Southern Hub would be the introduction of exchange trading, making the trading mechanism consistent with the Northern Hub at Wallumbilla in Queensland.
- Entry-exit capacity allocation: to support this new form of trading, transitioning the market carriage model and associated limited pipeline transportation rights to a system of entry and exit rights for capacity allocation. This would allow network users to book firm transportation capacity rights independently at each entry and exit point to the DTS. Collectively, these enhancements would contribute to gas being able to be traded independently of its location in the system.[5]

4 COAG Energy Council, Gas Market Reform Package Appendix A - Energy Council response to ACCC and AEMC's reports, 19 August 2016, page 2. Access online at http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Gas%20Market%20Reform%20Package%20Appendix%20A%20-%20Energy%20Council%20response%20to%20ACCC%20and%20AEMC%27s%20reports.docx

5 AEMC 2016, Review of the Victorian Declared Wholesale Gas Market, Discussion Paper, 3 March 2016, page 6.

Figure 1: Summary of AEMC's East Coast and DWGM Review

Having noted the complexity in assessing the nature and magnitude of these expected economic impacts[6], the AEMC engaged PwC to undertake an analysis of the indicative economic benefits and the costs of implementing the proposed reforms. That analysis is considered indicative to the extent that:

- specific details of the reforms are yet to be determined, which has resulted in a wide range of stakeholder estimates surrounding the associated costs of the reform
- the potential benefits are relatively unique in that they are driven by reforms that are a mix of models seen abroad, while the scale and nature of the benefits is difficult to assess as they relate to, in effect, the creation of a new market[7]
- the benefits are diffuse, reflecting the nature of gas as a commodity that is widely used for production processes, heating, export and household consumption
- these reforms and other options to solve the problems identified by the AEMC may be subject to further cost benefit analysis as part of the RISs that may be undertaken in 2017 following further consideration of the specific details of the changes by the Gas Market Reform Group (GMRG).[8]

Notwithstanding this, the approach developed has enabled an estimate of the additional benefits that the DWGM reforms will contribute to the Australian economy, assuming the gas pipeline access and information provision reforms (referred to in this report as the non-DWGM reforms) are undertaken.

6 AEMC 2015, East Coast Wholesale Gas Market and Pipeline Frameworks Review, Stage 2 Draft Report, 4 December 2015, page 107-108.

7 However, we note that broadly similar reforms have been observed in other countries and major reforms related to the National Electricity Market provide some precedent.

8 See http://www.coagenergycouncil.gov.au/publications/coag-energy-council-gas-market-reform-package Accessed 3 October 2016.

Approach to the cost benefit analysis

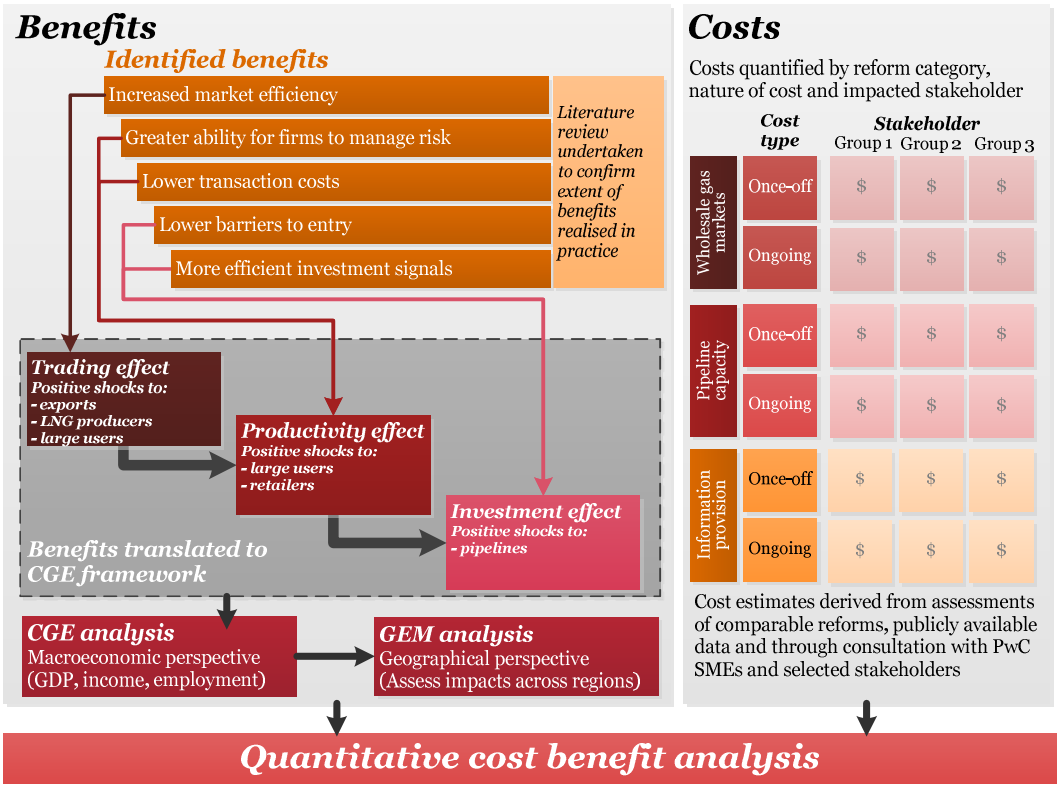
The cost benefit analysis conducted in this study on the DWGM reforms reflects a case where the benefits are widespread across the economy (including to market participants) and the costs are borne by market participants. Accordingly, our approach estimates the net economic benefits once the reforms are implemented, and for reference, provides an estimate of the investment required by stakeholders to implement the reforms. Consequently, a benefit cost ratio is not presented.

Figure 2 summarises the costs and benefits we identified in the previous analysis which in this analysis have been apportioned to either the DWGM or non-DWGM reforms to obtain the contribution of the DWGM reforms to the overall package.

The costs associated with the Southern Hub development were estimated in the initial analysis and were used in this report as a starting point for further stakeholder consultations. A survey was administered to key DWGM stakeholders in August 2016 to test the original (April 2016) cost estimates provided through industry consultations and to gather stakeholder feedback on the proposed DWGM reforms' qualitative benefits.

As was done for the analysis of benefits for the overall package of reforms, a computable general equilibrium (CGE) model was implemented to quantify the impacts of the DWGM reforms. The impacts are of the same nature as those developed in the original analysis but in this analysis they are weighted according to the proportion the DWGM reforms are estimated to contribute to each impact.

Figure 2: PwC's approach to cost benefit analysis



The base case includes assumptions about structural changes in the gas market, including the likely path of projected gas production, LNG exports and domestic use of gas reflected in the Australian Energy Market Operator's forecasts. As such, it takes into account the main constraints and structural changes already underway in the gas market such as moratoria on onshore gas exploration and changes in demand as a result of increased domestic gas prices. In addition, the base case in this analysis assumes that the non-DWGM reforms will be implemented.

The policy case simulates the economy with 'shocks' to the base case to represent the direct impacts of the reforms on gas market participants. These shocks were developed in the original analysis from conservative estimates from empirical literature on similar reforms, which were then confronted with contextual information on the east coast gas market and consideration of the likely timing of such impacts.

Estimated benefits

By 2040, the estimated net impact of the DWGM reforms is that GDP would be between 0.01 per cent and 0.05 per cent higher than the base case (0.03 per cent higher in the central scenario). This equates to GDP being between $0.2 billion to $1.7 billion higher in 2040 (or $0.9 billion in GDP in the central scenario) than it would otherwise have been. The range of the results highlights the sensitivity of the model outcomes to the predicted impacts on the gas market. Successful and timely implementation is required for the estimated benefits to be realised.

Table 1: Impacts of the DWGM reforms on GDP (deviation from baseline)

	2030		2040		PV
	%	$ bn	%	$ bn	$ bn
Low scenario	0.01	0.2	0.01	0.2	1.7
Central scenario	0.02	0.6	0.03	0.9	4.6
High scenario	0.05	1.2	0.05	1.7	12.2

Note: Results show deviation from baseline, including the impact on all states and territories. Values are rounded to two decimal places. Values are $2015-16. Present values are calculated using a real discount rate of 7 per cent.

Source: PwC analysis

Estimated costs

In order to estimate the costs of implementing these reforms we have drawn upon the costs estimated in our May 2016 report on the overall gas reform package and a survey we administered to key stakeholders specifically focused on the DWGM reforms.

In general, stakeholder's survey responses increased the costs of DWGM reform implementation relative to the May 2016 report estimates. By using these most recent stakeholder estimates of costs, we reflect a more accurate measure of costs in our analysis. Some submissions noted the complexity of the reforms and the costs involved in transitioning to a new system of trading while others expect some of the benefits to be realised if there is enough participation in the market.

The Gas Market Reform Group (GMRG) will further consider the design and implementation details of the proposed reforms. As such, there may be different benefits and costs associated with these different options than those presented here. The costs and benefits will be refined under subsequent RISs that may be undertaken in 2017.

The estimated costs of the reform are set out in Table 2. These costs are estimated to total between $58 and $480 million by 2040 (in present value terms).

Table 2: Estimated total costs for DWGM reforms ($m 2015-16)

	High estimate ($m)	Central estimate ($m)	Low estimate ($m)
Once off implementation costs	211	100	44
Ongoing annual costs	42	14	3
Total costs over 10 years (discounted)	295	121	43
Total costs to 2040 (discounted)	480	184	58

Note: Totals are subject to rounding. Discounted costs are calculated using a real discount rate of 7 per cent.

Source: PwC analysis

Implications

The results indicate that for an implementation cost of between $44 and $211 million, and ongoing annual costs between $3 and $42 million, the proposed reforms could lead to higher productivity growth, consumption, exports and investment, resulting in GDP that is between $0.2 billion and $1.7 billion higher in 2040.

Importantly, the change in GDP over and above the costs is estimated to be positive in each year following the reforms. That is, the reforms drive a 'level shift' in GDP that, in the central case, amounts to an estimated $4.6 billion of additional output in present value terms over the 20 years to 2040. In comparison, the overall package of reforms assessed in the previous report estimated the change in GDP to be $8.7 billion in present value terms over the 20 years to 2040.

Abbreviations

Acronym	Description
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
CBA	Cost benefit analysis
CGE	Computerised general equilibrium
COAG	Council of Australian Governments
CoPS	Centre of Policy Studies
CPI	Consumer price index
DTS	Declared transmission system
DWGM	Declared wholesale gas market
FTE	Full time equivalent
GBB	Gas Bulletin Board
GDP	Gross domestic product
GEM	Geospatial economic model
GMRG	Gas market reform group
GRP	Gross regional product
GSA	Gas supply agreement
GSP	Gross state product
GTA	Gas transfer agreement
GVA	Gross value added
LNG	Liquefied natural gas
PPI	Producer price index
PwC	PricewaterhouseCoopers Australia
RIS	Regulatory impact statement
STTM	Short term trading market
WPI	Wage price index

Contents

1 Introduction

Background

The Australian Energy Market Commission (AEMC) was requested by the Council of Australian Governments (COAG) Energy Council to review the design, function and roles of facilitated gas markets and gas transportation arrangements on the east coast of Australia (the East Coast Wholesale Gas Market and Pipeline Frameworks Review or "the East Coast Review"). The Energy Council, at the request of the Victorian Government, also asked the AEMC to undertake a detailed review of the Victorian Declared Wholesale Gas Market ("the DWGM Review").

Subsequent to the setup of the reviews, the key developments were as follows.

- In December 2015, the AEMC released its Stage 2 Draft Reports for the East Coast and DWGM Reviews, outlining a range of issues currently impeding the development of an efficient east coast gas market, as well as a range of reforms to address these issues.

- In May 2016, the Victorian Government requested an extension of the DWGM review to incorporate further stakeholder consultation with a draft final report due by October 2016.[9]

- In July 2016, the AEMC released its Stage 2 Final Report for the East Coast Review. That report outlined high level recommendations for the DWGM review, and noted that further analysis and consultation will be carried out on these recommendations as part of the (extended) DWGM review.

- In August 2016, the COAG Energy Council met and agreed in principle to support the DWGM recommendations with the assistance of a Gas Market Reform Group (GMRG), subject to the outcomes of the DWGM Review.[10]

As part of the AEMC's July report, PwC assessed the impacts of the combined reforms for both the East Coast Review and the DWGM Review (information provision reforms formed part of the package of analysis). The PwC report can be found online[11].

Subsequent to this, the AEMC has requested PwC to assess the impacts of the DWGM reforms on a standalone basis in order to inform its recommendations in the DWGM review. This report focuses on the additional benefits the DWGM reforms will contribute assuming the remainder of the gas reforms are implemented.

Through the reviews, the AEMC identified a range of issues affecting the DWGM. By and large these issues have emerged as a result of unprecedented growth in demand for gas, driven by the LNG export sector, an inefficient market structure and fundamental changes to the way market participants are operating. This has placed upward pressure on prices and significantly increased volatility in the spot market.

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9 Hon Lily D'Ambrosio, Minister for Energy and Resources, The Victorian Government's response to the draft review of the Victorian Declared Wholesale Gas Market, 15 May 2016.

10 COAG Energy Council, Gas Market Reform Package Appendix A - Energy Council response to ACCC and AEMC's reports, 19 August 2016, page 2. Access online at http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Gas%20Market%20Reform%20Package%20Appendix%20A%20-%20Energy%20Council%20response%20to%20ACCC%20and%20AEMC%27s%20reports.docx

11 PwC's Cost benefit analysis of gas market reforms from May 2016 can be found online at http://www.aemc.gov.au/Markets-Reviews-Advice/East-Coast-Wholesale-Gas-Market-and-Pipeline-Frame/Stage-2-Final-Report/AEMC-documents/Cost-Benefit-Analysis-%E2%80%93-PwC.aspx.

Key issues identified by the AEMC include: [12]

- The preconditions necessary for the development of financial risk management products do not exist in the DWGM. Unmanageable wholesale trading risks may be deterring market entry and resulting in consumers paying more than is necessary for gas in Victoria.

- Absent from the DWGM are the mechanisms necessary for market-driven investment in the pipeline system. Investment therefore occurs predominately through the regulatory process where costs are recovered from consumers. This means that the risk of inefficient investment is falling on those who are not best placed to manage it – the consumers.

- These issues are amplified by the growing LNG export industry. The size of LNG demand – three times the size of the domestic market – as well as the variable nature of the coal seam gas wells supplying the LNG production facilities, is expected to result in participants managing their portfolios more actively than in the past through short term trading. The need for markets which can foster liquidity and support the development of risk management products presents risks and opportunities for Victoria.

Project purpose

PwC has been engaged by the AEMC to disaggregate the overall package of reforms to estimate the costs and benefits of the proposed reforms to the DWGM. It is expected that the outcomes of this analysis will form a key input into future regulatory impact statements (RISs), and provide the AEMC with a robust information source from which to frame communications with key stakeholders, including the Victorian Government and market participants.

Proposed reforms

In its Stage 2 Draft Report, the AEMC put forward a suite of recommendations to address the issues affecting the East Coast gas market. The recommendations broadly fall under three categories:

1 Wholesale gas trading markets

2 Pipeline access

3 Information provision

Table 3 summarises the AEMC's recommendations as noted in the Stage 2 draft report. The highlighted elements of this table indicate those which were relevant to the DWGM.

