BLUE ECONOMY
COOPERATIVE RESEARCH CENTRE

RISKS & OPPORTUNITIES FOR THE BLUE ECONOMY

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program

Risks & Opportunities for the Blue Economy (4.20.006)

AUTHORS

- **Mischa Turschwell,** Griffith University
- **Chris Brown,** Griffith University
- **Beth Fulton,** CSIRO
- **Myriam Lacharité,** University of Tasmania
- **Jess Melbourne-Thomas,** CSIRO

PROJECT PARTICIPANTS

BMT · Carnegie Clean Energy · Cawthron · CSIRO · DNV · Griffith University · Huon Aquaculture · Macquarie University · New Zealand King Salmon · OceanPixel · Oysters Tasmania · Petuna · Sabella · Saitec Offshore Technologies · Tasmanian Government · The University of Queensland · University of Tasmania

The Blue Economy CRC is funded in part under the Australian Government's CRC Program, administered by the Department of Industry, Science and Resources. The CRC Program supports industry-led collaborations between industry, researchers and the community.

Table of Contents

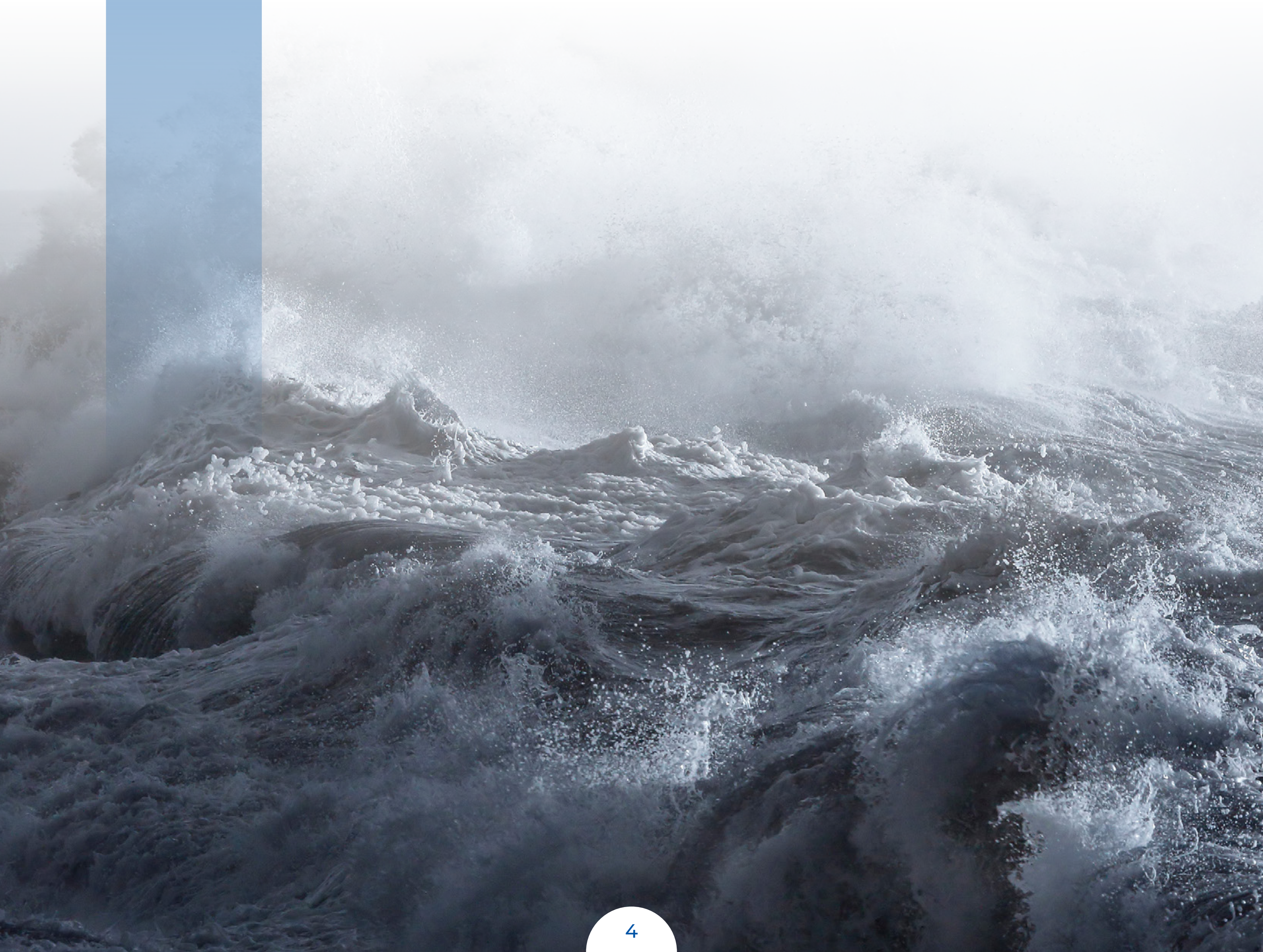
Introduction

Offshore marine economies have existed for decades, historically dominated by industries such as oil and gas (exploration and extraction), commercial fishing, shipping, and telecommunications.

In Australia, growth in emerging blue industries – such as offshore renewable energy and aquaculture production – has begun in earnest.

Growth in the offshore 'Blue Economy' is predicted to accelerate as emerging industries look to develop in high energy environments.

New development of any kind involves risk, and these risks may be poorly understood when industries are expanding into environments where they have limited operating experience. An important first step in risk management is to acknowledge hazards that exist currently, or may emerge in the future. Once identified, these hazards can be prioritised; those with high priority can be progressed to full risk assessment and those of lower concern can be downgraded and potentially 'retired'.



This project undertook a process to identify hazards across a very broad set of domains linked to Australia's emerging Blue Economy (Figure 1). Through an expert-driven, collaborative process, the project then analysed this large set of hazards and ranked them using an agreed set of criteria. The end result of this process is an interactive registry of hazards for the emerging offshore Blue Economy in Australia.

The eventual decommissioning of the new infrastructure associated with the expansion of these emerging domains was out of scope for this study, there was not sufficient available information to go into detail. It will be an important topic however and deserves future attention.

