Economic impact analysis of natural gas development and policy implications

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Abstract

In the US, the shale gas revolution ensured the development costs of natural gas have plummeted to the levels of $2-$3/ Mcf. This US shale gas success has motivated shale gas development in other regions including China, Australia and Europe. However, shale gas development is still in infancy in other regions outside the US. Although, there is a lot of hype, whether it can really be translated to a similar success as the US is not yet certain. This is mainly due to the geological complexities, lack of services and local supplies, infrastructure and community outrage, which are not only complicating the shale gas development but also contributing to the increase of development costs. This study compares the natural gas development based on direct development costs and fiscal costs, and suggests the policy initiatives required to increase the attractiveness of shale gas development in both Australia and Europe.

The increasing LNG developments in Australia are already straining domestic gas supplies. Therefore, development of more natural gas resources has been given a high priority to not only to keep the LNG projects sourced with adequate gas resources but also to fulfil domestic gas requirements. However, most of the Australian shale resources are of non-marine type which is significantly different from the marine type shale in the US. In addition, the challenges of direct development costs, infrastructure, service capacity and government policy are also inhibiting the shale gas development in Australia. The natural gas development in Australia is mostly associated with large scale multinational developers. The increasing attractiveness of more investment by local new developers with low risk is critical for Australian shale gas success, simultaneously increasing domestic gas security. This study describes the potential pathways to incentivise Australian small scale developers with fiscal policy concessions.

However, in the European context, unconventional gas development will be challenged by development costs more than the fiscal costs. The increased development costs would translate to average gas development costs of $13.32 / Mcf. Although, shale gas can certainly lead to increase energy security, it will struggle to attain the tag of cheap gas at least for the first decade of gas developments.

Keywords: Unconventional gas, Development costs, Shale gas, LNG

1.0 Introduction

In the current context, fossil fuels are important in any economy as there are no other dependable base load energy generators except for nuclear. Typically, fossil fuels refer to coal, oil and conventional natural gas resources. Thus, the emergence of unconventional gas development, particularly in terms of shale gas and shale oil has added a whole new dimension to the fossil fuel development. However, unconventional gas development is not straightforward in comparison to conventional gas development. It specifically needs some form of stimulation making the development processes more resource consumptive. Specifically, this process is referred to as hydro fracturing, which leads to increase the permeability of the underground formations, easing the gas out of the entrapment towards the well bore and subsequently to the wellhead. The success of hydro fracturing and horizontal drilling has contributed immensely to boost the commerciality of low permeable gas reservoirs that were previously identified as non-economical. In addition, the US shale gas revolution also benefitted from the favourable geology, availability of infrastructure, private mineral ownership, high liquid content, increased participation of independent small scale independent developers, and less community resistance (Stevens, 2012). Motivated by the US success, many other countries around the world are trying to capitalise on shale gas and shale oil development. However, there substantial differences of shale gas development elsewhere compared to the US context.

The unconventional gas development should have a high emphasis on economics as it is more resource consuming and expensive compared to conventional natural gas development. Unconventional gas development needs some form of a stimulation compared to conventional gas development. In Australia, coal seam gas is already planned to source three LNG projects operating on the east coast. Initially, it was relatively expensive compared to conventional onshore and offshore natural gas resource development, but became cheaper over the years with the enhancement of technology and efficiency.

2.0 Literature Review

The term 'unconventional gas' refers mainly to shale gas, coal seam gas and tight gas resources (ACOLA, 2013). These refer to natural gas extracted from various formations, such as coal and shale. While conventional gas can be recovered by using traditional drilling techniques, unconventional gas recovery requires additional stimulation, mainly in the form of hydraulic fracturing. Hydraulic fracturing is a process of injecting high pressure fluids consisting of water, proppants and chemicals (AEA, 2012). Most of the emerging shale plays in Australia and Poland are of non-marine type compared to marine type shale plays in the US (EIA, 2013). However, there are no commercially proven non-marine shale plays in the world as yet. The reservoir characterisation based on the TOC, thermal maturity, gas content and brittleness is important to understand the reservoir deliverability of these shale plays. Thus, geology and economics are the most critical elements that will need to be understood in the shale gas development process.

