



**AUSTRALIAN
CONSERVATION
FOUNDATION**

YELLOWCAKE FEVER

Exposing the Uranium Industry's Economic Myths

April 2013

Olympic Dam uranium/copper mine,
South Australia - photo: Jessie Boylan

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'Potential' is one of the most powerful chemicals available to the political alchemist. Any individual, firm or sector deemed to have potential is relieved of a massive and perpetual burden - the need to account for past and present achievements (or, more probably, the lack of them). ... The history of Australian involvement in the civil uranium industry offers an excellent example of this alchemy at work.

Richard Leaver, Flinders University

1.EXECUTIVE SUMMARY



Ranger uranium mill, Northern Territory.

The Australian uranium industry remains a contested and controversial sector that lacks a secure social license. The industry's economic and employment contribution is small in relation to its significant domestic and international risks and legacies and there is an urgent need for an independent cost-benefit analysis and a comprehensive and transparent assessment of Australia's uranium trade. Uranium is a small contributor to Australian export revenue

and employment. From 2002 to 2011, uranium sales averaged \$627 million annually and accounted for only 0.29% of all national export revenue.

In the 2011/12 financial year, uranium revenue of \$607 million was 4.4 times lower than Australia's 20th biggest export earner, 8.7 times lower than Australia's 10th biggest export earner and 103 times lower than the biggest earner, iron ore. Small industrial sectors can play an important economic role but the unique

properties and risks of uranium mining relative to any benefits means its role requires particular scrutiny.

The industry's contribution to employment is also underwhelming. The World Nuclear Association estimates 1,760 jobs in Australia's uranium industry. That is the highest of all estimates yet it represents just 0.015% of all jobs in Australia. The industry's primary promotional body, the Australian Uranium Association (AUA), claims its members are "significant employers of First Australians" however the sector only provides around one job for every three thousand Indigenous Australians.

In the mid-2000s, there was a speculative uranium price bubble. Since this bubble burst the uranium industry has been battered by a falling commodity price, rising production costs, the Global Financial Crisis (and associated credit crisis), the failure of the global nuclear power 'renaissance' to materialise, the failure to develop new mines and serious production shortfalls.

In July 2007, shortly after the peak of the speculative price bubble, *The Australian* reported that the market had "reacted savagely to uranium hopefuls". In the 12 months to December 2008, the market valuation of Australian uranium companies fell by 75%. In March 2009 *The Australian* reported that the "drastic decline in the price has really hit the local sector for six" and "many local uranium explorers have more or less gone into hibernation", while Far East Capital's Warwick Grigor said there "are many walking dead companies out there - zombie companies." In April 2010 *The Age* reported that uranium explorers "are generally showing falls of 50 per cent from their 52-week peaks" and "a whole bunch of junior explorers ... do not have a hope of getting in to production while uranium prices remain in the doldrums".

Since March 2011 the industry has had to deal with the fallout from the Fukushima disaster. In late 2011 *The Australian* said the sector is doing a "passable imitation of Death Valley". In 2012, BHP Billiton cancelled the planned expansion of Olympic Dam, disbanded its

Uranium Division and sold the Yeelirrie uranium project in WA for around 11% of the nominal value of the uranium resource. Also indicative of the state of the industry was Cameco's February 2013 announcement of a \$162.5 million write-down on the Kintyre project in WA as a result of the weakening of the uranium market. Very few projects are under active development.

A number of factors will affect the future of Australia's uranium industry, but in any plausible scenario uranium could be, at most, a small contributor to export revenue and employment. An important constraint is the size of the global market for uranium. The value of global uranium demand is around \$9.6 billion annually (using generous assumptions). Even in the implausible scenario of Australia supplying entire global demand, uranium would be Australia's eighth biggest export earning industry and it would fall short of iron ore revenue by a factor of 6.5.

The industry hopes that bilateral uranium supply agreements with China (2007) and Russia (2010), along with agreements currently being negotiated with India and the United Arab Emirates, will lead to export growth. Growth is likely in those countries - growth from a low base (excepting Russia) and of uncertain pace. Claims that growth in China and India will drive huge increases in uranium exports do not withstand scrutiny.

There is little for Australia's uranium companies to cheer about in other export markets for Australian uranium:

- Plans to expand nuclear power (or at least to maintain current capacity with new build) are in trouble in the UK, the USA and Canada.
- Germany and Belgium plan to abandon nuclear power.
- The restart of reactors in Japan promises to be a protracted, contentious affair and pre-Fukushima plans to expand nuclear to 50% of total electricity supply are now firmly in the past.
- South Korea's nuclear industry has been hit by a series of scandals including bribery, corruption and cover-ups,

and the proportion of South Koreans who consider nuclear power safe fell from 71% in 2010 to 35% in 2012.

- France plans to reduce its reliance on nuclear power.
- Taiwan, Finland, and Spain have fewer than 10 reactors each and will remain, at most, small markets.
- Sweden has 10 reactors, with no scope for growth under existing government policy.

A decade into the nuclear 'renaissance' and global nuclear capacity has not increased. There may be modest growth, but utilities will have to build several hundred reactors in the coming decades just to replace the current cohort of mostly middle-aged reactors. The huge capital cost of reactors is proving to be the industry's Achilles heel. An Exelon executive recently warned that new reactors "won't become economically viable for the foreseeable future" in the US, while General Electric's CEO said "it's just hard to justify nuclear, really hard".

Most growth is anticipated in economically and/or politically illiberal countries. *The Wall Street Journal* noted in February 2013 that "new nuclear works best in countries where consumers and financiers are shielded from its full costs - hardly the best basis for the industry's ever-elusive renaissance".

Industry enthusiasm is no substitute for analysis and evidence and a transparent review of the sustained dissonance between the performance and promise of the uranium sector is long overdue.

This report concludes with a call for a national inquiry into the uranium industry that would examine the domestic and international implications and impacts of Australia's uranium trade. It is by no means clear that the industry's meagre economic benefits outweigh its unresolved problems and risks to environmental and public health, proliferation, safety and security and more.

2. AUSTRALIA'S URANIUM EXPORT REVENUE IN PERSPECTIVE

(See Appendix I for more detail and sources.)

	2002	2005	2008	2011	10-year avge 2002-11*	2011/12
Export (t U)	6,476	10,481	8,194	6,170	7,774	5,865
Uranium export revenue (A\$)	363m	573m	749m	642m	627m	607m
Uranium % of national export revenue	0.23%	0.32%	0.27%	0.20%	0.29%	0.19%
Export value (\$A / kg U)	56	55	91	104	82	103
Australian % of global U production	19%	23%	19%	11%	18.2%	11%

* Average of figures from all 10 years, not just those shown here.

The following national export revenue **figures** put uranium exports into perspective:

Rank	Commodity	2011/12 (A\$)
1	Iron ore and concentrates	62.7b
2	Coal	47.9b
3	Gold	16.6b
10	Aluminium ores and concentrates	5.3b
20	Wool and other animal hair (inc. tops)	2.7b
-	Uranium	0.6b

In the 2011/12 financial year:

- uranium accounted for 0.19% of national export revenue;
- uranium revenue was 4.4 times lower than Australia's 20th biggest export earner, wool;
- uranium revenue was 8.7 times lower than Australia's 10th biggest export earner, aluminium; and
- uranium revenue was 103 times lower than the biggest earner, iron ore.

A serious constraint is the modest size of the global market for uranium. Even if all secondary supply is bundled into the primary market, and lower spot prices are ignored, the figure still falls short of \$10 billion p.a:

2011 production	64,402 t U3O8 (142 million lb)
2011 contract price	US\$60/lb U3O8
Value of 2011 production	US\$8.52 billion (A\$8.21 billion - exchange rate as of 20/3/13)
Value of total 2011 requirements (production met 85% of requirements)	US\$10.0 billion= A\$9.6 billion

The claims of mining advocates about the economic benefits to Australia from uranium mining need to be tempered by consideration of the high level of foreign ownership. Of the four companies producing uranium as of March 2013: BHP Billiton (Olympic Dam) is 76% foreign-owned, Rio Tinto (Ranger) 83%, General Atomics/Heathgate Resources (Beverley) 100%, and Uranium One (Honeymoon) 100%.¹ There is also considerable foreign ownership of **uranium exploration companies**.

Much has been written about the mixed economic effects of Australia's mining boom. Negative impacts **include** upward pressure on exchange rates; driving up the costs of skilled labour for businesses in other sectors; driving up the prices of raw materials used in mining (for example concrete and steel); driving up the cost of other services (for example construction). However the uranium industry could not be accused of contributing to those negative impacts to any significant degree - its economic impacts, positive and negative, are minimal.

URANIUM EXPLORATION EXPENDITURE

The Bureau of Resources and Energy Economics' (BREE) **March 2013 Resources and Energy Quarterly** provides the following information on private mineral exploration expenditure in Australia including energy (petroleum, coal, uranium), minerals and other metals:

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	Six-year average
Uranium \$m	114.1	231.5	185.2	169.1	213.9	153.6	178
Total \$m	3940.1	5496.3	6033.9	5726.7	6266.7	7150.0	5770
Uranium % of total	2.9 %	4.2%	3.1%	3.0%	3.4%	2.1%	3.1.%

According to a 2012 BREE **report**, Australia's identified uranium resources have more than doubled in the past two decades and increased by 62% from 2006 to 2010. However a large majority of the increase comes from revised estimates of Olympic Dam (first discovered in 1975). New resource discoveries include Beverley Four Mile (SA - 2005), Samphire (SA - 2007), Lake Mackay (WA - 2011), and some other mostly small, technically challenging deposits - primarily in WA and Queensland.

¹ The figures for BHP Billiton and Rio Tinto are taken from a 2011 **report** by the Australia Institute. Ranger is operated by Energy Resources of Australia - Rio Tinto owns **68.4%** of ERA shares.

3. EMPLOYMENT

IBISWorld's market report (March 2013) states there are just **650 jobs** across Australia in uranium mining. In May 2006, the federal Department of Industry, Tourism and Resources estimated "**over 700 jobs**" in uranium mining and in October 2007 the Department's estimate was "over 800 jobs". The World Nuclear Association puts the figure at **1,760 jobs** (1,200 in mining, 500 in exploration and 60 in regulation).

Even the higher World Nuclear Association figure represents just 0.015% of all jobs in Australia² and considerably less than 1% of **jobs** in mining, oil and gas operations (while all mining accounts for about **2%** of the total workforce).

Prime Minister Julia Gillard puts the figure at "**over 4,200 jobs**" in uranium mining in Australia - presumably using a 1,400 x 3 multiplier for indirect jobs. Yet Dr David Gruen from the Macroeconomic Group at Treasury **states** that "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 ... there really isn't a multiplier".

Inflated claims and estimates of uranium employment are neither new nor the domain of one political party. In 1988, Labor MHR Gordon Bilney **claimed** that the unfettered expansion of the uranium industry would generate 250,000 new jobs. In 2012, Premier Campbell Newman stated the industry would generate "**thousands of jobs**" in Queensland despite not having any economic analysis to justify this implausible claim.

The Australian Uranium Association **claims** the industry is a "significant employer of First Australians, with some workforces comprising up to 15 per cent indigenous employees." In order to better reflect the Indigenous employment variance between projects, if we apply a 5% discount rate to the Association's claim and assume that Indigenous people comprise 10% of the uranium workforce (still a generous estimate), and if we take the highest of the available estimates of total employment (1,760), that amounts to 176 jobs or roughly one job for every 3,000 Indigenous Australians – hardly a fast track to closing the gap. And this is before Dr Gruen's point about redistribution is considered in the employment equation.

². **11.54** million full-time and part-time jobs as of December 2012.

4. ROYALTIES, REBATES AND TAXES

Steve Kidd from the World Nuclear Association [wrote](#) in May 2008: “[U]ranium mines generate about A\$21 million in royalties each year, with corporate taxes amounting to over A\$42 million per year. These are important numbers but are dwarfed by the magnitude of, for example, Australia’s coal and iron ore sectors.”

In an assessment of the Olympic Dam royalties regime enshrined in South Australia’s amended Roxby Downs Indenture Act, journalist Paul Clearly [wrote](#) in *The Australian* in October 2011 that the regime “has robbed the state’s citizens and all Australians of the opportunity to share in the profits of what will become the world’s biggest mine”. He added that the agreement “will unfortunately stand as a sad and enduring indictment of the weakness of our state governments when it comes to negotiating with powerful mining multinationals”.

