Economic assessment of environmentally damaging mining and gas developments in New South Wales

Rod Campbell – Economists at Large
Matt Grudnoff – The Australia Institute

Report prepared by:
Economists at Large Pty Ltd
Melbourne, Australia
www.ecolarge.com
research@ecolarge.com
Phone: +61 3 9005 0154
Fax: +61 3 8080 1604

The Australia Institute
Canberra, ACT, Australia
www.TAI.org.au
Phone: +61 2 6206 8700
Fax +61 2 6206 8708

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Summary

Over the last three years, Economists at Large and The Australia Institute have assisted various community groups in NSW to better understand the economics of coal and coal seam gas projects proposed for their areas. These projects are always presented as being an economic boon for the community and the state, but more careful examination reveals that the benefits are rarely so clear and the costs always more significant than may first appear. Rather than being an unambiguous bonanza, all projects involve winners and losers, positive and negative aspects. Often these subtleties are contained in technical assessments that are difficult for general readers to assess. We help communities understand the effects that matter to them.

Many of these projects affect not just local communities, but areas of state and national environmental significance, including several identified by the Nature Conservation Council of NSW as natural "icons". Given the potential effects of the projects on such significant areas, the NSW community should be closely weighing the costs and the benefits of development.

NCC has commissioned us to review proponent assessments and our submissions to identify recurring problems in economic assessments and cumulative impacts of projects. The projects assessed in this review were:

- Cobbora Coal Project
- Ashton Coal Project
- Boggabri Coal Project
- Tarrawonga Coal Project
- Warkworth Coal Project
- Maules Creek Coal Project
- Santos Coal Seam Gas Project.

Several themes emerge from the assessments of these projects:

Economic benefits are overstated
Economic assessment commissioned by industry routinely inflates the estimates of benefit of these projects. Common misrepresentations involve including profits accruing to foreign shareholders as "NSW community benefits", even in wholly foreign owned projects such as Boggabri Coal Project. The proponents of the Warkworth project claimed "community" benefits of nearly $2b, later conceding that only around $0.5b of these would accrue to NSW.

Environmental costs downplayed
Where these projects impact on native vegetation and areas of environmental significance, they are required to plan environmental offsets. Commissioned economic assessments invariably assume that these offsets will perfectly compensate for the areas destroyed. However, ecologists are divided about the potential for offsets to achieve their goals. A recent review of the Maules Creek offset program found serious oversights and omissions. We feel that economic assessments should consider an element of risk around offsets that reflects debate between biological scientists.

Greenhouse emissions downplayed
Commissioned assessments consider the greenhouse emissions produced by project operations, but not from downstream combustion. From an economic perspective, the approval of these projects will likely have some marginal effect on coal prices and therefore a marginal increase in consumption. The emissions associated with this increase in consumption should be considered as a cost of the projects. Basic calculations based on published estimates suggest these costs alone are greater than the value of the projects.

Employment benefits are overstated
Commissioned assessments use economic models to predict the "indirect" and "downstream" impacts of their projects. These models make assumptions such as the existence of an unlimited supply of skilled labour and that prices and wages will not increase around major projects. Thus, the Tarrawonga project will employ only around 120 people, but claims to generate almost 1800 jobs. The Warkworth project went one step further, using similar modeling, but redefined "job" as lasting only one year, to claim nearly 45,000 jobs created.

Costs to other industries ignored
Commissioned assessments downplay or ignore costs to other industries such as higher labour costs and a higher exchange rate. Resource projects have forced up the wage rate for certain skill sets as well as moving workers away from other industries. Industries such as manufacturing which use similar skill sets are having trouble paying the higher wages and are forced to cut back production or shut down. The high Australian dollar has been driven by the higher value of mineral exports. Resource projects that expand Australian exports, such as coal and coal seam gas projects put further upward pressure on the exchange rate. The high value of the dollar has put pressure on exporting industries and industries that compete with imports and has led to job losses.

Health costs ignored
Coal mining, transport and combustion can have a major impact on human health. Studies in the USA suggest that the economic effects of health impacts – through increased health costs, reduced productivity, increased mortality, etc – often outweigh the financial value of the project. Despite widespread community concern in NSW, the economic assessments of these projects do not include consideration of health impacts. When questioned, the justification given is that noise and dust levels are forecast to comply with legislated guidelines. However, forecasts are often understated and compliance with guidelines does not ensure a zero health impact. We believe these assumptions do not justify a value of zero for health impacts in project economic assessment.

Our full reports and the economic assessments commissioned by project proponents are available through our websites:

www.ecolarge.com
www.tai.org.au

Summaries of each are provided at the end of this report.

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Introduction

We often hear about a "billion dollar mine[1]", but what does this actually mean? Does it mean the project will cost a billion dollars to build, or that it will bring a billion dollars in profit? Will the mine generate a billion dollars in public benefits? Generally we're not told and generally it doesn't really matter – the authors' point is to emphasise that these projects are big and important.

Big and important they may be, but this does not mean these projects are without serious cost, or even that they are in the best interests of the local communities, the state or the nation. Clearly project proponents think these projects are in their interests. State governments are also understandably enthusiastic about projects that will provide royalty revenue, but local communities are often left wondering where the proclaimed benefits have gone and who will compensate them for impacts on health and the local environment.

Over the last three years Economists at Large and The Australia Institute have assisted various community groups in NSW to better understand the economics of coal and coal seam gas projects proposed for their areas. The proponents of these projects have commissioned economic assessments that paint a rosy picture of the projects' impacts. Some of these projects will be very profitable and pay considerable royalties to the state. They will provide well paid employment to a number of people and will benefit certain local businesses. However, they will also send money overseas, reduce employment in other industries, destroy environmental assets, impact on health and increase greenhouse gas emissions.

Many of these projects will have an impact on areas the Nature Conservation Council of NSW (NCC) considers natural icons[2], areas with particular conservation significance and refuge of endangered flora and fauna species. Given the potential impacts on such important areas, the NCC is keen to use the earlier work of Economists at Large and The Australia Institute to explore common themes in project assessment and cumulative impacts. The projects examined in this report are:

- Cobbora Coal Project
- Ashton Coal Project
- Boggabri Coal Project
- Tarrawonga Coal Project
- Warkworth Coal Project
- Maules Creek Coal Project
- Santos Coal Seam Gas Project

The assessments of all of these projects have tended to paint them in a flattering light. Our work has found a range of overstated benefits and understated costs, which suggest that they are not as valuable to NSW as their proponents suggest.

