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The Secretary
Senate Standing Committee on Rural and Regional Affairs and Transport
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Parliament House
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Submision to inquiry into the investment of Commonwealth and State funds in public passenger transport infrastructure and services

Executive Summary

Sustainable Energy Now Inc. (SEN) is pleased to have the opportunity to make a submission to the Senate Committee on the investment of Commonwealth and State funds in public passenger transport infrastructure and services.

The intent of SEN's submission is to state the options that Western Australia (WA), and Australia have to expand and power its existing and new public transport network from our abundant renewable energy supplies, displacing and eventually replacing our present fossil fuel dependency, with the added benefits of:

- Reduced environmental damage, including greenhouse gas emissions.
- Reduced risk of health issues from emissions of mercury, sulphur-dioxide and nitrogen oxides from conventional fossil-generated electricity for electrified light rail etc.
- Security and robustness of energy supply for transport networks by use of multiple and dispersed renewable energies.
- Plentiful energy supply, independent and insulated from future fossil fuel cost rises and, in fact an energy cost which is steadily reducing relative to our conventional fossil fuels, particularly as fossil fuel prices rise from increasing demand, the effects of peak oil and the inclusion of carbon emissions costs.
- Increased employment, in a clean energy industry for the future, particularly in rural areas.
- Increased income for rural land owners/farmers.

By way of a quick demonstration of the availability of renewable energy in WA now and its relevance to public transport energy supply, WA's current public rail networks' peak electrical energy requirement of 28.2 MW could be met by any one of the following renewable energies: [1]

Energy	Size	Cost of infrastructure (estimate) ^
Solar thermal plant area:	1.2 km x 1.2 km [2]	$270 million [2]
Wind turbine land area:	4.1 km x 4.1 km [2]	$217 million [2]
Wave farm along coastline:	2.1 km[1] [2]	n/a *
Geothermal resource:	1.7 km x 1.7 km (x 1 km thick granite underground) [2]	n/a *

Table 1 Required area for required energy generation capacity
^ The cost of infrastructure estimate is based on the generating plant only and does not include upgraded or expanded transmission and other infrastructure.
*** Wave and geothermal infrastructure cost estimates are not available to us at this time.**

Alternatively, and more likely, a mixture of the above could also meet the energy demand. Some of these, namely geothermal, solar thermal and wave energy are fully capable of providing base-load and better yet, load-following power, thereby being able to provide the requisite power when needed. However, given that the present public rail energy use is such a small portion of the South West Interconnected System (SWIS) – which is the electricity grid supplying the southern half of WA – at just 0.7 per cent of generation [2], variable/intermittent sources such as wind could readily be incorporated into the system.

These technologies are largely proven and ready for utility-scale implementation, as is occurring internationally. SEN demonstrated the potential for renewables to power the SWIS in its submission to the Senate Economics Committee Inquiry into the Varanus Island Gas Explosion. [3]

[1] The wave resource, though demonstrably large along the coastline from Geraldton to Bremer Bay, has regions along the lower west and south coast where wave conditions are most suitable for base load power extraction. These wave areas are of prime commercial importance and can conceivably support large aggregations of CETO wave units within a few well chosen sites that combine high wave resource availability with access to onshore power and/or water grid connection.

It should be noted that while the upfront costs for renewable energy plants are higher than fossil fueled, the on-costs are dramatically lower because of the lack of need for fuel, therefore cost comparisons need to be made on a life-cycle, or long-range average cost (LRAC) basis. For example, it is commonly mooted that fossil plants lifecycle cost consists of 20% upfront and 80% ongoing, while renewable energy is the inverse. [4]

Contents

1 Introduction

1.1 SEN'S Background & Aims

- Sustainable Energy Now (SEN) is a volunteer organisation formed in 2007. The backgrounds of SEN members include fields of engineering, physics, geology, geophysics, renewable energy and communications.
- Our aim is to promote practical, affordable strategies for the adoption of renewable energy and a sustainable future.
- Through promotion, research and the creation of a computer simulation, we are demonstrating that renewable energy can sustain and diversify WA's electrical energy supply, while reducing greenhouse emissions.

