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BACKGROUND BRIEFING

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International experts comment on draft Nuclear Taskforce Report

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"So realistically, new nuclear orders cannot have much impact in most countries for more than 20 years and is in contradiction with the claim made in the Switkowski report that 'the earliest that nuclear electricity could be delivered to the grid is around 2016'."

"For the future, major costs such as decommissioning, disposal of waste, especially intermediate- and high-level are at present little more than guesses because of lack of experience. Estimated costs have been rising rapidly and, if the history of nuclear power is a good guide, actual costs will still turn out to be much higher than forecast."

Introduction

An international panel of experts was convened by Greenpeace Australia to be available to answer questions from the media and politicians between 15-17th November 2006. A compilation of these questions have been made available at http://www.greenpeace.org/australia/news-and-events/media/releases/international-experts-push-for

The panel has also made a series of comments on the report from the Uranium and Nuclear Energy Taskforce – herein referred to as the Switkowski report. These preliminary comments were prepared during the day [UK, UK and France) of the 21 November 2006.

The panel members in answering these questions do not represent the views of Greenpeace but their own expertise. This initial response have been provided within a very short time-frame and therefore does not cover all parts of the draft Taskforce report.

Panel Participants

- **Antony Froggatt,** international energy and nuclear policy consultant, United Kingdom (Panel Chair)
- **Peter Bradford,** former member, Nuclear Regulatory Commission, United States
- **David Milborrow,** renewable energy studies consultant, United Kingdom
- **Mycle Schneider,** international consultant on energy and nuclear policy, France
- **Stephen Thomas,** Professor of Energy Policy, Public Services International Research Unit, Business School, University of Greenwich, United Kingdom

Energy efficiency

The Switkowski report fails to address the opportunities for energy saving and energy efficiency. However it does recognise its importance as it quotes the International Energy Agency's World Energy Outlook, which states that in reducing CO_2 emissions, *"energy efficiency improvements make the greatest contribution (one-third to half of total abatement achieved)"*.

The Switkowski report makes little reference to energy efficiency and in fact states '*While improved energy efficiency can delay investment in generation, it also has a rebound effect. The efficiency gain may not result in an equivalent reduction in consumption. Historically, efficiency improvements have been offset by increased electricity use through extended applications and larger appliances'*. This is not the view of the European Union, which in October 2006 introduced an Action Plan on energy efficiency that is aiming to increase energy efficiency by 20% by 2020. It is estimated that this will lead to a saving of €100 billion per year in energy bills and to an overall decline in energy consumption.[1]. This is a win-win situation.

This contrasts with the Switkowski report, which predicts that *'Australia's demand for electricity will more than double before 2050'*. The wording suggests that the increase of power consumption is a fait accompli. This is strongly misleading. The average Australian consumes about 12,000 kWh per year that is twice the EU average consumption per capita. The energy service delivered in Australia via these high consumption levels are not substantially different from the EU. If Australian citizens consumed the same amount of electricity as the Europeans, it could save half of the installed generation capacity, or 22,000 MW away, rather than building new plants. Because efficiency is much cheaper than new

[1] Action Plan For Energy Efficiency: Realising The Potential - Saving 20% By 2020, European Commission, October 2006, http://ec.europa.eu/energy/action_plan_energy_efficiency/index_en.htm

generation, such a course would also lower Australian electric bills and make Australian industry more competitive in world markets.

Given the acknowledgement that energy efficiency can contribute up to 50% of the total CO_2 emissions reductions the lack of prominence given to energy efficiency is remarkable. To meet Australia's needs without emphasizing energy efficiency would make no more sense than adding additional furnaces to a house with a large hole in its roof.

Renewable energy issues

The Switkowski report appears pre-disposed to reject the possibility of any significant contribution from renewable energy sources, especially wind. Worldwide wind capacity is now around 70,000 MW and increasing at the rate of around 25% per annum. It is already close to being cost-competitive with gas in many locations – especially if carbon-trading costs are taken into account – and, unlike nuclear, does not attract a risk premium if developed by the private sector. The variability of wind, wave and other renewable sources does not, contrary to popular opinion, cause any significant increase in the operating costs of electricity systems up to a wind energy penetration level of around 20%. In fact, in several German Länder the share of wind energy is now over 25%, Schleswig-Holstein (2.8 million citizens) leading the ranks with over 30%.

