Digging for Answers

Response to tentative findings: Radioactive waste storage and disposal facilities in South Australia

Dan Gilchrist
Rod Campbell
March 2016

The Australia Institute
Research that matters.

The Australia Institute
Research that matters.

Digging for answers

Response to tentative findings: Radioactive waste storage and disposal facilities in South Australia

The business case for a nuclear waste storage facility in South Australia is exaggerated. The project is risky, and a loss overall is well within the range of possible outcomes.

Submission on Tentative Findings 84-95

Dan Gilchrist
Rod Campbell

March 2016

ABOUT THE AUSTRALIA INSTITUTE

The Australia Institute is an independent public policy think tank based in Canberra. It is funded by donations from philanthropic trusts and individuals and commissioned research. Since its launch in 1994, the Institute has carried out highly influential research on a broad range of economic, social and environmental issues.

OUR PHILOSOPHY

As we begin the 21st century, new dilemmas confront our society and our planet. Unprecedented levels of consumption co-exist with extreme poverty. Through new technology we are more connected than we have ever been, yet civic engagement is declining. Environmental neglect continues despite heightened ecological awareness. A better balance is urgently needed.

The Australia Institute's directors, staff and supporters represent a broad range of views and priorities. What unites us is a belief that through a combination of research and creativity we can promote new solutions and ways of thinking.

OUR PURPOSE – 'RESEARCH THAT MATTERS'

The Institute aims to foster informed debate about our culture, our economy and our environment and bring greater accountability to the democratic process. Our goal is to gather, interpret and communicate evidence in order to both diagnose the problems we face and propose new solutions to tackle them.

The Institute is wholly independent and not affiliated with any other organisation. As an Approved Research Institute, donations to its Research Fund are tax deductible for the donor. Anyone wishing to donate can do so via the website at https://www.tai.org.au or by calling the Institute on 02 6130 0530. Our secure and user-friendly website allows donors to make either one-off or regular monthly donations and we encourage everyone who can to donate in this way as it assists our research in the most significant manner.

Level 5, 131 City Walk
Canberra, ACT 2601
Tel: (02) 61300530
Email: mail@tai.org.au
Website: www.tai.org.au

Acknowledgement

The Australia Institute gratefully acknowledges the generous support of the Conservation Council SA for funding this paper. As the state's peak environment organisation, the Conservation Council SA represents over 50 environment related community groups across South Australia.

Tentative findings

This submission relates to Tentative Findings on management, storage and disposal of waste, findings 84 to 95. In particular, Finding 91a, b and c should be revised to reflect the economic realities facing the proposal.

Exchange rate

This submission follows the Jacobs Engineering report convention of converting prices (except where otherwise noted) into Australian dollars at the long term exchange rate of AUD:USD 0.77.

Summary

South Australia's Nuclear Fuel Cycle Royal Commission has handed down its tentative findings. One recommendation is for an international nuclear waste dump in South Australia.

The financial case for this project is put forward by Jacobs MCM, and it paints an optimistic picture. With $257 billion in projected revenue, and only $145 billion in costs, the proposal would appear certain to deliver major financial benefits to South Australia.

However, the initial beneficiaries of a commitment to build a nuclear waste storage facility in South Australia would be companies involved in the international nuclear industry. This is made clear in Jacobs assessment:

> The removal of the 'back end problem' will definitely reduce the perceived risk for potential investors in a new nuclear programme or a debt provider for a mid-project refinancing.[1]

Nuclear companies are anxious to reduce financing and other costs, as nuclear power is already uncompetitive with most other generation technologies. Australian government agencies forecast that by 2030 renewable energy with storage is likely to be cheaper than nuclear in almost all circumstances.

It is against this background of economic competitiveness that this proposal must be seen. This project is not about solving existing nuclear waste problems – it is about facilitating more nuclear energy and more nuclear waste in the future. A taxpayer-funded nuclear waste storage facility would be a boon to proponents of future nuclear development.

Benefits of the proposal that would accrue to the public of South Australia are far less certain and far further into the future. They have been estimated in the commissioned economic assessment by Jacobs MCM and accepted in the Royal Commission's Tentative Findings.

Like all commissioned economic assessment, the motivations of the consultants should be considered and the assumptions in their analysis questioned. Jacobs consult extensively to the nuclear industry and have an interest in its expansion and continuation.

[1] Jacobs MCM (2016) *Radioactive waste storage and disposal facilities in South Australia: Quantitative Cost Analysis and Business Case,* page 121

Jacobs' assessment is based on a number of assumptions that overstate the benefits of the proposal and understate its risks.

Many of Jacobs' important assumptions relate to the potential market for, and price of, nuclear waste disposal services. It must be remembered that there is no existing market or price for such services and that all estimates should be considered speculative.

Jacobs assume that some 37 countries could send waste to Australia. Many of these countries are yet to develop nuclear programs, have their own storage options, or have contractual obligations to other countries. For example, Bangladesh does not have any nuclear power plants, despite plans dating back to the 1960s. The current unfunded proposals are being proposed by Russian companies that would take waste back to Russia.

Jacobs' claim that the Ukraine is a potential client country as it lacks storage options is equally hollow – Ukraine has an ideal site for storage at the Chernobyl nuclear disaster site. A facility is already under construction.

