# Sydney's Desalination Plant

## Greenhouse Gas Reduction Plan

**November 2009**

Sydney WATER

# Executive Summary

The Kurnell desalination plant is one of the initiatives to secure Sydney's water supply against the effects of climate change, population growth and drought. The plant provides an extra source of water that doesn't rely on rain.

The Minister's Conditions of Approval for the desalination plant (MCoA 2.2) and Sydney Waters' Statement of Commitments (SoC 2) require a Greenhouse Gas Reduction Plan to be developed before the plant starts operating. The Greenhouse Gas Reduction Plan must describe the strategy for how the greenhouse gases from the operation of the plant will be managed, minimised and offset. The Director-General of the Department of Planning must approve the plan. This document fulfils these requirements.

The desalination plant can supply up to 250 million litres of drinking water a day. It can be scaled up to 500 million litres a day (up to 30% of Sydney's drinking water needs) if required in the future. To ensure that electricity used to operate the desalination plant does not increase New South Wales' greenhouse gas output, the NSW Government has committed to the plant being powered by 100% renewable energy.

A number of options were considered for securing renewable energy. The preferred option involves the purchase of renewable energy certificates to match electricity use at the desalination plant. This will demonstrate that renewable energy is being used from the day that water from the desalination plant is first supplied to customers. Renewable energy certificates will be supplied from the Capital Wind Farm near Bungendore NSW, from November 2009.

The desalination plant will operate for most of the time for the first two years. This is needed to assure its performance and reliability. After this period, the plant will operate depending on climate-related factors, including seasonal rainfall outlook and dam storage levels. The renewable energy purchase arrangements include a framework for accommodating this variability in future operations of the plant (Section 4).

The plant will comply with all current regulatory requirements for energy and greenhouse gases. The greenhouse gas strategy is also adaptable, and recognises that regulatory requirements may change over time (Section 5).

A monitoring and recording system will be used to track electricity use at the desalination plant, as well as the quantity of greenhouse gases that were offset due to the use of 100% renewable energy to operate the plant (Section 6).

To ensure the plant minimises energy use, energy recovery systems and energy efficient equipment were a mandatory requirement of design. The operator of the plant is also required to meet energy efficiency targets and explore future energy efficiency measures (Section 7).

Systems will be established to ensure compliance with the processes, procedures and outcomes stipulated under this plan (Section 8).

The Greenhouse Gas Reduction Plan outlines how Sydney's desalination plant will be powered by 100% renewable energy and provides confidence to the NSW public that electricity used at the plant will not increase the state's greenhouse gas emissions.

# Contents

# 1. Background and Overview

This section provides background information on the desalination plant and requirements in relation to greenhouse gases and renewable energy.

## 1.1 Overview

Desalination is one of the initiatives to secure Sydney's water supply against the effects of climate change, population growth and drought.

The NSW Government's Metropolitan Water Plan outlines the measures that ensure Sydney, the Illawarra and the Blue Mountains have enough water now and in the future (to at least 2015). These include:

- Increasing the amount of water recycling
- Water Wise Rules to reinforce the importance of using water responsibly and minimising waste
- Demand management programs for business and domestic use
- Accessing the deep storages of the dams
- Investigating ground water sources, and
- Building a desalination plant to provide an extra source of water that doesn't rely on rain.

The government has committed to the desalination plant being powered by 100% renewable energy. Renewable energy will be used from the day that water is first supplied to customers.

The Greenhouse Gas Reduction Plan (this document) addresses the following key areas:

- Greenhouse gas reduction approach (Section 3)
- Renewable energy purchasing arrangements (Section 4)
- Regulatory requirements (Section 5)
- Greenhouse gas measurement and reporting (Section 6)
- Energy performance and energy efficiency (Section 7) and
- Monitoring and compliance (Section 8).

## 1.2 Project Approval Conditions (context for this plan)

The Minister's Conditions of Approval for the Desalination Plant require the development of a Greenhouse Gas Reduction Plan before the plant starts operating, as does Sydney Water's Statement of Commitments (reproduced in Figures 1 and 2 below).

### Figure 1. Minister's Conditions of Approval (MCoA) 2.2, Greenhouse Gas Reduction Plan

2.2 Prior to the commencement of operation of the desalination plant project, the Proponent shall develop and submit for the approval of the Director-General, a Greenhouse Gas Reduction Plan to detail a strategic plan for the management, minimisation and off-set of greenhouse gas generation associated with electricity supply to the desalination plant. The Plan shall be consistent with the Plan detailed in the Proponent's Statement of Commitments and shall include, but not necessarily be limited to:

a) a specified outcome that the desalination plant will be powered by 100% renewable energy, or equivalent;
b) details of how renewable energy will be purchased, such as using "Green Power", or equivalent;
c) details of relevant regulatory requirements with respect to energy and greenhouse gases, and a system for managing change in these requirements over time;
d) a monitoring and recording system to track the energy consumption of the desalination plant project and the resultant equivalent emissions of carbon dioxide;
e) a framework for considering and managing factors such as availability, certainty, flexibility, adaptability, additionality and any co-benefits of options identified and/ or applied to achieve the outcome specified under a) above;
f) a framework and management principles for accommodating any shortfalls in the availability of renewable energy that may occur from time to time;
g) systems to monitor and audit the processes, procedures and outcomes stipulated under the Plan; and
h) a program for periodic review of the energy performance, and consideration of additional or improved energy efficiency measures that may be reasonably applied from time to time to ensure efficiency energy use.

### Figure 2. Statement of Commitment – Greenhouse Gas Reduction Plan

| | | | |
|---|---|---|---|
| AMENDED SOC | Greenhouse gas emissions from operation mitigated. | 2 A Greenhouse Reduction Plan will be prepared to ensure that the desalination plant will be effectively powered by 100% renewable energy resulting in no net greenhouse emissions. The plan will:<br>(a) Identify how renewable energy will be purchased, such as using "green power" or equivalent;<br>(b) Need to be somewhat flexible in approach to accommodate the changing energy and greenhouse regulatory requirements over the life of the plant;<br>(c) Include a monitoring program to audit compliance. This will be publicly reported through Sydney Water's *Annual Report;* and<br>(d) Be submitted to the Department of Planning. | Before the commencement of operation. |

This document is the Greenhouse Gas Reduction Plan as required in the Minister's Conditions of Approval and Statement of Commitments.

## 1.3 Powered by 100% Renewable Energy

Many options are available to manage and minimise greenhouse gas emissions. During 2007, the NSW Government asked Sydney Water to chair a committee of representatives from various NSW Government agencies to develop criteria and assess the available options. The option evaluation criteria were:

- Certainty of delivery – contractual certainty that abatement is delivered when required
- Additionality – as a result of the option there is additional renewable energy being produced and supplied onto to the electricity grid equal to the electricity consumption of the desalination plant
- Flexibility to accommodate desalination plant operating regimes which may change from year to year
- Adaptability to future policy and market environments
- Cost – measured in terms of $/tonne greenhouse gas abated
- Management complexity of implementation (for Sydney Water)
- Transparency and verifiability of abatement
- Competitiveness of markets
- Communications – ability for abatement to be articulated to stakeholders, and
- Co-benefits – existence of benefits beyond the primary outcome of greenhouse gas abatement.

