DYESOL

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Mr Russell Chafer
Secretary
House of Representatives Standing Committee on Industry and Resources

Dear Mr Chafer

DYESOL LIMITED SUBMISSION FOR THE CASE STUDY INTO RENEWABLE ENERGY SECTORS IN AUSTRALIA

Summary

- The USA government's National Renewable Energy Laboratory has stated that Dye Solar Cell (DSC) technology has the potential to produce electricity which is "grid competitive" ie at the cost to the consumer of electricity from fossil fuel power stations.

- We believe that international volume production of DSC will be sufficient within 10 years, for DSC electricity to be grid competitive in Australia.

- Dyesol (listed on the ASX and based in NSW), is recognised as a leading company in commercialising DSC technology internationally. Dyesol's role in the value chain is as a supplier of the value added materials and components needed to manufacture DSC.

Background

Solar Photovoltaic (PV) represent one of the fastest growing global industries with sales growth exceeding 30% per annum over the last decade, and sales reaching $15 billion US in 2006.

While the current industry is dominated by Silicon based technologies the European Union and Japanese PV roadmaps forecast that Dye Solar Cell (DSC), an emerging 3rd generation solar technology, will enter the market progressively increasing its share of an expanding PV market. The EU forecast is that DSC will capture 1% of the market by 2010, growing to 10% by 2020. By 2020 the general consensus is that the Solar PV market will have grown to around $200 Billion US. This growth represents a major challenge and unparalleled opportunity for DSC. Furthermore the highly respected U.S National Renewable Energy Laboratory (NREL) has state that DSC is a technology with the potential to be truly competitive with fossil fuel power generation.

Through the efforts of an Australian enterprise, Dyesol Limited, Australia is at the forefront of commercializing this exciting new technology.

Summary of the technology

Dye Solar Cells, (DSC) is a rapidly emerging photovoltaic technology that uses nano-chemical techniques and processes to create photo electrochemical materials.. DSC materials have significant advantages over traditional silicon solar cells.

DSC technology can best be described as 'artificial photosynthesis' created by using an electrolyte, a layer of titania (a pigment used in white paints and tooth paste) and ruthenium dye. Photons striking the ruthenium dye excite electrons which are absorbed by the titania to become an electric current many times stronger than that found in natural photosynthesis in plants. Early DSC prototype products were laminated between two sheets of glass. More recently flexible materials are being used to develop DSC products.

The technology was first demonstrated at laboratory scale by Professor Michael Graetzel in Switzerland in 1991. In 2007 a major investment in a DSC manufacturing plant in South Wales by G24i Inc. has heralded the impending entry of the first DSC products to mass markets. Roadmaps produced by the EU and Japan show DSC as a significant proportion of the solar market in the coming decade.

This rapid transition from the laboratory to early stage commercialization in just 16 years is evidence of the versatility and technological virtues of DSC. Australia has played a leading role in the development of DSC through the efforts, since 1995, of a small team of Australian based scientists now exporting commercial supplies of DSC material feedstocks to companies like G24i through an ASX listed company called Dyesol Ltd.

DSC is not, at this point, a significant direct competitor to silicon based solar power or the more exotic high efficiency cells such as gallium arsenide space grade pv materials. DSC however has a significant renewable energy role to play in applications and markets that are likely to never be satisfied by silicon solar cells.

The technological risks and commercial barriers associated with DSC have not been entirely overcome and continuing government support for research, development and demonstration will continue to advance the technology and improve its commercial prospects and technological utility.

State of development of the technology

DSC is a technology on the cusp of commercialization in early applications, while simultaneously becoming the focus of attention of considerable numbers of corporate and institutional research laboratories around the planet.

At present there are no commercial products available for mass markets based on DSC. By the end of 2007, if the plans of G24i are successful, this situation will have changed. In the first instance G24i believes that it can develop and market a range of small, flexible DSC products that will be capable of charging mobile phones and other electronic devices. They believe the market for a cheap product in this sector will follow the growth of mobile phone sales in the developing world.
(see http://www.g24i.com/developing.html).

As the G24i South Wales facility prepares for the commencement of commercial scale manufacturing, Australia's Dyesol Ltd is filling an order from G24i for what is possibly the world's largest ever single purchase of ruthenium dye, a material for which Dyesol is recognized around the world as being able to manufacture to the highest degrees of purity and consistency.

Dyesol, (see http://www.dyesol.com) a company with an extensive suite of international patents across all aspects of DSC technology, is also presently engaged in a research and development program with UK based international steel giant Corus in the demonstration of a rolled steel coating plant that is intended to pave the way for manufacture of DSC enabled photovoltaic steel sheet products. Dyesol is also working with the Australian Defence Science Technology Organisation developing and demonstrating flexible cells for field applications.

