

# Queensland Biofutures 10-Year Roadmap

Consultation paper  
November 2015



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The Department of State Development

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# Vision

By 2025, Queensland will have a \$1 billion dollar sustainable and export-orientated industrial biotechnology sector attracting significant international investment and creating thousands of regional, high-value and knowledge-intensive jobs.

## GLOBAL DEMAND FOR BIOPRODUCTS

Demand for biofuels and bioproducts is booming globally and Queensland can be an international leader in this industry of the future. By positioning Queensland now to capitalise on the global 'bio' boom through forging strong collaborations between government/industry/research and our international partners, Queensland can capture its rightful share of the new 'bioeconomy'.

At the launch of the Advance Queensland initiative in July 2015, Queensland Premier, Anastacia Palaszczuk, spoke of empowering our best entrepreneurs, innovators and thinkers, and translating their work into commercial successes. You can help us to identify the initiatives required for this industry to reach its potential in Queensland by having your say on this consultation paper.

The World Economic Forum estimates that by 2020, the market for biofuels, biobased chemicals and bioplastics will approach US\$100 billion. In 2014, a joint Deloitte Access Economics and Queensland University of Technology (QUT) study projected that by 2035 industrial bioproducts (i.e. fuels, chemicals and plastics from agricultural,

forestry and greenwaste feedstocks) could contribute \$1.8 billion to Queensland's annual Gross State Product and support an estimated 6640 full-time jobs in the state.

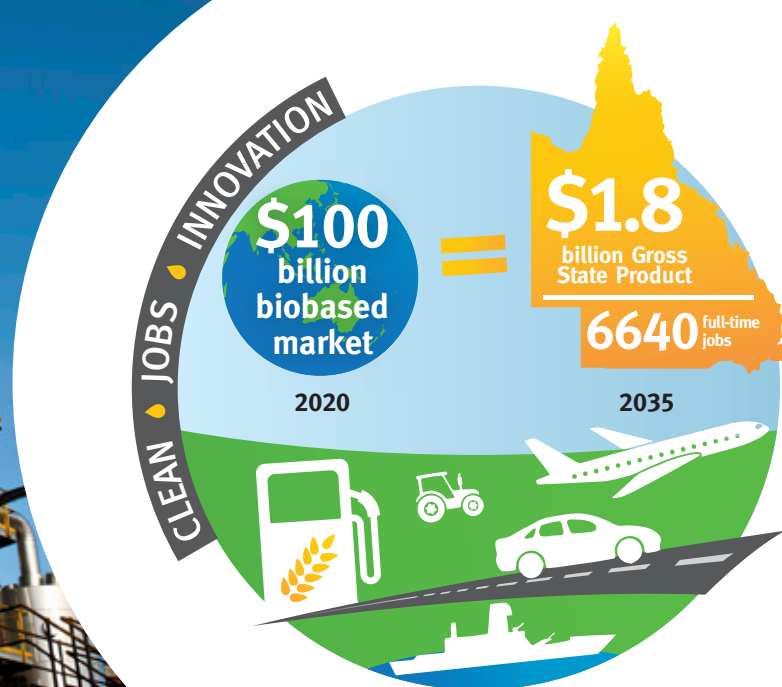
Rapid advances in industrial biotechnology, consumer demand for 'greener' products and growth of the middle class in Asia are all converging to create the business environment for this sector to flourish.

Major opportunities are forecast in biofuels, biochemical and bioproducts. For example, commercial aviation is aspiring to have carbon neutral growth by 2020 and a 50 per cent net emissions reduction by 2050. Globally, by 2025 biobased chemical production is projected to account for up to \$570 billion of the \$4 trillion market for bulk, specialty and new industrial chemicals.

The global bioplastics market is projected to grow approximately six times its value from US\$7.5 billion in 2013 to US\$43.8 billion in 2020.







## What is industrial biotechnology?

Industrial biotechnology is the creation of fuel, chemicals, plastics and other materials from biological materials. It encompasses a broad spectrum of scientific and industrial technologies to convert renewable feedstocks into a diverse range of bioproducts. Agriculture, forestry, green waste, biosolids and algal feedstocks can be used to generate a range of chemicals, advanced aviation fuel, synthetic rubber, cosmetics, detergents and textiles.