After applying these criteria, the recommended short-list of options were to purchase energy from:

1. A supplier of accredited GreenPower (such as an electricity retailer)
2. A renewable energy generator through a power purchase agreement
3. A specific renewable energy generator via a third party trader (such as an electricity retailer), or
4. Market purchases of electricity and renewable energy certificates (RECs).

The NSW Government then committed to power the desalination plant with 100% renewable energy.

Section 4 of this plan describes the procurement process used by Sydney Water to meet the Government commitment to use 100% renewable energy.

In addition to the selection criteria shown above, the procurement process was shaped by consideration of the market for renewable energy Australia (Section 2), as well as the likely operating characteristics and regulatory requirements of the desalination plant (Section 3).

# 2. Renewable Energy and Greenhouse Gases

This section provides background information on renewable energy generation in Australia, including the role that renewable energy plays in minimising and offsetting greenhouse gas emissions.

Renewable energy is a term used to describe energy that has been generated from sources that are naturally replenished, such as sunlight, wind, tides and geothermal heat. This can include the generation of electricity, as well as other forms of energy such as heat.

## 2.1 Renewable Energy in Australia

Across Australia, around 220 million megawatt hours of grid electricity is used every year. Electricity generated from renewable sources accounts for around 6.5 per cent of total electricity use[1].

Generating electricity from renewable sources avoids the need to generate the same amount of electricity from the burning of non-renewable sources such as coal and natural gas.

On average, one megawatt hour of electricity generated from a non-renewable source in Australia releases greenhouse gases equivalent to around one tonne of carbon dioxide (1 $tCO_2$-e). One megawatt hour of 'renewable' electricity therefore avoids around one tonne of $CO_2$-e being released to the atmosphere.

The use of renewable sources for electricity generation is part of Australia's strategy for managing greenhouse gas emissions.

### 2.1.1 Wind Energy

Wind energy is the most economic large-scale renewable generation readily available, and forms the largest source of new renewable generation in Australia over recent years. However, wind energy currently accounts for less than 1% of total electricity generation in Australia.

Electricity generation at wind farms can be intermittent, reflecting natural variability in wind conditions. This can be partly overcome by increasing the number of turbines, as well as careful placement of turbines across the landscape.

### 2.1.2 Hydro-Electric Power

Hydroelectric power captures the energy of flowing water to generate electricity, and currently accounts for more than 90% of total electricity generation from renewable sources. However, opportunities for new large-scale hydroelectric generation are limited.

[1] ABARE (2009) Energy in Australia 2009

The most likely source of growth will be small-scale mini-hydro schemes, utilising existing reservoirs and water flows. For example, Sydney Water is implementing a Renewable Energy Generation (REG) Program that includes 3 hydroelectric plants with a total capacity of up to 6 MW. The largest plant is located at Prospect, and will have a capacity of up to 3.7MW when Warragamba Dam is full[2].

### 2.1.3 Solar Power

Solar power converts solar radiation into electrical energy. This is achieved using photovoltaic cells that generate electricity directly, or the use of heat concentrating solar collectors that produce heat / steam which is then used to generate electricity.

### 2.1.4 Biomass

Biomass describes a variety of fuels including sugar cane bagasse, agricultural waste, wood waste, and biosolids. Electricity generation using biomass typically involves the combustion of solid or liquid biomass (either alone or co-fired with conventional fossil fuels) in a thermal power plant boiler to produce steam to drive a steam turbine.

### 2.1.5 Biogas

Waste disposal in landfill sites or sewage treatment plants can produce useful quantities of methane gas (also known as biogas). Combustion of biogas can be used to drive a spark ignition engine or gas turbine to generate electricity.

Sydney Water is currently implementing 5 new co-generation plants using sewage biogas. These projects combined with the two existing co-generation plants will have a total capacity of around 7.5 MW.

### 2.1.6 Wave Power

Wave power captures the energy of ocean surface waves to generate electricity. Given the proximity to the sea of most desalination plants, wave power would appear to be potentially well suited to desalination applications. However, wave power technology is still in the development stages, and there are no large-scale wave power farms currently operating in Australia.

## 2.2 The National Electricity Market

The National Electricity Market (NEM) is an inter-connected grid serving New South Wales, Victoria, South Australia, Queensland, and Tasmania. The NEM allows consumers to buy electricity from any renewable energy generator connected to the grid, even if they are located in different States. In most cases, an electricity retailer manages transactions in the NEM on behalf of the final consumer.

[2] The project will use turbines to convert the energy of water travelling through the pipeline between Warragamba Dam and the Prospect Water Filtration Plant into electricity.

## 2.3 Regulation of Renewable Energy

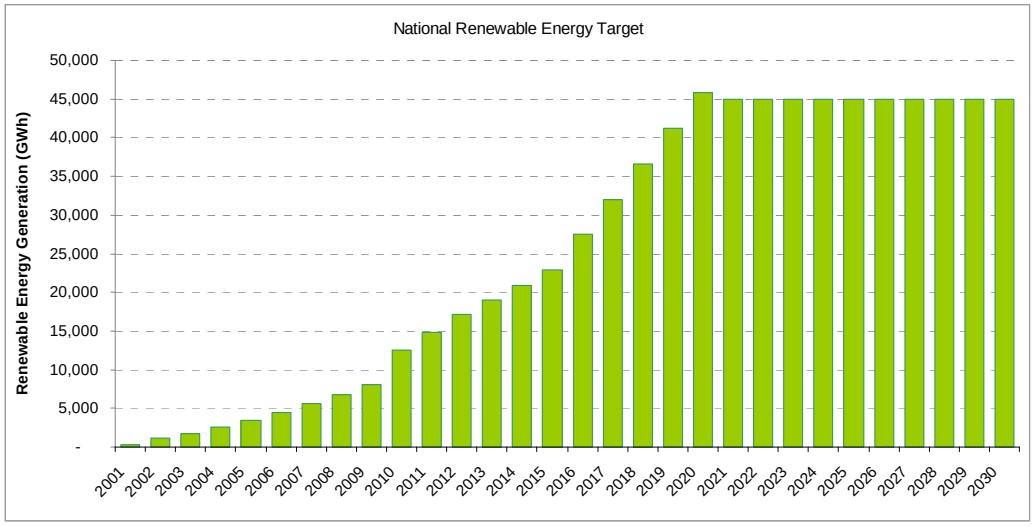
Since 1997, governments at State and Commonwealth level have introduced measures to increase the generation of renewable energy, as well as encourage the more efficient use of energy, to help minimise greenhouse gas emissions.

The rest of this section contains a summary of the relevant regulations. Further detail is contained in Section 5.