[1] http://www.smh.com.au/nsw/1b-mine-looks-doomed-20130221-2eud3.html
[2] (Hogan 2011)

Overstatement of economic benefits

All the projects that will impact on the NCC's natural icon areas have been given the big number treatment. According to their economic assessments, the Maules Creek Coal Project will increase state business turnover by $2.8b per year, while the Cobbora Coal Project will have operating costs of over $3.2b – but while they demonstrate that a project is "big", these figures do not tell us whether the project will provide net benefit to society.

From an economic perspective, the measure to look for is a project's "net present value" – that is, what benefits are left over after the project's costs have been accounted for. Most of the projects near icon sites have been subject to economic assessment through cost benefit analysis and without exception these overstate the benefits of the projects.

One of the most important steps in working out a project's net benefits is deciding whose costs and benefits count:

> *Let us now turn to … issues that challenge and bedevil practitioners of social benefit-cost analysis. The first challenge is deciding "whose benefits and costs count" …. It sometimes is called the issue of standing--that is, who has standing in the analysis of benefits and costs? This is an issue of scope. Should the analysis include only those costs and benefits affecting residents of the local community? The state or province? The nation? The world? Whether the net benefits of a project are positive or negative often depends on how narrow or broad the scope of the study is.*[3]

In our view the most appropriate scope for these projects is around the costs and benefits to NSW. Indeed, the Director General's requirements for economic assessment of most of these projects is do demonstrate a net benefit to the "NSW community". So it should come as a surprise to the people of NSW that the economic assessment of these projects – projects that aim to exploit their natural resources – routinely includes profit to overseas shareholders as part of benefits to the NSW community.

The economic assessment of the Warkworth coal project initially claimed a "net community benefit" of $1.9 billion[4]. It was only under the scrutiny of the NSW Land and Environment Court that the authors conceded that the value to NSW was closer to $0.5b[5] and the court heard that even this was in dispute[6].

The Maules Creek project was also presented in a misleading manner, with the initial assessment boasting a net benefit of $8.7b[7], revised down to $5.5b in response to Economists at Large submissions on the original assessment. This lower figure still did not represent a net benefit to the NSW community, as it included distributions to stakeholders around the country. No calculation for NSW was ever made, the best approximation being royalties to the state valued at $1.2b.[8]

[3] (Eggert 2001) p27
[4] (Gillespie Economics 2009a)
[5] (Bennett and Gillespie 2012)
[6] (Campbell 2012)
[7] (Gillespie Economics 2011)
[8] (Hansen Bailey 2011)

The same misrepresentations were made of the Boggabri Coal Project and Ashton Coal Project[9]. Despite these projects being entirely foreign owned, the profits accruing to their foreign owners were included in calculations of "community benefits". No revisions have ever been made to inform the NSW public and decision makers as to how much they stand to benefit from these projects.

The Cobbora Coal Project took a different approach to the net benefits to the NSW community. As the project is wholly owned by the NSW state government, profits accruing to foreign shareholders would not be an issue. In fact, profits accruing to anyone would not be an issue as the project is not expecting to make any – it is proposing to sell its coal on a "cost recovery basis" to favoured electricity generators.

If the project goes ahead it will sell 9.5 million tonnes per annum to favoured generators at $31 per tonne, producing present value revenue of $3.4 billion. Present value of capital and operating costs, according to the project's economic assessment are over $4.3b. Unless production could be increased and the remaining low quality coal sold at a premium – unlikely in current coal markets – the project stands to produce a loss of around $1 billion.

However, the economic assessment's definition of "NSW community" includes benefits to favoured generators, but not the losses to competing generators. The economic assessment offsets the financial loss to the operation with the value of the coal delivered to receiving generators, a value of around $3b. The analysts then claim a net benefit to "the community" of nearly $2b[10].

Overstatement of employment

The public and decision makers are rightly interested in the impacts of projects on employment. Here again, big coal and coal seam gas projects have made claims that do not always withstand close scrutiny.

For example, the Warkworth Coal Project estimates that it will employ between 148 and 951 workers depending on the stage of its operations. However, the economic impact assessment of the project estimated that:

> *a further 44,675 jobs will be generated in the Hunter Region economy from Year 1 (2011) to Year 21 (2031) because of the Warkworth extension.*[11]

Turning a couple of hundred jobs into nearly 45,000 jobs requires some imagination. Firstly, the consultants employed a definition of "job" that meant employment for one year. This means that if you have been in your job for the last decade, according to these consultants, you have actually had ten different "jobs". The Warkworth project was modeled to run for 21 years, so on average it seems the consultants expect a little over 2000 jobs to be "created".

[9] (Gillespie Economics 2010) (Gillespie Economics 2009b)
[10] (Gillespie Economics 2012) (Economists at Large 2012)
[11] (HVRF 2009a)

Even this seems unlikely. The type of economic model used for this calculation, input-output models, is treated with caution by most economists. The ABS stopped publishing some data important for use in these models due to:

> *considerable debate in the user community as to their suitability for the purposes to which they were most commonly applied, that is, to produce measures of the size and impact of a particular project to support bids for industry assistance of various forms.*[12]

The ABS goes on to explain why these models ensure the results will overstate the economic impact of the project:

> ***Lack of supply–side constraints:*** *The most significant limitation of economic impact analysis using multipliers is the implicit assumption that the economy has no supply–side constraints. That is, it is assumed that extra output can be produced in one area without taking resources away from other activities, thus overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.*
>
> ***Fixed prices****: Constraints on the availability of inputs, such as skilled labour, require prices to act as a rationing device. In assessments using multipliers, where factors of production are assumed to be limitless, this rationing response is assumed not to occur. Prices are assumed to be unaffected by policy and any crowding out effects are not captured.*

In other words, these models assume that in the areas around these projects there is a limitless supply of skilled miners, construction workers, water, capital and all other inputs to production. It is therefore assumed that projects that use a large amount of these inputs do not affect the price of them, assumptions that are clearly unrealistic.