### UNITED STATES NAVY—GREAT GREEN FLEET

The United States Department of Defence is the single largest oil consumer in the United States, using an estimated 300 000 barrels per day. A major initiative of the United States Navy is a drive to improve energy efficiency in response to climate change, drive down operating costs and reduce the reliance on fossil fuels as part of an energy security strategy. The Great Green Fleet program envisions a fleet made up of hybrid electric biofuelled surface ships, and biofuelled aircraft, supported by shore-based installations that run largely off renewable electricity. The primary objective is to have 50 per cent of all Department of the Navy energy consumption ashore and afloat coming from alternative sources by 2020. Queensland has the opportunity to play a role in supplying the biofuels they need.



# Opportunity for Queensland

Queensland has numerous competitive advantages in the industrial biotechnology sector with a favourable climate, a strong existing agricultural sector, a mature existing manufacturing base, stable political system and a world-class research and development (R&D) sector. The state is well-positioned to supply the forecast growth in the domestic and international biobased markets.

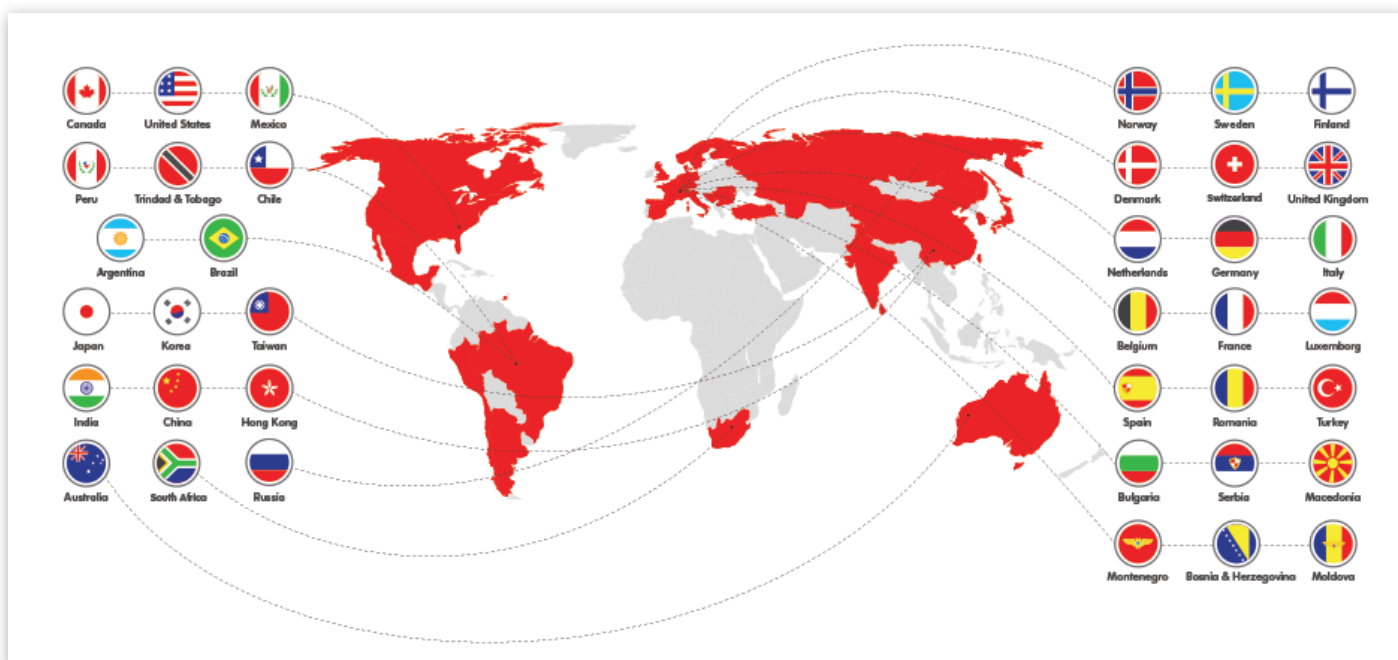
Investment in industrial biotechnology will provide Queensland's agricultural industry with pathways to diversify their operations and increase their revenue base.

Opportunities will be created based on new crops and intensive production systems such as algae. A range of other materials that currently have limited commercial value, such as forestry, industrial and municipal waste, also have potential as feedstock for renewable fuel, plastics, cosmetics, chemicals and other bioproducts.