RENEWABLE ENERGY PRODUCTION

Includes the construction, deployment and operations of technology to capture renewable energy in offshore locations (primarily wind and wave), as well as operational logistics of accessing sites.

MARINE ENGINEERING

The manufacture and production of structures to be used offshore for renewable energy production and aquaculture production.

AQUACULTURE PRODUCTION

The rearing of species (e.g. fish) in offshore high-energy environments, including operational logistics of accessing sites.

INTERACTIONS WITH THE ENVIRONMENT

Interactions with the local environment from renewable energy production, aquaculture production and marine engineering.

SOCIETY (INCLUDING POLICY CONSIDERATIONS)

Social considerations of new development including obtaining a social licence to operate and impacts on local communities from emerging industries.

ECONOMICS

The psychology of decision making and the financial viability of operations for offshore renewable and aquaculture production.

Figure 1. *Descriptions of the six research domains involved in establishing a food and energy generating offshore Blue Economy.*

WP1

A synthesis of approaches for hazard analysis in the emerging offshore Blue Economy

Hazard analysis is typically a broadly scoped 'screening' step to identify and prioritise all possible hazards. This process was originally developed for industrial systems safety, aiming to identify hazards, their effects, and their causal factors. Approaches to analyse hazards and assess risks have been developed and applied across a wide variety of disciplines including engineering, medical research, ecology, and economics, but these approaches vary widely in their scope and complexity.

The goal of the first work package was to review and identify the most appropriate method(s) for hazard analysis in the context of multi-domain blue economic growth. We undertook a high-level literature review of hazard analysis approaches, evaluation processes and tools used by the diverse domains involved in the development of an offshore food and energy production centred Blue Economy. This meant looking at what is used by marine engineers, economists, ecologists, social scientists and within the aquaculture and marine renewable energy production industries. The review also looked at commonly used risk analysis and assessment techniques in general where it looked that they could be relevant.

We also reviewed and compiled a list of hazards to and from offshore activities, with a primary focus on aquaculture and renewable energy systems. Our database of hazards considered onshore and logistics components, as well as the planning, construction and operational phase of offshore developments.

