Health, Safety and Environment (HSE) in all Origin workplaces is governed by legislation and regulations applicable to those operations. At a minimum, we seek to meet these requirements. Where appropriate, we apply higher standards.

All Origin employees and contractors are encouraged and empowered to stop any activity they find unsafe.

We continue to build and monitor our HSE culture through a range of programs and activities that create:

– effective safety leadership;
– operational discipline and compliance;
– open communication at all levels of the organisation; and
– a capable and empowered safety team.

Origin’s approach to health and safety is governed by the Health, Safety and Environment (HSE) Policy. This policy outlines our aspiration to conduct our business in a way that causes no harm to the health and safety of people and has no unforeseen impacts to the environment. It explains how we think about, plan and manage HSE risks and initiatives across our business. Our management approach is described in our HSE System and HSE Risk Controls Directive which form part of our HSE management system. It mandates the minimum requirements for the management of health, safety and environment risks and/or impacts.

The Board is responsible for the oversight of HSE matters including key HSE risks and/or impacts arising out of the activities and operations of Origin (and its related companies). The HSE Committee of the Board supports and provides advice to the Board in these respects.

The Operational Risk Committee meets quarterly and supports the Executive Leadership Team to monitor and manage the operational risks including HSE.

HSE Committees operate across Origin’s sites and major office locations. They provide an opportunity for employees to be actively involved in the resolution of health, safety and environmental issues at work.

Origin measures HSE performance using a variety of performance metrics. Key performance measures are published in our Sustainability Report each year, including those that are linked to remuneration.
SAFETY

We strive for a safe working environment. Our management approach is to ensure that everyone at work is mindful of health and safety risks, enabled to manage them, accountable for doing so, continuously learning, and improving the way we work safely. We ensure everyone has the right tools, equipment, knowledge, skills and supervision to complete their tasks safely. Our systems of work include, among other tools, personal job safety assessments, permit-to-work systems and safety observation cards.

Anyone can stop a work activity if they believe it, or the work area, is unsafe.

Our equipment, facilities and work practices are subject to detailed hazard identification and risk management processes designed to prevent harm to our people, contractors and visitors to our sites. We have HSE committees at our operational sites and major office locations to continually update our understanding of health and safety issues. Our field verification activities, assurance programs and audits test the effectiveness of the management system and its implementation.

We manage the health and safety risks associated with our operations and activities using Australian Standards, international Standards, and Codes of Practice for occupational health and safety management. In addition, we also draw upon industry guidance from the International Association of Oil & Gas Producers (IOGP), the Institution of Chemical Engineers (IChemE) Safety Centre (ISC), the UK Energy Institute and the American Institute of Chemical Engineers (AIChE) Center for Chemical Process Safety (CCPS).

We implement safety critical control elements at all of our assets. Process safety performance is tracked daily using leading and lagging indicators. Process safety reporting is conducted through our management-level Operational Risk Committee as well as the Board HSE Committee.

We use assurance programs and audits to test the effectiveness of the management system and the operational discipline with which it is implemented. We also record, investigate and examine trend data for lower-consequence process safety incidents, to ensure the integrity of our system.

EMISSIONS

Our business activities result in emissions which we report on, and seek to reduce. The majority of the carbon emissions we report are categorised as Scope 1, which are direct emissions created through our business activities. The remainder of what we report, Scope 2 emissions, are from electricity we purchase to undertake those activities. Scope 3 emissions, which are largely associated with the combustion by end users of fuels we deliver to domestic and international markets, are not reported.

We report our emissions to the Clean Energy Regulator (CER) according to the National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act) and the National Pollutant Inventory (NPI).
OUR GENERATION PORTFOLIO

Australia’s National Electricity Market (NEM) is an aggregate of different sources of electricity. Origin’s generation portfolio has been less emissions intensive than the NEM for many years. In our generation portfolio, the majority of Scope 1 emissions relate to Eraring Power Station, our only coal-fired power station, which uses black coal. Gas-fired power stations are typically less emissions intensive than coal-fired power stations.

