



Government of **Western Australia**  
Department of **Water and Environmental Regulation**

# **Climate Change Actions 2017 Stocktake Report**

*Summary of climate change measures implemented by Western Australian State Government agencies and trading enterprises*

**Version: Final**

September 2017



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## Executive Summary

The Department of Water and Environmental Regulation (DWER) has conducted a stocktake of climate change actions and measures across government to guide the Government's future approach and priorities in this area.

In August 2017, government agencies and government trading enterprises (GTEs) were invited to provide information on climate change actions within their organisations using an electronic survey. Survey responses were received from 36 organisations (31 agencies and five GTEs) and supplementary measures for an additional three organisations were identified through other processes. The stocktake focuses on current climate change adaptation and mitigation actions including, but not limited to, policies, plans and strategies; research programs; communication initiatives; grants or subsidies; legislation; and infrastructure projects.

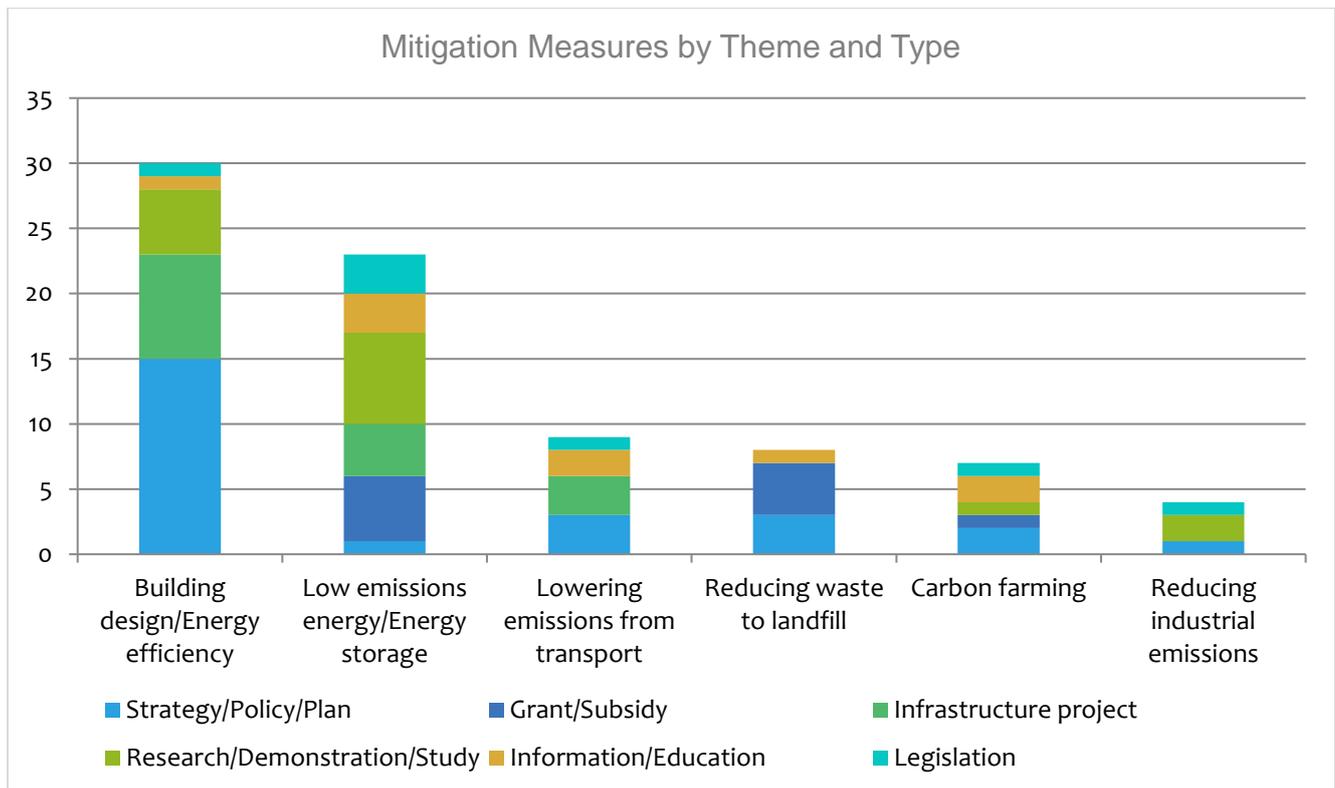
The stocktake reveals that 84 mitigation and 115 adaptation measures are implemented across government. Mitigation initiatives include measures to promote renewable energy and energy storage technologies, sustainability programs, measures to reduce waste to landfill, and travel behaviour change initiatives. Adaptation initiatives include measures to address extreme events, the natural environment, water or food security, the built environment, and the coastal zone.

Over two thirds of all adaptation-related measures were implemented by five organisations: Department of Biodiversity, Conservation and Attractions (DBCA); Department of Primary Industries and Regional Development (DPIRD); DWER; Department of Planning, Lands and Heritage (DPLH) and Water Corporation. A third of all mitigation-related were implemented by four organisations - DWER, Department of Finance, VenuesWest and Synergy.

Half of all mitigation measures were identified as having specific funding, and a small number of these (e.g. national Solar Schools, Alkimos Beach solar and battery trial) received funding from Commonwealth sources. Just under half of adaptation measures have specific funding, of which 12 received at least part of their funding from a Commonwealth Government funded organisation, mostly research institutions or funding programs. Four adaptation measures were identified as being driven completely or partially by Commonwealth legislation, policy or program.

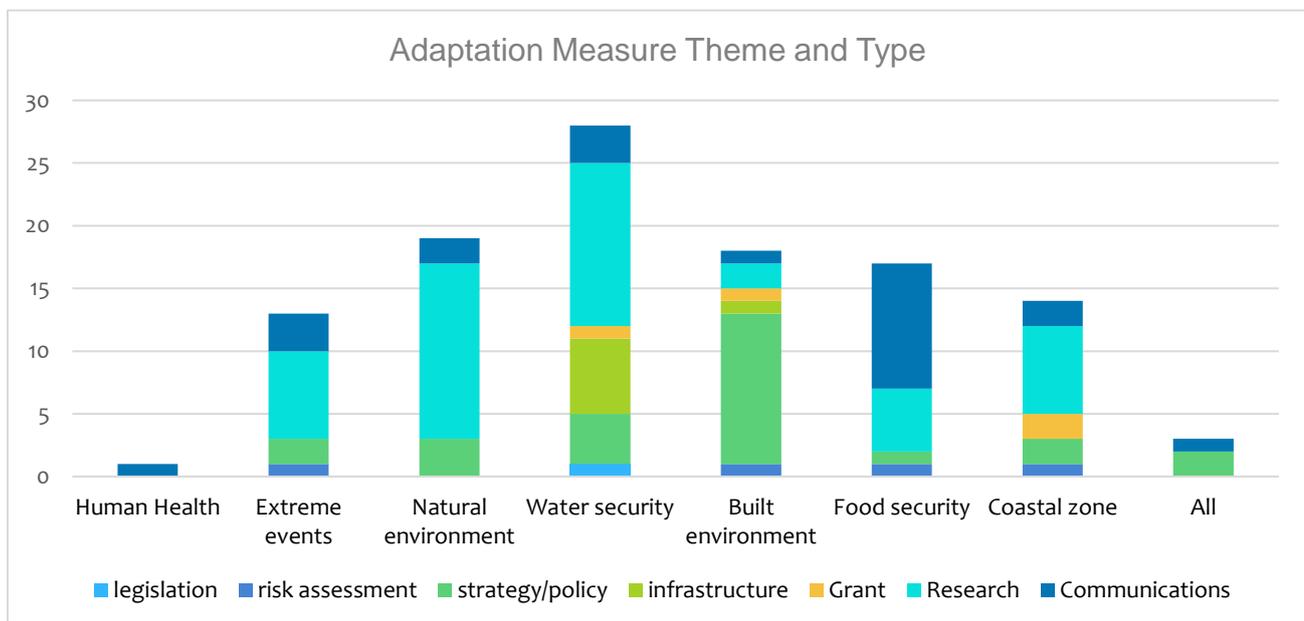
The most common type of mitigation measure was a strategy/policy/plan, while legislation was the least common type. Two organisations (Main Roads and Fremantle Ports) have a strategy or plan to reduce greenhouse gas emissions across their operations. The most common type of adaptation measure was research, followed by strategies/policies/plans and communications/capacity building. One agency (Main Roads) has an overarching adaptation strategy. Two agencies (DBCA and DPIRD) have adaptation assessment reports or plans for some of their functions.

The bulk of mitigation measures were aimed at improved building design and/or energy efficiency (36 per cent) and low emissions energy or energy storage technologies (27 per cent). A smaller number of measures was aimed at lowering emissions from transport (11 per cent), reducing waste disposed of to landfill (10 per cent), carbon farming (eight per cent), and reducing industrial emissions (five per cent). Figure 1 presents a breakdown of the number of mitigation measures by theme/sector and type.



**Figure 1. Breakdown of mitigation measures by theme and type**

The majority of adaptation measures was aimed at water security, followed by measures directed at the natural environment and built environment. Figure 2 presents a breakdown of adaptation measures by theme and type.



**Figure 2. Breakdown of adaptation measures by theme and type**

Overall, around two thirds of mitigation measures and just over half of all adaptation measures were primarily directed at climate change mitigation or adaptation (or had climate change mitigation or adaptation as one of a number of primary or significant aims), with the remainder of measures implemented for other reasons, and climate change mitigation or adaptation being identified as an ancillary benefit.

DWER considers the stocktake results to constitute a reasonably accurate assessment of current climate change actions and measures implemented across Government.

Building on the stocktake findings, a high-level strategy to guide future whole of government policy, approaches, priorities and increased resourcing for climate change will be provided by end of December 2017. The strategy will identify areas where Government can work with business and industry, local governments and regional communities to understand and adapt, to use current science to support decision-making, and to support the transition to a low carbon economy.

## 1. Introduction

In August 2017, the Department of Water and Environmental Regulation (DWER) coordinated a stocktake of climate change actions and measures across State Government agencies and government trading enterprises (GTEs) to guide the Government's future approach and priorities in this area.

Government agencies and GTEs were invited to participate in the stocktake via a letter from the Minister for Environment to his ministerial colleagues in July 2017. Organisations subsequently provided consolidated information on their respective climate change actions through a survey developed by DWER (Appendix A). The survey was administered using an electronic online software application known as 'Formstack' to allow input from different sections of organisations to be easily collated, and to facilitate review and approval prior to submission to DWER.

Both adaptation and mitigation measures were included in the climate change stocktake. Organisations were encouraged to report measures which were primarily driven by climate change objectives (including those measures which had climate change as one of a number of key objectives), and measures which were primarily implemented for other reasons but delivered ancillary climate change benefits.

Where DWER identified additional climate change measures that were not reported through the survey, either through publicly available information, previous departmental advice, or supplementary liaison with organisations, those measures were also included.

Thirty-six survey responses were received (31 agencies and five GTEs) and measures for three additional organisations were included by DWER (Appendix B).

Organisations were asked to list the name, description and key objectives of all relevant measures, along with specific funding allocations, implementation timeframes and current status (e.g. ongoing, complete).

On the basis of DWER's initial assessment, the stocktake findings provide a reasonably comprehensive indication of current climate change actions and measures implemented by key State Government agencies and GTEs. A consolidated list of measures is at Attachment B.

This report summarises the stocktake results and presents statistics on adaptation and mitigation measures reported.

## 2. Analysis of results

Adaptation and mitigation results generated by the survey responses have been grouped for ease of analysis and to provide context.

Mitigation measures have been sorted by sector/theme into improved building design and/or energy efficiency; low emissions energy or energy storage technologies; lowering emissions

from transport; reducing waste disposed of to landfill; carbon farming; and reducing industrial emissions. Adaptation measures have been grouped into water security; food security and primary industries; natural environment; built environment; extreme events; health; and coastal zone.

DWER has undertaken validation of the primary objective of the measure (i.e. whether measures were aimed primarily or significantly at climate change, or whether they were implemented primarily for other reasons), and identified those measures implemented (either solely or partly) as a result of an Australian Government law, policy, subsidy or program.

Measures have been classified by type research/study; infrastructure project; grant/subsidy; legislation; strategy/policy/plan; information/education/communication; and risk assessment. The latter category applies exclusively to adaptation measures.

Mitigation and adaptation results are presented by sector/theme in the following sections.

