Uranium & Nuclear Energy

FACTSHEET

The public policy issues of clean energy from uranium

How natural is uranium?

Uranium is a natural part of many rocks and is barely radioactive - very much less so than many of the other elements usually found with it. However it provides the main heat source inside the Earth, causing convection and continental drift

How natural is nuclear energy?

The first nuclear reactors started up and operated naturally about 2000 million years ago, in a uranium orebody, in west Africa[1].

And the Sun is a large nuclear reactor!

How much from Australia?

Australia provides about 20% of the world's uranium, representing almost half (42%) of Australia's energy exports in thermal terms. Australia has 30% of world economic uranium resources and the prospect of much more.

Production amounts to about 10,500 tonnes of uranium oxide concentrate[2] (9000 t uranium) per year. Our export of this avoids some 400 million tonnes of CO_2 emissions (relative to coal) - twice as much as Australia's total CO_2 emissions from power generation.

How sufficient and sustainable?

Known economic resources are equivalent to 50 years consumption, and there is much scope for identifying more. Little uranium exploration has been done since mid 1980s.

With a change in reactor technology which is well-proven but not yet economic, even present known resources would be sufficient for hundreds of years.

When uranium is used to generate electricity it produces no pollution or greenhouse gases.

How significant?

Nuclear energy provides 16% of world electricity (24% in developed countries). Today there is as much electricity generated by nuclear power as from all sources worldwide in 1961. There have been almost 12,000 reactor-years of operation for civil nuclear power (and slightly more for naval reactors).

France gets over 75% of its electricity from nuclear power. It is the world's largest electricity exporter, and gains over A$4 billion per year from that.

[1] Due to natural changes over time in the uranium, this can no longer happen.
[2] U_3O_8

No uranium traded for electricity production has ever been diverted for military use. No weapons program has ever arisen out of civil nuclear power. Civil plutonium is unsuitable for weapons, but is also subject to rigorous accounting and auditing under the international safeguards system.

Uranium Information Centre Ltd
GPO Box 1649N
Melbourne Vic 3001

Phone: (03) 9629 7744
Fax: (03) 9629 7207

uicinfo@optusnet.com.au
www.uic.com.au

7/05

There are some 440 nuclear reactors in 31 countries, totalling 366 GWe capacity, and producing 2619 billion kWh in 2004 (13 times Australian total). 56 countries operate more than 280 research reactors. Over 200 reactors are used for naval propulsion today.

Uranium as exported from Australia contains 20,000 times as much energy per kilogram as coal.

To supply Australia's gross electricity production, 6000 tonnes U_3O_8 per year would be needed.

A 1000 MWe reactor producing 7 billion kWh/yr supplies 780,000 people (at Australian average of 9000 kWh each per year).

What potential?

To produce all today's base-load power[3] worldwide would require about 1700 nuclear reactors. The figure in 2030 would be double.

Nuclear energy is widely considered the most promising means of cleanly making hydrogen, initially by electrolysis, but later by thermochemical means.

If in 2050 nuclear reactors also produce most of the world's hydrogen which by then is the main transport fuel, there could be over 8000 reactors for electricity, plus 1300 units for the hydrogen: say a total of 9500[4] worldwide.

How competitive?

Very! Today nuclear power is competitive in many places - which is why 30 or so reactors are under construction and more are planned.

If the costs of carbon emissions are factored in to fossil fuels, it becomes universally competitive, even in Australia.

What about wastes?

Nuclear power is the only energy producing industry which takes full responsibility for all its wastes, and fully costs this into the product[5]. High-level civil wastes - mostly spent fuel - are contained and managed safely, and have been - virtually without incident - for 50 years.

The heat and radioactivity from spent fuel diminish significantly, eg to less than 0.1% of original, by 50 yrs. Hence storage for several decades means they are more easily handled for eventual disposal.

There are multiple barriers for waste disposal: immobilise, seal, bury deep in stable rock formations. There are two broad strategies: direct disposal and reprocessing. Either way, net cost is about 5% of electricity generation.

[3] Assuming base load 75% of total, and using 1000 MWe units.
[4] 1000 MWe size units
[5] Adding about 5% to the generating cost. This is met by levy, eg 0.1 c/kWh in USA, giving a $24+ billion fund in USA. Decommissioning cost is also c 5% of electricity.

Plutonium??

When uranium is "burned" in a reactor, some plutonium is formed. Much of this is a valuable energy source like the fissile portion of the uranium (ie U-235).

Reprocessing spent fuel with recycle of plutonium into fresh mixed oxide (MOX) fuel extracts about 30% more energy from the original fuel. Currently 10-12 tonnes plutonium is used in MOX fuel each year (of about 100 tonnes generated). This reactor plutonium is very different from weapons plutonium.

Megatonnes to Megawatts

Ex-weapons uranium is now well established as a source of fuel for power generation. One tenth of US electricity (ie half of the nuclear electricity) is generated from Russian ex-weapons uranium.

Military plutonium is now starting to be made into MOX. This is an important disposal option since the plutonium will be permanently denatured.

Greenhouse significance?

Nuclear power generation emits no carbon dioxide (CO_2), and worldwide it avoids the emission of about 2.5 billion tonnes of CO_2 per year (relative to coal). Other electricity generation emits over 7 billion tonnes per year[6]. Every 22 tonnes of uranium (26 t U_3O_8) used for generating electricity saves about one million tonnes of CO_2 relative to coal[7].

A carbon value or tax of $37 per tonne carbon - $10/t CO_2 - on black coal would lift electricity generation costs from those sources by one cent per kWh. The European Emission Trading scheme in July 2005 was pricing CO_2 emissions at over EUR 28 per tonne (A$45/t).

Safety?

Nuclear power has an excellent - and arguably unmatched - safety record, considering almost 12,000 reactor years of nuclear power generation. Some early Russian reactors remain a concern.

How secure?

All Australian uranium is used for electricity (though Australia is almost the only developed country not using any electricity generated by nuclear power).

Proliferation of weapons?

Avoiding nuclear weapons proliferation has been a high priority from the inception of nuclear power - which in at least three countries arose from weapons programs. Nuclear safeguards are international means of accounting and auditing the disposition of fissile materials.

[6] 1 TWh from coal => 1 Mt CO_2 - ie 1 kWh => 1 kg
[7] U @ 500 GJ/kg, Coal @26.4 MJ/kg, 67% C & 33% thermal efficiency.