All the projects near icon sites have had their employment impacts inflated by input output models:

- The Cobbora project will employ between 300 and 600 people, but boasts that it will create 3,150 jobs[13].
- The Ashton mine will employ 160 people, but claims it will be responsible for 700 jobs[14].
- The Maules Creek Project will employ just under 400 people, but claims to generate over 4000 jobs[15].
- The Boggabri Project will employ around 450 people, but claims to create 3,675 jobs[16].
- The Tarrawonga project will employ only around 120 people, but claims to generate almost 1800 jobs.
- The Santos gas project will employ 200 people, but claims to generate 2900 ongoing, full-time positions[17]

[12] (ABS 2011)
[13] (Gillespie Economics 2012)
[14] (HVRF 2009b)
[15] (Gillespie Economics 2011)
[16] (Gillespie Economics 2010)
[17] (Allen Consulting Group 2011)

These claims clearly overstate the employment impacts of these projects. While the impacts on some local areas will be considerable, their impact on overall employment will be negligible. These projects will not recruit unemployed people, but skilled workers who generally have other jobs either in the mining or other industries. This has been acknowledged by Dr David Gruen, head of Macroeconomics at the Commonwealth Treasury:

> *"In a well-functioning economy like ours, with unemployment close to its lowest sustainable rate, it is not the case that individual industries are creating jobs, they are simply re-distributing them."*[18]

Costs to other industries

Resource project investment is at record levels driven by high world commodity prices. According to the Bureau of Resources and Energy Economics (BREE) Australia has a record $268 billion of advanced resource projects.[19] This huge mining investment boom is creating bottlenecks and labour shortages. People who have the skills and are prepared to work on remote resource projects are fully employed. Additional projects are only able to proceed by moving workers with offers of higher pay either from existing projects or from other industries. The result is rapidly rising wages and any industry apart from the mining industry is having real difficulty finding certain skilled workers and being able to afford to pay them.

The Economic Impact Assessment of the China First Project, a large coal mine in Queensland's Bowen Basin estimated that this project alone would destroy 3,000 jobs across Queensland and Australia.[20] These losses would be caused by the project drawing labour from other parts of the economy. Complete Economic Impact Assessments include these kinds of findings that look at both the gains and losses the project will create. While not all Economic Impact Assessments are complete, even those that do provide this information tend to bury it in the report and those parts that are highlighted are usually the gross employment numbers which ignore job losses the project creates.

One very important impact on other industries that is consistently ignored by project proponents is the effect on the exchange rate. The mining boom has driven the Australian dollar to historically high levels. The high exchange rate has reduced the Australian dollar value of our exports. Since most of Australia's exporters are price takers this effectively reduces the price that our exporters receive. It has also made imports into Australia cheaper. This has caused considerable stress to Australia's trade exposed industries, with many of them cutting back or closing down. This has been particularly true of manufacturing, tourism, agriculture and higher education.

As the value of Australia's exports has grown so has demand for Australian dollars by foreigners to buy our exports. This increased demand has pushed up the exchange rate. Resource projects that plan to export all or significant amounts of their output will add to this demand for the Australian dollar and hence put further upward pressure on the exchange rate.

Economic Impact Assessments tend not to deal with effect on the exchange rate by assuming that their one project is not likely to have a significant impact on the dollar. The problem with this is that each approved project adds additional pressure and the number of

[18] Transcript of evidence to senate economics committee 16 Feb 2012, p. 17
[19] (BREE 2012)
[20] (Denniss 2011)

projects collectively is having an impact. Because of this Economic Impact Statements underestimate the cost of their projects on other industries.

Understated health costs

Open cut coal mining, transportation of coal in uncovered wagons, coal loading and unloading facilities and coal burning power plants can have a serious impact on air and water quality. This can affect human and animal health, reducing our productivity and increasing health costs. A well known study in the American Economic Review found that the effects of coal mining and coal fired power on health outweigh the industry's value of production:

> *The largest industrial contributor to external costs is coal-fired electric generation, whose damages range from 0.8 to 5.6 times value added.*[21]

This study is not alone. Other researchers in the Appalachian region found that the health costs associated with coal mining in that region from 1979 to 2005 ranged from $18 billion to $86 billion, while the financial benefits of the industry had been only $8 billion. The study concluded:

> *The human cost of the Appalachian coal mining economy outweighs its economic benefits.*[22]

Australian research in this area is less advanced, but supports these general findings. In a submission to the Senate Committee Inquiry into the Impacts of Air Quality on Health, a University of Newcastle researcher has applied the results of research into the costs of air pollution in Sydney's Greater Metropolitan Region to the predicted air quality impacts of a coal project on the Hunter region. This analysis finds that air pollution in the Hunter causes annual health costs of approximately $1,766 million and that a proposed coal export terminal project would increase this cost by approximately $29 million[23].

The economic assessments of these projects do include items relating to air quality, dust, noise and other physical impacts that may impact on health. These impacts are rarely explored in detail, however, as they assume that mitigation measures and property acquisition will perfectly offset any impacts. The assessments then claim that the value of these impacts are "included in opportunity cost of land and capital costs"[24]. Impacts on areas outside of acquisition zones are considered to be negligible as proponent's noise and dust modeling estimates that impacts will be within relevant guidelines.

This approach is inappropriate for two reasons. Firstly, project proponents' commissioned noise and dust studies are rarely accepted as accurate by local people near the project sites. A recent study on particulate pollution in the Hunter Valley finds that exceedances of guidelines are routine. For example, particulate pollution guidelines allow for five exceedances of average levels per year. They recorded thirteen in less than four months[25].

[21] (Muller, Mendelsohn, and Nordhaus 2011)
[22] (Hendryx and Ahern 2009)
[23] (HCEC 2013) based on (DEC NSW 2005)
[24] This quote is from (Gillespie Economics 2009b) p3, others have a similar item
[25] (CTAG 2013)

Secondly, while projects may comply with legislated guidelines, medical studies conclude that there is no threshold level below which health is unaffected by some pollutants. People with heart and lung conditions, respiratory infections, asthma, infants and the elderly are vulnerable to even very low levels of exposure to particulate pollution[26].

By not including an estimate of impacts on health, or by assuming that compliance with guidelines ensures a zero impact, economic assessments are overstating the value of these projects. This is inappropriate given the high costs of health impacts identified in overseas studies and recent findings in NSW.