The Australian Uranium Association [supports](#) a profits-based, rather than production-linked, royalty system in the NT although such a system fails to provide a certain, secure and assured revenue platform for Indigenous communities. During the first 5 -10 years of a uranium mining operation, there is a high likelihood that little or no income would be generated under a profit-based royalty scheme, even though there would be direct environmental and social impacts from any such operations.

In WA, the Liberal National Government’s [‘Royalties for Regions’](#) policy was meant to use mining royalties to fund schools, health services and other community infrastructure. But [\\$80 million](#) was redirected to support mineral exploration and a significant amount has gone to uranium companies despite the promise that the Government would not fund uranium mining. This issue was highlighted in the March 2013 state election context when community opposition led to the WA Nationals commitment to end R4R uranium funding.

BHP Billiton enjoys extensive subsidies in the form of fuel-tax credits (formerly known as diesel fuel rebates). Under the mine expansion plan, the company would have enjoyed [\\$350 million in diesel fuel rebates over five years](#) – more than was to be paid to the State in royalties from the existing underground mine over the same period - and an effective subsidy of [\\$85 million](#) annually to 2050. A 2012 Australia Institute [report](#) found that at a time when the mining industry is earning record profits, it received subsidies and concessions worth more than \$4 billion per year from the Federal Government alone. The biggest single subsidy comes in the form of fuel-tax credits, valued at \$1.9 billion in 2009/10.

Uranium mining companies - and the [Australian Uranium Association](#) - fought the proposed Resources Super Profits Tax in 2010. Ross Gittins [wrote](#) in *The Age* in February 2013: “Last year the mining industry accounted for more than a fifth of all the profit made in Australia, even though it had a much smaller share of the economy. This was mainly because the royalties charged by the state governments failed to capture enough of the market value of the minerals the largely foreign-owned miners were being permitted to extract. When the Rudd government tried to correct this with a resource super profits tax, the industry set out to bring about its electoral defeat.”

Uranium was to be included in the proposed Resource Super Profit Tax, but it was subsequently excluded from the Minerals Resource Rent Tax.

A 2011 [report](#) by the Australia Institute notes that the average rate of corporate tax paid by the mining industry in 2008/09 was 13.9% - substantially below the theoretical 30%.

5. UNTANGLING INDUSTRY RHETORIC

DELOITTE REPORT COMMISSIONED BY THE AUSTRALIAN URANIUM ASSOCIATION

The uranium industry spins its modest figures with long-term forward projections based on bullish assumptions. The Australian Uranium Association commissioned Deloitte Insight Economics to produce a 2008 [report](#) on the economic outlook for the industry to 2030. The most bullish of the three scenarios modelled by Deloitte assumes:

- a 67% increase in the uranium contract price from 2008-2030 (from US\$90 to US\$150/lb U3O8)
- global nuclear power capacity increases by a factor of 4.4 (from 370 GW to 1,634 GW)
- uranium exports increase by a factor of 7.9 (from 9,663 to 76,000 t U3O8)

The economic impact is further inflated by using a multiplier to estimate overall increases in GDP - \$32.3 billion above the base case in the most bullish scenario. Further, Deloitte's 'base case' makes the reasonable assumption that Australia's uranium production "remains at around current levels", but that assumption is inconsistent given that the base case anticipates global nuclear capacity growth of 40% (from 370 GW to 519 GW).

Among a raft of other problems, the assumption that Australia could increase uranium exports by an order of magnitude without deflating prices defies logic. As Flinders University academic Richard Leaver [said](#) of an earlier period: "In essence, the idea that world prices could remain high while Australian production skyrocketed required that the basic laws of supply and demand be suspended."

THE AUSTRALIAN URANIUM ASSOCIATION - REPEATEDLY WRONG

The Australian Uranium Association has 36 members representing all of Australia's uranium producers and most of the major uranium exploration companies. Thus its estimates of future uranium production and demand ought to be better than anyone else's. However the Association's persistent pattern of unrealised predictions has deeply eroded its reliability.

In June 2011, the Association [claimed](#) there were "good prospects that four or five projects in WA will begin operation in the next three to four years". As of March 2013, no uranium mines are in operation in WA. It is possible that one mine (Toro Energy's Wiluna project) may be producing in the next few years, but there is no possibility that the prediction of 4-5 mines by 2014-15 will be realised.

In September 2011, the Association [predicted](#) \$756 million export revenue in 2011/12 - the true figure was [\\$607m](#), nearly 20% lower.

In February 2012, the Association [estimated](#) production of 9,800 t U3O8 in 2012 - the true figure was around 16% lower.³

The Association frequently (and [prominently](#)) promotes a consultant's estimate of 14,000 t U3O8 exports in 2014, earning \$1.7 billion. Yet revenue in 2011/12 was nearly three times lower at \$607m and the Bureau of Resources and Energy Economics [estimates](#) that revenue in 2012/13 will increase by just 5.1%.

The Association promulgates different estimates. For 2014, the Association frequently promotes the consultant's estimate of 14,000 t U3O8 exports. But in a 2012 paper on the Association's website, it [predicts](#) production (and presumably export) of 9,800 t U3O8 in 2014. The downwardly-revised estimate is still ambitious given that 2012 production was around 8,250 t U.⁴

Michael Angwin, the Association's Executive Director, [claims](#) that Australia "has enough reserves to be to uranium what Saudi Arabia is to oil". However even a cursory financial comparison highlights the gulf between the two sectors.

- Saudi oil exports in 2011 amounted to \$299 billion ([US\\$311b](#)) - 466 times greater than revenue from Australian uranium in the same year.
- Australia would need to supply entire global uranium demand 31 times over to match Saudi oil revenue.
- If all of Australia's Reasonably Assured plus Inferred uranium resources (to US\$130/kg U) were mined and sold at the price realised for 2011/12 uranium exports, the one-off economic windfall would fall short of annual Saudi oil revenue by \$128 billion.⁵ Even without the US\$130/kg U constraint, the figure would fall short of annual Saudi oil revenue.⁶

³ Based on 2012 company production figures for Olympic Dam (4,032 t U3O8), Ranger (3,710) and Honeymoon (130.6), and assuming Beverley production is the average of the past two financial years (380) - totalling 8,250 t U3O8.

⁴ Based on 2012 company production figures and assuming Beverley production is the average of the past two financial years.

⁵ Reasonably Assured Resources plus Inferred Resources, to US\$130/kg U, total [1.66 million tonnes](#). 2011/12 price \$103,000 / t U. Total: \$171 billion. The comparison between Saudi oil and Australian uranium has also been made by, among others, former SA Premier [Mike Rann](#), former SA treasurer [Kevin Foley](#), academics [Ian Plimer](#) and [Haydon Manning](#), Murdoch journalist [Brad Crouch](#), [Access Economics](#) and [Paul Howes](#) from the Australian Workers Union.

⁶ 2.83 million t U, \$103,000 / t U, total \$291 billion. Mudd estimates a total Australian resource of 3.34 million t U3O8 (2.83 million t U), of which 73% is at Olympic Dam. Mudd, Gavin, 'Uranium', in Letcher, Trevor and Janet Scott (eds.), 2012, 'Materials for a Sustainable Future', Royal Society of Chemistry ([www.rsc.org](#)), p.186, 188. Available from [Gavin.Mudd@monash.edu](#)

ABARES BARELY CREDIBLE ESTIMATES

In 2007, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) **predicted** uranium export revenue in 2010 would be \$1,295 million (the true figure was 47% of that estimate) and revenue in 2011 would be \$1,469 million (the true figure was 44% of that estimate).

In 2009, ABARES **estimated** a 112% increase in uranium export revenue in the six years from 2007/08 (from \$887 million to \$1,880 million). In fact, in the four subsequent financial years, average revenue was \$751 million - 15% below the 2007/08 figure.

Despite those unhappy experiences, ABARES continued publishing bullish estimates. In March 2011, it **estimated** that export revenue would reach \$2.94 billion in 2015/16. If so, it will need to get a wriggle on:

2010/11 - \$0.61billion

2011/12 - \$0.61billion

2012/13 - \$0.69billion

(Bureau of Resources and Energy Economics **estimate**)

2013/14 - \$0.61billion

(Bureau of Resources and Energy Economics **estimate**)

2014/15 - \$0.71billion

(Bureau of Resources and Energy Economics **estimate**)

2015/16 - \$2.94billion (ABARES estimate)

The task of producing over-inflated uranium estimates has been transferred from ABARES to the Bureau of Resources and Energy Economics (BREE). A March 2012 BREE **report**:

- estimated that the spot price would average around US\$53/lb in 2012, but it fell to US\$43.50 (and the average was around US\$48).
- estimated export revenue of \$708 million in 2011/12, but the true figure was \$607 million.
- estimated 15 reactor restarts in Japan in 2012, but there were only two restarts.
- estimates revenue of \$1.69 billion in 2016/17 - an estimate that stretches credulity though less so than ABARES' estimate of \$2.94 billion in 2015/16. ('Global uranium demand expected to skyrocket', *The Australian* **reported** in response to the BREE report.)
- anticipated the following mines producing in the "medium term" - Wiluna, Mulga Rocks, Lake Maitland, Yeelirrie and Bigirlyi - though most are in care and maintenance with no effort being made to move through approvals processes or to secure financing (for details see **Australian Nuclear Map**).

BREE's **March 2013 Resources and Energy Quarterly** estimates uranium export revenue of \$0.9 billion in 2016/17. In the ABARES/BREE tradition the assumptions are bullish, but more striking is the dramatic downward revision of mid-term estimates. In March 2012, BREE estimated \$1.69 billion in 2016/17, 88% higher than the March 2013 estimate for the same period.

Also striking is the gap between BREE's latest mid-term estimates and those of the Australian Uranium Association. In the three years 2016-2018, the **Australian Uranium Association estimates** average annual exports of 16,000 t U3O8. In the three financial years 2015/16 to 2017/18, **BREE estimates** average annual exports of 9,300 t U3O8. BREE's estimate is just 58% of the Australian Uranium Association's estimate.

SPINNING FUKUSHIMA

The uranium industry was in decline long before the Fukushima disaster. In July 2007, shortly after the peak of the speculative price bubble, *The Australian* **reported** that the market had "reacted savagely to uranium hopefuls". In the 12 months to December 2008, the market valuation of Australian uranium companies **fell by 75%**. In March 2009 *The Australian* **reported** that the "drastic decline in the price has really hit the local sector for six" and "many local uranium explorers have more or less gone into hibernation" while Far East Capital's Warwick Grigor said there "are many walking dead companies out there - zombie companies". In April 2010 *The Age* **reported** that uranium explorers "are generally showing falls of 50 per cent from their 52-week peaks" and "a whole bunch of junior explorers ... do not have a hope of getting in to production while uranium prices remain in the doldrums".

Since March 2011 the industry has had to deal with the fallout from Fukushima. In late 2011 *The Australian* said the sector is doing a "passable imitation of Death Valley". Yet a June 2012 ABC **report** asserted that the nuclear renaissance was "well underway" one year after the Fukushima disaster and uncritically reported claims by Greg Cochrane of uranium hopeful Deep Yellow that Fukushima hadn't dampened demand for nuclear energy at all.

Bill Repard, the organiser of the Paydirt Uranium Conference, **said** in February 2012: "The sector's hiccups in the wake of Fukushima are now over with, the global development of new nuclear power stations continues unabated and the Australian sector has literally commenced a U-turn in every sense. ... [T]his is an extraordinary turnaround in under a year in the current and emerging prospects for Australia's uranium exploration and mining sectors. It is little wonder that many equities market commentators see uranium as the sleeper commodity that is awakening with a vengeance."

Yet at the same conference, it was clear many companies were looking elsewhere, prompting an industry veteran to **quip** that copper and gold had never before enjoyed so much airtime at a uranium conference.

There was little or no objective basis for Mr Repard's comments, nor was there any up-turn for the rest of 2012. Ironically, the most positive development for would-be uranium miners in 2012 was BHP Billiton's decision to cancel the Olympic Dam expansion and to disband its Uranium Division.

