Analysis of the Draft Report of the Uranium Mining, Processing and Nuclear Energy Review (the Switkowski Report)

Prepared by the EnergyScience Coalition
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combination of renewable energy and gas to displace coal, combined with energy efficiency measures, without recourse to nuclear power.

Economics (Dr. Mark Diesendorf)
* The Switkowski report makes questionable assumptions that are highly favorable to nuclear power. In reality, nuclear power is likely to cost more than double dirty coal power and hence even more than wind power. The report's very low estimates of the costs of nuclear electricity are achieved by means of a magician's trick.
* The report cites studies on the external costs of electricity generating technologies. The low environmental and health costs obtained are misleading, because these studies do not include the main hazards of nuclear power - the proliferation of nuclear weapons and terrorism - and most do not treat adequately the hazards of rare but devastating accidents.

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Weapons proliferation and uranium safeguards (Professor Richard Broinowski)
* Switkowski's recommendation to expand Australian uranium exports is irresponsible in today's political climate: the international non-proliferation regime is deeply flawed, pressures exist for both vertical and horizontal nuclear weapons proliferation, and Australian nuclear materials are increasingly likely to end up in weapons programs.
Despite statements from as high as the Prime Minister from within the current Federal Government advocating extending nuclear fuel cycle of activities in

Australia, the report is correctly dismissive of the economic potential and technical capacity of Australia to participate in these, at least in the medium term.

Uranium enrichment (Professor Jim Falk)

* The Switkowski report is pessimistic about the short- to medium-term prospects for uranium conversion, uranium enrichment, fuel fabrication or spent nuclear fuel reprocessing industries to be established in Australia.
* On the issue of enrichment, the report concludes that "there may be little real opportunity for Australian companies to extend profitably" into enrichment and that "given the new investment and expansion plans under way around the world, the market looks to be reasonably well balanced in the medium term."
* The report states: "Reprocessing in Australia seems unlikely to be commercially attractive, unless the value of the recovered nuclear fuel increases significantly."
* The report states that: "While all fuel cycle activities are covered by Australia's safeguards agreement with the IAEA, a decision to enrich uranium in Australia would require the management of international perceptions, given that enrichment is a proliferation-sensitive technology." Given the present intense global attention on this matter in the context of Iran, the evident increasing weakness of the effectiveness of the Nuclear Non-Proliferation Treaty, and the resulting increasing possibility of nuclear proliferation and arms races commencing in various regions, including the Asia-Pacific region, this comment from the Report is if anything an understatement.

A doctor's perspective (Dr. Bill Williams)

* The report optimistically asserts that 25 nuclear reactors could give an 8-18% reduction in Australia's greenhouse gas emissions by 2050, but is silent on the vast amount of weapons-useable plutonium the reactors would produce.
* The report fails to seriously address the vulnerability of nuclear reactors to sabotage resulting in catastrophic radiation emergencies.
* The report is silent on known and quantified increased risks to workers in nuclear industry, and it is silent on multiple reported and controversial clusters of childhood cancers and congenital malformations in the vicinity of nuclear reactors.
* The report is silent on the well-documented capacity of low-level ionising radiation to injure chromosomes and the long-term genetic implications, i.e., gene pool effects and generational toxicity.
* The report fails to anticipate 'necessary' increases in the power of police and

other surveillance authorities associated with a nuclear power program, in addition to the potential for restrictions on the public's right-to-know and to resist imposition.

Uranium mining (Dr. Gavin Mudd)

* The Switkowski report fails to properly account for the increasing environmental cost of uranium mining. This includes the magnitude of mine wastes, the long-term impacts on surface water and groundwater resources, the energy costs of extraction which will invariably increase in the future for proposed, and the true life-cycle greenhouse emissions.
* Uranium market / nuclear power scenarios in the past have always proven to be overoptimistic, often by a large margin.
* The current "boom" in uranium exploration from 2004-2006 has not seen any new economic deposit discovered at all - only further drilling at known deposits or prospects.
* There are no "well established plans" for rehabilitation at Ranger as the mining-milling plan changes every year. Additionally, the current bond held by the Australian Government is only one-fifth of the estimated cost of full rehabilitation. For Olympic Dam, the bond held by the South Australian Government is only one-tenth of the estimated cost.
* The Beverley and Honeymoon projects are not required to rehabilitate contaminated groundwater following mining.
* Not one former Australian uranium mine site has demonstrated successful and stable long-term closure of mine wastes (tailings, waste rock and/or low grade ores).