### 3. Mitigation measures

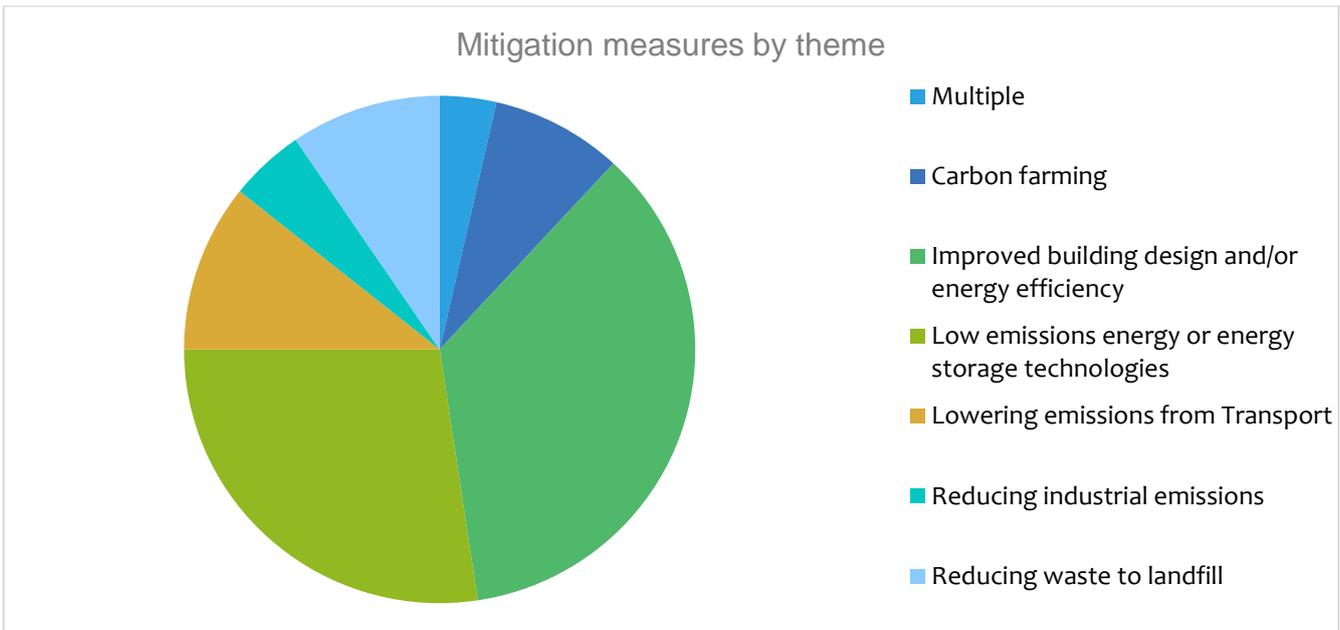
Across agencies and government trading enterprises, 84 measures related to climate change mitigation were identified by 24 organisations. Fifteen organisations reported not implementing any mitigation initiatives.

A third of all initiatives were implemented by four organisations - DWER, Department of Finance, VenuesWest and Synergy.

Initiatives included Synergy's renewable energy generation installations, for example the Albany wind farm and Greenough solar farm, school sustainability programs, measures to reduce waste disposed of to landfill, and travel behaviour change.

Around a third of measures was a strategy/policy/plan, while the least common type of measure was legislation. Half of all mitigation measures were identified as having specific funding; a small number of these (e.g. national Solar Schools, Alkimos Beach solar and battery trial) received funding from Commonwealth sources.

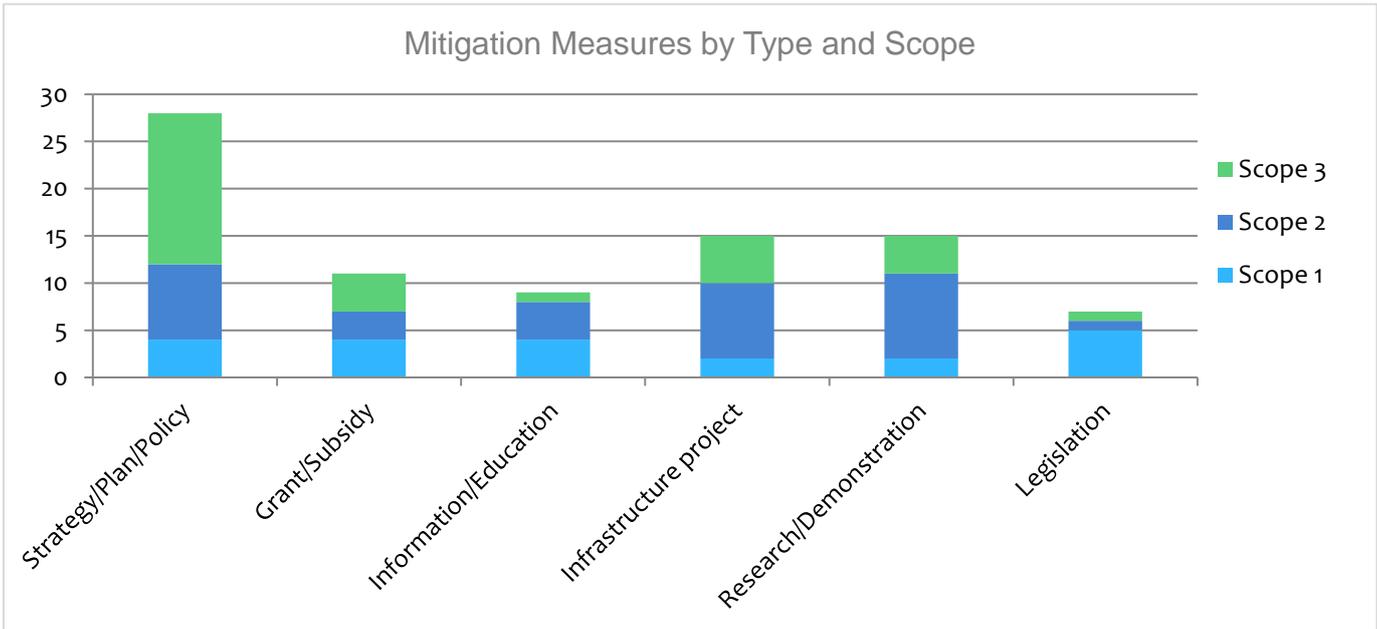
The bulk of mitigation measures were aimed at improved building design and/or energy efficiency (36 per cent) and low emissions energy or energy storage technologies (27 per cent). A smaller number of measures were aimed at lowering emissions from transport (11 per cent), reducing waste to landfill (10 per cent), carbon farming (eight per cent), and reducing industrial emissions (five per cent) (Figure 3).



**Figure 3. Number of mitigation measures by sector/theme**

Three mitigation measures were identified as having outcomes in multiple sectors. This includes DWER’s provision of policy advice on climate change mitigation to government and key State agencies. Two organisations, Main Roads and Fremantle Ports, have a climate change mitigation policy or plan that focuses on reducing greenhouse gas emissions across their operations. These plans set out strategies and actions to reduce energy use and carbon emissions in areas including electricity use, transport, and waste.

Overall, around two thirds of measures were primarily directed at climate change mitigation (or had climate change mitigation as one of a number of primary or significant aims), while around one third of measures were implemented for other reasons, with climate change mitigation identified as an ancillary benefit (Figure 4). Organisations identified seven measures which are now complete.



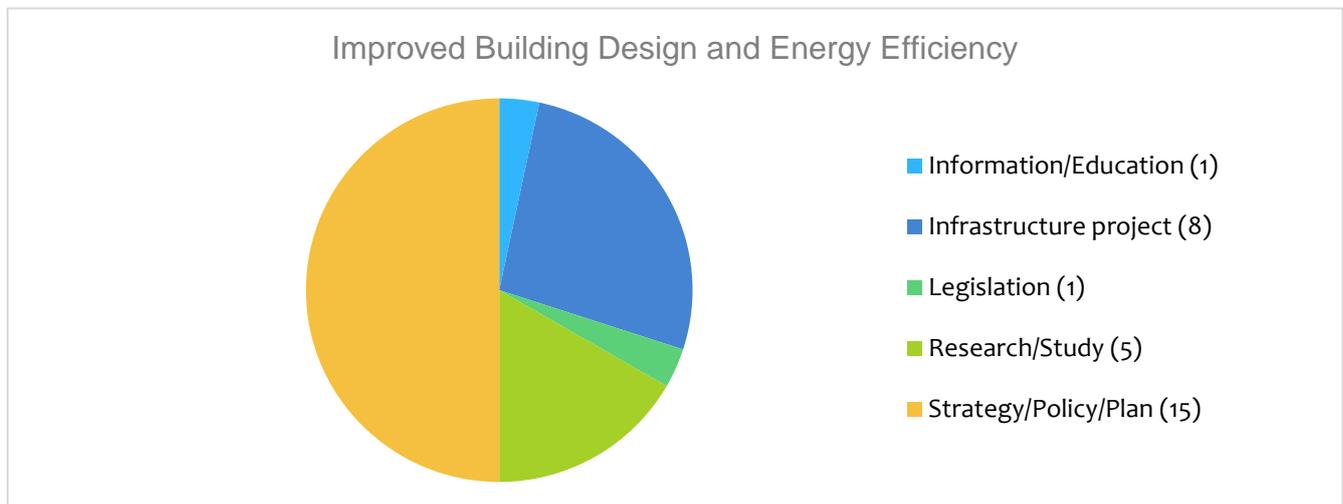
**Figure 4. Mitigation measure type and scope** (scope 1 measures have climate change mitigation as a primary aim, scope 2 measures have climate change mitigation as one of a number of key aims, scope 3 measures have climate change mitigation as an ancillary benefit)

### 3.1 Improved building design and/or energy efficiency

Measures to reduce greenhouse gas emissions within the building and energy efficiency sector include reducing the use of energy, water and consumables; implementing energy efficient building design; and integrating renewable energy such as solar photovoltaic panels.

Emissions from the building sector are estimated to account for almost 25 per cent of national greenhouse gas emissions. Thirteen organisations currently implement 30 measures that assist with climate change mitigation in this area. Of these, 20 per cent are undertaken by VenuesWest to improve the energy and water efficiency of its operations and use renewable energy. The Department of Finance implements four initiatives to improve the energy efficiency of government buildings.

Two-thirds of measures were implemented with climate change as a primary or significant aim; the remainder achieve greenhouse gas mitigation as an ancillary benefit. Half of the initiatives were classed as a strategy, policy or plan (Figure 5). These include *State Planning Policy 7 – Design for the Built Environment* implemented by DPLH and the *National Energy Productivity Plan* being delivered through the Council of Australian Governments.



**Figure 5. Breakdown of improved building design and energy efficiency by type**

Infrastructure projects accounted for 27 per cent of the initiatives in the building design and energy efficiency sector. Projects include the Department of Communities Onslow Solar Panel Project (now complete), the installation of LED lighting at new and existing stations by the Public Transport Authority (PTA), and the retrofit installation of solar hot water heating for aquatic facilities by VenuesWest at HBF Stadium and HBF Arena.

Five research projects are being undertaken by agencies studying and demonstrating energy efficient building materials, products and designs. This includes LandCorp's partnership in the Living Laboratory at White Gum Valley - a four-year research project led by the Cooperative Research Centre for Low Carbon Living that is monitoring and assessing how energy and water efficient design, technology performance and occupant behaviour impact on the carbon and ecological footprints of the precinct.

There is one legislative initiative implemented in this sector – the energy efficiency requirements for homes and commercial buildings in the National Construction Code administered in Western Australia by the Department of Mines, Industry, Regulation and Safety (DMIRS).

One information/education initiative is implemented by the Department of Finance. Building Management and Works, within the Department of Finance, has been comparing modelled energy use prior to construction of non-residential projects with actual energy use with the aim of investigating the reasons if there are any major discrepancies.

