

AUSTRALIAN
OCEAN ENERGY
GROUP

Ocean Energy Market Investigation

A PROJECT OF THE AUSTRALIAN OCEAN ENERGY GROUP



Copyright

© Climate-KIC Australia 2022.

Ocean Energy Market Investigation: A project of the Australian Ocean Energy Group is licensed by Climate-KIC Australia Limited under an Open Source Licence.

Published December 2022

This report is available for download from the Australian Ocean Energy Group website at www.oceanenergygroup.org.au

Prepared by the Ocean Energy Market Investigation Project Team

Stephanie Thornton, AOEG General Manager – Project Lead

Alex Ogg, AOEG Ocean Energy Program Manager – Project Co-lead

David Rissik, BMT Commercial

Jake Dunstan, Cornwall Insight Australia

Louis Croxton Toulemonde, United Spirits Agency

Louise Richardson, UWA

Michael Byrne, EHL Solutions/AZURA

Project funded by:

National Energy Resources Australia (NERA)

Australian Ethical Foundation

Blue Economy Cooperative Research Centre

About AOEG

Australian Ocean Energy Group (AOEG) is an industry-led cluster, established to accelerate the commercialisation of Australia's ocean energy. Founded in 2018 with start-up support provided by National Energy Resources Australia and Climate-KIC Australia, AOEG has grown from a 'coordinating organisation' to one that provides a mechanism to bring the end users (such as market customers) together with technology providers and suppliers to advance the commerciality of ocean energy.

Contact

Enquiries regarding this report should be addressed to:

Australian Ocean Energy Group
info@oceanenergygroup.org.au

Contents

Executive Summary	1	Schedule 1	12
Project Context	3	Ocean Energy Market Investigation Potential Available Markets for AOEG Market Investigation	12
Project Approach	5	Schedule 2	14
Survey Results & Observations	6	Ocean Energy Market Maps	14
Survey Results	6		
Observations	9		
Conclusions	11		

Executive Summary

According to the World Bank, the blue economy is the “sustainable use of ocean resources for economic growth, improved livelihoods, and jobs, while preserving the health of ocean ecosystem.”

Australia has the third largest Exclusive Economic Zone (EEZ) in the world, where 80% of the area is classified as offshore. The EEZ is a sea area for which a coastal state holds sovereign rights to explore and use its natural marine resources across a range of marine activities. Significantly, over 85% of Australia’s population lives within 50km of the coast. This provides a unique opportunity to boost an emerging renewable energy sector that promises a highly effective means to decarbonise coastal businesses, industries, and communities. Australia is well placed to demonstrate to the world the true economic, social and environmental value of Ocean Energy.

While ocean energy is following near-identical development pathways as solar, onshore, offshore wind, battery storage, green hydrogen production and other forms of renewable energy generation and storage technologies, demand for ocean energy technologies continues to be elusive.

While global “supply” in the ocean energy sector includes a diversity of innovative wave and tidal technologies, along with corresponding technology development support mechanisms and growing supply chains in different countries, little to no customer demand exists for these technologies, as yet, particularly in an Australian context. The general lack of awareness of the potential benefits of ocean energy and its value as an energy solution within market end user groups, is what sustains this overall lack of demand.

Given its mission of ‘accelerating commercialisation of ocean energy in Australia’, AOEG acknowledges that commercialisation cannot be achieved unless customer demand exists. While AOEG’s premise is that Australia’s Blue Economy businesses, communities and industries are the right near-term customer focus for ocean energy development, there is little existing data to verify that assumption. AOEG established its Ocean Energy Market Investigation program to provide evidence that potential demand for ocean energy exists, identify potential early-adopter customers, and identify the constraints and opportunities to accelerate its uptake.

AOEG completed the first phase of its Market Investigation in June 2022. The study approach and results are summarised in this report. Validating AOEG’s assumption about the potential markets for ocean energy in Australia- local governments representing Blue Economy communities (eg, coastal locations), ports and aquaculture were identified as key target markets.

This inaugural study documented a clear interest by these markets to learn more about ocean energy and identified gaps in information/data required to increase uptake of this nascent source of renewable energy.

In particular, markets and end users need the following information to provide confidence when considering investment in and adoption of ocean energy:

- Costs/benefits of an ocean energy system relative to an end-user's current energy business model
- Capital costs/comparative analysis of energy costs and corresponding business model
- Technology maturity or readiness
- Permitting and licensing requirements for ocean energy projects

AOEG has an important opportunity to build capacity in ocean energy and promote the benefits of what it can deliver for the end-user. This work further validates the development of the Integrated Ocean Energy Marketplace, AOEG's ocean energy 'showroom', currently underway.