FUGITIVE AND MIGRATORY EMISSIONS

Gas production facilities require periodic pressure relief in the system, which can be achieved by either venting or flaring gas. Venting emits methane to the atmosphere, whereas flaring converts methane to carbon dioxide, a less potent greenhouse gas. Emissions from these practices are reported annually in Origin’s National Greenhouse and Energy Report.

We survey Australia Pacific LNG’s gas field infrastructure, such as at well-heads, pipe joints and flanges, for methane leaks. Survey methods and emission factors used to estimate leaks are in line with the Queensland Government’s regulatory requirements.

Methane gas can also occur naturally from the surrounding landscape. Queensland gas fields have a history of natural methane emissions that predate the CSG industry. We work with the Queensland Government, the CSIRO and other research organisations to understand this phenomenon and to quantify methane emissions from abandoned coal exploration bores, landholder bores and from geological structures.

OTHER AIR EMISSIONS

As a part of the Australian National Pollutant Inventory (NPI), Origin’s larger operating sites track and report emissions of oxides of nitrogen (NOx), oxides of sulphur (SOx), volatile organic compounds (VOC) and particulate matter. These primarily arise from the combustion of fuels such as natural gas, kerosene, diesel and coal.

The majority of NOx, SOx and VOC emissions and particulate emissions for our operated Australian sites resulted from electricity generation at Eraring Power Station. Emissions of NOx, SOx and particulates from Eraring stacks are managed through low NOx burners, boiler tuning, fabric filter maintenance and ensuring the use of quality coal and fuel oil.

As the upstream operator of Australia Pacific LNG, Origin continues to monitor ambient air quality in the Surat Basin using specialised instruments to measure a wide range of pollutants in the atmosphere. Managed by the CSIRO through the GISERA alliance, a network of five ambient air quality stations collects air quality data which is streamed live to the Queensland Government’s website to ensure transparency of data collection.

REPORTING OUR EMISSIONS

We are committed to complying with relevant emissions reporting frameworks. In Australia, Greenhouse Gas (GHG) emissions reporting is tightly regulated and aligned to the Intergovernmental Panel on Climate Change (IPCC) reporting framework. We follow the Australian Government’s National Greenhouse Emissions Reporting Act 2007 (Cth) (NGER Act) to calculate and report GHG emissions produced directly and indirectly by our Australia based activities and operations. In New Zealand, we report our emissions under the Climate Change Response Act 2002. By 31 October each year, we report our GHG emissions to the Commonwealth regulator under the NGER Act.

Since 2007 we have also undertaken voluntary reporting of our GHG emissions to the Carbon Disclosure Project (CDP). Our responses to the CDP climate change survey have also been publicly available since 2008 and can be accessed via CDP’s website www.cdp.net.

Under the National Pollutant Inventory, Origin also reports annually on pollutants that are emitted into the environment. In line with regulatory requirements, our emissions are reported to the relevant state environment regulators by 30 September each year.
WATER

We primarily use water in electricity generation and we also extract water in the development of natural gas for Australia Pacific LNG.

We recognise that managing water is essential to Origin’s long term success. We view water as a valuable resource. Our operations seek to responsibly manage our consumption of water, protect water resources in the natural environment, and ensure water is available for other users near our operations.

Our water use is monitored in line with legal conditions, and guided by our HSE Risk Controls Directive. We also make additional commitments such as maximising the availability of water for beneficial uses from our coal seam gas (CSG) activities.

Across our operations, electricity generation at Eraring Power Station (2,880 MW) and the Shoalhaven Hydro Pump Storage Scheme (240 MW), as well as our CSG development operations account for the vast majority of our water use.

ELECTRICITY GENERATION

The Eraring Power Station is designed to take salt water from Lake Macquarie as cooling water for its generating units, which is returned to the lake after use in accordance with water quality and temperature limits set within our Environment Protection Licence. When compared to generators using evaporative cooling, this system design means that the power station typically has a lower impact on municipal water supplies and can continue to provide reliable power generation in times of water scarcity.