Our review confirmed that domains generally approach hazard analysis with their siloed techniques and language, and that to date hazard analyses have been done within disciplines. We found that no existing method considers multi-domain hazards both to and from marine developments.

With a growing focus on sustainable economic growth and optimizing the use of ocean space through multi-use it was clear that a standardised approach to hazard analysis that could span domains is needed.

With a growing focus on sustainable economic growth and optimizing the use of ocean space through multi-use it was clear that a standardised approach to hazard analysis that could span domains is needed.

A clear benefit to the emerging offshore Blue Economy existed from the development of a flexible, integrated approach to identifying and assessing hazards in a transparent, comprehensive and robust manner. Such an approach could underpin successful planning, development, and operations.

As no existing approach was fit for the task, the project team had to begin by developing a method.

WP2 Co-designing a multi-criteria approach to ranking hazards to and from Australia's emerging offshore Blue Economy

With input from experts from several disciplines, industry professionals, regulators, and government planners, we co-developed (1) a list of hazards across the six domains (Figure 1) and (2) an approach to integrated hazard analysis.

This co-development approach involved expert elicitation, conceptual modelling, and multi-criteria decision analysis (Figure 2).

During two expert workshops, 46 experts ranked 56 hazards against four criteria:

1. The **likelihood** of the hazard having an impact;
2. The **consequence** of that impact;
3. How difficult is it to **detect** the impact; and
4. How difficult it is to **respond** to the impact.

This ranking was done using interactive online tools where experts could clearly define what they considered to be low, medium, high or extreme scores for each criterion and then drag the hazards into the order that made sense to them. To make this scoring more tangible it was done in the context of hypothetical developments of different kinds (e.g. see Figure 3).

Figure 2. *Conceptual workflow of the integrated hazard analysis methodology. Out of workshop sessions were led by a core team while workshops included all project participants*

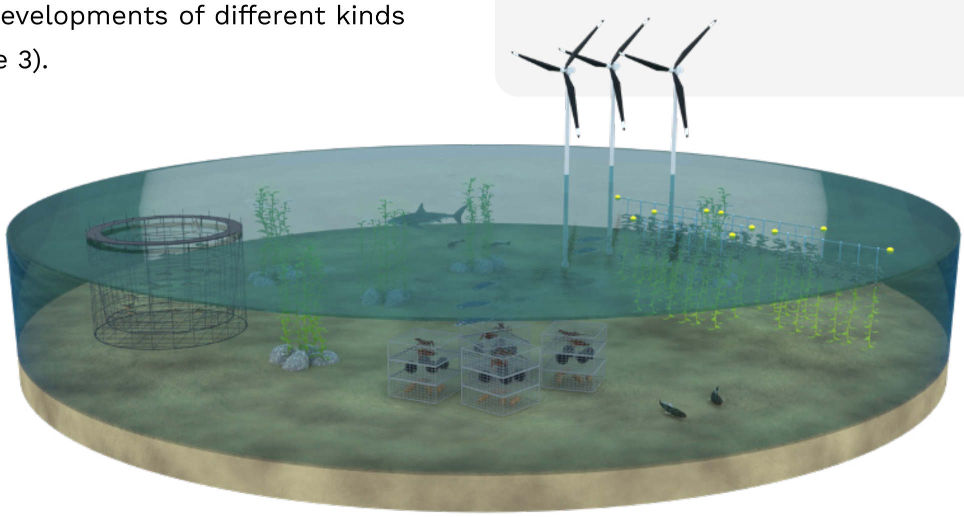


Figure 3. *A graphic of one of the hypothetical development scenarios (showing temperate species being cultured near an offshore wind development) used to give context to the expert hazard ranking exercise.*

WP2

Co-designing a multi-criteria approach to ranking hazards to and from Australia's emerging offshore Blue Economy

