

# Powering a desalination plant: clean energy or more coal?

## A discussion paper by Environment Victoria

### 1. Introduction

In June 2007 the Victorian Government released its water blueprint "Our Water Our future – The next Stage of the Government's Water Plan" (commonly known as the Victorian Water Plan). This plan emerged as the Victorian Government panicked about the security of Melbourne's water supplies in the face of an extremely dry year in 2006. It made proposals to augment Melbourne's water supply that had been rejected in the Government's well supported Central Region Sustainable Water Strategy. The process by which the Government released its new water blueprint has since been criticized by the Auditor General<sup>1</sup> as being conceived in haste and secrecy as a knee jerk reaction to the lack of rain in 2006.

The Victorian Water Plan included the Victorian Government's plan to build a 150GL desalination plant near Wonthaggi (which could be increased to 200 GL) which the Government intends to bring on-line by the end of 2011.

Building a desalination plant for Melbourne's water supplies raises many issues. Environment Victoria does not support the decision to build a desalination plant as many of the lower cost, less impacting alternatives have not been exhausted or in some cases even considered. For instance there is great potential to augment Melbourne's water supply through increased water recycling, rain and storm water harvesting, catchment protection and also to use water more efficiently. Water recycling, a less energy intensive and cheaper alternative to desalination has not yet been considered as one way to replenish Melbourne's dams. Furthermore building a large, inflexible desalination plant (that is one that is required to operate continuously to maximize profits) threatens to undermine incentives for water efficiency and conservation, which as the Government's own Central Region Sustainable Water Strategy argued "is generally the most cost effective solution and it has little or no environmental or social drawbacks. Conservation and efficiency also have a positive impact on greenhouse gas emissions".<sup>2</sup>

Environment Victoria will be releasing a discussion paper shortly looking at more sustainable ways of meeting Melbourne's water needs.

However given that the Government is proceeding quickly with plans to build a desalination plant it is important that one of the key potential impacts- the project's greenhouse gas emissions- is eliminated if the plant proceeds.

The State Government recently called for Expressions of Interest to build the desalination plant and requires proponents to outline how they intend to 'offset' the energy use of the project. Expressions of

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<sup>1</sup> The Auditor General's report can be viewed at [http://www.audit.vic.gov.au/reports\\_publications/reports\\_by\\_year/2008/20080409\\_water\\_infrastructure.aspx](http://www.audit.vic.gov.au/reports_publications/reports_by_year/2008/20080409_water_infrastructure.aspx)

<sup>2</sup> Sustainable Water Strategy Central Region, DSE, 2006 p.4

Interest are due on July 24<sup>th</sup> 2008.<sup>3</sup> However Environment Victoria is concerned that there is still some ambiguity around the process for securing renewable energy purchase. It is important that there is absolute clarity about how the desalination plant's electricity needs will be met, and what impact the plant would have on Victoria's greenhouse gas emissions if it proceeds.

## 2. Desalinated water: bottled electricity

The process of desalinating sea water and the reverse osmosis treatment at the heart of the desalination plant is extremely energy intensive. Desalinated water was once famously described as bottled electricity by former NSW Premier Bob Carr. Desalination uses considerably more energy than our existing storage and pipe network and more energy than would be required to recycle waste water to a level fit for human consumption.<sup>4</sup> The 150 GL plant is estimated to require a continuous supply of 90 MW of power. The Feasibility Study completed for Melbourne Water by GHD estimates that the 150 GL plant will require 800 GWh per year of electricity which includes water pumping.<sup>5</sup>

The Victorian Government has committed to 'offsetting' the energy use of the desalination plant. However at times the Government's language has been loose around what this means, with gas generation, wind power, and tree-planting all mentioned as the vehicles for achieving carbon neutrality. The situation was clarified somewhat in a media release from the Minister for Water on May 8 2008 in which Minister Holding said:

*"The plant will require around 90 megawatts of power which will be offset by the purchase of renewable energy, in addition to the Government's current renewable energy targets. This means the plant will be carbon neutral".*