2.1 Australia

Australian natural gas developers have favoured the international gas markets over the domestic markets due to higher revenue potential and long term revenue security with oil-linked gas price based contracts. The linking of both east coast and west coast markets with the Asian markets will lead to increase gas prices towards the export parity level ($9-10/Mcf), though it is undesirable, this will make some of the shale gas developments viable in Australia. In 2013, EIA estimated Australian shale gas resources to be around 437Tcf mainly based on six reservoir basins (Table1).

Currently, Australian LNG exports are confined to the Asian markets due to the strategic location and Asian premium. The Australian LNG projects have the advantage of low transportation costs to the Asian markets compared to US, but the increasing costs of natural gas development projects will make it challenging to compete with the low cost LNG exports from elsewhere with low development costs and higher market efficiency. Unless, there is an extensive demand growth from the Asian countries, high costs would reduce the attractiveness of Australian LNG exports in the future.

Table 1: Australian reservoir basins with estimated technically recoverable resources (EIA, 2013)

Basin	Technically Recoverable (Tcf)
Cooper	93
Maryborough	19
Perth	33
Canning	235
Georgina	13
Beetaloo	44

2.2 Europe

In Europe, energy security is becoming a prime concern. The recent political unrests in Crimea have led to increase the interest in shale gas development in Europe (EURACTIV, 2014). In the current context, shale gas development in Europe has been perceived favourably, mainly by Poland and UK. Ukraine with 148Tcf of technically recoverable resources, is moving to initiate shale gas development to reduce the dependency on Russian gas imports. However, still some European countries such as France, Bulgaria and Germany practice moratorium on hydraulic fracturing deterring any shale gas development plans in those countries. Even in Poland and UK, full scale development of shale gas is at least 5-10 years away. It will at least need about 100 shale gas wells to understand the commercial potential of these resources. In European context, except for concerns such as the community outrage, regulations, and property rights, the most concerning factor to deter investment is the direct development costs (Uliasz-Misiak et al., 2014). Poland and UK have introduced attractive fiscal policy regimes for shale gas developments for both the developers and communities. Table 2 lists the European shale gas resources as estimated by EIA in 2013 along with the energy security rankings. The energy security rankings reflect the need for more energy resources, thus shale gas can become one of most viable resources to increase the energy security in Europe.

Table 2: European countries energy security ranking and technically recoverable shale gas resources (EIA, 2013; World Energy Council, 2014)

European countries / Energy security rank	Technically Recoverable (Tcf)
Russia (2)	285
Ukraine (59)	148
Poland (38)	145
France (44)	136
Romania/Bulgaria (9/26)	37
UK (11)	26
Netherlands (42)	26
Germany (31)	17
Ukraine/Romania (59/9)	10
Sweden (24)	10
Spain (22)	8
Lithuania/Kaliningrad (93)	2

The following sections describe the current context of shale gas development commitments in Poland and UK.

2.2.1 Poland

To date Poland has been successful in spudding about 40 exploration wells. Also, there is lots of encouragement by the government in the form of direct investment and tax incentives up to 2020. However, Poland suffered major setbacks due to the subsequent departures of international companies, Exxon Mobil in 2011 and Total in 2013 (Natural Gas Europe, 2012, 2014). These are not encouraging signs, both these companies highlighted the complexity of Polish shale geology, which is deeper and associated concerns such as the high pressures and temperatures leading to reductions in the commercial potential of these plays. Currently, the development success mainly lies with the Chevron and Conoco Philips.

2.2.2 UK

Cuadrilla Resources has been active in shale gas development in the UK since 2010 (Selley, 2012). There were some major setbacks due to triggering of minor earthquakes in Blackpool, possibly related to hydro fracturing of shale wells completed by Cuadrilla (Mobbs, 2012). This may be due to the lubrication of active fault planes with stimulation fluids in the region, which could be avoided in future shale gas development activities. The UK government is becoming more proactive and recognising the importance of shale gas for energy security and potential to create jobs (UK Government, 2013). Until now, only Bowland basin is exploited for shale gas development with four exploration wells drilled by Cuadrilla resources and another well drilled by IGAS Energy.