Understated impacts on native vegetation and wildlife

Most of these projects will destroy areas of native habitat and endangered ecological communities. The following table shows the area of native vegetation that will be destroyed by each coal project, based on estimates in their original environmental assessments:

Table 1: Impact on native vegetation

Project	Area (hectares)
Cobbora Coal Project	2,843
Ashton Coal Project	27
Boggabri Coal Project	1,503
Tarrawonga Coal Project	397
Warkworth Coal Project	765
Maules Creek Coal Project	1,665
Total	7,200

The impact of the original Santos coal seam gas proposal in the Pilliga on native vegetation is also considerable, directly impacting 600 hectares of native vegetation.[27]

Because they will destroy native vegetation the projects are required to prepare plans for vegetation offset areas, where proponents will attempt to restore and improve degraded areas of the ecosystems they are destroying with their projects.

The economic assessments of most of these projects do not include a value for the destruction of these areas. They assume that the offsets will compensate for any losses and so claim:

> *Some loss of values but offset. Cost of offset included in capital costs and operating costs.*[28]

In theory, if the offset programs can achieve a perfect recreation of the areas the projects destroy then this is a valid approach. However, there is enormous debate between ecologists as to whether or not this is likely, or even possible. They point out that offsets often consist of protecting one area in exchange for destroying another, resulting in a net loss of the destroyed ecological community. Offsets that recreate a destroyed community elsewhere may take many years to mature, placing pressure on species dependant on this

[26] (CTAG 2013)
[27] (http://www.santos.com/library/130410_A_balanced_energy_solution_for_NSW.pdf)
[28] This quote is from (Gillespie Economics 2011) p13, others have a similar item

community for long periods. Importantly, there is considerable uncertainty around the future security of offset areas[29].

One example of this debate centers on the offset program proposed for the Maules Creek Coal Project. The Maules Creek Community Council commissioned North West Ecological Services to review the plan of the proponents. Their review[30] contests the accuracy and appropriateness of the offset program and planning for the Maules Creek mine. Their review finds that:

- Offset areas are not replacing "like with like", i.e. that the proposal will destroy one type of area and replace it with another.
- Offset areas are not suitable habitat for endangered species.
- Mapping of areas was misleading.
- Endangered plant species were not found in the initial survey.

Economists should not be expected to understand and review the work of specialists such as ecologists and botanists. They should not have to adjudicate in these debates between physical scientists, but the allocation of zero values to these external costs is just such a judgment.

Instead, the economic assessment should reflect the uncertainty that exists around offset proposals. Environmental economics has tools that can assist in these evaluations and could provide the NSW community with an estimate of what they stand to lose in economic terms depending on the outcome of the offset program.

This issue is at the heart of public concern around these projects and should not be downplayed. The public is likely to lose environmental assets – species, ecosystems, areas of native habitat – as a result of these projects. These losses may be minor and partial, or they may be permanent and irreplaceable. Understanding and considering the extent of this value is a potentially important role that economic assessment can play. However the assessments of these projects have not considered these issues.

Understated greenhouse gas emissions

The economic assessments of these projects include an item valuing the greenhouse gas emissions of the mining operations. This relates not to the coal being burned, but to the operations of the mine itself, transport and perhaps some fugitive emissions. These values range between $32m (Ashton) and $184m (Cobbora).

The greenhouse gas emissions of the mining operations themselves are relatively small, however, when compared with the emissions that will be generated by the combustion of the coal by final users. From an economic point of view, the main greenhouse impact of these projects is the emissions associated with the increase in coal consumption caused by these projects. This increase in consumption is caused as the projects will push coal prices lower and this lower price will cause some consumers to consume coal at the lower price, who would not have at the higher price.

[29] For an introduction to this debate see (Bekessy et al. 2010)
[30] (NWES 2013)

It is important to understand the difference between this position and the positions of coal industry proponents and opponents respectively. Coal industry proponents suggest that reducing Australian coal production will result in all of that production coming from somewhere else, such as Indonesia. Climate change advocates sometimes suggest that a coal project should consider the entire weight of its downstream emissions. In economic jargon, these two positions suggest "perfect price elasticity of supply" on one hand and perfect inelasticity on the other.

We suggest the correct approach is between these two extremes. The assessment of these projects should consider the marginal increase in coal consumption that they are likely to cause and the emissions associated with this increase. We can make some estimate of this increase from the economic assessments and published estimates of the elasticity of coal supply and demand. Firstly, considering the volume of the production from the projects:

Table 2: Project coal production

Project	Tonnes per year	Years	Total
Warkworth	18,000,000	14	252,000,000
Cobbora	20,000,000	21	420,000,000
Maules Creek	13,000,000	21	273,000,000
Boggabri	7,000,000	21	147,000,000
Tarrawonga	3,000,000	17	51,000,000
Ashton	3,600,000	7	25,200,000
Total			1,168,200,000

This figure likely overstates the total production of these projects as project specifications and consent conditions are changing through the assessment process and some assessments present figures for production coal and others for unprocessed "run of mine" coal. For purposes of illustration, however, we will use the round figure of one billion tonnes over the lives of the projects.

Some estimate of this effect can be made from published sources and consideration of the price elasticities of supply and demand for coal. The standard analysis gives the equilibrium effect on aggregate quantity by the project as $\Delta(\varepsilon/(\varepsilon+\eta))$ where:

Δ is the initial change in supply
ε is the elasticity of demand
η is the elasticity of supply

The elasticity of demand for coal is estimated at -0.3[31]. Estimates of the elasticity of supply vary widely from 0.3 to 2.0 with one source concluding that the best estimate is around 0.5[32]. Using these estimates of price elasticities in the equation above, we see that the likely market outcome would be an increase in total consumption of:

1,000,000,000 * (0.3/(0.3+0.5)) = 375,000,000

[31] (Ball and Loncar 1991)
[32] (Light, Kolstad, and Rutherford 1999)

Burning one tonne of coal produces between two and three tonnes of carbon dioxide, depending on the quality of the coal and other impurities. Increasing world coal consumption by 375m tonnes would therefore produce emissions of around 1 billion tonnes of CO_2 equivelant.

The value of the damage caused to the world's climate by a tonne of carbon dioxide emitted is one of the most important and controversial topics in current economic debate. The cost benefit analysis prepared by the proponents for each of the mining proposals covered in this report includes a review of some of the major studies on this question, with estimates of between USD$0.55 and $85 per tonne. The value included in most of these cost benefit analyses is AUD $30 per tonne.