At Eraring, we also operate a Water Reclamation Plant which further purifies secondary treated effluent from the Dora Creek Waste Water Treatment Facility for boiler and plant use, minimising the use of potable water.

SHOALHAVEN SCHEME

The Shoalhaven Hydro Pump Storage Scheme consists of two pump storage hydropower stations, Kangaroo Valley Power Station and Bendeela Power Station. These are located in the Southern Highlands of New South Wales.

The power stations use the pumped storage hydro electric principle to generate electricity. Water is released from the Fitzroy Falls Reservoir and passed through the power stations to generate electricity during peak periods. During periods of low demand, water is pumped back to storage headponds above each station in the Fitzroy Falls Reservoir for use when generation is next required.

GAS-FIRED POWER STATIONS

Gas-fired power stations such as Origin’s Darling Downs, Mortlake and Uranquinty typically use less water than coal-fired power stations. Electricity generated by gas-fired power stations relies on heat or a combination of heat and steam, as opposed to steam alone, resulting in lower water use.
The Darling Downs Power Station uses a cooling technology which relies on air rather than water for its steam cycle, further reducing the power station’s water usage.

**COAL SEAM GAS EXTRACTION**

As the upstream operator of Australia Pacific LNG in the Surat basins of Queensland, Origin extracts brackish groundwater from coal seams to depressurise the coal seam allowing gas to be extracted. This extracted water is called associated water or CSG water. It has a higher salt content than freshwater but generally contains less than a third of the salt content of sea water.

In our capacity as the upstream operator, we are required to manage CSG water extraction in accordance with legislative requirements, conditions specified in our permits and agreements we have with stakeholders.

**TREATED CSG WATER**

Most of the extracted CSG water is treated using reverse osmosis in water treatment facilities. Treated water is supplied for a range beneficial uses including aquifer injection, irrigation and livestock drinking water.

Origin has established aquifer injection schemes for the beneficial use of treated CSG water. Through these schemes we inject treated CSG water into aquifers to increase available groundwater. Origin pioneered these schemes, and its initial Spring Gully scheme was the first to be approved by the Queensland Department of Environment, Heritage and Protection in 2015.

Origin has supplied treated CSG water to landholders since 2014 via the Fairymeadow Road Irrigation Pipeline, which is used for irrigation and livestock drinking water. The scheme is a practical application of the Queensland Government’s Coal Seam Gas Water Management Policy (2012) which requires CSG companies to find beneficial uses for treated CSG water.

Origin has also operated a Pongamia plantation next to its Spring Gully water treatment facility since 2010, which is irrigated with treated CSG water. Pongamia can be used as a biodiesel fuel and as a protein meal for stock feed, among other potential uses.

In accordance with our licence conditions, excess treated CSG water is released into rivers when water production rates exceed demand for beneficial use applications.

Australia Pacific LNG also uses treated and untreated CSG water for project purposes such as drilling and construction activities, dust suppression and as potable water at a number of facilities and accommodation camps.

The use of treated and untreated CSG water for these purposes reduces pressure on municipal and groundwater supplies in the region and helps to make sites self-sufficient for water.

**WATER AVAILABILITY TO OTHER USERS**

The upstream activities of Australia Pacific LNG cover a large pastoral area. Groundwater availability is important to agricultural and other industrial users in the Great Artesian and Surat basins.

In some areas where landowners draw their groundwater from the same coal seams as CSG wells, some bores are expected to be impacted by gas production.

Every three years, the Queensland Government issues an Underground Water Impact Report (UWIR) for the Surat Basin cumulative management area which identifies potentially impacted bores. Where reduced groundwater availability is identified as a result of CSG production, we are required to ‘make good’ any impacts under the Water Act 2000. ‘Make good’ measures are guided by individual landholders’ preferences, and include providing alternative water sources such as drilling deeper bores.

In addition to bores identified in the current UWIR, Origin identifies bores that are likely to require make good activity in future UWIRs and enters into agreements with landowners. These agreements are similar to ‘make good’ agreements and provide greater certainty for both landowners and Origin.