Radioactive waste (Dr. Jim Green)

* The Switkowski report notes that 25 power reactors would produce up to 45,000 tonnes of spent nuclear fuel but is silent on the proliferation and security implications of the 450 tonnes of plutonium contained in that amount of spent fuel.
* The Switkowski report floats the possibility of exporting spent nuclear fuel to the USA although that is at best a remote prospect. The report then ignores the term of reference regarding importation of spent nuclear fuel and high-level nuclear waste for disposal in Australia.
* The Switkowski report stresses the need for public acceptance of waste management proposals but is silent on the draconian imposition of a nuclear dump in the NT. An expanded nuclear industry in Australia would very likely result in further impositions of nuclear facilities on unwilling communities.

* A member of Switkowski's panel, Prof. Peter Johnston, has previously attacked the federal government over its incompetent handling of radioactive waste but there is no mention of these problems in the Switkowski report.

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THE SWITKOWSKI REPORT MISSES THE POINT

Professor Jim Falk is Director of the Australian Centre for Science, Innovation and Society at the University of Melbourne.

Given its origins and the composition of its panel, the Switkowski nuclear report is in some respects surprisingly downbeat.

It supports uranium mining and nuclear power, rejects uranium conversion and enrichment, and all but ignores the original requirement to investigate the "business case" for establishing a repository accepting high-level nuclear waste from overseas. It stresses that nuclear power could be competitive only if a substantial carbon tax is imposed.

The narrow terms of reference set by the federal government have restricted the panel to a study of nuclear power, not a serious study of energy options for Australia. A panel with broader range of expertise and a less limited brief could have been asked to explore the impact of carbon tax and other policy measures on energy demand. From that it could have tackled the most effective means by which that demand can be met, and greenhouse emissions reduced, taking into account all the energy options, costs, timeframes, waste, safety and other relevant issues.

While the Switkowski panel was prevented from asking key questions, there's no reason for the rest of us to avoid them. A body of existing research indicates that the objectives of meeting energy demand and reducing greenhouse emissions can be met with a combination of renewable energy and gas to displace coal, combined with energy efficiency measures, without recourse to nuclear power.

For example, a study by AGL, Frontier Economics and WWF Australia published in May 2006 finds that a 40% reduction in greenhouse gas emissions from electricity generation in Australia can be achieved by 2030 at the modest cost of $0.43/week per person over 24 years.

The Australian Ministerial Council on Energy published a report in 2003, *Towards a National Framework for Energy Efficiency*, which concludes that "consumption in the manufacturing, commercial and residential sectors could be reduced by 20–30% with the adoption of current commercially available technologies with an average payback of four years."

A detailed study, *A Clean Energy Future for Australia*, by Hugh Saddler, Richard Denniss and Mark Diesendorf, identifies methods by which a 50% reduction in greenhouse emissions from stationary energy can be achieved by 2040.

There is an equally impressive body of overseas research, one recent example being the RAND Corporation report released on 13 November which concludes that renewable energy could produce 25% of the electricity and motor vehicle fuels used in the US by 2025 at little or no additional cost.

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ECONOMICS

Dr Mark Diesendorf is Director of Sustainability Centre Pty Ltd and Senior Lecturer in Environmental Studies at University of New South Wales.

The Switkowski report acknowledges that nuclear power would be 20-50% more costly than (dirty) coal power and that it would require "low to moderate pricing of carbon dioxide emissions" in order to compete. However, the report obtained this result by making questionable assumptions that are highly favorable to nuclear power. In reality, nuclear power is likely to cost more than double dirty coal power and hence even more than wind power.

The report's very low estimates of the costs of nuclear electricity are achieved by means of a magician's trick. The report's Figure 4.6 shows that the cost estimates

depend critically upon the interest rates and that, at the high interest rates prevailing in a competitive market (10% real or more), nuclear electricity is likely to cost about 10 cents per kilowatt-hour (c/kWh). However, in the comparison with the costs of competing technologies in Figure 4.7, the report selects lower interest rates for nuclear power, in effect halving the costs of nuclear electricity. These carefully selected results are then reproduced in the executive summary, without any explanation that low interest rates were assumed.

In other parts of its report, the report recognises implicitly that it has underestimated the costs of nuclear electricity and the size of the subsidy needed. In the summary (p.1), it says: "Even then [that is, after implementing carbon pricing], private investment in the first-built nuclear reactors may require some form of government support or directive."

Furthermore, on p.46, it admits that "If investor perceptions of risk were greater [than for other baseload technologies], ... higher carbon prices or other policies [that is, subsidies] would be required to stimulate investment in nuclear power. On p.45, the report confirms that this situation is likely, by stating that "In practice, investors may consider nuclear power to be more commercially risky." [my parentheses]

On pp.48-49, the report cites studies by ExternE and other authors on the external costs of electricity generating technologies. The low environmental and health costs obtained, and the Switkowski report's discussion of them, are misleading, because these studies do not include the main hazards of nuclear power - the proliferation of nuclear weapons and terrorism - and most do not treat adequately the hazards of rare but devastating accidents.