### 3.2 Low emissions energy or energy storage technologies

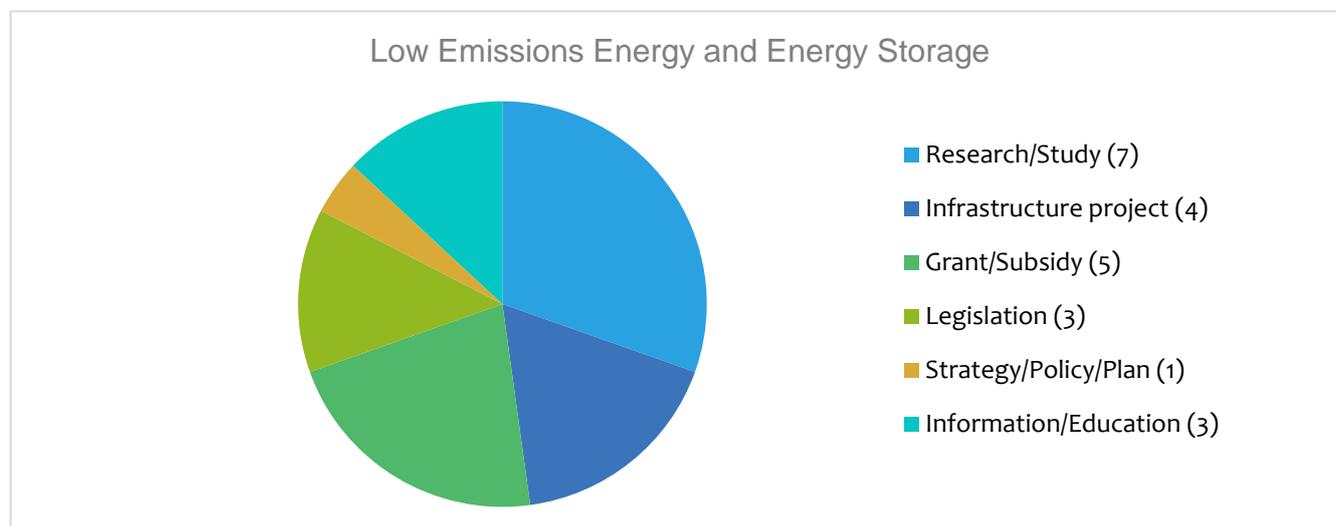
Low emissions energy or energy storage technology actions cover a wide array of measures aimed at promoting or removing barriers to renewable energy (wind, wave and solar) and battery storage.

Emissions from electricity contributed 26 per cent of Western Australia's emissions in 2015. The current level of renewable energy generation in the State's main electricity grid is 13 per cent, including both large and small scale (e.g. rooftop solar PV) generation.

A total of 23 measures were implemented by 10 organisations. These included feasibility studies, installation and/or promotion of renewable technologies, energy storage trials, education programs and renewable resource assessments.

Approximately 60 per cent of projects have specific funding. Of these, several were carried out under Commonwealth programs (including the national Solar Schools Program), and one with funding from the Australian Renewable Energy Agency (ARENA).

The majority of measures were implemented by four organisations: Synergy (5 measures), along with Horizon Power, LandCorp and Western Power (3 measures each).



**Figure 6. Breakdown of low emissions and energy storage measures by type**

The breakdown of measures by type is presented in Figure 6. Around 30 per cent of measures can be classed as a research project/study, and include solar feasibility studies in remote communities (DoC), the Alkimos Beach energy storage trial (Synergy & LandCorp), the Carnarvon energy storage trial and Onslow power project (Horizon Power), the solar/battery microgrid trial at Whitegum Valley (LandCorp), and Western Power's solar/battery storage trials at Ravensthorpe/Jerramungup and Kalbarri, and wave powered microgrid at Garden Island.

Overall, 70 per cent of measures were implemented primarily for climate change mitigation and 30 per cent were implemented primarily for other reasons. Two of the measures – the national Solar Schools Program and the Kalbarri feasibility study – are now complete.

### 3.3 Lowering emissions from transport

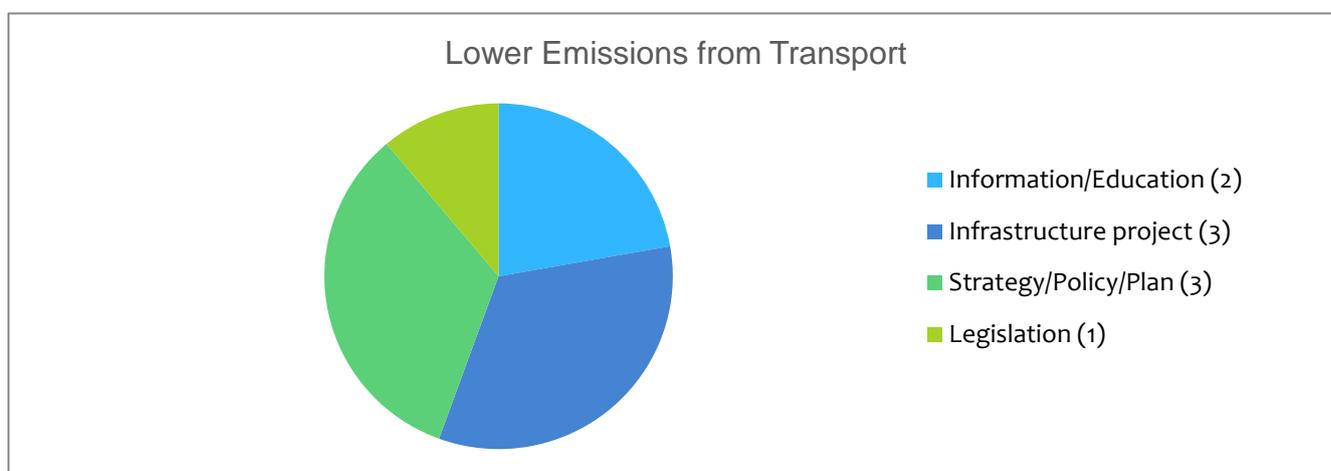
Measures designed to lower emissions from transport include provision of public transport infrastructure, infrastructure to encourage cycling and walking, fuel efficiency and alternative fuel initiatives, behaviour change and other travel demand management initiatives.

Transport currently contributes 15 per cent of Western Australia's emissions, and emissions from this sector have grown by around 18 per cent since 2000.

Six agencies reported implementing nine measures in this sector. Seven measures have addressing climate change as a primary or significant aim. Figure 7 below presents a breakdown of measures by type.

The two information/education initiatives in this sector are implemented by the Department of Transport. These include the behaviour change program, *Your Move* and a package of travel demand initiatives through the *Travel Choices for Perth and Peel* plan. *Your Move* encourages and facilitates community members within particular locations as well as local governments, schools and workplaces to consider and use active transport such as cycling, walking and public transport.

Infrastructure projects include METRONET which will expand and improve public transport and enhance lower emissions transport options. Other infrastructure projects include the Department of Transport’s \$84 million investment over four years (2018-2022) to retrofit cycling infrastructure across Western Australia and Synergy’s partnership with the Australian Electric Vehicle Association to install more than 70 electric vehicle charge points through rural and remote Western Australia.



**Figure 7. Breakdown of lower emissions from transport measures by type**

Three organisations implement policies or plans to improve the fuel efficiency of their vehicle fleet. The Western Australian Government Fleet Policy and Guidelines state that agencies are required to select vehicles not exceeding a maximum specified carbon dioxide emission rating other than where a clear operational need for an alternative exists.

The *State Supply Commission Act 1991*, administered by the Department of Finance, stipulates requirements relating to the minimisation of greenhouse gas emissions associated with vehicles used by public authorities and offsetting the greenhouse gas emissions that occur from the vehicle fleet.

### 3.4 Reducing waste to landfill

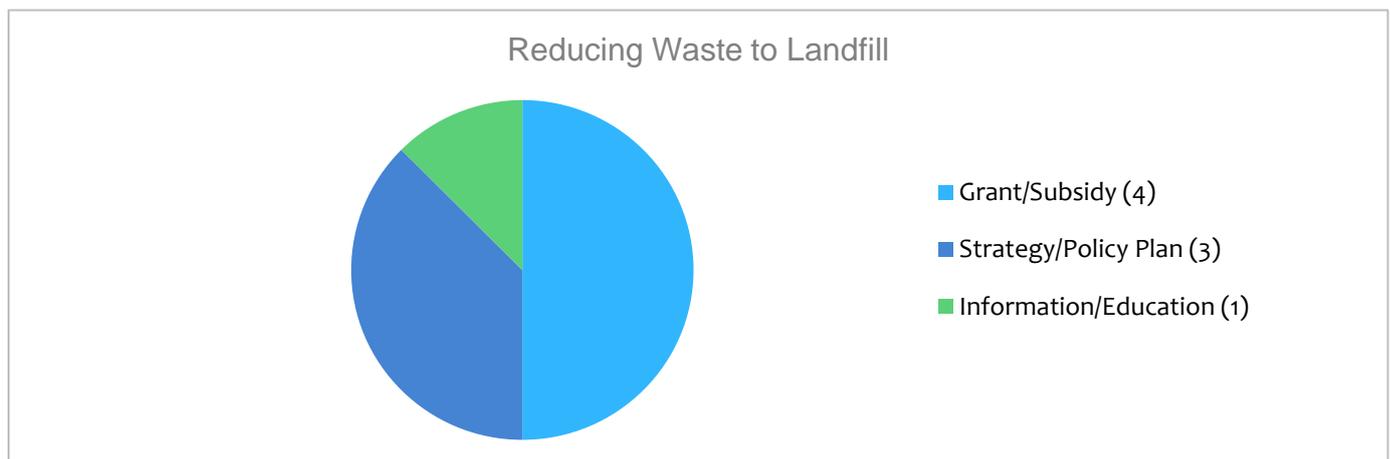
Measures that assist to reduce greenhouse gas emissions from the waste sector can include improved resource recovery and reuse; the destruction of landfill methane gas; and composting of organic matter that has been diverted from landfill.

The waste sector contributes less than 2 per cent of Western Australia’s emissions, and emissions from the sector have declined slightly since 2000.

Eight measures are currently implemented across three government organisations that assist to reduce greenhouse gas emissions from waste going to landfill. The majority of these measures (75 per cent) report climate change mitigation as an ancillary benefit and not a primary aim of the activity. Figure 8 presents a breakdown of measures by type.

DWER implements six of the eight measures. Four measures are grant or subsidy programs funded through the Waste Avoidance and Resource Recovery Account to promote resource recovery, including the Better Bins, Waste Wise Schools, Household Hazardous Waste, and Recycled Construction Products Programs. Other measures include the Western Australian Waste Authority’s position statement on waste to energy and the collection of waste and recycling data from local governments and recyclers.

The WA Police and VenuesWest implement two further strategies in this sector to minimise waste and increase recycling across their operations.



**Figure 8. Breakdown of reducing waste to landfill measures by type**

### 3.5 Carbon farming

Carbon farming measures include those aimed at enhancing or promoting the biosequestration of carbon in vegetation or soils, and reducing emissions by adopting new technologies or improved land management practices. The latter may include, for instance, stock reduction, feed additives to reduce methane emissions from cattle, or early dry season savannah burning.

Emissions from the agriculture, land use and forestry sectors collectively account for around 10 per cent of Western Australia’s emissions, and have declined since 2000.

A total of seven carbon farming measures are implemented by Government in the areas of agriculture, land management and forestry by five organisations: DWER, Forest Products Commission (FPC), DPIRD, DBCA and Landgate.

Two of the forestry measures – the Softwood Plantation Expansion Strategy (FPC) and the Forest Management Plan 2014 – 2023 (DBCA) - are not primarily aimed at climate change mitigation but may deliver some mitigation benefits.

The remaining measures are exclusively aimed at enhancing carbon farming opportunities and access to carbon credits. These include: the *Carbon Rights Act 2003* administered by DWER, which creates the legal framework for carbon rights in Western Australia; carbon farming information and research projects implemented by DPIRD; a savannah burning project carried out by DBCA under the Australian Government’s Emissions Reduction Fund (ERF); and Landgate’s CarbonWatch, a suite of products develop to assist land managers identify land suitable for forest sink abatement projects under the Kyoto Protocol.

Three of the seven carbon farming measures have specific funding; one of which is funded under the ERF. Two of the measures – DPIRD’s carbon farming research project and Landgate’s CarbonWatch – are now complete.

### 3.6 Reducing industrial emissions

Measures to reduce industrial emissions include policy or regulatory approaches to improved industry energy efficiency and best practice, as well as R&D to support development of new technologies, and pilot and demonstration projects. An example of the latter is the now concluded Low Emissions Energy Development (LEED) Fund, administered by the former Department of Environment Regulation.

Emissions from stationary energy sources (i.e. energy industries, manufacturing, fugitive emissions) were 58.4 MtCO<sub>2</sub>-e in 2015, which is 68 per cent of Western Australia's overall emissions. Emissions from energy industries and manufacturing have been the largest contributor to Western Australia's emissions growth since 2000, and a relatively small number of facilities contribute the majority of Western Australia's emissions.

Four measures aimed at reducing industrial emissions are being implemented by three organisations; DMIRS, DWER and the Water Corporation.

The South West Hub carbon capture and storage (CCS) project, implemented by DMIRS, aims to pilot the capture and injection of emissions from industries in the South West for permanent storage (geosequestration) within the Lesueur Sandstone formation. The project is currently testing the feasibility of the southern Perth Basin as a suitable reservoir for CO<sub>2</sub> storage and has received federal funding through the CCS Flagships program.

In parallel, DMIRS is also progressing the *Petroleum and Geothermal Energy Legislation Amendment Bill 2012* to provide a regulatory regime for the onshore storage of greenhouse gas.

In addition, the Water Corporation is participating in a national research partnership – the Zero-Energy Sewage Treatment Project - to demonstrate a zero-energy sewage treatment technology at pilot scale. The overarching aim of the three year project, led by Southern Cross University, is greenhouse neutral sewerage management.

