

Australian Seaweed Industry Sector Development & Economic Impact



Australian
Sustainable
Seaweed
Alliance

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Australian Sustainable Seaweed Alliance acknowledges Australia's Indigenous People who are Traditional Owners of country throughout Australia, and recognise their continuing connection to land, waters and culture. We pay our respect to their Elders past, present and future and extend that respect to all Indigenous People.

About ASSA

The Australian Sustainable Seaweed Alliance (ASSA) has a mission to scale up environmentally responsible commercial farming of seaweed to provide food, feed and bioproducts. ASSA provides a coordinated voice to government and in the media to represent the Australian seaweed industry and help grow the industry sustainably.

ASSA has a national membership of around 30 members who are supported by a board of four and secretariat of ten who collaborate across six locations including hubs in Sydney, Queensland and South Australia.

ASSA and the Fisheries, Research and Development Corporation (FRDC) are working together with the Department of Agriculture, Fisheries and Forestry (DAFF) to deliver on an \$8.1 million grant provided by the Australian Government to accelerate seaweed aquaculture in Australia, under the 'Developing Australia's Seaweed Farming Program.'

The latest information and news from the industry can be found at www.seaweedalliance.org.au

About this report

The purpose of the report is to provide an update on the progress of the Australian Seaweed industry since AgriFutures and The Australian Seaweed Institute's Australian Seaweed Industry Blueprint² was published in 2020. This report extends the economic impact assessment by analysis of scenarios extending from current Australian seaweed sector development activities and investments, confirming the opportunities in Australia's role in the global demand for seaweed-derived products and more.

It is intended to be a reference to global and local industry stakeholders including industry investors and supply chain participants across cultivation, processing and industry development.

The Australian Sustainable Seaweed Alliance commissioned this project with Deloitte Australia to examine the current activities in the Australian seaweed industry, and to determine economic contributions of growth scenarios. This report comprises Deloitte analysis supported by industry data and insights provided by ASSA and interviewed ASSA members, reviewed and validated by Australian Seaweed industry subject matter experts.

The information contained in this publication is intended for general use to assist public knowledge and discussion and to help improve the development of sustainable seaweed industry in Australia. You must not rely on any information contained in this publication without taking specialist advice relevant to your particular circumstances.

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Forward

Australia offers a real competitive advantage across global seaweed-derived products value chains:

- We are home to an abundance of native seaweed species providing genetic diversity and a significant opportunity for advanced product development.
- Our industrial ecosystem combined with strong government policies, industry collaborations, and funding opportunities create a conducive environment for new ventures and innovation.
- Stability of the Australian political system has also allowed for innovation with comprehensive laws to be established safeguarding aquaculture-related innovations, such as novel cultivation techniques, processing methods, and product formulations.
- This provides a unique opportunity to advance untested global nature repair markets alongside carbon markets, as they evolve and become more widely adopted.

The report is the result of extensive consultation and coordination with seaweed value chain stakeholders across researchers, primary producers, seaweed-derived product developers, regulators and industry professionals, and offers a deep dive into the activities that are shaping investment attraction and industry growth scenarios for a high-tech and high-value seaweed industry.

Since 2020 over A\$400M of industry activation and development activities across the industry has been funded by government, philanthropy and the private sector¹. Many programs have supported seaweed sector development, connecting university research teams with advancing industry, positioning the seaweed industry in Australian for growth. This has led to the emergence of an expanded value-chain with new industry participants

here in Australia servicing a range of new product innovation across industry sectors that have a global reach.

A key challenge includes complex state government regulatory permit process for onshore and offshore aquaculture zones targeting seaweed production. If addressed appropriately, this will allow for increasing opportunities for investment attraction and business development to support commercialisation at scale in key hubs. This comes as industry activation groups like ASSA and others are proactively addressing these critical challenges and other barriers to growth.

Global advances in regenerative aquaculture technology, decarbonisation and healthy living are driving high growth market projections for seaweed-derived products. Primary producers of seaweeds including key market leaders in Asia visited by ASSA delegates are balancing cost and scale challenges. Advancing bioremediation solutions and IMTA offer cost-effective biomass supply.

The global demand is significant, the supply potential is vast, and Australia has a real opportunity right now, to lay the foundations to compete in his sustainable and growing global marketplace over the decades to come.

Kind regards



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The scope of this document focuses on seaweed, or macroalgae and does not consider microalgae and any of its derived products, although likely to have aligned sector development activities and market opportunities.



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EXECUTIVE SUMMARY

Global demand shaping the Australian seaweed sector development

Deloitte analysis, adapted from The World Bank with industry contributions, has assessed growth scenarios where Australian-based seaweed production and connected industry could contribute up to **A\$4.6 billion to Australia’s GDP** per year by 2050, with bioproducts markets trading seaweed-derived products with a market value of **A\$5–A\$10 billion**. This scale of industry would require up to **22,000 hectares** of seaweed aquaculture producing up to **9 million tonnes** wet weight per annum of seaweed biomass a year, employing up to **17,400 full-time jobs**.

Private and public sector investment contributed over A\$400 million for development activities across the Australian seaweed sector since 2020. The private sector has underpinned the growth projection for Australian-based seaweed production on 22,000 hectares in offshore and onshore aquaculture zones, that could annually produce up to 9 million tonnes per annum of wet seaweed from local species.

With this biomass, Australia could service 13–19% of the emerging global markets for seaweed derived-products estimated at A\$16 billion of value by 2030, and projected to have a collective market value of A\$5–A\$10 billion by 2030.

Key growth markets include nutraceuticals, alternative proteins, animal feed additives, bio stimulants and methane-reducing animal supplements. Plus additional value may be derived from nature repair and biodiversity market activity.

Under the modelled scenarios to 2050, the wider economic contributions to Australia could be A\$2.2–A\$4.6 billion per annum, with employment opportunities 9,000–17,500 FTE for those employed directly in primary production and across the value chain. The average annual GDP uplift over this period is (2024–2050) A\$1.6 billion, and the net present value of additional GDP is A\$13.6 billion.

Biomass Production (2050)
4 – 9 million tonnes of wet seaweed from local species per annum

Land & Sea Cultivation (2050)
11,000 – 22,000 hectares onshore and offshore primary production

Economic contribution (2050)
A\$5 – A\$10 billion GVP: gross value of production (market value) for seaweed-derived products
A\$2.2 – A\$4.6 billion GDP: contribution to Australia’s gross domestic product
8,500 – 17,500 FTE employment opportunities including those directly employed in seaweed primary production as well as those across the broader value chain (direct and indirect).
(Deloitte analysis, adapted from The World Bank 2023)

Opportunities to drive industry expansion

Our findings suggest the following opportunities can enable industry expansion:

Improved biomass availability 	Co-locate cultivation with existing aquaculture systems	Utilise nutrient-rich waste streams for seaweed cultivation	Activate participants/ growers with offtake pre-sales agreements	Invest in technology to scale up production
	Improved capital allocation and time-to-market 	Undertake mid-stream processing trials	Utilise industrial infrastructure for processing	Develop-out standards and certifications
	Improved demand-led production and manufacture of seaweed-derived products 	Establish biodiversity, environmental, reef and ACCU credit methodologies	Advance product discovery for high-value products	Supply workforce, communication and education development

Comparing to the Australian Seaweed Industry Blueprint set in 2020³.
Projections for 2040 economic contribution (2024 analysis) up to A\$3b–A\$46b GVP and 11,500 jobs created, (seaweed-derived products)¹
Projections for 2040 economic contribution (2020 analysis) up to A\$1.5b GVP, and 9,000 jobs created (under a different scenario analysis and industry definition)³

01 Demand from the global seaweed industry

Seaweed farming and derived-products are one of the world's fastest growing industries, over the past two decades, the industry has surged from A\$7.5 billion to A\$25.5 billion

The industry is at the intersection of a new frontier holding substantial potential to support current and future global challenges – driving significant economic development and progression of environmental goals and objectives.

Industry context

Seaweed is attracting substantial and growing commercial interest driven by the increasing recognition of the role that seaweed can play in global sustainability challenges, such as climate change, energy insecurity, and poverty. Seaweed has significant potential in emissions reduction through carbon sequestration or product substitution (including biofuels and bioplastics), in addition to helping address global nutrition challenges as an alternative source of protein. These examples are just the surface of seaweed's potential – the multi-faceted utility of seaweed positions it as a crucial component in the quest for sustainable solutions.