Beyond being willing to send waste to South Australia, Jacobs assume these countries will be willing to pay $AUD1.75 million per tonne to do so. Their estimate is based on principally on budgeted costs for storage in Sweden, Switzerland, the UK, USA and other rich countries. Jacobs reason that:

> The "best equipped" countries [are willing to pay an] average of at least AUD1.2M per tonne of spent fuel, other countries will be yet higher.[2]

This assumption that poor countries including Bangladesh, Vietnam, Nigeria and Ghana would be willing and able to pay a higher price for waste storage than the richest countries in the world is not realistic.

Still less realistic is Jacobs' assumption that no other countries would attempt to compete with South Australia and lower the price received for storage. China and Russia are listed as potential competitors, but no consideration made of this impact on price. Other potential competitors abound - Ukraine, Kazakhstan and South Africa already have nuclear industries and substantial sparsely inhabited areas. This is to say nothing of Western Australia, Northern Territory, Queensland, New South Wales and Victoria, all of which border South Australia and share its claimed advantages for nuclear waste storage. Still more competition could come from other technologies such as borehole disposal or generation IV nuclear reactors.

The storage facility proposal is economically unviable even under Jacobs' optimistic central assumptions unless South Australia is prepared to hold large amounts of nuclear waste in above ground "interim" storage for decades. South Australia must start taking

[2] See page 116

in high level waste long before the final facility is complete. The modelled project sees waste accumulate in temporary storage for 17 years before storage in the permanent facility commences. The "temporary" storage is used until year 120 of the project. In total, nuclear waste would be stored above ground in interim storage for over 100 years, with 70,000 tonnes held between years 40 to 65. Minimal consideration is given to this risk in Jacobs' assessment.

Even if revenues are generated according to the plan, neither Jacobs nor the Royal Commission has given any consideration to how new revenues to South Australia would be treated by the Commonwealth Grants Commission. Depending on this body's decision, South Australia could lose large parts of its GST revenue under laws relating to GST distribution.

Parts of the Tentative Findings border on nuclear advocacy rather than a realistic assessment of how this project might affect the finances of the state. Major revisions should be made before the Commission's findings are finalised.

Introduction

South Australia's Nuclear Fuel Cycle Royal Commission, commissioned in March 2015, has released its "Tentative Findings".

Initially looking at mining, enrichment and processing, power generation, and waste, its most significant recommendation is to establish an "international radioactive waste storage and disposal facility" in outback South Australia. This facility would take 138,000 tonnes of spent nuclear fuel from other countries, as well as a large quantity of intermediate level waste, and bury it in a deep geological storage facility.

South Australia would store nuclear waste in above-ground 'interim' storage while the main storage facility is built. The first waste would go into permanent geological storage after 17 years sitting above ground. Not until year 120 of the project does all waste enter permanent storage.

The Commission's Tentative findings state:

> South Australia can safely increase its participation in nuclear activities and, by doing so, significantly improve the economic welfare of the South Australian community.[3]

The economic benefits the Commission refers to relate to building a storage facility for nuclear waste, particularly aimed at receiving spent fuel and high-level nuclear waste from other countries. The Commission says:

> Net present value of profits (the amount that would be accepted today for a stream of future payments) of more than $51 billion (at the intergenerational discount rate of 4 per cent).[4]

This evaluation comes from a separate 'Quantitative Cost Analysis and Business Case' commissioned by the Royal Commission, conducted by consultants Jacobs MCM.

The Jacobs analysis is flawed and presents an unrealistic picture of the benefits, costs and risks of a nuclear waste facility in South Australia. The Jacobs assessment should be thoroughly revised before being incorporated into the Commission's final findings.

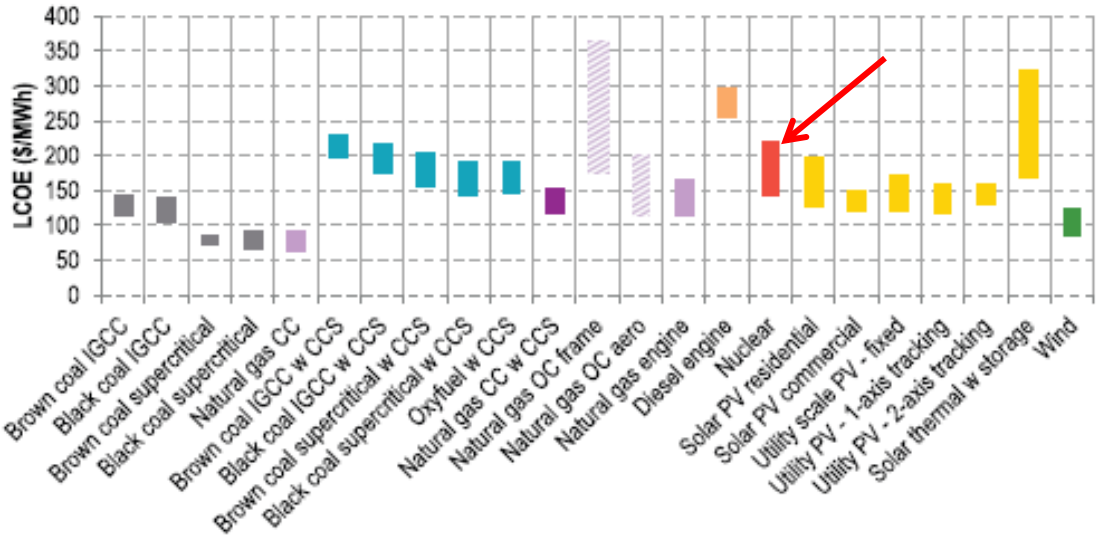
[3] Nuclear Fuel Cycle Royal Commission (2016) Tentative Findings, page 6. http://nuclearrc.sa.gov.au/app/uploads/2016/02/NFCRC-Tentative-Findings.pdf