### 2.3.1 Renewable Energy (Electricity) Act 2000 (Cth)

The *Renewable Energy (Electricity) Act* establishes a Renewable Energy Target (RET) scheme to increase renewable energy generation in Australia. As shown in **Figure 3**, the scheme includes annual targets for renewable energy generation between 2001 and 2030. If the targets are achieved, 20% of Australia's electricity needs will be supplied from renewable energy sources by 2020.

**Figure 3: Annual Targets in the Renewable Energy Target Scheme**




The RET scheme is based on the creation, sale and surrender of Renewable Energy Certificates (RECs). One REC is equivalent to one-megawatt hour of electricity. Under the RET scheme:

- Renewable energy generators are able to create and sell RECs, helping to offset the higher production costs of renewable energy, and
- Buyers of electricity in the NEM, such as electricity retailers and large users, must also buy a minimum number of RECs every year. The minimum number of RECs increases every year.

The Office of the Renewable Energy Regulator (ORER) administers the RET scheme.

All transactions relating to the creation, transfer and surrender of RECs are recorded in a publicly available REC Registry. RECs can also be bought, sold or surrendered voluntarily by anyone that has an account in the registry.

### 2.3.2 Electricity Supply Act 1995 (NSW)

The *Electricity Supply Act* established the NSW Greenhouse Gas Abatement Scheme (GGAS), which aims to reduce greenhouse gas emissions from the generation and use of electricity in NSW. The scheme sets a benchmark for greenhouse gas emissions from the electricity sector of 7.27 tonnes $CO_2$-e per person.

GGAS is based on the creation, sale and surrender of NSW Greenhouse Gas Abatement Certificates (NGACs). One NGAC is evidence that greenhouse emissions have been reduced by one tonne of $CO_2$-e. Under the scheme:

- NGACs are created by undertaking projects that reduce greenhouse gas emissions, and
- Participants in the scheme must reduce their greenhouse emissions to the benchmark level or meet the short-fall by purchasing and surrendering NGACs. Participation is mandatory for all electricity retailers in NSW, electricity generators that sell directly to retail customers, and users that purchase electricity directly in the National Electricity Market.

The NSW Independent Pricing and Regulatory Tribunal (IPART) administers the scheme.

### 2.3.3 National Greenhouse and Energy Reporting Act 2007 (Cth)

The *National Greenhouse and Energy Reporting Act 2007* (Cth) is a national framework for the reporting of greenhouse gas emissions, reductions, removals and offsets, as well as energy consumption and production. The framework is known as the National Greenhouse and Energy Reporting System (NGERS).

Corporations are required to register and report under the Act if they

1. emit greenhouse gases, or
2. produce energy, or
3. consume energy,

   at or above defined trigger levels in a reporting year.

### 2.3.4 Energy Efficiency Opportunities Act 2006 (Cth)

The *Energy Efficiency Opportunities Act 2006* (Cth) applies for users of more than 0.5 peta joules (PJ) of energy in a year. This is equivalent to approximately 138,900 MWh of electricity.

The purpose of the Act is to improve the identification, evaluation and implementation of cost effective energy efficiency projects. It includes a requirement for mandatory reporting of energy efficiency improvement opportunities for large energy users.

# 3. Renewable Energy and the Desalination Plant

This section outlines the key issues in the operation of the plant relevant to the greenhouse gas plan and the purchase of renewable energy, including an overview of regulatory requirements that affect the purchase of renewable energy.

## 3.1 Operation of the Plant

The renewable energy purchasing strategy considered the following factors:

- The 250 ML a day desalination plant will use between 330,000 - 360,000 MWh of electricity a year when operating at full capacity for one year[3]. While this makes the desalination plant one of the largest single users of electricity in NSW, it is less than 3% of the total Australian market for renewable energy.
- When the desalination plant is operating, electricity use is expected to be relatively constant throughout the day. In contrast, generation of electricity from some renewable sources may not be possible at all times due to natural variability in factors such as wind speed.
- After the initial two-year proving period, operation of the plant will depend on operating rules currently being developed by the NSW Government as part of the Metropolitan Water Plan. The plant may be switched off for several years at a time.

The renewable energy purchase arrangements for the plant need to accommodate this flexibility, while also ensuring that electricity used to operate the plant is 100% matched by renewable energy. Section 4 contains further detail on the purchasing arrangements for renewable energy.

In addition, while the desalination plant is able to be up-scaled to an ultimate capacity of 500 ML a day if required, the timing for this decision is highly uncertain. If a decision is made to up-scale the plant, Sydney Water will have sufficient time to source the additional renewable energy required using a new procurement process.

## 3.2 Lifecycle Greenhouse Gas Emissions

Desalination plants use a significant quantity of electricity for activities such as:

(a) seawater intake pumping and pre-treatment

(b) operation of the reverse osmosis high pressure pumps

(c) potabilisation and waste water treatment facilities

(d) general site use such as lighting, HVAC, laboratories and workshops, and

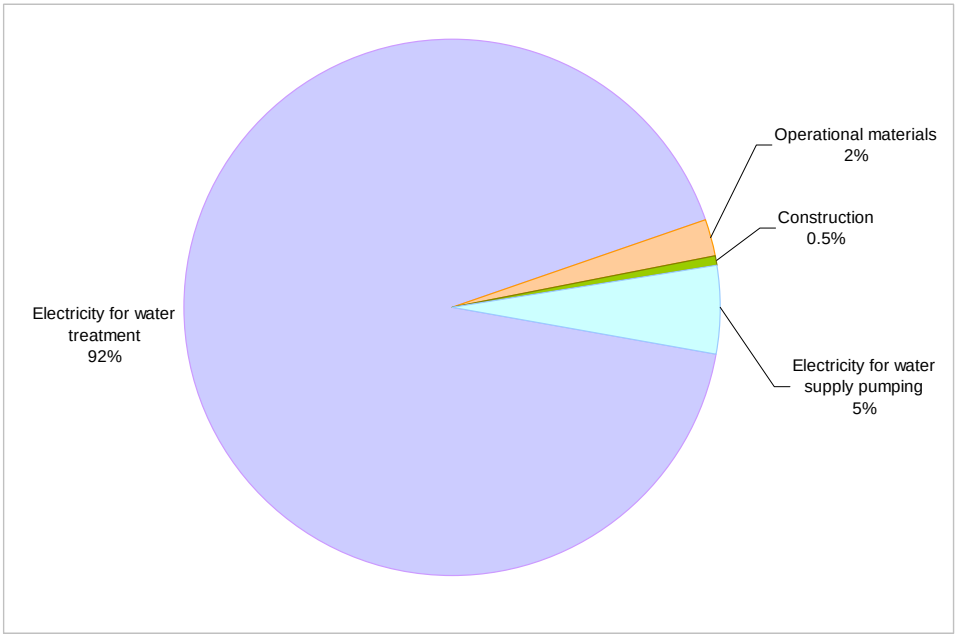
(e) pumping water to existing storage reservoirs or water supply networks.

[3] Based on estimates from the plant operator included in the Operate and Maintain contract for the desalination plant. Actual use may differ from these estimates.