Table 3: Summary of the AEMC's recommendations

Market development area	Recommendation
Wholesale gas trading markets	Two primary trading hubs on the east coast, one in the north and one in the south, with common trading mechanisms applying to each.
	The Northern Hub to be defined as (the existing) physical hub at Wallumbilla (consistent with AEMO's ongoing reform), with the potential for a virtual hub at a later date.
	The Southern Hub to consist of a virtual hub covering the Victorian transmission system, with an entry-exit regime for allocating capacity.
	Simplification of the STTM hubs to a balancing role once liquidity has developed at the Northern and Southern hubs and in pipeline capacity trading.

12 Australian Energy Market Commission, Review of the Victorian Declared Wholesale Gas Market, 4 December 2015, page iii.

Market development area	Recommendation
Pipeline access	Introduction of an auction for contracted but un-nominated capacity with a regulated reserve price on all pipelines.
	Mandatory creation of capacity trading platforms, through which information regarding all capacity trades, including prices, must be published. Capacity product standardisation would facilitate trading through the platform.
	Publication of the actual price of all primary capacity sales, and terms and conditions of those sales, which might impact the price.
Information provision	Broaden the purpose of the (Gas) Bulletin Board in the National Gas Rules to reflect the wider role that information plays in the sector
	Expand the coverage of the (Gas) Bulletin Board and improve and strengthen the reporting framework.
	Make the (Gas) Bulletin Board more responsive to changes in market conditions by removing funding methodology from National Gas Rules and creating a framework to support ongoing improvement.

Source: AEMC 2015, East Coast Wholesale Gas Market and Pipeline Frameworks Review, Stage 2 Draft Report, 4 December 2015, Sydney.

Most of AEMC's recommendations now form the base case of this analysis. The reforms related to the DWGM will form the policy case.

The proposed changes to the DWGM and associated market carriage arrangements in Victoria are focused on two key areas:[13]

- **Trading gas at the Southern Hub:** The Commission recommends that the DWGM, where trading and balancing currently occurs on a mandatory, operator-led basis, transitions to a new Southern Hub model, where trading would occur on a voluntary, continuous basis, with the hub operator playing only a residual role in balancing. A key feature of the Southern Hub would be the introduction of exchange trading, similar to that in place at Wallumbilla currently.

- **Access to transportation capacity at the Southern Hub:** The Commission recommends that the market carriage model and associated limited pipeline transportation rights mechanisms be transitioned to an entry-exit system for capacity allocation. The current implicit allocation of transportation capacity should be replaced with a new system that allows network users to book firm transportation capacity rights at each entry and exit point to the Declared Transmission System (DTS). Users would be able to book entry and exit capacity at these points separately.

13 AEMC 2015, Review of the Victorian Declared Wholesale Gas Market, Draft Report, 4 December 2015, page i-ii.

2 Approach

Part of the challenge of this analysis has been in developing an approach that can capture not just the costs, which are more identifiable for direct wholesale gas market participants, but also the benefits, which are largely spread across the economy. This chapter describes the approach we have developed to undertake the analysis.

The merits of the proposed reforms are assessed through a cost benefit analysis (CBA) framework that builds on work undertaken by the AEMC through its review. CBA is a form of economic evaluation that seeks to quantify in monetary values the benefits derived, and costs incurred, by those parties affected by a particular policy change or investment to determine its net impact to society.

Under the CBA framework, the benefits and costs are calculated by applying a policy change, or shock, to a base or reference case and calculating, in dollar terms, incremental costs and benefits of the change. A comparison of costs with benefits is used to determine if an activity is worthwhile (also called the net present value). If the net present value is positive, benefits exceed the costs and the proposed reforms are worth undertaking.

This study adopts the general equilibrium approach to analysing the reforms' benefits, using a carefully calibrated CGE model of the Australian economy. The key benefit of CGE modelling is that it has the ability to capture flow-on impacts of changes in the gas market to other participants in the economy in an integrated framework. This is particularly relevant to the extent that the reforms improve price signals and allocative efficiency in the gas market. In sectors such as gas production and supply, which have pervasive linkages with the rest of the economy, it is not only the response of gas market participants that is relevant, but the subsequent responses of other sectors that will also be a key factor.

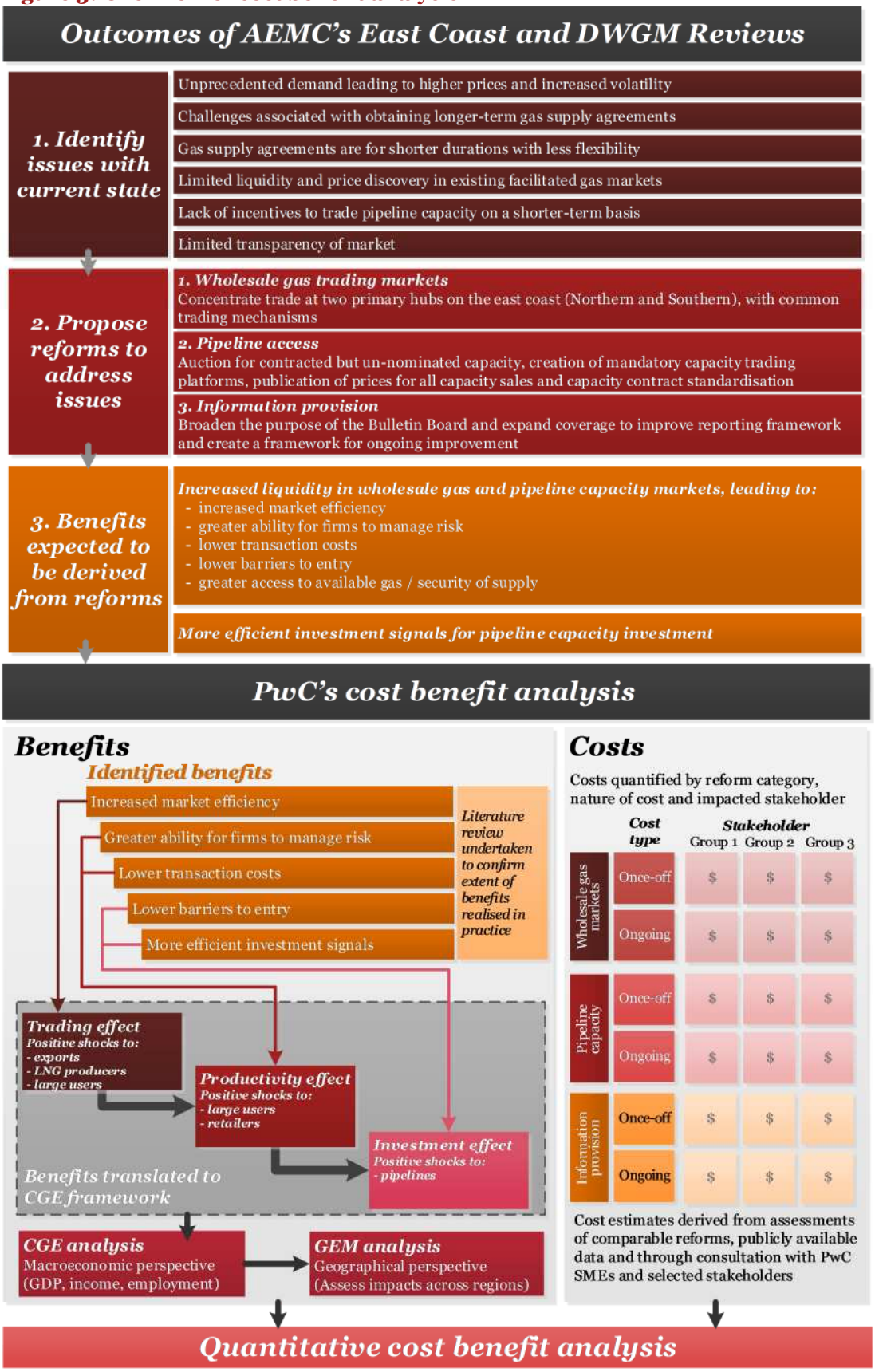
The costs of the reforms are informed by detailed bottom-up calculations and stakeholder engagement to capture the incremental change in costs to gas market participants.

Accordingly, our approach estimates the net economic benefits once the reforms are implemented, and for reference, provides an estimate of the investment required by stakeholders to implement the reforms. Consequently, a benefit cost ratio or net present value is not presented.

This analysis follows a similar methodology used in the previous PwC report[14] with adjustments for DWGM-specific costs and benefits. For that reason, the conceptual framework underpinning the CBA methodology illustrated in Figure 3, while consistent with the previous analysis of the overall package, has different weightings attributed to the scale of benefits due to the fact that we are only analysing part of the overall package of reforms. The base case in this analysis assumes that the non-DWGM reforms will be implemented.

14 PwC's Cost benefit analysis of gas market reforms from, May 2016 can be found online at http://www.aemc.gov.au/Markets-Reviews-Advice/East-Coast-Wholesale-Gas-Market-and-Pipeline-Frame/Stage-2-Final-Report/AEMC-documents/Cost-Benefit-Analysis-%E2%80%93-PwC.aspx.

Figure 3: Overview of cost benefit analysis



2.1 Framework for modelling expected benefits

To recap, the benefits proposed by AEMC's overall gas market reforms included:[15]

- increased market efficiency from greater price transparency and more efficient price discovery
- greater ability for firms to manage risk
- lower transaction costs
- lower barriers to entry
- more efficient investment signals.

The May 2016 analysis estimated the impact of the overall gas market reforms by considering their three elements (the pipeline capacity, Southern Hub development and information provisions) as a whole package. The proposed benefits of the reforms were modelled through three phases: a trading effect, a productivity effect and an investment effect[16] (Figure 4). This reflects that the efficiency benefits, which are driven by greater trading opportunities, could occur relatively quickly, but that it takes time for producers to adapt to the changes before production patterns and investment plans can be fully reflective of improved market operations.

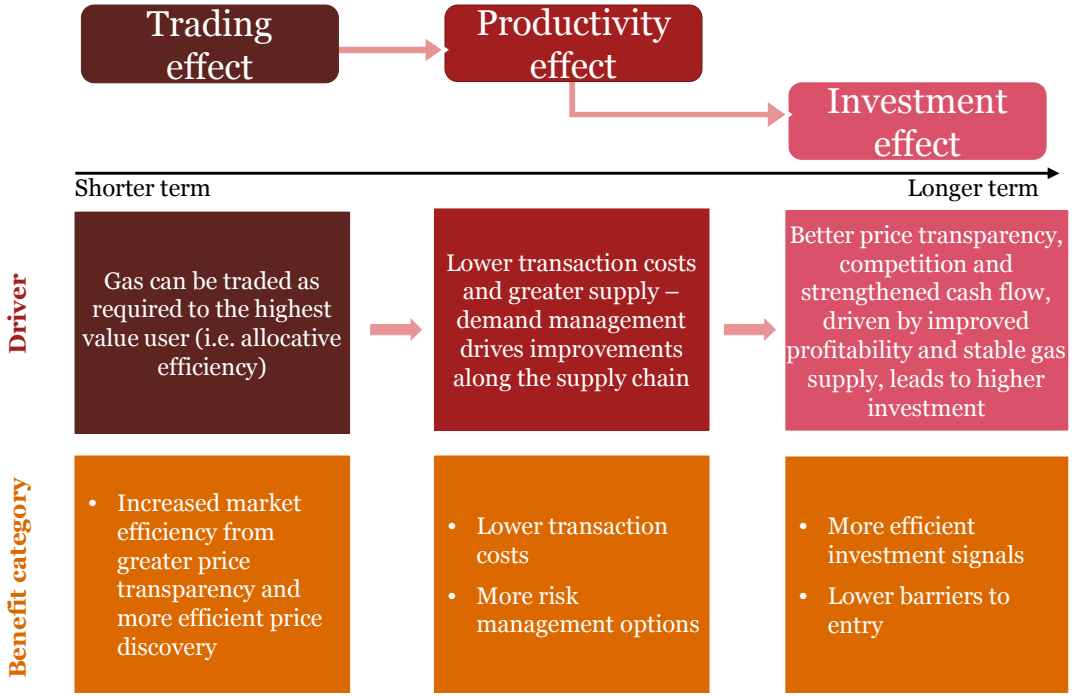
Many elements of the reform will individually lead to similar observable effects on economic activity. For example, increased profitability and greater investment are likely to be encouraged by an economically efficient allocation of gas, reduction of transaction costs and increasing use of risk management options. To account for this, we have produced direct impacts that cover off on all of the likely impacts that are material while avoiding impacts that double-count one another.

Given the DWGM reforms form part of the overall package of reforms that are believed to lead to the above benefits, the DWGM reforms are on their own expected to contribute to many of these same benefits. Through discussion with the AEMC we were able to agree on the estimated share of impacts that would be attributable to the DWGM reforms relative to the non-DWGM reforms. Section 3.1.2 describes how we have apportioned these benefits to the DWGM.

15 Australian Energy Market Commission, Review of the Victorian Declared Wholesale Gas Market, page 3, 4 December 2015.

16 Note that while these are modelled as three separate phases, they are all linked to the package of reforms rather than any one specific recommendation. For this reason they indicate the overall magnitude of benefits of the reforms but not the relative magnitude of benefits of different elements of the reforms.

Figure 4: Proposed economic lenses for the impact of gas market reforms



Source: PwC analysis

2.2 Framework for modelling expected costs

Costs are categorised as:

- once off costs to capture the effort required in planning and implementation
- ongoing costs to capture the change in continuing effort.

The quantification of these costs focuses on the marginal change from the reforms – ie the additional level of effort required on an ongoing basis relative to the base case.

As indicated in Table 4, the level of analysis is high level and focuses on the broad categories of reforms rather than the specific details of each recommendation. This was necessary due to the time available and the level of detail of the reforms.

Table 4: Framework of costs considered in analysis

Reform	Costs	Market operator	Pipeline operator	Large and small participants
Southern Hub Reforms	**Planning**			
	Industry council and working groups	✔	✔	✔
	Implementation			
	Methodologies, system development, project management	✔	✔	✔
	Cost of expert guidance		✔	
	Ongoing costs			
	Additional operational staff required	✔		✔
	Additional IT, risk management and finance activities			✔

3 Net benefits

By considering the potential long term impacts of the DWGM reforms on market participants using a methodology informed by an extensive literature review of similar market reforms in other sectors, we are able to estimate the net economic benefits of these reforms. This chapter describes our approach and the resulting estimates of our analysis. Supplementary technical details can be found in Chapter 3 and Appendix C of the May 2016 report on the overall package of gas market reforms.[17]

3.1 Framework

The economy-wide benefits of the reforms are estimated through an economic impact analysis conducted using a CGE model. CGE models provide a robust, coherent framework for assessing the general equilibrium effects of shocks to the gas market, by accounting for the flow on effects to other industries, households and prices over time.

We have used the Victoria University Regional Model (VURM), which is a multi-regional, dynamic CGE model[18] that distinguishes up to eight Australian regions (six States and two Territories) and up to 144 commodities/industries.

The model includes producers, investors, households, foreign consumers, and governments and accounts for regional and international trade flows. As each region is modelled as a mini-economy, VURM is ideally suited to determining the impact of region-specific economic shocks. Second round effects are captured via the model's industry (input-output) linkages and account for economy-wide and international constraints. This framework is described in further detail in Appendix A.

The economic impacts of the reforms are quantified by comparing a base case – that is, projections under the status quo – with a policy case that includes the reforms. The policy case simulates the economy with 'shocks' to the base case to represent the direct impacts of the reforms. The study does not aim to measure if the reforms are optimally designed or timed, but rather the benefits of the reforms relative to a continuation of the status quo.