1.2 Disclaimers & Definitions

- This submission seeks only to make comment on a portion of the issues relating to the provision of energy supplies, in particular section (c) *an assessment of the benefits of public passenger transport, including integration with bicycle and pedestrian initiatives* and (d) *measures by which the Commonwealth Government could facilitate improvement in public passenger transport services and infrastructure.*
- SEN's focus is presently on stationary electrical energy generation for the Southwest Interconnected System (SWIS). This represents approximately 55 per cent of the total electrical energy use in WA. [5]
- SEN does not claim expertise in the field of renewable energy, however we apply our technical and other skills to research and collate our findings on renewable energy resources and applicable energy conversion technologies which are commercially available or very close.
- References and supporting calculations for information in this submission are contained in the Appendix. Supporting calculations are available on request.

2 An assessment of the benefits of public passenger transport, including integration with bicycle and pedestrian initiatives

By building infrastructure to supplement WA's energy supply for electrified public transport from multiple renewable energy sources, benefits will flow beyond the usual public transport advantages of reduced congestion and highway infrastructure, and air pollution.

The added benefits that utilising renewable energies provide are:

- Reduced environmental damage, including greenhouse gas emissions.
- Reduced risk of health issues from emissions of mercury, sulphur-dioxide and nitrogen oxides from conventional fossil-generated electricity for electrified light rail etc.
- Security and robustness of energy supply for transport networks by use of multiple and dispersed renewable energies.
- Plentiful energy supply, independent and insulated from future fossil fuel cost rises and, in fact an energy cost which is steadily reducing relative to our conventional fossil fuels, particularly as fossil fuel prices rise from increasing demand, the effects of peak oil and the inclusion of carbon emissions costs[2].
- Increased employment, in a clean energy industry for the future, particularly in rural areas.
- Increased income for rural land owners/farmers.

Designing public transport networks to connect residential areas with business and industry areas will aid in the transition from car and oil dependency to a sustainable energy future.

[2] Between 2006-2007 and 2007-2008, Transperth's system-operating cost (excluding capital charges on long-life infrastructure) rose 16.7 per cent, including a 26.2 per cent rise in train services and a 10.1 and 1.4 per cent rise in bus and ferry operating costs respectively.
The WA Public Transport Authority attributes the system total cost rise mainly to energy costs on train services increasing 35.3 per cent, as well as similar rises in train staffing and maintenance costs; and a 17 per cent rise in fuel costs for bus services. [6]

Powering our electrified public transport network with renewable energy is entirely possible, as is powering the entire Western Australian South West Interconnected System (SWIS). [7] To achieve this, the present electrical grid infrastructure may require upgrades. Such upgrades are currently in the planning stages in WA as they were first installed in the 1950s. In the present economic climate, where infrastructure spending is being promoted to stimulate the economy, it is the right time to upgrade so that the grid meets the needs of both renewable energy and of the public transport industries.

3 Measures by which the Commonwealth Government could facilitate improvement in public passenger transport services and infrastructure

Figure 1 below indicates that transport contributes 14% of greenhouse gas emissions (GHG) in Australia.

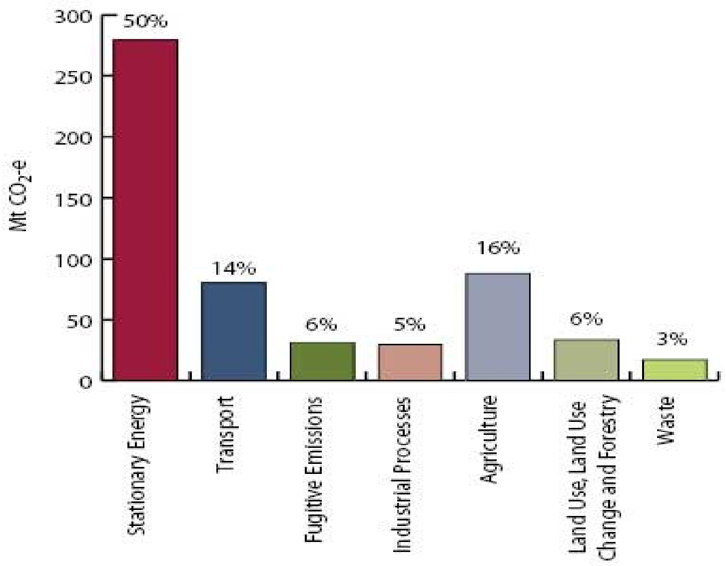

Figure 1 Australian Greenhouse Office GHG emissions by sector 2005.