To ensure that water from the desalination plant meets Australian Drinking Water Guidelines and NSW Health requirements, chemicals and other materials are used in the treatment process. The manufacture and transport of these materials may also generate greenhouse gas emissions.

A lifecycle assessment was undertaken to assess the relative contribution of greenhouse gas emissions from different activities at the Kurnell desalination plant. The results are shown in Figure 4.

**Figure 4. Desalination Plant Greenhouse Gas Emissions by Source**




The assessment shows that around 97% of potential greenhouse gas emissions over the life of the plant are due to electricity used to operate the plant, including the electricity needed to pump water from the plant at Kurnell to the existing water supply network at Erskineville.

The remaining sources contribute less than 3% of total greenhouse gas emissions. Emissions from these sources have therefore been excluded from the scope of this Greenhouse Gas Reduction Plan.

## 3.3 Regulatory Requirements

Section 2.3 contained a summary of key regulatory requirements for renewable energy generation and use in Australia. Many of these regulations directly affect the purchase and use of 100% renewable energy at the desalination plant, including:

- *Renewable Energy (Electricity) Act 2000 (Cth)*

  Electricity used to operate the desalination plant will create a mandatory obligation on the electricity retailer to surrender RECs under the Act.

  Details of how Sydney Water has addressed this requirement is provided in Section 5.

- *Electricity Supply Act 1995 (NSW)*

  Electricity used to operate the desalination plant will create a mandatory obligation on the electricity retailer to surrender NGACs under the Act.

  Details of how Sydney Water has addressed this requirement is provided in Section 5.

- *National Greenhouse and Energy Reporting Act 2007 (Cth)*

  The desalination plant is likely to trigger the thresholds for reporting under the Act, even if the plant does not produce water in a year.

  Details of how Sydney Water has addressed this requirement is provided in Section 5.

  The reporting framework established by the Act also contains methodologies for estimating greenhouse gas emissions. Sydney Water has considered these methodologies in developing this Greenhouse Gas Reduction Plan.

  Details of how Sydney Water has addressed these requirements is provided in Section 6.

- *Energy Efficiency Opportunities Act 2006 (Cth)*

  Depending on the amount of water production (which is the main driver of electricity use), the desalination plant may trigger the application of this Act.

  Details of how Sydney Water has addressed this requirement is provided in Section 7.

# 4. Renewable Energy Purchasing

This section outlines the renewable energy purchasing for the desalination plant and specifically addresses sections a) b) e) and f) of the project approval condition 2.2:

a) *a specific outcome that the desalination plant will be powered by 100% renewable energy, or equivalent;*

b) *details of how renewable energy will be purchased, such as using "Green Power" or equivalent;*

e) *a framework for considering and managing factors such as availability, certainty, flexibility, adaptability, additionality, and any co-benefits of options identified and/or applied to achieve the outcomes specified under a) above;*

f) *a framework and management principles for accommodating any shortfalls in the availability of renewable energy from time to time;*

and;

Statement of Commitments 2a & 2b.

Sydney Water has established a wholly owned subsidiary company, Sydney Desalination Plant Pty Limited (SDP), to own the desalination plant. Veolia Water (Australia) Pty Ltd will operate and maintain the plant for up to 20 years under contract to SDP. SDP is accountable for the supply of 100% renewable energy to the plant.

## 4.1 Procurement of 100% renewable energy

In November 2007, Sydney Water issued a Request for Proposals for the supply of 100% renewable energy to the desalination plant. The proposals were assessed against the evaluation criteria (see Section 1.3), and six proponents were short-listed to receive a Request for Tender (RFT).

The RFT was issued in January 2008, and invited proponents to submit tenders for the supply of electricity and RECs for the 250 ML a day desalination plant over a twenty-year term. However, the RFT specified that SDP would not accept RECs from certain sources, including RECs created:

- at a power station not connected to the National Electricity Market (NEM); and/or
- from the burning of wood waste.

Tenders closed in March 2008. All tenders relied on wind power as the primary source of renewable energy certificates. Contracts were awarded in July 2008.

The following two contracts relate to the supply of renewable energy:

- A REC Supply Agreement with Renewable Power Ventures Pty Ltd (RPV), a subsidiary of Infigen Energy Limited, and
- A Project Deed, also with RPV, for the construction and operation of the Capital Wind Farm.

In addition, SDP entered into a separate Electricity Supply Agreement with BBP Energy Markets Pty Ltd, a subsidiary of Babcock & Brown Power. This contract is for the supply of electricity and related retail services.

A summary of the key commercial terms, and copies of the contracts, are available on the Sydney Water website at:

http://www.sydneywater.com.au/Water4Life/Desalination/.

## 4.2 How renewable energy will be purchased

SDP will achieve 100% renewable energy use by ensuring that enough environmental certificates (RECs and, if required, NGACs) are surrendered to match electricity used at the desalination plant. This will usually occur after the end of each calendar year.

Environmental certificates will be supplied to SDP under the REC Supply Agreement All certificates must be supplied from the Capital Wind Farm[4]. SDP may elect to receive certificates from the wind farm as RECs, NGACs, or a combination. RECs are available from the wind farm from 17 November 2009.

An order for certificates will be placed before the start of each calendar year.

The final number and type of certificates to be delivered is determined by SDP at the end of each year, based on the amount of electricity used to operate the plant, an obligation to buy at least 180,000 certificates regardless of electricity use, and any regulatory requirements (discussed in more detail in Section 5).

### 4.2.1 Electricity Supply

Electricity to operate the desalination plant will be purchased under the retail Electricity Supply Agreement. The electricity retailer is responsible for ensuring the supply of electricity to the plant from the National Electricity Market.

### 4.2.2 Surrender of Renewable Energy Certificates

Surrendering RECs is a two-stage process. In the first stage, RECs are offered to the regulator (ORER) for surrender. The ORER aims to make a decision within 4 weeks of the surrender offer. In the second stage, ORER accepts or rejects the surrender offer.

ORER may reject an offer to surrender a REC if:

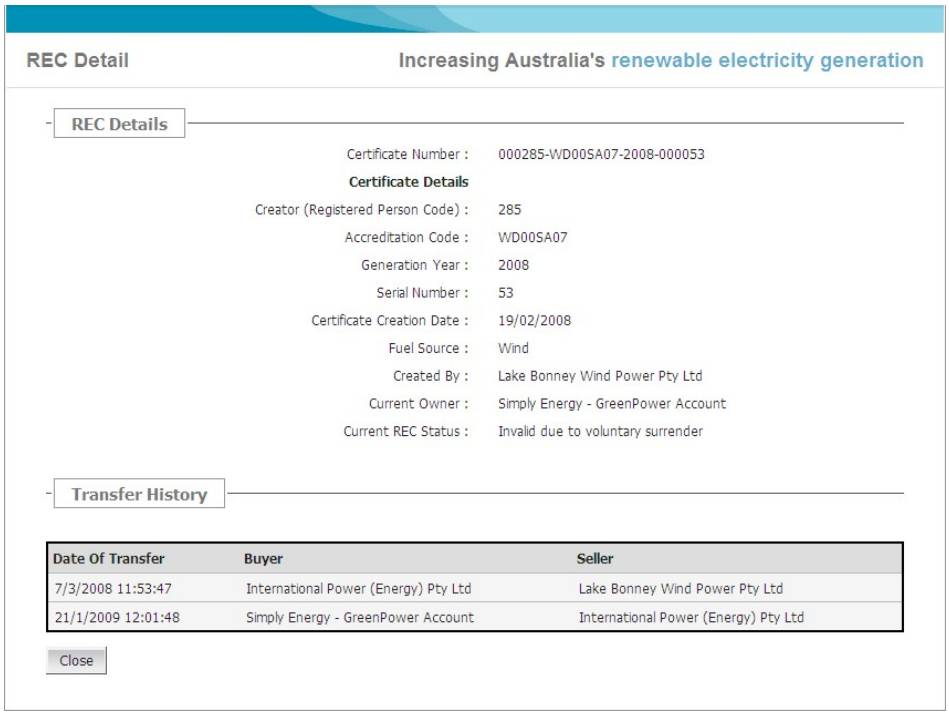
- the REC is not valid under the scheme
- the REC was created after the end of the reporting period (eg, a retailer cannot surrender a REC created in 2010 to meet liability for the 2009 calendar year)
- ownership of the REC had not been transferred before the reporting date (February 14).

If the offer to surrender RECs is accepted, the RECs will become permanently marked as ‘Invalid’ and cannot be traded. An example is shown in Figure 5 below.

[4] The Capital Wind Farm is located near Bungendore in NSW, and has a capacity of 140.7 MW. It received ORER accreditation as a renewable energy power station in July 2009 (accreditation code WD00NS06).

A similar process is used for the surrender of NGACs under the NSW GGAS scheme. IPART is the regulator for GGAS. Further detail is provided in Section 6.

**Figure 5: Example of a REC that has been surrendered**




## 4.3 Framework for Managing Availability, Certainty, Flexibility, Adaptability

The contracts allow flexibility and adaptability in the desalination plant's operations, but also provide certainty that renewable energy will be available to meet the plant's needs.

### 4.3.1 Availability and certainty

The supplier of environmental certificates must deliver all the certificates that SDP has ordered each year, even if wind conditions reduce the amount of energy generated at the wind farm. Section 4.4 describes the framework for managing any 'short-fall'.

Under the Electricity Supply Agreement, the retailer must ensure that electricity is available as and when required to operate the plant.

### 4.3.2 Flexibility

The purchase of electricity and environmental certificates will both occur on a calendar year basis. In addition, there is no cap on the amount of electricity or renewable energy that may be used to operate the desalination plant.

As a result, SDP has flexibility to adjust to changing circumstances and different operating regimes at the desalination plant. This includes the ability to direct a shutdown or restart of the plant, if required by the desalination plant operating rules, without affecting the availability of renewable energy.

### 4.3.3 Adaptability

As described in Section 4.2, SDP has the ability to determine the number and type of environmental certificates delivered from the wind farm each year.

If the current REC scheme ceases to exist, SDP may direct the wind farm to deliver a different type of certificate or instrument to ensure continued use of 100% renewable energy. The contract allows SDP to choose the instrument that it considers meets the Minister's Conditions of Approval in the most effective manner.

## 4.4 Framework for Managing "Shortfalls" in Renewable Energy

At the end of a calendar year, there may be a potential shortfall in RECs (and, if required, NGACs) because the wind farm has not been able to generate enough renewable energy, for example, due to low winds. In these situations, the supplier is allowed to deliver RECs obtained from other sources, provided that:

- The RECs were created from electricity generated in the same year; and
- The RECs must not have been created from electricity generated by the burning of wood waste; and
- The creator of the RECs must supply electricity to the NEM.

A short-fall in renewable energy may also occur because the desalination plant has used significantly more electricity than anticipated. Depending on the size of the short-fall, SDP may choose to:

- Purchase and surrender more RECs from the wind farm; and/or
- Surrender surplus RECs it already owns (purchased from the wind farm in a previous year); and/or
- Purchase and surrender more RECs from another accredited renewable energy generator.

This assessment will occur on a case-by-case basis, depending on what is the most cost-effective option at the time.

## 4.5 Framework for Managing "Excess" Renewable Energy

SDP will contract to buy enough RECs (and, if required, NGACs) each year to match forecast electricity use at the desalination plant. However, electricity use may be less than forecast because:

- Energy efficiency is better than expected,
- There were unplanned operational or maintenance issues, or
- A decision was made to shut down the plant under the operating rules.

In addition, as identified in Section 4.2, SDP must buy at least 180,000 RECs each year even if the plant is not expected to produce water.

As a result SDP may occasionally be left with more RECs than it needs to offset electricity use at the plant. These 'excess' RECs may be retained, surrendered or sold at SDP's discretion. For example, excess RECs from one year could be used to help

meet a shortfall in a future year. This assessment will occur on a case-by-case basis, depending on what is the most cost-effective option at the time.

## 4.6 Additionality and Co benefits

Additionality is when there is additional renewable energy being produced and supplied to the electricity grid equal to the electricity consumption of a project. Co-benefits consider the extra environmental or social benefits that can be provided by some sources of renewable energy.

Additionality and co-benefits were two of the criteria used to evaluate proposals in the renewable energy procurement process. While additionality and co-benefits were not mandatory conditions, SDP entered into a Project Deed with RPV (Infigen Energy) to ensure the construction and operation of the Capital Wind Farm. The wind farm is a new renewable energy generator that has increased the total generating capacity of wind energy in NSW by more than 700 per cent.

The wind farm will also result in a number of co-benefits, including the donation of a fire truck to the local rural fire service and erosion control measures on the properties where the turbines are located.

# 5. Regulatory Requirements

This section addresses the regulatory requirements with respect to energy and greenhouse gases and specifically addresses section c) of the project approval condition 2.2

c) *details of the relevant regulatory requirements with respect to energy and greenhouse gases, and a system for managing change in these requirements over time;*

## 5.1 Current Regulatory Requirements

The greenhouse gas reduction strategy involves the purchase of 100% renewable energy to power the desalination plant. This will be achieved by ensuring that enough environmental certificates are surrendered to match electricity used at the desalination plant.

**Table 1** shows how environmental certificates will be surrendered to achieve 100% renewable energy use for a typical year where the 250 ML a day desalination plant operates at full capacity. The table is based on current regulatory requirements, which were summarised in Section 2. Further detail on these requirements is provided in Sections 5.1.1 to 5.1.4.

