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PRELIMINARY RESEARCH: BLADE DISPOSAL –CLEAN AND GREEN? OCTOBER 2011

(in progress)

I INTRODUCTION

Misrepresentation to investors and landholders? Not Clean and Green

Industrial wind turbine development ('wind farms') in Australia should be developed in an ecologically sustainable manner as defined in s6 of the *Protection of Environment Administration Act 1991* (NSW) (See Appendix 1).

An object of this Act was to constitute the *Environment Protection Authority*.¹

Preliminary research indicates 'wind farms' are not the appropriate use of technology for the collection of 'renewable energy' because of the need to dispose of large quantities of redundant wind turbine blades as waste in landfill.²

Governments and citizens need to be vigilant of products that may cause environmental harm to humans, flora and fauna, in the immediate and distant future. On this basis, the adoption of the use of composite materials needs to be closely examined before allowing its use. Significance must be attributed to the precautionary principle,³ and our adoption of intergenerational equality.⁴

What constitutes 'carbon composite'?

Each carbon composite is tailored for specific uses, therefore the constituent parts of composites used are unknown, including use in wind turbine blades.

It is known that:

- Boeing is concerned about the disposal of Hexavalent Chromium primer used in conjunction with their 'carbon composite' products.⁵
- Bayer is supplying its 'carbon nanotubes' for use in the construction of 'carbon composite' wind turbine blades for a Chinese manufacturer. The material's (Hybtonite) unusually high strength is attributable to *Baytubes* brand carbon nanotubes supplied by Bayer Material Science. A Bayer Material Science customer in China manufactures rotor blades between 40 and 50 metres long from 'Hybtonite' for large wind power plants.⁶

¹ *Protection of Environment Administration Act 1991* (NSW) s 4(a).

² *Ibid* s 1(b).

³ *Ibid* s 6(2)(a).

⁴ *Ibid* s 6(2)(b).

⁵ Boeing, *Composite Recycling and Disposal: An Environmental R&D Issue* (2003) 8 (4)

<http://www.boeing.com/environmental/TechNotes/TechNotes2003-11.pdf>.

⁶ Bayer, *A wind turbine for the home* <http://www.bayer.com/en/a-wind-turbine-for-the-home.aspx>.

- Specific lengths of the tiny fibres (carbon nanotubes) were found to cause ‘asbestos-like’ inflammation and lesions in mice.⁷

It is submitted that the full health and environmental risks associated with carbon nanotubes is unknown if they are released into the environment.⁸

II PROBLEMS OF DISPOSAL OF WIND TURBINE BLADES:

There are currently only four possible means of disposing of ‘carbon composite’ wind turbine blades:

1. **Landfill:** Depositing wind turbine blades whole as land fill.

Problems:

- It is unknown the period for decomposition. Suggestions are that the time period should be measured in decades if not centuries.⁹
- If the turbine blades do decompose it is unknown what product have been used in their manufacture and the dangers they pose to the environment, both flora and fauna, including human health.
- It is possible that Australia will follow Germany, which has banned wind turbine blades from landfill since June 2005.¹⁰

2. **Re-grinding:-** Cutting, grinding, or chipping the waste composite down to a suitable size to be used as filler material in new moulded composite products. The maximum particle size for most products is under several millimetres.¹¹

Problems:

- A problem with using re-grinded material is the continuous fibres are broken down into small fragments, and thereby lose their ability to provide high stiffness and strength.
- It is unknown what the health risks will be to the workers or the greater environment by the destruction of the resins that contain ‘carbon fibre’ and/or ‘carbon nanotubes’.¹²
- Wind turbine blades also have to be dismantled and crushed before transportation to incineration plants, placing further strain on the environment in terms of energy used

⁷ See CA Poland *et al.*, ‘Carbon nanotubes introduced into the abdominal cavity of mice show asbestos-like pathogenicity in a pilot study’ (2008) 3(7) *Nature Nanotechnology* 423; J Fildes, ‘Asbestos warning on nanotubes’, *BBC News*, 20th May 2008.

⁸ See CW Lam, *et al.* ‘A review of carbon nanotube toxicity and assessment of potential occupational and environmental health risks’ (2006) 36(3) *Crit Rev Toxicol* 189; Poland above n 282, 423: ‘The toxicity of carbon nanotubes has been an important question in nanotechnology, the needle-like fibre shape of CNTs is similar to asbestos fibers. Results suggest the need for further research and great caution before introducing such products into the market if long-term harm is to be avoided; Centers for Disease Control and Prevention National Institute for Occupational Safety and Health, *Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials*, Publication No. 2009-125 (March 2009) Department of Health and Human Services, USA, DHHS (NIOSH) www.cdc.gov/niosh/ (‘*Safe Nanotech Approaches*’).

