2 National challenges

Australia’s challenge in the next decades is to realise the potential economic benefits of the marine estate while maintaining social and environmental values. Policy-makers and managers are required to responsibly evaluate the tradeoffs between economics, social values and environmental sustainability. This balance is made difficult by the lack of knowledge about our vast and varied marine systems, their resources, and how their ecosystems function. Limited information is also available about social values and the economic tradeoffs that are important to the Australian people. While we grapple with limited understanding of our marine estate, Australia, and other societies around the world, face significant challenges as the oceans change as part of the world’s changing climate. Already, the impacts of ocean and coastal change are being felt through increased coastal flooding, inundation and erosion, increasing frequency and intensity of extreme events, and growing effects on ocean ecosystems including acidification of the ocean and coral bleaching. These threats are already having profound and growing impacts on society.

Oceans are inextricably linked to some of the most pressing challenges facing society, both in Australia and globally, in the next decades: maritime sovereignty and security, energy security, food security, biodiversity conservation and ecosystem health, climate variability and change and the policy challenge of equitable resource allocation. Marine research and innovation is an essential input to informed policy and management and is critical to developing solutions to and opportunities from these challenges.

2.1 Maritime sovereignty, security and safety

The protection and security of national sovereignty, for both Australia’s territory and people, and the safety of the population are essential responsibilities for the government. These responsibilities support our national values and the advancement of the social, environmental and economic well-being of our nation.

Maritime sovereignty, security and safety are particularly important for Australia because of our economic reliance on the oceans for transport, trade, energy, international communication and food. We are separated from our neighbours by oceans, and rely on good order at sea to promote peaceful and prosperous relations. Our national interests need to be protected against maritime security threats that include the illegal exploitation of natural resources, illegal activity in protected areas, maritime terrorism, piracy, robbery or violence at sea, and compromise to biosecurity and marine pollution. Substantial growth in oil and gas developments and shipping of resources has meant that our ability to protect the much expanded ports, shipping and offshore infrastructure from attack such as terrorism is vital to our economy. There will also be greater risk of oil spills requiring improved management to minimise impacts on biodiversity. Adapting to a changing climate will place greater demand for assessment of risks in the protection of assets, the safety of maritime operations and occurrence of natural hazards to allow adequate preparedness.

The physical environment of our EEZ is extraordinarily complex. It ranges from tropical seas with strong tidal flows, cyclones and areas where breaking internal waves belie a smooth sea surface, to the huge swells and storms of the wild Southern Ocean. To facilitate safe navigation for maritime trade routes, manage commercial fisheries and to undertake patrols, rescues and Defence activities successfully in these waters, it is necessary to understand and predict the waves, current systems, tides and other oceanographic phenomena. Accurate hydrographic data and charts are essential for safety of navigation for maritime trade and recreational users alike. They are also crucial for defining changing maritime boundaries of legislative jurisdictions and assist in substantiating our sovereign claims. Hydrography also assists in the exploration and management of seafloor resource exploitation and responses to natural or human disasters. However, significant parts of Australia’s marine jurisdiction are not adequately charted.

The impact of extreme events, such as tsunamis, cyclones and severe storms, on communities and infrastructure is a significant issue for Australia’s maritime security7. To improve our ability to predict the impact and risk of these and other marine natural hazards, and better plan for emergency response, fine-scale coastal bathymetric and oceanographic data and advanced risk-based modelling approaches are needed.

Safety of life at sea also depends on reliable predictions about the behaviour of the marine environment. Maritime incidents caused by a lack of appropriate information can be potentially catastrophic in terms of loss of human life, economic impact, degradation of the environment and the maintenance of safe navigation. Crucially, surveillance and security activities require legally robust data to support prevention and compliance activities and enhanced operational forecasts for the ocean, atmospheric and geohazard domains. Limited blue water and tsunami forecasting capacities exist for the open ocean and to some extent near shore, but long term commitment is required to develop a national operational oceanographic and geohazard forecasting capability with an enhanced coastal component. To provide real benefit to the Australian community, these operational forecasting systems will need to focus on