Peter Ker analysed the impacts of Fukushima on the Australian uranium industry in **The Age** in March 2012. He noted that more than \$1.5 billion was wiped off the value of ASX-listed uranium companies on the first day of trading after the Fukushima disaster. Paladin Energy and ERA lost more than \$1 billion of that and within six months both companies had shrunk to barely 20% of their former selves. Martin Place Securities said the combined enterprise value of companies on its uranium index fell from \$11.4 billion in February 2011 to \$4.5 billion in October 2011. Analyst Warwick Grigor anticipated that "90% of the uranium hopefuls out there are going to find that the road is just too hard for them".



Share prices partly recovered from their earlier decimation - in April 2012, the Merrill Lynch Uranium Equity Index was **up 37%** from its low in October 2011. But in June 2012, Peter Ker **noted** that "there was evidence that the small end of the industry was close to conceding defeat". In September 2012, Bloomberg reported that Cameco was selling some of its uranium at below the cost of production. In October 2012, Reuters **reported** that with the spot price for uranium at a two-year low, Cameco had lost more than 48% of its market value in the aftermath of Fukushima, Uranium One was down 62%, while Paladin Energy had fallen 72%.

In February 2013, Cameco **announced** a \$162.5 million write-down on the Kintyre project in WA. The company said: "Due to the weakening of the uranium market since the asset was purchased in 2008, no increase in mineral resources in 2012 and the decision not to proceed with the feasibility study, we concluded it was appropriate to recognise an impairment charge for this asset." Following Cameco's announcement, Paladin Energy made its half-yearly announcement, reporting a **net loss of \$193.5 million** - a further deterioration on the net loss of \$120.2 million reported over the previous corresponding period.

Despite this reality, there is no situation so dire as to preclude yellowcake fever. Significant, protracted price falls are met with predictions that the market will soon turn. Readers of the *Energy Report* are **advised** to "pounce now and ride the upswing" with uranium stocks at two-year lows. A November 2012 article in *The Australian*, titled '**Yellowcake starts to glow again**', speculated that the uranium price may be close to bottoming.

THE FUKUSHIMA DISASTER

The most authoritative report on the Fukushima disaster was released in 2012 by the Nuclear Accident Independent Investigation Commission, which was established by an Act of the Japanese Parliament. The report states that the accident was "a profoundly man-made disaster that could and should have been foreseen and prevented" if not for "a multitude of errors and wilful negligence that left the Fukushima plant unprepared for the events of March 11". The accident was the result of "collusion between the government, the regulators and TEPCO".

A large majority of the 160,000 evacuees from the nuclear disaster are still dislocated and they "continue to face grave concerns, including the health effects of radiation exposure, displacement, the dissolution of families, disruption of their lives and lifestyles and the contamination of vast areas of the environment".

Australia's uranium companies failed to exert influence or address the endemic corruption and collusion in Japan's nuclear industry that was responsible for the Fukushima disaster and many previous accidents, incidents and scandals. A great deal of evidence about the industry's failings was on the public record long before the Fukushima disaster yet Australia's uranium companies did nothing - except blithely supply the fuel that made the accident possible and fail to review or modify any operational or administrative practises after it did. Such inaction is inconsistent with industry claims of leading practise and social responsibility.

POOR PRICE PREDICTIONS (PRICES IN US\$/LB U₃O₈)

7/4/07

All indications are that a uranium price of \$140 will be reached by September 2008 - *The Australian*, citing Resource Capital Research.

Actual price: *The bubble peaked at \$138 in June 2007. In September 2008 the price ranged from \$58 to \$64.50.*

6/6/07

The price could reach \$150 by the end of 2007 and \$200 by June 2009 - *The Advertiser*, citing Macquarie.

Actual price: *\$90 at the end of 2007, and in June 2009 the price ranged from \$49 to \$54.*

2/7/07

Indications are for a price of \$165 by September 2008 - *The Age*, citing Resource Capital Research.

Actual price: *In September 2008 the price ranged from \$58 to \$64.50.*

28/7/07

UBS forecast a price of almost \$200 in 2008 - *The Australian*.

Actual price: *\$90 at the start of 2008 and \$53 at the end of the year.*

5/12/07

The price of uranium could surge higher - *The Advertiser*, citing Energy Resources of Australia.

Actual price: *\$90 at the start of 2008 and \$53 at the end of the year.*

18/3/08

The worst of the fall in uranium prices has already happened; the price could reasonably trade within \$60-90 for the rest of 2008; it would be most surprising to see it fall any lower - *The Advertiser*, citing Far East Capital.

Actual price: *On the day the article was published the price was \$74; it fell to \$53 at the end of the year.*

21/7/08

The “worst may be over for the uranium explorers, all of which have been savaged in the past 12 months.” Uranium “has emerged as something of a beacon in the darkness” and UBS expects prices to rise to \$90 in 2009 and \$110 in 2010 - *The Age*.

Actual price: *\$45 at the end of 2009, \$62.50 at the end of 2010, and back down to \$43.50 at the end of 2012.*

2/11/09

“Australia’s exports of coal, natural gas and uranium are all set to explode.” - *The Age*.

Actual price: *The price has fallen between 2/11/09 and March 2013. Export volume fell from 8,230 t U in 2009 to an estimated 7,000 t U in 2012.*

10/3/12

A recent survey of five analysts predicted a 15% rally in the spot price in 2012 - *The Age*.

Actual price: *Fell by more than 15% over the course of 2012 (from \$52 to \$43.50).*

6. FUTURE PROSPECTS

Here we consider some drivers and impediments affecting Australia's uranium industry under the following headings:

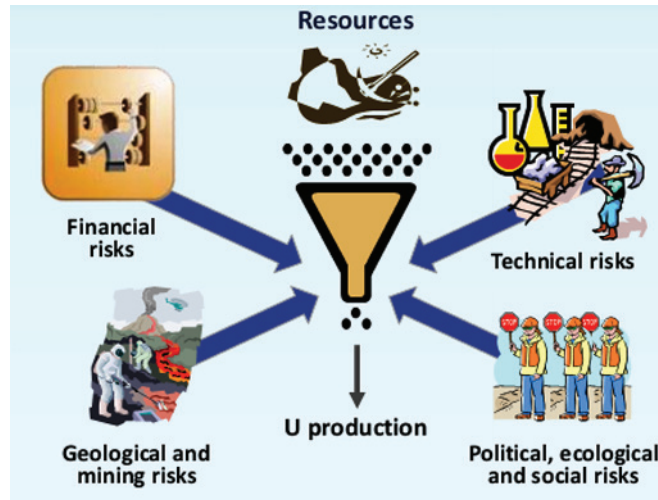
Drivers of Growth

- Relaxation of State Bans
- Large Uranium Resources
- Climate Change Abatement
- Declining Secondary Sources
- New Export Markets

A Nuclear Renaissance?

- Impediments to Growth
- Too cheap to meter ... or too expensive to matter?
- Uranium Prices
- Mining Costs
- Public Opinion and Concern

The central point of this paper is that uranium is and will remain, at most, a small contributor to Australia's export revenue and employment. If we momentarily accept industry hype and assume that uranium revenue doubles, it would overtake revenue from milk and cream exports - but uranium revenue could double again and still fall outside the top 20 list of export revenue earning industries. Uranium revenue could triple, triple again, triple a third and a fourth time and still fall billions of dollars short of iron ore export revenue. It is not this paper's contention that industry sectors that make a small contribution to economic activity do not deserve support but rather that the unique properties and risks of the uranium sector require dedicated assessment and that a meaningful cost-benefit analysis would highlight that this is a high risk, low return activity that continues to lack a secure social license.



Source: [World Nuclear Association](#)

DRIVERS OF GROWTH

Relaxation of State Bans:

A number of states have made policy changes that have been favourable to the uranium sector in recent years, but not all policy changes have bipartisan support and industry uncertainty remains.

As of March 2013:

- There is bipartisan support for uranium mining at the federal level and in SA and the NT.
- The Queensland LNP Government has overturned a long-standing state ban on uranium mining, but Queensland Labor remains opposed to uranium mining.
- The NSW Liberal Government has overturned legislation banning uranium exploration and has stated its support for the industry and for an end to the legal prohibition against uranium mining. NSW Labor remains opposed to uranium mining.
- The WA Liberal-National government supports uranium mining, however WA Labor opposes mining.

Large Uranium Resources:

Australia has around **31%** of the world's known recoverable uranium resources (Reasonably Assured Resources plus Inferred Resources, to US\$130/kg U), amounting to **1.66 million tonnes**. A majority of that uranium is in one location - Olympic Dam.

Climate Change Abatement:

The uranium industry is keen to promote its potential future contribution to climate change abatement. Such claims are compromised by the fact that the two companies responsible for most of Australia's uranium production - BHP Billiton and Rio Tinto - are also major coal miners and exporters. There is (unfortunately) considerable uncertainty about the extent to which concern about climate change will influence energy policy around the world in coming decades. There is also considerable uncertainty regarding the extent to which climate change abatement policies may lead to nuclear expansion given the sector's costs and concerns and the myriad of abatement options (including **baseload renewables**).

"For eight years in the White House, every weapons-proliferation problem we dealt with was connected to a civilian reactor program. And if we ever got to the point where we wanted to use nuclear reactors to back out a lot of coal ... we'd have to put them in so many places we'd run that proliferation risk right off the reasonability scale."

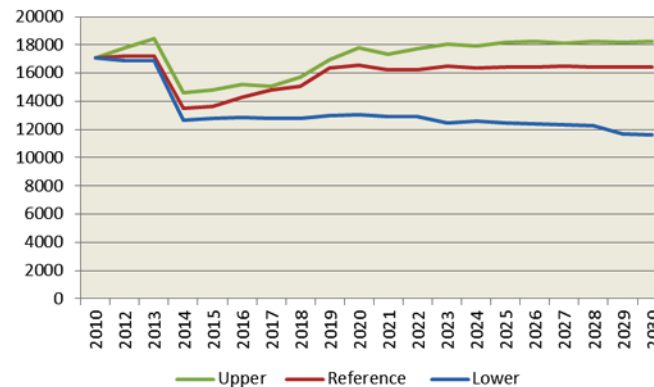
-Former US Vice President Al Gore

Declining Secondary Sources:

Some predict a significant increase in global uranium demand as a result of declining supply from downblended weapons material - in particular, the end of the US-Russian 'Megatons to Megawatts' program in 2013.

However mine production has met an increasing proportion of demand in recent years - 78% in 2009 and 2010, and **85%** in 2011 (the shortfall was around 10,000 t U in 2011). This suggests that the end of the Megatons to Megawatts program will have a moderate impact, but not greatly change the fundamentals of the uranium market. There is scope for weapons material to **continue to supply** the civil market regardless of future bilateral US-Russian agreements. Ux Consulting **noted** last year that reduction in demand stemming from the Fukushima accident "essentially negates much of the reduction in supply resulting from the end of the U.S.-Russia HEU deal". Utilities have built up uranium **stockpiles** in recent years as a result of low uranium prices (the World Nuclear Association **estimated** commercial inventories totalling 145,000 t U in 2010 - enough to supply global demand for two years).

Short-term decline of secondary supplies:



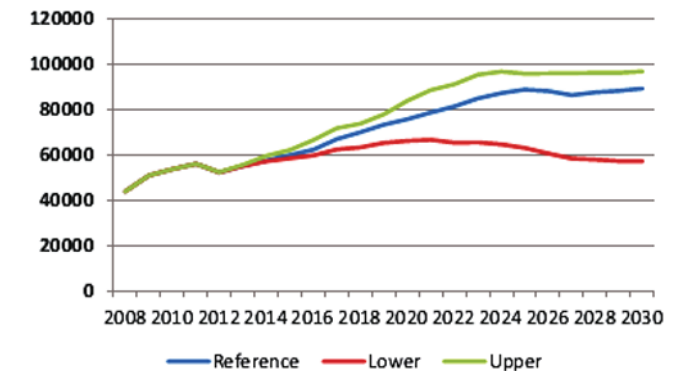
Source: World Nuclear Association, 2011.

Other than mined uranium and down-blended weapons material, **other sources** of nuclear fuel are reprocessed uranium and plutonium and the re-enrichment of vast stockpiles of depleted uranium (**1.5 million t U**). These sources do not currently contribute significantly to supply but they could do so and, speculative bubbles notwithstanding, their availability acts as a further constraint on uranium prices.