The shocks were developed in the initial analysis, drawing on an extensive literature review found in Appendix B of the May 2016 report on the overall gas market reforms.[19] The economic impact of the reforms is measured using outputs from the model under the policy case as a deviation from the base case.

Outputs from the model include but are not limited to projections of output and employment by sector and region, income and trade flows. While GDP, a measure of aggregate output is the primary measure of economic impact, this does not consider economic returns to foreign owned capital (resulting in additional income accruing to foreign entities). For this reason, household consumption is also reported as an alternative welfare measure, to the extent that it represents improved consumption opportunities (which generate utility) resulting from additional income growth to domestic households.

A stylised example of general equilibrium modelling is discussed below in Box 1. The formulation of the base and project case is described below.

17 See http://www.aemc.gov.au/Markets-Reviews-Advice/East-Coast-Wholesale-Gas-Market-and-Pipeline-Frame/Stage-2-Final-Report/AEMC-documents/Cost-Benefit-Analysis-%E2%80%93-PwC.aspx, accessed 22 August 2016.

18 VURM is the latest incarnation of the Centre of Policy Studies' MMRF model. The name change was triggered by CoPS move from Monash University to Victoria University in 2014.

19 See http://www.aemc.gov.au/Markets-Reviews-Advice/East-Coast-Wholesale-Gas-Market-and-Pipeline-Frame/Stage-2-Final-Report/AEMC-documents/Cost-Benefit-Analysis-%E2%80%93-PwC.aspx, accessed 22 August 2016.

Box 1: How to interpret results from general equilibrium modelling

A CGE model is a stylised representation of the Australian economy. It assumes the starting point is the economy is in equilibrium and therefore does not include business or commodity price cycles or monopolistic characteristics of certain sectors. The interpretation and relevance of CGE results can be seen in the context of an example; in this case the construction of a new hospital in Victoria.

A CGE model would describe the number of jobs created by the hospital, the degree to which it inflated the local wage and bid workers away from other industries, and the likely impact on gross state product. However, it would not reflect disequilibrium properties in the short run (eg the time required to train new labour to work in the hospital, financing issues associated with acquiring capital (such as X-ray machines)). Further the results would be 'all other things equal': they would not reflect an unforeseen decline in labour supply that emerged five years down the line (unless the modeller inserted this change). In this way, CGE models present an over-arching 'big picture' impact of a change, once it has resolved itself in the economy.

3.1.1 Base case

The base case represents the economic future under the status quo. The base case includes structural changes in the nature of the gas market that are expected to occur, as in the previous analysis. In addition the non-DWGM elements of the gas reforms form the base case. The economic impacts can then be measured as incremental benefits from the policy changes. The base case in VURM required a number of adjustments to ensure it accurately reflected the future path of economy, including:

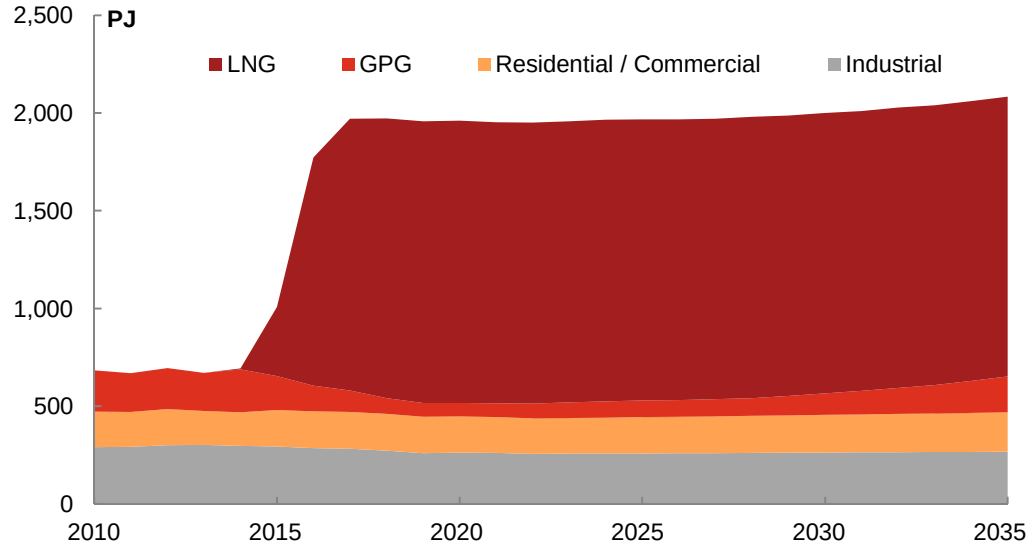
- an internally consistent set of macroeconomic forecasts for the states and territories, based on mid-year state and federal budget outlooks[20]
- structural changes in gas use as embodied in AEMO's central demand forecasts,[21] which included a significant ramp-up in Queensland LNG exports and shifts in consumption for the power generating and industrial using sector (Figure 5)
- a large expansion in gas supply originating out of the Surat and Bowen basins, consistent with AEMO's 2016 Gas Statement of Opportunities (GSOO)[22].

20 At the time the original base case was developed (March 2016), the 2016-17 Federal Budget had not been released. However, it is unlikely that incorporating these forecasts into either the previous or current base case would make a material impact on the incremental impact of the reforms derived from the project case.

21 Australian Energy Market Operator, 2015 National Gas Forecasting Report for Eastern and South-Eastern Australia, December 2015.

22 Australian Energy Market Operator, Gas statement of opportunities for Eastern and South-Eastern Australia, March 2016.

Figure 5: Projected east-coast gas consumption by use



Source: AEMO, 2015

3.1.2 Policy case

The policy case includes shocks to the base case, which alter the projected path of the economy. The resulting deviations of this path from the base case represent the economic impact of the policies. The effects are of the same nature as in the previous, May 2016, analysis but their scale is adjusted to reflect DWGM reform specific impacts. The reforms (shocks) are assumed to begin in 2021 (one year later than in the previous analysis to allow for an increased length of time to prepare for the changes); however, their associated effects are expected to occur gradually over three stages (and then result in second round-effects).

- **trading effects** are assumed to be realised immediately from 2021 over one year
- **productivity effects** are assumed to begin from 2021, but are phased in over three years, reflecting the gradual incorporation of improved risk management practices and optimisation of productive processes
- **investment effects** are assumed to occur from 2026 over one year, as the expected equilibrium rate of return is expected to increase with a lag, allowing sufficient time for clearer investment signals to be established.

The formulation of these shocks requires an assessment of how the reforms will affect the price and/or quantity of gas traded – that is, the partial equilibrium impact on the gas market. The issues, policy solutions and evidence relating to these three effects are explained in detail in section 3.2.1 of our previous report.[23] Below is a summary of the impacts modelled for the three effects. We also describe below how we derived the assumed share of these three effects that we expect could be attributable to the DWGM reforms relative to the overall package of reforms.

Trading effect

Three categories of shocks were developed in the May 2016 analysis of the overall gas market reforms to reflect the trading effect:

23 See http://www.aemc.gov.au/Markets-Reviews-Advice/East-Coast-Wholesale-Gas-Market-and-Pipeline-Frame/Stage-2-Final-Report/AEMC-documents/Cost-Benefit-Analysis-%E2%80%93-PwC.aspx, accessed 22 August 2016.

- **Capital productivity shock to industrial users:** a productivity improvement shock to the industrial use sector[24] of 5 per cent from being able to source additional gas. This is modelled as a capital productivity improvement; ie existing capital is better utilised given an increase in intermediate production inputs. This assumes that some, but not all, of these constraints are alleviated through the improved gas trading platforms. The shock was assessed as small enough to allow for the fact that not all capital will be lying in production assets and was scaled downwards according to different degrees of gas intensity relative to the most gas intensive industrial user.[25]

- **Total factor productivity shock to LNG producers:** a shock to improved total factor productivity of LNG producers of 0.2 per cent from being able to sell excess gas during periods in which an LNG plant is shut for maintenance or a vessel is late. The magnitude of the shock reflects the frequency of LNG plant disruptions (due to planned or unplanned outages); the magnitude of the excess supply observed during historical disruptions; and an assumed reduction in deadweight loss from this 'average' level of excess supply.

- **LNG exports:** a positive shock to LNG exports of 1 per cent, as a result of surplus gas traded from the domestic sector to the export sector. This is small because the gas consumed by the east coast export market is approximately three times the size of gas consumed domestically and this will only be a marginal impact whereby exporters are able to top up their production volumes. This equates to an estimated four additional LNG ships worth of gas per annum compared to the 360 ships expected to depart each year from Gladstone.[26]

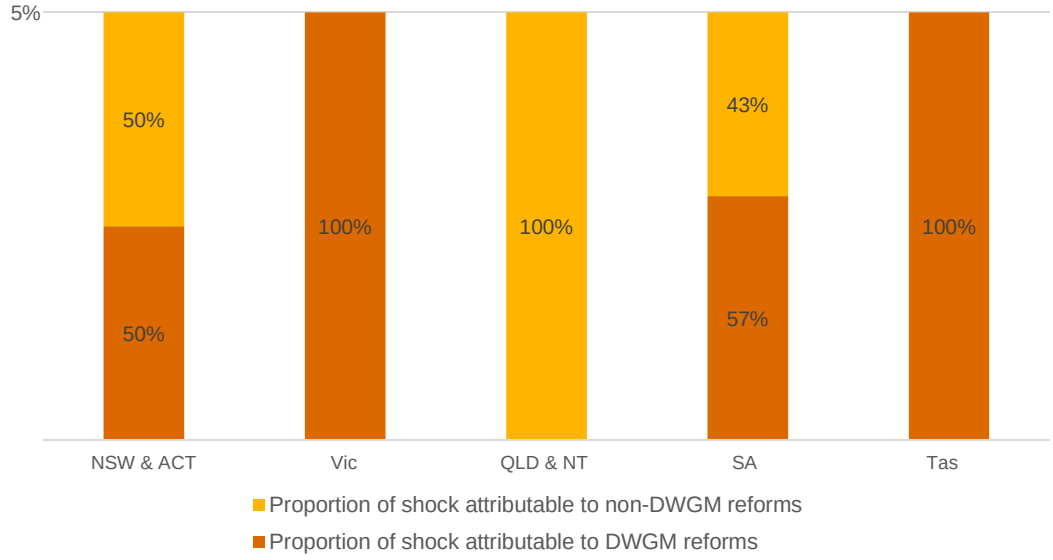
The benefits of the DWGM reforms are assumed to be a proportion of the benefits of the overall east coast gas market reform package. The proportions assumed to be attributable to the DWGM and non-DWGM components of the overall package were developed in collaboration with the AEMC and are shown in Figure 6 - Figure 8. The proportions are summarised in Table 5 and explained below.

24 We have categorised industrial users as including the cement, alumina, non-metal construction products, paper products, steel, chemicals, other metals, and rubber and plastics sectors. These sectors were chosen as being relevant large users by looking at the sectors which are most gas reliant on a cost basis in the VURM CGE model. We excluded the gas sector itself and gas electricity production (as it is generally reducing its gas use over the foreseeable future in AEMO forecasts and hence does not appear to have issues accessing gas). We also considered including other sectors like the food manufacturing sector as some food manufacturers are large users. Given the broad nature of the sector (with some food manufacturers more inclined to use gas than others) with many small firms (which are less likely to be participants in the wholesale gas market) we decided the shock at the industry-wide level would be relatively immaterial.

25 In the subset of industrial users, this was the cement manufacturing sector.

26 http://www.abc.net.au/news/2015-01-06/first-lng-from-csg-ship-leaves-queensland/6002446 Accessed 15 April 2016.

Figure 6: Capital productivity shock to industrial users of 5%



Note: Western Australia is not included here as it does not form part of the East Coast market.
Source: PwC; AEMC.

NSW and ACT

NSW and the ACT source gas from Victoria, Queensland and South Australia. Industrial gas users are expected to benefit from the DWGM and non-DWGM reforms equally. Gas Bulletin Board data shows NSW and ACT, over August 2015 to July 2016, sourced 77 per cent of its gas from Victoria.[27] This is higher than historical levels. In 2011 it was 43 per cent[28] and this is likely driven by changes in the market where, since December 2015, gas has been flowing away from Sydney on the Moomba to Sydney Pipeline instead of towards it as it had done historically.[29] Given the base case reforms to pipeline capacity may enable NSW users to secure more gas from South Australia or Queensland, we have not applied the 77 per cent but a lower figure of 50 per cent.

Victoria

Capital productivity improvements for large industrial gas users in Victoria are expected to be realised predominately as a result of the reforms to the DWGM because this is where they will typically source their gas. It was discussed with the AEMC that that industrial gas users in Victoria will possibly see productivity improvements through non-DWGM reforms, but that given Victoria is typically a net exporter of gas it is likely to mostly benefit from the DWGM reforms. Hence we assume 100 per cent of the capital productivity impact is attributable to the DWGM reforms.

Tasmania

Tasmania currently sources all of its gas supply from Victoria through Gas Supply Agreements (GSAs) from the Gippsland basin. While this gas comes straight from the Gippsland Basin and does not directly use the DWGM, the reforms to the DWGM will provide a more liquid market reference price, which should benefit Tasmanian industry as industrial gas users should also benefit from improved price discovery and additional access to gas. As discussed with the AEMC, all of the benefits that accrue to Tasmania as a result of improved price discovery and additional access to gas would be due to the DWGM reforms. Therefore we assume 100 per cent of the capital productivity impact seen in Tasmania due to the reform package as a whole is attributable to the DWGM reforms.

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27 AEMO, Analysis provided of gas bulletin board data August 2015 to July 2016, August 2016.

28 Grattan Institute, Getting gas right Australia's energy challenge, Figure 14, June 2013.

29 The Australian, Gladstone demand draws gas from NSW, 9 February 2016.

Queensland and the Northern Territory

Large industrial gas users in Queensland and the Northern Territory are expected to benefit predominantly from the non-DWGM reforms. There is potential for benefits to be gained from the DWGM reforms as a second trading hub develops as increased liquidity could facilitate more trades between Queensland/the Northern Territory and Victoria but the size of these benefits are likely to be small. For simplicity we assume all of the capital productivity impact for Queensland and the Northern Territory are derived from the non-DWGM reforms.

South Australia

The proportion of benefits attributed to the DWGM reforms are based on data from AEMO[30] which measures the quantity of gas supplied from Victoria to South Australia. This shows South Australia sources just over half (57 per cent) of its gas from Victoria and so industrial users are expected to benefit from the DWGM reforms in this proportion.

Shocks to LNG producers and exports[31]

Given the location of the LNG production facilities and the quantity of gas traded on the DWGM, we assume the majority of the productivity gains to LNG producers to be derived from the non-DWGM pipeline capacity reforms. We anticipate the DWGM reforms to account for 11 per cent of these gains. This represents Victoria's contribution to east coast gas consumption.[32] As the amount of gas traded into and out of the Southern Hub increases and transaction costs decline, LNG producers/exporters should find it easier to trade in the Southern Hub. We discussed and agreed with the AEMC that 11 per cent is a reasonable proxy for the share attributable to DWGM reforms of the benefits of increased exports from the overall package of reforms. This may underestimate the benefits of DWGM reforms to Queensland LNG producers if greater market interaction between the hubs increases the volume of gas traded.

Productivity effect

Two categories of shocks were developed in the May 2016 analysis of the overall gas market reforms to reflect the productivity effect. These were:

- **Factor productivity shock to industrial users:** a productivity gain of 4.9 per cent was applied to the industrial users, derived from improved risk management options and a lower cost structure.[33] The magnitude of this shock represented the lowest bound of the data from the literature. Industry data was scaled according to gas intensity, in line with data from the VURM CGE model.