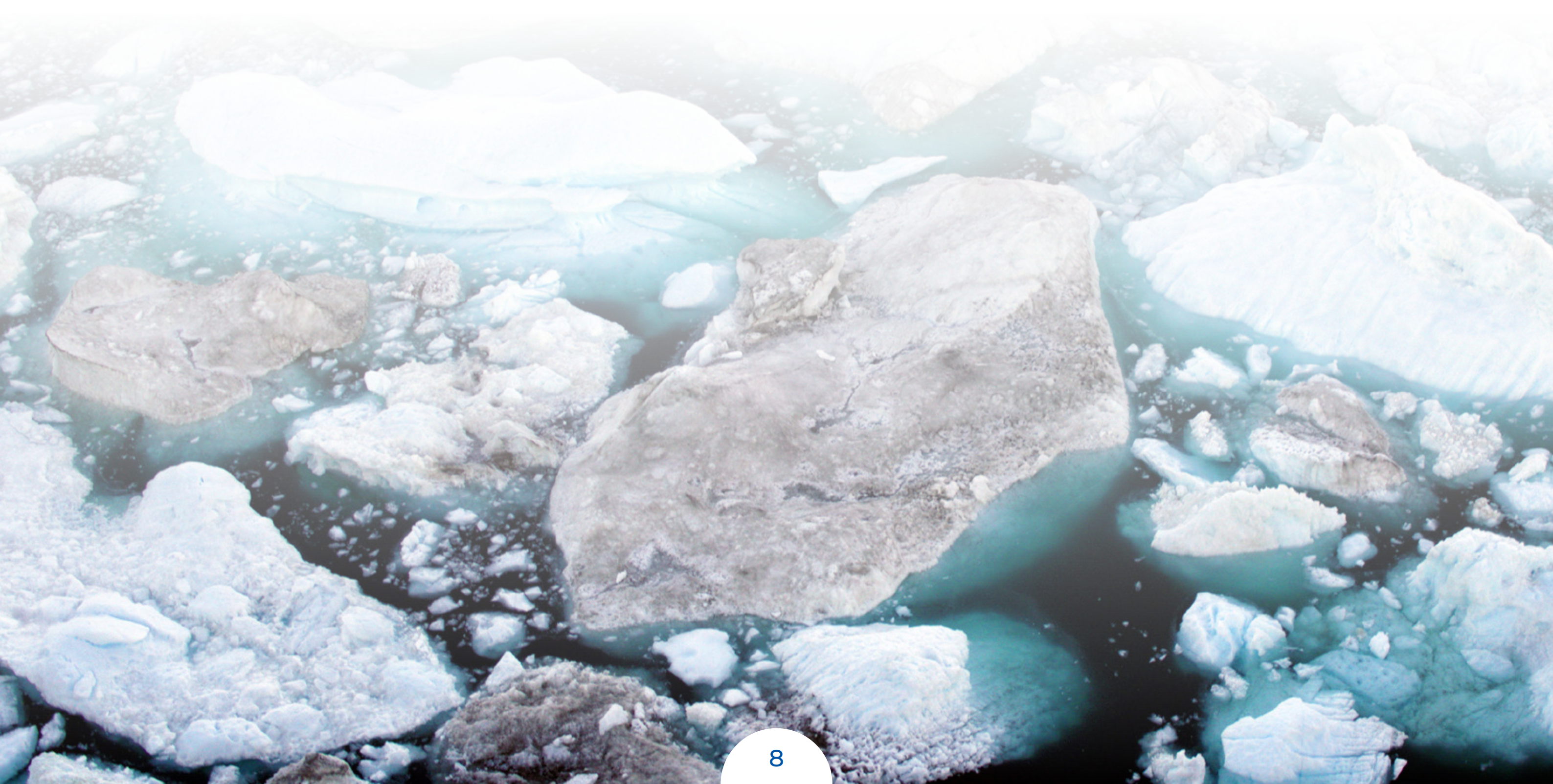
Climate Change was the hazard with the highest score overall, with experts from all domains marking it out as the clearest hazard to offshore developments.

Hazards pertaining to *Altered Ecosystem Functioning, Biosecurity, The Inadequate Assessment of Cumulative Effects, Structural Failure due to High Energy Environments* and *Public Opposition to Development* were also highly ranked across multiple domains.

In contrast there were a number of hazards that were consistently the most lowly ranked in each domain. These hazards – such as *Reliance on Technology Rather Than Manual Labour and Maritime Transport* – could potentially be retired from future risk assessments.