The section on 'Electricity Generation' is misleading. To quote: *"Intermittent generators (principally wind power and some other renewables) require complementary generation capacity that can be called upon when the intermittent capacity is unavailable.*" That is correct, strictly speaking, but it fails to acknowledge that the amount of additional spinning reserve is extremely low and the associated costs are also low – typically around AUD$0.7/MWh (US$0.4/MWh) of electricity, with 10% wind. What matters is the additional uncertainty that the introduction of variable renewables imposes on electricity networks. All networks have to contend with uncertainties due to sudden plant breakdowns and consumer demands and need to schedule spinning reserve as a result. In fact, in section 4.4.2, the report acknowledges that *"A move to larger base load [nuclear] plants will increase the reserve capacity requirement"*, but no costing of this appears to have been made.

Variability issues have been analysed by a number of utilities and reputable authorities, including the International Energy Agency and all have reached similar conclusions. An analysis by the Australian Greenhouse Office: *National Wind Power Study – an estimate of readily accepted wind energy in the National Electricity Market* – does not appear to be acknowledged.

In section 4.2.2 'Future prospects for Australian electricity generation', it is acknowledged that some renewables are competitive in some situations, but "are typically not competitive with conventional fossil fuel and are likely to remain so even over the medium to long term". There are two issues here. Firstly, even with modest carbon costs, wind becomes competitive with gas and is likely to become significantly cheaper into the future. Table 4.3 in the EPRI report, commissioned in support of the analysis, suggests generating costs will almost halve by 2020 and the US Department of Energy suggests wind will typically be cheaper than nuclear in 2015.[2]

Secondly, the Switkowski report is silent on comparisons between the generating costs of wind and nuclear, although one of the graphs (figure 4.7) suggests that the cost ranges

[2] Annual Energy Outlook, United States Energy Information Administration, 2006

overlap. Closer inspection of that graph, however, suggests that the 'low' estimate of nuclear costs (A$40/MWh) does not square with most recent estimates and would almost certainly require low interest, long-term public sector finance.[3]

To conclude it is surprising to find that there is no proper consideration of the potential of wind and the other renewable energy sources and disappointing to find that myths about the impacts of variability are included. A more thorough comparison of nuclear generating costs with those of wind seems very desirable.

Contribution of nuclear to global energy mix and status of industry

The contribution of nuclear power to the world's energy supply is modest and it is *decreasing*. As the Switkowski report points out, nuclear power provides about 15% of the world's electricity. One should add a number of other significant points:

- Nuclear power covers less than 6% of the *commercial* primary energy and an estimated 2% of the world's final energy. That is less than the contribution of hydropower.
- 31 countries generate nuclear power (15% of the countries represented at the UN). But 6 countries produce three quarters of the nuclear electricity.
- The role of nuclear energy in China and India is very minor (ca. 2% of the electricity). Spain produces more nuclear power than China and Slovakia outpaces India.
- The contribution to final energy in the respective countries with the largest nuclear power generation remains low (see table) and it is *decreasing*. An estimate for 2005 for France, the country with, by far, the largest contribution, indicates 15%, down from 17.5% in 2004.
- There are 25 nuclear units *less* operating in the EU than 1989 when the number peaked at 172. While one reactor is under construction in the EU, three units have been shut down over the last two years alone.
- Ten out of 29 units listed as 'under construction' by the IAEA have been in the statistics for between 19 and 31 years.

The Role of Nuclear Power in the Final Energy Supply of the Six Largest Nuclear Electricity Producers

Country	**Total Primary Energy** *(in Mtoe)*	**Total Final Energy** *(in Mtoe)*	**Nuclear Final Energy Supply** *(in Mtoe)*	**Nuclear Share in Final Energy** *(in %)*
France	276	161	28	17,5
Japan	515	359	23	6.4
South Korea	217	138	9	6,7
Germany	330	241	15	6,4
USA	2332	1557	61	3,9
Russia	671	418	13	3,1

Source: Mycle Schneider Consulting[4]

[3] see Mighty Mice, Amory B. Lovins, Nuclear Engineering International, December 2005

[4] Note: data derived from various sources, figures for 2002, except for France, which is 2004

Given an estimated lead time of at least 10 years for a new nuclear power plant, significant increase over the next 10 years in nuclear energy generation is not only improbable it is impossible, unless a considerable number of reactors would be operated beyond 40 years of age, which raises not only economic but also significant safety issues.