- **Factor productivity shock to retail users:** an equivalent shock was applied to the gas retailer sector of 4.9 per cent. This excluded retailers that are vertically integrated with gas production, since they are assumed to have a natural hedge advantage and so will gain less from the improved risk management options.[34]

30 AEMO, Analysis provided of gas bulletin board data August 2015 to July 2016, August 2016.

31 Factor productivity improvements to LNG producers and exporters are relevant for Queensland only as it is the only state with LNG production plants.

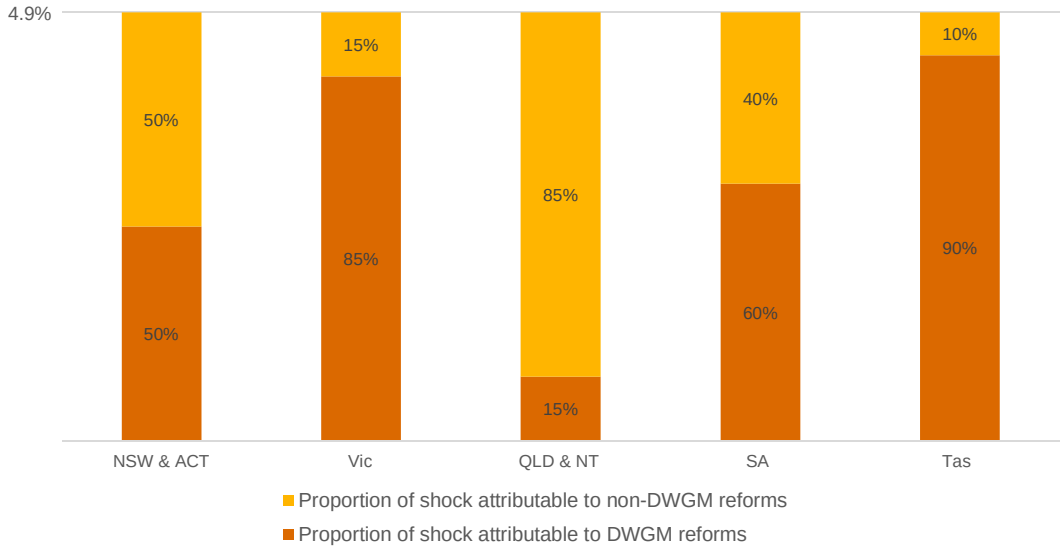
32 11 per cent of all gas consumed in the east coast is consumed in Victoria. Source: AEMO analysis of: AEMO, National Gas Forecasting Report, December 2015; Data provided by AEMO, August 2016.

33 This considers that increasing firm value-add can drive higher firm value at an industry wide level.

34 We note that some small retailers have raised issues with the Southern Hub recommendations (source: http://www.aemc.gov.au/Markets-Reviews-Advice/Review-of-the-Victorian-Declared-Wholesale-Gas-Mar Accessed 15 April 2016) and that the main impact will be to increase costs. In our central estimate we have assumed that these concerns are not reflective of the impact on the broader retail market as the parties raising these issues have a small market share. However, this is acknowledged and tested as a sensitivity (the sensitivity analysis is described further in Chapter 5). These views are provided by ERM Power and Covau – see http://www.aemc.gov.au/Markets-Reviews-Advice/Review-of-the-Victorian-Declared-Wholesale-Gas-Mar Accessed 15 April 2016. These retailers do not materially feature in the small residential customer market (Australian Energy Regulator, State of the Energy Market 2015, March 2016, p 125-126), which comprises the majority of customer numbers,

The proportions of these shocks that are assumed to be attributable to the DWGM and non-DWGM components of the overall gas market reform package are shown in Figure 7 and described below.

Figure 7: Factor productivity shock to industrial users & gas retailers of 4.9%



Note: Western Australia is not included here as it does not form part of the East Coast market.

Source: PwC; AEMC.

NSW and ACT

Industrial gas users and retailers in NSW and the ACT are expected to benefit as much from the DWGM reforms as they are expected to benefit from the East Coast gas reforms because they access gas from both the southern and northern states (as noted above). With their location and potential to benefit from the development of liquid markets in both the Northern and Southern Hubs, it was discussed with the AEMC that 50 per cent was a reasonable attribution of the benefits to the DWGM reforms.

Victoria

We assume a high proportion (85 per cent) of Victoria's productivity improvements from increased risk management options to be attributable to the DWGM reforms as Victorian gas users typically source their gas locally. For two reasons, we assume the non-DWGM reforms will provide some benefits to Victorian wholesale gas market participants:

- We expect the pipeline capacity reforms to develop liquidity in the Northern Hub, thereby providing an improved platform for derivative products to be traded. This may provide improve risk management options to users in the Southern Hub.

- The pipeline capacity reforms may also lead to ease of trade between the Northern and Southern Hubs (38 per cent of stakeholders surveyed supported this statement - Figure 10) and this may lead to price convergence in the north and south with some efficiency gains for industrial users and retailers in the south.

Queensland and the Northern Territory

Gas users in Queensland and the Northern Territory are assumed to benefit from the DWGM reforms through the equalisation in gas prices with the Southern Hub. This may increase liquidity and reduce fluctuation in prices at the Northern Hub. There is already evidence that

and a large component of the retail market by revenue (IBIS World, Gas supply in Australia, IBISWorld Industry Report D2700, October 2015, page 14).

such price arbitraging is occurring: the price difference between the northern and the southern markets in July and August 2016 has seen gas flow southward.[35] The non-DWGM reforms are likely to make this easier but the productivity gains will be greater once both hubs are reformed. So we assume Queensland and the Northern Territory are likely to gain mainly in the base case reforms and that 15 per cent of the overall productivity effect benefits are attributable to the DWGM reforms.

South Australia

South Australian gas users and retailers are assumed to benefit relatively more than NSW given that, historically, South Australia has depended more on Victoria for gas than NSW has.[36] For this reason it was discussed with the AEMC that 60 per cent was a reasonable attribution to the DWGM reforms. The remainder of the benefits (40 per cent) are expected to be derived in the base case through the development of derivatives from the non-DWGM reforms.

Tasmania

Similar to Victoria, Tasmania is likely to acquire most of its benefit from the DWGM reforms and is expected to benefit less from the non-DWGM reforms given its geographic location (ie transport costs are higher to bring gas from the North). Hence it was agreed with the AEMC that 90 per cent of the productivity effect benefits for Tasmania could be attributed to the DWGM reforms.

Investment effect

A literature review provides evidence to show that futures markets lead to more efficient price discovery and increased investment levels[37]. We consider it likely that more transparent information on the supply and demand fundamentals across the east coast market would improve the level of information available for pipeline investment decisions and lead to increased efficiency for future investments.

To model this improvement to investment we reduced the expected equilibrium rate of return required on investment for pipelines by 1 per cent.[38] The lower the required rate of return on investment the greater the amount of investment in the industry.[39]

To allocate the share of this benefit that might be attributable to the DWGM and non-DWGM reforms, we discussed and agreed the following assumed proportions with the AEMC.

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35 Some LNG producers are shipping Queensland gas to South Australia to take advantage of the lower prices in the Wallumbilla Gas Supply Hub compared to the South Australian STTM and the Victorian DWGM. Australian Financial Review, Shell Australia juggles gas sales amid pricing swings, 30 August 2016. Online at http://www.afr.com/business/energy/gas/shell-australia-juggles-gas-sales-amid-pricing-swings-20160829-gr45uk#ixzz4Lb52AGgm.

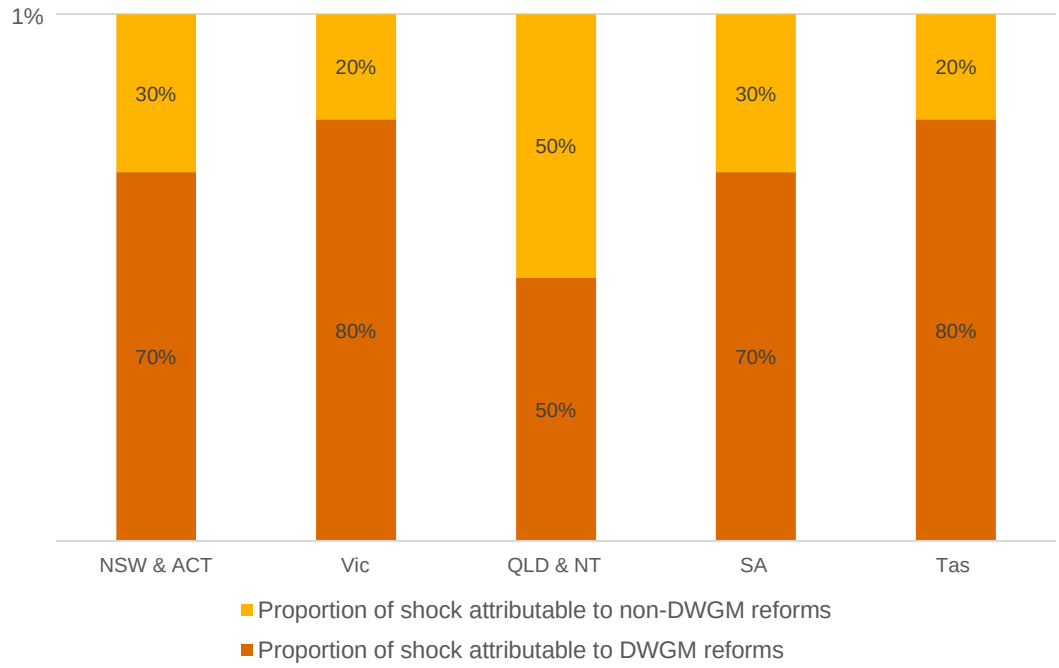
36 For example, in 2011, 57 per cent of South Australia's gas and 44 per cent of NSW's gas was from Victoria. Grattan Institute, Getting gas right Australia's energy challenge, Figure 14, June 2013.

37 Perez-Gonzalez, F and Yun, H (2013) 'Risk Management and Firm Value: Evidence from Weather Derivatives', The Journal of Finance, 68(5) pp 2143-2176.

38 Ideally, changes to the rate of return for pipelines determined by the Australian Energy Regulator to be appropriate and used to set pipeline prices would be modelled but the CGE model is only a stylised framework of the economy. It is important to note that this does not necessarily equate to a change in the regulated rates of return for parts of the gas network that are regulated by the Australian Energy Regulator. Nor does it follow that any benefits necessarily accrue to pipeline owners; the CGE model provides a stylised framework of the economy and while it has a sector for the transmission of gas, it does not include specific behaviours surrounding regulatory oversight. Neither does the CGE model assume that these benefits necessarily accrue to pipeline owners.

39 Lowering the expected equilibrium rate of return required increases the amount of investment in the industry as investment does not need to be expected to be quite so profitable in order to be undertaken. Another variable in the CGE model that could have been shocked is capital productivity however that would affect existing capital and this impact is intentionally on new capital as it will be affecting investment decisions.

Figure 8: Equilibrium rate of return shock to pipeline investment of 1%



Note: Western Australia is not included here as it does not form part of the East Coast market.

Source: PwC; AEMC.

Victoria

We anticipate that the existence of a second hub could allow for price arbitrage to occur (with the Northern Hub) and that this price discovery will help to identify opportunities to improve the transmission network. It is assumed that this element will only develop if the DWGM reforms are implemented. We also expect there to be greater information available on the constraints of the DTS following the auctioning of entry and exit rights. Victoria would gain from both of these elements, were they to come to fruition. We assume there to be some gains to investment efficiency from the non-DWGM reforms, but that it is mainly the DWGM reforms from which Victoria benefits. We assume 50 per cent is attributable to improved price discovery from arbitrage opportunities between the North and South and 30 per cent is attributable to the entry/exit auctioning (totalling 80 per cent).

Tasmania

Similar to Victoria, we assume that 80 per cent of the investment efficiency gains in Tasmania are attributable to the DWGM reforms, as investment efficiency will be reliant on the development of the Southern Hub.

NSW, ACT and South Australia

We assume that 50 per cent of the overall reforms' investment efficiency gains will be due to the improved price discovery from the development of arbitrage between the Northern and Southern Hubs (the same as the case above for Victoria) while 20 per cent will be attributable to the improved information transparency from auctioning entry-exit rights.

Queensland and the Northern Territory

We expect that 50 per cent of the investment benefits identified in the analysis of the overall gas market reforms will be attributable to the DWGM reforms with the remaining 50 per cent attributable to the pipeline capacity and information provision reforms. We assume that the interaction of the Northern and Southern Hub will drive improved price discovery around transport costs and arbitrage opportunities that will enable improved investment decisions. These would apply to both Queensland and the Northern Territory.

Table 5: Summary of the proportion of shocks attributable to DWGM reforms

	Shock applied in overall reforms	Size of shock	Proportion of shock attributable to DWGM reforms				
			NSW & ACT	Vic	QLD & NT	SA	Tas
Trading	Capital productivity shock to industrial users (ability to source additional gas through improved capacity trading platforms)	5%	50%	100%	0%	57%	100%
Trading	Factor productivity shock to LNG producers (ability to sell excess gas during LNG plant disruptions)	0.20%	N/A	N/A	11%	N/A	N/A
Trading	Increase in gas exports (ability for exporters to source supply from the domestic sector)	1%	N/A	N/A	11%	N/A	N/A
Productivity	Factor productivity shock to industrial users and gas retail industry	4.90%	50%	85%	15%	60%	90%
Investment	Equilibrium rate of return shock to pipeline investment	1%	70%	80%	50%	70%	80%

Source: PwC; AEMC

3.1.3 Survey responses

We conducted a survey in August 2016 to gather stakeholder perspectives on the benefits (and costs) of the DWGM reforms. Stakeholders contacted for the survey included market and pipeline operators, large market participants (major users and producers) and small market participants (retailers).[40] We asked stakeholders about their views on whether they agreed with statements relating to the benefits that the AEMC identified for the DWGM reforms. The results were largely negative as Figure 9 shows; most did not agree with the view that the benefits would be achieved. The free text field responses to the benefits questions in the survey tended to indicate a focus more so on the costs and less so on the benefits of the reforms.

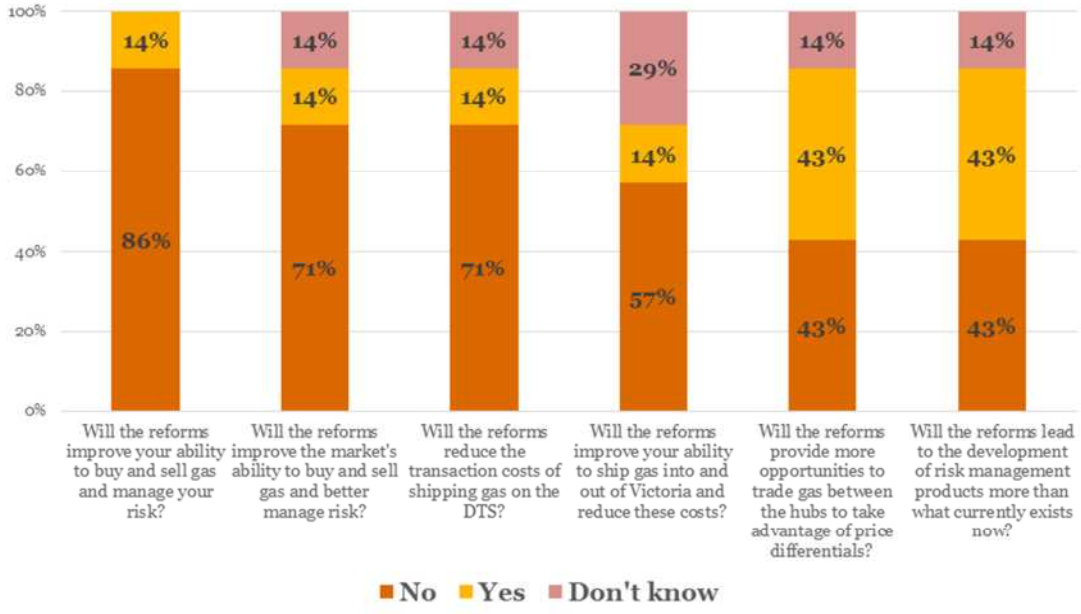
Reconciling the results of this survey with the expected returns from our modelling may be best seen in the context of the incidence (or burden) of reform; namely that our modelling shows the benefits are spread across many areas of the economy, but costs are largely concentrated on market participants, which may explain the survey results. The stakeholder's comments in the survey suggest the greatest area of concern is costs rather than the likely achievement of benefits. Perhaps, more bluntly, they may be considering their costs and whether they will benefit from a more efficient gas market.