In between these two extremes were a longer list of hazards considered important to one discipline but not another. For example, *Excessive Biofouling* was an engineering concern, but of less importance to the other disciplines.

A multi-sectoral assessment of risk that integrates knowledge and perspectives from many domains can direct research needs and investment decisions. Through the ranking of hazards, the methodological approach developed in the current study can be applied to support strategic decision making and risk mitigation by identifying and prioritising hazards that should be considered and progressed to full risk assessment.



WP3

Identifying opportunities for Australia's offshore Blue Economy using conceptual models

We used interactive workshops with expert participants and an online software tool (Mental modeler) to capture conceptual models of how the offshore developments function, what influences them and what they influence.

These models captured the interactions – including causes and consequences – among different hazards relevant to the offshore Blue Economy (Figure 4). The conceptual modelling exercise was also used to identify opportunities and needs for future research and development in the context of Australia's offshore Blue Economy.

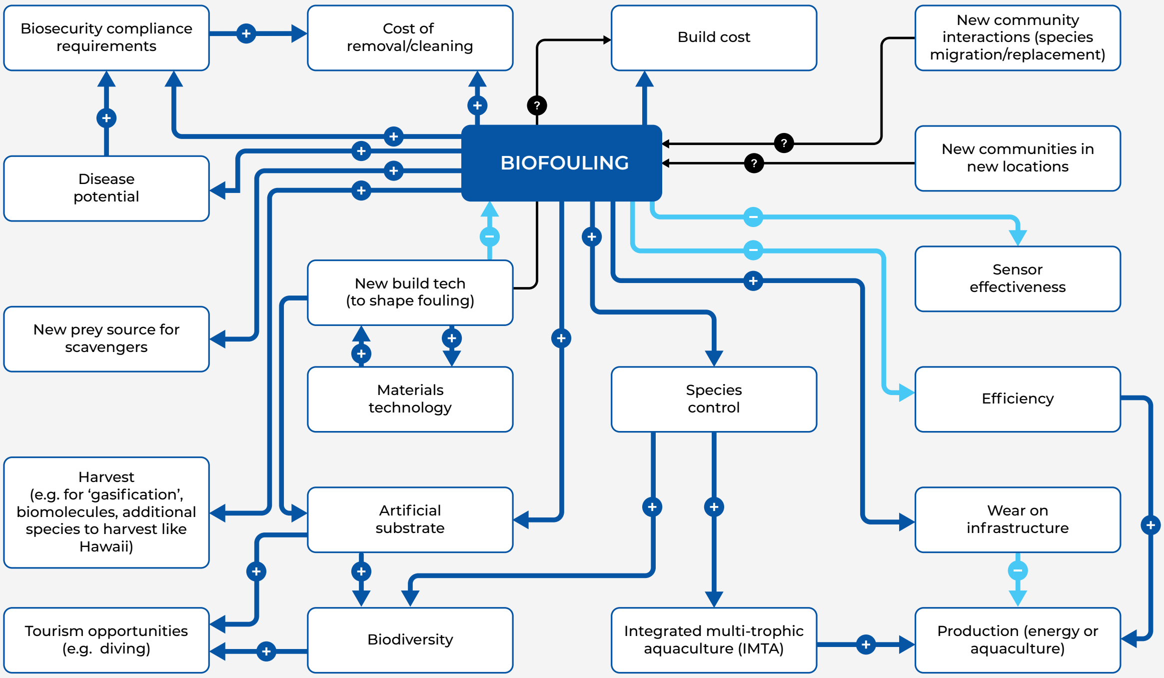


Figure 4. *Example of a conceptual model, developed in the expert workshops for the hazard 'biofouling'. A **+** indicates connection where growth in the source box leads to growth in the receiving box; a **-** indicates were growth in the source box causes a decline in the receiving box; and a **?** means the type of connection is unknown.*

We summarised 22 conceptual models and four key themes emerged as opportunities for the Blue Economy CRC: **technology** (e.g., improved sensor development to adapt to monitoring needs); **policy and regulation** (e.g., development and implementations of a transparent and holistic framework for regulating cumulative effects); **business development** (e.g., tourism – opportunities for novel tourism operation such as diving and fishing on and around multi-use platforms); and **environment** (e.g., physical infrastructure acting as an artificial reef or fishing exclusion zone). These opportunities fit well with the CRC's overall goals and could be prioritised for future work by the CRC.