Project Context

With over 70% of earth covered by oceans, Australia's 25,780 kilometres of coastline provides access to hundreds of terawatts of untapped potential energy from its waves and tides. Australia's Blue Economy¹ has a projected value of \$100 billion per annum by 2025.² Marine industries alone make up a significant component of the national economy, with marine industries accounting for 4.8% of GDP and providing over 40,000 new employments (Moltmann, 2017). This growing economic significance demonstrates a sizable market opportunity exists for renewable ocean energy.

Although new markets for ocean energy can be identified, the ability to transform Blue Economy businesses, industries and communities into buyers of ocean energy technologies and systems requires a new and targeted/strategic approach to develop this nascent industry sector. Currently there is a technology focus where new innovative approaches to energy generation are developed and offered to market (often uncompetitively because of cost and scale).

As ocean energy technologies continue to mature and regulation has been implemented to facilitate progress, it is now time to shift the dynamic from a "technology push to a market pull". This new "market pull" approach requires a detailed analysis of the end-user's energy needs, constraints and opportunities, but also accumulation and analysis of data necessary to prepare a compelling business case to support an end-user's adoption of or a transition to ocean energy.

To launch this new paradigm shift, AOEG conducted the first phase of its "market-pull" initiative through implementation of an **Ocean Energy Market Investigation ("market investigation")**.

The primary aim of this project was to identify a potential group of early adopter end-users for ocean energy operating in the Blue Economy markets. In addition to identification of this priority target market group, AOEG also desired to understand the overlay where the key markets are located relative to Australia's wave and tidal resources and to learn what issues need to be addressed for these early adopters to evaluate and commit to adoption of an ocean energy system.

To the best of AOEG's knowledge, availability of market data for the ocean energy sector is pioneering global work with the desired benefits being:

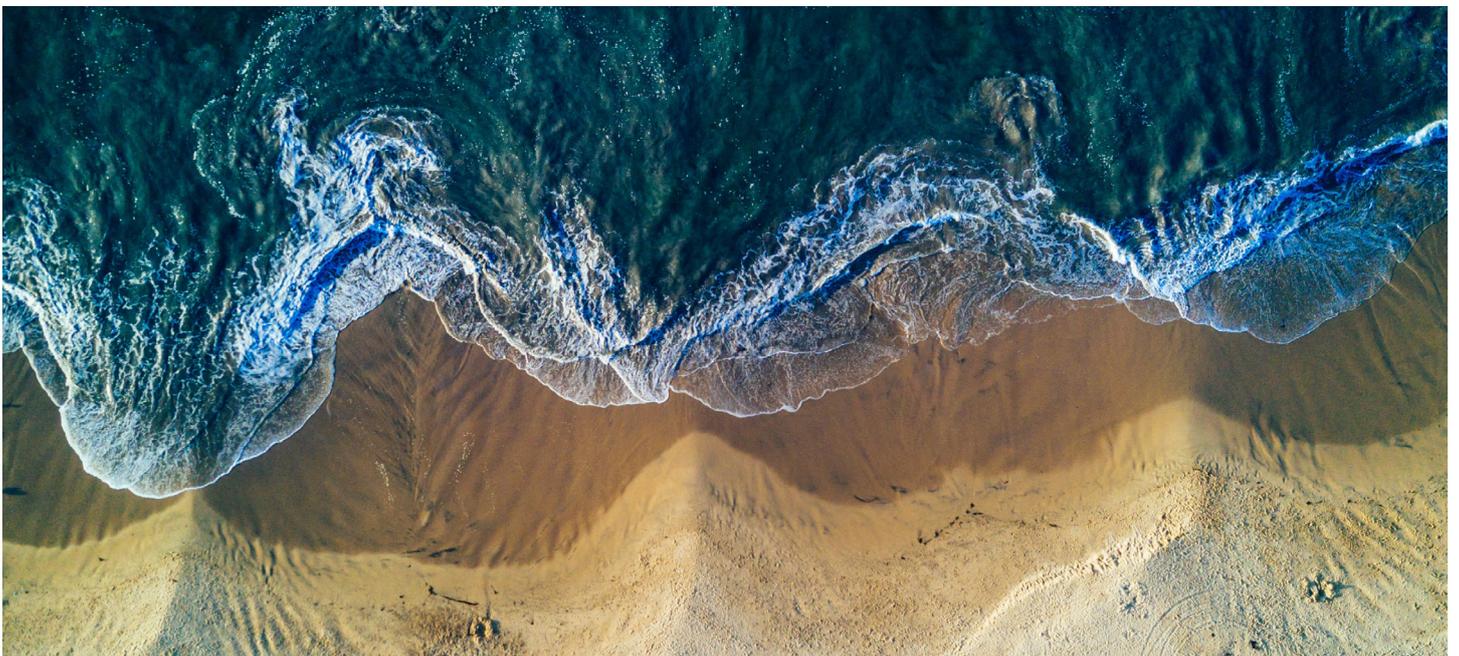
- Reduced time to market for the technology developers through increased visibility and identification of early-adopter markets willing and suitable to "co-develop" appropriate ocean energy systems.