CGE modelling, by its nature, raises the level of assessment above any one sector to address the impact on the economy as a whole. The responses from stakeholders nevertheless raise important points for government to consider in the implementation of the changes and how to minimise any unnecessary costs for market participants and maximise the potential for participants to achieve the benefits from a more efficient gas sector.

[40] Stakeholders contacted included AEMO, APA, AGL, Origin Energy, Lochard Energy Australia, Energy Australia, ExxonMobil Australia, Queensland Gas Company, M2 Energy/Dodo Power & Gas, ERM Power, Engie and the Major Energy Users' Association.

Based on the survey results, there is clearly a need for a more detailed and rigorous assessment of the costs of implementation. Appropriately this current analysis is undertaken at a high level (with all of the available information on costs provided by stakeholders to date) in the next chapter but this should be expanded upon in the following stages of implementation, perhaps as part of the regulatory impact statements that may be undertaken in 2017.[41]

Figure 10: Summary of survey responses to benefits of the DWGM reforms



Source: PwC

3.2 Estimation of impacts

This section describes the results of the CGE modelling and quantifies the economic benefits of the reforms at an aggregated, regional and sectoral level.

The reforms are assumed to begin in 2021. However, their associated effects are expected to occur gradually over three stages (and then resulting in second round-effects).

The main results reflect the central shocks, as described in Chapter 3 above, with tests of robustness undertaken through the use of 'high' and 'low' alternatives. Unless specified, the results consider the trading, productivity and investment effects are combined.

Values are expressed in $2015-16. Industry level output is escalated to $2015-16 using the implicit price deflator (IPD) for that industry's output, while state and national output is escalated using the GDP deflator.[42]

3.2.1 Aggregate impact

Simulations of the DWGM package of reforms in an economy wide-model indicate that they are expected to have substantial, widespread impacts on the economy. In aggregate the reforms are expected to lift GDP, relative to the baseline, by $0.6 billion per year after nine

[41] See http://www.coagenergycouncil.gov.au/publications/coag-energy-council-gas-market-reform-package Accessed 3 October 2016

[42] Industry level IPD's and the GDP deflator are derived using ABS catalogue 5204.0. 2015-16 values are estimated using national forecasts contained in the 2015 Commonwealth Mid-Year Economic and Fiscal Outlook. The mining industry IPD is estimated by extrapolating the relationship between its movements and the terms of trade observed in 2014-15, while the IPD for other industries is derived to ensure that the GDP moves in line with the forecast movements in the non-farm GDP deflator.

years beginning in 2030, and by $0.9 billion per year after 2040 (Table 6). The increase in income generated by the reforms supports an extra $0.5 billion of household consumption by 2040 and the employment of an additional 600 people. The increased productivity impacts mean the economic gains are mainly in higher real wages rather than employment.

In present value terms, the reforms drive an additional $4.6 billion of GDP, including $2.2 billion of household consumption over the 20 years to 2040. In comparison, the overall package of reforms was estimated to contribute $8.7 billion to GDP over the 20 years to 2040, including $3.7 billion of household consumption. The total estimated impacts of the DWGM reforms on GDP by 2040 (in present value terms) are therefore 53 per cent of those from the overall package of reforms (Table 6).

Table 6: Cumulative impacts of DWGM reforms on real GDP, consumption and employment

Indicator	DWGM reforms			Overall reforms
	2030	2040	PV	PV
Increase in GDP above baseline (%)	0.02%	0.03%	-	-
Increase in GDP above baseline ($b)	0.6	0.9	4.6	8.7
Increase in household consumption above baseline (%)	0.03%	0.03%	-	-
Increase in household consumption above baseline ($b)	0.3	0.5	2.2	3.8
Increase in employment above baseline (%)	0.004%	0.004%	-	-
Increase in employment above baseline ('000)	0.6	0.6	-	-

Note: Results show deviation from baseline, including the impact on all states and territories. Values are $2015-16. Present values are calculated to 2040 using a 7% real discount rate.

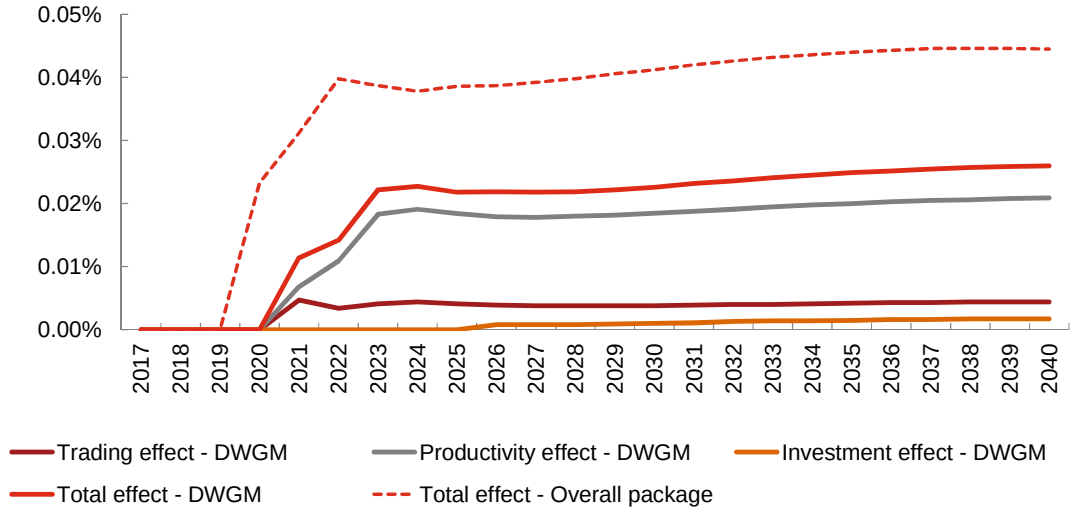
Source: PwC analysis

The trading effect, productivity effect, and investment effect all impact GDP positively, relative to the base case. Similar to the overall package of reforms the largest contributor to GDP is productivity, driven by lower transaction costs and improved risk management capabilities. GDP is estimated to increase by 0.03 per cent by 2040 (compared to the overall reforms which are estimated to increase GDP by 0.04 per cent). In the case of the DWGM reforms productivity contributes 0.02 per cent of the 0.03 per cent rise in GDP. This is illustrated in Figure 11, which shows the cumulative impacts on GDP over time with individual trends for the trading, productivity and investment effects.

The impacts accumulate over time as the different effects come into play. This is due to the assumptions about the timing of the benefits outlined above. While the productivity effect and the investment effect exhibit a step change in GDP, the trading effect shows an initial spike that is then offset. This pattern is attributed to the increased exports increasing resource demands in the LNG production sector and an appreciation in the real exchange rate. Both of these effects impact other export orientated sectors and this offsets the initial growth.

The pattern of the rise is similar to the overall package of reforms, however the accumulated effects are smaller in magnitude and they begin a year later in 2020 (see Figure 11).

Figure 11: GDP deviation from baseline by individual effect (%, deviation from baseline GDP)



Source: PwC analysis

3.2.2 Sectoral impact

The effects of the reforms were also assessed in terms of their impact on different industries and sectors within the economy (the sectoral impact). This includes both the direct impact of the reforms on gas market participants and the broader second-round affect to other industries through economic linkages.

The results are driven by several economic adjustments that occur as a result of the shock. In particular:

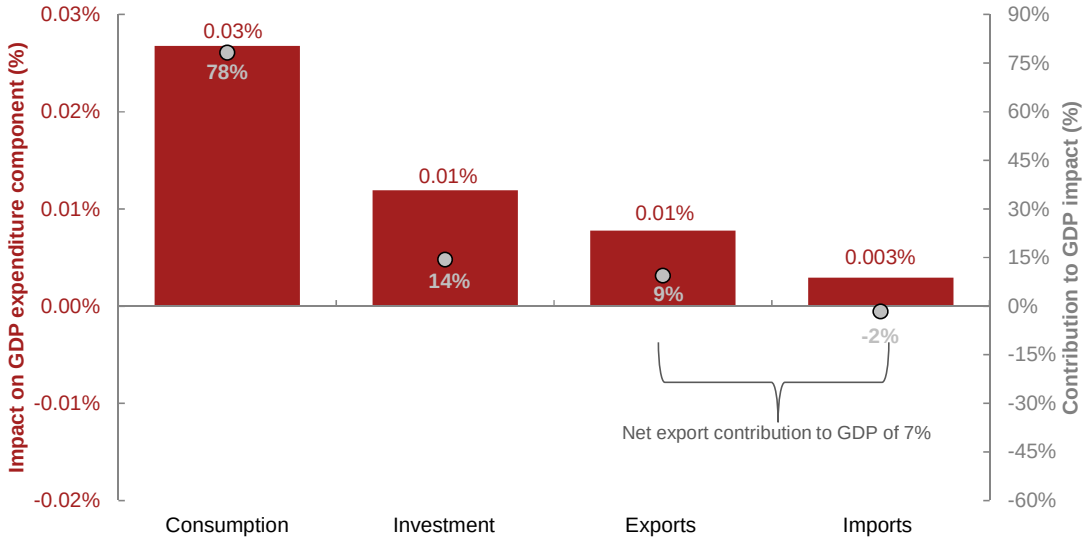
- The productivity of gas-using and producing industries is increased relative to the status quo, increasing the returns from its factors of production relative to industries that use similar factors of production elsewhere.
- The expansion of output in these industries increases the demand for intermediate goods and services from other industries, increasing the value-added of those supplying industries.
- The increase in sales also results in higher investment, which, together with increased productivity, flows back to households through higher real wages, resulting in additional consumption spending.
- At the same time an expansion in LNG and other exports, driven by the productivity gains, places upward pressure on the exchange rate, reducing the competitiveness of a number of trade exposed industries. However, the DWGM reforms are expected to contribute only partially to this effect as they are predominately driving changes in Victoria rather than LNG production zones.

The relative contribution of the impacts on consumption, investment and trade are shown below in Figure 12. This highlights that while the estimated appreciation of the exchange rate had a dampening effect on trade exposed sectors, the reforms contribute significantly to domestic economic activity, with consumption (78 per cent) and investment (14 per cent, both private and public) driving the majority of the increase in GDP relative to the baseline.

While the contributions from consumption and investment to the total GDP impact are unchanged relative to the overall package of reforms, the absolute impacts are larger for the overall reforms relative to the DWGM reforms – 0.05 per cent for consumption and 0.03 per

cent for investment for the overall reform package compared to 0.03 and 0.01 per cent respectively for the DWGM reforms.

Figure 12: DWGM reforms - impact on GDP by expenditure component in 2040 (% deviation from baseline level)



Note: A positive change to imports will negatively affect GDP.

Source: PwC analysis

As shown in Figure 13, the overall outcome is that reforms are expected to have pervasive sectoral impacts.[43] In particular:

- Manufacturing output (Gross Value Added (GVA)) is estimated to expand by around 0.06 per cent relative to the baseline, accounting for nearly 40 per cent of the incremental change in GDP (this is similar to the analysis of the overall package of reforms). This reflects a step change in production possibilities for gas intensive manufacturers.

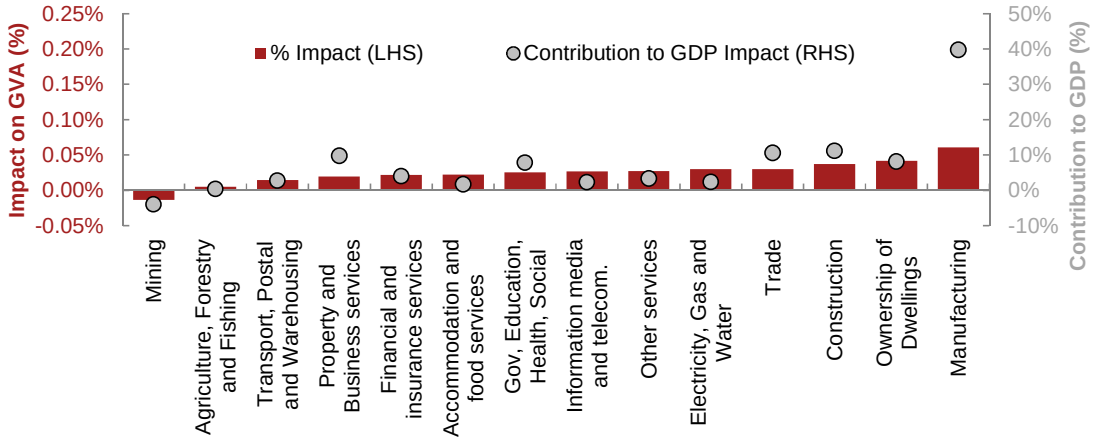
- Gas retailing and distribution (counted in the electricity, gas and water industry), construction and ownership of dwellings are driving large changes to GDP. These sectors were also the largest beneficiaries from the improved gains in the analysis of the overall reforms.

- There is evidence of broad second round impact, particularly in services industries, which benefit from an expansion of investment and household consumption.

- The output of the mining industry (which includes natural gas extraction and LNG production) is estimated to be smaller than the base case despite productivity improvements in the gas extraction industry. This reflects the effects of a higher than otherwise exchange rate and competition for labour and intermediate goods with other extractive industries. These offset the gains in the gas sector so that when combined, the mining sector output is smaller.

43 Shows impacts by broad ANZSIC category, which is standard for ABS national accounting purposes. See Appendix C in previous report (found here http://www.aemc.gov.au/Markets-Reviews-Advice/East-Coast-Wholesale-Gas-Market-and-Pipeline-Frame/Stage-2-Final-Report/AEMC-documents/Cost-Benefit-Analysis-%E2%80%93-PwC.aspx) for more detail on the concordance between industry classification and the shocks described in this chapter.