**Table 1: Surrender of certificates to achieve 100% renewable energy**

| | Quantity | Units |
|---|---|---|
| **Renewable energy purchases by SDP** | | |
| Electricity to operate the plant | 360,000 | MWh |
| Environmental credits (from Capital Wind Farm) | 360,000 | Certificates |
| **Surrender of environmental certificates** | | |
| RECs surrendered by electricity retailer[1] | 13,104 | RECs |
| NGACs surrendered by electricity retailer[2] | 105,389 | NGACs |
| RECs surrendered by SDP | 241,507 | RECs |
| **Total environmental certificates surrendered** | **360,000** | |

Notes:

[1] calculated under the Renewable Energy (Electricity) Act (Cth). Also see Section 5.1.1.

[2] calculated using IPARTs NSW Annual Greenhouse Gas Benchmark Statement. Also see Section 5.1.2.

Section 5.2 discusses the framework for managing changes in requirements over time.

### 5.1.1 Renewable Energy (Electricity) Act 2000 (Cth)

The *Renewable Energy (Electricity) Act* establishes a Renewable Energy Target (RET) scheme to increase renewable energy generation in Australia.

The supplier of electricity to the desalination plant is a 'liable party' under the Act. Liable parties must buy and surrender a minimum number of RECs each year, equal to the quantity of electricity they have purchased multiplied by the Renewable Power Percentage (RRP) for that year.

For example, in 2009 the RPP is 3.64%. A liable party purchasing 100,000 MWh of electricity in 2009 must buy and surrender 3,640 certificates by February 14 of the following year.

In order to allow the retailer to discharge its obligations under the Act, SDP will transfer a portion of its RECs to the electricity retailer. For example, if the desalination plant used 360,000 MWh of electricity to produce drinking water for supply to customers in 2010, SDP would transfer 13,104 RECs to be surrendered by the electricity retailer by 14 February 2011.

The RET scheme will run until 31 December 2030.

### 5.1.2 Electricity Supply Act 1995 (NSW)

The *Electricity Supply Act 1995* (NSW) established a Greenhouse Gas Abatement Scheme (GGAS) to reduce greenhouse gas emissions from the generation and use of electricity in NSW.

The scheme sets a State-wide benchmark for greenhouse gas emissions from the electricity sector of 7.27 tonnes $CO_2$-e per person (equivalent to around 51 million tonnes of $CO_2$-e in 2009). Participants in the scheme are then allocated an individual benchmark, based on their relative share of NSW electricity use. The liability of an electricity buyer to surrender NGACs is calculated using the following equation:

NGAC Liability = Attributable Emissions – Greenhouse Gas Benchmark

Where

Attributable Emissions = Electricity Sold x NSW Pool Coefficient – RECs Counted

Greenhouse Gas Benchmark = Electricity Sold / Total NSW Electricity Sold x NSW Benchmark

For example, if the desalination plant operates at 250 ML a day for one year, and the electricity retailer does not supply any other customers, the liability for NGACs would be calculated as:

| | |
|---|---|
| Attributable Emissions | = 360,000 MWh x 0.967 $tCO_2e$ – 13,104 RECs |
| | = 335,448 $tCO_2$-e |
| Greenhouse Gas Benchmark | = 360,000 MWh / 80,109,000 MWh x 51,193,886 $tCO_2$-e |
| | = 230,059 $tCO_2$-e |

Therefore,

NGAC Liability = 335,448 – 230,059 = 105,389

Participants that exceed their individual greenhouse gas benchmark must offset the excess emissions by surrendering:

- NSW Greenhouse Abatement Certificates (NGACs) (created by accredited providers that have undertaken abatement activities such as carbon sequestration, generation efficiency, or reducing electricity use), and
- Renewable Energy Certificates under the MRET / RET scheme.

Large electricity users can also choose to join GGAS as an elective participant[5], rather than allowing their electricity supplier to manage liabilities under GGAS.

The electricity retailer to the desalination plant will have a mandatory liability under GGAS. As discussed in Section 5.1.2, SDP will transfer a share of its RECs to the electricity retailer, allowing them to meet their obligations under the Commonwealth RET scheme. This also reduces the liability of the retailer under GGAS. The remaining GGAS liability must be met by surrendering NGACs.

SDP will therefore supply NGACs to the retailer for surrender under GGAS. The retailer must surrender NGACs by March of the following year. **Table 1** showed how this is achieved for a year of production at an average of 250 ML a day.

GGAS will end when the Australian Carbon Pollution Trading Scheme (CPRS) starts. This is expected to occur on 1 July 2011, when the liability to surrender abatement certificates under GGAS would also cease.

### 5.1.3 National Greenhouse and Energy Reporting Act 2007 (Cth)

The *National Greenhouse and Energy Reporting Act 2007* (Cth) is a national framework for the reporting of greenhouse gas emissions, reductions, removals and offsets, as well as energy consumption and production. The framework is known as the National Greenhouse and Energy Reporting System (NGERS).

Corporations are required to register and report under the Act if they

(a) emit greenhouse gases, or

(b) produce energy, or

(c) consume energy,

at or above defined trigger levels in a reporting year.

The trigger levels for reporting are shown in **Table 2** below, and include separate threshold levels for corporations and for individual facilities. This is to ensure that all major emitters of greenhouse gases, and significant users or producers of energy, are captured in the reporting scheme.

[5] A 'large' user of electricity consumes at least 100 GWh of electricity a year, where at least one facility uses at least 50 GWh.

**Table 2: National Greenhouse and Energy Reporting System Thresholds**

| NGERS thresholds for facilities | 2008-09 | 2009-10 | 2010-11 |
|---|---|---|---|
| Greenhouse gases (kilo tonnes $CO_{2\text{-}e}$) | 25 kt | 25 kt | 25 kt |
| Energy consumption (tera joules) | 100 TJ | 100 TJ | 100 TJ |
| NGERS thresholds for corporations | 2008-09 | 2009-10 | 2010-11 |
| Greenhouse gases (kilo tonnes $CO_{2\text{-}e}$) | 125 kt | 87.5 kt | 50 kt |
| Energy consumption (tera joules) | 500 TJ | 350 TJ | 200 TJ |

*Note: 1TJ is equivalent to approximately 278 MWh of electricity use*

A corporation may control a number of separate facilities that, when considered individually, are not large users of energy. Using the facility reporting thresholds, the company would not be required to report on energy use at any of the sites. However, when aggregated across all sites controlled by the company, total energy consumption may be very large. If the corporate reporting threshold is triggered, the company must report energy use at all facilities under its control.

Responsibility for reporting rests with the party that has operational control over the facility. For the desalination plant, SDP has established a 20-year performance-based, fixed price Operate and Maintain (O&M) contract with Veolia Water Australia. As a result, Veolia Water Australia has primary responsibility for day-to-day operational policies and decisions, and would be responsible for reporting under the *National Greenhouse and Energy Reporting Act*.

The reporting system and threshold levels are likely to be amended in future as a result of the introduction of a Carbon Pollution Reduction Scheme.

### Greenhouse Gas Emissions / Energy Production Threshold

The electricity used by the desalination plant is supplied from the grid, and is generated off-site at another facility. As a result, the desalination plant would not trigger the NGERS facility threshold levels for energy production or total greenhouse gas emissions.

There may be some incidental greenhouse gas emissions from on-site sources such as:

(a) back-up diesel generators,

(b) air conditioning, and

(c) refrigeration.