The seaweed industry can be understood as the cultivation, harvesting, processing and commercialisation of various seaweed species for diverse applications across multiple market offerings. Due to their importance in marine ecologies and for absorbing carbon dioxide, recent attention has been on cultivating seaweeds as a potential climate change mitigation strategy for bio-sequestration of carbon dioxide, alongside other benefits like nutrient pollution reduction, increased habitat for coastal aquatic species, and reducing local ocean acidification.

Seaweed market values

Current market value: The global market for seaweed has more than tripled over the past two decades, increasing from A\$7.5 billion in 2000 to A\$25.5 billion in 2021², driven by the discovery of novel applications in food, cosmetics, pharmaceuticals, and agriculture⁹.

Geographic spread of seaweed production

Asia-Pacific dominance: The Asia-Pacific region, particularly China, Indonesia, and the Philippines, dominate global seaweed production. Together, these three countries account for over 80% of global seaweed production². These countries benefit from favourable climatic conditions and traditional farming practices.

Emerging markets: There is growing interest in seaweed farming in Europe, North America, and Africa. Countries like Norway, Ireland, and the USA are investing in seaweed aquaculture to diversify their marine economy and meet sustainable development goals.

Services and benefits of seaweed

Environmental benefits: Seaweed farming offers significant environmental advantages, such as carbon sequestration, nutrient cycling, and habitat provision. Seaweed can absorb up to 20 times more carbon per acre than terrestrial forests, holding great potential in mitigating climate change effects.

Economic and social benefits: The seaweed industry creates employment opportunities in coastal communities and

supports gender equality by involving women in farming and processing activities. It contributes to food security and poverty alleviation by providing a source of income and nutrition.

Industrial applications: Seaweed can be used in biofuels, bioplastics, and as a feed additive to reduce methane emissions in livestock. Its extracts are valuable in pharmaceuticals and cosmetics for their bioactive properties.

Established seaweed industries are present globally however the significant sustainability impact that could be realised is driving growth in new and emerging markets.

Supporting Australia's emerging seaweed farming sector, the National (Seaweed) Hatchery Network Project was launched in 2022. Hatcheries in Townsville and Adelaide are helping primary producers accelerate growth of primary production.



With 36 million tonnes produced Globally in 2020, seaweed markets in Australia are expanding beyond food and nutraceuticals to include biofuels, bioplastics, pharmaceuticals, and more.

According to the most recent data released by the United Nations, 36 million tonnes (wet weight) of seaweed was produced globally in 2020⁹.

Established seaweed markets have been driven by food products and additives for human consumption as well as inputs into fodder for low-trophic aquaculture, and nutraceuticals. Traditionally associated as a food product, seaweed can also serve as a valuable feedstock into a variety of products and markets as new bio-technological applications continue to be researched and developed globally. There is an emerging case for the expansion of seaweed markets with promising research occurring into the bio-technological application of seaweed, involving biofuels, biostimulants, bioremediation, biomaterials, fabrics, pharmaceuticals, cosmetics and biofertilisers.

Providing such a diversified offering of products, the seaweed industry can feed a variety of markets. Some of these identified markets have high unit costs and low demand, such as the pharmaceutical and fresh kelp markets. Other markets have low margins such as the agricultural feed market. Some markets identified have high volume needs such as bioplastics, specialist nutraceuticals, dried food products and fertilisers.

Established markets globally as defined by the World Bank³

Food Product

Edible seaweeds:
Nori, Wakame, Kombu

Food additives

Thickening agents
Emulsifiers

Emerging markets globally as Defined by the World bank³

- Commercial activity in Australia
- ◆ Research and development activity in Australia

Animal feed additives

Aquaculture feed ◆
Methane reducing agents ◆●

Fabrics

Alginate-based textiles ◆
Biodegradable fabrics ◆

Biofuels

Biogas ◆
Feedstock into biofuel production ◆

Cosmetics

Moisturisers ●
Sunscreens ●

Biomaterials

Bioplastics ◆
Green-construction materials ◆

Biostimulants

Soil conditioners ●
Stress resistance enhancers ●

Pharmaceuticals

Drug-delivery systems ●
Anti-microbial agents ◆

Bioremediation

Carbon sequestration ◆
Waste water treatment ●

Nutraceuticals

Functional foods ●
Vitamins, anti-oxidants, supplements ●

Biofertilisers

Plant growth enhancer ◆

Australia's Seaweed Industry is rooted deeply in the nation's culture and heritage

Australia holds a rich long history with seaweed dating back to 65,000 years ago to First Nations people

Chart 1.1: Timeline of Seaweed Industry Influences in Australia



The opportunity to harness 65,000 years of rich cultural and sustainable practices to co-develop a sustainable seaweed future for Australia

Australia: A biodiversity hotspot

Australia's lands and seas are renowned for their extensive seaweed biodiversity, enriched by an Indigenous history spanning over 65,000 years. Indigenous Australians possess profound traditional knowledge of local natural resources, including seaweed.

Research on Indigenous Seaweed Uses⁶

Recent investigations, which include interviews and archival literature reviews, have explored both contemporary and historical uses of seaweed by Indigenous Australians, highlighting its cultural significance¹. Evidence shows that Indigenous Saltwater Australians—Aboriginal peoples from coastal areas who are Traditional Owners and custodians of saltwater environments—have utilised seaweed in numerous ways:

- Cultural Activities:** Integral to various cultural practices and ceremonies.
- Medicinal Uses:** Valued for its healing properties.
- Clothing and Shelter:** Used in making clothing and constructing shelters.
- Food and Fishing:** Serves as a nutritional source and aids in fishing.
- Domestic Uses:** Has multiple household applications.

Opportunity for innovative Indigenous business activities and product creation focused on:

Food	Developing new, sustainable food products.
Natural-Fibre Technologies	Innovating with sustainable materials derived from seaweed.
Health	Leveraging medicinal uses of seaweed for health and wellness products.

Contribution to the Australian Seaweed Industry

The insights gained from Indigenous culture and knowledge have the potential to significantly enhance the developing Australian seaweed industry. By guiding species selection, preparation methods, and sustainable resource management practices, these findings can help ensure the industry's growth aligns with sustainability principles.

SOUTH COAST SEAWEED YUIN COUNTRY Case Study

Indigenous Seaweed Tourism. South Coast Seaweed (NSW) conducts Eco Tourism business focused on the reconnection of traditional knowledge and learning to create sustainable resources using Seaweed.

02 Australia's advantage in the global market

Australia's Seaweed Industry is positioned to capitalise from growing global demand

Australia's diverse seaweed industry, holds immense growth potential and significant export opportunities due to its unique native species and supportive government policies.

Australia's domestic seaweed industry, is in its early stages. Despite its nascent state, Australia boasts 15% of the world's recorded red and brown seaweed species⁷, positioning it among the most diverse regions globally. Although the Australian seaweed market remains relatively small, it holds significant growth potential due to favourable environmental conditions, investment opportunities, and rising domestic and global demand. Since the release of the AgriFutures report in 2020, the Australian Government released an Aquaculture Statement, underscoring support for

investment in the seaweed industry, particularly to scale up the production of seaweed as a supplement to reduce methane emissions in livestock feed.

Australian production value of seaweed was estimated to be A\$3 million in 2021⁴. The Australian seaweed import trade currently exceeds A\$40 million⁸.

Current production and International trade

While Australia continues to be an importer of seaweed, there is considerable potential for domestic cultivation at

a commercial scale. With 15% of the world's seaweed species, many of which are native exclusively to Australia⁷, the country offers a unique value proposition with significant export potential.


Global surge for low carbon products

Market participants highlighted a significant surge in demand seen for low-carbon products from European, American and Asian markets in 2024¹ – providing existent and emerging Australian seaweed producers readily available export opportunities. oceanographic patterns.

Australian seaweed species


Analysis of current active seaweed markets, native species, and stakeholder interviews concluded that the main genii/species of interest to the Australian Seaweed Industry are: Asparagopsis, Ecklonia radiata, Ulva spp, Durvillaea, Cladophora, and Caulerpa. The commercial cultivation of these species groups has significantly increased in the past 20 years, almost doubling from 2010 to 2021⁴.

Asparagopsis, Ecklonia, Ulva, Durvillaea, Cladophora, and Caulerpa exhibit distinct distributions across Australia, reflecting their ecological preferences and adaptability.