3.0 Methodology

In this study, economic impact analysis of unconventional gas resource development has been evaluated using excel spreadsheets for Australia, US and Europe. The data inputs such as the drilling and completion costs, royalties, income taxes, operational costs and other fiscal costs will be accounted to estimate the costs involved in the development. Then, a sensitivity analysis is conducted to assess the effect of the major cost components on the breakeven gas price. Further, annually discounted cash flow analysis is conducted to evaluate the yearly progression of the unconventional gas development process. In addition, this study will also contribute to the understanding of the market conditions that will be necessary to commercially develop shale gas resources.

4.0 Results and Discussion

The energy security and sustainable development of resources are important concepts to avoid concerns such as the Dutch disease and over dependence on overseas energy resources (Stevens, 2003). The energy security concerns of Europe have been gaining high priority with the over dependence on Russian gas and geopolitical developments. However, Australia has been experiencing a resource curse with declining manufacturing, though there is an abundance of energy resources. If shale gas development is also going to have a similar impact it will not be worthwhile. Thus, though at a slower development pace, ‘learning by doing’ by small scale Australian developers with long term supply contracts with manufacturers could not only lead to sustainable shale gas development, but also could lead to more value added end products. Overall, expectations from shale gas are very different in Australia and Europe. Table 3 compares the development costs for Australia and Europe with that of the US. In this analysis, the estimation of European shale gas costs does not consider petroleum revenue tax and ring fence corporation tax that applicable in the UK, as the UK government is considering large tax incentives for onshore shale gas development, bringing down from the existing 62% of taxes applicable on conventional hydro carbon fields to 32% taxes for the onshore shale gas fields (Mainwaring, 2013). In Poland, petroleum revenue taxes are not applicable, but already there are proposals to impose such taxes (Meurs, 2012). For Euopean shale gas developments, a uniform depreciation of 10% has been accounted.

Table 3. Comparison of fiscal and development costs of US, Europe and Australia (EY, 2013; Weijermars, 2013)

United States	**Australia**	**Europe**
Royalty (12.5% - 30%) – Private owner Based on value of petroleum	Royalty (10% - 12.5%) – State revenue May be credited against PRRT	Royalty (0%-13%) – Crown
Income tax (35% Federal) + (0-12% State)	Income tax Earnings before interest and tax *30%	Income tax 19% - 30%
Severance tax Up to 5% of revenue	Petroleum resource rent tax (PRRT) PRRT Taxable profit * 40%	N/A
Leasehold costs $5,000 per acre	Land lease costs (State) + Native lands Up to 1-2% of revenue	Land leasehold costs Up to 1-3% of revenue
Depreciation Drilling and lease costs	Depreciation Diminishing value or Prime cost	Depreciation Uniform depreciation (10%)
Drilling and completion costs $3.5 to $7.0 M per well	Drilling and completion costs $12 -16 M per well	Drilling and completion costs $ 8-24.5 M per well
Operating costs $0.50 to $1.00 /Mcf	Operating costs $1.00 /Mcf	Operating costs $ 0.4 – 1.2 /Mcf

4.1 Australia

In the Australian context, choice of shale gas development is predominantly dependent on the direct development costs, more than the domestic gas price which was one of the underpinning factors of the US shale gas revolution (Stevens, 2010). The availability of other cheaper natural gas resources, in the forms of onshore conventional, offshore conventional and coal seam gas is leading to delay the commitments on the shale gas assets. As reflected from the US shale gas revolution, shale plays require increased activity levels and rapid well replacement procedures to benefit from the economies of scale. The distinctive differences of high depths and essential requirements of hydro fracturing will delay new investment in shale gas. Therefore, shale gas development will need to be incentivised, particularly through the fiscal policy regime to increase the attractiveness of investment on shale gas development. This could be achieved through rapid depreciation policies, Petroleum Resource Rent Tax (PRRT), royalty and income tax holidays. This will make it attractive for local small scale developers leading to more agreements such as the agreement between Strike energy and Orica to supply gas for a 20 year duration (Stevens et al., 2013). Thus, reducing the risks of investment is vital for financial institutions to lend money for shale gas development projects. Thus, having a development plan to increase the attractiveness of shale gas development for Australian small scale developers can lead to not only increase the energy security of Australia, but also to develop strategic service sectors that can capitalise on shale gas development in the Asian region. This study describes the potential strategies to incentivise small-scale Australian natural gas developers.