Monitoring bores installed by Australia Pacific LNG support ongoing and extensive regulatory monitoring of groundwater levels and groundwater quality in and surrounding the areas of our operation. Results from these bores are submitted to the Queensland Government for aggregation with other coal seam gas operations for regional monitoring and management. This information is available in the Queensland Government’s Surat UWIR which is available on the Department of Natural Resources and Minerals.
HYDRAULIC FRACTURE STIMULATION

Hydraulic fracture stimulation increases the local permeability of the coal seams so that water and natural gas flows more readily to the surface. Origin uses hydraulic fracturing in a small portion of wells as the upstream operator of Australia Pacific LNG and in our Northern Territory shale gas exploration program.

The fluid used in our operations for hydraulic fracturing comprises around 99 per cent water and sand. Of the remaining additives, approximately 0.33 to 1.2 per cent of these are used in clay management, gel management and water conditioning. Hydraulic fracturing fluids are subject to strict regulatory control in Australia. All additives used are also found in a typical household; in items such as food and cleaning products.

The additives in hydraulic fracturing fluid used by Origin are available contained on page 27 of the Sustainability Report.

WATER QUALITY

The presence of wells that cross aquifer boundaries has the potential to result in groundwater migrating vertically from one aquifer to another if well integrity is not maintained. The risk of aquifer connection and leakage, where water from fresher aquifers enters the coal reservoir or vice versa, is managed carefully via high regulatory standards of well design and construction. Our Well Integrity Management Plan sets out our program of ongoing monitoring of well integrity.

WASTE

At Origin, our approach to waste management is governed by operating licences and conditions at an asset level. Where hazardous materials are present, our HSE Risk Controls Directive sets requirements for the management of hazardous materials to reduce risks to our people, the environment and the community. Hazardous materials must be managed in accordance with applicable law(s), or where there is no applicable law(s) with reference to relevant international standards.

Most of the waste material that we manage is not considered to be hazardous. However, the greatest potential impact to neighbouring communities and environments comes from Eraring Power Station and our upstream operations in Australia Pacific LNG.

ERARING ASH DAM

The primary waste output at Eraring Power Station is solid waste from the coal combusted at the power station known as Coal Combustion Products (CCP). CCP is an ash by-product of electricity generation produced through the burning of coal. This comes in the forms of finer fly-ash and a coarser bottom ash which represent 90 per cent and 10 per cent of the waste material respectively. CCP is subject to regulatory controls including the Environmental Protection Licence 1429 at this asset.

While a large proportion of CCP generated by Eraring is reused, the remainder is stored in an ash dam located north east of the power station. CCP waste is managed under Eraring’s Hazardous Materials Management Strategy.
AUSTRALIA PACIFIC LNG
BRINE MANAGEMENT

Brine is a waste product generated by the reverse osmosis treatment of coal seam gas (CSG) water. As the upstream operator of Australia Pacific LNG, we treat groundwater produced during CSG operations through Reverse Osmosis plants. Treated water is made available for beneficial use. The salt removed during the Reverse Osmosis process is captured within a brine waste stream, which is sent to specifically designed and lined brine ponds to undergo further concentration through evaporation.

The brine ponds at Australia Pacific LNG’s upstream operations are classified as regulated dams under the Environmental Authority (EA) issued by the Queensland Government. In addition to annual certification by registered professional engineers, regular inspections and sampling occurs in line with asset integrity, groundwater and surface monitoring protocols and operational procedures.

BIODIVERSITY

Origin’s development activities and operations span both marine and terrestrial environments. Our operations are located across a wide geographical area and include a variety of environmental settings with different biodiversity values. We always seek to understand and protect these values in accordance with their significance, applicable laws and stakeholder expectations.

The greatest land footprint of Origin’s activities is in the development and operation of the coal seam gas fields in the Surat and Bowen basins in Queensland, as the upstream operator of Australia Pacific LNG.

In Australia, our approach to managing biodiversity is governed by the requirements of Federal and relevant state and territory laws and regulations. We are also required to comply with legal and regulatory conditions of the specific operating licences for our activities with regard to biodiversity management.