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achieving true forecasting skill at fine spatial and temporal scales, predict seabed and shoreline conditions and be able to provide a clear indication of the reliability of the forecast. These aspirations will need to be supported by a wide range of observations, collected both remotely and in situ, to feed into forecasting and compliance systems. Future sensors collecting these observations will need to be able to adjust to the limitations of environmental conditions such as turbidity, waves and other effects caused by the weather. Methods used to analyse the data, integrate and calculate the forecasts will also need to improve. As we acquire ocean data at finer scales and in real (or near real) time, the demand for efficient and interoperable data systems will become critical. National ocean observation and data systems will provide rapid, more accurate and accessible forecasts of Australian ocean and geohazard conditions, potentially saving lives, averting major incidents, reducing industry operating costs and improving the efficiency of our Defence and other compliance forces and enhancing our ability to predict the impact and risk of marine natural hazards.

2.2 Energy security
Access to secure, affordable, reliable, and sustainable energy is vital for ensuring Australia’s societal and economic security. Australia’s energy policy strives to deliver energy security, facilitating economic development, and meeting clean energy goals. The Australian Government’s recently released energy white paper\(^8\) includes two core priorities relevant to marine research:

- developing Australia’s critical energy resources, particularly Australia’s gas resources
- accelerating our clean energy transformation.

Energy reserves in Australia’s vast maritime jurisdiction, from sub-seabed oil and gas deposits to renewable wave, wind and tidal energy, are yet to be fully explored. Nevertheless, they will play a vital role in securing Australia’s future energy needs and those of its regional neighbours and long term trading partners, by providing a diversity of reliable supply.

The Australian liquid natural gas (LNG) export market is predicted to grow from around 20 million tonnes per annum to 107 million tonnes by 2034\(^9\). Capital expenditure for new LNG projects currently approved or planned totals more than $170 billion.

To sustain this scenario, more gas resources must be found. The quest for more gas and oil is being driven by increasing demand, particularly from China, India, Korea, and Japan. As known hydrocarbon fields mature, it is urgent to explore more reserves. Although more than 75 per cent of Australia’s known hydrocarbon reserves occur in our maritime jurisdiction, less than 10 per cent of the area of known offshore reserves is under exploration permit.

Decreasing greenhouse gas emissions to the atmosphere is one of the key issues facing Australia and the world. Emission reduction will require a full suite of responses: increased use of renewable energy, greater energy efficiency, fuel switching, and increased sequestration of greenhouse gases away from the atmosphere, particularly geological storage of carbon dioxide. The vast majority of the carbon dioxide storage capacity in Australia is offshore. To develop the potential of this capacity, research is required to further understand and model the architecture of offshore sedimentary basins, and the geomechanical behaviour and likely fluid flow at potential carbon storage sites.

Australia’s oceans have great potential to generate electricity with zero or low carbon emissions from tides, wind\(^10\), waves and ocean thermal energy. An initial resource assessment has identified world-class wave energy resources along the western and southern coastline, and valuable tidal energy resources in the northwest of Australia\(^11\). Marine hydrodynamic models are critical to predict the best places for installation of wave and tide converters, but the models are constrained by lack of data in the areas most suited to energy production (e.g. remote north-western Australia). Further investment in both observation and modelling capability is critical for efficient development of ocean renewable energy and to assess potential impacts on marine ecosystems from ocean and wave energy facilities.

Sustainable energy development in Australia requires strong and sustained engagement between industry and marine researchers. The changing energy profile presents new technological and engineering challenges for industry and opportunities for scientific research.

Systematic research and sustained exploration will result in a more comprehensive understanding of Australia’s offshore sedimentary basins. New geophysical and rock property data that can be visualised to 6000 m below the sea floor would mean that deep earth fluid systems — the flow of water, oil, gas and carbon dioxide through sedimentary rocks — could be modelled accurately for monitoring

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\(^9\) Australian Energy Resource Assessment 2012 Geoscience Australia and Bureau of Resources and Energy Economics, Canberra
\(^10\) http://multi-science.metapress.com/content/yh6030v3s33235152/