The small-scale/ junior developers could be incentivised by a variety of mechanisms. Most importantly, long term sustainability of policy is vital for the industry. This study compares the single well development using discounted cashflow analysis for four alternative policy directions based on the current Australian context based on a gas unit price of $9.57/Mcf (Table 4 lists the parameters used in this analysis). Namely;

1. 100% depreciation of exploration and development costs in the first year
2. 70% depreciation of exploration and development costs in the first year, remaining divided equally within remaining well life (14 years)
3. PRRT holidays – first 3 years
4. PRRT holidays – first 5 years

Table 4: Data table and discounted cashflow analysis of an Australian shale well

Drilling and Completion Costs	$9,000,000
State Royalties	10%
Well Spacing	80 acres
PRRT	40%
Income Tax	30%
Well life time	15 years
Discount rate	10%

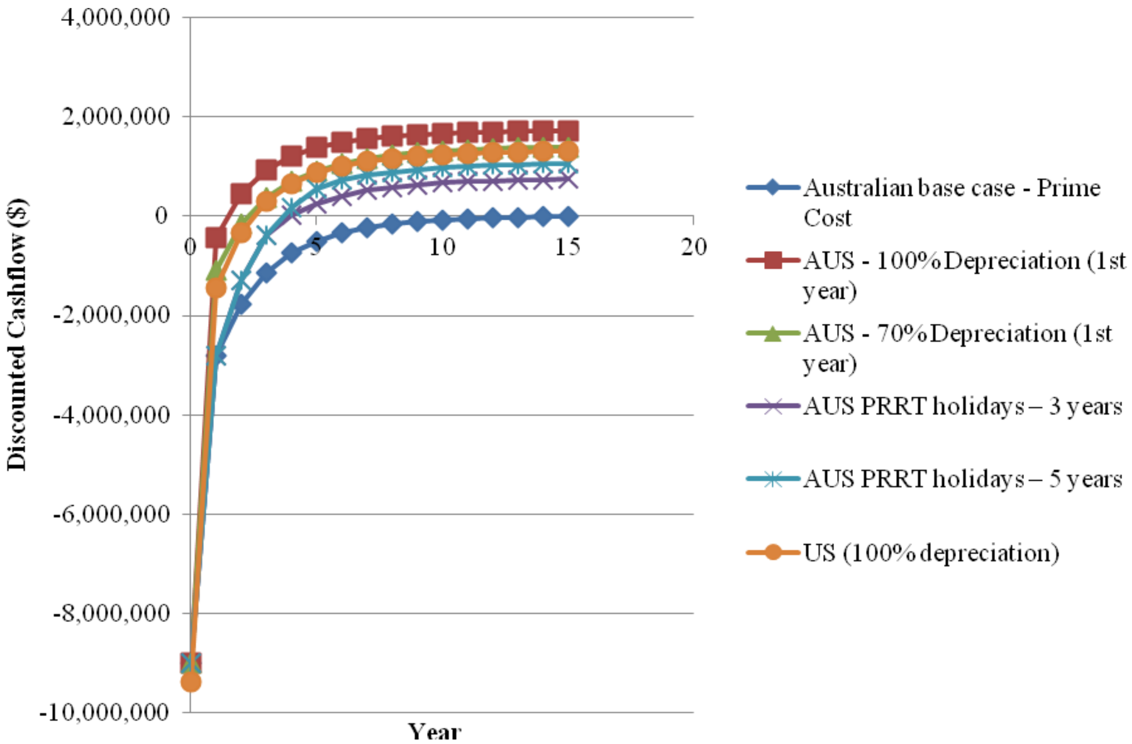

Figure 1. Annually discounted cashflow of Australian shale gas developments based on fiscal policy incentives

As depicted by Figure 1, 100% depreciation of well drilling and completion costs in the Australian context has translated to a positive cashflow of $1,726,943 and total fiscal cost contribution of $5,675,401. Therefore, as depicted by these results and the US experience, this could become a more attractive policy in increasing the shale gas investment among small scale developers. This would also be a more stable policy, especially since shale gas plays need rapid well replacement procedures. Thus, it will also be attractive for service companies, leading to higher economies of scale in development, leading to lower gas development costs.