By providing energy for public transport from renewable sources, the emissions from this sector would greatly reduce, and continue to do so as infrastructure around the development of transit cities improves. As shown previously in the Executive Summary table, Perth's public transport network could be provided for with a combination of solar thermal, wind and wave. The technologies are available now, or are on the cusp of commercial demonstration. The reliance on market forces to implement the industry to support the renewable energy technologies will prevent the benefits being realised. The Federal and State Governments could facilitate improvement in public passenger transport by developing policy to provide electrical energy for public transport, amongst other applications, from renewable sources. The present economic downturn is an ideal time to install the required infrastructure, given the present efforts to stimulate the economy.

The development of regulations to guide a Gross National Feed-In Tariff, as was recently considered by the Standing Committee on Environment, Communication and the Arts, would enable the market to be established in a controlled and efficient way. Public transport infrastructure such as train, bus and ferry stations or terminals, park and ride facilities, and car parks, could be transformed into energy-generating facilities through photovoltaic cells or wind generators, which would over the operational life of the generators, offset, or largely offset, the cost of purchase and installation, by elimination of fuel costs. This has been demonstrated in Adelaide where South Australia's largest grid connected photovoltaic charges the battery for the solar-powered electric bus. [8]

Thinking beyond public transport infrastructure, there are the private transport needs of those who are not yet connected to the public transport network. For these car-dependent people, the transition to electric vehicles should be supported by the Commonwealth Government by removing any policy or regulatory blockages that would inhibit the development of plug-in points and battery exchange stations such as the AGL Better Place Project is aiming to achieve. [9 & 10]

As a sidenote regarding the energy charging needs of electric vehicles (EVs), the AGL/MacQuarie Better Place Project planned for Australia estimates that to charge the "entire (EV) fleet in Australia" would require only a 7 per cent increase in electrical generation but would cut greenhouse emissions dramatically more due to the inherently higher efficiency of EVs than internal combustion vehicles (80 per cent efficiency versus 25 to 30 per cent efficiency). [9 & 10] The charging of EVs would be at low-demand periods (late night, early mornings), not affecting peak supplies.

4 Best practice international examples of public passenger transport services and infrastructure.

Some of Australia's cities are showing leadership in sustainable public transport options:

South Australia – Adelaide has Australia's first solar-powered electric bus entirely charged by electricity generated from solar panels on the station roof. The bus doesn't have a combustion engine and is charged using 100% solar energy so is carbon neutral. It features high quality, state-of-the-art components sourced from some of the world's leading transport and technology companies including MAN and Siemens. The air-conditioned solar electric bus can carry up to 42 passengers, with 25 standard seats, two seats especially designed for disabled passengers, and room for 15 standing passengers. This innovative, sustainable transport option is free to people of Adelaide.

Victoria – Melbourne has secured green electricity to run Victoria's first 'wind powered' tram.
From March 2008, in partnership with renewable energy company Pacific Hydro and the State Government, Yarra Trams, electricity from Victorian wind farms is used to power the tram that runs on Route 96 (St Kilda Beach and East Brunswick).
Melbourne tram operator Yarra Trams has also introduced the Green Depot initiative at its Preston and Malvern depots to save energy and water. The project includes initiatives such as using rainwater caught from the depot roofs to wash trams and harnessing solar energy.

Australia's commitment to developing a public transport system that broadly connects passengers will provide a socially, economically and environmentally sustainable network for the future.

5 Reliability & Security

As stated in Section 2 above, multiple, dispersed energy sources provide a more resilient network. Development of demand-side management is needed to unlock potential of renewable energy generators, thus strengthening the electricity system by creating a competitive energy market.

