

# Nuclear Versus Fossil Fuel Electricity Generation For Western Australia

## **General:**

- Nuclear energy would be about 20% more expensive than a new coal fired station when generated in stations of more than 1,000 Mw capacity and coal being priced with no carbon penalty. WA would need 4 for all its current electrical energy needs and 6 if cars went electric.
- Survey 2007 (Macintosh 2007): 69% (50%) of West Australian are against a plant in neighborhood (in general), 24% (35%) support, 5% (15%) undecided (women and young more opposed).

## **Uranium Processing:**

- Mining produces uranium oxide  $U_3O_8$  (200 tonnes)
- Converted to uranium hexafluoride gas or solid, this contains about 0.7% U-235, (170 tonnes)
- Need to enrich to about 5% U-235 via centrifuge, laser etc, (24 tonnes)
- Then fabricated into uranium oxide to make fuel rods. (24 tonnes of  $UO_2$  plus 146 tonnes uranium tailings)
- Three suppliers globally supply 80% of all fuel rods

## **Waste Processing Form Open Cycles Plants:**

- *Low Level Waste:*
  - Contaminated material, such as towels etc. easily treated
- *Intermediate Level Waste:*
  - Components exposed to radiation important in decommissioning
- *High Level Waste: Fuel, self-heating*
  - Bind fuel rod material into rock, such as Synroc
  - Cool and radioactive decay in water ponds for 3 years
  - Store underground, but need to remain for about 1000 yrs.
  - 1,000 MW plant ( $8.8 \times 10^9$  kWh per year); requires 25 tonnes of enriched uranium as fuel each year. (re-processing leaves only ~1 tonne of waste)
  - WA has capacity of 3,500 MW =  $30.8 \times 10^9$  kWh, of electricity generated in WA in 2001 (ABARE 2004).
  - Suppose WA converted everything to nuclear. This would need disposal of 100 tonnes of waste per year, then after 1000 years there would be 100,000 tonnes of waste or about 50,000 m<sup>3</sup>. This is a volume of about 50m x 30m x 35m or about 14 Olympic swimming pools, 2.5 m deep. Store in stable geological sites, not a problem in WA, which has many suitable sites.

## **The Future of Nuclear Power Plants:**

- 2<sup>nd</sup> generation plants are now in operation
- 3<sup>rd</sup> generation as standard in design, reduced waste and risk.
- 4<sup>th</sup> generation will be closed cycle, much less waste deployment between 2010 and 2030, initiated by 10 countries
- There are also thorium cycles that produce no plutonium, fast breeder,

- not yet in operation
- Fusion, the same process as the sun's heat, no waste estimated to be available in 2030.

***Uranium Reserves:***

- Known worldwide reserves, 50 to 100 years, but level of exploration has been low. Supply is not expected to constrain development in near future, given that fusion will be available in a maximum of 50 years.

***Comparison With Fossil Fuel Use in WA:***

- Electricity Generation: In 2005 WA; 92% from fossil, 8 % from renewables; Capacity  $30.8 \times 10^9$  kWh yields about 38.9 Mt CO<sub>2</sub> or  $14.1 \times 10^6$  tC .
- Transport approx  $15 \times 10^9$  kWh or about half yields about 8.9 MtCO<sub>2</sub> or  $3.2 \times 10^6$  tC
- If WA changed to electric cars and trucks, would need about  $46 \times 10^9$  kWh and produce about 0.017 GtC per annum compared with 17 GtC globally or 1% of global total, yet population is about 2 mill in 6 billion or 0.03%
- Existing plants will need to be replaced in 20 yrs, so a decision must be made as soon as possible
- Deaths due to accidents between 1969 and 2000; 31 nuclear, ~90,000 other, worldwide
- Particulate pollution (2 microns and less) from coal fired stations and coal mining activity have been documented to contribute substantially in WA to respiratory health problems. Many of WA's coal fired stations have good scrubbing devices, but some stations still use very old technology; however, modern scrubbers do not remove all the particles that are smaller than 2 microns, the source for health problems.

***References:***

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3. Macintosh, A. (2007), Who wants a nuclear power plant? Research Paper No 39, Australian Institute For A Sustainable Peaceful Future
4. Dimitrova, R. et al (2009), Linking Particulate Matter and Childhood Asthma in Central Phoenix, submitted for publication.