It is remarkable that the Switkowski report has based its future projections of uranium demand on the upper scenario of the lobby organization World Nuclear Association, which forecasts an increase from currently about 370,000 MW to 518,000 MW of installed nuclear capacity in 2020. This is entirely impossible from an industrial point of view. It would mean to connect to the grid ten 1,000 MW reactors *every year*, starting 2006, over the next 15 years. As a matter of comparison: if the largest nuclear builder in the world, the French AREVA, dedicated its entire industrial capacity to new-build – which is not possible, because life time extension in many plants are impossible without the replacement of large components like steam generators and vessel heads – the company could provide 2.5 reactors per year.

The use of such heavily biased and misleading nuclear lobby data unfortunately drains the Switkowski report of much of its credibility.

Nuclear power's role in the global energy picture will remain very limited and will most likely decline over the next two decades.

Nuclear power undermines efforts to effectively address climate change

Nuclear power is not and cannot be a magic bullet answer to climate change. Even if it is scaled up much faster than anything now in prospect, it cannot provide more than 10-15% of the greenhouse gas displacement that is likely to be needed by mid-century.

The Switkowski report notes the widely quoted paper by Princeton professors Stephen Pacala and Robert Socolow introduces the useful concept of a 'wedge' defined as any measure that would, over the next 50 years, lead to a global reduction of 25 billion tons of carbon dioxide emissions relative to business as usual. The number of wedges that will be required to avoid dangerous climate change will depend on many factors. Under optimistic assumptions, some seven wedges will be needed; this number could increase significantly under less optimistic assumptions. The study provides a list of fifteen measures from technologies to public policy initiatives that exist today and could be scaled up to become one or more wedges. In brief, energy efficiency and conservation comprise three wedges, alternatives to business-as-usual gasoline-powered transportation accounts for another four, and increasing natural sinks provides two wedges. Generating electricity in less carbon intensive ways contributes four wedges. Of the latter, *at most one wedge would be contributed by a world-wide tripling of nuclear power"*[5] – one third of the potential contribution of energy efficiency.

Proposals to increase the use of nuclear power are dangerous policy and technological distractions from a truly sustainable energy sector. The UK Government's Sustainable Development Commission[6] raised concerns, when considering the construction of nuclear power once again in the UK that '*the political attention would shift and undermine efforts to increase the proportion of renewables in the energy mix, and the efforts to improve energy*

[5] From Peter Bradford and Kurt Gottfried, http://www.commondreams.org/views06/0915-28.htm
[6] *The role of nuclear power in a low carbon economy.* Sustainable Development Commission, March 2006 http://www.sd-commission.org.uk/pages/060306.html

efficiency throughout the economy'. Furthermore the SDC noted that *'there are concerns that investment in a new nuclear programme would reinforce the UK's reliance on a centralised grid system and could therefore decrease the investment available for the network reinforcement needed to cope with much higher levels of decentralised generation and large-scale renewables'*.

These concerns are justified when looking at the scenarios undertaken for the Switkowski Report that even if Australia does invest in a large nuclear power programme, its CO_2 emissions are forecast to increase by 40% by 2030 and only stabilise by 2050.