Asparagopsis taxiformis, armata

Asparagopsis includes two primary species: Asparagopsis taxiformis, found in warmer waters, and Asparagopsis armata, which thrives in cooler climates; both can be found along the western to southern coasts of Australia.




Durvillaea potatorum

Durvillaea, commonly known as southern bull kelp, occurs on rocky, wave-exposed shorelines throughout southeastern Australia, particularly in Tasmania and South Australia. This genus includes several species that exhibit a honeycomb-like structure in their fronds, allowing them to float and disperse over long distances.



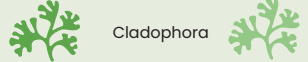
Caulerpa taxifolia

Caulerpa species are also notable; for instance, Caulerpa taxifolia is found from tropical regions down to southern Queensland and has been introduced into various estuaries in New South Wales. Other species like Caulerpa remotifolia and Caulerpa longifolia are distributed from South Australia to Tasmania.



Ecklonia radiata

Ecklonia radiata, a prominent kelp species, is predominantly found in temperate coastal waters, often forming extensive underwater forests that provide habitat for diverse marine life.



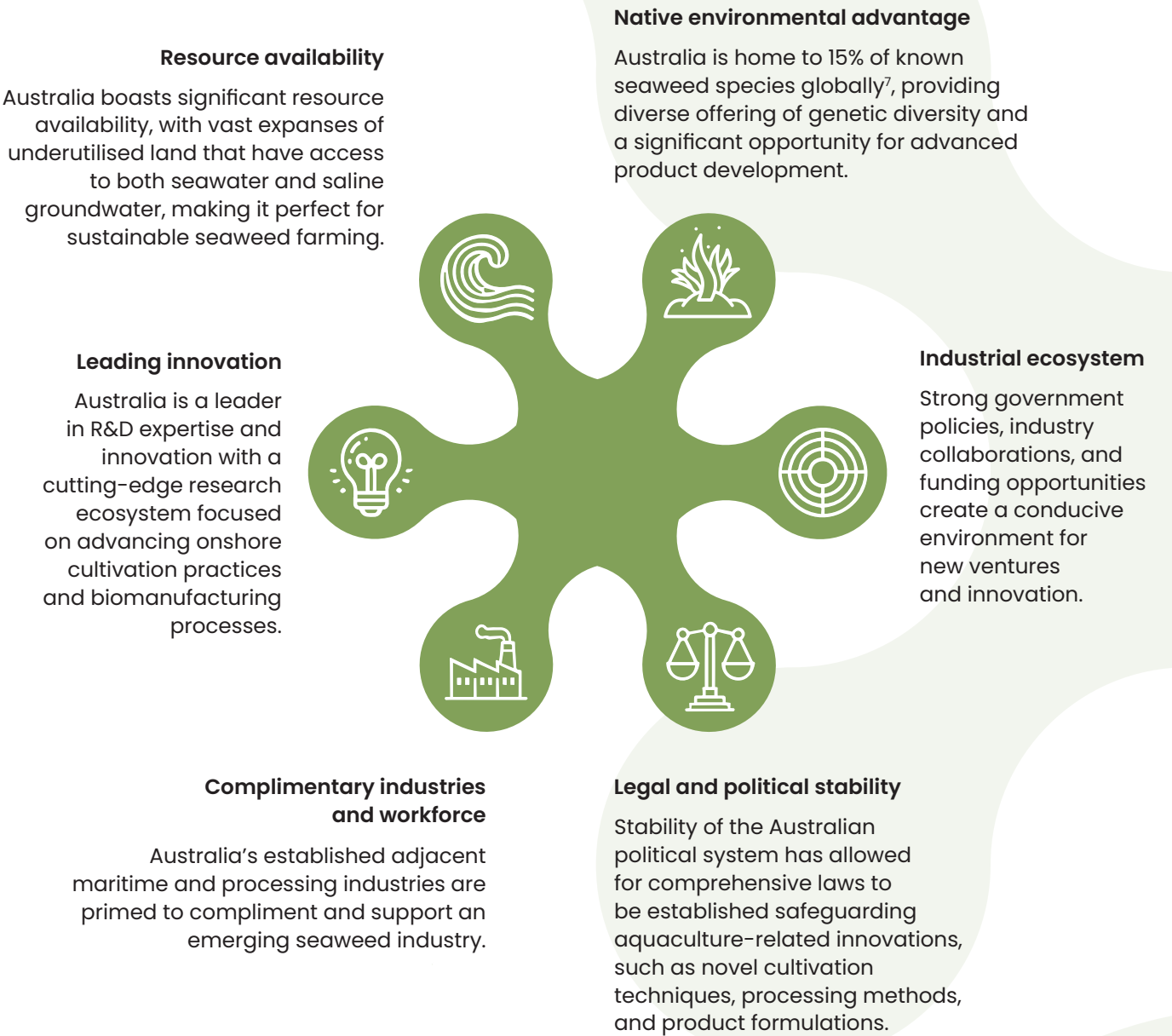
Cladophora Ulva spp.

Cladophora and Ulva, both green algae, are widespread along Australian coastlines and flourish in intertidal zones and shallow waters, where they play essential roles in coastal ecosystems.

The distribution of these seaweeds is influenced by factors such as water temperature, salinity, and nutrient availability, which vary across Australia's diverse marine environments.

Competitive Advantages of the Australian Seaweed Industry

Australia's biological competitive advantage: Stakeholders agreed that Australia's endemic species and access to marine space make it competitive player in the global seaweed market.



"The opportunity is for us (Australia) to have a regenerative seaweed industry, one that is not just a primary industry but also provides value-added products and has the environmental credentials"
- Jo Kelly , Chair of the Australia Seaweed Institute

Australia's varied regulatory landscape and targeted government initiatives are paving the way for significant growth potential in the seaweed industry.

Access to abundant land and sea suitable for Seaweed production, processing and global supply chains – the Australian seaweed policy environment is under development aligning to the opportunities of 2024

A state-by-state case
Currently, the delegation of power for the designation of aquaculture sites in Australia is through state governments and the Marine Bioproducts CRC. As certain state-waters are considered eligible for aquaculture activities, there is no plans to involve Commonwealth waters (3 nautical miles from shore) as suitable sites for aquaculture cultivation sites as of yet.

Within Australia, governance for seaweed aquaculture development varies by state and territory. Many states and territories have aquacultural policy and regulation, but do not specifically refer to seaweed. All Australian states and territories have implemented some form of general aquacultural legislation and/or policy.

Western Australia and South Australia, have made additional strides to advance their seaweed industry through specific policies, strategies, and zoning for marine and onshore areas.

There exists an opportunity to incorporate Commonwealth waters into seaweed cultivation policies and legislation. This expansion could significantly increase the cultivation area, either independently or in conjunction with proposed wind farms and other aquaculture initiatives.