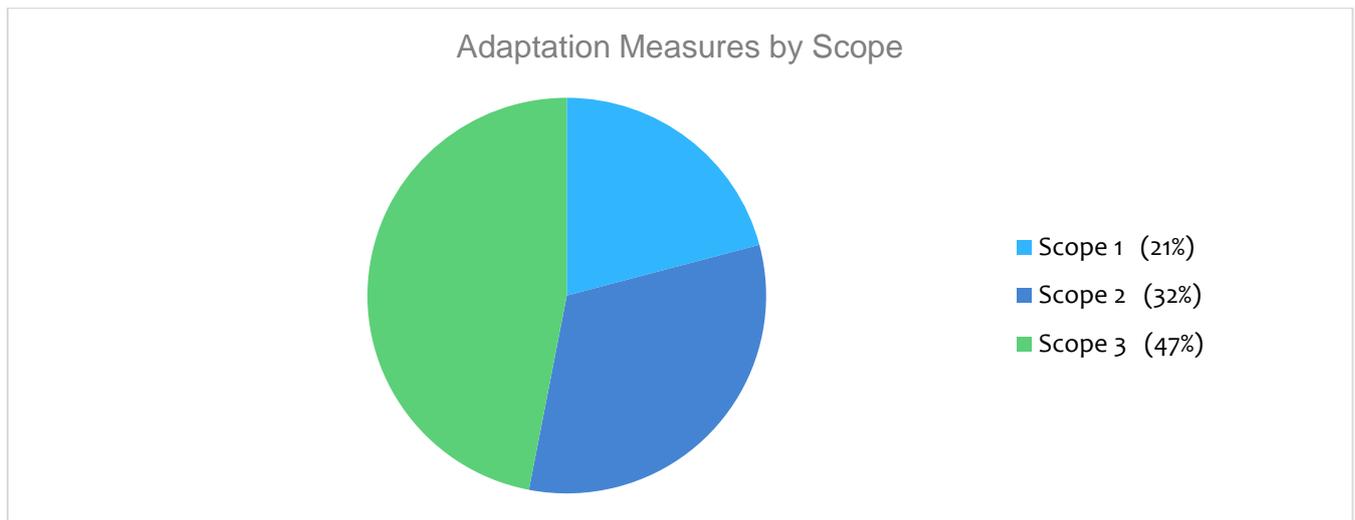
The final measure is the Environmental Protection Authority's (EPA) Environmental Factor Guideline on Air Quality, which sets out how this factor is considered by the EPA in the environmental impact assessment process and guides conditioning of projects under Part IV of the *Environmental Protection Act 1986*. The Air Quality Guideline is not primarily aimed at climate change mitigation, but may deliver climate change benefits to the extent that it encourages proponents to reduce emissions of greenhouse gases.

## 4. Adaptation measures

Across government (agencies and GTEs), 115 climate change adaptation related measures were identified by 23 organisations. 16 organisations reported not implementing any adaptation initiatives.

Over two thirds of all measures were implemented by five organisations: Department of Biodiversity, Conservation and Attractions (DBCA); Department of Primary Industries and Regional Development (DPIRD); Department of Water and Environmental Regulation (DWER); Department of Planning, Lands and Heritage (DPLH) and Water Corporation.

Climate change adaptation was the primary, or one of the primary aims for implementing 62 of the measures (53 per cent) (see Figure 9). The remaining measures were implemented for other reasons with climate change adaptation identified as an ancillary benefit.



**Figure 9. Adaptation measures by scope** (*scope 1 measures have climate change adaptation as a primary aim, scope 2 measures have climate change adaptation as one of a number of key aims, scope 3 measures have climate change adaptation as an ancillary benefit*)

Only measures that were either a) completed and still relevant, or b) on-going, were recorded in the Stocktake. Three of the adaptation related measures were reported to require updating.

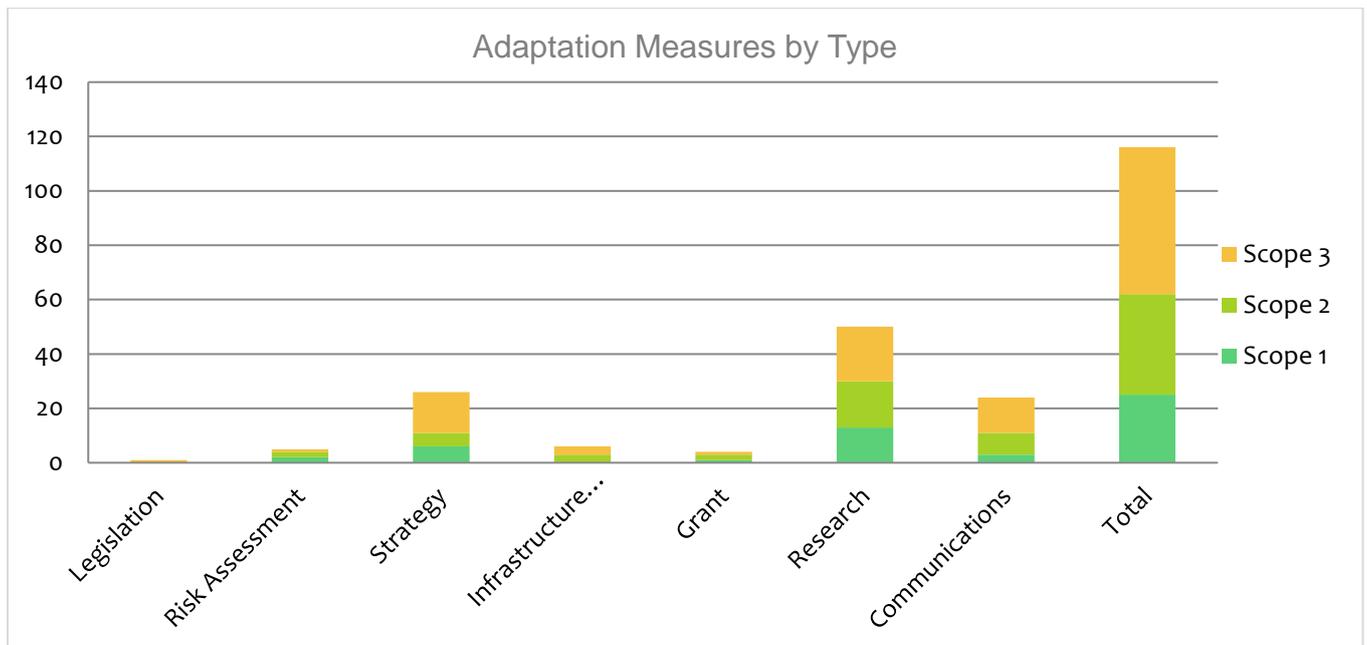
Just under half of all adaptation measures were identified as having specific funding. Of these 12 received at least part of their funding from a Commonwealth Government funded organisation, mostly research institutions or funding programs. Four adaptation related measures were identified as being driven completely or partially by a Commonwealth legislation, policy or program.

Geographically, just over half of adaptation measures were state-wide projects (or scattered across the state), 10 per cent of measures were located or focused on the Perth Metropolitan Region, 27 per cent in the Southwest (excluding Perth), nine per cent are regional.

Significant adaptation measures include:

- State Planning Policies 2.6 State Coastal Planning Policy and 3.7 Planning in Bushfire Prone Areas – these provide state-wide, cross portfolio guidance, neither primarily driven by climate change but both have benefits for adaptation.
- Research undertaken by DBCA into changing fire environment of southwest Western Australia which has potential benefits to all sectors.
- Water Corporation investment in securing water sources into the future.
- Department of Transport (DoT) – Climate Adaptation and Protection grants for local coastal managers, that builds capacity and supports coastal adaptation planning and action.

The most common type of adaptation measure (43 per cent) were ‘research/improving understanding’; these types also had the largest portion of projects directly related to climate change (Figure 10). Strategies/policies/plans and communications/capacity building measures were the next most common type of measures, although these measures were more likely to be motivated by either multiple objectives or non-climate factors.



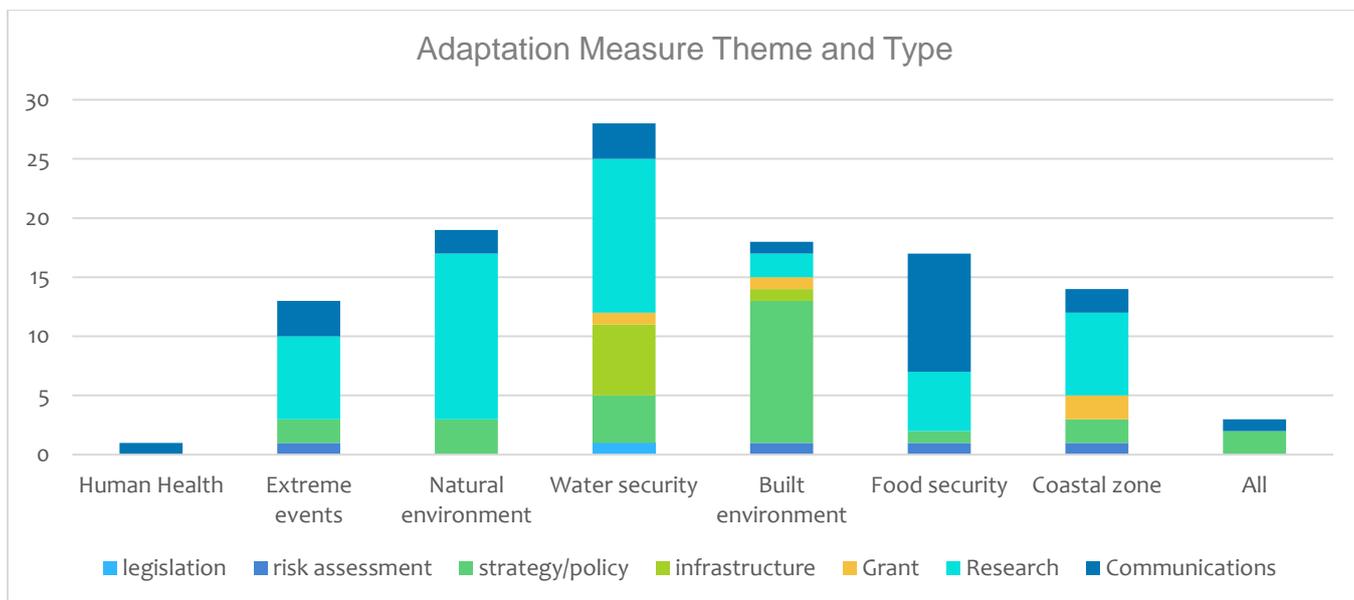
**Figure 10. Adaptation measures by type and scope** (scope 1 measures have climate change adaptation as a primary aim, scope 2 measures have climate change adaptation as one of a number of key aims, scope 3 measures have climate change adaptation as an ancillary benefit)

Other observations about the adaptation measures reported include:

- One legislative type measure was reported as adaptation related: the proposed *Water Resource Management Bill*.
- One agency has an overarching adaptation strategy/plan for their agency: Main Roads with their Climate Change Key Aspect Management Plan.
- Two agencies have significant adaptation assessment reports or plans for aspects of their function. DPIRD has separate assessments and plans for agriculture and fisheries - Climate Ready Agriculture: A Situation Statement, and Assessment of Climate Change Effects on Fisheries. Additionally, DBCA's Forest Management Plan 2014-2023 contains a chapter on climate change.
- The Department of Communities prepared a climate change adaptation plan for a particular project: Green Star Communities Climate Adaptation Plan for the 'East Green' Development.
- The Office of Emergency Management's State Risk Project is the only identified state-wide risk assessment, however it is not primarily driven by climate change. It looks at risks posed by 27 natural hazards, six of which are influenced by climate.
- Two agencies have internal policies requiring risk assessments for their projects: Main Roads WA requires projects of \$100 million and above to undertake climate change risk assessments and PTA requires major projects to have risk assessments.
- Water utility GTEs were the only organisations with climate change adaptation-related infrastructure projects. Water Corporation and Bunbury Water Corporation each had large scale infrastructure developments, such as a water treatment plant and groundwater replenishment scheme.
- Four agencies had grant programs to assist in adaptation practice. DoT and DPLH both provide assistance for coastal managers through the Coastal Adaptation and Protection grant program and the Coastal Management Plan Assistance Program respectively. These programs, with annual grant cycles, support local governments and other land managers to implement State Planning Policy 2.6. In addition, DWER provides grants up to \$100,000 to assist farmers develop farm water supplies in areas across the state which receive less than 600mm ppt per year.