[4] Ibid, page 18

Context – nuclear energy is expensive

The Jacobs assessment fails to make an important point – nuclear energy is not cost competitive with other forms of energy generation in most circumstances. Wind, coal and gas generation is almost always cheaper than nuclear when capital costs, operating costs and total electricity generated are considered (levelised cost of energy). Some solar and even some carbon capture and storage-equipped generation options are now estimated to be cheaper than nuclear, as shown in Figure 1 below:

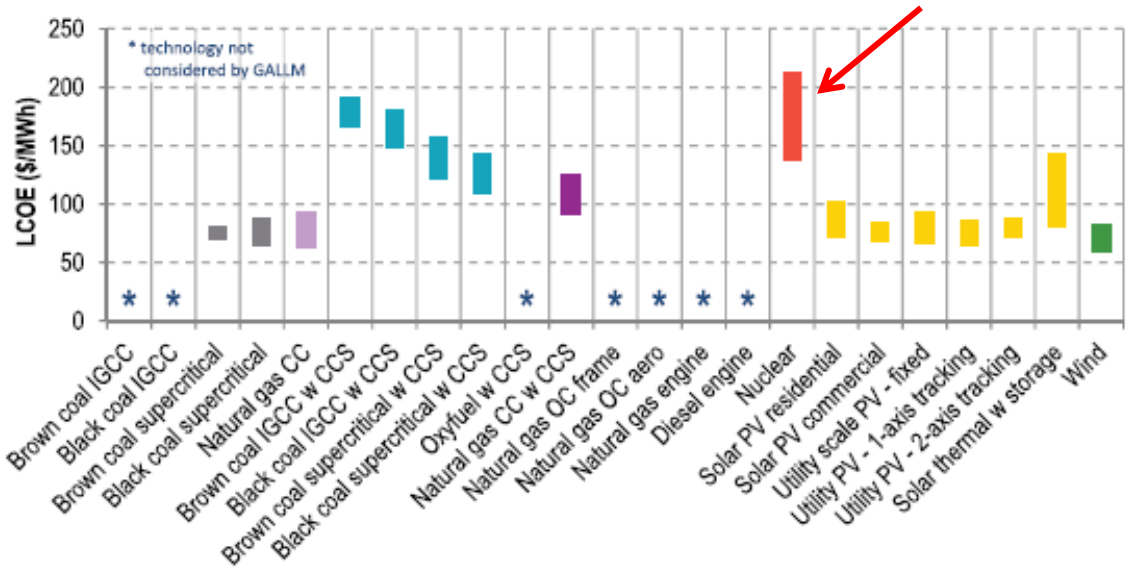
Figure 1 Levelised cost of energy 2015, various technologies:



Source: Australian Power Generation Technology Report (2015), page iii. Note that this study, co-written by the CSIRO, Department of Industry and others uses different assumptions to the OECD study quoted by Jacobs, which uses assumptions very favourable to nuclear energy, such as a $30 per tonne carbon price and low discount rates/financing assumptions.

Figure 1 shows that nuclear energy (in red) costs between $150 and $200 per megawatt hour, while wind, coal and gas rarely cost so much. Furthermore, renewable energy is expected to get cheaper in the near term, while costs of nuclear generation are expected to change little, as shown in Figure 2 below:

Figure 2 Levelised cost of energy forecast 2030, various technologies:



Source: Australian Power Generation Technology Report (2015), page v.

Figure 2 shows that all wind, solar and supercritical coal generation are expected to be considerably cheaper than nuclear energy by 2030. As nuclear energy will be uncompetitive in almost all situations by 2030, the nuclear industry is anxious to reduce costs and commence as many projects as possible while this technology can still be competitive.

Waste costs are significant for nuclear

The main reason existing nuclear technologies are becoming uncompetitive is their up-front capital costs. However, another reason why the levelised cost of nuclear energy is high is because of the high costs of nuclear waste disposal. As Jacobs put it:

> [The] 'back end' is estimated to make up some 25% of the overall fuel cycle cost.

In fact, even this is speculative. There are currently no permanent geological nuclear waste disposal facilities in operation, so this cost reflects estimates based on above-ground 'temporary' storage and perhaps other budgeted expenses.

With the price of renewable generation falling rapidly, nuclear power proponents are anxious to lock in projects before they become uncompetitive. A key way this could be done would be through finding a solution to the nuclear waste issue. For the industry this would ideally be funded by taxpayers rather than investors.