In the long-term it is possible the uranium industry will be undermined by alternative nuclear fuels (such as thorium) or by fast neutron reactors which use uranium feedstock far more efficiently. However these alternatives will be of little significance for the foreseeable future. A more immediate concern for the uranium industry is that nuclear utilities are improving efficiency through practices such as increasing uranium enrichment levels and increasing burn-up rates in reactors. From 1980 to 2008, nuclear electricity generation increased by a factor of 3.6 while **uranium used** increased by a factor of only 2.5.⁷

Factoring in secondary supplies, the World Nuclear Association provides the following **uranium production scenarios**:

Scenarios for prospective uranium production, tU



⁷ Since the early 1990s, global nuclear **capacity** has grown at around 1% p.a. with growth almost coming to a halt in the past decade; nuclear electricity generation has increased at a greater rate due to uprates and increasing load factors.

New Export Markets:

Australia's uranium is exported for use in nuclear power reactors in the following **countries**: USA, Japan, South Korea, Taiwan, Canada, China and Russia and in European Union countries (France, UK, Finland, Sweden, Belgium, Spain and Germany).

The industry hopes bilateral uranium sales agreements with China (2007) and Russia (2010), along with agreements currently being negotiated with India and the United Arab Emirates, will lead to export growth.

Russia:

The uranium industry repeatedly claims uranium sales from Australia to Russia will net \$1 billion dollars annually. That is the accepted wisdom and it has been routinely and uncritically repeated by sections of the media.⁸ As Richard Denniss from the Australia Institute **notes**: "Much has been written in recent years about the difficulty that the media seems to have sorting fact from fiction and distinguishing balance from barracking but the mining industry provides a clear example of the difficulties that all our media seem to have dealing with - an industry that spends more on public relations than some industries spend on research and development."

Some simple calculations give the lie to inflated claims about uranium exports to Russia. Russia's uranium requirement in 2012 was **5,488 t U**. If we assume Australia supplied 18.2% of that total⁹ at a price of \$103,000 / t U¹⁰, export volumes would increase by 999 t U and revenue would be \$103m - an order of magnitude short of the \$1 billion figure.

Moreover Russia's uranium production was equivalent to almost three-quarters of its requirements in 2010 (**3,562 t U**) and Russia has **around 9%** of the world's known recoverable uranium resources (up to US\$ 130/kg U). The World Nuclear Association's '**Nuclear Century**

Outlook' estimates that nuclear capacity in Russia in 2030 will be 2-4 times greater than the 2008 figure. Russia's nuclear power expansion plans, if realised, would generate increased demand for uranium though still far short of the order-of-magnitude expansion required for the \$1 billion dollar figure to be realised.

India:

India's nuclear sector is contested, dogged by continuing safety concerns and is unlikely to develop speedily. India's uranium requirement in 2012 was **937 t U**. If Australia supplied 18.2% of that demand¹¹ uranium exports would increase by 171 tonnes, worth \$17.6 million.¹² Australia's national export revenue (\$315 billion in 2011/12) would grow by an imperceptible 0.006%.

The figures remain underwhelming even if the projected growth of nuclear power in India is included. Projections of a several-fold increase from a very low base (4.4 GW) are plausible. The World Nuclear Association's '**Nuclear Century Outlook**' gives a range of 20-70 GW for nuclear capacity in India in 2030.

Projections of exponential growth leading to hundreds of gigawatts of nuclear capacity should be disregarded. India has a history of making projections that have not been realised. In 1962, India's Department of Atomic Energy **predicted** 20-25 GW in 1987 - the true figure was 0.95 GW (less than 5% of the forecast). The Department later **predicted** 43 GW in 2000 - the true figure was 2.7 GW (6% of the forecast).

Despite their poor track records, the Indian Department of Atomic Energy, the Indian Atomic Energy Commission and others continue to make unrealistic predictions. These predictions are then used to bolster the case for uranium sales from Australia to India. Michael Angwin from the Australian Uranium Association **claims** Australia can sell 2,500 tonnes of uranium annually to India by 2030, generating export sales of \$300 million. Prime Minister Gillard **claims** India "is expected to increase its use of nuclear power from its current three per cent of electricity generation to 40 per cent by 2050." A 2011 **report** in the Sydney Morning Herald claims uranium sales to India "could add up to \$1.7 billion in annual exports" - two orders of magnitude greater than our figure of \$17.6 million.

It is claimed uranium sales to India will indirectly boost trade between the two countries by fostering trust and goodwill. Such claims appear fanciful given that bilateral trade grew from **\$3.3 billion** at the turn of the century to **more than \$20 billion** in 2011, despite Australia's principled ban on uranium exports to countries that refuse to sign the Nuclear Non-Proliferation Treaty (NPT).

8. The \$1 billion figure has been uncritically cited in [The Australian](#), [The Age](#) (**again and again and again and again and again and again and again and again**), the [Sydney Morning Herald](#), the [ABC](#), the [Herald Sun](#), the Canberra Times and elsewhere.

9. Australia's average share of world production from 2002-2011.

10. The 2011/12 figure for Australia's uranium exports - \$87,000 / t U3O8 or \$103,000 / t U.

11. Australia's average share of world production from 2002-11.

12. Using the 2011/12 figure for Australia's uranium exports - \$87,000 / t U3O8 or \$103,000 / t U.

China:

China has **16** reactors listed as operable (12.9 GW) with nuclear contributing 1.8% to electricity supply. China's uranium production in 2011 was an estimated 1,500 tonnes - about twice the annual production from 2001-2010 (future production is uncertain). Twenty-nine reactors (30 GW) are listed as under construction and larger numbers are listed as planned (51) and proposed (120).

A wide range of estimates (some of them fantastic) are provided for nuclear growth in China to 2030. The World Nuclear Association's '[Nuclear Century Outlook](#)' gives a range of 50-200 GW. Pre-Fukushima growth projections have been sharply reduced and China now plans to approve a "**small number**" of new reactors projects each year. Even so, China's current projections of 40 GW capacity by 2015 and 80 GW by 2020 lack credibility. China has a history of failing to meet earlier nuclear projections - in 1985 authorities **forecast** 20 GW in 2000 but the true figure was 2.2 GW (11% of the forecast); and in 1996 authorities **forecast** 20 GW in 2010 but the true figure was 8.4 GW (42% of the forecast).

Assuming 50 GW nuclear capacity in China in 2030:

- nuclear capacity (and uranium demand) increases by a factor of 3.9;
- annual uranium demand reaches 9,100 t U (based on 182 t U/GW-year¹³ and
- if Australia supplies 18.2% of Chinese demand,¹⁴ that amounts to 1,658 t U worth \$171 million.¹⁵

The 1,658 t U figure would represent a 21% increase on Australia's average exports from 2002-2011 (7,774 t U) - far short of the hype about exponential export growth based on Chinese demand. If nuclear capacity in China reaches 75 GW, and using the same assumptions, Australian supply would near 2,500 t U p.a. - still less than one-third of average exports from 2002-2011.

United Arab Emirates:

Government officials from Australia and the United Arab Emirates are negotiating a uranium export agreement. However advancing a bilateral agreement would not significantly affect Australia's exports. The UAE has one 1.4 GW reactor under construction - its first - and another three planned. If those plans reach fruition, total annual uranium demand would be around 1,000 t U - less than 2% of current global production and demand.

Other customer countries:

There is little for Australia's uranium companies to cheer about in other customer countries (see the [World Nuclear Industry Status Report](#) for more detail):

- Plans to expand nuclear power (or at least to maintain current capacity with new build) are in trouble in the **UK**, the USA and Canada.
- Germany and Belgium plan to abandon nuclear power.
- The restart of reactors in Japan promises to be a protracted, contentious affair - and pre-Fukushima plans to expand nuclear to 50% of total electricity supply are now firmly in the past.
- South Korea's nuclear industry has been hit by a series of **scandals** including bribery, corruption, and cover-ups, and the proportion of South Koreans who consider nuclear power safe **fell** from 71% in 2010 to 40% in 2011 and 35% in 2012.
- France plans to reduce its reliance on nuclear power.
- Taiwan, Finland, and Spain have fewer than 10 reactors each and will remain, at most, small markets.
- Sweden has 10 reactors, with no scope for growth under existing government policy (new reactors are permitted only if replacing shut-down reactors).

As the International Atomic Energy Agency **notes**, the Fukushima disaster has "seriously undermined public confidence in the safety of nuclear power". To give one concrete example of the fallout from Fukushima, tests carried out at the European Union's 143 nuclear power reactors have exposed **hundreds of problems** requiring up to €25 billion (A\$31 billion) to remedy.

¹³ 2010 **WNA figures**: total uranium requirements 68,646 t U, operable reactor capacity 377.2 GW, hence 182 t U / GW.

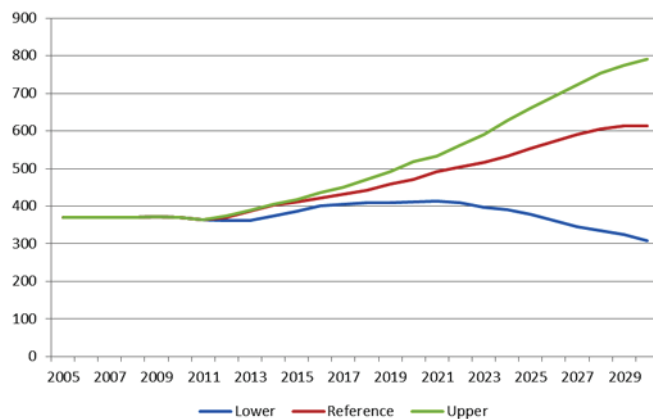
¹⁴ Australia's average share of world production from 2002-11.

¹⁵ Using the 2011/12 figure for Australia's uranium exports - \$87,000 / t U3O8 or \$103,000 / t U.

A Nuclear Renaissance?

A decade into the nuclear 'renaissance' and global nuclear capacity has **not increased**.

The Australian Uranium Association makes the **absurd claim** that "under conservative assumptions" nuclear power capacity will grow by a factor of 2.57 by 2030, from 374 GW to 960 GW.¹⁶ In contrast, the World Nuclear Association's most bullish **scenario** (around 800 GW) falls well short of that estimate.



Source: **WNA, 2011**.

The International Atomic Energy Agency is more modest with a 2030 **estimate** of 456-740 GW. On average the IAEA's 'low' **predictions** have been too high by 13% and its high predictions have been too high by 22%.¹⁷ If we take the IAEA's low estimate for 2030 and reduce it by 13%, the figure is 397 GW - a mere 6% expansion from the current figure.

Notwithstanding its track record of producing 'low' estimates that are later proven to be too high, the IAEA's low estimates have become more reliable over the years and its 2030 low estimate of 456 GW represents 22% growth above current capacity. The continuing

political and economic impacts of the Fukushima disaster make it far more difficult to project future nuclear growth and create a number of downside risks; therefore the 456 GW figure is best considered as being towards the upper end of plausible estimates.

There has been a sharp escalation of the number of reactors listed as under construction, 'on order or planned' or 'proposed' over the past decade. However, figures in those categories tend to be rubbery (all the more so after Fukushima). For example the French Atomic Energy Commission recorded **253 cancelled orders** in 31 countries until the year 2002 (when the Commission stopped recording cancellation figures).

The situation in the US illustrates how data, used out of context, can create the impression of a renaissance when none exists. In January 2007, the World Nuclear Association **listed** two reactors in the 'on order or planned' category for the US. The number jumped to **nine** in 2011 and **13** in January 2013. From those figures one could argue the 'renaissance' is on in the US. However many reactor plans have been **cancelled** in recent years, despite the availability of multi-billion-dollar federal loan guarantees. As of March 2013 just one reactor is listed as under construction. The **Bush administration** tried but failed to stimulate new build and the regulatory, economic and social license constraints on the nuclear sector have all increased since then.

Japan provides another example. As of March 2013, the World Nuclear Association **lists** 50 reactors in the 'operable' category for Japan - but only two are operating. Three reactors are listed as under construction, 10 'on order or planned' and three 'proposed'. These numbers are much the same as in **February 2011**. From the out-of-context data, one would not know that the industry has been shaken to its foundations by the March 2011 Fukushima disaster.