Economics of nuclear

Forecasts of the economics of nuclear power vary widely. Most are optimistic about new orders and assume that the problems that previous orders have suffered will be solved by new designs and better planning. While this is intuitively plausible, after 50 years of nuclear power when these forecasts have seldom been fulfilled, it is necessary to examine these forecasts more critically and put more weight on past experience. The new plant being built in Finland, Olkiluoto 3 was meant to be a demonstration that new designs would solve past problems, but only a year into the construction phase, costs have escalated seriously and the project is already a year behind schedule. One factor working strongly against new nuclear orders is that reforms of electricity industries mean that the economic risk of building nuclear plants is more likely to fall on plant owners than in the past when these risks were shouldered solely by electricity consumers. When the risk was borne by consumers, the cost of borrowing, a major element in the economics of nuclear power because of its capital intensity, was artificially low. Any problems were paid for by consumers and the risk to financiers of financing a nuclear project was minimal. Now, if things go wrong either in construction or operation, the plant owners will bear at least some of the financial consequences and the risk of bankruptcy for nuclear plant owners is no longer negligible.

Nuclear power hasn't been 'viable' in any country with competitive power supply procurement, ever. No nuclear plant has ever won an open competitive power supply auction. There is no reason to think that this would be different in Australia, a country with abundant coal and no nuclear experience.

So without a large carbon tax, this proposition is nonsense. But even with a large carbon tax, nuclear is not an assured winner against coal with sequestration, and it is an assured loser against energy efficiency and probably combinations of fossil fuels with renewables.

Timing of delivery

Tony Blair announced in July 2006 that nuclear power was 'back with a vengeance'. However, the first plant from this UK revival is not expected on-line before 2021 and only 3-4 follow on plants are expected to be completed by 2026. This reflects a number of factors. First, the designs now being considered (e.g. Areva EPR, Westinghouse AP-1000 and GE ESBWR) are all unproven. The Olkiluoto EPR, only a year into construction, is the only order for any of these designs. All face regulatory hurdles, either in Europe or the USA, that could delay their availability and raise their cost. Second, all experience with nuclear facilities shows that they need the active consent of those most affected by them. Success in gaining this consent will take time and cannot be assumed. Imposing facilities on an unwilling population is a recipe for costly delays and opposition. These two factors mean that the UK government assumes that it will take up to eight years before regulatory and planning consents have been received and an order can be placed. The UK government assumes a six-

year construction period. While some countries with large nuclear programmes and well-practiced skills have been able to beat such a target, many projects have taken longer. So particularly for a country without recent experience of nuclear projects (this covers all countries except a few Pacific Rim countries), a target of six years for construction is challenging. Building more than one or two successor plants will also require major input from government not only smoothing planning processes but ensuring local industry is able to deliver all the required elements, especially the highly skilled workforce required. So realistically, new nuclear orders cannot have much impact in most countries for more than 20 years and is in contradiction with the claim made in the Switkowski report that '*the earliest that nuclear electricity could be delivered to the grid is around 2016*'.

Risk

'The cost of nuclear power is strongly influenced by investor perceptions of risk. Risk is highly dependent on regulatory policy and the certainty of licensing and construction timeframes. A stable policy environment and a predictable licensing and regulatory regime would be a necessary precursor to the development of nuclear power in Australia[7]*'.*

While the Switkowski report correctly identifies risk as a major barrier to financing new nuclear power plants, it misrepresents the source of this risk as primarily due to lack of regulatory certainty. Few would disagree that a regulatory regime that is consistent is desirable. But to suggest that the failure to achieve this has been at the root of the perception that investing in nuclear power is risky is simply wrong.

The most obvious example of this is the failure of the privatised British nuclear generator, British Energy in 2002. This collapsed at huge cost to the British public paying for its rescue, not because of public opposition, or capricious regulatory decisions, but because its operating costs could not be covered by proceeds from the sale of electricity.

Nuclear power is seen as economically risky because nuclear plants have frequently not been built to time and cost because of poor management, because they have been unreliable in operation, and because the operating costs have been much higher than forecast. For the future, major costs such as decommissioning, disposal of waste, especially intermediate- and high-level are at present little more than guesses because of lack of experience. Estimated costs have been rising rapidly and, if the history of nuclear power is a good guide, actual costs will still turn out to be much higher than forecast. This perception of risk will only be reduced when there is a high degree of certainty that nuclear plants will be built to time and cost and will operate reliably and at predictable costs. And when the costs of waste disposal and decommissioning are firmly established, based on a solid body of actual experience. For high-level waste, such experience is many decades away.