Initial benefits of a SA waste facility flow to the nuclear industry and investors

If South Australia commits to building a waste storage facility and accepting other countries' waste the initial beneficiaries will not be South Australians, but proponents of, and investors in, international nuclear energy projects. As the risks and responsibilities of high level waste storage will be transferred from proponents and host countries to South Australia, investors will be more likely to put their money into these nuclear projects, or be more willing to refinance the debt of existing nuclear power stations, as Jacobs make clear:

> The removal of the 'back end problem' will definitely reduce the perceived risk for potential investors in a new nuclear programme or a debt provider for a mid-project refinancing.[5]

According to Jacobs, the lower interest rates that may apply to nuclear projects could save nuclear facilities USD$1.5 to $2 million per tonne of waste produced. This would represent US$1.7 billion to US$2.3 billion over the life of a 1 gigawatt power station under Jacobs' estimates.[6]

To put this plainly, the South Australian nuclear waste facility would not be focused on 'solving' the world's existing nuclear waste problem, but on expanding and extending the nuclear industry. The goal is to make new nuclear projects financially viable and extend the life of existing power stations.

Beyond lenders and investors, Jacobs make it clear that access to an international nuclear waste facility is politically beneficial for proponents of "emerging nuclear programs":

> [Access to an] international back-end solution in a country [Australia] with impeccable safeguards and security standing can demonstrate to the national population and to the international community that a new nuclear nation is taking its responsibilities seriously.[7]

It should be noted that Jacobs themselves have a vested interest in expanding the nuclear industry globally. They consult extensively to the industry on construction of new plants, maintenance and operation of existing plants as well as waste disposal and decommissioning.[8]

---

[5] Jacobs MCM (2016) *Radioactive waste storage and disposal facilities in South Australia: Quantitative Cost Analysis and Business Case,* page 121

[6] Jacobs MCM, table 2.4, page 110.

[7] Jacobs MCM, page 121.

[8] http://www.jacobs.com/workwithus/ourindustries/nuclear.aspx#Overview

While a careful reading of Jacobs assessment shows that the benefits of a South Australian nuclear waste facility flow mostly to the international nuclear industry, most public attention has focused on potential economic benefits to South Australia, such as over $5 billion per year in revenue or a total net present benefit of $51 billion. The assumptions behind such estimates should be closely questioned and have not received adequate scrutiny from the Royal Commission so far, which has merely repeated the consultant's results.

Key elements of Jacobs assessment

There is no existing market for nuclear waste. There have never been any transfers of nuclear waste between countries for permanent geological storage, largely because successful permanent geological storage facilities do not yet exist. Given this context, all the assumptions in Jacobs' assessment should be considered speculative.

MARKET FOR NUCLEAR WASTE DISPOSAL

The Jacobs' assessment is based on the assumption that a large number of countries will want to send nuclear waste to South Australia. Despite no historical precedent for this, Jacobs central case assumes that 50 percent of 'target countries' current and future waste will be sent to South Australia. Basic investigation of several of the target countries shows this is highly uncertain.

Ukraine is highlighted as a target country in Jacobs' assessment:

> The Ukraine currently lacks sufficient storage options, with much of its fuel being stored (at a cost) in Russia or in interim (dry cask) storage. Given the tenuous nature of current arrangements with Russia, its growing reliance on nuclear energy and its lack of a developed disposal option, the Ukraine is considered a candidate country for an international solution.[9]

On the contrary, Ukraine has an obvious option for storage of its nuclear waste – the site of the nuclear disaster at Chernobyl. Construction began on surface facilities near the Chernobyl site in 2014.[10]

The Jacobs assessment assumes that many countries that do not have nuclear power stations will build them and operate them out to 2080. Bangladesh for example currently does not have a nuclear power plant, despite plans to build one dating back to the 1960s.[11] As of December 2015, Russian companies were conducting preliminary engineering surveys, although final investment decisions appear some way off. Furthermore:

> All fuel for [Bangladesh's nuclear power] is being provided by Rosatom, and all used fuel is to be repatriated to Russia, in line with standard Russian practice for such countries. [8]

[9] Jacobs assessment, page 107

[10] http://www.world-nuclear-news.org/WR-Ukrainian-used-fuel-store-under-construction-2708145.html

[11] http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/bangladesh.aspx

This would rule out Bangladesh sending nuclear waste to South Australia.

The Australia Institute has only conducted basic research on the 'target countries' in the Jacobs assessment. Many of the assumptions around nuclear developments in developing countries are optimistic, assuming that plants will be built despite decades of delays in countries like Vietnam, Egypt, Ghana and Nigeria. Even basic internet research on these countries suggests that Jacobs' assessment overstates the ability or willingness for these countries to send waste to South Australia.

Generation IV nuclear reactors

More important to the quantity of waste that could be sent to South Australia is the development of Generation IV nuclear technology. Although still decades away from commercialisation, advocates such as South Australian Senator Sean Edwards, envisage the next generation of nuclear technology to use as an energy source:

> spent fuel (routinely mischaracterized as "nuclear waste") that has accumulated from decades of light-water reactor use.[12]

If this technology becomes a reality and is widely adopted, countries willingness to send spent fuel to South Australia may disappear entirely. Much of the volume of waste estimated by Jacobs consists of spent fuel.