Figure 13: DWGM reforms – impact on industry output in 2040 (% deviation from baseline GVA)



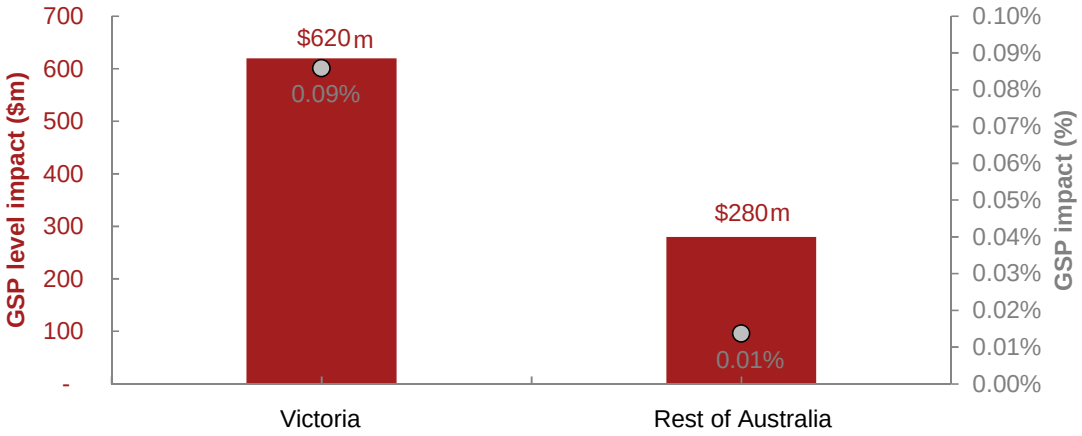
Source: PwC analysis

3.2.3 Impact by state and region

As was the case with industries, not all states and territories will experience equal economic impacts, given that the DWGM reforms will affect the southern states proportionally more. This is highlighted below in Figure 14, which displays the impact of the reforms on Gross State Product (GSP) for Victoria, being the key state affected by the reforms, and the rest of Australia. Victoria's GSP in 2040 is estimated to be 0.09 per cent higher ($620 million higher in 2015-16 dollars). The combined impact on the GSP of all other States and Territories in 2040 is estimated to be $280 million or a 0.01 per cent change on average.

The results suggest that the benefits of the reforms predominately fall on Victoria, although as the following charts show, there are gains to South Australia as well while the impacts on the other states in the east coast gas market are more muted.

Figure 14: Impact of DWGM reforms on Gross State Product (GSP, %) and level impact in 2040 ($m)



Source: PwC analysis

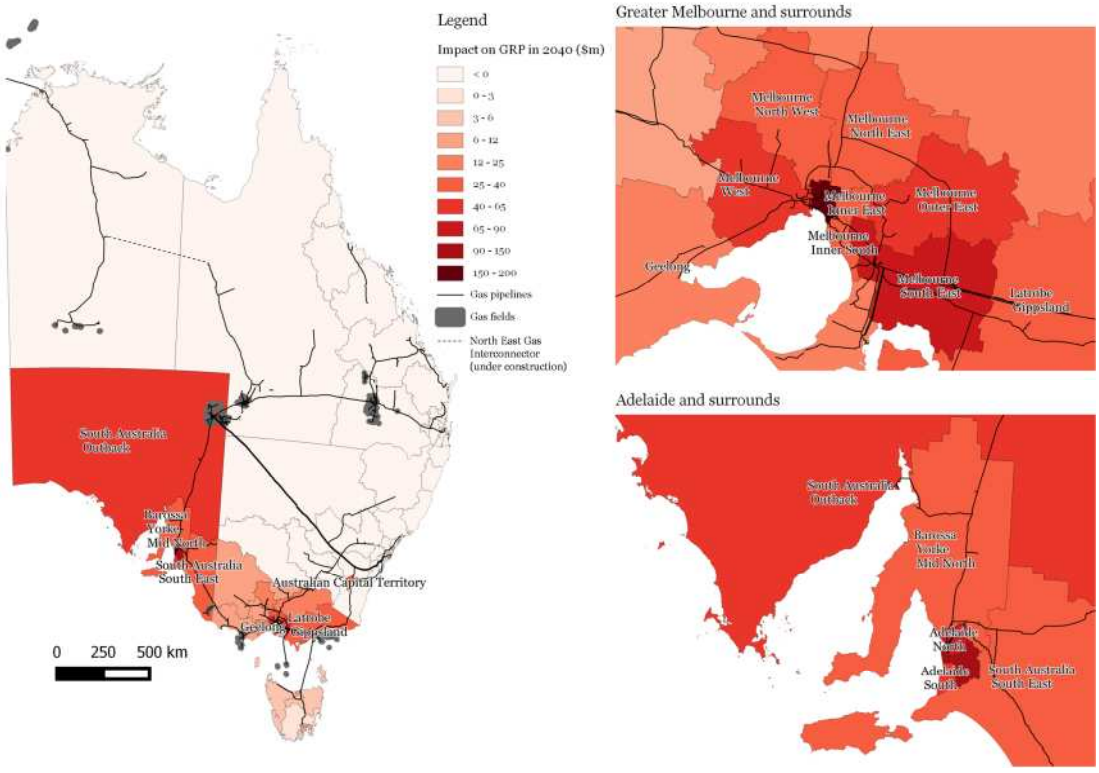
The economic impacts of the reforms on different regions were also analysed using PwC's Geospatial Economic Model (GEM). GEM is a framework that contains economic and social accounts for 2,214 locations across Australia, providing a lens for analysing the implications of industry impacts, as estimated in the CGE model, for different regions across Australia. Further detail on GEM can be found in Appendix B.

The impacts of the reform on regions at the SA4 level[44] are highlighted in Figure 15, which shows the impact on Gross Regional Product (GRP) and Figure 16, which shows the impact on manufacturing output. Some key outcomes include:

- The benefits of the reforms are expected to benefit both urban and regional areas in South Australia and Victoria, with little to no impact in other states. This reflects the nature of the reforms whereby Victoria, South Australia and Tasmania are the main consumers of Victorian gas and are therefore the main beneficiaries. It also reflects that, given the higher productivity gains in the southern states, at the margin businesses and workers will choose to locate there, which has a dampening effect on the productivity gains in other states. This differs to the overall package of reforms where the impact on Queensland was more significant, reflecting the location of key production basins and LNG plants in the state which are unlikely to be significantly affected by reforms to the DWGM.

- The capital city regions in South Australia and Victoria are also expected to benefit. This reflects the size of services industries and retail gas in Greater Melbourne and Adelaide where the majority of the benefits are gained.

Figure 15: Economic Impacts on gross regional product in 2040

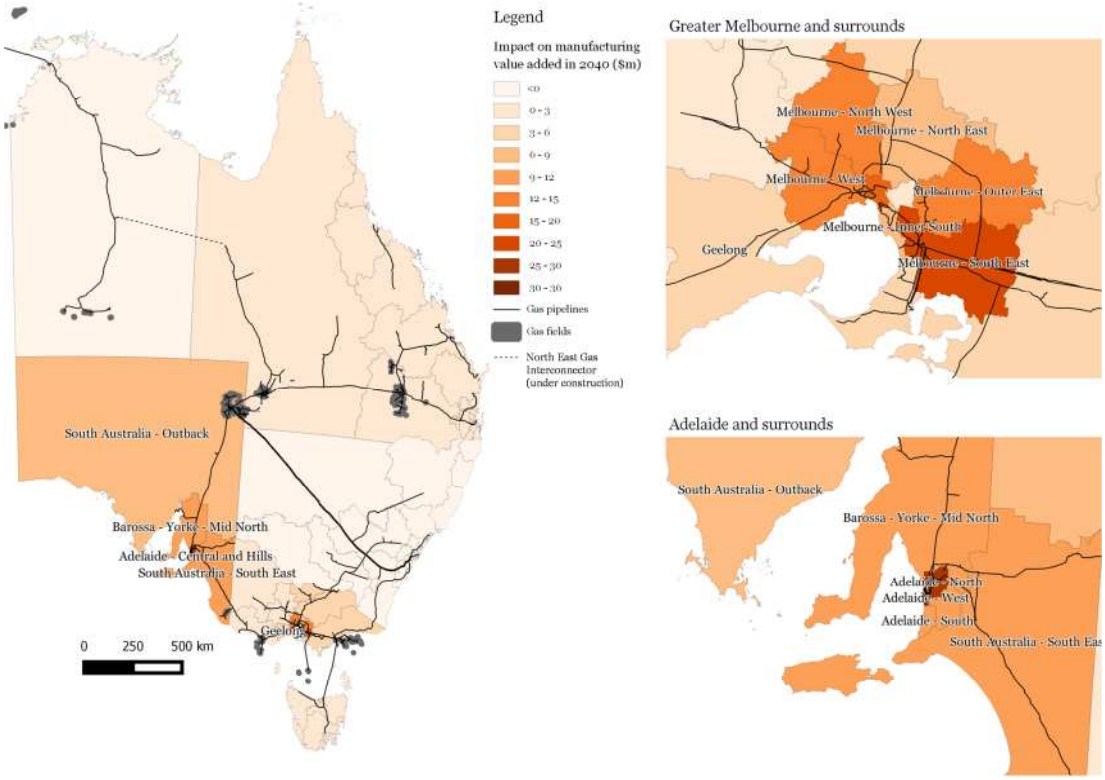


Note: Regions represented are Statistical Areas 4 as defined by the ABS. Values are in 2015-16 dollars. Regions with the largest impacts are named. Western Australia is not included here as it is not part of the east coast gas market; however, as is noted above, the impact is to reallocate some resources away from Western Australia.

Source: PwC analysis.

[44] Statistical Area 4 (SA4) are the largest sub-State regions, as classified by the ABS.

Figure 16: Impacts on manufacturing GVA in 2040 by region



Note: Regions represented are Statistical Areas 4 as defined by the ABS. Values are in 2015-16 dollars. Regions with the largest impacts are named. Western Australia is not included here as it is not part of the east coast gas market; however, as is noted above, the impact is to reallocate some resources away from Western Australia.

Source: PwC analysis.

4 Reform costs

This chapter describes and quantifies, at a high level, the direct costs associated with the AEMC's proposed reforms for the DWGM. Our approach to this cost benefit analysis has been to estimate the net economic benefits once the reforms are implemented (these are outlined in detail in chapter 3), and for reference, provide an estimate of the investment required by stakeholders in order to implement the reforms. The costs are detailed in this chapter. To be clear, these costs are not net of the benefits. While the nature and quantum of costs incurred by stakeholders will depend on the final recommendations put forward by the AEMC and further developed by the GMRG, consultation has allowed us to provide indicative estimates of costs based on informed assumptions of the way that the reforms may be implemented and operated. The sensitivity analysis (provided in Chapter 5) provides low, central and high estimates of the costs to show the range of potential costs. The central estimate represents the most likely scenario of costs as expressed by stakeholders and assumed by PwC. This chapter describes assumptions and results estimated under the central scenario, further detail is provided in Appendix C.

4.1 Overview

4.1.1 Framework

A discounted cash flow framework is used to capture the various costs (eg planning, IT systems, labour) expected to be incurred by stakeholders as the reforms are implemented. A bottom up approach is used to capture three broad cost types:

- ***Planning costs:*** costs associated with working groups and related work streams to design elements of various reforms.
- ***Implementation costs:*** "up front" costs incurred on a one-off basis in relation to systems development and implementation, and any training costs (net of any necessary improvements, upgrades or maintenance that would happen under the base case of no reforms to the DWGM).
- ***Ongoing costs:*** any additional costs incurred on an ongoing basis such as labour and systems maintenance costs of new systems.

We have broadly captured costs specific to the DWGM reforms that have been identified by the AEMC. In particular these costs are associated with the development of a Southern Hub trading model (the transition from the current DWGM framework in Victoria to a voluntary entry-exit model with exchange-based trading). Costs related to the non-DWGM reforms are considered to be included in the base case and so are not quantified here.

Costs are captured over two time periods – the first ten years of the reform period (2016 to 2026), as well as out to 2040 (to align with the benefits analysis in Chapter 3). All costs are discounted to 2015-16 dollars using a real discount rate of 7 per cent[45].

4.1.2 Data sources

In order to build up indicative costs around the DWGM reforms the estimates collected in the previous analysis were tested with stakeholders via an online survey in August 2016. We contacted 12 stakeholders who included the market operator, pipeline owner and large and small participants. Costs gathered from stakeholders are assumed to be provided in 2015-16 dollars unless otherwise stated. Where stakeholder submissions and consultations could not inform estimates we have used the costs collected in the previous analysis.

[45] Department of Prime Minister and Cabinet: Office of Best Practice Regulation, (2016), Guidance note: Cost benefit analysis, https://www.dpmc.gov.au/sites/default/files/publications/006_Cost-benefit_analysis_0.pdf, page 7.

4.2 Cost estimates

The following section provides the results of the cost analysis for the DWGM reforms.

4.2.1 Southern Hub wholesale gas market reforms

Many of the details of reforms to the DWGM are still being developed and will continue to be refined under the efforts of the GMRG. For the purposes of this analysis we assume that the system operator role remains with AEMO under the voluntary entry-exit market.[46]

Timing

We have based our timeframes on discussion with AEMC and their Stage 2 Draft Report. Key assumptions are:

- a two year planning process commencing in January 2018
- a one year implementation process commencing January 2020[47]
- market operation commencing in January 2021.

These are now one year later than specified in our previous analysis given the extended timeframes for the DWGM reforms.

Planning costs

Planning costs are consistent with those set out in the previous analysis for the DWGM reforms with amendments to reflect costs and effort associated with the operation of an industry council (now to be known as the GMRG). The industry council is expected to operate in support of both the Southern hub and pipeline reforms, however, 75 per cent of these costs have been apportioned to the Southern Hub reforms in this analysis, reflecting the complexity of these reforms compared to the pipeline capacity reforms. This portion is consistent with that applied in apportioning a number of cost elements in the May 2016 analysis of the overall package of gas market reforms. The estimated planning costs are $7 million in present value terms, over ten years.

AEMO costs

Consultation with AEMO indicates that costs associated with the transition to a new market model in Victoria are expected to be material. At a high level, the nature of costs expected to be incurred relate to IT systems, design and legal costs and planning. Via the survey, AEMO indicated that implementation costs will be higher than previously stated. They anticipate costs being between $30 million and $80 million over two years. The mid-point estimate of these costs is approximately $41 million in present value terms, over ten years.

In regards to ongoing costs we assume that AEMO will retain responsibility as the system operator, as well as market operator. Changes to the DWGM are expected to require AEMO to take on additional roles not currently required by them. AEMO increased its estimates of ongoing costs as well (relative to those provided in the May 2016 report on the overall package of gas market reforms) and anticipate costs being between $0.5 million and $2 million per year for the DWGM reforms alone. This results in ongoing costs of $4 million in present value terms, over ten years.

Total costs incurred by AEMO are estimated to be $45 million in present value terms, over ten years (these are expected to be recovered from market participants through fees).

46 While the proposed wholesale gas market reforms also include supporting the development of a Northern Hub, the additional costs associated with this component of the reforms is assumed to be minor given that developments are occurring independently of the AEMC's work (eg work around optional hub services at Wallumbilla has already been undertaken by AEMO).

47 AEMC, 2015, Stage 2 draft report; East coast wholesale gas market and pipeline frameworks review, 4 Dec 2015, page vii (which included anticipated timelines for implementation of the DWGM reforms).

Pipeline owner operator

Under the AEMC's proposed allocation of responsibilities as per its December 2015 draft report, the pipeline owner in Victoria (APA Group) would be responsible for auctioning entry and exit rights. Additionally, up-front costs would be incurred in order to develop a new tariff model, likely requiring external expertise from overseas markets. Stakeholder consultations indicate these costs may no longer be supported given the emerging nature of the DWGM changes. In the absence of any information to otherwise quantify the costs to the pipeline operator, we have applied the same costs from the previous analysis. These were upfront costs associated with designing an auction system and developing a tariff model. These are in the range of $1 million in present value terms, over ten years. It is also expected that the current regulatory process undertaken with the Australian Energy Regulator (AER) would continue, with ongoing costs likely to remain similar to what they otherwise would have been.