Furthermore, increasing the penetration of renewable energy generation, by developing the required framework and policy, will create more reliability for Australia's electricity systems.

The stronger the renewable energy industry, the more emissions will be reduced from stationary electricity generation and potentially, the transport sector.

Building our renewable energy industry will also reduce reliance on depleting fossil fuel resources, creating energy security and independence for Australia.

6 Indicative Costs

McLellan Megasanik (2007) has reported on economic analysis of renewable energy generation costs commissioned by the Renewable Energy Generators of Australia (REGA). Figures 2 and 3 are reproduced from this source.

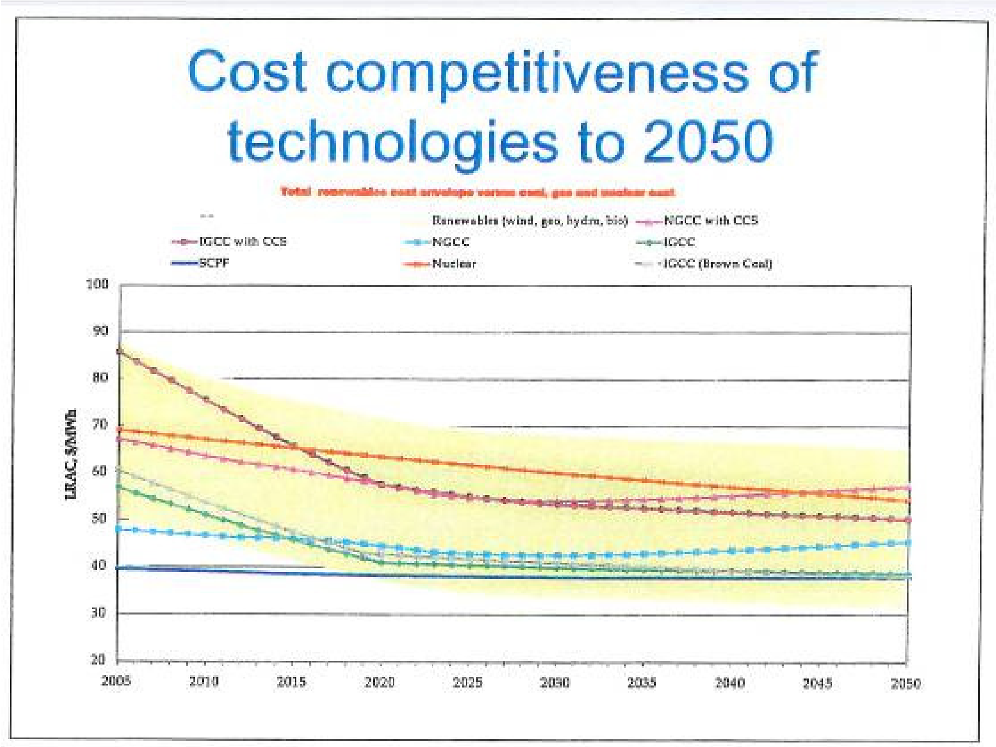

Figure 2
The coloured region represents the band of cost of renewable energy technologies, ref. Figure 3