The Jacobs assessment assumes, of course, not only that countries will be willing and able to send waste and spent fuel to South Australia – but that they will be willing to pay substantial amounts of money to do so.

PRICE FOR NUCLEAR WASTE DISPOSAL

Because there is no existing market for nuclear waste disposal services there is no data on the prices that the South Australian proposals might attract. Estimating the price that environmental externalities might attract in such a market is notoriously difficult, as the Australian and European experiences in pricing carbon emissions demonstrate.

Jacobs' central estimates are based on an inferred price of $AUD1.75 million per tonne of 'heavy metal' or spent fuel. They base this estimate on:

- Published geological disposal costs
- Levelised cost of energy estimates
- A failed Taiwanese program of fuel reprocessing

[12] http://www.sciencedirect.com/science/article/pii/S2214993714000086. See also Edwards (2015) *Transforming our economy. Cleaning our energy. Sustaining our future: Submission to the South Australian Nuclear Fuel Cycle Royal Commission*

- Other 'enhancements'

Published geological disposal costs

Several wealthy countries with advanced nuclear programs have published their budgets for geological disposal programs - Sweden, Switzerland, Finland, Canada, France, USA and UK. As far as we are aware, none of these programs have been successfully completed and the estimates represent budgets rather than realised costs. Jacobs conclude:

> The "best equipped" countries [are willing to pay an] average of at least AUD1.2M per tonne of spent fuel, other countries will be yet higher.[13]

We disagree. The assumption that countries such as Armenia, Ghana or Thailand will be willing and able to pay a higher amount for waste disposal than the richest countries in the world is not logical and not borne out in other markets. Poorer countries are prepared to pay far less than the richest countries for other environmental costs, yet Jacobs assume in this case they will pay more. This assumption heavily skews Jacobs' assessment.

Levelised cost of energy estimates

Levelised cost of energy is a useful economic construct to compare the life-cycle costs of different power generation options. It is not an estimate of nuclear waste disposal costs or of potential willingness to pay.

Furthermore, the study cited by Jacobs shows levelised costs of nuclear energy far below the estimates made by Australian government agencies, with no explanation for this difference.[14]

Taiwan example

Jacobs cite the example of Taiwan tendering for spent fuel reprocessing as an example of willingness to pay for permanent geological disposal. Indeed, this is the only example of a real-world example in Jacobs assessment to export waste, at least temporarily.

Taiwan is in a difficult position. Their nuclear reactors are running out of room to store spent fuel. While most countries would simply expand the storage available, Taiwan has been unable to do so, due to stiff political opposition. If storage space is not

[13] See page 116

[14] See for example: Australian Power Generation Technology Report (2015).

cleared, the reactors will need to be permanently shut down, years earlier than their rated lifespan would otherwise permit.

In early 2015 Taipower looked to other countries for reprocessing of some of its spent fuel, as a way to free up storage space. The price offered by Taipower amounted to A$1.54 million per tonne. [15]

The material would be shipped to a reprocessing facility in another country. Twenty percent of the material was to be extracted, turned into vitrified waste and returned to Taiwan, while the remaining eighty percent would be reclaimed as usable fuel. Taiwan would not be permitted to use that fuel itself, due to treaty constraints, but would remain the owner of the material, with a view to the fuel being sold. [16][17]

However, only a month later in March 2015 the tender was suspended, pending parliamentary budget review. It is still suspended nearly a year later. [18]

First it can be seen that, as an indicator of "willingness to pay", this example simply does not hold water. To date, Taiwan has not been willing to pay anything.

Furthermore, they may well have expected to recoup part or all of their costs with the sale of the reclaimed fuel.

Reprocessed fuel can fetch up to $3 million per tonne. [19] Depending on how much the Taiwanese authorities hoped to earn from sales, the final cost could have been anything from the offered $1.54 million, down to zero, or it could even have been a net profit.

Yet the Jacobs Engineering report concluded that this plan shows a willingness to pay, not just at the base rate, but at a higher rate.

Other "enhancements of willingness to pay"

Further, in Section 3.4 of the Jacobs report discusses "distressed payments". The point is made that if a reactor was unable to continue operation due to an inability to store more spent fuel, the reactor's operator would be willing to pay a great deal more than others – five to ten times as much.

Yet this is precisely the position that Taiwan is in. By the report's own logic, we should expect that Taiwanese power stations would be willing to pay a great deal more than

[15] Jacobs MCM (2016). Part 3.3

[16] Burnie, S (2015). Taiwan tenders spent fuel reprocessing contract.

[17] World Nuclear Association (2015a). Weekly Digest, Archive 2015

[18] World Nuclear Association (2015a). Country Profile - Taiwan

[19] Edwards, S (2015). Transforming our Economy. Cleaning our energy. Sustaining our future.

others. However, they were not even willing to pay $1.54 million per tonne to free up storage space, minus whatever they expected to make in fuel sales.