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CO2 EMISSIONS

Dr Mark Diesendorf is Director of Sustainability Centre Pty Ltd and Senior Lecturer in Environmental Studies at University of New South Wales.

The Switkowski report evades the issue of the large increases in CO2 emissions from mining and milling uranium ore as the ore grade decreases from the

current high-grade to low-grade over the next few decades.

The report (Box 7.2, p.79) acknowledges that "nuclear currently generates at least five times more energy than it uses". This is not impressive, considering that wind power generates 30-80 times the energy it uses.

The report (Box 7.2) dismisses the fact that CO2 emissions from mining and milling uranium ore increase dramatically as ore-grade declines from 0.1% uranium oxide to 0.01%, by claiming that this problem "will not be the case for several decades". It then attempts to support this vague statement with the irrelevant statement that "The IEA estimates that known uranium reserves are sufficient to fuel nuclear power for 85 years." The relevant issue is the life-time of **high-grade** uranium reserves, which is likely to be much shorter than 85 years.

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RENEWABLE ENERGY

Dr Mark Diesendorf is Director of Sustainability Centre Pty Ltd and Senior Lecturer in Environmental Studies at University of New South Wales.

The report has no basis for its claim that "Nuclear power is the least-cost low-emission technology ..."

Renewable energy is outside Switkowski's terms of reference and so is only given passing mention in the main body of the report. Therefore, it is surprising that the Switkowski report makes the following heroic claim in its summary (p.4): "Nuclear power is the least-cost low-emission technology that can provide baseload power." How can the report assert that nuclear is least cost, when it has neither performed any analysis nor commissioned any on this topic?

To the contrary, wind power is a lower cost, lower emission technology in both the UK and USA and would also be lower cost in Australia. Hot dry rock geothermal power should be commercially available within a decade and is likely to be less expensive than nuclear power. So are some power stations burning biomass from existing crops and existing plantation forests.

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NUCLEAR WEAPONS PROLIFERATION & SAFEGUARDS

Professor Richard Broinowski is an Adjunct Professor at the University of Sydney and a former Australian Ambassador to Vietnam, Republic of Korea, Mexico, the Central American Republics and Cuba

Switkowski's recommendation to expand Australian uranium exports is irresponsible in today's political climate: the international non proliferation regime is deeply flawed, pressures exist for both vertical and horizontal nuclear weapons proliferation, and Australian nuclear materials are increasingly likely to end up in weapons programs.

Chapter Eight of the Switkowski report asserts that Australian uranium exports are encased in stringent bilateral safeguards arrangements, backed up by a reliable international non proliferation regime, itself reinforced by an additional International Atomic Energy Agency inspection protocol. The report therefore assumes that Australian uranium cannot end up in nuclear weapons programs, and that an increase in the volume of uranium exported will not increase the risk of nuclear weapons proliferation.

These assumptions are badly flawed.

First, Australian bilateral safeguards may have been stringent when first promulgated by the Fraser government in 1977, but they have been modified and attenuated by commercial pressures ever since. They can no longer guarantee that Australian atoms will not be used in weapons programs.

Second, the Nuclear Non Proliferation Treaty, the core of the international system inhibiting nuclear weapons proliferation, is losing credibility. Non nuclear weapons states, abjured from acquiring their own nuclear weapons, become increasingly cynical as the recognised nuclear weapons states continue to refine their arsenals and ignore their Treaty obligations to reduce and eventually eliminate, their nuclear weapons.

Third, Australian uranium may not be used by the Chinese in their nuclear weapons programs (although Australia has no way of enforcing this obligation). But supplying it as fuel for Chinese power reactors allows the Chinese to release their own limited nuclear fissile material for their weapons program.

If Australia also supplies uranium to India (a possibility), the same kind of substitution is likely to occur. Supplying India would also breach what has hitherto been a fundamental principle of Australian uranium export policy: no sales to non signatories of the NPT. (In 2002, the federal government signed an "exchange of notes" with the US allowing "re-transfer" of Australian uranium to Taiwan, a non-NPT state.)

The Switkowski report also asserts that actual cases of proliferation have involved illegal supply networks, secret nuclear facilities and undeclared materials, not the diversion of declared materials from safeguarded facilities such as nuclear power plants. Perhaps the best documented example of repeated misuse of safeguarded facilities and materials took place in Iraq from the 1970s to 1991; these breaches were not exposed until after the 1991 Gulf War.