WP4

The Blue Economy and Indigenous Perspectives of Risk – Working Toward an Indigenous-Centred Social Licence to Operate

The implementation of the ranking approach was limited in this instance to workshop participants from research organisations, industry and government and did not consider community-based and Indigenous perspectives of hazards.

This was because, after much deliberation, the project team concluded that technical workshops to elicit hazards ranking would not be appropriate without proper context and resources to engage with communities and Traditional Custodians. Respectful and meaningful engagement with Traditional Custodians would require a co-designed process that was not possible in this project. Consequently, the project team opted to provide a literature review of Indigenous perspectives of risk and hazards in the context of the Blue Economy.

The review examined questions of governance and mechanisms for Indigenous participation and inclusion in the distribution of economic benefits, as well as in monitoring and managing environmental and cultural impacts of Blue Economy industries.

The outcomes of the review suggest that...

a shift in practice of social licence to operate is needed, such that consent is granted by Indigenous groups based on their perspective of social licence at all stages of the project life-cycle

...and whenever new social and cultural risks and opportunities emerge.

Such a shift in practice across the Blue Economy requires the consideration of multiple collaborative arrangements and a platform for Indigenous driven transformation in how Indigenous Peoples participate in the sector and in business agreements based on their particular historical, social, cultural and economic context and goals.

WP5

Blue Economy “Interactive Registry”

To make the hazard rankings accessible to participants and future development proponents, we developed an interactive online risk registry that houses the information collected during hazard ranking exercise.

The registry is intended to be primarily used as an initial screening tool, scanning across a wide range of possible hazards to operators, the environment, society and regulators. Users can use interactive tables (Figure 5) to access the expert ranking of the hazards - a dataset that can be updated and grow into the future as more is known about the existing hazards (which may modify perceptions of their importance), as new expert perspectives are added or as new hazards are uncovered.

Copy Excel PDF Columns Reset

Search:

Domain	Hazard	MCA (R)	Variability (R)	Consequence (R)	Likelihood (R)	Diff Det (R)
Aquaculture Production	Maintenance: effects of cleaning operations on surrounding environment	32	28	39	18	5
Environment	Maintenance: effects of cleaning operations on surrounding environment	18	22	24	10	14
Marine Engineering	Maintenance: effects of cleaning operations on surrounding environment	10	31	9	8	21
Renewable Energy Production	Maintenance: effects of cleaning operations on surrounding environment	26	36	35	36	3
None	Maintenance: effects of cleaning operations on surrounding environment					

Showing 1 to 4 of 4 entries (filtered from 202 total entries)
Show 10 entries

Figure 5. *An example of the registry’s interactive data table, which can easily be searched or filtered to allow users to focus more easily on their interests. The information can also be downloaded for offline use.*

Visualisation tools (e.g. Figure 6) built into the registry let users explore which hazards are seen as the most pressing and how the different disciplines agree (or not) over hazards that are considered unlikely to happen (or those with minimal impacts).

The most highly ranked hazards would definitely need to be considered in future risk assessments, but the lowliest ranked hazards could potentially be retired from further consideration, by proponents or regulators.

This kind of prioritisation allows for the focus to be put on more important hazards, where more thorough risk analysis is likely required to provide rigorous, detailed and precise estimates of risk; and ensure the most appropriate risk mitigation measures are identified and applied. The online registry has been developed in such a way that it could be amended in future as new information arises, potentially changing the hazard rankings.