By comparison, the revenues predicted in the Jacobs report relies on other countries being willing to spend, on average, $1.95 million per tonne.[20]

Competition

Willingness to pay is an important economic concept, but even if it can be estimated accurately, it is not the only factor that decides prices paid. This is particularly the case if users of a service such as nuclear waste disposal have other options aside from sending waste to South Australia.

Jacobs note:

> It is also possible that serious interest shown by an Australian government in seizing this business opportunity might lead to competitive offers from other countries - obvious candidates here could be Russia and China.[21]

Despite noting the potential for competition, Jacobs make no attempt to estimate how this might impact on the price received by South Australia for its waste. While Jacobs consider scenarios where South Australia receives smaller volumes of waste, there is no consideration of what lower prices South Australia may have to accept to store waste and how this affects the overall economics of the project.

The prospect of competition should be seriously considered. Aside from Russia and China, which already deal with substantial amounts of nuclear waste, other countries such as the USA, UK, France, Finland, etc could decide to recoup some of their costs spent on their own storage by competing for international waste.

Still more countries such as the Ukraine, Kazakhstan or South Africa already have nuclear industries and substantial sparsely inhabited areas. This is to say nothing of Western Australia, Northern Territory, Queensland, New South Wales and Victoria, all of which border South Australia and share its claimed advantages for nuclear waste storage.

Still more competition could come from alternatives to permanent geological storage. Borehole disposal could permanently dispose of waste for around $AUD200,000 per tonne.[22] Above ground storage, such as that envisaged in Jacobs' "Interim Storage

[20] That is, A$1.75 million per tonne paid to Australia, plus A$0.195 million per tonne to transport the material to Australia – or US$1.5 million. Figures taken from Jacobs Engineering report (3.7.1).

[21] See page 111

[22] Brady et al (2012) Deep Borehole Disposal of Nuclear Waste: Final Report http://prod.sandia.gov/techlib/access-control.cgi/2012/127789.pdf, cited in Edwards, S (2015). Transforming our Economy. Cleaning our energy. Sustaining our future.

Facility" can store waste relatively cheaply for decades or centuries, giving client companies the option to defer payment for geological disposal for long periods.

In the face of competition from other countries, states and technologies, South Australia must ask not what others might be willing to pay, but what is South Australia willing to accept as a minimum price for waste storage. Based on the Jacobs Table 4.2 a break-even price is around $AUD600,000 per tonne, assuming all other estimates are accurate.[23] As this is above several options available to client countries, the potential for the storage facility as planned to run at a financial and economic loss is real and must be considered.

Furthermore, there are several aspects of risk in the proposal that are not adequately considered in the Jacobs assessment.

IMPORTING RISK

The storage facility proposal is economically unviable even under Jacobs' optimistic central assumptions unless South Australia is prepared to hold large amounts of nuclear waste in above ground "interim" storage for decades.

As the summary to the report makes plain, "a facility is viable only with the establishment of a surface [interim storage] ... prior to construction of geological disposal facilities". Options for development that involve building the storage facility first and then accepting waste return a negative net present value. See Jacobs Table 4.1, options 2 and 3.

That is, to be financially viable, Australia must start taking in high level waste long before the final facility is complete. The modelled project sees waste accumulate in temporary storage for 17 years before storage in the permanent facility commences. The "temporary" storage is used until year 120 of the project, see Jacobs Figure 2.1. In total, nuclear waste would be stored above ground in interim storage for over 100 years, with 70,000 tonnes held between years 40 to 65.

If anything were to stop the completion of the long term facility – some unforeseen problem, political change, accident or other issue – Australia would find itself with the same problem client countries have paid to be rid of.

The service Australia would offer would include the "transfer of all risk and liability for waste storage and disposal". Jacobs note that the price paid would:

[23] Working available on request.

> correspond with a transfer of ownership, noting that if ownership remained with the consigning country, with the potential 'risk' of repatriation, this would clearly influence willingness to pay until the point of irreversible disposal… [24]

In other words, the possibility that the permanent solution might fail is sufficiently worrying to Australia's potential customers that it would materially affect the price they might be willing to pay, unless South Australia indemnifies them against that possibility.

If a country is willing to pay more for waste disposal that it might reasonably be expected to cost, this additional willingness must come from a transfer of risk – risk which is therefore taken on by Australia.

COSTS

The Australia Institute has not reviewed the Jacobs cost assumptions in detail. It should be noted, however, that nuclear waste facilities often experience cost overruns.

The example of Yucca Mountain should be noted. The US government is required by law to develop a permanent repository for civilian nuclear waste. [25] A savings scheme has made many billions of dollars available to pursue a solution.