4.2 Europe

In the European context, direct development costs range from $8.1 - $24.5 million (Weijermars, 2013). As a result, average gas development cost is about $13.32 / Mcf (Figure 2). Table 5 lists the parameters used in this analysis. However, with the same gas price, with lower development costs and US fiscal regime, it leads to a positive cashflow of $4,845,371 indicating the substantial reduction of direct development costs. In Europe, the fiscal cost regime is much friendlier for shale gas development. Poland already committed for a six year corporate tax free period until 2020. The UK already proposed to give more money to the local councils who will commit to develop shale gas (UK Government, 2014). This will promote more shale gas developments, as it will provide direct incentives to the local communities. However, the concerns mainly lie with the direct development costs. These costs will need to come down substantially. Gas costs should ideally not be too expensive relative to Qatar LNG or even in comparison to Australian LNG or US LNG. Main obstacles lie with materials, infrastructure and services required for shale gas developments. The shale gas developments need rapid well replacement procedures and also benefits from the economies of scale with larger production as reflected from the US experience. Therefore, the development plans for shale gas in Europe must specifically look into development costs. Shale gas development specifically requires hydro fracturing services, needs large volumes of water, proppants and ingredients such as guar gum. Therefore, there should be considerations to develop local supply chains for these essential materials to avoid any bottlenecks. Otherwise, it will need to depend on exports from elsewhere, such as china for proppants and India for guar gum. This will reduce the attractiveness of the industry, which is already enraged with community resistance and due to the inconsistency of regulations across Europe. Although there are lower fiscal costs, development costs have been much larger, increasing the total shale gas development costs.

Table 5: Data table and discounted cashflow analysis of European shale gas developments

Drilling and Completion Costs	$8,100,000 – 24,500,000
State Royalties	6.5%
Well Spacing	80 acres
Income Tax	25%
Well life time	15 years
Discount rate	10%

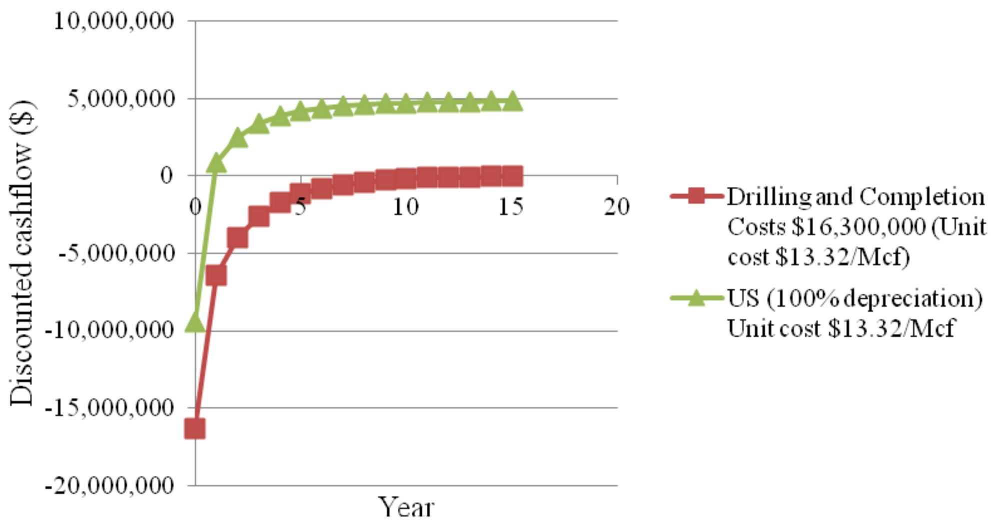

Figure 2. Comparison of discounted cashflow analysis for Europe and the US based on a gas cost of $13.32/Mcf

5.0 Conclusions

The unconventional gas development is economically challenging compared to conventional natural gas development as it utilizes the hydraulic fracturing technology. However, the shale gas development challenges vary for Australia and Europe. In Europe it is more to do with the direct development costs rather than the fiscal costs, whereas in Australia, it is more about the fiscal regime related costs. Europe and Australia can benefit immensely by collective learning of the challenges concerning shale gas development. Incentives based on fiscal policy regimes will be needed to develop unconventional gas resources in the Australian context, whereas in the European context, it will be more about reducing direct development costs through local supply chains and increased activity levels. Energy security implications are also very different for Australia and Europe. As described in the study, Europe will need shale gas to fulfil primary energy needs, whereas Australia could use it as a swing supply source to maintain steady domestic gas prices with increasing LNG exports.

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