Large market participants

Upfront costs to large market participants are expected to be material. Stakeholders reported that the proposed reforms are complex and would require significant additional training, IT and software upgrades in the short term and are likely to require additional full time staff on an ongoing basis. Two large participants expected costs to be higher than stated in the previous analysis; one participant reported that implementation costs would be much higher than the upper estimate of $10 million. Neither respondent indicated a likely range. Another large participant agreed with the original cost estimates while a fourth noted that they did not have the capacity to provide an estimate. Given the lack of clarity around the costs for large participants we were unable to update our cost estimates and have taken an average of the estimates sourced from literature and the previous analysis. Upfront costs are estimated to be $20 million in present value terms.

Ongoing costs are expected to be incurred in relation to additional trading staff (given market participants will need to continuously monitor and balance their position) as well as additional finance, risk and settlements staff. Ongoing IT systems maintenance costs will also be incurred. Two large participants who responded to the survey agreed with the estimate we provided from the previous analysis while two respondents disagreed but did not indicate a range. In total, we estimate ongoing costs to be $23 million in present value terms, over ten years.

Total costs incurred by large market participants are estimated to be $42 million in present value terms, over ten years.

Small market participants

We have assumed that 19 "small" entities will participate in the Southern Hub market. In addition to large market participants, this results in a total of 25 participants.[48]

Participants expect to incur costs in relation to training of staff and additional resources for legal costs, IT systems and trading staff. One small participant expects implementation costs to be between $500,000 and $700,000 over two years and one participant lobby group representative expects costs to be between $500,000 and $1 million over two years. The original cost estimates ranged between $100,000 and $200,000 over two years. For this analysis we have taken the average of these three estimates. In total implementation costs are estimated to be approximately $7 million in present value terms.

Small participants will incur additional ongoing costs given there will be a need to balance gas positions on a continual basis. One small participant agreed with the ongoing costs originally estimated in the previous analysis of $150,000 - $300,000 per annum. A participant lobby group representative expects ongoing costs of at least $450,000 - $600,000 per annum to allow for three additional FTE to work in shifts to enable trade 24 hours a day. We note AEMC's view that this is unlikely to be required for small participants

48 Our analysis of available information has found differing figures in relation to the number of current participants in the DWGM. Consistent with our May 2016 analysis we assume there are 25 market participants.

with typically steady load profiles. In this respect, it is a conservative estimate and forms the upper bound. For this analysis we have taken an average of these two responses and those sourced from the May 2016 analysis of the overall package of gas market reforms. We expect small participants to incur ongoing costs of $20 million in present value terms, over ten years.

Total costs incurred by small market participants are estimated at $27 million in present value terms, over ten years.

4.2.2 Considerations

As outlined above, there are large ranges associated with the cost estimates given the high degree of uncertainty around specific elements of the proposed reforms. In particular estimates are sensitive to:

- a number of roles and responsibilities which are yet to be determined and thus the implementation and ongoing costs are uncertain
- the final design of the reforms remain uncertain, influencing the ongoing costs that industry participants can expect to incur to participate
- the extent to which certain reforms will be implemented.

We have made the best effort to verify our initial cost estimates with stakeholders through an online survey. We received updated cost estimates from 8 out of 12 participants contacted. Some stakeholders expect the costs of implementation to outweigh the overall benefits to the market. Participants are particularly concerned about the added complexity the reforms will bring to an already complex market. The separation of the commodity and capacity products is a clear concern for participants who prefer the current model of purchasing the products as a bundle.

Participants are concerned that the change will require them to also manage capacity, something which is currently performed by the pipeline operators. While the proposed reforms require participants to purchase a capacity right when purchasing or selling gas the pipeline operator will still be in charge of managing the flows. The responses indicate that, large participants are clearer about the reforms and appear to be more positive about what they will mean for the market as a whole. Smaller participants on the other hand tend to be focused on the short-term costs involved in implementing the market changes.

Original cost estimates were updated to reflect the ranges specified in the survey responses. The mid-point estimate is an average of all data points collected in this analysis and the May 2016 analysis of the overall package of gas market reforms, while the high and low estimates are the maximum and minimum points respectively.

In the initial consultations participants emphasised the difficulty in providing firm cost estimates and that any figures provided were subject to final recommendations. Consequently, all cost estimates should be seen as indicative only and would be developed further through the consultative RIS process prior to any final decision or implementation occurring.

4.3 Summary

The following table summarises the costs that have been described above. It includes the undiscounted upfront and annual costs as well as the total costs at 2040.

Table 7: Estimated total costs for DWGM reforms ($m 2015-16)

	Once off implementation costs	Ongoing annual costs	Total costs over 10 years (discounted)	Total costs to 2040 (discounted)
Planning	8	-	7	7
AEMO	55	1	45	50
Pipeline operator	1	-	1	1
Small participants	9	6	27	53
Large participants	26	7	42	73
Total	100	14	121	184

Note: Totals are subject to rounding.

Source: PwC analysis

The following table summarises the costs for the overall gas market reform package. It incorporates the revised DWGM costs following the stakeholder survey conducted in August, with the non-DWGM costs prepared in our May report. The DWGM reforms account for 69 per cent of the (revised) total costs to 2040 for the overall reform package.

Table 8: Revised estimated total costs of reform package ($m 2015-16)

	Once off implementation costs	Ongoing annual costs	Total costs over 10 years (discounted)	Total costs to 2040 (discounted)
DWGM costs ($m)	100	14	121	184
Non-DWGM costs ($m)	42	4	64	84
Total ($m)	143	19	185	268
DWGM proportion of total costs (%)	70	76	65	69

Note: Totals are subject to rounding. Non-DWGM costs include the pipeline access costs (excluding the portion of planning costs that related to the Southern Hub) and the information provision costs.

Source: PwC analysis

5 Summary and sensitivity analysis

5.1 Overall impact

The analysis in the central scenario indicates that, for an implementation cost of approximately $100 million and ongoing annual costs of approximately $7 million, the proposed reforms could lead to greater productivity growth, consumption, exports and investment, resulting in GDP that in net terms is $0.9 billion higher than it would have otherwise been in 2040.

Importantly, the change in GDP over and above the costs is estimated to be positive in each year following the reforms. That is, the reforms drive a 'level shift' in GDP that, in the central case, amounts to an estimated $4.6 billion of additional output in present value terms over the 20 years to 2040.

We note, however, that the estimated economic impacts and costs should be considered indicative. While the analysis is conducted using a robust analytical framework, the proposed reforms are still in a relatively early stage of development, and guidance on direct economic benefits has been sought from broadly comparable, but not equivalent policy experience elsewhere.

Accordingly, high and low sensitivities for the net benefits and the costs of reform are considered in the section below.

5.2 Sensitivity analysis

Net benefits:

As in the previous analysis high and low sensitivity tests were conducted to test the robustness of the results to changes in inputs. The total shocks applied in May 2016 for the analysis of the overall reform package are shown in Table 9. The same proportions attributed to the DWGM in the central case (summarised in Table 5) are then applied to these to estimate the impacts of the DWGM reforms under the high and low cases. A comparison of the high and low scenario assumptions with the central scenario is shown in Table 10.

Table 9: Economic shock assumptions in high and low scenario

Indicator	Central	High scenario		Low scenario	
		%	Comment	%	Comment
Trading effect					
Capital productivity shock to industrial users	5%	7.5%	50% increase	0%	Lack of quantitative data
Factor productivity shock to LNG producers	0.2%	0.3%	50% increase	0.1%	50% decrease
Increase in gas exports	1%	1.5%	50% increase	0%	Lack of quantitative data
Productivity effect					
Factor productivity shock to industrial users	4.9%	12%	The low end in a research paper.[49]	2.45%	50% decrease
Factor productivity shock for gas retail industry	4.9%	12%	As above, but shock is applied to all retailers	0%	Assumes that no retailers gain, reflecting concerns of some smaller retailers
Investment effect					
Equilibrium rate of return shock to pipeline investment	1%	1.5%	50% increase	0%	No benefit to pipeline operators, reflecting the concerns of some.

Source: PwC analysis

The results of the simulations under the high and low scenarios are shown below in Table 10. They indicate that the reforms are estimated to increase GDP by a range of 0.01 to 0.05 per cent relative to the baseline by 2040 (or around $0.2 to $1.8 billion in $2015-16).

Table 10: Sensitivity of simulation to alternative assumptions (% deviation from baseline)

Indicator	DWGM reforms		Overall reform package	
	2030	2040	2030	2040
GDP				
High scenario	0.05	0.05	0.09	0.10
Central scenario	0.02	0.03	0.04	0.04
Low scenario	0.01	0.01	0.01	0.01
Employment				
High scenario	0.008	0.007	0.013	0.013
Central scenario	0.004	0.004	0.006	0.006
Low scenario	0.001	0.001	0.002	0.002
Household consumption				
High scenario	0.05	0.07	0.09	0.12
Central scenario	0.03	0.03	0.04	0.05
Low scenario	0.01	0.01	0.01	0.02

Source: PwC analysis.

Even under the low scenario, in which aggregate benefits to the economy are solely underpinned by productivity gains to industrial users sourcing gas through wholesale markets and efficiency gains from improved trading of excess gas supply, the new GDP generated, relative to the baseline, is material.

49 Carter, D. Rogers, D. Simkins, B. (2003). Does fuel hedging make economic sense: the case of the US Airline industry. Unpublished. Accessed: http://www.gresi-cetai.hec.ca/cref/sem/documents/030923.pdf, 10/03/2016.

Costs:

Table 12 shows the range in the low and high estimates of costs relative to the central estimate presented in Chapter 4 for the standalone DWGM reforms. High and low estimates have been formulated from the upper and lower bounds of cost information supplied by stakeholders. Table 11 shows that the implementation costs could be between $44 million and $211 million for the DWGM reforms while the ongoing costs could range from $3 million to $42 million annually.

The table also presents the sensitivity analysis for costs of the overall reform package using the revised DWGM cost estimates. Implementation costs and ongoing costs for the package of overall reform package could range from $63 million to $279 million and $5 million to $50 million respectively. Some of the costs associated with the DWGM reforms were revised upwards following the August stakeholder survey which explains the upward revision of the high cost estimates relative to the May sensitivity analysis.

Table 12: Costs estimates ($m 2015-16)

	DWGM reforms			Overall reform package (revised estimate)		
	High estimate ($m)	Central estimate ($m)	Low estimate ($m)	High estimate ($m)	Central estimate ($m)	Low estimate ($m)
Once off implementation costs	211	100	44	279	143	63
Ongoing annual costs	42	14	3	50	19	5
Total costs over 10 years (discounted)	295	121	43	402	185	69
Total costs to 2040 (discounted)	480	184	58	623	268	89

Note: Totals are subject to rounding. Discounted costs are calculated using a real discount rate of 7 per cent.

Source: PwC analysis

Appendices

Appendix A CGE model overview

Computable General Equilibrium (CGE) modelling is an economic modelling technique used to evaluate the direct and indirect impacts of policy reforms, environmental impacts, and other economy-wide changes. This appendix outlines what CGE models are; what they can and cannot do; and the CGE model that we propose to use in this engagement.

What are CGE models?

CGE models are detailed representations of the Australia economy, combining a real-world database (sourced from ABS input–output tables) with economic theory. These models are used to estimate the impact of external changes on the real economy. Based on the input–output National Accounting framework, they focus on the productive economy by looking at the way that different industries demand labour, capital and intermediate inputs subject to economic capacity constraints. Prices in the model are market clearing by default for all goods and services (although this assumption can be relaxed). The models include numerous industries, regions, and labour types, as well as several types of final demand (consumption, investment, state and federal governments, and exports).

CGE models are used to examine the economy-wide impacts of reform. By including each industry's demand for intermediate inputs, inter-state trade connections, and labour–capital intensity, the degree to which one industry impacts on another can be estimated. This not only includes the productive output of all industries, but also the income flows associated payments to labour, capital and governments (through taxation). In this way CGE models are used to examine three changes associated with an external impact to the economy (called a 'shock'):

- The degree to which the shock impacts directly on the industries targeted by the change
- The degree to which other industries are indirectly impacted by their connections to the directly targeted industry
- The degree to which economy-wide aggregates (such as gross state or national product, household consumption or real wages) are impacted, through the aggregation and interaction of all the industries in the economy.

Due to the detail in CGE models, they are able to report on a large number of industry, regional, and macroeconomic results. At the industry level, CGE models can report changes in activity level, employment, capital utilisation, wages, and prices, amongst others. At the regional level, they can report domestic and international trade flows, final demands, and population movements. At the macroeconomic level, they can be used to examine:

- gross domestic product (GDP)
- final demand
- trade balances
- government accounts
- various price aggregates (eg CPI and the GDP deflator).

Assumptions within the CGE model can also be controlled to reflect the nature of the scenario being examined. Short-run policies (approximately five years) can be examined, as can longer run policies (estimating the impact of policy in 20+ years). Further, the models can be tailored to reflect certain characteristics of the economy unique to the modelling: the nature of government balances, drivers of government spending, and household consumption.

What the results of CGE models mean

CGE models are principally used to look at the impacts of policy changes on real economic variables, such as employment or the productive capital stock. They are used to estimate the relative expansion or contraction of industries or regions relative to one another. The models themselves are built on a strong and well researched academic foundation: including a variety of price responses and substitution affects.

However, CGE results should not be interpreted as a prediction of exactly where the economy will be at a certain point in the future. CGE models are based on the economic concept of the general equilibrium: the point at which the markets for all goods and services clear.[50] As a result, CGE models do not incorporate the range of disequilibrium impacts seen in the short run in the real world. As a result, CGE model results can be thought of as the medium-to long-run impact that would result on the baseline level of output in the economy, abstracting from nominal and short-run disequilibrium effects.

CGE models only show the impact of the policy under investigation. They are not a broader tool for economic forecasting. As a result, any given CGE simulation will likely omit a range of external influences that are not directly relevant to the policy under investigation. Consequently, CGE results represent the change in the baseline level in the economic variables under investigation, solely attributable to the policy in question.

The interpretation and relevance of CGE results can be seen in the context of an example; in this case the construction of a new hospital in Victoria. A CGE model would describe the number of jobs created by the hospital, the degree to which it inflated the local wage and bid workers away from other industries, and the likely impact on gross state product. However, it would not reflect disequilibrium properties in the short run (eg the time required to train new labour to work in the hospital, financing issues associated with acquiring a capital (such as X-ray machines)). Further the results would be 'all other things equal': they would not reflect an unforeseen decline in labour supply that emerged five years down the line (unless the modeller inserted this change). In this way, CGE models present an over-arching 'big picture' impact of a change, once it has resolved itself in the economy and become part of the economic baseline.

CGE models do not include financial markets. It is argued that financial markets have no long-run persistent impacts on the real economy, only having real impacts in the short run. These short-run, disequilibrium states are not included in CGE results. Long-run impacts resulting from financial markets — such as changes in consumer preferences resulting from stocks of wealth — must be inserted in to the modelling externally. Further, CGE models are built around the ABS National Accounts Input–Output framework (as mentioned above), which does not include financial data. To include them would upset the balances in the national accounting.

50 Note that this does not imply that the markets have to clear efficiently. We can insert taxes, or uncompetitive behaviour moving the market to an inefficient market clearing price.