*"As part of the Environment Effects Statement (EES) we are investigating a range of options for power supply, including grid-based connections, gas generation and hybrid solutions."<sup>6</sup>*

Environment Victoria is concerned that this statement still provides wriggle room for the State Government. Other Governments, like the WA Government, have previously made claims that desalination plants were 'running on renewable energy' however these claims do not stack up to close inspection.<sup>7</sup> In WA renewable energy certificates (REC's) were purchased supposedly to offset the Kwinana desalination plant, but then the REC's were surrendered as a contribution to meeting the Federal Mandatory Renewable Energy Target. Therefore the renewable energy associated with the desalination plant would have happened anyway, and the desalination plant was effectively running on fossil fuels.

## 3. Reducing and eliminating greenhouse gas emissions from the Wonthaggi desalination plant

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<sup>3</sup> [http://www.tenders.vic.gov.au/domino/web\\_notes/etenders/etdrpublishing.nsf?Open](http://www.tenders.vic.gov.au/domino/web_notes/etenders/etdrpublishing.nsf?Open)

<sup>4</sup> See Knights, MacGill & Passey, "The sustainability of desalination plants in Australia: is renewable energy the answer?" Available at [http://www.ceem.unsw.edu.au/content/userDocs/OzWaterpaperIMRP\\_000.pdf](http://www.ceem.unsw.edu.au/content/userDocs/OzWaterpaperIMRP_000.pdf)

<sup>5</sup> Melbourne Augmentation: Seawater Desalination Feasibility Study, Prepared by Melbourne Water, GHD, June 2007, p.33  
<sup>6</sup> [http://www.dpc.vic.gov.au/domino/Web\\_Notes/newmedia.nsf/8fc6e140ef55837cca256c8c00183cdc/1f95f992f2d48391ca257444000680ff!OpenDocument](http://www.dpc.vic.gov.au/domino/Web_Notes/newmedia.nsf/8fc6e140ef55837cca256c8c00183cdc/1f95f992f2d48391ca257444000680ff!OpenDocument)

<sup>7</sup> See Harries, Professor David, "Why the Kwinana Desalination Plant does not operate on renewable energy", The Greener Times, Autumn 2008, page 12, <http://conservationwa.asn.au/images/GreenerTimes/gt%20autumn%2008%20pg1-13.pdf>

The desalination plant at Wonthaggi is likely to be connected to the electricity grid. The amount of energy used by the plant will depend on whether it operates at peak capacity or whether it is powered up or down depending on the need to boost water supplies. As Knights, MacGill and Passey explain:

*Because of electricity's unique physical characteristics, electricity supply must exactly match electricity demand at all times and at all points within a network. Furthermore, it is not possible to direct electricity flows from a particular generator to a particular load – the network effectively combines all electricity from all generators. The concept of reducing or eliminating the emissions from a grid connected desalination plant is therefore necessarily somewhat abstract. For example, a desalination plant might be claimed to be greenhouse neutral if additional renewable generation is supplied to the network equivalent to the electricity consumption of the desalination plant over time.<sup>8</sup>*

**To ensure that the desalination plant does not further fuel greenhouse gas emission increases it will be important that the plant is powered by ADDITIONAL renewable energy.** That is, renewable energy generation that would not otherwise have happened. This means that in the awarding of desalination contracts there needs to be a strict requirement that the project purchases renewable energy credits equivalent to the total energy use of the plant and that these credits are not counted towards meeting any existing renewable energy targets.