<b>CLIMATE</b>	Queensland's tropical and subtropical climate provides ideal conditions to produce strong yields and high quality feedstocks all year round. Queensland boasts one of the very few developed economies in the tropics.
<b>LAND</b>	Queensland has more than 20 million hectares of available growing land. The cultivation and management of sugarcane, forestry and other feedstocks is supported by large tracts of land and substantial areas of wood producing native and plantation forests.
<b>FEEDSTOCKS</b>	Queensland accounts for 94 per cent of Australia's 30 million tonne sugarcane crop and almost two-thirds of Australia's sorghum crop. Additional feedstock includes native grasses, crop stubble, eucalypts, cassava, agave, algae, pongamia and exotic pines.
<b>INFRASTRUCTURE</b>	<p>Queensland's agricultural communities include several large regional centres connected to international markets through world class infrastructure including:</p> <ul style="list-style-type: none"><li>◦ four international airports and 56 certified airports</li><li>◦ 10 000 kilometres of reliable and environmentally sustainable freight service rail network</li><li>◦ 15 seaports and seven bulk shipping terminals</li><li>◦ 177 000 kilometres of modern and efficient road network</li><li>◦ advanced sugarcane and forestry processing facilities</li><li>◦ nine modern universities.</li></ul>







Coca-Cola's PlantBottle™ packaging initiative accounts for seven per cent of the company's packaging volume globally, making the Coca-Cola Company a global leader in bioplastics. Introduced in 2009, the first-ever, fully recyclable polyethylene (PET) plastic beverage bottle made partially from plants, looks and functions just like traditional PET plastic. Coca-Cola have publicly stated their goal to convert all new PET plastic bottles to PlantBottle™ packaging by 2020.

## INDUSTRIAL BIOTECHNOLOGY PRECINCTS

The QUT Mackay Renewable Biocommodities Pilot Plant was established in 2010 with \$3.1 million in funding from the Queensland Government. The facility is located at the Racecourse Sugar Mill and tests the commercial viability of innovative products and processes within a factory setting.

The facility offers a unique pilot scale research and development infrastructure for the conversion of cellulosic biomass into renewable transport fuels and high-value biocommodities in an integrated biorefinery. The facility aims to link innovations in product and process development with the assessment of commercial viability to enhance the uptake of this technology in Australia.

One of the world's largest food and beverage conglomerates, Asahi Holdings, recently signed an agreement with QUT to build on research previously undertaken at the pilot plant.

# What are we already doing?

Industry leaders are exploring opportunities to establish new commercial biorefineries in Queensland. The state has three commercial biofuel refineries that are capable of producing more than 170 million litres of biofuel for domestic transport, using conventional first generation production techniques. First generation biofuels refer to the fuels that have been derived from sources like starch, sugar, animal fats and vegetable oil.

Second generation biofuels are fuels manufactured from agricultural and forest residues and other non-food feedstocks.

The Queensland Government is currently supporting the Australian Renewable Energy Agency's Australian Biomass for Bioenergy Assessment. This project aims to catalyse investment in the renewable sector by providing detailed information about biomass feedstock resources across Australia. This will assist in planning, project development and decision making for new industrial biotechnology project proponents.

**The Queensland Government and its partners have made significant investments that have laid the foundation for an industrial biotechnology sector.**

Queensland has a well-established research base specialising in:

- sustainable aviation fuels
- enzymatic and thermochemical conversion technologies
- techno-economic modelling

- integrated supply chain logistics
- emerging specialised energy crops
- germplasm improvement
- process optimisation.

A number of demonstration sites are also located in Queensland including the Queensland University of Technology (QUT) Mackay Renewable Biocommodity Pilot Plant; the Tarong Algal Synthesiser Display Plant—a joint venture between MBD Energy, Stanwell and James Cook University;

and the University of Queensland's Solar Biofuels Research Centre.

Recently, the world's largest pharmaceutical company Johnson & Johnson signed a Memorandum of Understanding with the Queensland Government and QUT to build a 'partnering office' in Brisbane. This will facilitate access to the vast resources and expertise across Johnson & Johnson scientific research, investor and commercial business sectors.

## BIOFUELS MANDATE

Through its proposed biofuel mandate, the government will provide certainty to the biofuel industry to drive investment and increase commercial production. The biofuels industry is widely accepted as being an important step in the development of an industrial biotechnology sector in Queensland, providing a feedstock for biobased products, technology development and transfer.

For further information on the biofuels mandate please visit <https://www.dews.qld.gov.au/energy-industry/renewable-energy/projects/biofuel-mandate>



One of the world's largest food and beverage conglomerates, Asahi Holdings, has also signed a Memorandum of Understanding with a leading Queensland research organisation. This will see Asahi increase collaboration on research that will have significant benefits for Queensland's sugarcane industry. It will build on work already undertaken at the QUT Mackay Renewable Biocommodities Pilot Plant.