Emissions from these sources would not trigger the NGERS facility threshold level for greenhouse gases. However, some of the high voltage switchgear on the desalination plant site is insulated with sulphur hexafluoride ($SF_6$), and reporting of emissions from this source is mandatory under NGERS.

#### Energy Consumption Threshold

Depending on water production and energy efficiency rates, the desalination plant is likely to trigger the NGERS energy consumption threshold level for facilities.

The plant may not trigger the facility-reporting threshold level in all years, even if the plant is producing water.

However, energy consumption at the desalination plant may still be reported under NGERS if Veolia Water Australia has triggered the corporate reporting thresholds due to the total energy it uses across all facilities that it operates.

### 5.1.4 Energy Efficiency Opportunities Act 2006 (Cth)

The *Energy Efficiency Opportunities Act 2006* (Cth) applies for users of more than 0.5 peta joules (PJ) of energy in a year. This is equivalent to approximately 138,900 MWh of electricity.

The purpose of the Act is to improve the identification, evaluation and implementation of cost effective energy efficiency projects. Depending on water production, the desalination plant may trigger the application of this Act.

The O&M contract with the desalination plant operator includes mechanisms and incentives to encourage investment in energy efficiency. This is discussed further in Section 7.2. Details of energy efficiency opportunities will be reported in line with the requirements of the *Energy Efficiency Opportunities Act 2006* (Cth) and regulations.

## 5.2 Process for Managing Change in Regulatory Requirements

Renewable energy for the desalination plant is supplied under the REC Supply Agreement and Project Deed. Both contracts end in February 2030, at around the same time that the O&M contract with the desalination plant operator is likely to conclude. All contracts are therefore likely to conclude before the anticipated end of the RET scheme in December 2030.

The legislation that establishes the RET scheme includes a mandatory review that must commence no later than 31 December 2013. It is therefore possible, though unlikely, that another renewable energy scheme may be introduced prior to 2030 to operate in parallel with the existing RET scheme. If this occurs, and the scheme allows for the creation of a new type of environmental credit from the wind farm, then SDP may choose to receive these other environmental credits in lieu of RECs (see also Section 4).

If the RET scheme were to be abolished, and/or changes are made that prevent the wind farm from creating RECs, then SDP may elect to receive whatever form of environmental credit the wind farm is eligible to create under the new (or modified) scheme.

In the unlikely event that the RET scheme were to be abolished and no replacement scheme introduced, SDP would be obliged to continue paying the wind farm an amount equivalent to the purchase of 180,000 RECs each year. As a result, it is highly likely that the wind farm would continue to generate electricity in this scenario.

# 6. Greenhouse Gas Measurement and Reporting

This section addresses the measurement and reporting of renewable energy and greenhouse gas and specifically addresses section d) of the project approval condition 2.2

*d) a monitoring and recording system to track the energy consumption of the desalination plant project and the resultant equivalent emissions of carbon dioxide;*

## 6.1 Recording of Greenhouse Gas Emissions

Most greenhouse gas reporting frameworks identify three types of emissions:

(a) Direct emissions: greenhouse gas emissions generated from sources owned or controlled by an organisation. These are also known as scope 1 emissions. An example would be the combustion of diesel fuel to run on-site generators that produce electricity to operate a facility.

(b) Indirect emissions: greenhouse gas emissions from the generation of imported electricity (from the grid) used by an organisation. These are known as scope 2 emissions, and physically occur at the facility where the electricity was generated.

(c) Other indirect emissions: all other emissions that are generated as a result of an organisations' activities, but which are produced from sources owned or controlled by another organisation. These are known as scope 3 emissions.

SDP will ensure that systems are in place to record all direct and indirect greenhouse gas emissions (ie. (a) and (b) above) associated with the generation of electricity used to operate the desalination plant, expressed as $CO_2$ equivalent emissions ($CO_2$-e).

Other indirect emissions will not be recorded, and will not be offset by the purchase of RECs or NGACs. These include transmission and distribution losses in the electricity supply network, and energy used during the manufacture and transport of chemicals used in the water treatment process.

### 6.1.1 (a) Direct emissions

The desalination plant operator is required to report to SDP on the consumption of gas and other fuels. This information will be used to estimate the direct greenhouse gas emissions of the desalination plant, using the following methodology (based on Australia's *National Greenhouse and Energy Reporting (Measurement) Technical Guidelines*):

$$\Sigma E_{ij} = \frac{Q_i \times EC_i \times EF_{ij}}{1000}$$ Equation (1)

where

$E_{ij}$ is the greenhouse gas emissions of type (j) (carbon dioxide, methane, and nitrous oxide), from fuel type (i) ($CO_2$-e)

$Q_i$ is the quantity of fuel type (i) (kilolitres) combusted to produce electricity

$EC_i$ is the energy content of fuel type (i) (gigajoules per kilolitre) (if $Q_i$ is measured in gigajoules, $EC_i = 1$)

$EF_{ij}$ is the emission factor for gas type (j) (including an oxidation factor) for fuel type (i)

Assumptions regarding energy content and emission factors are based on the National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1), and may be amended from time to time.

### 6.1.2 (b) Indirect emissions

As the desalination plant will use 100% renewable energy, there will be no net emissions of greenhouse gases as a result of electricity used to operate the plant.

However, SDP will ensure that estimates are calculated of the equivalent greenhouse gas emissions that would have been produced if all the electricity consumed by the plant had been generated at a power station that involves the combustion of fossil fuels.

The following methodology is used to estimate indirect greenhouse gas emissions, based on Australia's *National Greenhouse and Energy Reporting (Measurement) Technical Guidelines*:

$$Y_i = Q_i \times \frac{EF_i}{1000}$$ Equation (2)

where

$Y_i$ is the total indirect greenhouse gas emissions in year (i) ($CO_2$-e)

$Q_i$ is the quantity of electricity purchased by the desalination plant from the electricity grid in year (i) (kilowatt-hours)

$EF_i$ is the emission factor for electricity consumed in NSW in year (i)

Assumptions regarding emission factors will be based on the National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1), as amended from time to time.

### 6.1.3 Baseline level of emissions

A baseline level of greenhouse gas emissions will be established to quantify the reductions in emissions that may be achieved over time (eg, as a result of energy efficiency projects). An initial baseline will be established after the desalination plant has been operating for a period of at least 12 months under a range of different operating conditions (eg, sea water characteristics, membrane age etc.).

A separate baseline may also be set prior to implementing individual emission reduction initiatives (eg, to quantify the incremental impact of a specific project).