There are a number of alternatives for purchasing renewable energy certificates. Federally the Mandatory Renewable Energy Target imposes an obligation on electricity retailers to buy or generate renewable energy certificates (RECs). One REC is equivalent to 1 MWh of electricity. REC's can only be created from new, accredited renewable energy projects, though it is worth pointing out that design weaknesses in the MRET have seen significant amounts of non-additional renewable energy in the form of solar hot water and hydro power earn RECS at the expense of new, additional projects. The Victorian Government could impose a condition on the operators of the desalination plant (presumably Melbourne Water) that they purchase and then surrender 800 GWh of RECS to the Office of the Renewable Energy Regulator each year. Provided that the RECS purchased by the operator did not count towards any electricity retailers meeting their renewable energy obligation, this would guarantee that new renewable energy projects would be brought online to power the desalination plant.

There are also new state renewable energy targets, including Victoria's Renewable Energy Target (VRET) and New South Wales' Renewable Energy Target (NRET). Similarly purchases of renewable energy certificates under either of these schemes could be made and then surrendered to guarantee the desalination plant's energy emissions are 'offset'. If the operator was required to use the VRET scheme this would have the added advantage that the renewable energy projects would happen in Victoria, giving Victoria the investment and development benefits of the projects.

However the existing renewable energy targets, state and Federal are all set to be amalgamated later this year by the Federal Labor Government. The Federal Government has committed to 20% of Australia's electricity generation coming from renewable energy by 2020. Translated into a GWh figure the total target (including existing renewable energy generation) will be 60,000 GWh by 2020. There is a distinct risk that if the desalination plant is required to purchase RECS under the Federal scheme that the RECS will be lost in translation- that is that the renewable energy target will not be increased

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<sup>8</sup> Knights. MacGill & Passey, *ibid*, p.3.

by 800 GWh to take account of the desalination plants power needs. Therefore Environment Victoria recommends that the renewable energy obligation on the desalination plant operator not be administered using the State or Federal renewable energy targets.

The other credible market for purchasing renewable energy credits is the Green Power market. Accredited Green Power allows electricity consumers to voluntarily pay a premium on their electricity bill to ensure an equivalent amount of renewable energy is generated. The State Government could require that the operators purchase 100% accredited Green power to meet their energy needs. Note there is also an unaccredited Green Power market selling power from hydro power stations that have been operating for decades. Unless the Green Power product purchased was accredited there would be no effective 'offsetting' of greenhouse gas emissions.

While other carbon markets operate and are emerging in Australia (eg Emissions trading, Kyoto markets, voluntary offsets including tree-planting schemes, NSW Greenhouse Gas Abatement Scheme) accredited Green Power and the renewable energy target schemes are the most credible. **Given that the federal and state renewable energy targets are in a state of flux the surest way of guaranteeing ADDITIONAL renewable energy to power the desalination plant would be to require the operators purchase 100% accredited Green Power equivalent to the entire energy demand of the desalination plant.**

If the State Government failed to require that the emissions from the desalination plant were offset through the purchase of renewable energy **the project would add 1.048 million tonnes<sup>9</sup> of CO<sub>2</sub> to Victoria's annual greenhouse emissions.**

#### 4. Cost of 'offsetting emissions'

Desalination is one of the most expensive ways of augmenting water supply. While commitments to ensure a desalination plant does not deliver increased greenhouse gas emissions are critical if the desalination plant proceeds, 'offsetting' emissions further increases the cost of an already expensive option. Melbourne Water's feasibility study estimated that the plant and transfer pumping would use 800 GWh of electricity per year. **At today's market prices this represents a total electricity bill for the plant in the order of \$78 million every year if the plant is operating at full capacity year round.** The renewable energy component of the electricity bill is \$42 million per year based on the current renewable energy certificate (REC) price of \$53 MWh.<sup>10</sup> While Melbourne Water's feasibility study does not provide a number for operational energy costs, this total electricity bill of \$78 million accords with the relative breakdown of operating costs pictured on page 82 of the feasibility study.<sup>11</sup> The additional annual bill of \$42 million per year is one reason that Environment Victoria is concerned that the Victorian Government or the proponent may try and 'fudge' their renewable energy purchase and fail to purchase **additional** renewable energy to offset the desalination plant's emissions.