Applying this social damage estimate of $30 per tonne to the increase in emissions caused by these projects gives a total cost of:

$30 * 1,000,000,000 = $30,000,000,000

The proponents' economic assessments estimate their total economic benefit is around $15 billion. At any emission damage value of over $15 per tonne, the damage associated with marginal increases in emissions would outweigh estimates of their value.

Conclusion

In reviewing the economic assessment of major coal and coal seam gas projects in NSW, we see that there are recurring issues that are overlooked and the cumulative impacts are rarely considered. As a result, we believe the value of these projects to the people of NSW is being heavily overstated. The main issues identified in our review of these seven projects are:

- **Economic benefits are overstated** – assessments often include benefits to overseas and interstate interests as accruing to the "NSW community". This serves to overstate the benefits of the project.
- **Damage to native vegetation is downplayed** – assessments assume that ecological offsets will perfectly compensate for the destruction of endangered ecological assets. This is contrary to the opinion of most ecologists.
- **Greenhouse emissions are downplayed** – expanding the supply of coal in the world will decrease its price and increase the amount consumed. This will result in extra emissions as a result of these projects. Depending on the damage value of emissions, this cost alone can cast into doubt the economic merits of the projects.
- **Employment benefits are overstated** – models used to assess impacts on employment include unrealistic assumptions such as there being no limits on the supply of skilled labour. Some employ definitions of a "job" that serve to overstate the impacts of the project by tens of thousands of "jobs".
- **Costs to other industries are ignored** – these projects will cause competition in labour markets with other industries, increasing their costs and reducing their output. They will also place upward pressure on exchange rates, putting trade exposed industries at a disadvantage.
- **Health cost are ignored** – research in Australia and overseas shows there are substantial health costs associated with coal mining, but no value is included in economic assessments.

This is occurring at a time when the mining industry is perceived as lacking a "social licence to operate" in farming areas and areas of environmental importance. Conflicts over coal and coal seam gas developments are making headlines regularly, with farmers, environmentalists and the broader community challenging industry claims that these developments are in the public interest. More thorough assessment of resource development proposals would provide more meaningful information for affected communities and government decision-makers.

Appendix: summaries of TAI and EAL reviews and submissions

Cobbora coal project

The proposed Cobbora Coal Project is for an open-cut mine into agricultural land and native vegetation 60km east of Dubbo, NSW. The proposal is for a 21-year open cut mine which will mine up to 20 megatonnes of coal per year. The proponent is currently seeking planning approval and has prepared an Environmental Assessment.

Local community group, the Mudgee District Environment Group (MDEG) is concerned that the proposed project will affect agriculture, the community, indigenous heritage and threatened ecosystems and species, which include owls, woodland birds, freshwater fish and bat species. Many communities in Australia are facing similar issues and are concerned that the often-touted benefits of the mining boom may be overstated and/or not accruing to local people.

In late 2012, Economists at Large reviewed the Economic Assessment of the Cobbora Coal Project, made a submission on the EA and presented our results to a Planning and Assessment Commission hearing in Dunedoo.

Contrary to the claim in the Project's Environmental Assessment that "the EA includes a full comparison of the Project's costs and benefits" that "provides decision makers and other interested parties with a reliable indication of the Project's overall merits", we found that the economic assessment significantly overstates the benefits of the project while understating the costs. The Assessment should be revised to account for the following issues:

Project benefits

By adopting a definition of the project that differs with the rest of the Environmental Assessment and Cobbora Holdings' own website, the economic assessment finds a net present value (NPV) of around $2b. By adjusting this narrow definition of the project to address the actual impacts on the people of NSW, however, we see that the likely NPV is -$1b, an overstatement of $3b.

Greenhouse gas emissions

The economic assessment includes only direct emissions of the mine, rather than the increase in emissions attributable to the project, as is standard in economic analysis. Such an estimate is easily obtained from published estimates of coal price elasticities. This omission results in an understatement of the project's costs of approximately $4b.

Social value of employment

The use of social value of employment in economic evaluation of coal projects has been criticised by many of Australia's most prominent economists and charitably labelled as "contentious". With the existence of this value in doubt, the magnitude included in the economic assessment ($192m) is at best a wild overstatement.

Noise, dust, vibration and amenity impacts

None of these impacts have been adequately assessed through property evaluation and impacts on residents outside noise-affected areas have not been quantified at all. This is clearly inappropriate in economic analysis.

Value of rural communities

In other studies Gillespie Economics have calculated a value for the impact of mines on rural communities, but have failed to incorporate this value into this assessment. By their own estimates this may overstate the value of the project by $1.9b.

Ecology and water quality

The assumption that offsets will perfectly substitute for impacts on ecology and water quality is unrealistic and contested by experts in these fields. This serves to overstate the value of the project.

Road and rail transport

The assumption that impacts on road and rail transport construction and maintenance will be adequately covered by capital expenditure is contrary to recent local experience and serves to overstate the value of the project.

Health impacts

No impact on health is incorporated in the economic assessment, despite this issue garnering much attention in the local region.

Transparency

Most calculations in the economic assessment are not replicable with the information provided, those that are result in values significantly different to those reported. This must be explained for the assessment to have any validity.

Input Output modelling

The use of input output modelling in the economic impact statement serves to overstate the project's impacts on economic activity and employment. This is well known by the Australian Bureau of Statistics who have published warnings about inappropriate use due to the lack of resource constraints and no impact on price estimates.

In the economic assessment of the Cobbora Coal project, Gillespie Economics has overstated the project's benefits and understated its costs to the extent that there is no doubt the project represents a net loss to the welfare of the NSW public. The project should be rejected without hesitation based on this assessment.

Ashton coal project

The Ashton Coal Mine is an existing mine in the Hunter Valley, 14km from the town of Singleton. The project proponent is proposing to extend the existing operations with an open-cut mine into agricultural land and native vegetation. The proposal is for a seven year open cut mine which will mine up to 3.6 million tonnes per annum. The proponent prepared an Environmental Assessment in the planning approval process, which is currently being contested in the NSW Land and Environment Court.

Economists at Large are preparing to appear as expert witnesses in the case and have reviewed the Benefit Cost Analysis of the Ashton Coal Project written by Gillespie Economics, at the request of the Hunter Environment Lobby.