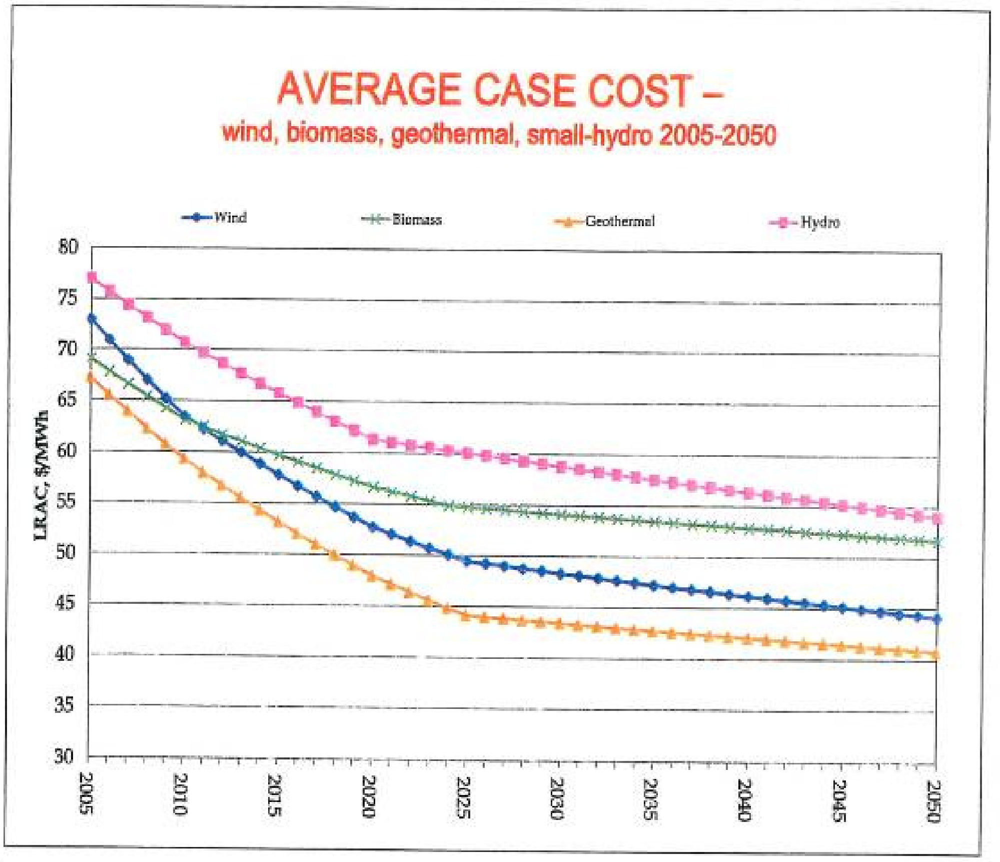

Figure 3

More specific examples (shown below) of some recently announced renewable energy projects indicate the estimated cost of the generating infrastructure and are worth noting below. (N.B. These costs do not include consideration for required upgrades or installation of transmission infrastructure, part of which is currently in planning in WA.)

Wind:
Collgar, Merredin WA [11]
AU$600,000,000/(260MW peak x 30% capacity factor) = $7.7million/MW

Solar Thermal with limited storage:
Worley Parsons AST (Australia) [12]
AU$1,000,000,000/250MW = $4.0 million/MW
(This is relevant for large-scale solar thermal plants of the order of 250MW, however when scaling to significantly differently sized plants, the costing should be scaled as shown in Ref 2.)

Wave:
Carnegie Corporation are not able presently to disclose electricity costs for their wave energy technology due to commercial sensitivity, however, they claim that it will be competitive with wind initially, and fossil fuel generation as scale increases. [13]

Geothermal:
We do not have this data at this time.

The penalty of not implementing renewable energy to provide for public transport will be increased cost to run the public transport in the long run, which will make the option to travel by public transport more difficult for those in the poorest income brackets. Not expanding the public transport network will lead to more congestion emissions from the increased road network requirements and traffic. The effects of climate change and need to reduce and mitigate greenhouse gas emissions are widely recognised by international community, governments and scientists.

REFERENCES

[1] WA's Current Transperth Train Energy and Power Consumption:
The load demand for Perth's public transport rail operations varies as shown in table below:

TRANSPERTH TRAIN OPERATIONS
Consumption of Energy for Railcars
(Ref: Transperth Train Operations Public Transport Authority of WA)

Month	On Peak KWh	Off Peak KWh
Jul-08	4,915,560	3,488,688
Aug-08	4,516,512	3,980,472
Sep-08	4,716,336	3,473,304
Oct-08	5,082,384	3,499,464
Nov-08	4,059,696	3,730,392
Dec-08	4,653,168	3,427,968
Jan-09	4,648,032	3,483,048
	32,591,688	25,083,336

Calculated average peak power = 5,082,384 kWHr/(1month x 30days/month x 6 peak hrs/day) = 28,235kW (or 28.2MW) *
* Assumed: Peak periods total 6 hours per day