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<sup>9</sup> 800 GWh x 1.31kg/KWh- Victoria's average emissions intensity per KWh

<sup>10</sup> 800GWh x Victorian pool price (\$45 MWh) + 800 GWh x Renewable Energy Certificate price (\$53 MWh- pers comm. Ric Brazzale, Carbon Markets). Prices correct as at May 28 2008.

<sup>11</sup> However the current cost of energy is significantly higher than at the time of the Feasibility study, principally because the REC price has recovered significantly since June 2007.

The cost of the desalination plant has equity impacts for Melbournians. The capital cost of the desalination plant is estimated at \$3.1 billion while the operating costs (including renewable energy component) are estimated at \$130 million per annum.<sup>12</sup> The Victorian Government has said that retail water prices will approximately double by 2012 to pay for new water infrastructure for Melbourne<sup>13</sup>. While there is a strong argument that water has been too cheap and its price does not reflect the true price of the asset, nevertheless doubling water prices will represent an additional cost impact for low income households. Given that water bills are likely to take up a larger proportion of low income households budgets the pricing structure is effectively regressive. To date there has been little public debate about the impact of rising water costs for low income households. As this debate amplifies there is a risk that the renewable energy component of the desalination plant will become a target if there is not some additional assistance or changes to the pricing structures for low income households water (and energy) bills. Environment Victoria would support changes to the pricing structure to remove regressive pricing structures for low income households. However it is worth emphasizing again that there are cheaper alternatives to a 150 GL desalination plant operating at full capacity, discussed in section 6.

## 5. Complications arising from 'offsetting' emissions

It is important to note that 'offsetting' emissions is an imperfect response to both climate change and meeting Melbourne's water needs.

Under current Kyoto negotiations developed countries like Australia will need to reduce greenhouse pollution by 25-40% by 2020 and upwards of 90% by 2050. These negotiating pathways are only likely to get more stringent as the science paints a more alarming picture of climate change.

To reduce emissions by 25-40% or more in Australia is an enormous challenge. To achieve such a goal it will be necessary to significantly reduce energy demand, and then to rapidly grow the proportion of our electricity coming from renewable sources. Building a desalination plant will add considerably (800 GWh) to our electricity demand. This is equivalent to the generation of 5 x 54 MW wind farms. In 2004-05 Victoria's electricity consumption was 58,354 GWh<sup>14</sup>, therefore **the desalination plant is likely to add another 1.37% to Victoria's energy use**. Given current technologies there are likely to be financial and technical limits to the amount of renewable energy in the grid (although these limits will increase as geothermal and solar thermal technologies advance). To construct the equivalent of 5 x 54 MW wind farms just to meet new demand associated with desalination means that these 5 market-ready renewable energy projects will not be able to contribute to meeting greenhouse reduction targets. The fact that the principle reason we are proceeding with a desalination plant is to supplement our climate change affected water supply adds further complexity if building a desalination plant makes it harder for us to achieve emissions reduction targets. Hence Environment Victoria's view that if the

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<sup>12</sup> Melbourne Water and GHD, Seawater Desalination Feasibility Study, June 2007, Executive Summary, p. vi

<sup>13</sup> Premier Brumby media release, 14 August 2007,

[http://www.dpc.vic.gov.au/domino/Web\\_Notes/newmedia.nsf/798c8b072d117a01ca256c8c0019bb01/7c8e19492e25b999ca257337007fc3ab!OpenDocument](http://www.dpc.vic.gov.au/domino/Web_Notes/newmedia.nsf/798c8b072d117a01ca256c8c0019bb01/7c8e19492e25b999ca257337007fc3ab!OpenDocument)

<sup>14</sup> ABARE Australian consumption of electricity, by fuel state,

<http://www.abareconomics.com/interactive/energy/hm/tables.htm>

desalination plant proceeds then powering it with renewable energy is a necessary but imperfect response.