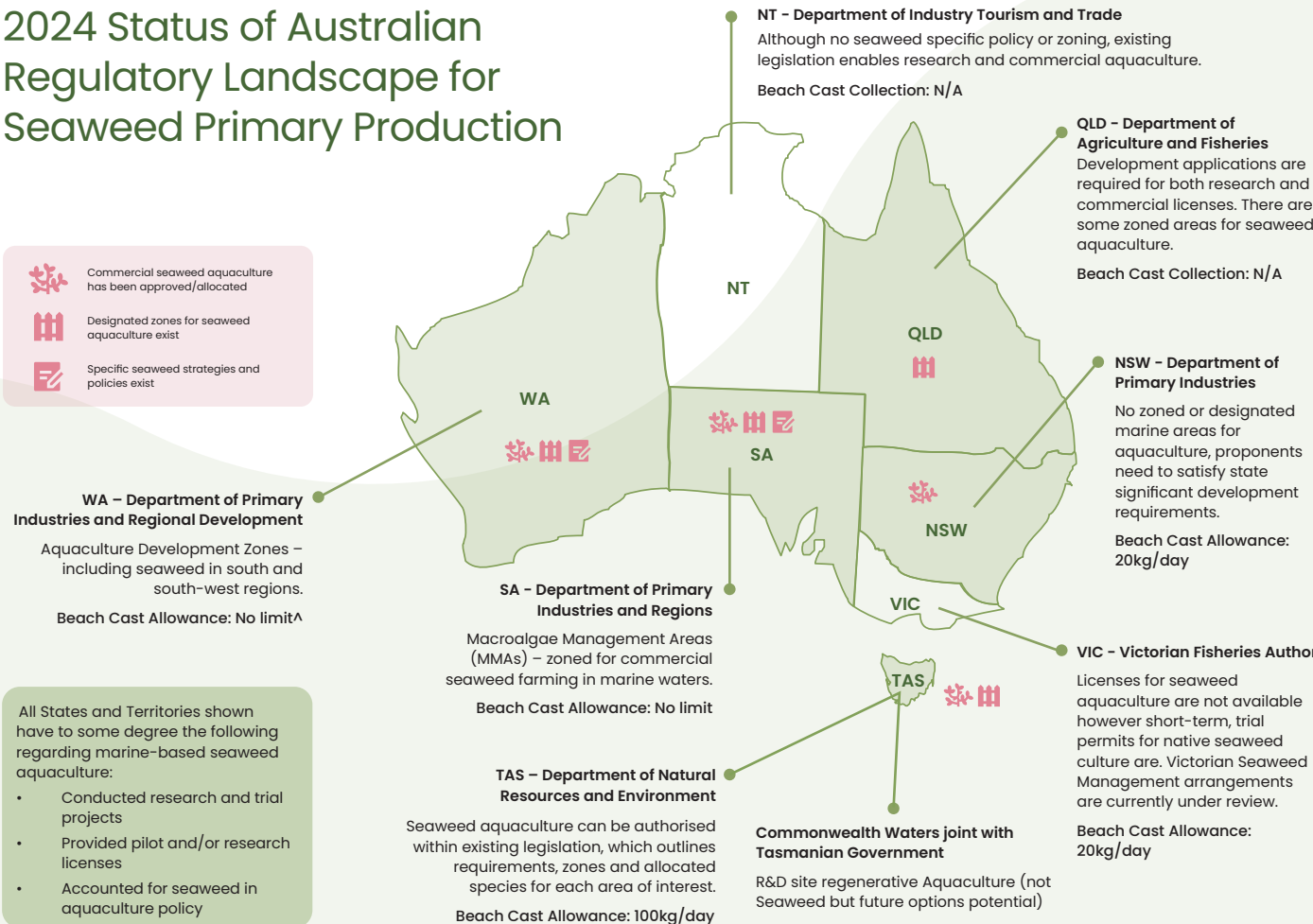
All states and territories have some form of general aquacultural legislation and/or policy, while some states such as Western Australia and South Australia have taken

more steps to activate their seaweed industry through seaweed-specific policy, strategy, and zoning of marine and onshore areas.

Beyond the states and territories, there is an opportunity to include Commonwealth waters in seaweed cultivation policies and legislation. This has potential to increase cultivation area, either independently or for co-location with proposed wind farms and other aquaculture.

The Tasmanian government is currently developing legislative framework to enable commercial scale aquaculture, including seaweed, in adjacent Commonwealth waters.

2024 Status of Australian Regulatory Landscape for Seaweed Primary Production



03 Economic impact of industry growth scenarios

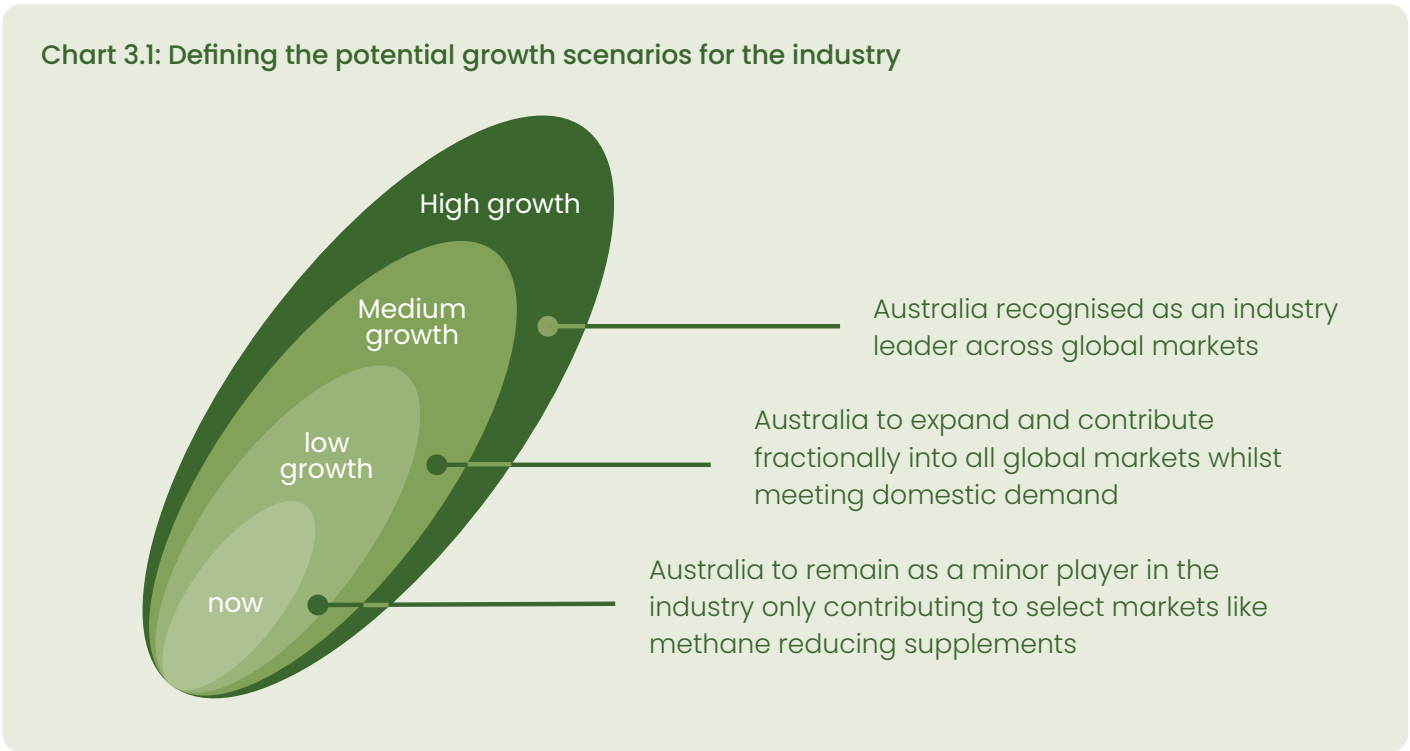
It is expected that emerging markets for seaweed-derived products will unlock an additional annual global value of A\$16 billion by 2030

The estimated value of the growth sectors that make up the global seaweed market is derived from the Deloitte analysis, adapted from The World Bank^{1,3}. Australian Industry feedback¹ confirmed some of these listed seaweed-derived bioproduct markets may be slower to scale than indicated in the World Bank report extending to a 2030–2040 timeline for equivalent market size.

Table 3.1: Estimated value of global seaweed markets^{1,2} adapted from The World Bank, Global Seaweed: New and Emerging Markets Report 2023

Market insights	Growth Market	2030 global market value (AU\$ converted from US\$ as reported 2023)
Short-term (before 2025) Local product developers are successfully launching seaweed-derived products in premium markets Products include innovative bioplastic packaging, fertilisers, and animal feed additives Initial production relies on imported or recycled feedstock Increasing demand for competitively priced, locally sourced feedstock Existing buyers favour local feedstock to reduce import costs, biosecurity risk and ensure product quality	Biostimulants / biofertilisers	A\$2.7 billion
	Animal feed additives	A\$1.7 billion
	Pet food	A\$1.6 billion
	Methane-reducing supplements	A\$0.46 billion
Medium-term (2025–2028) Scaling local seaweed cultivation (both onshore and offshore) to support expanded product ranges and higher feedstock prices Enhancements in processing capacity to meet growing market needs Development of industrial infrastructure and supply chains to improve cost efficiency and scalability. Enabling at-scale production and penetrating high-value markets such as nutraceuticals	Nutraceuticals	A\$5.9 billion
	Alternative proteins	A\$0.67 billion
	Bioplastics	A\$1.1 billion
Long-term (beyond 2028) Regulatory compliance and robust testing are crucial for market entry and will enhance product credibility and market acceptance, while also pushing out development timelines Investment in advanced manufacturing techniques and technologies necessary, streamlining production and reducing costs over time	Pharmaceuticals	A\$0.43 billion
	Cosmetics	A\$1.5 billion
Total: A\$16 billion		

A qualitative snapshot of the potential economic growth scenarios for the Seaweed industry



To model these scenarios, Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM) was used. DAE-RGEM is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium model of the world economy with bottom-up modelling of Australian regions. The model allows scenario analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as GDP, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

From a baseline of 2024, the broader economic impact of three growth scenarios (developed by Deloitte and the Australian Sustainable Seaweed Association (ASSA)) are modelled in DAE-RGEM. These scenarios are characterised by different growth rates in output of the Australian seaweed industry. The majority of this output is assumed to be exported. Increased investment in output in the seaweed industry generates direct employment and economic value added, as well as creating employment and value added in upstream industries. The underlying linkages captured in DAE-RGEM quantifies these impacts across the economy.