The Benefit Cost Analysis overstates the project's benefits and understates its costs, making it unsuitable for decision making purposes. The Assessment should be revised to account for the following issues:

- **Overstatement of benefits**
    - Payments to foreign shareholders are included in "net community benefits" in a way which overstates the value of the project to NSW by perhaps $260m
    - Inclusion of "social benefits of employment". The validity of this value has been widely criticised by prominent economists and its inclusion may overstate the value of the project by $108m.
- **Understatement of costs**

- Increases in greenhouse gas emissions associated with the project's impact on coal consumption are not included, potentially overstating the project's value to the world by $460m.
- Noise, air quality and amenity impacts are undervalued, with inappropriate assumptions used in relation to property acquisition, impacts on non-acquisition zone residents and the NSW public which are not supported by literature or local experience.
- Ecological impacts are unquantified, with the assumption that offsets are a perfect substitute for impacts, despite debate between ecologists and findings from economic studies also by Gillespie Economics.
- No consideration of health impacts
- No consideration of lost recreational space

- **Non-transparent calculations and lack of data**

Given these issues, we believe it is highly unlikely that this project will result in a net benefit for the community of NSW. We recommend rejecting the project until a thorough revision of the benefit cost analysis is conducted and these issues are clarified. Doing so would not only allow for the best outcome in relation to this project, but could serve as a guide for other projects in the area and nationally. This is occurring at a time when the mining industry is perceived as lacking a "social licence to operate" in farming areas. Robust and transparent assessment of this project can help to address this issue.

Maules Creek coal project

The Maules Creek Proposal is for a new mine, largely within the Leard State Forest. The mine would destroy a large part of the forest and produce 13 million tonnes of coal per year for 21 years. The project gained prominence in January 2013 when anti-coal activist Jonathan Moylan sent a hoax email to media outlets purporting that ANZ had withdrawn support for the project. The project is currently owned by Whitehaven Coal.

In 2011 Economists at Large reviewed the Economic Assessment of the Maules Creek Coal Project on behalf of the Maules Creek Community Council. We found that the Economic Assessment contains flaws and omissions that make it unsuitable for decision making purposes. The Assessment should be revised to account for the following issues:

- **Inconsistent scope of analysis.** The Economic Assessment is required by NSW Department of Planning Environmental Assessment Requirements to consider the project from the perspective of the NSW community. It fails to do this on a number of fronts, notably:
  - **Consideration of alternative projects-no underground option considered –** only the option most beneficial to the proponent is considered, with no consideration of underground mining options, despite local studies finding underground mining is economically viable.
  - **Net production benefits –** Most of these will be lost to the NSW community due to the ownership structure of the project. No adjustment is made in the Economic Assessment.
  - **Opportunity costs –** considered strictly from the perspective of the proponent, with no consideration of forgone projects in NSW, or alternative uses of capital for NSW investors.

- **Greenhouse gas costs –** confusion between what costs will accrue to NSW or the world.
- **Discussion of distribution of costs and benefits –** Little discussion of distribution, particularly of external costs which will accrue mainly at local or state levels.

- **External costs.**
  - No consideration has been made for the debate between physical scientists as to the effectiveness of environmental offset programmes.
  - No consideration given to the health impacts of open cut coal mining and transport.
  - Social value of employment has been overstated.
  - No consideration of recreational losses.

- **Inconsistent figures.** Present value figures presented in the cost benefit analysis do not match the values presented in the text of the assessment. We present our working from the values in the text, which show differences of over $1.5 billion on the major items of the assessment. The public can have no confidence in an assessment where large errors have been made in basic calculations such as present value. These figures need to be explained or revised.

We believe that all these issues need to be clarified and adjustments made to the economic assessment of the project to ensure a decision is made in line with the NSW public interest. Doing so would not only allow for the best outcome in relation to this project, but could serve as a guide for other projects in the area and nationally. This is occurring at a time when the mining industry is perceived as lacking a "social licence to operate" in farming areas. Robust and transparent assessment of this project can help to address this issue.

Tarrawonga coal project

The Tarrawonga Coal Project proposes to expand an existing mine into agricultural land and the Leard State Forest. The project is in the same area as the Maules Creek and Boggabri projects and hopes to produce three million tonnes of coal per year for 17 years.

Economists at Large were asked by the Maules Creek Community Council to review the assessment of the project, *Appendix M – Socio-Economic Assessment* by Gillespie Economics. We found that there were a number of very significant issues in the economic assessment, which, without being addressed, would render the assessment unsuitable to contribute to decision-making. These issues are:

- **Scope of the assessment** Particularly relating to:
  - **Benefits accruing to Australia and overseas**
  - **Greenhouse gas emissions**
  - **Consideration of alternative projects**
- **External costs and benefits.** Many are inappropriately given a zero value, and we offer further comment on
  - **Health impacts**
  - **Social value of employment**
- **Inappropriate use of input-output modelling in impact assessment**
- **Transparency of calculations**

We believe that all these issues need to be clarified and adjustments made to the economic assessment of the project to ensure a decision is made in line with the NSW public interest. Doing so would not only allow for the best outcome in relation to this project, but could serve as a guide for other projects in the area and nationally.
This is occurring at a time when the mining industry is perceived as lacking a "social licence to operate" in farming areas. Conflicts between farming communities and coal and coal seam gas developments are making headlines regularly, with farmers and the broader community losing confidence that such developments are in the community's best interests. Robust and transparent assessment of this project could help to address this issue.

Boggabri coal project

The Boggabri Coal Project is proposing to extend an existing mine in north western NSW. Located near the Maules Creek and Tarrawonga projects, the Boggabri project would see the mine expand into Leard State Forest and agricultural land, to produce up to 7 million tones per annum of product coal. The project is wholly owned by Japanese trading company Idemitsu.
In early 2011 Economists at Large have undertook a review of the project's economic assessment - *Appendix Q - Economic assessment of the environmental impact statement into the continuation of the Boggabri Coal Mine,* by Gillespie Economics.

We found several issues that call into question aspects of the analysis presented by the Economic Assessment. These issues are:

- No economic analysis of scenarios have been undertaken other than cessation of mining in 2011 and a 21 year, open cut extension despite seven alternative scenarios being mentioned in the Environmental Assessment report.

- Mixing of private financial values and public economic values within the cost-benefit analysis.

- Miscalculation and/or omission of external costs and benefits.