1 The **World Bank** defines the blue economy as the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem."

2 *Australia's National Marine Science Committee, 2021*

- Attraction of first mover investors who recognise market opportunities for ocean energy and are willing to be in on the ground floor, gaining foundational knowledge about the industry, diversity of technologies and emerging markets.
- Improved collaboration. Reducing barriers to development on market-facing issues that are not viable for individual technology developers to do by themselves for an entire sector, such as working with government regulators to establish fit for purpose and proportionate local, regional and national planning and permitting processes, facilitating development of government incentive plans, etc.
- Increased collaboration with research and industry partners, ensuring technology advancements are connected to end users.
- Generation of new knowledge which can support the research community and help determine other research questions and needs which can stimulate additional research funding into this important area.
- Provide investors with analysis to underpin their consideration of when and where to invest and how their investment might generate a return as well as other ESG benefits such as supporting achievement of various sustainability goals.
- Expanded number of pilot commercial demonstration projects that serve as “showrooms” for “co-design/co-development” ocean energy initiatives and catalysts for commercialisation. These are use cases to help early adopters get started on their own ocean energy journey and bring successful ocean energy projects to the public eye.

This study is first stage of a long-term ongoing effort by AOEG to gather in-depth intelligence about Blue Economy markets (end-users) and establish the foundation for building demand for ocean energy in Australia. Importantly, the market data collected in this inaugural study represents a ‘snapshot’ of the markets and does not include a comprehensive picture all markets available to ocean energy. A preliminary list of potential markets for ocean energy is included in [Schedule 1](#).



Project Approach

The AOEG's Market Investigation launched on 19 January 2022 and was completed 31 May 2022.

A seven (7) member project team was assembled to carry out the investigation. The table below identifies the project team and their primary (*but not limited to*) role in the project.

Name	Affiliation	Primary team role
Stephanie Thornton	AOEG Manager	Project Lead
Alex Ogg	AOEG Ocean Energy Manager	Project Co-Lead
David Rissik	BMT Commercial	Market maps
Jake Dunstan	Cornwall Insight Australia	Professional market research survey design, data analysis & recommendations
Louis Croxton Toulemonde	United Spirits Agency	Survey contact list & communications
Louise Richardson	UWA Master of Ocean Leadership Candidate	Data collection & synthesis
Michael Byrne	EHL Solutions/ AZURA	Ocean energy technology development subject-matter expert

The project team worked collaboratively to design and implement the following project segments:

- **Market survey.** Under the direction of Cornwall Insights, the project team developed a comprehensive survey tool to collect data from Blue Economy end-users on two key issues: 1) their awareness or knowledge about ocean energy and 2) their energy use and requirements. Click [HERE](#) to view the survey. The project team received 58 eligible survey responses.

Schedule 1 identifies the target group of desired markets for AOEG Market Investigation. However, the results presented in this report represent a sub-set of those markets, as reach to each of the target markets was not possible in the first stage.

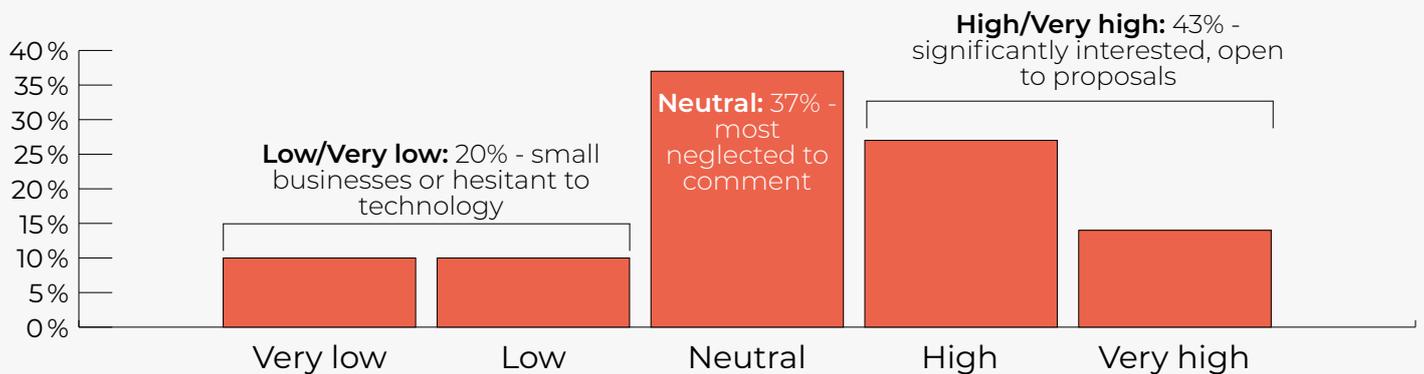
- **Ocean Energy Market Maps.** A key activity and deliverable were production of 'market overlay maps'. The maps visually illustrate the location of key markets relative to the location of the wave or tidal resource. The maps are included in **Schedule 2**.
- **Findings Summary.** Data from the validated surveys was compiled into a central repository, assessed for quality and consistency by the team and synthesised for reporting. The data findings are summarised in the next section.
- **Ocean Energy Market Development Summit.** The Australian [Ocean Energy Group's Market Summit](#) is its signature event, supporting their primary aim to increase market adoption of renewable ocean energy in Australia. This Summit program was built around the outcomes of the market investigation, with the substantive program designed and facilitated by Aquatera (located in Orkney, Scotland). The Summit was held on 10 & 11 May 2022 in Hobart, Tasmania.