## 6.2 Reporting of Renewable Energy Consumption

Each year, SDP will include in its Annual Report details of renewable energy use at the desalination plant, including:

(a) Estimates of direct greenhouse gas emissions, quantified separately for each type of greenhouse gas (eg, $N_2O$, $CH_4$, $SF_6$) but expressed in $CO_2$-e;

(b) Total metered electricity consumption;

(c) Estimates of indirect greenhouse gas emissions associated with the consumption of electricity imported from the grid, expressed in $CO_2$-e;

(d) A description of the greenhouse gas quantification methodologies used (including an explanation of any change from methodologies previously used);

(e) The number and type of environmental certificates surrendered, including the source of those certificates (including whether a short-fall, if any, will be carried forward to another year);

(f) Additional relevant indicators, such as energy efficiency or emissions intensity (eg, emissions per unit of production);

(g) A description of energy efficiency improvement opportunities; and

(h) A statement describing whether the report has been verified, including the type of verification and the level of assurance achieved.

This will be in addition to any reports that the operator is required to produce under NGERS. In the first year of operation, renewable energy use will be recorded from the day that water from the desalination plant is first supplied to customers.

### 6.2.1 RECs and direct greenhouse gas emissions

If electricity is generated on-site, the resulting direct greenhouse gases will first be estimated using equation 1 above (see Section 6.1.1). This estimate of greenhouse gas emissions will then be converted into an equivalent quantity of electricity from the grid by re-arranging equation 2 above to derive the following relationship:

$$\frac{Y_i}{EF_i} \times 1000 = Q_i \qquad \text{Equation (3)}$$

where

$Y_i$ is the total direct greenhouse gas emissions of the desalination plant in year (i) ($CO_2$-e), as measured by $E_{ij}$ in Equation (1)

$EF_i$ is the emission factor for grid electricity consumed in NSW in year (i)

$Q_i$ is the equivalent quantity of grid electricity in year (i) from the combustion of gas or fuel used to operate the desalination plant (kilowatt-hours)

This will allow SDP to acquire and surrender an additional quantity of RECs (equivalent to Q from equation 3) to offset direct greenhouse gas emissions over time.

# 7. Energy Reduction and Energy Efficiency

This section looks at the energy efficiency of the desalination plant and specifically addresses section h) of the project approval condition 2.2:

*h) a program for periodic review of energy performance, and consideration of additional and improved efficiency measures that may reasonably be applied from time to time to ensure efficient energy use.*

The minimisation of energy use was a key part of the design process for the desalination plant. The use of energy recovery devices and other design features means the plant will be up to 50% more efficient than older desalination plants.

Energy use performance targets are built into the O&M contract (Section 7.1). There are also commercial incentives for the operator to identify opportunities for further reductions in the amount of electricity used to operate the plant (Section 7.2).

## 7.1 Energy Performance

The O&M contract includes energy efficiency targets at all possible levels of water production. The energy efficiency target is determined by:

- The volume of water produced,
- Sea water temperature and salinity, and
- Average age of the reverse osmosis membranes.

The energy performance of the operator is measured each month, and the fee adjusted accordingly. For example, if energy use exceeds the target, the fee payable to the operator is reduced. Conversely, if the operator can achieve energy efficiency rates that are better than the target, the service fee is increased. The operator therefore has a strong financial incentive to continuously minimise electricity use.

## 7.2 Energy Efficiency Measures

The O&M contract also includes commercial incentives for the operator to actively explore opportunities for better energy efficiency. This includes the ability for the operator to request joint funding for energy reduction initiatives that require capital investment.

In addition, SDP has the ability to investigate and propose energy efficiency initiatives. If the initiative is adopted, the benefits are shared between SDP and the operator. As a result, the operator has an incentive to actively explore energy efficiency measures, so that they can be implemented before SDP proposes its own initiatives.

As discussed in Section 5.1.4, a formal review of energy efficiency opportunities may also be required each year under the *Energy Efficiency Opportunities Act*.

# 8. Greenhouse Gas Plan Monitoring and Compliance

This section addresses monitoring and compliance with the plan and specifically addresses section g) of the project approval condition 2.2:

*g)* *systems to monitor and audit the processes, procedures and outcomes stipulated under the plan;*

*and*

*Statement of Commitment 2c*

This plan describes the strategy for how greenhouse gases from electricity used to operate the desalination plant will be managed, minimised and offset.

The desalination plant will be powered by 100% renewable energy. As a result, the greenhouse gas output of the plant from the consumption of electricity will be offset under all operational regimes.

The approach described in this plan is consistent with national and international frameworks for greenhouse gas reporting, including the *National Greenhouse and Energy Reporting Guidelines*, the World Resources Institute *Greenhouse Gas Protocol*, and ISO 14064.

Sydney Water will monitor the processes, procedures and outcomes stipulated under this plan. This includes processes and procedures for:

(a) collection and management of greenhouse gas records;

(b) approval and dissemination of documents;

(c) data collection procedures and methodologies; and

(d) quality checks (eg, data collection, validation).

Independent audits will also be undertaken to verify compliance with this plan and related processes and procedures. This will be reported in Sydney Water's Annual Report.

# 9. Glossary

## *Electricity / Energy Units*

| Unit | Symbol | Explanation / Example |
|---|---|---|
| 1 watt | W | One joule of work per second.<br>A 60-watt light globe uses 60 watts of electricity to produce light. |
| 1 kilowatt | kW | One thousand watts.<br>The energy needed to power ten 100 W light globes simultaneously. |
| 1 kilowatt hour | kWh | The energy required to power ten 100 W light globes for one hour. |
| 1 megawatt | MW | One million watts.<br>A 1 MW generator can power ten thousand 100 W light globes simultaneously. |
| 1 megawatt hour | MWh | The energy required to power ten thousand 100 W light globes for one hour. |
| 1 gigawatt | GW | One thousand megawatts. |
| 1 gigawatt hour | GWh | 1 GWh = 1000 MWh |
| 1 tera joule | TJ | 1TJ = 1 x $10^{12}$ joules, or approximately 278 MWh of electricity. |
| 1 peta joule | PJ | 1PJ = 1 x $10^{15}$ joules, or approximately 277,778 MWh of electricity. |

## *Other Commonly Used Acronyms*

| | |
|---|---|
| $CO_2$-e | Carbon dioxide equivalent.<br>A unit for comparing the impact of different greenhouse gases compared to carbon dioxide. |
| EF | Emission factor |
| GGAS | Greenhouse Gas Abatement Scheme (NSW) |
| GWP | Global warming potential |
| kL | Kilo litres (1 kL = 1000 litres) |
| Kt | Kilo tonnes (1kt = 1000 tonnes) |
| ML | Mega litres (1 ML = 1,000,000 litres) |
| MRET | Mandatory Renewable Energy Target scheme |
| NEM | National Electricity Market |
| NGAC | NSW Greenhouse Abatement Certificate |
| NGERS | National Greenhouse and Energy Reporting System |
| ORER | The Office of the Renewable Energy Regulator |
| REC | Renewable Energy Certificate |
| RET | Renewable Energy Target scheme (Commonwealth) |
| SDP | Sydney Desalination Plant Pty Limited |
| SGU | Small generation unit (deemed REC from wind or solar photovoltaic cells) |
| SWU | Solar Water Heating Unit |

| REV | DESCRIPTION | PREPARED BY | REVIEWED BY | APPROVED BY | DATE |
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