## 6. Desalination: a sustainable water supply?

As mentioned, desalination is the most energy intensive of water supply augmentation technologies. It can also have significant on-site (including pipeline) environmental impacts arising from the discharge of highly saline water. Hopefully the Environmental Impact Assessment process will deal adequately with any onsite issues and that if the impacts are too great then the project will not be given approval.

However there are broader environmental implications of pursuing desalination at the expense of other options. As Knights, MacGill and Passey explain:

*“A desalination plant embodies the traditional paradigm of urban water supplies and contrasts with the emerging Integrated Urban Water Management (IUWM) paradigm: it is a large centralized, once-through system, providing potentially large volumes of potable water with limited complexity. A desalination plant might well entrench the traditional urban water supply paradigm because the economic size and nature of desalination plant means they are “option-foreclosing”. It prevents the entry of other alternate water supply options because of the large volume of water it will provide”<sup>15</sup>,*

More sustainable and decentralized water supplies such as recycling, storm and rain water harvesting, and water efficiency measures could be locked out or discouraged with a decision to build a desalination plant, particularly if the plant is tendered out and run as a Public Private Partnership and an incentive exists for the plant to run at full capacity continuously in order to maximize profits (known as a ‘take-or-pay’ arrangement). Unless it is built in stages or can be turned on and off as required desalination plants are an inflexible addition to Melbourne’s water supply. Although it is unlikely, if we experience consecutive years of high rainfall we could have a situation where we are locked into producing high-cost desalinated water that our reservoirs do not need. This is the situation currently in Sydney - recent rains have filled the reservoirs above the ‘trigger point’ for the desalination plant although construction of the desalination plant has already commenced.

**Table 1. Summary of key statistics for the proposed Wonthaggi Desalination Plant<sup>16</sup>**

Capital cost of plant	\$3.1 billion
Running costs of plant	\$130 million annually
Expected impact on consumer water prices (in conjunction with other major water infrastructure projects, particularly the Foodbowl Modernisation Project)	Retail prices approximately doubled by 2012
Annual electricity bill for the plant	\$78 million annually

<sup>15</sup> Knights, MacGill & Passey, “The sustainability of desalination plants in Australia: is renewable energy the answer?” Available at [http://www.ceem.unsw.edu.au/content/userDocs/OzWaterpaperIMRP\\_000.pdf](http://www.ceem.unsw.edu.au/content/userDocs/OzWaterpaperIMRP_000.pdf)

<sup>16</sup> These statistics are referenced where they appear throughout this document

Renewable energy component of the electricity bill	\$42 million annually
Annual electricity use of the plant	800 GWh
Electricity use of the plant as a proportion of Victoria's annual energy use (Based on 2004-05 baseline)	1.37%
Increase to Victoria's annual greenhouse gas emissions if the project is not offset through the purchase of renewable energy for 100% of the plant's electricity needs.	1.048 Million tonnes annually

## 7. Recommendations

Environment Victoria believes that desalination is an option of last resort, and that many more sustainable efficiency and augmentation measures are yet to be adopted or exhausted and should be prioritized ahead of desalination. This view is supported by a 2004 World Bank report which concluded that desalination "should remain the last resort, and should only be applied after cheaper alternatives in terms of supply and demand management have carefully been considered".<sup>17</sup>

However if a desalination plant is to be pursued and passes all environmental assessments it should:

1. Have its entire energy use (desalination and transfer) 'offset' through the purchase of 100% accredited Green Power, the simplest, most robust and most transparent method of ensuring renewable energy purchase.
2. Have its Green Power purchase audited and reported upon annually by Government eg the EPA.
3. Be built in stages, beginning with a facility much smaller than the currently planned 150 GL/year plant to maximize flexibility.
4. Be owned and operated by Government so that it can be turned on and off as needed to minimize additions to electricity demand and so that it doesn't destroy incentives for water efficiency and more sustainable water supply alternatives.

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<sup>17</sup> World Bank 2004, Seawater and Brackish Water Desalination in the Middle East, North Africa and Central Asia: A Review of Key issues and Experience in Six Countries, Main Report p11