Survey Results & Observations

Survey Results

The results of this inaugural phase of work documented a clear interest by varying Blue Economy end-users to learn more about ocean energy but showed that existing knowledge about ocean energy is very low. Minimal understanding about ocean energy, including its value and associated benefits, is one of the leading barriers to adoption.

How would you currently rate your interest in adopting ocean energy technologies or systems?

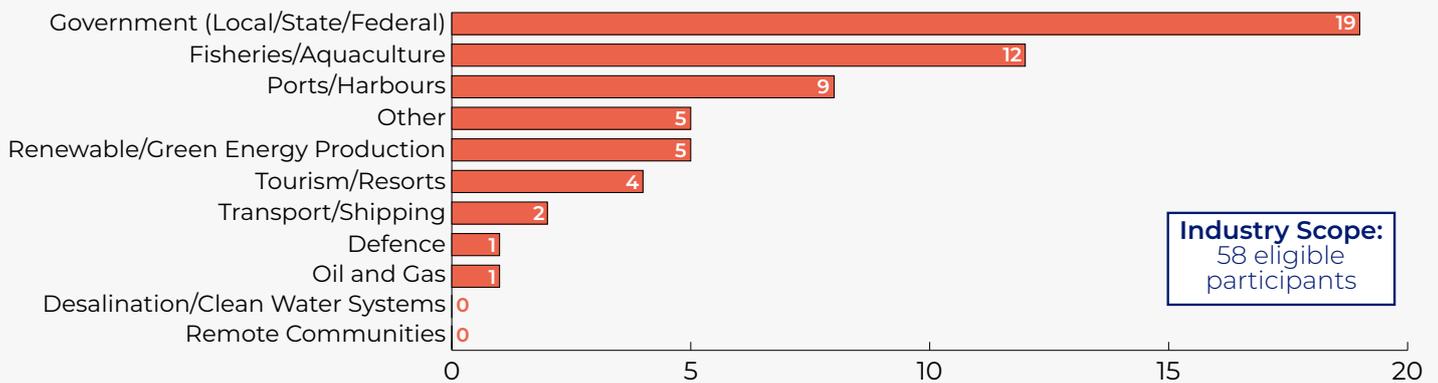


Generally speaking, those who responded to the survey were those individuals who have some awareness about ocean energy and are interested in learning more. Many of these survey responders ('respondents') have installed solar systems and are interested to learn about other technologies that can be added in to their energy supply mix to create an integrated renewable system with a strong level of predictability, reliability and cost effectiveness.

- **Priority markets for wave and tidal devices and/or systems.**

The data collected in this inaugural study is considered only a starting point or 'subset' of the total available market opportunity for ocean energy. It was interesting to note that, from the entire group of respondents, government indicated the strongest interest in ocean energy. In particular, the majority of the government survey respondents represented local governments (Councils), representative of Blue Economy communities.

Respondents by Industry Type



- **Priority markets are located in areas of high quality tidal and wave resources**

A set of ‘market maps’ were produced to visually illustrate the location of key markets relative to the location of the wave or tidal resource. The complete set of maps are included in [Schedule 2](#).

- **Issues of concern about adoption of ocean energy**

It is not surprising that in addition to increasing knowledge about what ocean energy is and how it works, the following (in priority order) were identified as they key issues of concern that need to be effectively communicated to gain market entry.