The VURM model

The Victoria University Regional Model (VURM) is a multi-regional, dynamic CGE model.[51] It distinguishes up to eight Australian regions (six States and two Territories) and up to 144 commodities/industries. The model recognises:

- domestic producers classified by industry and domestic region
- investors similarly classified
- up to eight region-specific household sectors
- an aggregate foreign purchaser of the domestic economy's exports
- flows of greenhouse gas emissions and energy usage by fuel and user
- up to eight state and territory governments
- the Commonwealth Government

The model contains explicit representations of intra-regional, inter-regional and international trade flows based on regional input-output data developed at the Centre of Policy Studies (CoPS), and includes detailed data on state and Federal governments' budgets. As each region is modelled as a mini-economy, VURM is ideally suited to determining the impact of region-specific economic shocks. Second round effects are captured via the model's input-output linkages and account for economy-wide and international constraints.

Outputs from the model include projections of:

- GDP and aggregate national employment
- sectoral output, value-added and employment by region
- export earnings, import expenditure and the balance of trade
- greenhouse gas emissions by fuel, fuel user and region of fuel use
- energy usage by fuel, energy user and region of energy use
- State and Territory revenues and expenditures
- regional gross products and employment
- regional international export earnings, international import expenditures and international balance of payments.

51 VURM is the latest incarnation of the Centre of Policy Studies' MMRF model. The name change was triggered by CoPS move from Monash University to Victoria University in 2014.

Appendix B GEM overview and methodology

GEM: What is it?

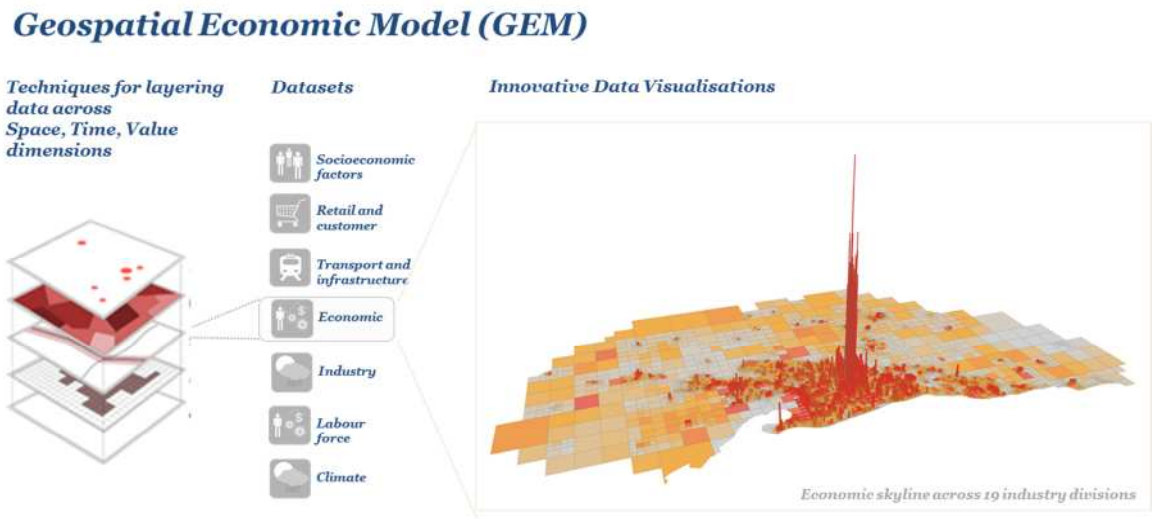
PwC created a big data modelling platform that captures the macroeconomic trends of small area economics that shape Australia. GEM was developed to provide a more granular understanding of Australia's economic geography. By understanding the underlying smaller economies that make up the States and Territories, allows us to understand the differing contributions of various small areas to each State and Territory's economic value by industry and across time. We can see how industry employment and output grow or shrink through time across these small areas, and examine how policies and other shocks play out in different geographies.

Our Small Area Economics work provides economic, social and demographic insights in 2,214 locations across Australia where business and government operate. By adding the "where" dimension to analysis and reporting, we assist clients to take advantage of geospatial insights that are not apparent using traditional, non-spatial methods. 'Locations' refer to socially and economically distinct areas (Statistical Areas – level 2 as defined by the ABS) that have, on average, a population of approximately 10,000 people.

GEM comprises a spatial library containing Australia economic data from 2001 to 2015, which is consistent and reconcilable with ABS data. Forecasts are also available out to 2050 which are consistent and reconcilable with Treasury's intergenerational model. As is the case with all economic data, including the underlying ABS GDP and employment data that are used to build GEM, these are estimates. None of these should be treated as 100 per cent accurate, and GEM is no different. Noting this, the methodology we've developed working closely with the ABS and our own experienced economists gives us great confidence in the model's outputs.

The GEM platform supports the collection, fusion and distribution of spatial as well as non-spatial data originating from a variety of sources (see Figure 17). We use a variety of desktop and server-side GIS, data visualisation and web mapping tools that allow spatial analyses to be published and shared with chosen audiences in a variety of printed and digital formats. The GEM platform consists of a server-side ecosystem and toolbox for near real-time bespoke analysis, and provides the opportunity to support consulting projects with extensive insights across a range of factors that typically drive or affect business performance.

Figure 17: GEM allows for a wide range of datasets to be layered and fused in near-real-time



Analysing data through a spatial lens can help to identify problems that are of local concern even if they are not a high priority at a state or national level - and can therefore assist in advocating for local funding initiatives and the tailoring of services based on specific community or market needs. Similarly, spatial analysis can enable top-down strategies and initiatives to be targeted more effectively in the areas where they are needed most.

Within GEM, we have compiled a range of significant Australian datasets across key subject areas including population and demographics, infrastructure and the economy. These datasets provide important context for the subsequent understanding, analysis and enrichment of data. The GEM platform can easily integrate a wide range of variables and data types, from customer transaction data through to fleet vehicle, network sensor and incident-related data.

How has GEM been used in this project?

The CGE modelling approach described in earlier sections of this report delivered estimates of the proposed reforms' impacts at a State and Industry level for Australia's eight States and Territories. These estimates were used to compute a cumulative impact against 2040 projected baseline levels that could occur as a result of implementation of the proposed reforms, for each considered industry in each State/Territory.

These estimates were then distributed among each State/Territory's subregions using GEM. The subregions used in this analysis were Statistical Areas 4 (SA4s), which reflect labour markets within each State and Territory and comprise regions of approximately 100,000 persons. The allocation was performed according to each region's relative contribution to industry Gross State Product in 2015. This approach provided estimates of the cumulative impact to 2040 flowing from the proposed reforms for each industry in each subregion.

This methodology was applied across all considered industries and locations. The resulting estimates were used to understand how different subregions of Australia would potentially benefit from the proposed reforms.

Appendix C Reform cost methodology

This section includes more detail on the process undertaken to estimate the cost of the proposed reforms.

Table 13 includes a summary of the general assumptions used to discount and index costs estimates within the model. Table 14 details the timing assumptions that were made and utilised to model the expected start and finish dates of phases of the reforms and their development processes. Table 15 to Table 19 include a detailed description of specific cost inputs and how they were sourced. In particular, it details where assumptions were made by PwC, sourced through stakeholder consultation or based on past reforms in the Australian gas market.

Table 13: General assumptions

Description	Rate
Discount rate (real)	7.00%
Inflation forecast	2.50%
CPI 2005-06 to 2016-17	1.27
CPI 2011-12 to 2016-17	1.09
CPI 2013-14 to 2016-17	1.03
WPI (all industries) 2005-06 to 2016-17	1.39
WPI (all industries) 2011-12 to 2016-17	1.11
WPI (all industries) 2013-14 to 2016-17	1.05
PPI (Data processing, web hosting and electronic information storage services) 2005-06 to 2016-17	1.06
PPI (Data processing, web hosting and electronic information storage services) 2011-12 to 2016-17	1.05
PPI (Data processing, web hosting and electronic information storage services) 2013-14 to 2016-17	1.01

Sources: Commonwealth Government Office of Best Practice Regulation. Australian Bureau of Statistics (ABS 2016), 6401.0 - Consumer Price Index, Australia, Mar 2016. Australian Bureau of Statistics (ABS 2016), 6345.0 - Wage Price Index, Australia, Mar 2016. Australian Bureau of Statistics (ABS 2016), 6427.0 - Producer Price Index, Australia, Mar 2016.

Table 14: Timing assumptions

Southern Hub Reforms	
Planning (working groups)	
Commencement of working groups	1-January-18
Completion of working groups	30-Dec-19
Implementation	
Implementation commencement	1-January-20
Implementation completion	30-December-20
Operation	
Market operation commencement	1-January-21

Source: PwC assumptions, stakeholder submissions and AEMC (2015), Stage 2 draft report: East coast wholesale gas market and pipeline frameworks review, Sydney, Australia, page vii.

Planning costs

Planning costs refers to working groups and the proposed industry council. Costs for planning groups can be broken into three streams

- preparation costs, which refers to completing submissions, consulting within the business and with experts
- meeting costs, which refers to the cost of time spent in meetings directly
- travel costs, which refers to the expected costs for some representatives to travel to attend the group.

Working groups are proposed for wholesale gas market reforms. The assumptions underpinning working groups for each of these reforms and for the industry council are summarised in Table 15.

Upfront costs

Upfront costs associated with implementing the Southern Hub reforms include costs for IT systems development, expert advice and training staff. They do not include working groups and planning. Upfront costs are expected to accrue to all stakeholders.

Ongoing costs

These costs are expected to accrue in all years that participants and operators interact with the proposed Southern Hub wholesale gas trading platform. Stakeholder consultations indicated large participants are expected to incur additional IT, risk management and finance costs. Pipeline operators are not expected to accrue any additional ongoing costs as consultations indicated the proposed reforms do not materially alter their role or function in the gas supply framework.

Table 15: Planning costs inputs and assumptions

Input/assumption	Value	Description	Source
Number of working groups	6	This reform is assumed to be more complex than those undertaken in the past by AEMO, as such they have estimated six working groups will be required to cover all of the issues.	AEMO
Number of meetings	36	First 12 months of planning, assume monthly meetings for final 12 months, assume fortnightly meetings, 36 meetings total, over two years.	Stakeholder and AEMO consultation.
Number of attendees at each meeting	15	We assume an average of 15 attendees, understanding that attendance at each meeting will vary based on a number of factors.	Stakeholder submissions
Percentage of attendees who will travel	25%	Given this is a Victorian reform, most participants are located in Melbourne. It is still expected that these reforms will attract participants from other states into the Victorian market and as such some attendees will travel.	AEMC
Average hourly cost of attendees	$174	Indexed to 2015-16 dollars, based on senior personnel wage and on-costs and overheads	MMA[52]
% uplift for consultation and support	200%	Applied to the total time commitment of attendees to reflect time to prepare submissions, questions and consult within their business.	PwC assumption
Average cost of return flight	$400	Estimate of the cost to fly return between the major cities.	PwC assumption
Project manager annual wage	$0.3 million	Project management is expected to be required for 1 year, estimate is based on MMA and indexed to 2015-16 dollars using WPI.	MMA[53]

[52] McLennan Magasanik Associates 2006, Gas Market Options Cost benefit Analysis, Report to Gas Market Leaders Group and MCE Standing Committee of Officials, Melbourne.

[53] McLennan Magasanik Associates 2006, Gas Market Options Cost benefit Analysis, Report to Gas Market Leaders Group and MCE Standing Committee of Officials, Melbourne.

Table 16: Market operator costs inputs and assumptions

Input/assumption	Value	Description	Source
Implementation costs	$30 – $80 million	These costs involve IT costs, design, implementation and legal costs and process/consultation costs.	Market operator survey, August 2016
Ongoing costs	$0.5 – $2 million	AEMO currently operates the DWGM in Victoria. In the May 2016 analysis of the overall gas market reforms it was noted that it was unclear what the incremental operational cost increase (or decrease) would be given the current uncertainty around what the market design will be and who will operate system. A simplified assumption is applied that there will be a slight increase in operational costs; equivalent to the initial Wallumbilla estimated operational costs. AEMO's response to the market operator survey provided this updated range.	Market operator survey, August 2016

Table 17: Pipeline operator costs inputs and assumptions

Input/assumption	Value	Description	Source
Implementation costs	$875,000 – 1.75 million	Auction system will be required for baseline capacity (allocating entry / exit rights) – we assume that this would be similar to auction costs for secondary pipeline capacity. It's expected that external expertise will be required to develop a tariff model. This would likely need to come from an overseas market (Europe) with entry-exit experience. Cost estimate is PwC's assumption based on 1 year FTE at a senior level.	Stakeholder consultation, April 2016.
Ongoing costs	0	Assume no additional ongoing costs incurred under new market structure, assuming that AEMO remains system operator.	Stakeholder consultation, April 2016.

Table 18: Large market participant costs inputs and assumptions

Input/assumption	Value	Description	Source
Implementation costs	$4.5 – $10 million	Relates to upfront costs like IT, training and staff	Large participant survey, August 2016
Implementation costs	$1.6 million	This estimate relates to upfront IT costs. This estimate was taken from the upper bound of the MMA's cost estimate for the STTM and GBB reforms to estimate the total costs. Consistent with the May 2016 analysis of the costs of the overall gas market reforms, 75% of this cost was attributed to the DWGM reforms. Significant costs were estimated due to the fact that custom systems are required - large businesses hold significant gas portfolios that need to be represented within a system and hence these businesses do not use an off the shelf product.	Literature: MMA[54]
Summary	**$1.6 - $10 million**	**Average estimate: $4.4 million**	
Ongoing costs	$0.1– $0.2 million	Relates to ongoing costs like IT and staff	Large participant survey, August 2016
Ongoing costs	$0.2 – $2 million	Consistent with the May 2016 analysis of the costs of the overall gas market reforms, ongoing costs were assumed to be 10% of overall implementation costs.	Stakeholder consultation, April 2016

54 McLennan Magasanik Associates 2006, Gas Market Options Cost benefit Analysis, Report to Gas Market Leaders Group and MCE Standing Committee of Officials, Melbourne.

Summary	**$0.1 - $2 million**	**Average estimate: $1.1 million**

Table 19: Small market participant costs inputs and assumptions

Input/assumption	Range	Description	Source
Implementation costs	$0.5-$1 million	Estimate of implementation costs provided by a small market participant survey respondent	Small market participant survey, August 2016
Implementation costs	$0.5-$0.7 million	Estimate of implementation costs provided by a small market participant survey respondent	Small market participant survey, August 2016
Implementation costs	$0.1-$0.2 million	May 2016 analysis of the costs of the overall gas market reforms estimate relating to training, implementation and updating systems. PwC assumption: assume 2 staff spend 2 months full time learning new system at $85 per hour	Literature: AEMO[55]
Summary	**$0.1 - $1 million**	**Average estimate: $0.5 million**	
Ongoing costs	$0.5-$0.6 million	Estimate of ongoing costs provided by a small market participant survey respondent	Small market participant survey, August 2016
Ongoing costs	$0.2-$0.3 million	Estimate of ongoing costs provided by a small market participant survey respondent	Small market participant survey, August 2016
Ongoing costs	$0.2-$0.3 million	May 2016 analysis of the costs of the overall gas market reforms estimate relating to trading staff as DWGM reforms will require participants to continuously be in balance. We assumed that one additional FTE would be employed.	Stakeholder consultation, April 2016.
Summary	**$0.2-$0.6 million**	**Average estimate: $0.3 million**	

Note: Numbers included in this table have been rounded, exact inputs into the cost model may have more significant figures based on indexing of past estimates to 2015-16 dollars.

55 Australian Energy Market Operator 2012, Detailed design for a gas supply hub at Wallumbilla, 19 October 2012, Australia.

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