The Switkowski report's requirements on the regulatory and licensing regime also need to be examined carefully. While consistency is clearly desirable where possible, the ability to respond to new information and events must remain. Are the report's authors really suggesting that regulators should not have examined the Three Mile Island and Chernobyl accidents to see whether this experience pointed to the need for additional safety features, perhaps restricting operation of some plants until their safety was demonstrated? Predictable licensing also sounds desirable, but nuclear power cannot be imposed on an unwilling public. The results of planning inquiries cannot be a foregone conclusion if the process is to have any credibility with the public and this means that sometimes planning inquiries will be lost or take longer than expected, or additional requirements, not budgeted for, will be imposed.

[7] Switkowski report p 7.

New generation of reactors

The Switkowski report states that new designs of reactors have been produced that are safer than the current generation of reactors. While this maybe the intention there are a number of factors that need to be taken into consideration.

The next generation of reactors that are being proposed, such as the European Pressurised Water Reactor (EPR – Areva) and the AP 1000 (Westinghouse) have not been built anywhere in the world and therefore no operating experience exists.

While there are a number of design changes that have been included that are said to increase the safety margin of the reactors, there are other changes that may lead to a reduction in safety. The AP 1000 reactor is based on the previously certified but never constructed the AP600. The AP 600 design was thought not to be economic and so it was transformed into an AP1000, by increasing the power output by 80% with only a 20% increase in construction costs. However, as a result, the AP-1000 has a ratio of containment volume to thermal power below that of most of current PWRs, increasing the risk of containment over-pressure and failure in a severe accident.[8].

Finally, the safety standard of an operating reactor is not just dependent on the design but on safety culture deployed during its operation and construction. The only Generation III reactor under construction in Europe or North America at Olkiluoto in Finland has already experienced serious safety culture problem during its construction. The Finish regulator has stated that '*The time and amount of work needed for the detailed design of the unit was clearly underestimated when the overall schedule was agreed on*' and that Areva NP – the main contractor '*was not sufficiently familiar with the Finnish practices at the beginning of the project'*[9]. These are particularly remarkable given the fact that Areva is Europe's most experienced nuclear vendor.

Proliferation

The Switkowski report pretends that *'Australia's uranium supply policy reinforces the international non-proliferation regime and ensures that Australian obligated nuclear material does not contribute to nuclear weapons programs'*. It is hard to follow an argument that says that spreading nuclear material is actually *reinforcing* the non-proliferation regime. It seems obvious that a non-export policy would further that purpose significantly more. Australia in fact supplies uranium to nuclear weapons states and can *not* guarantee that it has not ended up physically in nuclear weapons programs. In fact, the Switkowski report makes that nuance referring to "Australian *obligated* nuclear material" rather than to Australian nuclear material. In practice, the Australian uranium gets mixed up with other origin uranium in fuel facilities in countries like France that do not separate civil and military systems. An amount of uranium *equivalent* to the Australian material gets a peaceful end-use label and France can do what it wants with the rest. The system operates in a way that makes it most convenient to the needs of the weapons states.

[8] Statement Submitted by David Lochbaum to the House Government Reform Subcommittee on Energy and Resources: "The Next Generation of Nuclear Power". Union of Concerned Scientists 2005

[9] Management Of Safety Requirements In Subcontracting During The Olkiluoto 3 Nuclear Power Plant Construction Phase Investigation Report 1/06 1 Nuclear Reactor Regulation Translation, STUK, September 2006.

In addition the work force of the Australian Safeguards and Non-Proliferation Office (ASNO) is limited to a total of only 13 and seems hopelessly understaffed in order to follow Australia's 20 bilateral safeguards agreements, in addition to its responsibilities on other weapons of mass destruction.

The Switkowski report states that Australia's energy grid would not become *'more vulnerable to terrorist attack.'* In fact, every country that decides on the construction of a nuclear power plant makes the decision to place in the country a very large radiotoxic inventory. Terrorist organizations have shown keen interest in nuclear facilities in the past, reportedly including the Australian research reactor site at Lucas Height. Nuclear facilities are vulnerable to attack by a variety of attack modes. Mock attacks on facilities in the US have shown that a commando type operation is likely to succeed in penetrating into the most sensitive areas of nuclear plants.