The report further asserts that uranium is so ubiquitous in the earth's crust that any country wishing to develop a nuclear weapon need not rely on importing it. The assertion is either naive or disingenuous. Uranium can only be practically mined where it exists in abundance, and then only from a handful of countries. Even in its unenriched form it is regarded as a precious commodity.

Finally, the report asserts that the greatest proliferation risk is from undeclared centrifuge enrichment plants capable of producing highly enriched uranium. Well, no. Clandestine mining of plutonium from spent fuel, and nuclear theft from under-secured reactors are just two of several other likely risks. But it is the motivation of countries, or sub-national groups, to acquire nuclear weapons, that is the crucial factor. Take away the threat of the use of force to bring about regime change, stop categorising certain countries as rogue states, reduce the likelihood that nuclear weapons may be used against non nuclear countries (for example against Iran, where 'all options are on the table'), and the ambition to acquire nuclear weapons by whatever means is likely to diminish.

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URANIUM ENRICHMENT

Professor Jim Falk is Director of the Australian Centre for Science, Innovation and Society at the University of Melbourne.

Despite statements from as high as the Prime Minister from within the current Federal Government advocating extending nuclear fuel cycle of activities in Australia, the report is correctly dismissive of the economic potential and technical capacity of Australia to participate in these, at least in the medium term.

The nuclear fuel cycle falls into the following steps:
(i) Mining and milling - uranium is dug from the ground and converted into uranium oxide;
(ii) Conversion - the uranium oxide is then shipped to a plant where it is converted into uranium hexafluoride gas;
(iii) Enrichment - the uranium hexafluoride gas is then shipped to an enrichment plant where the gas is separated into two fractions - enriched uranium which has an increased proportion of fissile Uranium-235 atoms, and depleted uranium (from which some of the Uranium-235 has been extracted, and thus has a greater proportion of Uranium-238);
(iv) Fuel Fabrication - the enriched uranium is then shipped to a plant where it is fabricated into fuel rods;
(v) Reprocessing - after the fuel rods have been used in a reactor, they may be reprocessed to extract the long lived radioactive isotopes; and finally
(vi) Storage or Disposal - the waste materials so produced must be moved to some form of repository for storage and perhaps ultimate disposal.

In relation to the above steps the report is not supportive of the prospects in the short to intermediate term of any of these activities except the existing process (i) of uranium mining and milling being carried out in Australia.

The report states: "Establishment of Conversion is only likely to be attractive if it is associated with enrichment" (p.30). But the report goes on to note that: "The enrichment market is very concentrated, structured around a small number of suppliers in the United States, Europe and Russia. It is characterised by high barriers to entry, including limited and costly access to technology, trade restrictions, uncertainty around the future of secondary supply and

proliferation concerns." (p.33) The report concludes that "there may be little real opportunity for Australian companies to extend profitably" into enrichment and that "given the new investment and expansion plans under way around the world, the market looks to be reasonably well balanced in the medium term." (p.34)

The report states that: "While all fuel cycle activities are covered by Australia's safeguards agreement with the IAEA, a decision to enrich uranium in Australia would require the management of international perceptions, given that enrichment is a proliferation-sensitive technology." (p.93) Given the present intense global attention on this matter in the context of Iran, the evident increasing weakness of the effectiveness of the Nuclear Non-Proliferation Treaty, and the resulting increasing possibility of nuclear proliferation and arms races commencing in various regions, including the Asia-Pacific region, this comment from the Report is if anything an understatement.

The report goes on to note that "Fuel fabricators are typically associated with reactor vendors, who supply the initial core and in many cases refuel the reactor." (p.35) Accordingly this is unlikely to be a sensible venture for Australia. Added to this: "The WNA forecasts that fuel fabrication capacity for all types of LWRs significantly exceeds demand ..." (p.35).

Finally, the report notes that "The complexity of reprocessing plants involving remote handling of highly radioactive and corrosive materials requires expensive facilities and many highly trained staff... The only recently constructed commercial scale reprocessing plant (Rokkasho) is estimated to have cost approximately US$18 billion." (p.61). Not surprisingly, the report draws the obvious, if understated conclusion: "Reprocessing in Australia seems unlikely to be commercially attractive, unless the value of the recovered nuclear fuel increases significantly." (p.51)

In reaching the above conclusions the report acknowledges the no doubt persuasive and less hedged words in the submission by BHP-Billiton. The 'Big Australian' noted amongst other things:

- BHP Billiton believes that there is neither a commercial nor a non-proliferation case for it to become involved in front-end processing or for mandating the development of fuel leasing services in Australia. BHP

Billiton's uranium strategy focuses on its strengths as a miner and mineral exporter.