- Costs/benefits of an ocean energy system relative to an end-user’s current energy business model
- Capital costs/comparative analysis
- Technology readiness concerns
- Permitting and licensing

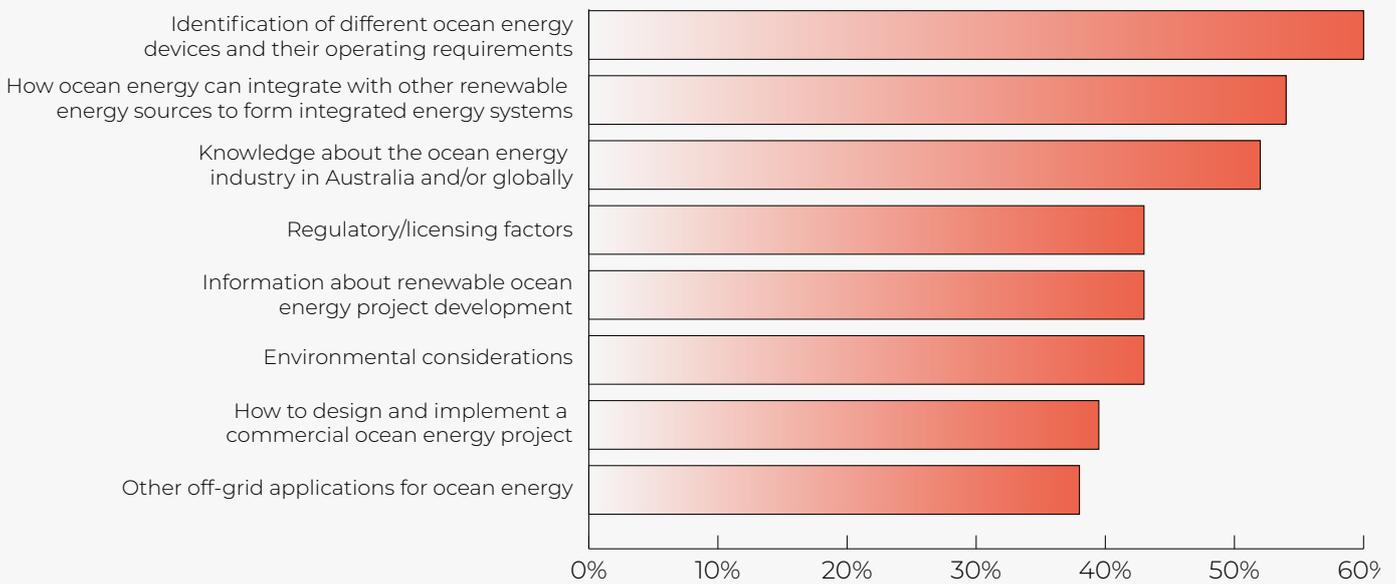
When making decisions on alternative energy generation, markets consider the following key factors (in priority order). In summary, an end-user wants to assess whether the ocean energy system (generation) will match their energy use and other requirements; and that the cost benefits of the system justify investment.

- Reliability of supply
- Price of system
- Emissions reduction
- Energy generation profiles

- **Information requirements to increase understanding about ocean energy.**

There is strong need to improve understanding about ocean energy across most aspects of the technology, industry and regulation.

What information would improve your understanding of ocean energy technologies?



Importance of energy supply reliability and cost

As was expected, in the surveyed Blue Economy Markets, reliability was identified as key feature in supply, alongside cost and transitions to renewable sources.

Key drivers of energy supply



Reliable Supply:
87% total respondents

- 67% very important
- 20% important



Cost of electricity:
81% total respondents

- 53% very important
- 28% important



Sourcing electricity from renewables:
86% total respondents

- 20% very important
- 66% important

- **Strategic Interest in Renewables to meet Sustainability Goals**

A key issue AOEG wanted to understand / investigate whether a transition to renewable energy supply was part of a market's strategic imperative. Most respondents indicated it as important but not essential and that other factors, such as cost, were the primary decision drivers.

Additional findings include:

- Many respondents have either started on their sustainability journey or were now planning to start their journey. Key reasons for pursuing a renewable energy or sustainability plan are to reduce dependency on fossil fuels and reduce their cost of energy.
- While respondents have a general preference for renewables, alternative technologies will be considered if and when the economic benefits can be demonstrated.
- Government mandated renewable targets is one of the exceptions about renewable energy uptake. Mandates may override internal decisions about when to proceed with a renewable energy transition and what renewable sources will be adopted within that timeframe.

Observations

The survey respondents generally fell into one of the three following categories:

- Those who well informed and are ready to transition to renewables.
- Those who are somewhat familiar with renewable solutions, including ocean energy; or are actively looking for solutions but may not know how or where to start.
- The remainder of respondents are considering the start of their sustainability and energy transition journey. Most likely they would start with established technologies, such as solar.

Priority target markets. Local governments/Councils representing coastal communities, aquaculture sector and ports represent the top three target market segments for ocean energy in Australia. The majority of these markets with existing energy challenges are situated in places with direct access to ocean energy resources (tidal or wave energy; see [Schedule 2](#)).