⁹ Kari Larson, ‘Recycling Wind Turbine blades’ (2009) 9 *Renewable Energy Focus* 70.

¹⁰ *Ibid*; Local, State and Federal government initiatives aimed at waste minimization and landfill reduction are legislated and recommended at all levels of government.

¹¹ A Subic, A Mouritz & O Troynikov, ‘Sustainable design and environmental impact of materials in sports products’ (2009) 2(3) *Sports Technology* 67-79.

¹² *Safe Nanotech Approaches*, above n 287.

and emissions. Henning Albers¹³ suggests that there are also cause for concern in relation to the health and safety of workers involved in the incineration process.¹⁴

3. Thermal Recycling:

- i) High Temperature: Thermal recycling involves the incineration of composite to reclaim the fibres for reuse. Waste composite is ground into fine powder and then incinerated using a rotary kiln or fluidized bed. The composite is thermally degraded at temperatures above 500–600C in the absence of oxygen to break the polymer down into oil/wax, char, and gas.¹⁵

Problem

- A ‘... problem is the cost to recycle composites by high-temperature incineration, which is often greater than the original cost of the material, and there is no financial incentive to reclaim fibres.’¹⁶
- Low Temperature:- ‘Recycling at low incineration temperatures is currently under development to minimize the loss in fibre strength’.¹⁷

Problem

- The problem of recycling carbon fibre composites at low incineration temperatures is ... the process is not ready for large-scale processing...¹⁸ and therefore it is suggested that the cost and economic viability for this method of incineration has not been determined.

4. **Chemical Processing:-** The process involves using strong acid (e.g. nitric acid, sulphuric acid) or base solvent (e.g. hydrogen peroxide) to dissolve the polymer matrix, leaving the fibres for recovery and reuse.¹⁹

Problems

- The solvents are corrosive and potentially harmful to the environment should they leak out during processing.²⁰
- The chemical dissolution of the polymer matrix is slow—much slower than pyrolysis—and therefore, large digestion facilities are required for commercial-scale recycling.²¹

Permit Conditions Considerations:

1. Environmental:

Environmental management plans must consider hazardous material and all potential contaminants stored on site and potential for water contamination.²²

Further, contamination risks must be identified to include recycling and disposal procedures.

¹³ Professor Henning Albers from the Institut für Umwelt und Biotechnik.

¹⁴ See Larson, above n 288, 31; *Safe Nanotech Approaches*, above n 287.

¹⁵ Subic, Mouritz & Troynikov, above n 290, 74.

¹⁶ Ibid 75.

¹⁷ Ibid 74; see Sharon Beder, 'The Case Against an Australian High Temperature Incinerator for Hazardous Wastes' (1990) 76(1) *Chemical Engineering in Australia* 12.

¹⁸ Subic, Mouritz & Troynikov, above n 290, 74.

¹⁹ Ibid 75.

²⁰ Ibid.

²¹ Ibid.

²² Planning Permit Form 11, Planning and Environment Regulations, Victorian Department of Planning, pt 11.

Problem:

the claims are that 80% of the turbines are recyclable.²³ This claim is not denied but the issue of disposal of the blades continues to be ignored.²⁴ Turbine blades replaced in South Australia have reportedly been shipped to India for burning,²⁵ but we have been unable to confirm this. The potential risk to water tables from damaged blades caused by erosion, wear and fire is unknown. Disposal procedures appear not to be considered even at contractual level with landowners, but especially not by local or state government departments.

2. Decommissioning Provision:

Within 12 months of the date that turbines cease to operate the wind facility operator, or in the absence of the operator, the owner of the land, must undertake project closure and decommissioning and remove all above ground equipment.²⁶

Problem: Liability: of Parent Company, Wind Farm Companies; landowners.

It would appear that individual wind farms are held in subsidiaries of Parent Wind Farm Companies. If the 'corporate veil' between the Parent and Subsidiary 'wind farm' operator cannot be lifted the Parent will not be responsible for decommissioning costs.²⁷ If this is the case, based on the model planning permit developed by the Victorian Government,²⁸ the cost would fall on the 'owner of the land' to decommission the 'wind farm'. It is suggested that the liability will not be limited to the value of the land but to the total assets of the landowner.