- Enrichment has massive barriers to entry—including access to technology and approvals under international protocols—and is concentrated with 4 large players: USEC, Areva, Urenco and Tenex, located within the nuclear weapon states of the United States, the United Kingdom, France and Russia respectively. There are high levels of government involvement both directly and in close regulatory oversight. Even mature power generation markets with strong technology bases like Japan and South Korea have not developed enrichment sectors.
- We do not believe that conversion and enrichment would be commercially viable in Australia. Nor do we believe any government imposed requirement to lease fuel, as distinct from acquiring uranium would be acceptable to its major customers, all of whom have alternative choices about where to acquire their U_3O_8, and all are highly respected utilities in countries with which Australia has rigorous safeguards agreements. These utilities generally regard their spent fuel as an asset.
- To date no country without a substantial domestic nuclear energy sector (or direct access to one through cross border trading in the case of prospective developments in Mexico) has developed a major commercial conversion and enrichment sector.
- The economics of any Australian conversion, enrichment or fabrication do not look positive, either individually or collectively. The global market is currently well supplied by services providers with strong customer relationships, economies of scale and scope, the necessary deep technological expertise and experience, solid reputations for delivery, and expansion plans in place.
- Our view is consistent with that expressed in a Submission to the Prosser Committee by representatives of the Australian Government with respect to the economics of enrichment and reprocessing: "Under current circumstances, with established global enrichment and reprocessing capacities exceeding demand, the development of indigenous enrichment/reprocessing is not economic, except possibly in the case of very large power programs."

BHP-Billiton also noted:

- While nuclear looks attractive as a possibility on these assumptions [a sufficient carbon tax], many other technologies (wind, solar, clean coal,

carbon geosequestration, carbon offsets, energy efficiency, etc.) could also become more competitive in a world of carbon prices. Actual costs will reflect whether the prices of emerging technologies (for example, coal with carbon capture and sequestration) can be brought down and whether the capital costs of nuclear power can be reduced with large scale installation of generating capacity in markets like China driving down the cost of key components.

It is a pity that, probably because of its Terms of Reference and possibly expertise, the Switkowski panel found itself unable to address these other options in anything like the detail and energy with which they addressed nuclear power.

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A DOCTOR'S PERSPECTIVE

Dr. Bill Williams, a General Practitioner on Victoria's Surfcoast, is Vice-President of the Medical Association for Prevention of War (Australia).

Despite its self-congratulatory claim to providing 'a factual base' and 'an analytical framework' for considering the role of nuclear power in Australia's energy future, the Switkowski report is partisan and narrow in perspective. The authors begin from the unsubstantiated and false assumption that there is little if any role for energy conservation and efficient use of electricity.

One example of the report's intrinsic and habitual bias: it (optimistically) asserts that 25 nuclear reactors could give an 8-18% reduction in Australia's greenhouse gas emissions by 2050, but there is no mention of the vast amount of plutonium that would be produced - up to 450 tonnes. This high burn-up 'reactor grade' plutonium is not *ideal* for weapons manufacture, but it can certainly be used in nuclear weapons as the International Atomic Energy Agency, the US Department of Energy and countless independent experts attest.

Further, the report's bold assertion that increasing uranium exports – i.e., the raw materials for nuclear bomb manufacture – would not have any influence on weapons proliferation is based on faith, not the facts, which illustrate the

recurring role of non-military nuclear applications in proliferation of weapons programs in multiple instances.

Similarly, the failure to seriously address the vulnerability of nuclear reactors to sabotage resulting in catastrophic radiation emergencies suggests the report's authors were not interested in detailing the less savoury potentialities of nuclear electricity generation ... a case of profound intellectual neglect.

Factual inaccuracies, omissions and other problems in the Switkowski report:

* Silent on known and quantified increased risks to workers in nuclear industry (Cardis. et al 2005 BMJ 331 77–80)

* Silent on multiple reported and controversial clusters of childhood cancers and congenital malformations in the vicinity of nuclear reactors.

* Asserts 'good management' in Australian nuclear industry to date: a clear misrepresentation in view of hundreds of instances of mismanagement (leaks, spills, contamination, regulatory breaches) at Ranger and Roxby and Beverly and failure to monitor health impacts in local populations despite known distribution of radio-toxins into habitat and food chain.

* Unsubstantiated assertion that increasing availability of raw materials will not facilitate weapons spread.

* No consideration of well-documented capacity of LLIR to injure chromosomes and the long-term genetic implications, i.e., gene pool effects and generational toxicity.