- Research and improving understanding accounted for almost half of all adaptation measures, and many of these (60 per cent) directly related to climate change (scope 1 and 2). Ten agencies nominated research measures, with DBCA (15 projects), Water Corporation (11 projects) and the Department of Fire and Emergency Services (six projects) accounting for 60 per cent of the measures in this category.
- Seven agencies/GTEs have measures aimed at capacity building and education, through communication material or programs. Eleven of 24 measures were primarily aimed at climate change. These include the provision of technical advice to stakeholders, community engagement and published materials.
- Two agencies reported maintaining a ‘watching brief’ on climate change policy and legislation or specific impacts that may affect their core business.

Two adaptation related measures were cross-sectoral. The first is DWER’s provision of policy advice on climate change adaptation and good practice to the State Government, other agencies, local governments and other external stakeholders. The second is the State Planning Strategy 2050 which provides a strategic context for planning and development decisions throughout the State. This Strategy incorporates consideration of a number of climate change issues that relevant for numerous agencies, but does not have adaptation as primary focus.



**Figure 11: Number of adaptation measures by theme and type**

#### 4.1 Increasing resilience of the natural environment

Twenty adaptation measures contribute to increasing the resilience of the natural environment. Of these, 14 are research and data collection projects, three are a strategy/policy/plan, and two are communication/education/capacity building measures. These measures are implemented by six agencies: DBCA, DPLH, DWER, DPIRD, Landgate and Kimberley Ports Authority. A third of the measures do not have climate adaptation as a primary objective but deliver significant benefits in relation to adaptation.

The 14 research/data collection projects are largely conducted by DBCA. Research topics include marine monitoring, coral reefs and bleaching events, forests, wetlands, and contribute to our understanding of how the natural environment is responding to the changing climate.

The three strategies/policies that relate to the natural environment are: DBCA’s Forest Management Plan 2014-2023; State Planning Policy 2 Environment and Natural Resources Policy (DPLH); and the Environmental Factor Guideline for Flora and Vegetation published by

the former Environmental Protection Authority (EPA).

The two communications/education/capacity building measures engage the community and provide information on: monitoring range shifts in marine species (Redmap); and a public access mapping service providing sea surface temperatures, chlorophyll and turbidity levels (OceanWatch by Landgate).

DBCA's project Restoring Riparian Vegetation Systems on the Warren and Donnelly Rivers is developing a framework for restoring and maximising resilience of revegetated populations of river bank vegetation. This is an example of an ecosystem-based approach to adaptation. Revegetating vegetation along river banks can reduce flood risk while improving biodiversity.

## 4.2 Securing water resources

The securing water resources sector, with 28 measures, has greatest number of existing climate change adaptation measures. These measures are reported by five agencies and two GTEs: DWER; Water Corporation; Bunbury Water Corporation; Department of Education; and DPLH. The majority of projects are undertaken by Water Corporation and Bunbury Water Corporation (16 measures), and DWER (eight measures).

Twelve research measures, including ten by Water Corporation, relate to water security. DWER identified two measures, including a project selecting standardised climate projections for use in water planning; and ongoing collection of data on groundwater and surface water resources in Western Australia. Other research measures were implemented by Water Corporation involving investigations of demand management, climate-independent water sources, and a suite of collaborative Research and Development projects.

Four communications/education/capacity building measures, all undertaken by DWER, involve the development of publications outlining the government's strategy of securing water resources in the southwest, in the context of the drying climate, and how climate projections are incorporated into water allocation planning.

Both Water Corporation and Bunbury Water Corporation have implemented infrastructure projects, including the Beenyup Groundwater Replenishment Scheme and demand management projects.

Four strategies/plans have been developed, two of which are primarily driven by climate change. The Greater Bunbury Integrated Water Management Strategy provides a framework for the development of new water sources in the context of a drying climate. DWER's Water Allocation Plans incorporate climate projections into water resource modelling and allocation planning for the south west and beyond.

DWER's Rural Water Plan, in conjunction with DPIRS, provides grant funding and support for farmers developing farm water supplies and efficiency plans in regions receiving very low rainfall.

The *Water Resource Management Bill* is the only legislative measure for adaptation in the stocktake. The Bill is seeking to consolidate the six existing water resource-related Acts and introduce water reform and statutory planning for the State's water resources. It will improve water trading and support the management of water resources that are in high demand.

The report, *Securing Water Resources for the Southwest*, published by DWER in collaboration with water utilities, provides a summary of climate trends, water use demand and sources in the southwest.

## 4.3 Improving resilience of the built environment

Eleven agencies and GTEs reported a total of 18 adaptation measures related to improving resilience of the built environment: PTA; Main Roads WA; DPLH; Department of Local Government, Planning and Infrastructure; Department of Water and Environmental Regulation

Government, Department of Sport and Cultural Industries; Department of Communities; Department of Finance; Metropolitan Regional Authority; Western Power; VenuesWest; Fremantle Ports; and Kimberley Ports Authority.

Twelve of these measures were identified as strategies/policies/plans, five of which are directly related to climate change, including incorporating climate change into existing plans or policies. Main Roads WA has developed a Climate Change Key Aspect Management Plan to provide a framework to improve organisational preparedness. It provides direction for actions, measures, procedures and capacity building to increase preparedness for future changes.

The Climate Adaptation Plan for the 'East Green' development was developed by the Department of Communities and Green Star and provides adaptation guidance at the project level. Main Roads WA and the PTA have a policy of undertaking climate change risk assessments for large projects. The PTA also has a policy on how it deals with high temperatures and flood risk.

A number of policies published by WAPC/ DPLH include climate change considerations. Kimberley Ports has included sea level rise, coastal flooding and other climate change impacts into its 50 Year Master Plan.

Fremantle Ports has undertaken research into the impacts of climate change on its assets, as well as the potential policies and legislation that may influence its business.

#### 4.4 Food security and primary industries

The stocktake has found 17 measures with aims related to improving the productivity and resilience of primary industries including agriculture, fisheries, and forestry. These measures were reported by two agencies: DPIRD and Landgate.

The most frequent type of measure reported in this sector was communication/education/capacity building (ten), all undertaken by DPIRD. These include the provision of climate change information, weather data, and a number of tools and publications to assist farmers to improve irrigation practices, manage climate variability and soil constraints, and improve seasonal forecasting.

Four research projects have been undertaken by DPIRD largely related to the impacts of changing climate on fisheries, and Landgate has an ongoing monitoring program which addresses changing salinity and remnant vegetation.

One risk assessment was identified by DPIRD. It assessed climate change impacts and risk ranking of various marine fish and invertebrate species, including an evaluation of the effects of an extreme marine heatwave event.

The report *Climate Ready Agriculture – a Situation Statement for Western Australia* sets out the likely changes to climate in Western Australia and proposes priority areas for investment to improve the resilience of agriculture in the state.

#### 4.5 Adapting our coastal zone

Climate change adaptation for the coastal zone has 15 measures across five agencies: DoT, DPLH; DWER; Landgate; and Kimberley Ports.

Unlike many other sectors, the coastal zone is one sector that has formal policy responses. This includes setting out climate change adaptation requirements and informing government agency decisions-making. For example, State Coastal Planning Policy (SPP 2.6) and its associated guideline includes requirements to consider sea level rise and coastal hazards in land use planning decisions. Similarly, the EPA's *Environmental Factor Guideline: Coastal Processes* incorporates consideration of coastal processes and vulnerability to climate change in the assessment of large scale developments.

Both the DoT and DPLH have grant programs to provide funding for local governments and other coastal managers to undertake coastal climate change adaptation projects. These funds assist in the implementation of SPP 2.6, and build understanding of coastal risks and hazards, including sea level rise, coastal erosion and coastal flooding.

DPLH, DoT and Landgate reported seven research/improving understanding/data collection measures related to the coastal zone. Each agency has gathered and presented data essential for supporting coastal vulnerability assessments and climate change adaptation planning. Data collected includes aerial photos; hydrographic, bathymetric and foreshore surveys; sediment cells determination (geomorphological classification); coastal landforms and tides levels. One example is the LiDar surveys undertaken by DPLH, in partnership with other organisations, which provide bathymetric mapping for over 700km of the Western Australian coastline.

DoT and DPLH also provide advice and support to other agencies and local governments regarding coastal engineering and technical input on coastal vulnerability and hazards, sea level rise and erosion risks through formal advice and regulatory reviews.

#### **4.6 Preparing and responding to extreme events (including fire)**

Thirteen adaptation measures related to improving resilience to extreme weather events were reported by seven organisations: Department of Fire and Emergency Services; Office of Emergency Management; Office of Bushfire Risk Management; DBCA; DPLH; Landgate; and DPIRD.

Measures that improve resilience to extreme events include research into weather-related hazards and extreme events; mapping hazards and other online tools to inform landowners of bushfire risk; two state-wide policies that provide guidance on responding to bushfire risk; and a state-wide risk assessment of natural hazards. Only one of the 13 measures identified in this sector is primarily a climate change adaptation measure. The remainder will assist in understanding of future changes to extreme weather events.

#### **4.7 Addressing impacts on human health**

The Department of Health (DoH) provides health advice that may relate to climate change to other government agencies and local governments. This includes inclusion of climate change in health risk assessment processes. DoH advice is the only adaptation related measure recorded in the stocktake from the human health sector.

### **5. Next steps**

DWER will refine the preliminary conclusions outlined in this report, and prepare a high-level strategy to guide future whole of government policy, approaches, priorities and increased resourcing for climate change will be provided by end of December 2017. Consideration will be given to opportunities to build on actions already underway, and areas Government can enhance, extend or refocus current measures or make the most of existing research and program outcomes.

The strategy will also identify areas where Government can work with business and industry, local governments and regional communities to understand and adapt, to use current science to support decision-making, and to support the transition to a low carbon economy.

## Appendix A — Climate change stocktake on-line survey questions

### Introduction

1. Name of your organisation
2. How many separate actions related to climate change is your organisation responsible for?

### For every project

3. Name of climate change action
4. Is addressing climate change the primary objective of this measure?
5. Does the measure relate to adaptation or mitigation?

#### *a. If adaptation is selected:*

How would you describe the main objectives of the action or project? (select all options that apply)

- Climate change impact, risk or vulnerability assessments and/or mapping
- Adaptation planning or selection of adaptation responses (e.g. evaluation of options for managing workplace occupational health and safety enhanced risks from projected increased frequency and intensity of heatwaves)
- Implementing adaptation measures (e.g. establishing wider coastal land use setbacks or building sea walls to better manage projected increased coastal erosion from sea level rise)
- Emergency response actions or policies (e.g. improving resilience to or preparedness for extreme events)
- Incorporating climate change adaptation considerations into agency policies, plans, strategies, guidelines or operations
- Communication and capacity building
- Improving understanding of climate science or adaptation through research
- Other (if other please describe)

#### *b. If mitigation is selected:*

How would you describe the main objectives of the action or project? (select all options that apply)

- Energy efficiency and low carbon built environment initiatives
- Promoting renewable energy (including removal of barriers) and/or promoting storage technologies for renewable energy (or removing barriers)
- Geosequestration, including removing barriers to geological storage of greenhouse gas emissions
- Promoting or removing barriers to carbon sequestration or other land-based emissions abatement
- Low(er) emission fuels and vehicles
- Transport mode shift/behaviour change (to lower emission transport options or cycling/walking)
- Infrastructure and land use planning initiatives that will reduce emissions
- Waste (including resource recovery and recycling)

- Carbon Offsets
- Communication, information sharing or education to support mitigation activities
- Other (if other please describe)

6. Please provide 2-3 sentences describing the project, policy or program
7. What geographic area does the action relate to?
8. What is the current life or status of the project?
9. Commencement year
10. Completion year (actual or expected)
11. Is the measure still current/relevant or does it need updating?
12. Is/was there specific funding for the measure?
13. How much? Where does/did the funding come from?
14. Are you the lead agency or organisation for this action?
15. List other stakeholders/partners involved (if any)
16. Please include relevant links to websites about the project
17. Please include contact details for the project (First)
18. Please include contact details for the project (Last)
19. Phone
20. Email
21. Have you finished completing the details for this project or action, and sought approval to submit if required (you'll be asked this for each project)?

**Prior to submitting survey**

22. Are there further opportunities for your organisation to take action to address climate change through government priorities being delivered in your portfolio area within existing budgets? For example through adjusting [re-engineering] existing projects or policies?
23. Have all climate change actions within your agency been added to this survey?

## Appendix B — Climate change stocktake: Consolidated list of measures

### Department of Biodiversity, Conservation and Attractions

#### **Mitigation**

**Forest Management Plan (2014-2023)** - provides for ecologically sustainable forest management. Climate change is addressed through statement of a goal, a series of management actions, and three key performance indicators.