The result of these issues is that the assessment - the cost-benefit analysis and then carried on into the economic impact assessment - present values that inflate public benefits and under estimate public costs. The assessment seems to avoid discussion of distribution of benefits between stakeholders and fail to assess all alternative methods of expanding this mine.

In summary, the overstatement of benefits and understatement of costs of the project mean that the modelling results for the Economic Impact Assessment are heavily compromised and should not be used for decision making purposes.

Warkworth coal project

The Warkworth coal project is a proposal to extend an existing mine through earlier environmental offset areas, other areas of native vegetation, farmland and close to the village of Bulga in the Hunter Valley. The proposal is to produce 18 million tonnes of coal per year for 17 years. The project is owned by Coal and Allied, a subsidiary of Rio Tinto.

The approval of the mine is currently being contested in the NSW Land and Environment Court by the Bulga-Milbrodale Progress Association. In August and September 2012 Rod Campbell from Economists at Large and Richard Denniss of the Australia Institute appeared as expert witnesses in this case.

Richard's evidence focused on the input output model used to assess the economic impacts of the project. He found that the model had the explicit assumption that a large pool of unemployed skilled mining workers exists, which contributed to the conclusion that the Warkworth mine will generate significant new employment and other local economic benefits.

The use of more realistic assumptions, in particular the assumption that there is a shortage of skilled mining workers, would result in fundamentally different conclusion. In particular, if a CGE model was used, that is a model that assumes that no large pool of unemployed skilled labour exists, then the direct and indirect benefits of the mine expansion would be significantly lower. This is primarily due to the fact that a CGE model would allow for the fact that the expansion of the mining industry would come at the expense of other industries as skilled labour is drawn away from existing employers (resulting in a reduction in their output) and redeployed in the mining industry.

Richard also found that the cost benefit analysis conflates the total sale price of coal produced at Warkworth with the local economic benefit. As most of the profit and taxes associated with the project will not accrue to residents of the Hunter Valley, or even NSW, such an assumption overstates the community benefits. Similarly, to the extent that most of the people employed at Warkworth would have been employed elsewhere in the absence of the Warkworth expansion the employment benefits to the community are similarly exaggerated.

Rod's evidence focussed on non-market valuation aspects of the economic assessment by Gillespie Economics. Non-market valuation seeks to quantify, in monetary terms, attributes of things that people or society as a whole value, that are not sold in markets. Rod found that:

- Noise, vibration, air quality, dust and amenity values were not accounted for in the BCA on the basis that community welfare would not be affected if the project complied with regulations. This is inappropriate as compliance with guidelines does not mean community welfare is unaffected.
- Finding there is no loss of welfare, Gillespie Economics did not include a non-use value for social value of rural communities in the cost benefit analysis, despite calculating one in their choice modelling study.
- No estimate of indirect use values associated with environmental services was included in the assessment.
- The cost benefit analysis includes a social value of employment. This is inappropriate given the nature of employment in the mining industry.
- The cost benefit analysis includes a social value of vegetation offsets. This is inappropriate given that respondents to the choice modelling survey were not informed that:
    - Offsets come at the expense of other land uses, for which respondents may also hold existence values
    - There is uncertainty of being able to generate appropriate EECs
    - There are existing levels of protection for EECs1 while protection of offsets is uncertain – as demonstrated by the project's proposed expansion through earlier offset areas.

Pilliga gas project

Santos is planning to mine the coal seam gas reserves of North West New South Wales and, as elsewhere with coal seam gas projects, has encountered substantial local opposition. In 2012 The Australia Institute reviewed commissioned economic assessment of the project, *The economic impacts of developing coal seam gas operations in North West NSW* undertaken by the Allen Consulting Group (the Allen Report). In an accompanying press release Santos says that the report examines what is likely to happen:

> *if the company's proposed coal seam gas (CSG) investments proceed as scheduled.*

Santos Vice President Eastern Australia, James Baulderstone, took the Allen Report to say that:

> *Allowing the natural gas industry to develop in NSW will deliver once-in-a-generation economic opportunities for the state, especially in regional areas.*

However, despite this claim Santos' own economic modelling shows that, on the contrary, the benefits to the local economy of the planned development will be quite small and that the major beneficiaries will be the owners of Santos who predominantly reside outside of the development area.

The Santos modelling contains a number of findings that should be of interest to both opponents and proponents of the mine alike, including:

- only 30 new gas jobs are expected to be created in the operational phase of the development
- 570 new public sector jobs will be created
- despite the very small number of new mining jobs the modellers find that economic output in NSW will grow by $821 million.

Due to the fact that the Allen Report does not provide a clear outline of the critical assumptions that they made readers are at a disadvantage in trying to understand how such a small increase in direct employment could create nearly $1 billion in additional economic activity. Similarly, the reader is left to wonder how an investment in coal seam gas creates 570 new public sector jobs as the report's authors provide no discussion of this intriguing conclusion.

While the reported findings in the Allen Report raise as many questions as they answer, those interested in the relative costs and benefits of the development should be even more concerned with the results that the report does not present. For example:

> 1) the modelling results appear to suggest that gas exports from the development will 'crowd out' $646 million in other exports by driving the value of the Australian dollar higher.
>
> 2) the loss of $646 million in exports from other sectors is likely to cause then loss of 5,770 jobs in the non-mining industries.

3) the report provides no broad context for the scale of the development, for example, it does not discuss the estimated 30 new gas jobs in relation to the 66,000 people in the labour force of the North Central Plains and Hunter Region.

4) whereas proponents of other large developments, such as the China First coal mine in Queensland, concede that their mine will lead to the loss of thousands of jobs in manufacturing the Allen Report provides no clear discussion of the net macroeconomic consequences of the development.

5) despite claiming to consider the 'economic impacts' of CSG development the Allen Report includes just three paragraphs on the impact of the proposed development on the region's water resources. Water is a vital economic resource for the region but no analysis of the environmental risks is attempted.

6) the Santos report does not provide evidence to support the assertion that treated water will be safe for crop and livestock use or for release into local water ways.

It is hard to escape the conclusion that the Allen Report, being based on a series of systematically generous assumptions and largely ignoring the biggest costs and risks of the project, provides a flawed basis on which to evaluate the net costs and benefits of the Santos development.

Indeed, given the inclusion of results such as the boost in public sector jobs of 570 and the exclusion of any analysis of the impact on the exchange rate and jobs in other sectors it would seem that the Allen Report conceals more than it reveals about the likely impact of CSG development in NSW.