* Biased and blinkered references to Chernobyl data: a 'balanced' assessment would refer to the multitude of scientific data available which authoritatively contradicts the IAEA material. Selective reporting does not provide either 'a factual base' or 'an analytical framework' for discussion: it gives a whitewash to a complex and controversial subject.

* Terrorism - disturbingly "pre-9/11" analytical framework - defence-in-depth mantra, statistical obfuscation. It is grossly inadequate to simply assert the unassailability of 'modern' reactors: serious and meaningful examination would include modeled projections of meltdown scenarios in vicinity of the 25 reactors. Humans err.

* In 'Looking ahead' [p.8] the authors refer to the importance of 'community involvement' … not 'community agreement'! This is in contradiction to IAEA guidelines. There is also no acknowledgement that 'community involvement' post Harrisburg and post-Chernobyl brought the nuclear industry to its knees in the US and Western Europe. There is an implicit assumption that the community will not resist imposition of nuclear facilities

and yet this is the factor most likely to ensure the non-viability of the Switkowski project! [Witness the restraints on uranium mining, the failure to resolve waste management, the rejection of the Jervis Bay reactor].

* Security and health: the authors have failed to consider the community health implications of building 25 nuclear reactors in our communities. As well as the financial burden, we can anticipate 'necessary' increases in the power of police and other surveillance authorities, in addition to the potential for restrictions on the public's right-to-know and resist imposition.

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URANIUM MINING

Dr Gavin Mudd holds a PhD in Environmental Engineering and is a Lecturer/Course Director in Environmental Engineering in the Department of Civil Engineering, Monash University.

The Switkowski report fails to properly account for the increasing environmental cost of uranium mining. This includes the magnitude of mine wastes (now greater than 300 million tonnes and growing by some 20 million tonnes per year), the long-term impacts on surface water and groundwater resources, the energy costs of extraction which will invariably increase in the future for proposed mines (including the next Olympic Dam expansion), and the true life-cycle greenhouse emissions.

Uranium market / nuclear power scenarios in the past have always proven to be overoptimistic, often by a large margin.

Exploration (section 2.1.4)

The report over-simplifies exploration. It is widely accepted within the uranium industry globally that future exploration to discover new deposits will increasingly have to be deeper, meaning more expensive drilling and studies, as well as higher energy costs should any mine proceed. In this light, it is worth noting that for the same time period of uranium exploration boom from 1969-1971, numerous major new deposits were discovered across Australia. The current "boom" in uranium exploration from 2004-2006 has not seen any new economic deposit discovered at all - only further drilling at known deposits or

prospects.

Production (section 2.1.5).

The increase of Australian uranium production higher than current 12,000 t U3O8/year cannot occur about 2015. This is due to the declining ore grade at Ranger, the long delay in construction and commissioning of the next proposed expansion at Olympic Dam, and the relatively minor production from Beverley (and proposed Honeymoon production is miniscule). Additionally, as noted in submissions to the House of Representatives Inquiry, the alleged production of 15,000 t U3O8/year for the next proposed expansion at Olympic Dam is unlikely to eventuate - ore grade drops by half as well as extraction efficiency likely to decline from the current 65% to less than 50%, thereby suggesting only 8,000 t U3O8/year (40 Mt/year at 0.04% U3O8, 50% extraction).

Australia's Radioactive Waste - Uranium Mining (section 5.1.5, page 59-60).

There are no "well established plans" for rehabilitation at Ranger as the mining-milling plan changes every year. Additionally, the current bond held by the Australian Government is only one-fifth of the estimated cost of full rehabilitation. For Olympic Dam, the bond held by the South Australian Government is only one-tenth of the estimated cost, though no public disclosure of this data has ever been made. Also, the Beverley and Honeymoon projects are not required to rehabilitate contaminated groundwater following mining - this is the largest impact from in-situ leach mining, and both companies acknowledge the potential for groundwater migration at their sites. Not one former Australian uranium mine site has demonstrated successful and stable long-term closure of mine wastes (tailings, waste rock and/or low grade ores).

Radioactive Emissions (section 6.4).

No measurements of radioactive emissions, e.g. radon gas, at Beverley have ever been published, with very few studies at Ranger and Olympic Dam in terms of environmental releases. The claims of low emissions are dubious. The available evidence clearly suggests that radon releases increase overall due to mining (see Mudd, G M, 2005, A Detailed Analysis of Radon Flux Studies at Australian Uranium Projects. Radiation Protection in Australia, December, 22 (3), pp 99-119).