Creating Market Demand for ocean energy. To realise substantive market adoption of ocean energy, a huge information gap needs to be filled. Key information to develop includes but not limited to:

- Showing how the addition of ocean energy solves a market's energy challenge and adds value.
- Articulating the benefits and demonstrating tangible solutions that can be provided.
- Enabling people to find the information they need from industry to inform decision-making.

- Providing use cases to help early adopters get started.
- Helping potential markets understand how to plan and develop an ocean energy project and what scale.
- Understand consumption profiles of end-users in more specifics.
- Cost-benefit analysis and tech readiness are leading issues to address to enable markets to make informed investment decisions.
- The 'Trilemma question' indicated that security/reliability is the leading concern by markets with sustainability also of importance. Communicating the value proposition of ocean energy needs to be around security, reliability and sustainability.

Key decision factors. End-users want to assess whether the generation source matches their demand profile and requirements and that the costs and benefits of the system justify the investment.

Diesel replacement. Many respondents indicated they use diesel generators for backup energy supply. An ocean energy system for a specific market has the potential to offset or replace reliance on diesel. It may not entirely remove the requirement of diesel generators depending on a market's reliability requirements. However, an ocean energy system could significantly reduce a generator's running time which could have a material financial impact on operational costs, while reducing emissions and impacts associated with air quality and noise.

Integrated systems. The preferential use of solar PV by end-users is not unexpected given the ability to passively offset midday consumption of energy in some situations and its low cost of operation. These users also offset capital cost requirement which improves unit paybacks. Given existing use of solar and in some cases wind, there is increased opportunity to promote integrated ocean energy solutions.

Planning for energy transition/renewable energy. The group of survey respondents were at mixed stages of development and implementation of their individual renewable energy plans. Given the majority are in development or thinking of developing transition plans presents an opportunity for consideration of ocean energy solutions in the planning stage. However, given there are, as yet no strong drivers or requirements for markets to adopt renewable energy, the value proposition of ocean energy must be compelling.

Energy importance. While cost reduction is an important consideration, there is also opportunity to help markets achieve their sustainability goals. Information provided to the markets needs to clearly explain how ocean energy can help deliver economic growth, social inclusion and environmental sustainability, while striving to emission reduction targets (national, regional and global). The costs of electricity and reliability are equally important. This was validated from the survey results documenting the consistent and energy intensive nature of surveyed businesses. It is important for supply interruptions to be minimal and for the cost of electricity to be actively managed and minimised as well. It is observed that affordability and sustainability are increasingly competing with each other.

Conclusions

Market data for developing the ocean energy industry is scarce, both in Australia and internationally. AOEG believes its initial market intelligence study has started something significant and critically important to continue and build upon. This study is considered only the beginning of a long-term ongoing effort by AOEG to gather in-depth intelligence about Blue Economy markets (end-users) for ocean energy.

A significant conclusion from our study is confirming that market interest does exist for ocean energy, further validating AOEG's strategic focus on the market-side of the ocean energy industry as opposed to focusing on technology development. AOEG has an important opportunity to build capacity in ocean energy and promote the benefits of what it can deliver for the end-user. This work further validates the development of the Integrated Ocean Energy Marketplace, AOEG's ocean energy 'showroom', currently underway.

Furthermore, this study strongly highlights the relative lack of end-user awareness of ocean energy. It provides a starting point of data to begin to enhance knowledge and capacity amongst users and to provide them with what they want and need. AOEG can begin tailoring its messages and communications to this group and design Marketplace products and services accordingly.

AOEG acknowledges the significant benefits of this study for ocean energy technology developers as well. Along with documenting that demand does indeed exist for ocean energy, identification of early adopter markets/end-users will help technology and/or project developers reduce time to market through understanding who these end-users are and aligning later stage product development to meet the requirements or needs of the market. It also enables technology and/or project developers to more accurately tailor their messages to potential customers.

Continued investigation into the end-users for ocean energy technologies and/or systems, will also benefit the research community by identifying the barriers to market uptake of ocean energy and directing research to reduce or eliminate those barriers.

This study is considered only the beginning of a long-term ongoing effort by AOEG to gather in-depth intelligence about Blue Economy markets (end-users) for ocean energy. Ongoing assessment of the markets is necessary, especially where data and information are insufficient or absent. [Schedule 1](#) identifies many of these additional markets. AOEG also believes that continued refinement of the markets maps is necessary to communicate the distribution and opportunities for ocean energy in Australia.

Schedule 1

Ocean Energy Market Investigation Potential Available Markets for AOEG Market Investigation

The table below identifies a range of potential Blue Economy target markets which AOEG seeks to include in its Market Investigation over time.