Key drivers of industry expansion leading to employment, industry value add, and market value of good produced.

Regulatory Landscape
Regulatory frameworks and processes

Biomass availability
Production volumes from primary producers and cultivators

Funding and investment
Government and Foreign direct investment into the industry

Demand-led production
Commercialisation of innovated sea-weed derived products.

With the right enablers in place moving forward, Australia can capture a major share by 2030 and beyond

A qualitative snapshot of the potential economic growth scenarios for the seaweed industry

Low growth

Australia to grow but remain as a minor player in the industry contributing to selected markets like methane reducing supplements

In a low-growth scenario, regulatory oversight stays as it is in 2024 and the slowing of investment into innovation and investment would hinder the seaweed industry's growth and international competitiveness. Cultivation and production volumes would continue with onshore regenerative aquaculture and on-shore production serving premium ranges of bioproducts. Additionally, waste biomass streams would remain underutilised and largely unknown, import volumes unmanaged, and investment in pre-processing facilities insufficient.

Medium growth

Australia to expand and contribute fractionally into all global markets whilst meeting domestic demand

In a medium-growth scenario, there would be significant growth in onshore production, albeit with restricted licences to control expansion, focusing on high-demand products. Biomass availability coming from offshore cultivation zones will significantly improve due to increased Macroalgae management (or equivalent Integrated Multi-Trophic Aquaculture (IMTA)) zones being declared by all state-governments, however, will be restricted to state waters only. Market activation activities, such as those led by ASSA, and Marine Bioproducts CRC would drive awareness and demand. Improved investment and funding from both government and industry would support innovation and infrastructure development.

High growth

Australia recognised as an industry leader across global markets

In a high-growth scenario, there would be substantial growth both onshore and offshore, driven by targeted support for high-demand products. Comprehensive regulatory frameworks and robust funding initiatives would foster innovation, sustainability, and scalability. This strong intervention would position the industry to meet global demand and ensure long-term competitiveness. Macroalagae management zones (or equivalent IMTA) will be incorporated with commonwealth waters, leading to significant hectares being opened up for primary producers and cultivators.

A quantitative snapshot of the potential economic growth scenarios for the seaweed industry , as expanded in the analysis on the next few pages.

A\$5 billion GVP by 2050 from 11,000 hectares on shore and offshore

4.3million tonnes (wet) biomass

Assuming average 40 tonnes per hectare per year across onshore and offshore cultivation

A\$7.5 billion GVP by 2050 from 16,000 hectares on shore and offshore

6.5million tonnes (wet) biomass

Assuming average 40 tonnes per hectare per year across onshore and offshore cultivation

A\$10 billion GVP by 2050 from 22,000 hectares onshore and offshore

8.7million tonnes (wet) biomass

Assuming average 40 tonnes per hectare per year across onshore and offshore cultivation

With this biomass, Australia could service 13–19% of the emerging global markets for seaweed-derived products estimated at A\$16 billion of value by 2030^{1,3,10}.

From a \$150 million market value in 2024, the value of Australia's seaweed-derived products is expected to reach \$5–\$10 billion by 2050.

Under the modelled scenarios, the Australian seaweed industry output is project to grow 67 times bigger than its current size by 2050.

Chart 3.2: Gross value of production for Australian seaweed derived products under future growth scenarios

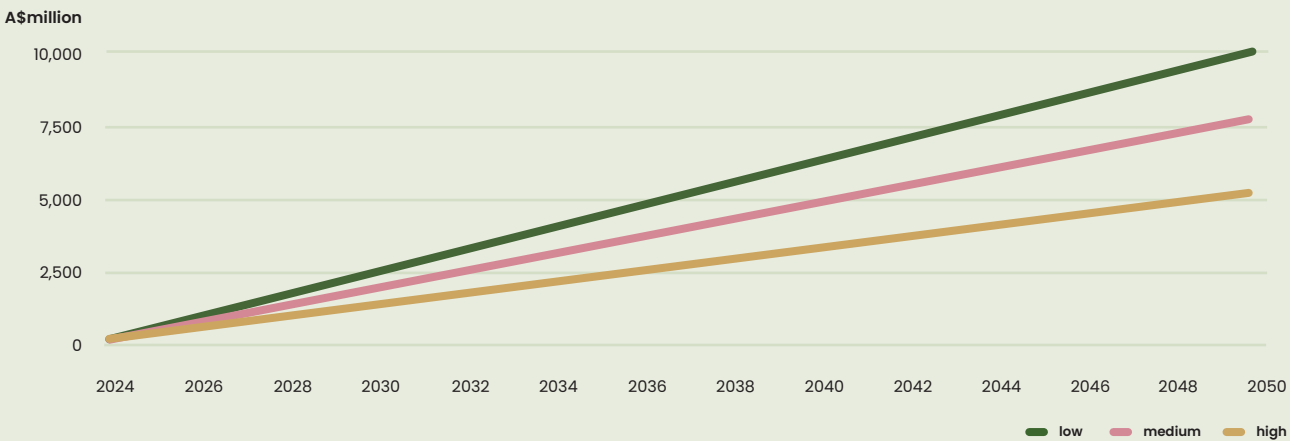


Table 3.1: Gross value of production for Australian seaweed derived products under future growth scenarios

Output (A\$mil)	Low	Medium	High	Aus Seaweed Industry Blueprint 2020 ²
Net present value	A\$24,198	A\$35,661	A\$47,123	
Annual average	A\$2,628	A\$3,904	A\$5,180	
2040	A\$3,135	A\$4,673	A\$6,212	A\$1,462
2050	A\$5,000	A\$7,500	A\$10,000	

Australian seaweed output under the growth scenarios

The Australian seaweed industry's output is currently estimated at A\$150 million in 2024. This encompasses a range of products identified earlier in the report, such as:

- Pharmaceuticals
- Nutraceuticals
- Cattle feed supplements
- Food

The Australian industry comprises all parts of the seaweed value chain, from research and development to primary production to additional value add (processing).

In the growth scenarios considered in

this report, industry output is expected to grow to A\$5–10 billion by 2050. This is driven by increased domestic demand for the products outlined above annually (in particular asparagopsis for cattle feed), as well as strong foreign demand for Australian products.

Benefits driving demand

- Makes soil more fertile for farming
- Is a cheap, high-quality fibre for manufacturing
- Aids in decarbonisation efforts, particularly in hard to abate sectors such as agriculture
- Is useful for a variety of nutritional, pharmaceutical and nutraceutical purposes.

In the medium scenario, Australian seaweed industry output is projected to reach A\$4.7 billion for 2040. This is significantly higher than the A\$1.5 billion for 2040, estimated in the Australian Seaweed Industry Blueprint (2020)², although it should be noted that part of this difference is explained by the broader industry scope considered in this report (it considers an updated understanding of the industry value chain).

In the low growth scenario, Australian seaweed industry output grows 14.4 per cent annually to reach A\$5 billion. In the high scenario, the industry grows at 17.5 per cent annually to reach A\$10 billion in 2050.



Results

Impact on GDP

Under the modelled scenarios, Australia’s GDP is estimated to be between A\$2.2 billion and A\$4.6 billion larger due to growth in the seaweed industry by 2050.