Environmental "Performance" of Australian Uranium Mines (section 7.4.3)

There is a clearly detectable downstream change in water quality in the Magela Creek due to Ranger (that is, magnesium and sulfate elevated by some 300% or so), a scientific fact now universally accepted by the Supervising Scientist and ERA. Recent research has shown that although the concentrations are minor, they have measurable effects on some aquatic species - yet the research is still ongoing to fully evaluate the extent of these impacts. Further to this, many of the incidents had major impacts on water quality on the Ranger site itself, with monitoring often inadequate to properly judge the true extent of impacts from the various incidents. The extent of incidents also shows the seriousness of the risks posed by uranium mining in World Heritage ecosystems and landscapes.

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RADIOACTIVE WASTE

Dr Jim Green is the national nuclear campaigner with Friends of the Earth and national coordinator of the Beyond Nuclear Initiative.

The Switkowski report states that: "The broad consensus of scientific and technical opinion is that high-level waste can be safely and permanently disposed of in deep geological repositories." This is typically disingenuous nuclear industry spin - a quaint way of acknowledging that proposed technological solutions such as transmutation will not be available for decades, if ever. Moreover, despite the 'consensus' about the wisdom of dumping nuclear waste in deep repositories, not a single permanent repository for high-level nuclear waste exists anywhere in the world.

Waste from nuclear power in Australia

The Switkowski report states that a repository for nuclear power waste would not be required until around 2050. It would be irresponsible to pursue nuclear power without first providing a waste management solution.

The Switkowski report states: "Based on current light water reactors, for each GW of nuclear power there would be an additional 100 m3 of LLW, 0.5 m3 of ILW and less than 10 m3 (25–30 tonnes) of spent fuel each year."

The Switkowski report notes that assuming a reactor lifetime of 60 years, 37,000 to 45,000 tonnes of spent fuel would be produced by a 25 GW nuclear industry in Australia (i.e. 25 reactors).

That amount of spent fuel contains 370-450 tonnes of plutonium (1% of the spent fuel mass) which is enough to build 37,000 to 45,000 nuclear weapons assuming 10 kgs of this high burn-up plutonium per weapon.

The Switkowski report states: "The multilateral non-proliferation mechanisms for spent fuel are critical in determining Australia's management arrangements. Should the Global Nuclear Energy Partnership be fully implemented, there may be opportunities for Australia to dispose of its spent fuel in an international repository in a fuel supplier nation such as the United States."

That comment betrays complete ignorance of the GNEP debate in the USA (see EnergyScience fact sheet #14). The USA has absolutely no intention of importing high-level nuclear waste. Moreover, while the Switkowski report floats the possibility of exporting nuclear waste, it fails to address the term of reference concerning the importation of nuclear waste.

The Switkowski report states that: "There is a high standard of uranium mining waste management at Australia's current mines." However, to give one of many examples which gives the lie to Switkowski's claim, on March 10, 2006, *The Australian* newspaper reported on documents obtained under Freedom of Information legislation. The documents, written by scientific consultants to BHP Billiton, state that the mine needs urgent improvements in radioactive waste management and monitoring.□□ The consultants call on government regulators to "encourage" changes to the tailings management, noting that radioactive slurry was deposited partially off a lined area of a storage pond thereby contributing to greater seepage and rising ground water levels.

The Switkowski report stresses the need for public acceptance of waste management proposals, so why no comment on the draconian approach of the federal government in relation to the proposed dump in the NT?

Importing high-level nuclear waste

The terms of reference for the Switkowski inquiry include the following question: "Is there a business case for acquisition and management of radioactive by-products generated outside Australia?"

The Switkowski report dismisses waste import schemes with the following comment: "There are advocates of a significant international waste facility in Australia, citing commercial and geopolitical benefits. The Review found such proposals still need to resolve a number of questions."

Why does the Switkowski report fail to even pose the questions let alone answer them?

During the Switkowski inquiry, the Prime Minister announced that Australia would not accept overseas waste for disposal in Australia. Switkowski's secretariat was located in the Department of Prime Minister and Cabinet. Was political pressure exerted on Switkowski to ignore the term of reference relating to importing high-level nuclear waste?

Prof. Peter Johnston's critique of federal government

The Switkowski report states that: "Safe disposal of low-level and short-lived intermediate-level waste has been demonstrated at many sites throughout the world." Why no mention of problematic low-level waste repositories, such as three in the USA which were closed because of environmental underperformance?

The Switkowski might also have investigated the reasons why repository projects succeed or fail in meeting environmental objectives, with competent project management and independent regulation being key criteria. Such an analysis would cast serious doubt over waste management in Australia.

Indeed, Prof. Peter Johnston from RMIT, a member of Switkowski's panel, made a submission to ARPANSA in 2004 arguing that the federal Department of Education, Science and Training (DEST) should not be granted a licence to operate a radioactive waste repository in SA because DEST had demonstrated its incompetence during the Maralinga 'clean up' in the late 1990s.