It is on such flimsy foundations that predictions of a 'renaissance' are built (see the **World Nuclear Industry Status Report** for more detail).

Nuclear power generated **12.8%** of world electricity in 2010 and **12.3%** in 2011 - well down from the historical peak of **17% in 1993**. The IAEA **estimates** that nuclear will account for 4.7-6.2% of electricity generation in 2030.

Growth projections should be considered in the context of the many historical examples of projections which have not been met. In addition to the Chinese and Indian examples already noted:

- In 1974, the IAEA **forecast** 4,450 GW globally in 2000 - the true figure was 352 GW (7.9% of the forecast).
- The IAEA **forecast** that there would be 14 new countries using nuclear power with a combined capacity of 52 GW by 1989 - the true figures were four countries (29% of the forecast) and 9 GW (17% of the forecast).
- In 1985, the IAEA's 'low' **forecast** was 502 GW in 2000 - the true figure was 350 GW (70% of the low forecast, 50% of the high forecast of 702 GW).
- In 1973, the US Atomic Energy Commission **forecast** 1,000 reactors in the US in 2000 - the true number was 103 (10% of the forecast).

¹⁶ To be precise, the Association points to potential economic benefits in the NT, and those benefits derive from an AUA-commissioned modelling **scenario** in which nuclear expands to 960 GW.

¹⁷ Calculated from tables 33 and 34, p.56.

IMPEDIMENTS TO GROWTH

Too cheap to meter ... or too expensive to matter?

Nuclear power is the one energy technology subject to a '**negative learning curve**' - it is becoming more expensive over time. Reasons include technological complexity and the need for stringent safety requirements. In contrast, the cost of solar PV has plummeted over the past decade.

The very large capital costs of nuclear power pose a major obstacle and make it acutely vulnerable to interest rate rises, credit squeezes and construction delays. As the World Nuclear Association **notes**, "long construction periods will push up financing costs, and in the past they have done so spectacularly." As an indication of the impact of financing costs, Georgia Power said in 2008 that two reactors would cost US\$9.6 billion if they could be financed progressively by tax-payers (though tax-payers generally don't consider these pay-in-advance schemes to be progressive), or \$14 billion if not.

The huge up-front costs make nuclear power difficult or impossible for all but the wealthiest countries and the wealthiest corporations to pursue. Countries with annual GDP of less than US\$50 billion, and electricity grid capacity of 5 GW or less, are poorly placed to be introducing nuclear power - and most countries which have expressed recent interest in introducing nuclear power do not meet both criteria.

In 2009, an **updated** version of a 2003 MIT study was published, stating: "The estimated cost of constructing a nuclear power plant has increased

at a rate of 15% per year heading into the current economic downturn. This is based both on the cost of actual builds in Japan and Korea and on the projected cost of new plants planned for in the United States. Capital costs for both coal and natural gas have increased as well, although not by as much."

Likewise, a 2010 **report** by the US Energy Information Administration states that the cost estimate for new reactors in the US has been revised upwards by 37% to a value of US\$5,339/kW. In a review of the economics of nuclear power in the US, Standard and Poors **stated**: "We expect unregulated companies, which are sponsoring new nuclear projects and which do not receive loan guarantees, will defer or abandon them altogether because it's too expensive, or uneconomic, to build them without such guarantees."

In March 2012, just-retired Exelon CEO John Rowe **said**: "Let me state unequivocally that I've never met a nuclear plant I didn't like. Having said that, let me also state unequivocally that new ones don't make any sense right now. And it won't become economically viable for the foreseeable future." The near-term prospects for nuclear in the US "will be miserably hard and extremely challenged by economics," he **said** in August 2012.

General Electric's CEO Jeffrey Immelt **said** in July 2012: "It's just hard to justify nuclear, really hard. ... So I think some combination of gas, and either wind or solar ... that's where we see most countries around the world going."

In relation to plans for new reactors in the UK, Citigroup **said** in 2009:

The three Corporate Killers - Three of the risks faced by developers - Construction, Power Price, and Operational - are so large and variable that individually they could each bring even the largest utility company to its knees financially. This makes new nuclear a unique investment proposition for utility companies.

In September 2011, German industrial conglomerate Siemens **announced** its intention to withdraw entirely from the nuclear industry, with Chief Executive Peter Loescher stating: "The chapter for us is closed." Siemens was responsible for building all Germany's existing nuclear power reactors.

The nuclear industry has written the book on squeezing many - often hidden - **subsidies** from tax-payers. Solemn promises not to subsidise new reactors in the UK have been abandoned. As Guardian columnist George Monbiot **noted** in February 2013: "While other sources of low-carbon energy are getting cheaper, nuclear power ... is becoming more expensive. Every year the industry raises its demands, insisting on more lavish guarantees before it builds. The higher the cost, the weaker the argument in favour of the technology becomes."

Other costs are also spiralling. The UK National Audit Office estimates the total future costs for decommissioning the (dual civil-military) Sellafield nuclear site in Cumbria will be £67 billion - well up from the 2009 estimate of £47 billion. Estimates of the clean up costs for a range of (civil and military) UK nuclear sites including Sellafield have jumped from a 2005 estimate of £56 billion to **over £100 billion**. In Sweden, the Nuclear Safety Authority has uncovered a deficit of at least €3.4 billion in the **Swedish Nuclear Waste Fund**.

The World Nuclear Association's **claim** that "in assessing the economics of nuclear power, decommissioning and waste disposal costs are

fully taken into account" is in clear conflict with the industry's operational reality.

Claims that 'Generation 4' reactors will produce cheap electricity are disingenuous. Fast breeder reactors are neither new nor cheap. The French Superphenix reactor was promoted as the first commercial-scale fast breeder reactor in the world but the electricity it produced is estimated to have cost US\$1.33 per kilowatt-hour - a number that even Enron failed to achieve during the manufactured energy crisis in California in 2000-2001.

Double Trouble

Here's a method of estimating nuclear power capital costs: double industry estimates and add a couple of billion for good measure. That formula works for reactors under construction in Finland and France. Since the contract was signed in 2003 for a new "**European Pressurized Reactor**" (EPR) in Finland, the estimated cost ballooned from €3 billion to **€8 billion** (A\$10 billion). Peter Atherton, utilities analyst at Citigroup, said: "There are few companies in the world that can take a **loss of that size** and remain solvent." The original estimated cost of EDF's Flamanville 3 EPR reactor in France was €3.3 billion and the **latest estimate** is €8.5 billion.

Uranium Prices:

A major impediment to an expansion of Australia's uranium industry, in the short-term at least, is the low uranium price. Paladin Energy **said** in November 2012 that it would require a sustained uranium price at or above US\$85/lb to warrant any further mine expansions or new mine development. Paladin is engaged in an "optimisation exercise" - i.e. cost cutting - as are many other uranium companies, including the major sector producers BHP Billiton and Energy Resources of Australia.

Rob Chang from Cantor Fitzgerald Canada **said** in January 2013: "Long-term, uranium really needs to be around \$70/lb, at minimum, to spur new mine development and ensure an adequate new supply to match demand. These deposits are getting deeper and harder to mine and were not easy to find to begin with... On average, it takes 7-10 years for a uranium mine to be discovered and then put into production. Prices have to rise to support new mine developments, exploration and production. We believe that the uranium price needs to be somewhere in the \$70 range, and that's actually a low estimate relative to others on the Street who are seeing something like \$75-85."

J.P. Morgan analyst Mark Busuttill **said** in July 2012: "The price that's required to give a 15 per cent return on a typical greenfield uranium project is about US\$83 per pound, so at the moment it is unlikely that any of the small uranium explorers would make appropriate returns."

Mining News (citing Bloomberg) **anticipates** a spot price rise up to \$55/lb in 2013, "still a long way short of the \$80 level that is widely argued to be the price needed to entice new developments or expansions." Raymond James analyst David Sadowski **said** in 2012 that "prices north of \$70/lb" are required to stimulate activity. (The long-term contract price has been **around US\$60/lb** in the past few years; the spot price has averaged around US\$50/lb.)

Mining Costs:

Ux Weekly **reported** in September 2008 that uranium mining costs have greatly exceeded the general inflation rate and that relationship would likely be maintained or exacerbated in the aftermath of the credit crisis.

In September 2008, Sebastien de Montessus, Areva's executive vice president for mining, **said** the uranium mining industry faces huge capital expenditure increases that are putting pressure on its ability to finance projects and that it was increasingly difficult for miners to pursue projects with no ability to see where the uranium price might be in 5-15 years.

A 2009 study by the London metals and mining consultancy CRU Group estimated that more than 3,000 uranium projects were under development globally but project quality was declining. The report found the average uranium grade of projects at the feasibility study stage was 35% lower than grades at current mines and the average grade was 60% lower for exploration projects. CRU **said**: "As result of these lower grades, and/or location in higher-cost geographical regions, next generation projects will have higher operating costs, on average, than current producers."

Escalating costs and continuing market uncertainty over uranium informed BHP Billiton's **decision** to cancel its plans for open-pit mining at Olympic Dam and to investigate alternative, less capital-intensive design options. At the same time development at Cameco's Kintyre project in WA has been deferred due to 'challenging economics'.

Reuters **reported** in October 2012 that new uranium projects are being stalled or shelved indefinitely due to the "sagging" price and "soaring" costs.

Public Opinion and Concern:

In general terms, public opinion in Australia is evenly divided on the topic of uranium mining. A 2008 **Newspoll** found 47% of Queenslanders opposed uranium mining compared to 45% support. A 2008 **Newspoll** found 48% of Western Australians supported a ban on uranium mining compared to 38% in favour of uranium mining. A 2011 **poll** found almost half the voters contacted by Western Australian Opinion Polls opposed uranium mining in WA, with 32% strongly opposed; 32% support uranium mining but only 5% were strong supporters; and only 28% of swinging voters supported uranium mining.

A 2011 **Morgan poll** illustrates how sensitive the results are to the framing of the question. When asked if they support exporting uranium for 'peaceful purposes', respondents were 59:34 in favour. When the same respondents were asked if they support exporting uranium to other countries for their 'nuclear power needs', the result was 44:50.

A 2012 **opinion poll** by the Lowy Institute found 61% of Australians opposed uranium sales to India, nearly double the number in support (33%). The number strongly opposed (39%) was more than four times the number strongly in support (9%). A 2008 **poll** by the Lowy Institute found that 88% agreed that Australia should "only export uranium to countries which have signed the global Nuclear Non-proliferation Treaty".

A **2008 survey** found 62% of Australians opposed uranium exports to nuclear weapons states compared to 31% in favour. An International Atomic Energy Agency **survey** of 1,000 Australians in 2005 found 56% believed the IAEA safeguards system was ineffective - nearly double the 29% who considered it effective.

There is also scepticism towards the mining industry generally. in a 2011 **poll** only 11% said "all Australians" benefited a lot from the mining boom compared to 68% for mining company executives, 48% for mining company shareholders, and 42% for "foreign companies".

Opposition to nuclear power is strong. A 2011 **poll** found just 12% of Australians would support a nuclear plant being built in their area, 13% would be anxious but would not oppose it, and 73% would oppose it. One can readily understand why at least 22 Coalition candidates publicly distanced themselves from former Prime Minister Howard's promotion of nuclear power in the lead-up to the 2007 federal election.

Australian attitudes are typical - a 2005 IAEA **survey** of attitudes in 18 countries found that about two-thirds of those expressing an opinion opposed building new reactors. South Korea was the only one of the 18 countries with majority support for new reactors. A 2011 **survey** covering 24 countries found 62% of respondents opposed nuclear power and 69% opposed the construction of new reactors.

7. A SOCIAL LICENCE?

The uranium industry is destined to be, at most, a small contributor to export revenue and employment in Australia. Do those small economic benefits justify the long-term problems and risks associated with the industry? Here we very briefly touch upon some of the problems and risks that need to be considered in any mature and meaningful assessment of the uranium industry.

RADIATION AND HEALTH

In 2010, a worker was sufficiently concerned about occupational health and safety issues at Olympic Dam that he **leaked** information to the media. The worker claimed BHP uses manipulated averages and distorted sampling to ensure its official figures of worker radiation exposure slip under the maximum exposure levels set by government. He said: "Assertions of safety of workers made by BHP are not credible because they rely on assumptions rather than, for example, blood sampling and, crucially, an assumption that all workers wear a respirator when exposed to highly radioactive polonium dust in the smelter." BHP Billiton claimed it complied with radiation protection limits, but both BHP Billiton and the Australian Uranium Association **declined** interview requests from the ABC.

