6

Water Sustainability and Power Generation in AUSTRALIA

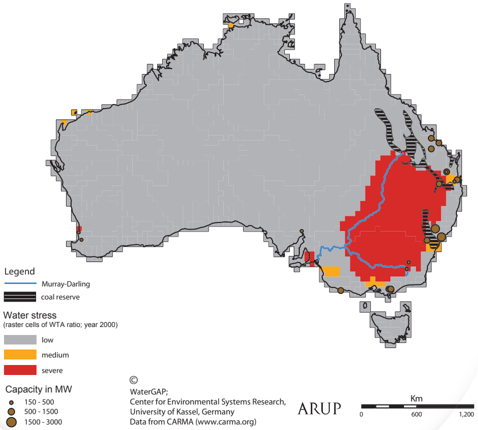
6.1 Local water challenges

Water challenges are experienced all across Australia's fresh water system, particularly in the Murray-Darling Basin (MDB). The MDB is an inter-jurisdictional area which is managed by the Australian Government, Australian Capital Territory and the States of Queensland, Victoria, South Australia and New South Wales (**Figure 6**). The Australian Capital Territory and the States are dependent upon these shared water resources.

The River Murray system of the MDB supplies, on average, more than two-thirds of the Basin's water resources for irrigation, industrial, stock and domestic and environmental purposes. Within the State of South Australia, around 75% of the water taken from the River Murray is used for primary production, such as water for stock and irrigating crops. Overall, agriculture accounts for about 96% of the water consumption in the MDB.

Figure 6:

Location of the Murray-Darling rivers and overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across Australia. The location of selected power stations (>150 MW) is also indicated.



6.1.1 Water availability

Overall, consumptive water use in the MDB and climate change induced changes in rainfall patterns (see below) have reduced average annual stream flow at the Murray River mouth by 61%. Over the 1895 to 2006 period, the average annual flow to the sea has declined by almost 40%.[26] The MDB is considered to be an acutely water stressed basin, **Figure 6**.

See PI-TP 4

6.1.2 Climate change impacts

Recently, water resources have been severely been affected by exceptionally hot, dry years.[27] In 2007, a 117-year low of water flowing in to the MDB river system together with historic low storage levels resulted in drought throughout the basin.

Surface water availability across the entire MDB is expected to decline further due to climate change. The average of likely climate scenarios suggests an 11% reduction in average surface water availability by 2030.[28] The reduction would be greatest in the south where the majority of the runoff is generated and where, therefore, the impacts of climate change are expected to be greatest. An outlook on how water availability (shown in **Figure 3**) is expected to change is provided by the University of Kassel.[29]

Financial institutions should, therefore, take into consideration the risks arising from the regional impacts of climate change on water availability.

See PI-TP 6

6.1.3 Institutional/regulatory context

Surface water diversions from the MDB have been capped since 1997 to prevent further growth in water withdrawals. Whilst this "cap" does not necessarily ensure a sustainable Basin ecosystem, it has been considered as an essential first step towards more sustainable water management. Compliance to the terms of the 'cap' by each of the states sharing the water in the basin is monitored annually.[30]

In response to the ongoing drought, the Australian Government has initiated policy changes to the management of water resources in the MDB as part of its *National Water Initiative*, *Water for the Future* program. New legislation, such as the *Water Act 2007* has also been introduced.[31] **In light of sharpening environmental regulation in the MDB and beyond, financial institutions should encourage clients to show their preparedness for compliance to increasingly stringent regulations and standards.**[32]

See PI-TP 3 & 8

There is also the "Restoring the Balance in the Murray-Darling Basin" Program for which the government has committed $3.1 billion to purchase water in the MDB over a 10 year period to restore environmental flows.[33] In May 2009 the Murray-Darling Basin Authority started to buy back water from licence holders on the open market. This water will help restore environmental flows to drought-affected wetlands in South Australia and improve environmental services.[34] Additionally, the Northern Victorian Irrigation Renewal Project is a major project identifying possibilities for structural change in the irrigation system, including the modernisation of channels and infrastructure and the closing down unviable channels.

See PI-TP 10

Freshwater supply is generally provided to inland power generators under licence arrangements. The mechanisms for accessing water include:

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6.2 The electricity power sector in Australia

Australia's energy consumption is dominated by coal, which fuels most of the country's power generating plants. In May 2009, Australia had approximately 47 gigawatts (GW) of installed electric generating capacity.[35] This was powered by fuels from the following sources: Coal (76%; with a majority coming from black coal), gas (15%), hydro (6%) and wind and biomass (1% each).[36]

The large coal fired thermal power stations are dominantly located outside the MDB. Selective information on their cooling technologies and plant locations is provided in **Figure 6** and **Table 3**. This shows the reduced water use of dry-cooled stations. In various locations seawater is used for cooling. In total, sea water provided around 9% of total water use and increases are expected.[37]

Table 3:

Overview of selected power stations in Australia and their absolute water use.[38]