NSW based Dyesol, possibly the largest DSC focused company in the world, has a significant and ongoing research and development program underway in collaboration with Australian research institutions focused on *inter alia*;

- Driving the cost of DSC materials manufacturing down by developing continuous processing techniques aimed at replacing the present batch processes used to manufacture a number of DSC materials (with UWA);
- Investigating novel materials for use as gel or polymer based electrolytes, understanding the performance of DSC components and materials in combination and overcoming some specific difficulties in manufacturing and longevity of DSC (with QUT).

Dyesol research programs are working on two fronts:

a) Collaborative demonstration programs with significant industrial or institutional partners to demonstrate products using the existing DSC capabilities and science, and;
b) Collaborative research programs aimed ultimately at doubling the present conversion efficiency light to electricity of DSC from the 6% routinely achieved, to possibly as high as 12% while at the same time driving down manufacturing costs.

Even with present day manufacturing cost structures, DSC operating at 12% efficiency of conversion would result in an installed capital cost of about AUD $1.65 per peak watt, significantly lower than the present average cost of silicon cells of US $5.47 per peak watt.

DSC Competitive Advantages

DSC has significantly lower embodied energy costs than silicon and other semiconductor based photovoltaic products. This means that on a life cycle basis DSC recovers the energy consumed in its production in a much shorter proportion of its useful life than silicon solar cells do.

DSC has an unparalleled low light performance capability and can be manufactured as either transparent or semi transparent material which means that it is far more suitable for use in;

- building integrated products such as facades, or even integrated as the glazing in windows;
- in cloudy or smoggy environments such as in equatorial areas, high latitudes and in major cities where low light conditions are commonplace; and
- inside the built environment where low voltage charging applications can be met using incidental and electric lighting falling on DSC materials.

DSC's tremendous low light performance capabilities also mean that, in a wide range of locations and situations, over the course of a year a given area of DSC materials will actually produce more electricity than a similar area of silicon based photovoltaics. This is because silicon based photovoltaic semiconductors have a relatively narrow range of conditions under which they will generate current.

The nature of DSC, as a laminate of several materials, all of which can be prepared as liquids pastes or gels, means that it is ideally suited for manufacturing onto flexible materials and via laminating lines onto materials such as steel sheeting.

In terms of the costs of materials per square metre of product, the component materials of DSC are already cheaper than the materials required for silicon based products, even those using the most advanced silicon minimization techniques such as vapor deposition on glass.

Contribution of DSC to large scale electricity generation and consumption

The forecast reductions in production costs for DSC products indicate that they will have a significant role to play in reducing electricity demand growth by providing alternative sources of power for consumer electronics, and a role in providing utility scale electrical generation across CBD landscapes as building integrated photovoltaic (BIPV) systems.

Early DSC products will be focused on providing 'nanogeneration' services, such as the charging of mobile phones. Even though these small, and low voltage battery powered devices are not individually large consumers of energy, it is estimated by the Energy Saving Trust in the UK that mobile phone chargers waste over £60m worth of electricity and are responsible for a quarter of a million tonnes of CO_2 emissions per annum.

The low light performance characteristics of DSC mean that they are highly favored to provide a range of building integrated photovoltaic (BIPV) products including;

- photovoltaic façade systems that have the double benefit of shading windows and thus reducing solar gain into buildings, creating heat loads that will often require energy to remove via HVAC systems;
- photovoltaic roofing material such as foreshadowed by the work of Corus and Dyesol;
- photovoltaic glazing systems for windows that can be manipulated to allow in the wavelengths that are desired, such as natural lighting, while converting wavelengths such as infra red or ultra violet to electrical current.

Dyesol has already demonstrated prototype products based on glass substrates for glazing systems and for facades. A number of government's around the world have programs aimed at promotion of BIPV into commercial buildings. The Government of Singapore for instance is both promoting the use of BIPV to the construction industry while seeking to directly support the development of innovative BIPV products through partnerships with industry and research institutions.

DSC BIPV systems integrated as facades over the glazing on a commercial building could certainly provide a considerable proportion of the day time electrical demand of a commercial building, renewably generated on site, and would have a very positive impact on satisfying demand peaks.

Peak electrical demand in the majority of commercial centres around the world occurs on the hottest summer days when demand for electrical cooling is at its height. The satisfaction of peak demand is the most expensive service provided by electrical distribution infrastructure as the most extreme 10% of demand peaks generally only occur for something in the vicinity of 100 hours a year, and these peaks tend to be a great deal higher than average demand. This phenomena, experienced by most of the large utilities around the world, requires large infrastructure investments to ensure security of supply at those peak times, infrastructure that is then not required for the other 8500 hours of the year. The size of demand peaks and the frequency of their occurrence is increasing in many economies.

Widespread commercialization and deployment of DSC BIPV products would help alleviate the economic burden of satisfying increasing demand peaks as DSC BIPV would be most productive exactly at those times when demand was highest, on hot sunny days.

For any further information. Please feel free to contact the undersigned.

Yours Faithfully

Sylvia Tulloch
Managing Director
Dyesol Limited