**Emissions Reduction Project** - jointly conducted with Australian Integrated Carbon Financial Services, involves planned burning of savanna areas in the high and low rainfall zones during the early dry season to reduce the risk of late dry season wild fires.

#### **Adaptation**

**Responses of aquatic invertebrate communities to changing hydrology and water quality in streams and significant wetlands of the south-west forests of Western Australia** - monitors the composition of aquatic invertebrate communities in select streams significant wetlands across south-west Western Australia's forests.

**Understanding peat wetland resilience** - evaluating the impact of climate and landuse change on the hydrodynamics and hydrogeochemistry of peat wetlands in the Warren (Muir-Bye up) District.

**Management of invertebrate pests in forest of south-west Western Australia** - The observed decline in mean annual rainfall in south-west and projections of a future warmer drier environment mean conditions for forest invertebrate pests will alter significantly in coming decades. This project investigates the biology of recognized and emerging/potential invertebrate forest pests and the environmental conditions (including climate) which lead to outbreaks.

**Fire regimes and impacts in transitional woodlands and shrublands** - this project is investigating the ecological impacts of the recent fire regime on ecological values and carbon pools in the Great Western Woodlands.

**The Western Australian Marine Monitoring Program** - a marine monitoring program which measures the condition of key marine reserve ecological values relative to natural and anthropogenic pressures, including those from climate change.

**Regional scale coral bleaching on Western Australian reefs** - assessing the extent and impact of the 2010/11 heat wave on WA corals.

**Long term stand dynamics of regrowth forest in relation to site productivity and climate** - emerging issues for the next decade of forest management include climate change and declining groundwater levels, interactions with pests and pathogens, and increased recognition of the role of forests in maintaining global carbon cycles.

**FORESTCHECK** - integrated site-based monitoring of the effects of timber harvesting and silviculture in the jarrah forest.

**Hydrological response to timber harvesting and associated silviculture in the intermediate rainfall zone of the northern jarrah forest** - monitoring data provides a unique long-term record of the hydrological response of the jarrah forest to climate change and forest management practices.

**Interactive effects of fishing and climate change on coral reef fish populations (Ningaloo MP)** - investigating how climate change and fishing are affecting the habitats and composition of coral reef fish communities.

**Restoring natural riparian vegetation systems along the Warren and Donnelly Rivers** - this project is developing a climate change framework for restoration of the Warren and Donnelly Rivers by determining the scale of adaptation to climate along the river system and determining the best seed source strategies to maximize resilience to future changes in climate in the revegetated populations.

**Protecting the safe havens** - the identification of areas that can act as refugia under projected climate

change.

**Climate-resilient vegetation of multi-use landscapes** - this group of projects is investigating genetic adaptation to climate in widespread plant species in south-west.

**South-West Wetlands Monitoring Program** - monitors water depth and water chemistry biannually at ca. 100 wetlands.

**Understanding the changing fire environment of south-west Western Australia** - much of the science linking interactions between climate, fire weather and fire behaviour was established in the 1960-70s when the climate in south-west was wetter. There is a need to review and update baseline information that underpins bushfire risk management planned burning programs.

**Forest Management Plan 2014-2023** - climate change is addressed through statement of goals, a series of management actions, and three key performance indicators.

## Bunbury Water Corporation (Aqwest)

### **Adaptation**

**Construction of Emergency and Disaster Recovery Centre** – the Centre is geographically separated from the depot and administrative office and has been located above sea level to enable continued operation and maintenance of critical water infrastructure should the depot and administrative office be inaccessible.

**Emergency and Bulk Water Connection Bunbury/Dalyellup** - The existing bore at Dalyellup is in the sensitive coastal seawater interface. Aqwest water could be used in an emergency to supplement or replace water drawn from the Dalyellup Bore.

**Greater Bunbury Integrated Water Management Strategy** - a framework for the staged development of new water sources, drinking and non-drinking water supply schemes, wastewater collection and management, rain/stormwater collection and management to meet the needs of Greater Bunbury in a future of drying climate.

## Office of Bushfire Risk Management

### **Adaptation**

**Map of Bushfire Prone Areas** - an online map identifying areas designated as bushfire prone. These areas require additional planning and building requirements for new proposals to ensure that future developments are designed to reflect the level of bushfire risk.

## Department of Communities

### **Mitigation**

**Onslow Solar Power Project** - Department of State Development and Chevron funded program to reduce the overall energy costs on Government Remote Officer Housing in Onslow.

**Trial of Solar PV on social housing properties** - installation of 1KW Solar PV systems onto 412 Social Housing Properties.

**Rammed Earth Construction Project (Kalgoorlie)** - research into the use of alternate building materials, in particular rammed earth as a construction material for use in remote Aboriginal communities.

**Solar Renewable Energy Feasibility Study of Remote Communities** - feasibility study undertaken in 3 medium size remote communities - Wakathuni (Pilbara), Wangkatjunga (Kimberley) and Warburton (Goldfields) - to determine the viability of solar energy and the cost of development.

### **Adaptation**

**Green Star Communities version 1.1 Climate Adaptation Plan** - describes likely future climate for the East Green development, assesses climate risks, and sets out adaptation actions to be implemented to reduce vulnerability of the site to future climate conditions.

## Department of Education

### **Mitigation**

**National Solar Schools Program** - a Commonwealth funded initiative that provided schools with grants of up to \$50,000 each to install a range for climate change initiatives, such as solar PV systems, rain water tanks, and energy efficient lighting.

**Sustainable Schools WA** - Students and teachers undertaking action to reduce greenhouse gas emissions in the school environment while learning about climate change.

### **Adaptation**

**Automatic Irrigation Program** – Initially a grant program allocated to convert existing irrigation, the Department now has a policy of installing automatic irrigation at all new public schools.

## Electricity Generation and Retail Corporation (Synergy)

### **Mitigation**

**Renewable Energy Buyback Scheme** - WA government initiative to buy excess renewable energy generated by its customers.

**Promoting and selling solar and battery systems to customers** - active promotion and sale of solar and battery systems to customers.

**Expanding EV charging network in rural and remote WA** - in partnership with Australian Electric Vehicle Association, installation of more than 70 electric vehicle charge points through rural and remote WA.

**Operation of renewable power stations (wind and solar)** - wind and solar farms at Albany, Esperance, Greenough, Denham and Coral Bay.

**Monitoring and reporting of greenhouse emissions** (National Greenhouse and Energy Reporting Scheme - NGERs) - Synergy estimates its CO<sub>2</sub>e emissions and reports under the NGERs Act.

**Living Labs (Tips to building a sustainable home)** - research project partnered with Josh Byrne. Living Labs encouraged 10 suburban families to reduce their environmental footprint through solar panels, rainwater tanks or low energy lighting and appliances.

**Energy storage trial at Alkimos Beach** - trial energy storage, supporting the vision for Alkimos Beach of creating an environmentally conscious and sustainable community.

## Office of Emergency Management

### **Adaptation**

**State Risk Project** –consistent and comprehensive understanding of the risk posed to the state by 27 hazards prescribed in WA Emergency Management legislation. Six of these natural hazards (bushfire, cyclone, flood, heatwave, tsunami, storm) are influenced by climate.

## Department of Finance

### **Mitigation**

**Measuring energy use of government facilities** - delivered in the first 10-12 months of occupation, this measure endeavors to compare modelled energy use with actual energy use and investigates reasons if there are major discrepancies.

**Sustainable non-residential building policy** - buildings procured by the Department are required to be energy efficient. Building Management and Works will identify, develop and promote best practice sustainability standards for its non-residential government buildings.

**Offsetting of State Fleet Emissions under *State Supply Commission Act 1991***- the Act stipulates requirements to the minimise greenhouse gas emissions associated with vehicles used by public authorities, including offsetting vehicle fleet emissions.

**WA Government Fleet Policy and Guidelines (Fuel Efficiency Policy)** - agencies are required to select passenger vehicles with a CO<sub>2</sub> emission rating not exceeding 185g/km and 195g/km for SUV's, other than where a clear operational need exists for an alternative.

**Set point project aimed at limiting excess energy use through inappropriate use of air conditioning** - a trial is proposed to test savings in energy by ensuring temperature set points for AC systems better reflect external or ambient temperatures.

**Review of plans of government facilities at design and post occupancy stages** - BMW Finance architects review plans of new government buildings.

### ***Adaptation***

**State facilities built to withstand future climate events** - ensuring facilities procured by Building Management and Works will withstand future climate events such as storms, storm surges, cyclonic events, excessive rainfall, rising water tables, heat waves etc.

## Department of Fire and Emergency Services

### ***Adaptation***

**Severe Wind Hazard Assessment Project** - aims to better understand the potential impacts of cyclones on population centres and elements of critical infrastructure. The project will model scenarios of cyclone impact for Carnarvon, Geraldton, Perth, Broome, Port Hedland, Karratha/Dampier, and Exmouth.

**River catchment flood studies** – enhances understanding of how the catchment responds as a system when conditions favour flood events.

**Post Flood Research** - identifies the needs, beliefs, and risk perceptions of a number of focus groups around tourism, motorists, remote indigenous communities and residents to generate recommendations for key stakeholders and community engagement.

**Aurora Bushfire simulator** - web based system to simulate fire behaviour developed by Landgate in partnership with UWA and DFES.

## Forest Products Commission

### ***Mitigation***

**Softwood Plantation Expansion Strategy** - expansion of the softwood plantation estate by 10,000 ha from government funding. This is to provide long term security to the timber industry. Qualifies under the Carbon Farming initiatives.

## Fremantle Ports

### ***Mitigation***

**Greenhouse Gas and Energy Management Policy and Plan** - indicates the port's intent to reduce energy use and greenhouse gas emissions. It sets out responsibilities for management and staff.

### ***Adaptation***

**Develop understanding of the size and nature of changes associated with climate change; identify specific impacts of climate change and include in the Operational Risk Register if required-** to consider necessary responses and options available there is a need to understand the local changes to sea level, storminess, rainfall, air and water temperature, wind climate and currents.

**Monitor responses to climate change proposed by other ports; monitor proposed climate change legislative and policy changes that may impact business** - Engaging with ports to benchmark our response and identify any collaborative opportunities. Understanding existing and emerging policy, legislation and guidance so that Fremantle Ports can respond appropriately and consistently.

## Department of Health

### **Mitigation**

**WA Health and Hospitals plans** - each hospital has individual site plans related to initiatives to mitigate or address climate change impacts.

### **Adaptation**

**Provision of advice to Government and Local Governments**, - related to climate change and health, including development of local planning Schemes, Strategies and development Plans, when requested.

## Kimberley Ports Authority

### **Adaptation**

**Marine Baseline Study** - baseline field study of marine environmental values and collection of data on water quality, sediment quality, benthic infauna and benthic habitat values.

**Coastal Vulnerability Assessment for Port Lands** - Addressed future development areas within the Port against the principles of SPP 2.6.

**50 Year Master Plan** - strategic planning document to guide the port on future development. The plan includes considerations of climate change, specifically; sea level rise, coastal flooding and increased cyclonic events.

## Horizon Power

### **Mitigation**

**Esperance Standalone Power System** - customers in Esperance who suffered network outages as a result of bushfires have been offered solar-driven stand-alone power systems instead of being reconnected to the grid.

**Carnarvon Energy Storage Trial** - 12-month trial into the benefits of two 1,000 kilowatt batteries at the Mungullah Power Station in Carnarvon to explore ways of meeting energy demand at a lower cost.

**Onslow Power Project** - construction of a new modular power station for Onslow (final commissioning early 2018). A detailed options analysis has begun for the deployment of distributed energy resources in the form of batteries and solar.

## Department of Local Government, Sport and Cultural Industries

### **Mitigation**

**Community Sporting and Recreation Facilities Fund** - Funding to local government and not for profit sport and recreation related organisations for initiatives such as water capture and reuse, upgrading irrigation systems to be more efficient, installing solar panels.

### **Adaptation**

**Water Efficient Aquatic Centres** - decision support system to assistance to aquatic centre managers in their exploration of water efficiency gains, system upgrades and management improvements.

## Main Roads

### **Mitigation**

**Carbon Reduction Plan** - drives carbon emission saving and energy efficiency activities on a routine basis.

### **Adaptation**

**Climate Change Key Aspect Management Plan** – framework at organisational level to increase Main Roads' preparedness for climate changes. Its intent is to provide direction for actions, measures,

procedures and capacity building.

**Climate Change Risk Assessments** - Projects of a value greater than \$100m are required to undertake climate change risk assessments.

## Metropolitan Redevelopment Authority

### **Adaptation**

**Sustainable Development Through Development Management** - Management of development to align with MRA Objectives including encouraging ecologically sustainable design, resource efficiency, recycling, renewable energy and protection of local ecology.