Even more alarming is the behaviour of Toro Energy, which is currently seeking to develop West Australia's first uranium mine at Wiluna in the Murchison region. Toro Energy has promoted the fringe scientific view that exposure to low-level radiation is not only harmless but is actually beneficial to human health. In response, 45 medical doctors working in Australia signed a **statement** calling on Toro Energy to stop promoting views which fundamentally conflict with mainstream scientific evidence and established safety and regulatory regimes.

Dr Peter Karamoskos - a nuclear radiologist and public representative on the radiation health committee of the federal nuclear regulator, the

Australian Radiation Protection and Nuclear Safety Agency - **stated**: "To promote such marginal views without any counter-balance is self-serving and irresponsible and it may be time for governments to step in to provide that balance. Recent research has heightened rather than lessened concern about the adverse health impacts of low-level radiation."

The growing international professional awareness and action in relation to uranium and health issues mirrors earlier concerns in relation to such activities as asbestos production and use and tobacco smoking. In 2010 the International Physician's for the Prevention of Nuclear War (IPPNW) formally called for a **global ban on uranium mining**. IPPNW, a Nobel Peace Prize winner, called for this ban on health, human rights and nuclear security grounds and described the action as 'preventative health care'.

INDIGENOUS AUSTRALIANS

Seventy per cent of the world's uranium is located on Indigenous land and Indigenous people continue to bear a disproportionate burden of the risks and impacts of the uranium sector. Despite considerable public relations efforts the uranium industry has a poor track record in its dealings with Indigenous Australians. Energy Resources of Australia's Ranger mine in the NT's Kakadu region was imposed on an unwilling community and a determination was made that the clear opposition of the area's Mirarr Aboriginal people should 'not prevail'. Legislation was passed specifically to **exempt** the Ranger uranium mine in the Northern Territory from the Aboriginal Land Rights Act. In the late 1990s, ERA attempted to develop the Jabiluka uranium mine despite the unanimous opposition of Mirarr Traditional Owners. A Mirarr-led international protest campaign halted the development of Jabiluka. Recent years have seen a welcome improvement in ERA's liaison efforts and the conclusion of the Jabiluka long

term care and maintenance agreement, however the company continues to express its desire to exploit the Jabiluka resource in spite of sustained Mirarr opposition.

The SA Roxby Downs Indenture Act 1982 - legislation that governs operations at Olympic Dam - provides a raft of exemptions from the SA Aboriginal Heritage Act. No attempt has ever been made to justify those exemptions. The legislation was amended in 2011 and the exemptions were retained. A government spokesperson **said** in Parliament: "BHP were satisfied with the current arrangements and insisted on the continuation of these arrangements, and the government did not consult further than that". BHP Billiton had a clear opportunity to harmonise the regulatory and operational regimes at Olympic Dam with its worthy corporate rhetoric. The company's choice not to do so highlights the repeated gap between promise and performance in Australia's uranium sector.

The experience of Adnyamathanha Traditional Owners in relation to the Beverley uranium mine in South Australia has been deeply divisive. Elder Enice Marsh **said** in 2009: "We have no decision making power under Native Title, we have been forced into signing a Native Title Mining Agreement that gives us royalty compensation. If we refused to sign it the proponent has the right to take the matter to the ERD Court and cut us out of the process altogether. Aboriginal people have no rights under Native Title to protect our heritage. Look at what's already happened and how people have just given in to the pressures."

In March 2012, the NSW government passed **legislation** that excluded uranium from provisions of the NSW Aboriginal Land Rights Act 1983, thus stripping Aboriginal Land Councils of any future say in uranium mining proposals.

ENVIRONMENTAL PERFORMANCE

A 2003 [report](#) by a federal Senate References and Legislation Committee found “a pattern of under-performance and non-compliance” in the uranium mining industry and concluded “that short-term considerations have been given greater weight than the potential for permanent damage to the environment”.

In 2008, Marathon Resources was caught [illegally dumping](#) thousands of uranium exploration drill samples and other material in the Mt Gee region of the Arkaroola Wilderness Sanctuary. Regulatory authorities did not uncover the illegal waste dumping - indeed it would never have been discovered if not for detective work by local residents. The Australian Uranium Association and the SA Chamber of Mines and Energy expressed scant concern about Marathon’s illegal waste dumping - but they complained long and loud when the SA Government eventually moved to protect the Arkaroola Wilderness Sanctuary from mining.

Currently, the Australian Uranium Association is actively lobbying for [weaker environmental regulations](#) and greatly reduced scrutiny of proposed uranium projects under the Environmental Protection and Biodiversity Conservation Act. Yet the Mt Gee saga - and other examples - strongly suggest the need for stronger regulation and more robust and transparent assessment and compliance monitoring.

The [Australian Nuclear Map](#) project documents several cases of children being exposed to radioactive materials because of inadequate rehabilitation and monitoring practices. These further support the need for stronger, not weaker, regulation. Australian Nuclear Map also documents numerous cases of contaminated sites that have not been properly rehabilitated.

When an Olympic Dam mine worker went to the [media](#) with photos of multiple leaks in the tailings dams in 2009, BHP’s response was to [threaten](#) “disciplinary action” against any workers caught taking photos. Yet again there is a clear case for stronger regulation and greater transparency, especially given that Olympic Dam is even exempt from some provisions of the SA Freedom of Information Act.

Following the Fukushima nuclear meltdowns a United Nations [study](#) into the continuing crisis recommended that to help countries to evaluate the potential contribution of nuclear energy to sustainable development, an in-depth assessment of the net cost impact was needed into the impacts of uranium mining. The report identified that “there are concerns regarding the impacts of mining fissionable material on local communities and ecosystems”. To date, despite repeated requests, neither the Australian government nor the uranium sector has responded to this clear call.

WEAPONS PROLIFERATION AND SAFEGUARDS

In 2008, the Department of Foreign Affairs Trade (DFAT) and the Australian Safeguards and Non-Proliferation Office (ASNO) **told** Parliament's Joint Standing Committee on Treaties that "strict" safeguards would "ensure" peaceful use of Australian uranium in Russia. They conspicuously failed to tell the Committee that there had not been a single IAEA safeguards inspection in Russia since 2001.

The Australian Uranium Association **states** that "in regard to proliferation, the best posture is 'to trust but verify'". Yet the Association **failed** to inform the Committee about the rarity of safeguards inspections in Russia, instead making the unsubstantiated claim that "the non-proliferation safeguards that will govern the export of Australia's uranium to Russia are robust".

The Joint Standing Committee on Treaties made the common sense recommendation that "It is essential that actual physical inspection by the IAEA occurs at any Russian sites that may handle [Australian Obligated Nuclear Materials]. Further, the supply of uranium to Russia should be contingent upon such inspections being carried out." Prioritising dollar signs over danger signs, the Gillard Government ignored the recommendation and ratified the agreement, with Opposition support.

Former Director-General of the IAEA, Dr Mohamed El Baradei, is frank about the limitations of safeguards. He has noted that the IAEA's basic rights of inspection are "fairly limited", that the safeguards system suffers from "vulnerabilities" and "clearly needs reinforcement", that efforts to tighten the system have been "half hearted" and that the IAEA safeguards system runs on a "shoestring budget ... comparable to a local police department."

The scale of the safeguards challenge is ever-increasing as the following table demonstrates:

DATE (31 Dec. each year)	2001	2006	2011	10-year increase
Total Australian Obligated Nuclear Materials overseas (t)	101,922	130,756	171,744	69%
Total Australian-obligated plutonium (t)	64.0	103.7	149.6	134%
Depleted Uranium (t)	52,083	80,580	110,079	111%

Source: Australian Safeguards and Non-Proliferation Office, **Annual Reports.**

Australia has uranium export agreements with:

- all of the original 'declared' nuclear weapons states (USA, UK, China, France, Russia), none of which is meeting their disarmament obligations under the Nuclear Non-Proliferation Treaty (NPT).
- countries with a history of weapons-related research based on their civil nuclear programs (such as South Korea and Taiwan).
- countries that have not ratified the Comprehensive Test Ban Treaty (China, USA).
- countries blocking progress on the proposed Fissile Material Cut-Off Treaty (e.g. USA).
- secretive states with poor human rights records and limited transparency (eg. China, Russia).

There is bipartisan federal political support for uranium exports to India - a country which has not signed or ratified the NPT, has not signed or ratified the Comprehensive Test Ban Treaty, continues to produce fissile material for nuclear weapons and continues to expand its weapons arsenal and its missile capabilities.

"It is clear that no international safeguards system can physically prevent diversion or the setting up of an undeclared or clandestine nuclear programme."

- International Atomic Energy Agency, 1993

8. THE CASE FOR A NATIONAL INQUIRY INTO AUSTRALIA'S URANIUM INDUSTRY

The most recent independent assessment of the Australian uranium sector is now a decade old. The October 2003 [Senate Inquiry](#) into the adequacy of federal regulation of uranium mining found the sector characterised by a pattern of underperformance and non-compliance, an absence of reliable data to measure the extent of contamination or its impact on the environment and an operational culture that gives greater weight to short term than long term considerations. The Inquiry concluded changes were necessary to protect the environment and its inhabitants from “serious or irreversible damage”.

There is a compelling case for a national inquiry into Australia's uranium industry to thoroughly assess its benefits, problems and risks. An inquiry ought to address the following issues (among others):

Economic Impacts

The 2005-07 speculative uranium price bubble undoubtedly hurt many Australians. As with all such speculative bubbles, it can be safely assumed that ‘mum and dad’ (‘retail’) investors suffered the most. Is it acceptable for the Association to advance implausible growth estimates or to simultaneously advance significantly different sets of estimates?

Is it acceptable for the Australian Uranium Association to routinely advance exaggerated estimates of future growth of uranium exports and nuclear power? To what extent do investors - in particular retail investors - rely on the Association's implausible claims? Is it acceptable for the Association to advance implausible growth estimates and then to distance itself from those projections when called to account (eg. by shifting accountability to consultants)? Is it acceptable for the Association to simultaneously advance significantly different sets of estimates?

Proliferation Risks and Safeguards

The EnergyScience Coalition [called](#) for an inquiry into the Australian Safeguards and Non-proliferation Office (ASNO) in 2007. Had that call been heeded, later problems could have been avoided such as ASNO poorly advising Parliament's Joint Standing Committee on Treaties by claiming that “strict” safeguards would “ensure” peaceful use of Australian uranium in Russia and by conspicuously failing to inform the Committee that not a single IAEA safeguards inspection in Russia had taken place since 2001. The EnergyScience Coalition said:

“The authors of this paper believe there is a compelling case for major reform of ASNO as a matter of urgency. An alternative course of action would be for the Australian government to establish an independent public inquiry. Such an inquiry should have a broad mandate to review all aspects of ASNO's structure and function, should be adequately resourced, and should have powers similar to those of a Royal Commission to access witnesses, documents and other evidence.”

The need for an inquiry into ASNO remains. The Australian Uranium Association has [called](#) for an investigation into ASNO's role, resourcing etc., albeit for different reasons than the EnergyScience Coalition.

Safeguards issues other than ASNO's performance also need investigation. One important example is the secrecy surrounding safeguards - the refusal of ASNO to publicly release country-by-country information on the separation and stockpiling of Australian-obligated plutonium; details of 'Administrative Arrangements'; and information on nuclear accounting discrepancies (Material Unaccounted For). Is there any justification for this secrecy and does it advance or hinder non-proliferation outcomes?

And to list just one further proliferation-related issue requiring investigation, why does the Australian Uranium Association [insist](#) that “the only use for ‘reactor-grade’ plutonium is as nuclear fuel” when the overwhelming weight of [informed scientific opinion](#) holds that it can be used in weapons? Does the Government hold the same view? Should Australian policy regarding plutonium separation and stockpiling be adjusted to reflect the risks associated with ‘reactor grade’ plutonium - e.g. a ban on stockpiling of ‘Australian-obligated’ plutonium (produced in reactors from Australian uranium), or should there be a return to the previous policy of requiring Australian permission for reprocessing on a case-by-case basis instead of ‘programmatic’ (open-ended) permission? Current Australian policy is inconsistent with US President Obama's statement last year that: “We simply can't go on accumulating huge amounts of the very material, like separated plutonium, that we're trying to keep away from terrorists.”