Chart 3.3: Change in Gross Domestic Product under seaweed future growth scenarios

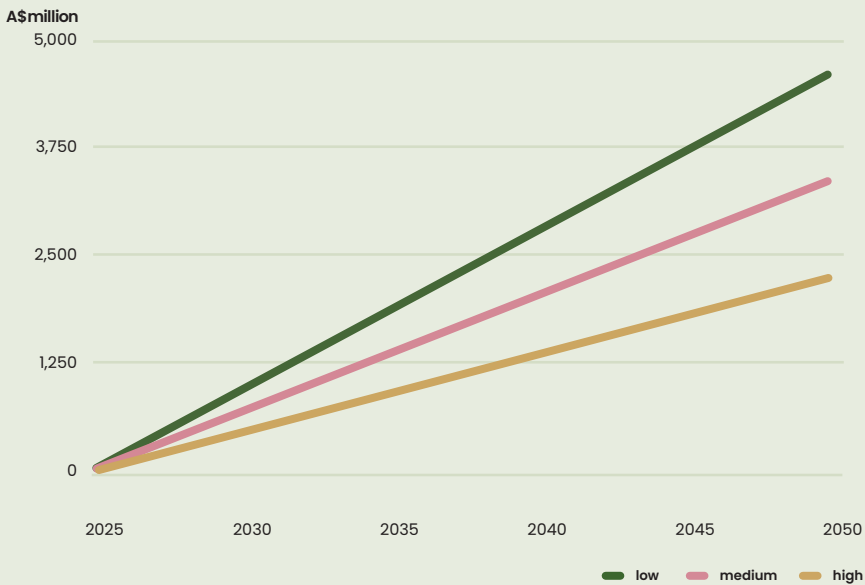


Table 3.2: Impact of future growth scenarios on Australian GDP

Impact on GDP (A\$m)	Low	Medium	High
Net present value	A\$8,969	A\$13,582	A\$18,312
Average annual impact (undiscounted)	A\$1,041	A\$1,590	A\$2,153
2040	A\$1,313	A\$2,010	A\$2,724
2050	A\$2,188	A\$3,382	A\$4,609

Source: DAE–RGEM

Impacts to GDP under seaweed industry growth scenarios

Alongside strong growth in Australian seaweed production, there is also a considerable uplift in Australian Gross Domestic Product (GDP) under the seaweed future growth scenarios. GDP is a measure of economic activity, encompassing the gross value added of all sectors across the economy. In addition to the gross value added contributed directly by the seaweed industry, these growth scenarios also stimulate further economic activity in Australia by virtue of the seaweed industry’s use of local suppliers and its end users. By purchasing inputs these suppliers (such as utilities, chemicals, equipment and netting), this enables the suppliers of these goods and services to generate further value added (and therefore GDP).

In addition to this effect, because the industry expansion results in expanded demand for both labour and capital, it results in higher real wages and more investment which go some way to boosting activity, also.

Results

By 2040, the Australian economy (as measured by GDP) is estimated to be around A\$2 billion higher in the medium scenario, compared to a scenario where the seaweed industry does not expand. By 2040, the GDP uplift is A\$1.3 billion in the low scenario, and A\$2.7 billion in the high scenario.

In the medium scenario, the Australian seaweed industry, and associated GDP uplift, continues to grow. By 2050, the Australian economy is estimated to be A\$3.4 billion higher if the outcomes in the medium scenario are achieved.

The average annual GDP uplift over this period is A\$1.6 billion, and the net present value of additional GDP is A\$13.6 billion.

Results

Employment

Growth in Australia’s seaweed industry is projected to result in up to 17,400 additional jobs in Australia, relative to a baseline where there is no additional investment or government support in the seaweed industry. This represents employment related to primary production but also product development.

Impact on employment under the growth scenarios

Alongside strong growth in Australian seaweed production, the level of employment in the Australian seaweed industry, and broader economy, are also estimated to grow considerably.

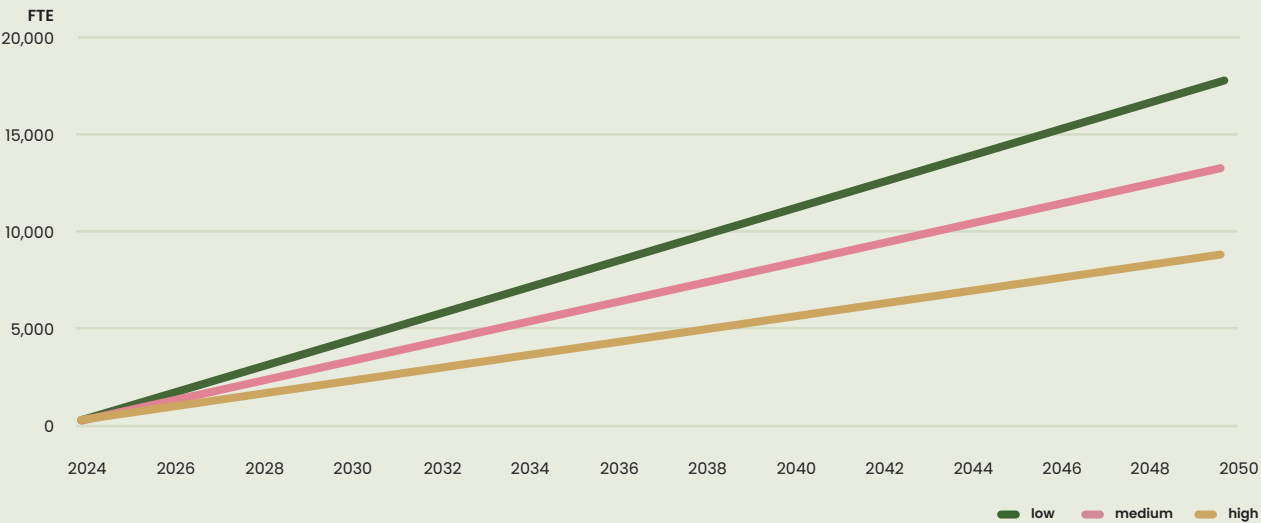
If the conditions for the medium growth scenario are realised, this is estimated to result in 8,600 additional FTEs across Australia by 2040.

This uplift in jobs includes a reduction in employment in other sectors as a result of the seaweed industry’s expansions (the modelling framework has a labour supply constraint built in – see appendix). These results also reflect an uplift in employment in sectors tangential to the seaweed industry.

Table 3.3: Impact on employment (FTEs), future growth scenarios

Impact on employment (FTEs)	Low	Medium	High	2020 Aus Seaweed Industry Blueprint
Average over the period 2024 to 2050	4,557	6,861	9,188	
2040	5,689	8,600	11,538	9,000* (headcount)
2050	8,538	12,955	17,415	

Chart 3.4: Impact on employment (FTEs), future growth scenarios



*AgriFutures Australia, Australian Seaweed Industry Blueprint – A Blueprint for Growth (2020)These figures are not directly comparable.

04 Industry activation

Addressing industry challenges is crucial to achieving projections

Australia's Seaweed industry is advancing through a collaborative ecosystem of market participants, positioning for growth across the value chain

Australia is home to a growing number of market participants, dedicated to propelling the industry forward. Market participants can be segmented accordingly to the value chain: Upstream, Midstream, Downstream, whilst encompassing industry initiatives – R&D.

Market participants – Stakeholder ecosystem

1. Biomass Growth (Upstream): Primary producers, Research Institutes – Cultivation, Hatcheries, Marine science
2. Processing & Productisation (Midstream): Product developers, Research institutes – Product development
3. End of life and Industry Initiatives (Downstream) : Industry bodies

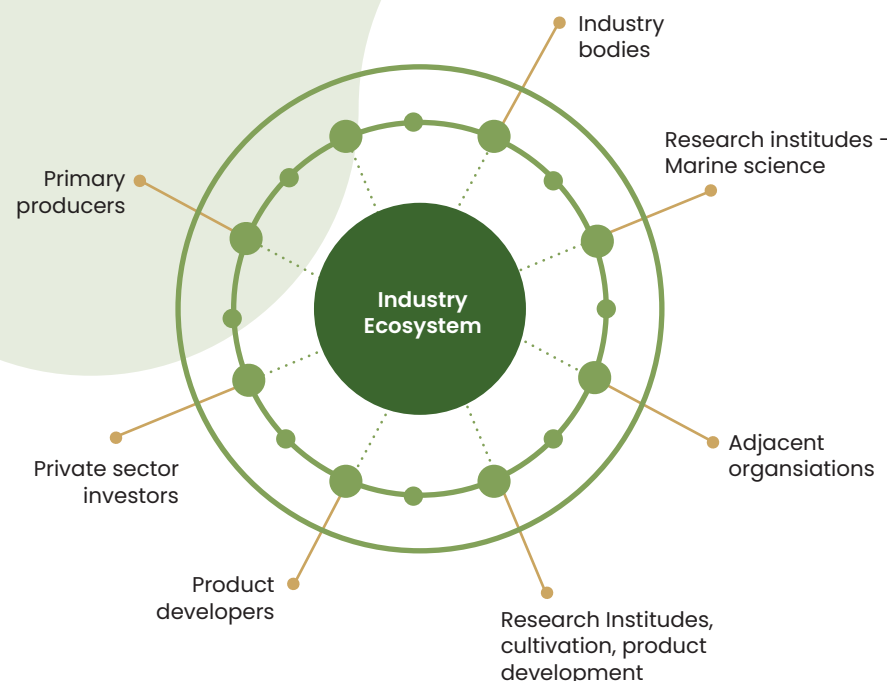
Where Australia plays a unique role in is the diverse range of R&D groups dedicated to advancing the seaweed value chain. Organisations such as Marine Bioproducts CRC, Blue Economy CRC, and Fisheries Research and Development Company and ASSA work in collaboration with universities, government bodies, and industry to propel the seaweed industry forward and stimulate economic growth. Their initiatives encompass sustainable cultivation methods, bioprocessing technologies, product development, and the creation of regulatory frameworks. Universities and other entities like University of Technology Sydney, the Australian Maritime College, University of New South Wales, and AgriFutures conduct extensive research and engineering on native species, genomics, cultivation techniques, as well as processing and manufacturing technologies. This comprehensive approach aims to unlock the full potential of Australia's seaweed industry, supporting the development of sustainable coastal economies.