The Queensland Government also has available a range of land use

planning and development levers such as Priority Development Areas and the tools available through the State Development Act to streamline the planning and development of major industrial biotechnology projects. Potential 'Industrial Biotechnology Precincts' could cater for the specific land-use needs of the sector.

The Queensland Government recently announced that investigations were underway into a State Development Area in Bundaberg, which has a strong agricultural sector and

potential as a location for a biofuel and industrial biotechnology precinct.

There are also numerous other global companies in Queensland currently collaborating on bioindustrial projects including Amyris, Boeing, Dow, Dupont, LanzaTech, Neste Oil, Novozymes, Proctor and Gamble, Qantas, Siemens, Syngenta, Virgin Australia, Wilmar and SkyNRG.

## ADVANCE QUEENSLAND - Jobs now, jobs for future

The Queensland Government's \$180 million Advance Queensland initiative, will create the jobs of the future and transform the Queensland economy through innovation. The Advance Queensland program provides the framework to achieve greater research and development outcomes, technology transfer and closer collaboration between researchers and industry. The core funding programs are:

**\$50 million Advance Queensland Best and Brightest Fund**, which will develop, attract and retain world-class talent—both scientific and entrepreneurial. This fund will include research fellowships based on partnerships and collaboration with industry end users.

**\$46 million Advance Queensland Future Jobs Strategy**, which will open the door to new industry/research collaborations, focus on translation, and deliver 10-year roadmaps for emerging industries with global growth potential. This strategy includes an Innovation Challenges program which will support research organisations, industry and government to collaboratively research, develop and provide solutions for significant challenges impacting industry growth in Queensland.

**\$76 million Business Investment Attraction package**, which will encourage a new wave of Queensland start-ups and support proof-of-concept projects. This package also includes the Business Development Fund, where the Queensland Government will co-invest to assist business turn their ideas and innovations into a commercial reality. Over the next four years, the fund will provide early-stage venture capital to emerging and growing innovative Queensland businesses.

For further information visit [qld.gov.au/advanceqld](http://qld.gov.au/advanceqld)





# Challenges for Queensland

Despite strong investment interest in the sector in Queensland, and the increasing global demand for biobased products, the industrial biotechnology sector in Queensland is currently limited to first generation biofuel production. A range of challenges have been identified for the conversion of investment leads into commercial business operations in Queensland, including:

- under-developed domestic market
- subsidised international competitors
- policy uncertainty
- access to sustainably produced biological material in sufficient quantities to warrant commercial investment
- access to capital, infrastructure and services (including price)
- difficulties with identifying suitable unconstrained land
- relative complexity of land use development assessment
- access to sufficient quantities of water
- finance and imperfect linkages between industry, government and researchers.

The cumulative risks these barriers pose for a particular project, rather than any one single issue, will be front-of-mind for investors when they are evaluating the relative risk of investment in Queensland.

Queensland needs greater collaboration and exchange between the research/government/business community, especially overseas. Once established, this will lead to a pipeline of world-leading, investment-ready business opportunities with access to private sector capital and the skills required to turn opportunities into sustainable products, profits and jobs.

## INTEGRATED BIOREFINERIES

Integrated biorefineries generate a mix of bulk and speciality chemicals as co-products with biofuel and bioenergy. Similar to processes within existing oil refineries, biorefineries are facilities that convert feedstock or biomass into fuels, energy, chemicals, materials and animal feeds. Biorefineries deliver multiple biobased products and value streams from biomass. This diversity of income streams generated by a portfolio of valuable products from various feedstocks, is the basis of a biorefinery's economic and environmental sustainability. Biorefineries could create new industries of significant value, particularly in regional Queensland.