Liability of landholders versus value of land:

Cost: Each turbine has 3 blades, a blade weight is about 9 tonnes and 10% of the Prepreg (the term for 'pre-impregnated' composite fibres.) turns into waste due to cut off, painting also affects recycling possibilities.²⁹ The turbines are painted to blend with the sky and reduce glint.

Currently recycling of Carbon Fibre is not available in Australia. UK firm, *Recycled Carbon Fibre Ltd*, charges approximately \$A15/ kilogram. At 9000kg per blade that is approx \$405,000 excluding site decommissioning, transportation and shipping for each turbine, at 2011 estimates. Any projection of the costs for decommissioning in 20 to 25 years can only be an estimate but an assumption that the cost will exceed \$1 million, would not seem unreasonable, to recycle wind turbine blades.

It would appear the line being perpetrated by 'wind farm' proponents is the cost of decommissioning will be able to be met by the residual value of 'wind turbines' at the end of their economic life.³⁰ We are highly sceptical of this assertion.

The question whether these costs will exceed the equity of the property owner will depend on the value of the site of the 'wind farm'. The question becomes; in the absence of the 'wind farm' operator and 'land owner', who will pick up the tab for the decommissioning of 'wind farms'. The options

²³ Barbara Batumbya Nalukowe, et al 'Life Cycle Assessment of a Wind Turbine IN 800 (Vestas) May 22 2006, 8.

²⁴ Permits and lease agreements do not discuss this in any detail.

²⁵ Personal communication with worker at Snowtown site on Pacific Hydro installation.

²⁶ Planning Permit Form 11, Planning and Environment Regulations, Victorian Department of Planning, pt 28.

²⁷ See *Patrick Stevedores Operations No 2 Pty Ltd v Maritime Union of Australia (No 3)* (1998) 195 CLR 1.

²⁸ *Ibid*.

²⁹ Nalukowe, above n 302, 11.8.

³⁰ Personal communication with employee of Infigen Ltd.

appear to be either the State Government or the Local Council? It is suggested that as the Planning Minister will direct the Local Council to issue the permit, it will be the Local Council that will become primarily liable for the shortfall in costs.

III CONCLUSION

There seems to be no *ecologically sustainable* solution for the disposal of ‘composite’ wind turbine blades. In order that we do not repeat the same mistakes made when our society allowed the introduction of unrecyclable ‘disposable’ bottles and plastic bags. We should not allow the development of ‘wind farms’ until a satisfactory manner of disposal has been determined i.e. a manner that is economically viable and *ecologically sustainable*.

Wind turbines may be a means of harnessing *renewable energy* but until an *ecologically sustainable* means is found for their disposal, they are certainly not a source of ‘green’ energy.

Note: We have limited our discussion to the disposal of wind turbine blades but we do acknowledge that there are further possible health impacts already documented overseas.³¹

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APPENDIX 1

PROTECTION OF THE ENVIRONMENT ADMINISTRATION ACT 1991 - SECT 6

6 Objectives of the Authority

(1) The objectives of the Authority are:

- (a) to protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development, and
- (b) to reduce the risks to human health and prevent the degradation of the environment, by means such as the following:
 - promoting pollution prevention,
 - adopting the principle of reducing to harmless levels the discharge into the air, water or land of substances likely to cause harm to the environment,
 - minimising the creation of waste by the use of appropriate technology,
 - regulating the transportation, collection, treatment, storage and disposal of waste,
 - encouraging the reduction of the use of materials, encouraging the re-use and recycling of materials and encouraging material recovery,
 - adopting minimum environmental standards prescribed by complementary Commonwealth and State legislation and advising the Government to prescribe more stringent standards where

³¹ See August 2011 issue *The Bulletin of Science Technology and Society*; *Erickson v Minister of Environment* July 2011, 10-121/10-122 (Canada).

appropriate,

- setting mandatory targets for environmental improvement,
- promoting community involvement in decisions about environmental matters,
- ensuring the community has access to relevant information about hazardous substances arising from, or stored, used or sold by, any industry or public authority,
- conducting public education and awareness programs about environmental matters.

(2) For the purposes of subsection (1) (a), ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:

(a) the precautionary principle-namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
 - (ii) an assessment of the risk-weighted consequences of various options,
- (b) inter-generational equity-namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,
- (c) conservation of biological diversity and ecological integrity-namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,
- (d) improved valuation, pricing and incentive mechanisms-namely, that environmental factors should be included in the valuation of assets and services, such as:
- (i) polluter pays-that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
 - (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
 - (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.