In relation to the Maralinga clean up, Professor Johnston wrote in his submission to ARPANSA that "there were ... very large expenditures and

significant hazards resulting from the deficient management of the project by DEST."

Inevitably the poor project management had adverse consequences for the Maralinga clean up. Professor Johnston's presentation for an ARPANSA forum listed some examples: "DEST concluded a contract with Geosafe Australia for technical services that contained no performance criteria. Draft documents prepared by DEST have often been technically wrong due to a lack of technical input. Non-technical public servants made decisions where technical expertise was needed. Technical advice often not sought except from a contractor."

Repositories

The Switkowski report states that: "The HLW waste from reprocessing spent nuclear fuel presents a greatly decreased potential hazard beyond 1000 years. At around 10 000 years, the level of activity is approximately the same as that in the original uranium ore body. However, protection is still required from long-lived transuranic elements and actinides. This is provided by engineered multiple barriers to the release of radioactive materials and by the geological environment, which ensure that any released radioactive materials move slowly from the repository."

The report ought to heavily qualify the above comments by noting that they amount to nothing more than speculation; obviously there is no experience over those timeframes.

In relation to high-level waste repositories, the Switkowski report states that: "The combination of natural barriers and engineered barrier systems provides a long lasting, passively safe system ensuring that significant radioactivity will not return to the surface environment, with no burden of care on future generations." In fact, there has been a clear shift within the nuclear industry towards acceptance of the principle of 'retrievability' such that waste can more easily be monitored and problems remediated. The monitoring and management costs will accrue for thousands of years.

The Switkowski report states that: "Safe disposal of long-lived intermediate and high-level waste can be accomplished with existing technology. The first European repository is expected to commence operating around 2020."

The Switkowski panel could only be referring to Sweden or Finland, but Sweden has yet to decide on a location for a permanent repository, and Finland will shortly begin studies on a site which may or may not prove to be suitable for a permanent repository. In the USA, the Yucca Mountain repository was expected to open in 1998, but now the US government states that the best-case scenario is for Yucca to begin accepting waste in 2017. Yucca Mountain has been a US$10 billion fiasco with no end in sight (see EnergyScience fact sheet #8).

As the Switkowski report later concedes: "no country has yet implemented permanent underground disposal of high-level radioactive waste."

Reprocessing

The Switkowski report states that: "Reprocessing in Australia seems unlikely to be commercially attractive, unless the value of recovered nuclear fuel increases significantly." The report should have gone much further by acknowledging that reprocessing makes no economic sense anywhere in the world (as the British Energy utility in the UK openly concedes), that it is "environmentally dirty" to use the words of an executive of the World Nuclear Association, and that it poses unacceptable proliferation risks.

The Switkowski report states: "The principal reason for reprocessing has been to recover unused uranium and plutonium for use as nuclear fuel, thereby closing the fuel cycle." However, very little uranium recovered from reprocessing is reused, and reprocessing outstrips the limited use of plutonium in power reactors. The Switkowski report ought to have noted that the main reason that nuclear utilities send their spent fuel to reprocessing plants (mainly those in the UK and France) is because reprocessing plants serve as long-term storage facilities allowing utilities to handball spent fuel problems to future generations.

The Switkowski report states: "Reprocessing also reduces the volume of HLW for disposal by a factor of between five and ten, compared to direct disposal of spent nuclear fuel." But the overall volume of waste, including low-level waste, is included.

The Switkowski report makes passing mention of the THORP reprocessing plant in the UK but fails to note that the plant remains closed following a major leak detected in early 2006 which led to the plant operator being fined 2.5 million pounds.

Transmutation

The Switkowski report states that: "In the more sophisticated fuel cycles incorporating fast reactor systems, the transuranics will not be separated in reprocessing and can be burnt as fuel, thus significantly reducing the long-lived burden." The report fails to note that these are speculative proposals which are viewed even within the nuclear industry as ambitious and expensive.

The Switkowski report states that "it is reasonable to expect that research into advanced fuel cycles will develop technologies to render harmless these [radioactive] by-products of the nuclear fuel cycle." That is not a reasonable expectation whatsoever and the report provides absolutely no evidence whatsoever to support it.

Research into transmutation - bombarding waste with subatomic particles to render it less harmful - has been protracted and problematic. According to Richard Lester, professor of nuclear science and engineering at the Massachusetts Institute of Technology, the reprocessing and transmutation schemes outlined in the US government's Global Nuclear Energy Partnership amount to an "appealing vision, but the reality is that GNEP is unlikely to achieve these goals and will also make nuclear power less competitive." (See EnergyScience fact sheet #14.)