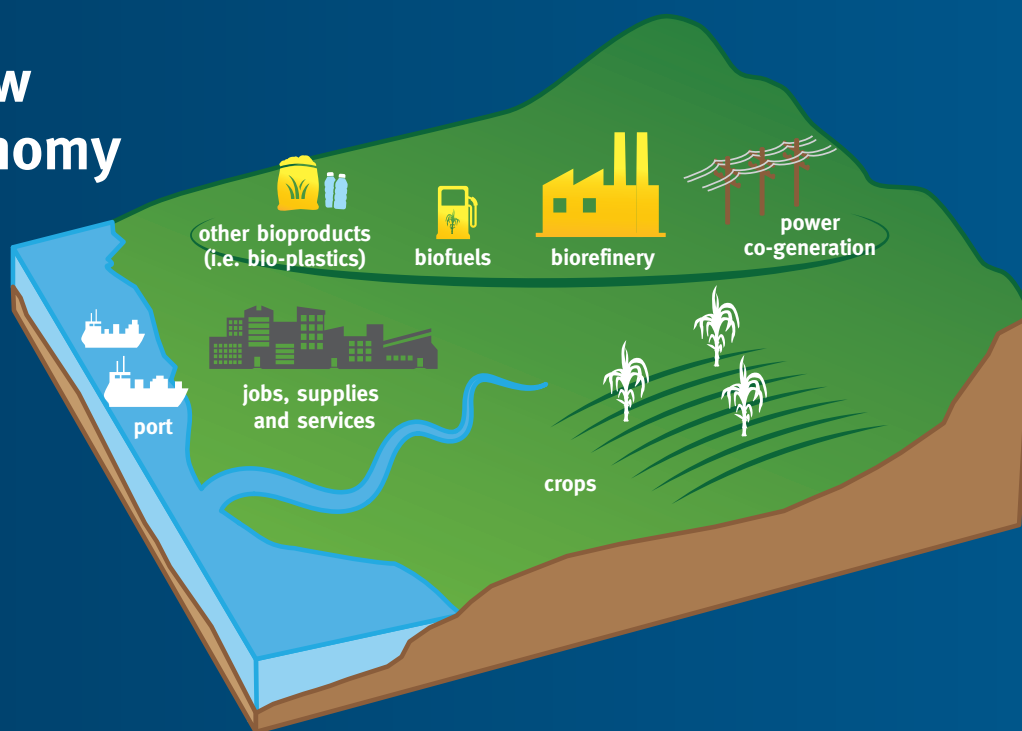
# Queensland Biofutures 10-Year Roadmap

The Queensland Biofutures 10-Year Roadmap will help unlock the full potential of Queensland's agricultural sector, creating regional jobs and growing Queensland's economy.

Capitalising on Queensland's comparative and competitive strengths in agriculture, innovation, its tropical and subtropical climate and proximity to Asia, the roadmap will respond to the challenges and set out the initiatives required to develop a competitive biofuel and industrial biotechnology industry in Queensland.



## The new bioeconomy



Regional co-location of an integrated bio-refinery within existing agricultural industries and supply chains can build the productive capacity of our regions.