Optimising the costs throughout the value chain

Despite the growing number of market participants across the value chain in Australia, a gap persists amongst participants in understanding who exists throughout the value-chain. This disconnect has resulted in the formation of cost-inefficient vertically integrated business models and misguided financial assumptions about market entry by stakeholders.

Australia's value chain distribution

Australia holds an evenly distributed number of participants across the value chain capable of providing balanced advancement across all segments facilitating value maximising growth capture for the industry.



Industry is supported by Private & Public investment into developing the emerging seaweed industry, with specific focus on Asparagopsis growth

The government has recognised the significant opportunity, along with private sector investment; together provided over A\$400* million to develop Australia's Seaweed Industry

Federal government funded A\$59 million over the next 10 years for the Marine Bioproducts Cooperative Research Centre (MBCRC). MBCRC plans to establish products and processes that will underpin whole new industries for Australia's marine estate. This substantial investment, which includes more than A\$70 million in direct cash support from 49 industry partners and additional funding from research entities and government organisations, will enable the establishment of Australia as a leader in sustainable marine bioindustries.

National (Seaweed) Hatchery Network Project: The Australian Government has committed A\$8.1 million to the 'Developing Australia's Seaweed Farming Program'. Administered by the Fisheries Research and Development Corporation (FRDC) on behalf of the departments of Climate Change, Energy, the

Environment and Water (DCCEEW) and Agriculture, Fisheries and Forestry (DAFF), this initiative aims to support investment in the Australian seaweed industry and scale up seaweed (Asparagopsis) production for livestock feed supplements to reduce methane emissions. Completed through the establishment of a National Hatchery Network, policy reform and priority research and development activities and aims to lower barriers to market entry.

Methane Emissions Reduction Initiatives: Australian Government has allocated A\$9.3 million to scale up Asparagopsis production. This funding will enable companies such as Sea Forest (Tasmania) and CH4 (South Australia) to collaborate with universities and industry bodies to develop the necessary infrastructure to scale-up and commercialise their Asparagopsis operations.

Other seaweed related projects across public and private sector funded programs provide ongoing support for scaling the industry.

*Funded Programs Commenced Since 2020¹

Co-funded Government and Industry R&D Programs **A\$280m+**

Private sector finance **A\$150m+**

State funded programs: **A\$30m+**

University funded research & development **A\$18m+**



A new online portal is expected to reduce the barriers for industry participation

Developing navigational tools to address regulatory and critical agriculture sector information

The Fisheries Research and Development Corporation (FRDC) announced a new project to establish an online portal aimed at streamlining the permitting process for the Australian seaweed industry.

By 2025, this initiative should deliver educational content sharing and streamlining addresses the complexity and state-specific nature of sourcing and completing seaweed permits, which often pose significant challenges for industry stakeholders. The core objective of the portal is to consolidate state and federal permitting information, guidelines, and applications into one accessible location, reducing administrative burdens and accelerating the timeline from permit application to operational activity.

Housing both regulatory and permitting processes alongside educational resources under one “digital roof,” this One-Stop-Shop not only simplifies navigation but also optimises resource use and reduces redundancy.

Additionally, it supports the industry’s operational needs while promoting awareness and understanding, ultimately strengthening social and regulatory standing. Complementing this initiative, states like Victoria, Tasmania, and New South Wales have introduced concierge-styled services to help seaweed industry participants navigate available grants and programs, many of which require matched funding and extensive financial statements, posing further challenges for emerging market players.

This integrated approach by the FRDC and state governments aims to foster growth and vibrancy within the Australian seaweed industry, ensuring its sustainable development and long-term success.

Seaweed value chain

The Seaweed industry value chain can be segmented into

- Up-stream: biomass growth
- Mid-stream: Processing and productisation
- Down-stream activities: product use/end of life

As shown in chart 4.1, each segment requires appropriate industry infrastructure and capabilities to support the diverse range of seaweed-derived products and markets.

A robust and commercially connected seaweed value chain, from cultivation to product use, is essential for de-risking investment. Co-ordination across the value chain is needed for industry scale-up as we see the need for integration across product market sectors, producing diverse cost-effective bio-products via bio-refineries or equivalent, and promoting environmental sustainability across the product life-cycle.

Chart 4.1: Industry challenges and activation opportunities across the value chain

	Challenges	Opportunities	Needs
Up-stream			
01	Biomass growth Biomass cultivated, restored, harvested, or wild harvested	Insufficient supply of sustainable biomass to meet forecasted demand Competing global supply chains, underpinned by cheap labour costs Regulatory zoning for aquaculture development and lengthy approval processes	Planning & identification of cultivation zones, investment Automation technology investment Marine Spatial planning Industry coordination, government support Government collaboration State government resources and support
Mid-stream			
02	Processing of biomass Biomass is processed through various methods to fit product specifications	Insufficient funding support and development capital for demonstrator-scale projects Lack of understanding of downstream processing participants, infrastructure	Provision of funding and support mechanisms Infrastructure and skills planning Understand the funding needs of market participants Industry engagement - investment
03	Product development Processed biomass is turned into end-products and packaged for market distribution	Insufficient knowledge around product-market fit amongst product developers inhibiting effective commercialisation/scale-up	Advocate capability building for market participants Develop/promote education programs for market participants
Down-stream			
04	End of life Market product is consumed, residual biomass to degrade or be recycled	Fragmented market activation efforts among value chain participants Overcoming community resistance to new industry development Information deficiencies and limited industry awareness	Industry representatives to bolster efforts Accumulate and consolidate evidence, partnerships with NGOs Drive promotion of the whole value chain Participation in the Nature Repair Market rules, ACCU methodology Research industry engagement (communications) Establish education campaigns

Opportunities to drive industry expansion

Stakeholder interviews highlighted challenges across the three key areas of the seaweed value chain inhibiting industry scale-up efforts and the realisation of greater regional economic complexity through downstream value-added activities.

These prompt the following opportunities to enable industry expansion:

Chart 4.2: Addressing challenges faced by industry participants

Top 3 Challenges for Biomass growth

1. Insufficient supply of sustainable biomass to meet forecasted demand. This shortfall limits the industry's ability to secure substantial offtake agreements, which are crucial for market growth and stability.
2. Competing global supply chains, underpinned by cheap labour costs, pose a significant threat to Australia's comparative advantages in upstream seaweed production.
3. Regulatory zoning for aquaculture development and lengthy approval processes are significantly inhibiting timely access to suitable lease areas and impeding industry commercialisation

Addressed by Improved biomass availability

Co-locate cultivation with existing aquaculture systems

Utilise nutrient-rich waste streams for seaweed cultivation

Activate participants/ growers with offtake pre-sales agreements

Invest in technology to scale up production

Challenges: Processing and Product Development

1. A lack of targeted funding support and development capital for demonstrator-scale projects is inhibiting scale-up efforts, particularly for biomanufacturing facilities and ecosystem service projects.
2. Lack of understanding of downstream processing and intermediate production participants, technology, infrastructure, and expertise.
3. Insufficient knowledge around product-market fit amongst product developers inhibiting effective commercialisation/ scale-up.