Fukushima and the Broader Issue of Nuclear Risks

Given that Japan is a major customer for Australian uranium, why did uranium companies not seek to address the serious systemic problems in, and demonstrably inadequate regulation of, Japan's nuclear industry in the decade preceding the Fukushima disaster? In 2002 and 2007 details of **inadequate practices**, accidents and cover-ups were made public. The inadequacy of nuclear regulation in Japan was evident. Might the situation in Japan have improved if Australian mining companies (and/or successive Australian governments) had insisted on reform in Japan's nuclear industry as an industry best practise pre-condition of ongoing uranium sales?

What can the Fukushima failure teach us about Australian uranium export policy? Would it not be wise to take a proactive stance towards inadequate regulation in a number of other countries using Australian uranium? There is a particular need for Australia to address many of the recommendations and issues raised in the September 2011 UN system-wide study on the implications of the accident at the Fukushima Daiichi nuclear power plant.

Fukushima Daiichi.



Environmental Contamination

What legislative and other changes are required to establish adequate environmental practices? What changes are required to prevent further examples of children **accessing** land contaminated by uranium exploration and mining wastes (e.g. at Port Pirie, Rum Jungle, Kalgoorlie, Yeelirrie, Hunters Hill) - improved security practices, rehabilitation, etc?

In 2009 the Australian Uranium Association **rejected** calls for an inquiry into proposed uranium mining in WA. No doubt the industry does not want attention drawn to problems such as inadequate rehabilitation at **Wiluna** after uranium exploration in the 1980s, or children entering a contaminated tailings storage site near **Kalgoorlie** in 2012, or the inadequate fencing and warning signs at **Yeelirrie** and the use of this contaminated site for recreational purposes including swimming. One wonders what else an inquiry might have uncovered.

Unresolved concerns over site specific contamination, regulatory failures, worker and community health and safety, tailings management, radioactive waste and nuclear proliferation mean the Australian uranium sector fails to satisfy key sustainability criteria.

Indigenous Australians

Over 70% of the world's uranium reserves are located on Indigenous land and in Australia, as elsewhere, it is Indigenous people who continue to bear the disproportionate burden of the environmental, public health, social and cultural impacts of uranium mining and processing. There is a clear and urgent need to assess the impacts of the uranium sector on Indigenous lands and peoples and to review the adequacy of approval, consent and environmental and human protection mechanisms.

Other key issues for consideration include:

- What is the justification for exemptions for the uranium industry from Aboriginal heritage laws (in SA and NSW)? Should those exemptions be repealed?
- Should Traditional Owners in other states/territories have a right of veto over mining, as is the case in much of the NT?
- What are the lasting social and community costs and benefits of uranium mining?
- Are uranium operations and practises consistent with Australia's international treaty obligations?

Uranium Transportation

Are emergency services, combat agencies and first responders adequately prepared with regard to transportation of uranium and other radioactive materials? Are emergency services organisations adequately prepared, resourced and co-ordinated across different jurisdictions? Are all tiers of government adequately involved in decision shaping and making?

"None of the promises last, but the problems always do."
Yvonne Margarula, Senior Mirarr Traditional Owner.
photo: Dominic O'Brien



Australian Uranium Companies Operating Overseas

Are Australian uranium companies operating overseas applying adequate standards with respect to occupational health and safety, environmental impacts, etc? Should these companies be required to meet Australian standards when operating overseas (e.g. regarding mine rehabilitation)? These issues are of concern given the absence of robust regulatory regimes covering this sector in many African countries in particular. This could see a situation where Australian companies are engaged in activities that would not be acceptable practise in this nation, especially given that many of the Australian uranium companies active in Africa are juniors with limited capacity and little or no operational experience or proven compliance ability.

AUSTRALIAN URANIUM: HIGH RISK – LOW RETURN

The Australian uranium sector remains a contested and controversial one that continues to lack a secure social license. At best, the industry is and will remain a minor contributor to national economic activity, however it poses significant domestic and international risks and threats. The need to manage radioactive materials over extremely long periods and specific security and proliferation issues make uranium mining fundamentally different from other types of mining and requires a higher level of assessment, scrutiny and options for redress. There is a need to review the operations and impacts of this sector, particularly in the shadow of Fukushima - a continuing nuclear crisis directly fuelled by Australian uranium. A national inquiry into the domestic and international costs and benefits of Australia's uranium trade would be a mature and timely way to identify and address these important and unresolved issues.

APPENDIX I - AUSTRALIAN URANIUM EXPORT DATA

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	10-year average 2002-11	2011/12
Export (t U)	6476	8151	8181	10481	7344	8676	8194	8230	5841	6170	7,774	5865 ##
Uranium export revenue (A\$)	363m	398m	411m	573m	529m	881m	749m	1116m	608m	642m**	\$627m	607m ##
Total national export revenue (A\$) #	155b	144b	156b	180b	210b	219b	275b	250b	282b	315b	\$219b	315b
Uranium percentage of national export revenue	0.23%	0.28%	0.27%	0.32%	0.25%	0.40%	0.27%	0.45%	0.21%	0.20%	0.29%	0.19%
Export value A\$/kg U3O8 (A\$/kg U)	48 (56)	41 (49)	43 (50)	46 (55)	61 (72)	86 (102)	78 (91)	115 (136)	88 (104)	88(104)	69(82)	87(103)
Australian % of global production* (t U)	6854/ 36,036 =19%	7572/ 35,576 =21%	8982/ 40,178 =22%	9516/ 41,179 =23%	7593/ 39,670 =19%	8611/ 41,282 =21%	8430/ 43,853 =19%	7982/ 50,772 =16%	5900/ 53,663 =11%	5983/ 54,610 =11%	18.2%	6530 /? =~11% ##

Unless otherwise indicated, data from the [World Nuclear Association](#) or calculated from WNA figures.

* Based on Australian uranium production figures from [World Nuclear Association](#) (production and export figures differ), global production figures from separate [WNA](#) data.

** Calculated from [September 2012](#) and [December 2012](#) 'Resources and Energy Quarterly' reports from Bureau of Resources and Energy Economics (A\$157m, 114m, 186m, 185m). Where BREE figures differ, the most recent figure is used.

National export revenue calculated from monthly data from Australian Bureau of Statistics, 'International Trade in Goods and Services, Australia', [series 5368.0](#).

ASNO, [2011/12 Annual Report](#).

APPENDIX II - A SNAPSHOT OF AUSTRALIA'S URANIUM MINES AND DEPOSITS

SOUTH AUSTRALIA	
Olympic Dam	Underground mining continues. Open-pit expansion cancelled with cheaper options to be explored.
Beverley	Extension approved in 2007 and Heathgate Resources is also developing the Beverley North resource.
Beverley Four Mile	Approved but production is yet to begin (because of legal disputes between the two partner companies).
Honeymoon	Approved but progress has been glacial and Mitsui withdrew from the project months after first production.
Samphire	Trial mining at this site near Whyalla has been approved but progress appears to be slow and uncertain.
Mt Gee	Stopped as a result of widespread community opposition, partly because of its location in the Arkaroola Wilderness Sanctuary, partly because community members exposed Marathon Resources' illegal dumping of low-level radioactive waste.
Other deposits	Little or no progress with Oban, etc. Extensive exploration.
NORTHERN TERRITORY	
Ranger	Open-pit mining has ceased and stockpiles are being processed; plans for heap leaching have been abandoned; Energy Resources of Australia are actively developing and seeking federal EIS approval for the planned Ranger 3 Deeps underground mining option.
Jabiluka	In the late 1990s ERA attempted to develop the Jabiluka uranium mine despite the unanimous opposition of Mirarr Traditional Owners. A Mirarr-led international protest campaign saw development of Jabiluka halted. Recent years have seen a welcome improvement in ERA's liaison efforts and the conclusion of the Jabiluka long term care and maintenance agreement, however the company continues to express its desire to exploit the Jabiluka resource in spite of sustained Mirarr opposition.
Angela-Pamela	Stalled in the face of significant public opposition. At various stages in recent years both the (pro-uranium) NT Labor Party and the CLP have opposed the mine.
Koongarra	Blocked by Traditional Owner veto; In a move that permanently precludes any mining the former Koongarra Project Area was formally incorporated into Kakadu National Park in March 2013.
Other deposits	Little or no progress with Biglryi and other deposits. Extensive exploration.
WESTERN AUSTRALIA	
Wiluna	Toro Energy has received conditional federal and state environmental approval. The company has yet to make a final investment decision and faces significant financial challenges.
Other deposits	Little or no progress with Yeelirrie; Kintyre, Mulga Rocks, Lake Maitland, Manyingee, Oobagooma, etc. Numerous projects are on hold citing poor economics (for details see Australian Nuclear Map).
QUEENSLAND	
The LNP Government has reversed the previous long-standing state ban on uranium mining in breach of pre-election promises. Queensland Labor remains opposed to uranium mining and there is no bi-partisan support for the sector. Deposits include Westmoreland, Valhalla, Mary Kathleen and Ben Lomond (for details see Australian Nuclear Map).	
NEW SOUTH WALES	
The NSW Liberal Government has overturned legislation banning uranium exploration and has stated its support for the industry and for an end to the legal prohibition against uranium mining. NSW Labor remains opposed to uranium mining and there is no bi-partisan support for the sector. It is uncertain whether any significant or economically viable resources will be identified.	

OPERATING URANIUM MINES

BHP Billiton's U-Turn

A business journalist (and BHP Billiton shareholder) from The Age **noted** in the still-heady, pre-Fukushima days of 2008 that “with the Olympic Dam expansion not to take hold until 2013-14, the early development of Yeelirrie could give BHP the chance to capture the higher prices now available for uranium, with China and India keen to secure new long-term supplies for nuclear power generation ambitions.”

However in July 2012, BHP Billiton **cancelled** the planned expansion of Olympic Dam, citing high capital costs and low uranium prices in the aftermath of Fukushima, and wrote-off US\$346 million which had been invested in the project. Cheaper expansion options for Olympic Dam will be explored in coming years.

The following month, BHP Billiton disbanded its Uranium Division and **sold** the Yeelirrie uranium resource in WA to Cameco despite previously **describing** it an “outstanding long-term opportunity”. BHP Billiton sold for A\$415m (US\$430m). The sale price represents just 11% of the nominal economic value of the uranium resource (\$3.87b)¹⁸ or less than 5% of the nominal value if we take an inflated estimate (\$9b) of the value of the resource - or 2.2% if using an even sillier **estimate** (\$19b).

Honeymoon - The Dampest of Squibs

Honeymoon is an in-situ leach (ISL) uranium mine in north-east SA. In 2006, Uranium One announced that development of Honeymoon would proceed. In 2008, the company announced a joint venture with Mitsui (49%) to complete development of the project.

The mine has proven to be the dampest of squibs. First production was in September 2011, but five months later Mitsui **announced** that it was withdrawing as it “could not foresee sufficient economic return from the project.” Economic returns would be weaker still if not for sub-standard environmental regulations, in particular the pollution of groundwater with radionuclides, heavy metals and acid and an exemption from any meaningful ground-water remediation requirements.

Production in the 2011/12 financial year was **151 tonnes** U3O8. According to a September 2012 Uranium One **financial statement**, the company has legacy sales contracts with unfavourable terms. With a ‘Proven and Probable’ reserve of **2,446 t U3O8**, a mine life of just six years is expected. If the mine life extends beyond six years it would most likely be because of production delays because the operation has proven **accident-prone**.

As of February 2013, the Uranium One **website** describes production since September 2011 as “pilot production” and states that “commissioning will be completed when a pre-defined operating level, based on the design of the plant, is maintained.”

The Strange Case of Beverley

Fortune Magazine **recounts** a controversy surrounding General Atomics / Heathgate's Beverley ISL uranium mine in SA. When uranium prices increased in the mid-2000s, the company was locked into long-term contracts to sell from Beverley at lower prices. GA / Heathgate devised plans to renegotiate its legally-binding contracts. Customers were told that production costs at Beverley were higher than expected, that production was lower than expected and that a failure to renegotiate contracts would force Heathgate to file for bankruptcy.