Generator	Fuel and cooling technology	Water use
Millmerran (852 MW)	Super critical thermal coal -air cooled condenser	0.7 – 0.8 GL/year for boiler and auxiliaries
Kogan Creek (781 MW)	Super critical thermal coal – air cooled condenser	1.2 GL/year for boiler and auxiliaries
Stanwell (1,400 MW)	Thermal coal – water cooled natural draft cooling tower	15 GL/year
Gladstone (1680 MW)	Thermal coal – once through saline water cooling	0.9 GL/year for boiler and auxiliaries 0.7 GL/year treated recycled sewage for ash disposal
Mt Piper Power Station (1320 MW)	Coal-fired– water cooled natural draft cooling tower	15.6 GL/year for cooling, ash plant, makeup water and auxiliaries
Wallerawang 'C' Power Station (1000 MW)	Coal-fired– water cooled - natural draft cooling tower + Forced draft cooling tower	10 GL/year for cooling, make up water and ash plant.
Yallourn Power Station (1450 MW)	Coal - natural draft cooling tower	Low quality water 36.5 GL/year with around 15 GL/year returned to the river system – a net consumption of 21.5 GL/year.
Loy Yang Power Station (2200 MW)	Coal-fired – natural draft cooling tower	High quality water around 1 GL/year; Low quality water – around 25 GL/year ; Ground water – around 10 GL/year.
Loy Yang B Power Station (1000 MW)	Coal-fired – natural draft cooling tower	1 GL/year high quality water 17 GL/year low quality water.
Hazelwood Power Station (1600 MW)	Coal-fired – cooling pond	Total water use around 27 GL/year

6.2.1 Expansion

Projections of growth in electricity requirements for the National Electricity Market and the West Interconnected System suggest an additional total requirement of 27453 GWh up to 2020. This will require an additional generating capacity of around 2000 MW in New South Wales and around 3000 MW in Queensland by 2020.[39]

The types of investments needed to meet the growth in demand for additional generating capacity depend on a number of considerations. An important factor will be the ultimate price of emission permits. Other issues relate to progress in meeting renewable energy targets and the load patterns that emerge across the electricity supply grids.

In a study completed for the Electricity Supply Association of Australia in 2007, ACIL Tasman modelled different scenarios for a 10% emissions reduction target by 2020. Indicative results show that an additional 1304 MW of coal or gas-fired steam turbine generation, 6520 MW of combined cycle gas turbine and 1500 MW of geothermal capacity is scheduled. These technologies require cooling, either wet or dry.[40]

With respect to the coal/gas-fired steam turbine technologies, 208 MW are projected to be in the Upper Collie catchment in Western Australia and 375 MW in south east Queensland. For new combined cycle gas turbine, 2790 MW is projected to be in Queensland and 3250 MW in Victoria over the next ten years. However, a recent Waterlines Report does not provide further details on the MDB.[41]

6.2.2 Renewable energy

In 2004, Australia generated 2.5 GWh of electricity from renewable sources (excluding hydropower). Biomass and wind power are the most significant sources of this energy and in 2006 they respectively contributed 0.8% and 0.7% of the national energy mix. Hydropower is dominated by the Snowy Mountains scheme which is located within the MDB, **Figure 6**. Therefore, release of water in the scheme is in many cases determined by the water need for irrigation rather than electricity.

Australia's Mandatory Renewable Energy Target (MRET) is currently set at 9.5 GWh of total electricity generation and it is hoped that this target will be achieved by 2010. In line with this target, there are a number of investments being made in the renewable energy sector across the country. The government has, however, proposed changes to this from January 2011.

6.2.3 Water sustainability in practice

Given the water stress pressures on parts of Australia, the energy sector has been active in looking at technologies and systems that respond to water scarcity risk. A survey further revealed that (shorter term) water use efficiency measures delivered savings of up to 15 per cent in existing coal-fired power stations across Australia. [42]

The Millmerran station in Queensland (super critical thermal coal, air cooled), for example, uses recycled sewage treated with ultrafiltration and osmosis. Also, the wet-cooled Swanbank B and E stations within the MDB use in part recycled water.[43]

At a strategic level the power sector has entered into collaboration with the mining sector to share benefits. Frequently, waste water from mine dewatering activities is delivered to cooling towers. Examples include the Wallerawang C Power Station in New South Wales, the Bluewaters and Muja stations in Western Australia and the Loy Yang Power Station in the Latrobe Valley.

See PI-TP 10

In another cross-sector initiative the Kwinana combined cycle gas station, which uses saline water cooling, has entered into a contract with an oil refinery to use recycled water.[44]

Some operators also undertake retention of run-off water (drainage) which can be used for dust suppression within their systems.

6.2.4 Other

Energy commodities are an important source of export earnings for Australia and the development of these resources in a sustainable manner is a primary goal for the government. Improving end-use efficiency in various economic sectors remains a key element of Australia's sustainable energy policy, as does the utilization of renewable energy resources.