Addressed by Improved capital allocation and time-to-market

Undertake mid-stream processing trials

Utilise industrial infrastructure for processing

Develop-out standards and certifications

Streamline regulatory approvals

Challenges: Wider economy

1. Fragmented market activation efforts among value chain participants, leading to inconsistent messaging and varied requirements. This lack of coordination results in insufficient support from government bodies and stakeholders, which ultimately impacts financial backing.
2. Overcoming community resistance to new industry development and delivering meaningful First Nations economic benefits are critical for achieving social license.
3. Information deficiencies and limited industry awareness are restricting investment in the seaweed value chain.

Addressed by Improved demand-led production and manufacture of seaweed-derived products

Establish biodiversity, environmental, reef and ACCU credit methodologies

Advance product discovery for high-value products

Supply workforce, communication and education development

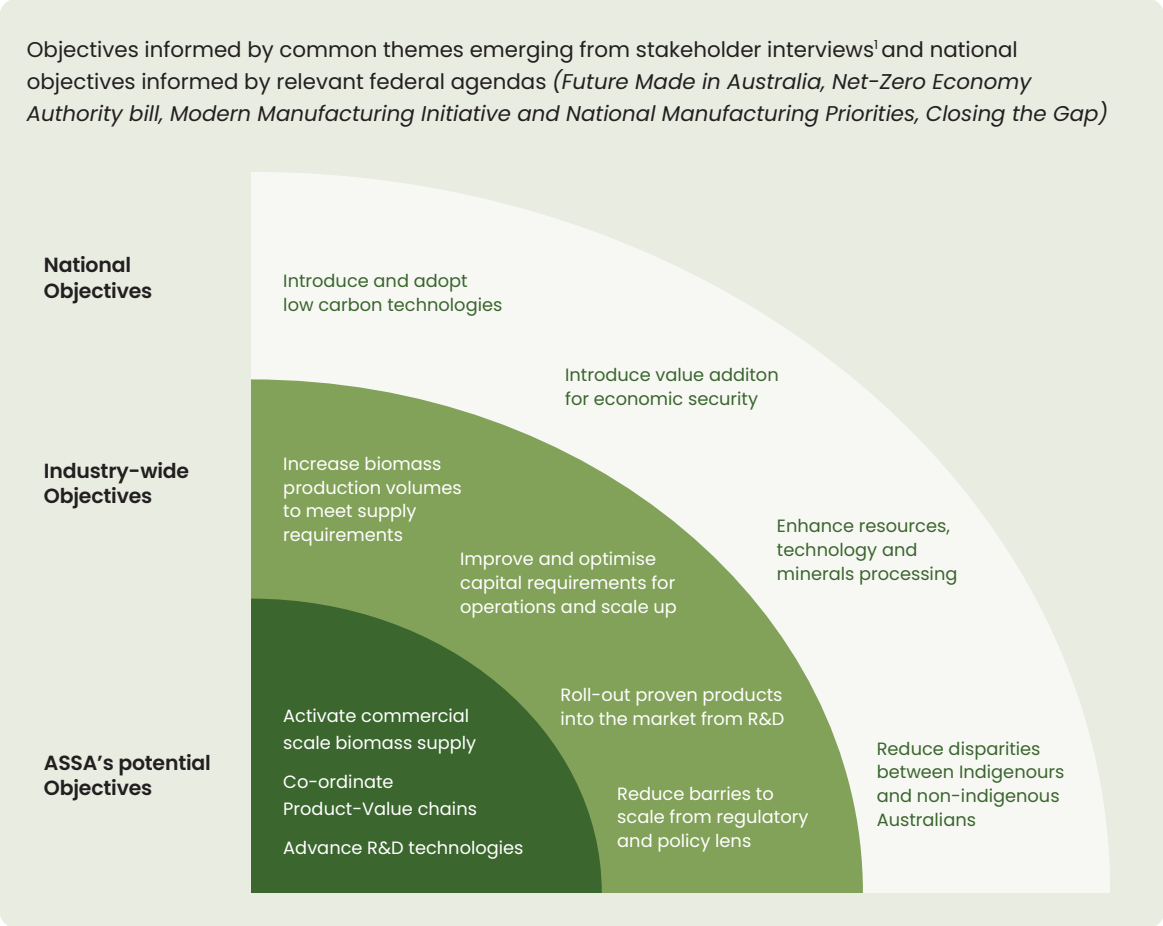
How Australia's industry body can drive investment, growth, and expansion

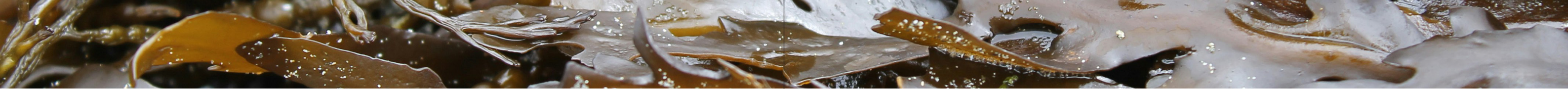
ASSA is well placed to deliver industry-defining programs to unlock value from broader industry and national objectives.

Chart 4.3: ASSA's future role on industry growth opportunities and strategic objectives

ASSA's Role	Growth Opportunities
Advocacy for commercial scale biomass supply	<ul style="list-style-type: none">Co-locate cultivation with existing aquaculture systemsUtilise nutrient-rich waste streams for seaweed cultivationClimate change risk assessment specific to primary producers
Coordinate product-value chains	<ul style="list-style-type: none">Undertake mid-stream processing trialsUtilise industrial infrastructure for processingDevelop-out standards and certificationsStreamline regulatory approvals
Advance R&D technologies	<ul style="list-style-type: none">Establish biodiversity credit methodologiesAboriginal-led cultivation techniques and product developmentTraining & upskilling programsHarness hidden value from waste seaweed biomass for advanced product development

Chart 4.4: Australia's seaweed industry aligns with broader growth industries and national objectives





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Glossary

Mariculture or marine aquaculture	Mariculture is the cultivation and farming of marine organisms for commercial purposes, such as food production and aquaculture.
Regenerative aquaculture	Regenerative aquaculture is an approach to farming aquatic organisms that aims to restore and enhance ecosystem health while producing food. It focuses on practices that improve water quality, increase biodiversity, sequester carbon, and create resilient marine environments.
Hatchery	A seaweed hatchery is a facility designed for the controlled cultivation and reproduction of seaweed species, where spores or seedlings are nurtured in optimal conditions before being transferred to open-water farms for further growth and harvesting.
Cultivation	The process of growing and cultivating seaweed in controlled environments, such as seaweed farms or aquaculture facilities.
Harvesting	The act of collecting mature seaweed from its cultivation site or natural habitat, typically done by using specialised equipment or by hand.
Processing	The series of steps involved in transforming harvested seaweed into various forms, such as drying, grinding, extracting, or refining.
Value-added products	Seaweed products that have undergone additional processing or modifications or enhance their value, functionality, or market attractiveness.
Wet weight	The weight of seaweed when it is fresh and contains its natural moisture content. It includes the weight of the seaweed itself as well as the water present within it (~70–90%).
Dry weight	The weight of seaweed after all moisture and water content have been removed, providing a measure of the solid biomass.
Offshore Aquaculture	Macroalgae Management Zones and equivalent dedicated for offshore primary production of seaweed. Can also include "IMTA" Aquaculture zones that have integrated multi-trophic aquaculture processes involving seaweed
Onshore Aquaculture	Tank farms and raceways, inland waterways and estuary areas where macro-algae grows naturally or could grow with assisted aquaculture). Onshore aquaculture zones – suitable for Tank systems of primary production cultivation of seaweed
Bio-remediation	Typically onshore dams and waste water systems management – co-located with sewerage treatment facilities and indsutrial waste water or agricultural land (saline / salt treatment zones)
Wild harvest	Shore collected biomass from coastline beaches
Imports	Seaweed that is imported by Ausrtalian value-chain participants inclusive but not limited to Bioplastics, Pharaceutical and Fertiliser processing plants located in Australia. usually requires security compliant processes.
Gross Domestic Product (GDP)	GDP is a measure of economic activity, encompassing the gross value added of all sectors across the economy.
Gross Value Added (GVA)	Value of goods/services produced minus intermediate consumption. It reflects the contribution to GDP made by individual producers or sectors.
Gross Value Product (GVP)	The market value of goods produced by an industry, representing the total revenue generated from production activities without adjustments for costs.
Net Present Value (NPV)	Accumulated additional GDP over the period

Acknowledgments

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