## Department of Mines, Industry, Regulation and Safety

### **Mitigation**

**The Petroleum and Geothermal Energy Legislation Amendment Bill 2012** - designed to amend the petroleum legislation to provide a regulatory regime for the onshore storage of greenhouse gas, predominantly Carbon Dioxide.

**Southwest Hub CCS Project** - a staged project that involves collecting and analysing data and samples from the Lesueur Sandstone formation, to test its feasibility as a CO2 reservoir.

**Energy Efficiency requirements in the National Construction Code** - stringency of energy efficiency requirements for new homes to a 6 Star standard or equivalent. National initiative, implemented at the state level.

**Alterations and Additions protocol** - industry-led protocol for the alteration and addition of existing homes.

## Department of Planning, Lands and Heritage

### **Mitigation**

**State Planning Policy 7 Design for the Built Environment** - SPP guiding good design including sustainability principles.

**Apartment Design, as part of SPP 7.3 Residential Design Codes** - the new draft Apartment Design Policy is part of the Design WA initiative which includes a new draft State Planning Policy on the Built Environment.

### **Adaptation**

**Coastal Vulnerability Assessment Western Australia Project List** - a tool for DPLH, DoT, local governments to track and reference coastal vulnerability assessment projects. Intended to increase awareness and knowledge sharing and contribute to the ongoing improvement of coastal vulnerability assessment and understanding.

**Coastal Vulnerability: LiDAR Survey and Bathymetric Mapping** - a complete high-resolution bathymetric and terrestrial coastal survey for more than 700 km of coastline, from Cape Naturaliste to Horrocks. The baseline information is used to inform decision-making on the coast.

**WA State Coastal Landform Map** – Mapping of coastal landform types in WA: sandy, rocky, mixed sandy and rock, coastal lowlands, tidal reaches of inland waters and islands. The indicative risk of landform change for these coastal types is also mapped, to inform decision making.

**State Planning Strategy 2050** - strategic context for planning and development decisions throughout the State, based on a framework of planning principles, strategic goals and State strategic directions that respond to the challenges and opportunities that drivers of change present for the future land-use planning and development of Western Australia.

**State Planning Policy 1 State Planning Framework** - Establishes general principles for land use planning and development. Strategic planning and planning decisions are made under the *Planning and Development Act 2005* and give due regard to SPPs, such that climate change should be considered (where relevant) in planning processes/decisions.

**State Planning Policy 2 Environment and Natural Resources Policy** - Policy measure 5.10 addressing greenhouse gas emissions and energy efficiency including supporting the adoption of adaptation measures to respond to climate change.

**State Planning Policy 2.10 Swan Canning River System** - Identifies the need to address flood management and protection.

**State Planning Policy 2.6 State Coastal Planning Policy and accompanying Guidelines: State Coastal Planning Policy Guidelines; Coastal Hazard Risk Management and Adaptation Planning Guidelines; Coastal Planning and Management Manual** - Objectives include ensuring development takes into account climate change; the calculation of coastal processes having regard to climate change and sea level rise (0.9m over a 100-year planning timeframe to 2110); requirement for coastal hazard risk management and adaptation planning and assisting local governments to undertake this planning.

**State Planning Policy 2.9 Water Resources** - recognition of the impact of climate change on water resources and the need to address flood risk; requirement to take into account total water cycle management and water-sensitive urban design principles.

**State Planning Policy 3.4 Natural Hazards and Disasters** - promotes a systematic approach to the consideration of natural hazards and disasters.

**State Planning Policy 3.7 Planning in Bushfire Prone Areas and accompanying Guidelines: Planning in Bushfire Prone Areas Guidelines** - Requirements apply to new proposals to ensure that future development in bushfire prone areas is designed to reflect the level of bushfire risk.

## Department of Primary Industries and Regional Development

### **Mitigation**

**Albany Wave Energy** - \$19.5 million dollars allocated to renewable energy projects in Albany including the deployment of wave energy technology, development of a common user infrastructure to facilitate the connection of wave energy to the grid and the establishment of a wave energy centre of excellence.

**Carbon Farming information** - information to land managers seeking to take advantage of carbon farming opportunities via website and publications such as, Carbon farming in relation to Western Australian agriculture (Bulletin 4856).

**Australian Biomass for Bioenergy Assessment** - catalyse investment in the renewable energy sector through the provision of detailed information about biomass resources across Western Australia, to assist in project development and decision making for new bioenergy projects, and provide linkages between biomass supply, through the supply chain, to the end user.

**Closing the research gap: Carbon farming science** - a suite of research projects aimed providing knowledge on which to base carbon farming activities to reduce carbon pollution.

### **Adaptation**

**Provision of weather and climate data** - a network of 170 automated weather stations and 3 Doppler radar stations, with real-time and historical data available online. Land managers can use these data to plan management activities and assess seasonal and longer-term climate trends at their location.

**Provision of seasonal outlooks to assist growers in planning and managing activities** - up-to-date information about the coming season and its potential impacts on cropping and agriculture. To assist farmers in seasonal planning, provides statistical seasonal rainfall forecasts, modelled plant available soil water at the start of the growing season and risk of frost occurring.

**Climate Change information** – provision of climate change information related to agriculture via

website and published bulletins such as, Climate change - Impacts and Adaptation for Agriculture in WA (Bulletin 4870).

**Climate Change policy advice and reports including a Climate Change Policy Officer position** – provision of information and advice to DPIRD management and Govt related to agriculture and climate change.

**Climate-ready Agriculture: A Situation Statement for Western Australia (Bulletin 4876)** - 2015 assessment and recommendations for WA's agriculture in a changing climate.

**Decision tools to help growers manage variable and extreme climate** – multiple decision support tools to assist growers manage climate variability and climate extremes, including fertiliser management, flowering date calculator (frost risk), and risk of extreme weather events.

**More dollars per drop: improving irrigation practices** - Free comprehensive on-farm assessments of irrigation systems and production capacity across WA's dairy, fruit, vegetable and grape industries, with demonstrations sites across WA.

**Managing soil constraints for cropping** - technical information for landholders to understand the condition and properties of their soils, and develop management strategies to maintain and improve soil condition to improve crop water use efficiency.

**Improved use of seasonal forecasting to improve farmer profitability** - national project aimed at improving knowledge about, and use of, climate change information. This is being achieved through the development of a network of practice among grower groups.

**Tactical agronomy** - A suite of projects aimed at dealing with climate variability by improving agronomic practices. Issues include dry seeding, frost, end of season heat stress and alternative pastures where continuous cropping is no longer viable.

**Redmap (Range Extension Database and Mapping project)** - national citizen science project involving observations of marine species while fishing, diving, boating, and beachcombing. Aims are ecological monitoring to provide an early indication of potential species range shifts; and actively engaging the broader community on issues regarding marine climate change.

**Emergency/incident response** – provision of recovery information and advice (agriculture), quantifying the extent of the problem, assisting landowners in accessing financial help, and liaising with other agencies.

**Crop Genetic Improvement** - suite of projects aimed to improve crop genetics to overcome climate and edaphic constraints.

**Management implications of climate change effect on fisheries** – research identifying the historical trends in marine conditions and their effect on fisheries; projected climate change trends and an assessment of the risk to fisheries; risk rankings for various fish and invertebrate species; the effects of an extreme event (marine heat wave) on fisheries; and climate change effects on the western rock lobster fishery.

**Assessing the cause of the low juvenile abundance of western rock lobsters in the late 2000s** – research identifying that water temperature and winter storms were the main cause of the low abundance of juvenile rock lobsters settling along the coast; and the need for early management action to protect the breeding stock.

**Research and management of the blue swimmer crab in Shark Bay** - surveys to understand the abundance of juveniles and the spawning stock in the Shark Bay crab fishery; identified increases in winter water temperature and the marine heat wave as contributing to a major decline in abundance of blue swimmer crabs in Shark Bay.

**Understanding the abundance variation of scallops stocks in WA and management options in a changing environment** - examined factors influencing recruitment variations in existing scallop WA stocks, particularly the collapse of the stocks in 2011; examined the effect of the marine heatwave in the summer of 2010/11 on the scallop stocks.

### **Mitigation**

**Energy and water efficiency** - energy efficiency and water efficiency measures introduced as a combination of business as usual, cost reduction and environmental benefits. LED lighting at all new station and program to install at existing stations.

**Metronet** - expand and improve public transport and enhance lower emissions transport options. Currently working on detailed project definition plans for the extension of the Joondalup Line and the connection between Thornlie and Cockburn stations.

### **Adaptation**

**Project-specific climate change risk assessments for major projects** - risk studies carried out during the planning phase with an emphasis on future flood levels and storm surges to inform final design.

**Bushfire Management Strategy** – Sets out PTA's approach to bushfire management and risk reduction. Considers the potential increased in extreme weather events causing more bushfires and impacting on operations.

**Code of Practice** - outlines conservative drainage requirements to protect rail assets from the impacts of surface water, potential caused by high rail fall events.

**Policy response to trains operating in high temperatures** - working instructions and procedures to react to high temperature events and extreme weather events. The frequency of such controls being triggered is expected to be influenced by any impacts of climate change.

## Department of Training and Workforce Development

### **Mitigation**

**Program to increase the solar panel capacity of TAFE College campuses** - a remedial works program across 70 TAFE College campuses; this program includes funding for solar energy panels to reduce a campus' use of grid powered energy.

**Smart Design** – working with stakeholders to ensure that new building projects and major upgrades are implemented to high sustainability standards, particularly where measure improve the ambient facilities environment for users and reduces ongoing maintenance and operating costs.

## Department of Transport

### **Mitigation**

**Your Move** - enables local governments, schools and workplaces to identify and implement activities to encourage greater use of active transport (i.e. walking, cycling, public transport). Also Your Move Central and Your Move Wanneroo.

**Travel Choices for Perth and Peel** - this plan sets out a package of initiatives to manage travel demand in the Perth and Peel region to approximately 2031.

**Retrofit Cycling Infrastructure across Western Australia** – Investment of \$84m over the next four years to retrofit cycling infrastructure across WA.

### **Adaptation**

**Coastal Adaptation and Protection (CAP) grant program** – Annual grant program providing financial assistance for local projects that identify and manage coastal hazards.

**Operation and maintenance of a state-wide network of tide gauges** - measures water levels to assist in the characterisation of changes in sea level at all time scales, including sea level rise due to climate change.

**Sediment cell determination and monitoring** - identifying sections of the coast within which sediment transport processes are strongly related, for the purposes of providing data to inform maritime/coastal infrastructure planning and management.

**Identification and monitoring of coastal erosion hotspots** – identification of coast where erosion is likely to impact public and private assets, and requires management and adaptation action within 25 years. 86 locations initially considered, 55 hotspots and 31 locations designated as a watch list for future investigation (when and where resources permit).

**Hydrographic and foreshore surveys** - including mapping of shoreline change and changes in sediment volumes to support state boating facility development and management.

**Technical coastal engineering advice to WAPC and DPLH** - regarding State Planning Policy 2.6 and coastal climate change risk and vulnerability assessments.

**Regulatory reviews for DPLH and the Environmental Protection Authority** - relating to proposals for coastal development or management and ensuring future climate change adaptation requirements and coastal setbacks are adequately considered.

## Department of Treasury (Public Utilities Office)

### *Mitigation*

**Renewable Energy Buyback Scheme** - requirement for retailers to offer a buyback scheme through the Electricity Industry (Licensing Conditions) Regulations 2005.

**Regulatory reforms (constrained access model)** - Under the existing framework for access to the Western Power network, there are significant barriers to large-scale renewable energy based power stations, due to connection costs and delays in the connection process. The Public Utilities Office has been tasked with implementing a 'constrained' network access model for Western Power's network, with the new arrangements to be in place by mid-2020.

**Work program for the Energy Market Transformation Project Team** - a work program was approved by the COAG Energy Council in December 2015. The working group will consider the changes necessary to support the adoption of new technologies, such as distributed generation, electric vehicles, storage, and energy management systems.

**National Energy Productivity Plan** - 2015-2030 Plan was approved by the Energy Council in December 2015. This plan aims to improve Australia's energy productivity by 40 per cent by 2030 and includes measures to address energy use in the built environment and integrating new renewable and storage technologies into the electricity system and market.

**COAG Energy Council** - the Public Utilities Office supports the Minister for Energy by participating in working groups established under the COAG Energy Council, and in providing advice on how decisions of the Energy Council will apply within WA (where relevant).

## VenuesWest

### *Mitigation*

**Photovoltaic solar array** - PV arrays utilised at a number of venues to provide electrical base load for building operation.

**Solar water heating** - retrofit installation of solar hot water heating for aquatic facilities at HBF Stadium & HBF Arena primarily to reduce gas consumption (gas fired heating).

**Installation & upgrade of lighting systems** - all new capital works initiatives utilise energy efficient lighting systems. Reactive maintenance changes out obsolete light fittings to energy efficient options on an as required basis.