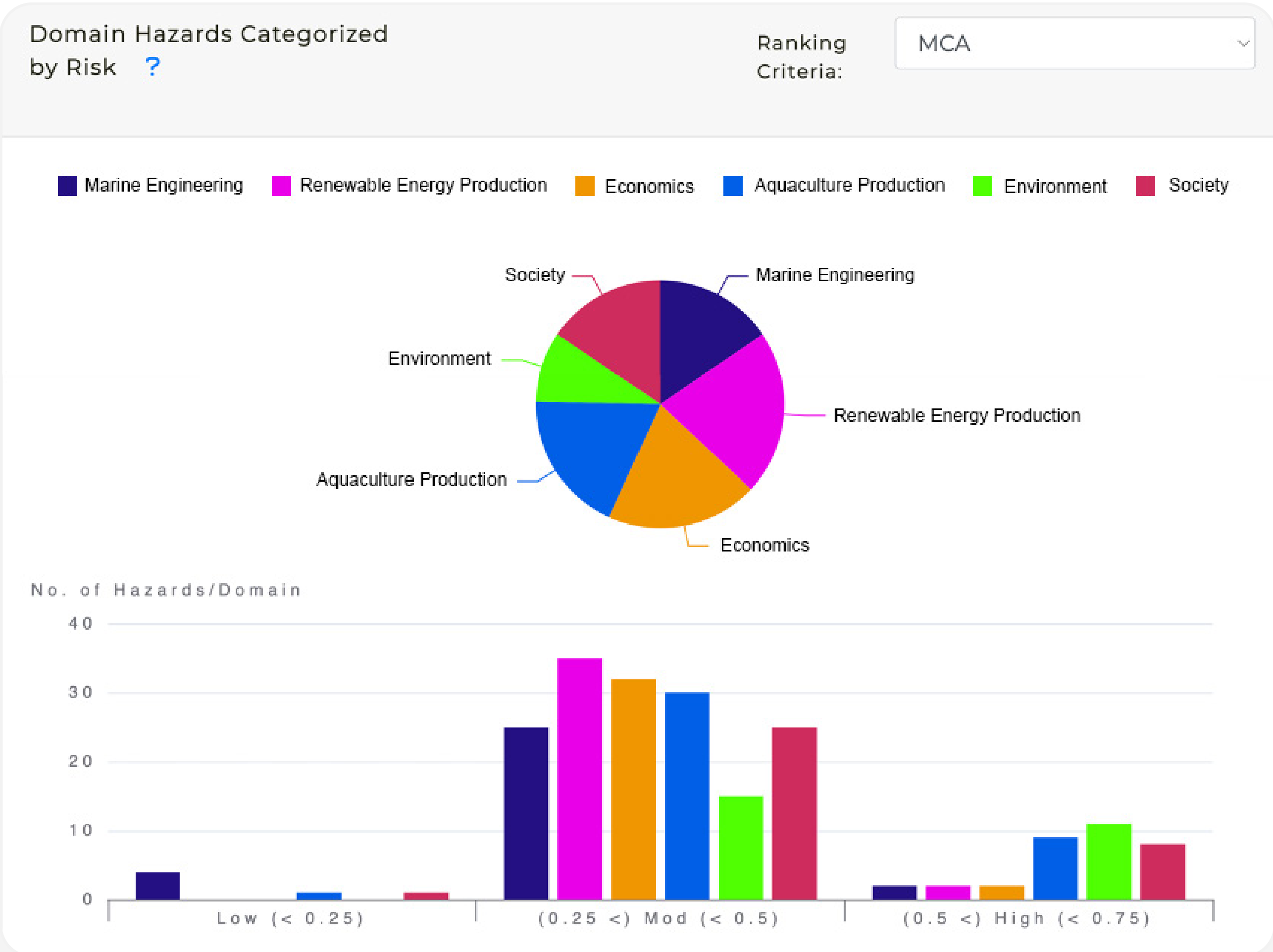


Figure 5. *Screenshot of some of the high-level statistics from the Interactive Registry. Clicking on a domain or hazard takes the user to more detailed information on that aspect.*

Summary

Australia's emerging Blue Economy industries provide many opportunities for our society and economy but may also present new risks to the quadruple bottom line of the economy, environment, society and culture.

We developed a method for ranking hazards that spans multiple disciplines and applied it to identify hazards associated with offshore infrastructure development. The results are presented in an interactive registry that can inform future research priorities and decision makers about risks and opportunities for the Blue Economy.

For more information, please see our website. Strategic Plan and Annual Reports **available here.**

ISBN: 978-1-922822-01-7

Blue Economy CRC
PO Box 897, Launceston, Tasmania 7250
www.blueeconomycrc.com.au
enquiries@blueeconomycrc.com.au

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program