[2] Calculations: Renewable Energy Power Source Size Requirements & Up-front Costs to Meet Current Transperth Train electrical needs:

Referring to the SEN submission to the Senate Economics Inquiry into the Varanus Island Gas Explosion (Supplemental Calculations), we scale the peak power of the train needs to the peak power of the SWIS, assuming a very conservative simplifying condition that peak power is required constantly. (For wind and solar PV, as variable sources, the calculations assume the capacity factors of the 'Supplemental Calculations')

Therefore, the Train energy requirements compared to the SWIS are

= 28.2MW/4,000MW of the SWIS
= 0.007, or 0.7% of the SWIS energy and power needs

<u>Solar Thermal Plant size (with thermal storage):</u>
Land area required = 0.007 x 200,000,000 m^2 for SWIS
= 1,410,000m^2
Square size = 1,200m
= 1.2 km x 1.2 km

Cost for solar thermal plant to supply Perth public rail energy using typical formula used for capital cost scale up:

Cost of plant x = (capacity of plant x/capacity of plant y)^0.6 * cost of plant y
Ref. Mineral processing equipment costs and preliminary capital cost estimations (Special volume - Canadian Institute of Mining and Metallurgy; 18) by Andrew L Mular (1978)

If the solar thermal plant is $1,000,000,000 for 250 MW of generating capacity then the cost of a

28.2 MW plant is:

(28.2/250)^0.6*1,000,000,000 = $270 million

Wave Generation area:
Length of coastline = 0.007 x 300 km
= 2.1 km length

Wind Generation area:
Land area required = 0.007 x 2,400 km^2
= 16.8 km^2
= 4.1 km x 4.1 km

Cost for wind plant to supply Perth public rail energy = $7.7 million/MW x 28.2 MW
= $217 million

Geothermal Generation area:
Hot rock volume required = 0.007 x 400 km^3
= 2.8 km^3
= 1.7 km x 1.7 km x 1 km thickness

[3] Sustainable Energy Now Inc; Submission,to Inquiry into matters relating to the gas explosion at Varanus Island, Western Australia, Available: http://www.aph.gov.au/SENATE/committee/economics_ctte/wa_gas_08/submissions/sublist.htm: Sub No. 27

[4] D. Aberle, Renewable Cities Conference, Nov 2008

[5] Office of Energy, Govt of WA, Energy WA: Electricity Generation from Renewable Energy, 2008

[6] p.12 Public Transport Authority Annual Report 2007-2008, Available: http://www.pta.wa.gov.au/annualreports/2008/pdf/pta_annual_report_2008.pdf

[7] Sustainable Energy Now Inc; Submission,to Inquiry into matters relating to the gas explosion at Varanus Island, Western Australia, Available: http://www.aph.gov.au/SENATE/committee/economics_ctte/wa_gas_08/submissions/sublist.htm: Sub No. 27

[8] Tindo Solar Bus, Available: http://www.adelaidecitycouncil.com/scripts/nc.dll?ADCC:STANDARD::pc=PC_151048

[9] AGL press statement, Available: http://www.australianit.news.com.au:80/story/0,24897,24541574-15306,00.html

[10] The AGL/MacQuarie Infrastructure Better Place Project in Australia: http://www.cnet.com.au:80/cartech/cars/0,2000438541,339294851,00.htm?feed=pt_better_place

[11] Collgar, Merredin WA, Available: http://www.collgarwindfarm.com.au/

[12] Worley Parsons AST (Australia), Sustainable Energy Now Inc; Submission,to Inquiry into matters relating to the gas explosion at Varanus Island, Western Australia, Available: http://www.aph.gov.au/SENATE/committee/economics_ctte/wa_gas_08/submissions/sublist.htm: Sub No. 27

[13] Carnegie, Sustainable Energy Now Inc; Submission,to Inquiry into matters relating to the gas explosion at Varanus Island, Western Australia, Available: http://www.aph.gov.au/SENATE/committee/economics_ctte/wa_gas_08/submissions/sublist.htm: Sub No. 27