**Water Efficiency Management Plan** - due to the amount of water used in aquatic facilities, we are on a water reduction strategy with the Water Corporation. This reduces emissions by reducing electricity required for water processing and distribution.

**Cardboard & co-mingled recycling** - introduction of co-mingled and cardboard recycling.

**Geothermal energy** – for domestic hot water heating and pool water heating, the use of geothermal

energy reduces our gas consumption and the use of gas fired appliances.

**Computerised Building Management System (CBMS)** - recent upgrade of CBMS to monitor utilities consumption across the venues. As part of this initiative we have also implemented automatic lighting systems and monitoring consumption trends of various equipment such as HVAC operation, with a view to further reductions.

### ***Adaptation***

**Water harvesting** - Water harvesting incorporated in construction of AK Reserve venues. Harvested rainwater used for sanitary services.

## Department of Water and Environmental Regulation

### ***Mitigation***

**Provision of policy advice on climate change mitigation policy** - DWER's climate change branch has specific funding to provide advice to Government and agencies on climate change mitigation matters.

**Waste Wise Schools Program** - educates students on good waste management practices.

**Household Hazardous Waste Program** - provides multiple functions including removing hazardous waste from the municipal solid waste stream to minimise harm to staff and equipment, and to reduce the environmental impacts at disposal sites.

**Better Bins Program** - provides an incentive for local governments to introduce best practice kerbside waste and recycling services to increase resource recovery and support the achievement of landfill diversion targets.

**Recycled Construction Products Program** - encourages the use of recycled construction and demolition (C&D) products in standard civil applications, such as road construction, by providing incentives to local government and private entities that use these products.

**Waste and Recycling data collection** - collects data from recyclers to estimate the States recycling activity.

**Carbon Rights Act 2003** - the Carbon Rights Act provides for the registration on the title to land of a "carbon right", and accompanying "carbon covenant".

**Waste to Energy position statement** - position statement addresses 'waste to energy' in the context of the Authority's efforts to reduce waste to landfill and increase resource recovery in Western Australia.

**Environmental Factor Guideline: Air Quality** - The purpose of this guideline is to communicate how the factor Air Quality is considered by the Environmental Protection Authority in the environmental impact assessment process.

### ***Adaptation***

**Provision of policy advice on climate change adaptation policy and good practice**- DWER's climate change branch has specific funding to provide advice to Government and agencies on climate change adaptation matters.

**Selection of future climate projections for Western Australia: Climate Tool for WA** - provides standard climate scenarios for five broad climatic regions within WA. The tool provides consistent application of climate projections, captures the associated range of uncertainty and provides climate scenarios in a readily accessible and applicable form.

**Guidelines and standards for using future climate projections in water allocation planning in WA** - provides standards on how future climate projections should be integrated in water allocation planning across the South West of Western Australia so that the application and communication of projections is systematic, defensible consistent, and clear.

**Water Allocation Plans** - future climate projections are being incorporated into water resource modelling and allocation planning for the Gnamangara, Cockburn, Albany, Esperance and South West

groundwater areas.

**Securing water resources for the South West** - publication outlining how government and utilities are securing water resources in the South West in a drying climate. It provides a summary of climate trends, water use and demand, groundwater systems, town water supply, urban water supplies for future, water for future agriculture and industry and water for tourism, recreation and environment.

**Water Resource Management Bill: Water reform and statutory planning for our water resources** – A new Water Resource Management Bill is being developed to address the existing issues of WA's water resource management legislation, and bring it up to date with modern resource management tools.

**Groundwater and surface water measurement data** - collected across the SW to measure the impact of a drying climate on streamflow and groundwater replenishment.

**Water for Growth** - An overview of water investigation and current and future water management plans in Western Australia by region. The document identifies past and future climate trends in the South West and how they are being considered as part of demand and allocation planning.

**Urban Water for Growth** – document outlines the urban water supplies and demand for WA and the outlook to the future. It describes the Department's strategy to build urban water security - as the climate of the South West dries.

**Rural Water Plan** - Advice and grant programs to dryland communities and farmers in the area of the State less than 600mm rainfall. Assists farmers develop farm water supply and efficiency plans and grants are available to implement these plans dollar-for-dollar.

**EPA Environmental Factor Guideline: Coastal Processes** - this guideline communicates how the 'Coastal Processes' factor is considered by the Environmental Protection Authority in the environmental impact assessment process.

**EPA Environmental Factor Guideline: Flora and Vegetation** - outlines how the factor 'Flora and Vegetation' is considered by the Environmental Protection Authority in the environmental impact assessment process.

## Water Corporation

### *Mitigation*

**Source energy for the Southern Seawater Desalination Plant from wind farm and solar farm** - Ministerial Statement 792 that authorised the development of the SSDP requires Water Corporation to purchase electricity from renewable sources, or offset the quantity of greenhouse gas emissions produced.

**Renewable energy self-generation projects** - a number of renewable energy projects have been implemented at its sites, both standalone at remote sites and supplementing grid supply.

**Zero-energy waste treatment demonstration project** - the project aims to demonstrate an innovative, yet very simple technology for zero-energy sewage treatment at pilot scale.

**Energy Efficiency Program** - ongoing energy efficiency program with staff dedicated to it.

**Energy Efficiency Procurement Policy** - ongoing energy efficiency procurement program with staff dedicated to it.

### *Adaptation*

**Demand Management**- to reduce the amount of source development required to meet the needs of public water supply.

**Developing Climate Independent Sources, Groundwater Replenishment Scheme (Beenyup)** - reducing reliance on climate dependent water sources such as surface water and groundwater for public water supply.

**Developing Climate Independent Sources, Investigations** - The WC is reducing reliance on climate dependent water sources such as surface water and groundwater for public water supply.

**A Unified Approach for Estimating Coastal Flood Risk Caused by Multiple Mechanisms –** Collaborative R&D, the revised ARR Guidelines will require consideration of joint probability between rainfall (extreme events) and tidal levels (storm surge), which is not currently taken into account or well understood.

**Better data-driven decision making under future climate uncertainty -** Collaborative R&D with Water Research Australia, the project proposes to develop a robust climate-change decision support framework for water utilities, in particular it should inform the Corporation's investment decision framework.

**Impact of Climate Change on Storm Patterns Relevant to Extreme Floods -** Collaborative R&D, the project was established to determine how higher temperatures influence the spatial and temporal patterns of extreme areal rainfalls, and to assess how these changes may impact on design floods relevant to dam safety.

**IWSS modelling (PHASE 1 and 2) -** The focus of this research is to develop a methodology and modelling tools/decision support system to assist evaluation of long term and short term operational strategies for the IWSS.

**Community Preferences for water use and supply in times of scarcity -** This research project will be based on social science to uncover the communities' expectations and preferences for allocation of water to essential uses during water scarcity.

**Ceramic membrane pilot trial –** As more traditionally unsuitable sources are accessed new technology will play a role in treating water. The pilot plant will investigate how ceramic membranes can be applied to WA's specific water challenges.

**CRC Water Sensitive Cities –** Collaborative R&D, this project will enable the Corporation to work in partnership with other research organisations, utilities and government agencies, and undertake research to address socio-technical issues associated with water sensitive urban design.

**Perth residential use study -** To achieve the 110kL/year per capita target in consumption we need to better understand the consumptive portfolio to ensure the best opportunities to drive down demand are identified.

**Naegleria research -** Pathogens that were previously only ever seen above the 26th parallel are increasingly being detected in southern waters. There are a number of projects in this area which aim to improve understanding of the pathogen *Naegleria fowleri*.

**Impacts of Drying Climate and Integrated Water Supplies on Microbial Population in the Great Southern treated water system -** Research project on how the different/changing water sources through the integrated water system are going to impact microbial ecology of both the bulk water and the pipe wall associated biofilm in the GSTWS.

## Western Australian Land Authority (LandCorp)

### **Mitigation**

**Shared solar and battery storage micro grid trial -** WGV at White Gum Valley is home to Australia's first shared solar and battery storage micro grid trial.

**Living Laboratory at WGV, White Gum Valley -** The WGV Living Laboratory is a four-year research project by the Cooperative Research Centre for Low Carbon Living and Curtin University, City of Fremantle, Josh Byrne and Associates, individual developers and LandCorp. The WGV living laboratory will monitoring and assessing how energy and water efficient design, technology performance and occupant behaviour impact on the carbon and ecological footprints of the precinct.

**Beyond WGV: Community Battery Storage at Knutsford -** the CRC for Low Carbon Living has approved funding for a research partnership with Western Power and the City of Fremantle to investigate how a district scale community battery storage can be integrated with low carbon development, demand management and innovative governance systems such as block chain.

**Cool Earth Geexchange Demonstration project -** explores alternative options for heating and

cooling homes in Perth. Two homes have been built side-by-side within The Vive estate at Craigie. One home contains a geexchange heating and cooling system, while the other has a standard reverse-cycle air conditioner.

**Solar and Community Battery Storage trial at Alkimos Beach** - the trial contains a 1.1Megawatt hour community scale battery, high penetration rooftop solar PV and energy management within a new residential development at Alkimos Beach.

## Western Australian Land Information Authority (Landgate)

### **Mitigation**

**CarbonWatch** - Carbonwatch is a suite of products being developed around carbon credits derived from forestry projects. The first product, Carbon Start, provides an Eligibility Support Package containing satellite derived property data which can be used to identify areas of land that are eligible for forest sink abatement projects under the Kyoto Protocol.

**Vehicle Management Program** - preference to select fleet vehicles with a low CO2 rating although given the work that must be carried out through some of our teams this can't always be the case.

### **Adaptation**

**Agimage** - Provides a historical, strategic view of landscape cropping performance to assist adaptation strategies to increasing variable rainfall

**PasturesfromSpace** – Provides estimates of pasture production during the growing season by means of remote sensing.

**Oceanwatch** - Sea Surface Temperature for determination of the Leeuwin Current, likely fish species location, water clarity, and chlorophyll concentration.

**Land Monitor** - Land Monitor is a coordinated initiative originally aimed to systematically monitor salt-affected land and remnant vegetation change over the agricultural area of south west of Western Australia.

**FireWatch Program (Myfirewatch, FireWatch-Pro, FireWatch Aurora)** - Near real-time fire monitoring webservice aimed at providing fire-related information to the community (Myfirewatch), land managers (FireWatch-Pro), and emergency services (FireWatch-Pro and FireWatch Aurora).

**CaptureWA/SLICP** – Landgate's historical aerial photography can be used to look at historical coastline movement to assist with determination of climate change impact vs. natural processes. The creation of orthophotomosaics also produces digital elevation models which are useful in storm surge assessment, flooding, and fire movement through the landscape.

## Western Australian Police

### **Mitigation**

**Implement governance arrangements within WA Police to embed sustainability and carbon reduction into our organisational culture** - the commitment to sustainability and carbon reduction is communicated to police officers and police staff, and to potential applicant for positions within WA Police. This project was to ensure all WA Police personnel have a clear and shared understanding regarding how to meet their obligations under the Sustainability Management Plan.

**Maximise the efficient use of energy, water and consumables** - improve energy conservation by implementing strategies and initiatives to reduce total operating greenhouse emissions and reduce associated energy costs.

**Minimise waste generation, promote reuse, reduce and recycling** - implement initiatives to significantly minimise the amount of waste created from WA Police activities.

**Minimise fleet and travel carbon emissions** - WA Police fleet to operate as efficiently without compromise to safety or front line commitment; continue to trial and adopt alternatively fuelled vehicles where operationally and cost effective within our fleet.

**Adopt Environmental Sustainable Design in planning, construction and operation of owned and leased WA Police Facilities** - ensure all WA Police facilities provide a healthy indoor environment for the well-being of building occupants through best practice design and operation. Providing a facility that will perform as efficiently as possible within the constraints of the operating environment.

## Western Power

### *Mitigation*

**Ravensthorpe/Jerramungup solar/battery/diesel trial** - Western Power established a pilot project in mid-2016 to trial around 10 solar-battery-diesel standalone power systems in the Ravensthorpe/Jerramungup area.

**Kalbarri Microgrid Feasibility Trial** - in 2016, Western Power undertook a feasibility trial of a microgrid in Kalbarri to determine whether a dynamically-connected microgrid would effectively and efficiently mitigate power reliability issues at Kalbarri.

**Wave-powered Microgrid Trial Garden Island** - Western Power is partnering with Carnegie Energy and the Australian Renewable Energy Agency (ARENA) to trial the world's first wave energy integrated microgrid and will produce both power and desalinated water.

### *Adaptation*

**Network planning and asset security** - Protecting the Western Power network through forward planning and asset protection including incorporating risks such as storms, bushfires and floods.