References

ABS. 2011. “Australian National Accounts: Input-Output Tables - Electronic Publication, Final Release 2006-07 Tables”. Australian Bureau of Statistics. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/5209.0.55.001Main Features4Final release 2006-07 tables?opendocument&tabname=Summary&prodno=5209.0.55.001&issue=Final release 2006-07 tables&num=&view=.

Allen Consulting Group. 2011. *The Economic Impacts of Developing Coal Seam Gas Operations in Northwest NSW*. Report to Santos. http://www.santos.com/library/1112_The_economic_impacts_of_developing_CSG_operations_in_NW_NSW.pdf.

Ball, Katrina, and Tomislav Loncar. 1991. *Factors Influencing the Demand for Australian Coal*. Project 4247.102 Australian Bureau of Agricultural and Resource Economics (ABARE).

Bekessy, Sarah A., Brendan A. Wintle, David B. Lindenmayer, Michael A. Mccarthy, Mark Colyvan, Mark A. Burgman, and Hugh P. Possingham. 2010. “The Biodiversity Bank Cannot Be a Lending Bank.” *Conservation Letters* 3 (3) (March 11): 151–158. doi:10.1111/j.1755-263X.2010.00110.x. http://doi.wiley.com/10.1111/j.1755-263X.2010.00110.x.

Bennett, Jeff, and Robert Gillespie. 2012. “Affidavit of Professor Jeffrey William Bennet Relating to the Proposed Warkworth Coal Mine Extension.”

Bureau of Resources and Energy Economics. 2012. *Mining Industry Major Projects: October 2012*.

Campbell, Roderick. 2012. *Affidavit of Roderick Campbell to the Land and Environment Court of NSW*. Expert witness evidence on the Warkworth Coal Project 23 August, 2012.

CTAG. 2013. *Coal Dust in Our Suburbs: A Community-led Study of Particle Pollution in Newcastle and the Lower Hunter Coal Train Corridor*. Prepared by the Coal Terminal Action Group Dust and Health Steering Group. http://www.hcec.org.au/sites/default/files/CoalDustMonitoringStudyCTAG2013_web.pdf.

DEC NSW. 2005. *Air Pollution Economics: Health Costs of Air Pollution in the Greater Sydney Metropolitan Region*. NSW Department of Environment and Conservation. http://www.environment.nsw.gov.au/resources/air/airpollution05623.pdf.

Denniss, Richard. 2011. *An analysis of the economic impacts of the China First mine*. Submission, The Australia Institute, December

Economists at Large. 2012. *Review of Cobbora Coal Project Environmental Assessment - Appendix R (economic Assessment)*. a report for the Mudgee District Environment Group and the Nature Conservation Council of NSW. http://www.ecolarge.com/wp-content/uploads/2012/12/Ecolarge-Nov-2012-Cobbora-mine-submission-FINAL.pdf.

Eggert, Roderick G. 2001. *Mining and Economic Sustainability: National Economies and Local Communities*. *Sustainable Development*. Report commissioned by the Mining, Minerals and Sustainable Development project of the Institute for Environment and Development, England.

Gillespie Economics. 2009a. *Warkworth Coal Project EIS: Annex O Economic Study*. Prepared for Warkworth Mining Limited.

———. 2009b. *Ashton Coal Project Extension Benefit Cost Analysis*. Analysis of the South East Open Cut Project and Ashton Coal Project Modification, Appendix 18 of Environmental Assessment.

———. 2010. *Continuation of Boggabri Coal Mine Economic Assessment*. *Assessment*. Prepared for Hansen Bailey Pty Ltd.

———. 2011. *Maules Creek Coal Project Economic Impact Assessment*. *Assessment*. Prepared for Aston Resources.

———. 2012. *Cobbora Coal Project Economic Assessment*. Prepared for Cobbora Holdings by Gillespie Economics.

Hansen Bailey. 2011. *Maules Creek Coal Project Environmental Assessment - Response to Submissions*. Prepared by Hansen Bailey for Aston Coal.

HCEC. 2013. *Submission to the Senate Committee Inquiry into the Impacts of Air Quality on Health*. Submission by the Hunter Community Environment Centre. http://www.hcec.org.au/sites/default/files/HCECSubmissionSenateAirQualityInquiry.pdf.

Hendryx, Michael, and Melissa M Ahern. 2009. "Mortality in Appalachian Coal Mining Regions: The Value of Statistical Life Lost." *Public Health Reports (Washington, D.C. : 1974)* 124 (4): 541–50. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2693168&tool=pmcentrez&rendertype=abstract.

Hogan, Naomi. 2011. *Icons Under Threat: Natural Areas and Threatened Species at Risk from Mining and Gas in NSW*.

HVRF. 2009a. *An Economic Assessment of the Warkworth Coal Resource*. Prepared by the Hunter Valley Research Foundation for Coal and Allied Ltd.

———. 2009b. *Ashton Coal EIS Appendix 17: Social and Economic Environment*. Prepared for Wells Environmental Services on behalf of Ashton Coal Operations.

Light, Miles K, Charles D Kolstad, and Thomas F Rutherford. 1999. *Coal Markets and the Kyoto Protocol*. Discussion Papers in Economics, Working Paper no. 99-23, Centre for Economic Analysis, University of Colorado at Boulder.

Muller, Nicholas Z, Robert Mendelsohn, and William Nordhaus. 2011. "Environmental Accounting for Pollution in the United States Economy." *American Economic Review* 101 (August): 1649–1675.

NWES. 2013. *Submission to Tony Burke Re the EPBC Assessment of Maules Creek and Boggabri Coal Mine Developments*. A report by North West Ecological Services commissioned by the Maules Creek Community Council. http://dl.dropbox.com/u/52581262/Whitehaven EPBC Reports/Final_overall_submission_leard_forest_coal_offsets 29th Jan 2013.pdf.

TWS, NCCNSW, and NICE. 2011. *Under the Radar: How Coal Seam Gas Mining in the Pilliga Is Impacting Matters of National Environmental Significance*. Report by The Wilderness Society, Nature Conservation Council of NSW and Northern Inland Council for the Environment. http://nccnsw.org.au/sites/default/files/110719 Under the Radar Eastern Star Gas EPBC Report email.pdf.