After many years of preparation, a project to construct a deep geological facility at Yucca Mountain was approved in 2002, and construction began. However, funding was withdrawn in 2011, leaving the site unfinished after the expenditure of US$15 billion. [26]

In France, the 2005 estimate for the total cost of nuclear decommissioning was from between €13.5 billion and €16.5 billion. By 2009 it was estimated at €36 billion – more than double the price. [27]

[24] See page 123

[25] US Government. Nuclear Waste Policy Act (1982)

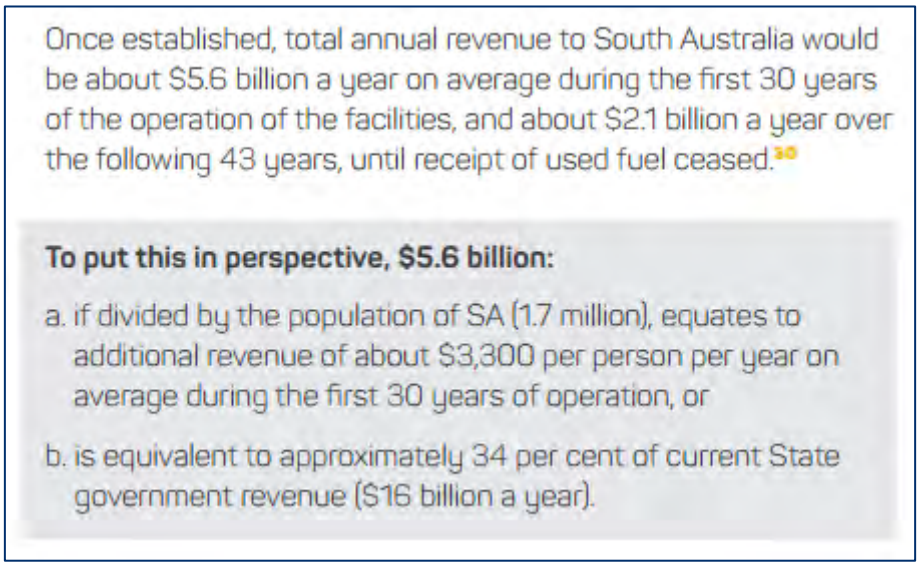
[26] ACB News (2013). Nuclear Waste: Yucca Mountain Gets Reprieve As Storage Site

[27] World Nuclear Association (2016c). Minister sets benchmark for French Repository.

Advocacy in the Tentative Findings

The way expected revenue is portrayed in the Royal Commission's tentative findings borders on advocacy rather than analysis:

Figure 3: Extract from tentative findings



Once established, total annual revenue to South Australia would be about $5.6 billion a year on average during the first 30 years of the operation of the facilities, and about $2.1 billion a year over the following 43 years, until receipt of used fuel ceased.[30]

To put this in perspective, $5.6 billion:

a. if divided by the population of SA (1.7 million), equates to additional revenue of about $3,300 per person per year on average during the first 30 years of operation, or

b. is equivalent to approximately 34 per cent of current State government revenue ($16 billion a year).

Source: Nuclear Fuel Cycle Royal Commission Summary, Radioactive waste storage and disposal facilities in South Australia

The figures quoted here are total revenue, not the net profits. It is difficult to see how the total revenue is relevant. The government of South Australia will not be putting $5.6 billion a year into their budget to provide services and infrastructure. Most of that money must be spent on disposing of the waste. Discussing the revenue alone is likely to create a false impression of the proposal's benefits.

The quoted material also fails to mention that, for the last 40 years of the project, the revenue is in the order of minus $1 billion a year. This is offset by savings earlier in the plan, but the highlighted numbers make no mention of this.

Putting the total revenue "into perspective" by implying the total is to go into state revenue or could be used for the direct benefit of South Australians creates an inflated view of the true benefit of the project. This is how the project has been described in the media, focussing on the highlighted numbers:

> Mr Scarce found there are possible revenues to the state of $5.6 billion a year on average for the first 30 years, and about $2.1 billion a year over the following 43 years.

> The state would earn an estimated $257 billion over the life of the project, with $145 billion to be spent on waste management as well as construction work which would create jobs.[28]

It is only by manually calculating the expected revenues over the years that it could be clearly seen by most readers that the "revenues to the state" mentioned in the first paragraph are before costs, and represent the entirety of the $257 billion income. They do not reflect the total benefit to the state budget.

And as discussed above, a net revenue of zero, or even a loss, is within the range of possible outcomes.

As the OECD's Nuclear Energy Agency writes, specifically addressing the issue of geological disposal: "Existing methods, such as cost-benefit analysis and cost discounting ... cannot reasonably be applied over times longer than 20-30 years".[29]

The proposed project takes 120 years to complete.

[28] Adelaide Advertiser(2016). 'Nearly half of SA supports nuclear waste dump in the state, Galaxy poll shows'

[29] OECD Nuclear Energy Agency. 'The Environmental and Ethical Basis of Geological Disposal of Long-Lived Radioactive Wastes'

Horizontal fiscal equalisation

Even if South Australia does receive net revenue from the nuclear storage facility proposal, neither Jacobs, nor the Royal Commission has made any consideration of how this would affect the revenue South Australia receives from the Commonwealth.

A large new revenue source such as the storage facility could have a negative impact on SA's distribution of GST revenue. Under the Intergovernmental Agreement on Federal Financial Relations payments of GST revenue to the states and territories reflect the principle of 'horizontal fiscal equalisation'.

Horizontal fiscal equalisation attempts to compensate states and territories that have greater spending pressures on the one hand or have different revenue-raising capabilities on the other. The equalisation essentially reflects those factors which are outside the control of state and territory governments.