The results presented in this report represent a sub-set of markets. Those include:

- Government (the majority of government respondents to the survey represented local government/councils.
- Aquaculture/fisheries
- Ports/harbours

Blue Economy Market Category	Market Sub-Category
Aquaculture/Agriculture	<ul style="list-style-type: none"> • Finfish • Seaweed • Salmon • Shellfish • Hatchery • Crustacean
Coastal Protection/OE as barrier	<ul style="list-style-type: none"> • Local government • Ports/marinas (included in "Ports" category below) • Coastal based research laboratories (locations with tanks/pumping, etc.)
Defence	<ul style="list-style-type: none"> • Communications at bases: power for security systems, underwater monitoring, etc.) • Surveillance systems • Power for remote locations • Instrumentation • At-sea recharging stations
Desalination and/or Clean Water systems (direct operator) Pumped hydro	<ul style="list-style-type: none"> • Large operators – public • Large operators – private • Sm/med operators – public • Sm/med operators – private • Municipal water companies (groundwater)
Green hydrogen	Green hydrogen producers
Integrated energy systems	<ul style="list-style-type: none"> • Energy storage "owners" • Microgrid operators/local distribution
Local government	Councils
Offshore wind	Project developers
Offshore energy	<ul style="list-style-type: none"> • oil/gas • Mineral extraction • Mining (coastal-based infrastructure and/or operations)
Offshore data	<ul style="list-style-type: none"> • Scientific monitoring/data collection • Navigation • Weather

Blue Economy Market Category	Market Sub-Category
Offshore charging stations	<ul style="list-style-type: none"> · Autonomous underwater vehicles · Electric vessels (eg, ferries, fishing, etc.)
Ports/harbours/marinas	<ul style="list-style-type: none"> · Industrial ports – public · Industrial ports - private · Sm/med ports – private · Sm/med ports – public · Recreational marinas
Remote communities	<ul style="list-style-type: none"> · Islands · Indigenous/Aboriginal communities · End-of-grid · Tourist resorts · Other isolated businesses
Marine transport/coastal based	<ul style="list-style-type: none"> · Autonomous vessels · EV charging stations · Commercial hybrid/electric vessels · Green hydrogen 'highway'
Waste Management	<ul style="list-style-type: none"> · Coastal-based: · Recycling centres · Sewage treatment · Ocean plastics/clean-up/remediation
Utilities	<ul style="list-style-type: none"> · Electricity providers to the grid
OTHER	<ul style="list-style-type: none"> · Marine bioproducts

Schedule 2

Ocean Energy Market Maps

The maps below provide a very high-level view of the distribution of potential markets for ocean energy spread throughout the coastal regions of Australia. A finer scale assessment will be needed in the future to identify the location of specific markets relative to Australia’s wave and tidal energy resources.

The maps below show industry distribution of a few broad markets:

- Aquaculture
- Petroleum wells
- Ports and marinas
- Coastal local government

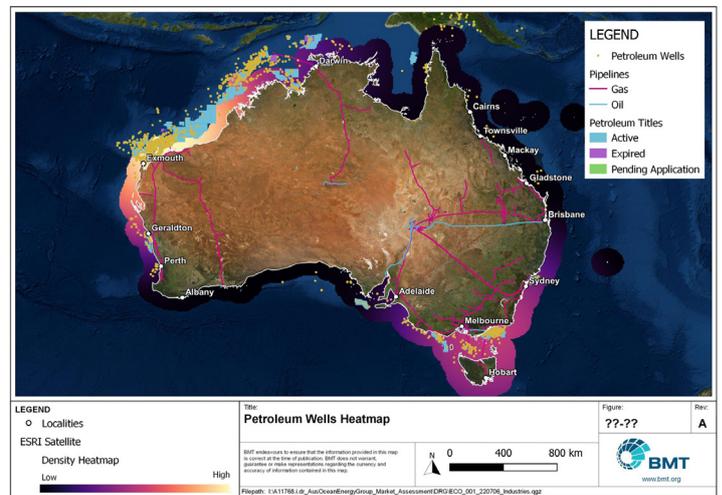
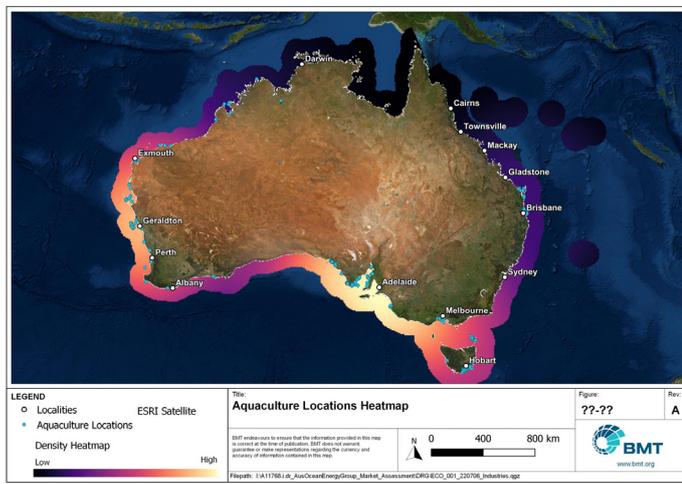


Figure 2.1

Figure 2.1 indicates the relative concentration of the industry around the coast (lighter shades being a higher density).