Former employees said that GA CEO Neal Blue had allegedly directed Heathgate to increase its production costs. Customers were not told that bankruptcy was unlikely since GA had agreed to continue providing Heathgate with financial assistance. Two of Heathgate's Australian directors left the company after receiving legal advice that the plan could be considered a conspiracy to defraud.

Exelon, one of Heathgate's uranium customers, sued. The lawsuit was settled for about US\$41 million. Because of the increased uranium price, GA / Heathgate ended up well in front despite the cost of the settlement with Exelon. Mr Blue was unrepentant: “It made more sense to, in essence, just pay the fine.”

¹⁸. Based on 44,500 t U ‘Measured and Indicated Resources’ (52,500 t U3O8) and the 2011/12 price of \$87,000 / t U3O8.

Ranger

Located in the heart of the rugged, unique and World Heritage listed Kakadu region the Ranger uranium mine has been a source of contest and contamination since the deposit was discovered in 1969.

Concerns over environmental and cultural damage and the social impact of large numbers of non-Aboriginal mine workers in the region saw the Mirarr people, the area's traditional Aboriginal owners, take a strong stand against the development of Ranger.

In 1977, against a background of relentless development pressure and with an assessment process skewed towards approving the mine, the Ranger Uranium Environmental Inquiry recognised the Mirarr's fundamental opposition to uranium mining on their country but declared that 'their opposition should not be allowed to prevail'. By this time the Mirarr people had already had their right of veto over development on their country removed in relation to operations at Ranger.

Since it opened in 1980 the Ranger mine has been the focus of sustained environmental criticism with NGOs documenting in excess of 200 spills, incidents

and environmental breaches at Ranger. Managing excess water and radioactive mine wastes remain key problems for mine operator Energy Resources of Australia (ERA), majority owned by Rio Tinto.

Open cut mining finished at Ranger in November 2012 and - amid falling production and sustained annual financial losses - the operation is now based around milling existing ore stockpiles while the company seeks federal environmental approval for a new underground project called Ranger 3 Deeps.

This renewed activity at Ranger is a cause of deep concern to many for three principal reasons. It continues the impacts of the already overstretched and underperforming Ranger mine infrastructure and regulatory regime. It adds considerable delay, cost and complexity to the final closure and rehabilitation of the site and it keeps the door open for future attempts by ERA to access its corporate Holy Grail – the development of the nearby and high-grade Jabiluka uranium deposit which remains halted following a major campaign by the Mirarr and environment groups.

APPENDIX III - SORTING FACT FROM FISSION IN QUEENSLAND

The Australian Uranium Association **claimed** in 2009 that 2,620 new jobs would be created by uranium mining in Queensland - far greater than the number employed in uranium mining, exploration and regulation across all other states and territories. A March 2013 **statement** by the Australian Uranium Association states that “uranium companies estimate the number of jobs associated with the development of their projects in Queensland at between 2275 and 3025”.

While the above figures include construction jobs, they still differ dramatically from the conclusion reached by **Deloitte Insight Economics** in a 2008 paper commissioned by the Australian Uranium Association itself: “In Queensland, a further 155 direct jobs would be added on average from 2010 to 2030 in both the Constrained Supply and Regulation Reform futures, with a peak increase of 410 projected for 2030 above base case expectations.”

The **Australian Uranium Association** and the **Queensland Resources Council** both claim that the known uranium resource in Queensland, using projected prices and exchange rates, is valued at around \$18 billion. The Minerals Council of Australia gives a figure of **\$18-20 billion**. However the figure is based on a number of implausible or questionable **assumptions**:

- the assumption that every last ounce of the estimated statewide uranium resource of 222 million pounds U3O8 (101,000 t) is mined and sold, including the least economical and the most technically-challenging deposits.
- an average price of US\$69/lb U3O8 in 2017 - well above the most recent available figure for Australia’s uranium exports (around US\$41/lb U3O8 in 2011/12), more than double the 2002-2011 average of US\$32/lb U3O8¹⁹, and one-third higher than the Bureau of Resources

and Energy Economics’ 2017 price estimate for Australia’s uranium exports of US\$47/lb U3O8.²⁰

- a favourable shift in the AUD/USD exchange rate to \$0.85 in 2017.

The \$18 billion figure has been repeated on **many occasions** despite its questionable basis. The World Nuclear Association gives a figure of **62,950 t U** (74,215 t U3O8) for Queensland deposits (of which 36% is in the less certain ‘Inferred Mineral Resource’ category). That equates to \$6.5 billion (using the 2011/12 price for Australian uranium exports), barely one third of the \$18 billion figure.

The \$6.5 billion estimate is also well short of the **\$10 billion figure** provided by Premier Campbell Newman, and still further removed from the Premier’s **claim** that uranium would earn Queensland “tens of billions of dollars over the next two decades”.

In March 2012, Mr Newman **said**: “The LNP has made it crystal clear that we have no plans to approve the development of uranium in Queensland.” Shortly after announcing the Government’s uranium policy backflip in October 2012, Mr Newman acknowledged that the Queensland Government had **no independent economic or employment figures** to inform its deliberations.

The **Australian Uranium Association** and the **Queensland Resources Council** claim that uranium mining has the potential to generate \$900 million in royalties for Queensland. They assume a 5% royalty rate - but the rate under existing legislation would be **2.5%**. Applying the lower rate to exports of \$6.5 billion would yield \$163 million in royalties - 5.5 times lower than the figure from the industry bodies. And even the \$163 million figure assumes that all of the deposits **listed** by the World Nuclear Association are mined (a heroic assumption as recent experience in other states/territories indicates).

As well as talking up the economic potential of uranium mining in Queensland, the Australian Uranium Association has, perplexingly, been talking down the industry - a March 2013 **statement** puts the resource at “upwards of 40,000 tonnes of reasonably assured and inferred resources”, notes that Queensland’s uranium “endowment” is about 2% of the national endowment, and states that uranium mining in Queensland “will likely be a moderately sized industry developed over a lengthy period”.

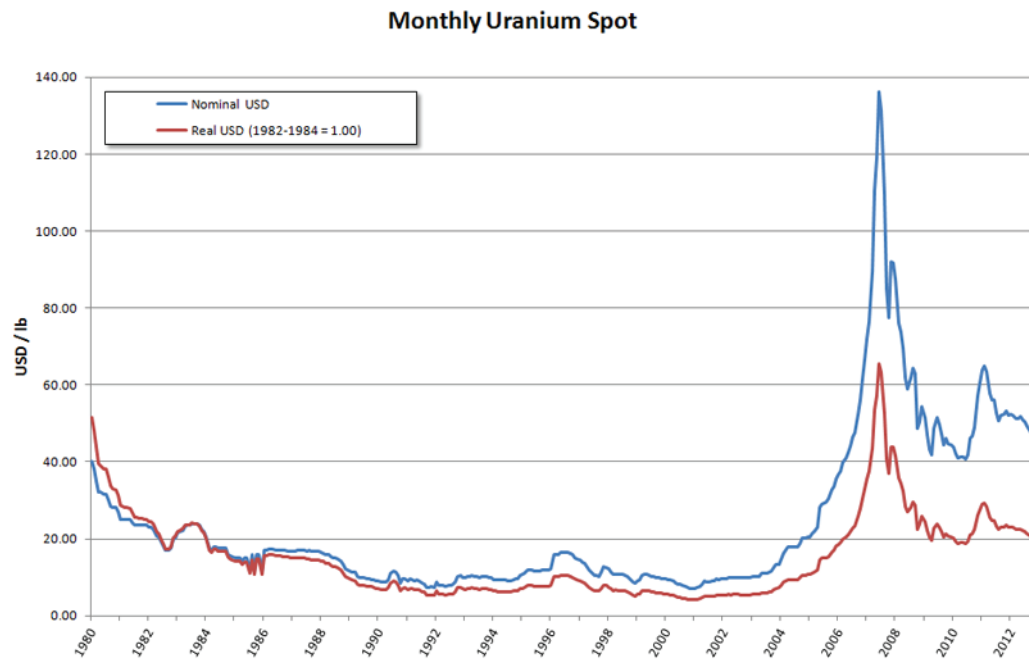
“We are sending a clear message to the industry and the wider community that vested interests in the uranium and nuclear industries are trying to hoodwink us about this dangerous product and industry.”

- ETU Queensland/NT secretary Peter Simpson **commenting** on the union’s ban on members working in uranium mines, May 2010.

¹⁹. Calculated from the figures in Appendix 1, and the 18 March 2013 exchange rate..

²⁰. BREE’s **March 2013 Resources and Energy Quarterly** (p.53) estimates prices for Australia’s uranium exports of A\$97.5 / kg U3O8 in 2016/17 and A\$103.6 in 2017/18. Converting to pounds and applying the 24 March 2013 exchange rates gives the figure of US\$47/lb U3O8.

APPENDIX IV - MINING THE MARKET: THE 2005-07 URANIUM PRICE BUBBLE



Source: http://en.wikipedia.org/wiki/Uranium_market

The uranium bubble that peaked in 2007 was a sadly familiar case of speculative mining of the market. Journalist Marcus Priest provided a detailed [account](#) in the Australian Financial Review in May 2007. Priest described some of the practices:

- shallow drilling or drilling beside an old hole that had good grades (called 'address pegging' or 'nearology').
- claiming to have found a geological type resembling a known deposit (e.g. Olympic Dam-style mineralisation).
- citing in-situ values for possible deposits without any reference to the cost, viability or legality of mining.
- using a lower cut-off grade of recoverable uranium to inflate the size of the estimate.
- capital raising or floating based on nothing more than applications for exploration leases which may never be granted because for various reasons such as environmental constraints.
- conflating a tenement application with a "project".
- companies with little or no experience, and a track record of jumping from one fad to the next, jumping on the uranium bandwagon.
- conflating the old and the new - Priest cites the example of Reefton Mining announcing a "major new uranium discovery" in Namibia which was in fact discovered in the 1970s.
- Spending only a small fraction of funds raised on exploration.

Michael West [wrote](#) in The Age in 2011:

Until now inveterate fraudsters, even convicted heroin traffickers, have happily promoted their floats on the ASX. Of the 2300-odd companies listed on the bourse it would be safe to say a couple of hundred are simply pump-and-dump schemes, executive options scams and the like that are controlled by people whose primary intent is to mine wallets, not mineral deposits.

Until now, the same promoters have beaten a path back to the market - decade in, decade out - pouncing on every fad, boom and bubble. That they haven't been required to disclose their myriad failures - before "backdoor listing" the likes of a "uranium" asset into a nickel explorer's shell, itself born from a dotcom play, having emerged from the ruins of a biotechnology float - has played nicely into the hands of the promoters, brokers, lawyers, accountants and other capital markets fee-takers. Retail investors, though, have been savaged time and again.

Despite moves to address these market short-comings progress has been slow. However progress has been slow and the focus narrow. **Mechanisms** are in train that seek to address the over-inflation of resource estimates. Changes to the requirements of the Joint Ore Reserves Committee code will come into effect in December 2013 - for example a pre-feasibility level study will have to be conducted before including an estimate of an ore reserve in a public report. However deficiencies remain and there seems to be little or no appetite or activity to address a raft of other problems.

Moreover, compliance and regulation remain compromised - the JORC Committee has **no powers**, the ASX prefers the light touch of providing "additional guidance" to companies, and ASIC **rarely prosecutes**.

Meanwhile, uranium mining companies are resisting reform. Examples include **Rio Tinto and BHP Billiton** lobbying the European Union to abandon plans to enforce full financial disclosure on all projects including those in developing nations, and **Paladin Energy's** resistance to proposed changes to Australia's anti-bribery and corruption laws in relation to mining in Africa.

A detailed timeline of the 2005-07 speculative bubble and its aftermath is posted on the **Choose Nuclear Free** website.

A price spike in the mid-1970s was underpinned by a global uranium **cartel** in which Australian uranium companies were heavily complicit. The cartel was exposed after a whistle-blower leaked company documents to Friends of the Earth in Australia. This led to international controversy, fines totalling hundreds of millions of dollars, the break-up of the cartel and a sharp drop in the uranium price.