For example, states that receive a lot of mining royalties such as WA is given commensurately less GST revenue because of its ability to raise revenue via royalties. On the other hand if a state levied a higher payroll tax or set up its own business it would not necessarily have its GST revenue reduced because those are measures open to all states and territories. The question is whether or not the nuclear waste dump would be a peculiar advantage to SA in its revenue raising capability or whether it should be treated as a 'business' that any other government could establish if it so desired.

This question would be answered by the Commonwealth Grants Commission. While the Commission makes the decision, it would certainly be lobbied by the other states who would call for the facility to be included in the next review of relativities, leading to reduced GST revenue for the state.

Conclusion

A commitment to build a nuclear waste facility in South Australia would provide immediate benefits to the international nuclear industry, making its projects easier to promote politically and to finance. This is critical for the industry as it struggles to remain cost competitive with other forms of electricity generation.

Benefits to South Australia of the proposed waste facility are far less certain and far further into the future. The assessment of the proposal by consultants Jacobs shows that the financial viability of the project depends on South Australia being willing to store nuclear waste in temporary, above ground facilities for 110 years, with volumes up to 70,000 tonnes.

The real financial risks to the project stem from the possibility that revenues may not outweigh costs. Jacobs estimates of revenues and volumes are based on uncertain assumptions, including that poor countries like Bangladesh are willing to pay more for nuclear waste storage than rich countries like the USA.

Perhaps even more far-fetched is Jacobs assumption that there will be no competition from other countries to store waste, or that any competition will not affect the price received by South Australia. Other countries, other states and other technologies pose a huge potential competition risk to the South Australian project.

Even if all of Jacobs' assumptions are realised, the impact to South Australia's financial situation will be affected by how the revenue is treated by the Commonwealth Grants Commission. It is surprising that the Royal Commission has not considered this. Parts of the Tentative Findings border on nuclear advocacy rather than a realistic assessment of how this project might affect the finances of the state. Major revisions should be made to Tentative Findings 84-95 before the Commission's findings are finalised.

Bibliography

ACB News (2013). Nuclear Waste: Yucca Mountain Gets Reprieve As Storage Site
http://abcnews.go.com/Business/yucca-mountain-reprieve-nuclear-waste-storage-site/story?id=19961367

Adelaide Advertiser(2016). 'Nearly half of SA supports nuclear waste dump in the state, Galaxy poll shows'
http://www.adelaidenow.com.au/news/south-australia/nearly-half-of-sa-supports-nuclear-waste-dump-in-the-state-galaxy-poll-shows/news-story/82be87d9218ce62eaa0574f3b6a9c7b9

Burnie, S (2015). Taiwan tenders spent fuel reprocessing contract.
http://fissilematerials.org/blog/2015/03/taiwan_tenders_spent_fuel.html

Gen IV international Forum. Accessed 24 Feb 2016.
https://www.gen-4.org/gif/jcms/c_9260/public

Government of Finland, Nuclear Energy Act
http://www.finlex.fi/en/laki/kaannokset/1987/en19870990.pdf

Government of the United Kingdom. Guidance, Waste: import and export
https://www.gov.uk/guidance/importing-and-exporting-waste

Government of Western Australia (2015). Electricity Market Review Discussion Paper
https://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utilities_Office/Electricity_Market_Review/electricity-market-review-discussion-paper.pdf

Edwards, S (2015) (3 August 2015). Transforming our Economy. Cleaning our energy. Sustaining our future.
http://nuclearrc.sa.gov.au/app/uploads/2015/10/Senator-Sean-Edwards-03-08-2015.pdf

International Atomic Energy Agency (2013). Agenda 10 JAPAN of Dry Cask Inspection at Fukushima
https://www.iaea.org/OurWork/ST/NE/NEFW/Technical-Areas/NFC/documents/spent-fuel/TM-45455/Agenda-10-JAPAN_of_Dry_Cask_Inspection_at_Fukushima_2013_7.pdf

Jacobs MCM (2016). Radioactive Waste Storage and Disposal Facilities in South Australia – Quantitative Cost Analysis and Business Case
http://nuclearrc.sa.gov.au/app/uploads/2016/02/Jacobs-MCM.pdf

Nuclear Fuel Cycle Royal Commission (2016). Summary, Jacobs MCM (2016), Radioactive waste storage and disposal facilities in South Australia—quantitative cost analysis and business case
http://nuclearrc.sa.gov.au/app/uploads/2016/02/NFCRC-Summary-Radioactive-waste-storage-and-disposal-facilities-in-South-Australia.pdf

OECD Nuclear Energy Agency. 'The Environmental and Ethical Basis of Geological Disposal of Long-Lived Radioactive Wastes'
http://www.oecd-nea.org/rwm/reports/1995/geodisp-entire-report.html

World Nuclear Association (2015a). Weekly Digest, Archive 2015
http://www.world-nuclear.org/our-association/publications/weekly-digest/archive/archive-2015.aspx

World Nuclear Association (2015b). Country Profile - Taiwan
http://www.world-nuclear.org/information-library/country-profiles/others/nuclear-power-in-taiwan.aspx

World Nuclear Association (2016c). Minister sets benchmark for French Repository.
http://www.world-nuclear-news.org/WR-Minister-sets-benchmark-cost-for-French-repository-1801165.html

The Australia Institute

Research that matters.