Figure 2.2

Figure 2.2 indicates the relative concentration of the industry around the coast (lighter shades being a higher density).

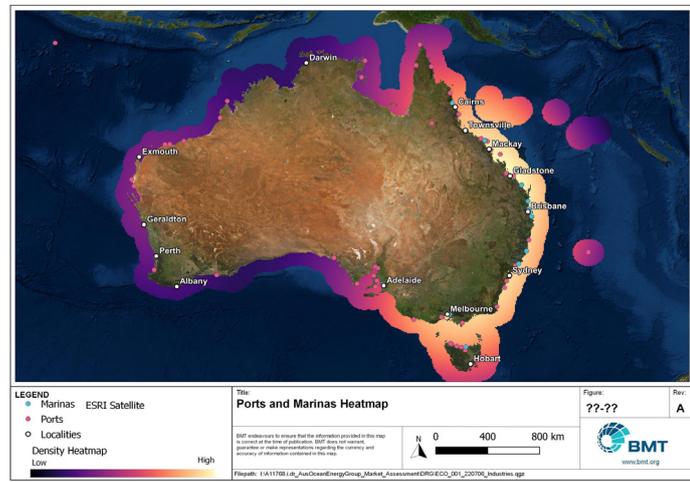


Figure 2.3

Figure 2.3 indicates the relative concentration of the industry around the coast (lighter shades being a higher density).

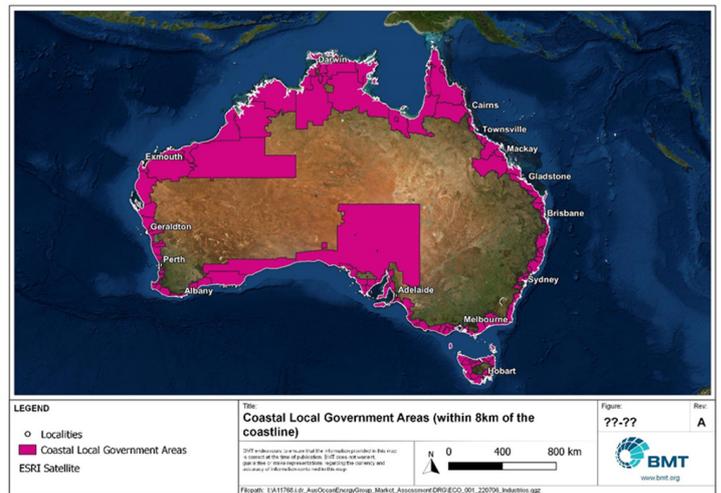


Figure 2.4

Figure 2.4 shows locations of coastal local governments in Australia.

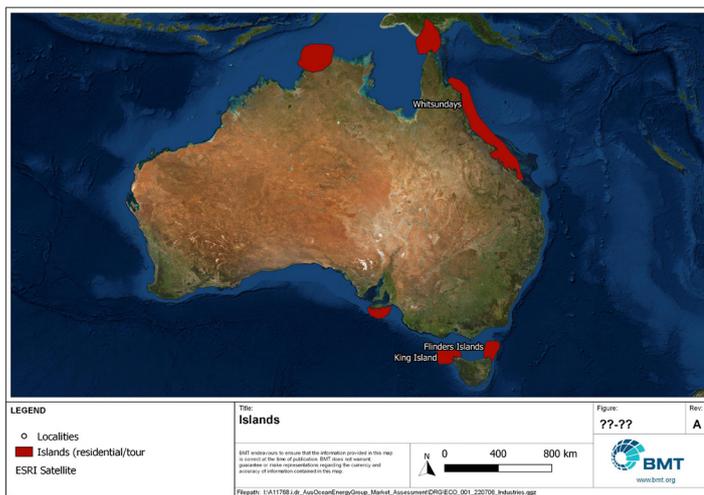


Figure 2.5

Figure 2.5 shows shows locations of many of the island groups or islands in Australia.





**AUSTRALIAN
OCEAN ENERGY
GROUP**

Australian Ocean Energy Group (AOEG) is an industry-led cluster, established to accelerate the commercialisation of Australia's ocean energy. Founded in 2018 with start-up support provided by National Energy Resources Australia and Climate-KIC Australia, AOEG has grown from a 'coordinating organisation' to one that provides a mechanism to bring the end users (such as market customers) together with technology providers and suppliers to advance the commerciality of ocean energy.