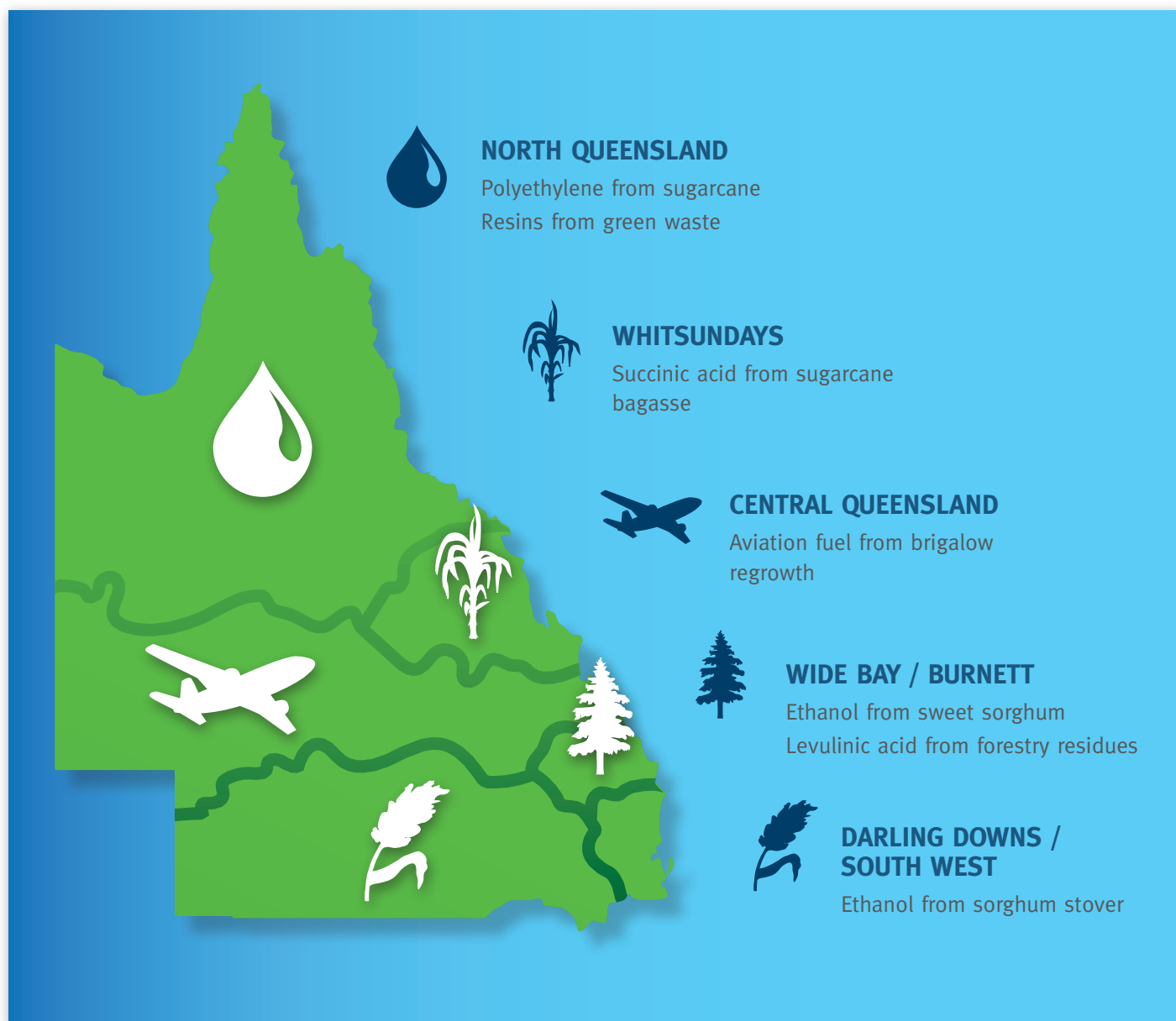




Whole-of-government leadership and direction is required if Queensland is to capitalise on its competitive advantages and become an attractive destination for large-scale industrial biotechnology investment. The realisation of the promise of what this sector can offer to Queensland can only be achieved through a sustained effort among its multiple stakeholders. Developed in partnership with an industry reference group and underpinned by the Queensland Government's \$180 million Advance Queensland initiative, the Biofutures Roadmap will:

- establish and promote industrial biotechnology as a priority sector for the government – Queensland Biofutures 10-Year Roadmap
- develop and attract leading research capability through Advance Queensland's fellowships and scholarships
- through Advance Queensland, support applied research and development in partnership with industry
- identify regional strengths – infrastructure and feedstock mapping to identify competitive advantages, community engagement and promoting regional opportunities
- build partnerships and provide focused support for sectoral development – enhance government/research/industry connectivity, provide a touch-point for industry, raise consumer awareness including international marketing, support projects of strategic significance e.g. Great Green Fleet
- apply or develop policy measures that support investment in early stage commercial projects – biofuels mandate, industrial biotechnology precincts, coordinated projects, Priority Development Areas
- identify key government legislation and commitments that may impact on the development of the industry (e.g. environmental standards)
- attract investment in Australia's first advanced biorefinery in regional Queensland – show success, leverage other initiatives and funding (e.g. Australian Renewable Energy Agency, Clean Energy Finance Corporation, Developing Northern Australia)
- facilitate projects – Industry Case Manager's as a 'one-stop-shop' for private investors assisting companies to obtain development approvals, reducing investment timeframes and costs
- attract investment and promote local business capabilities – Trade and Investment Queensland.

# Potential projects and regions

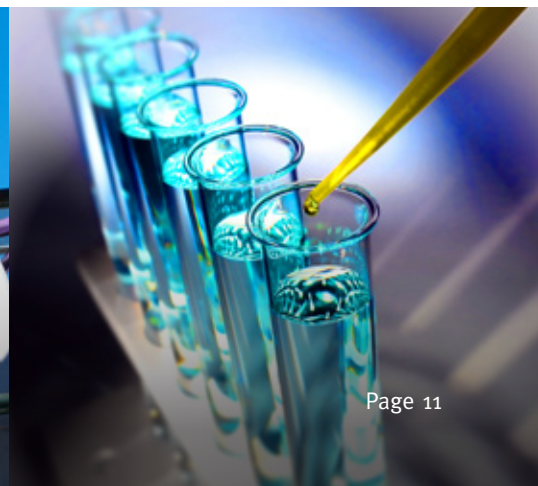
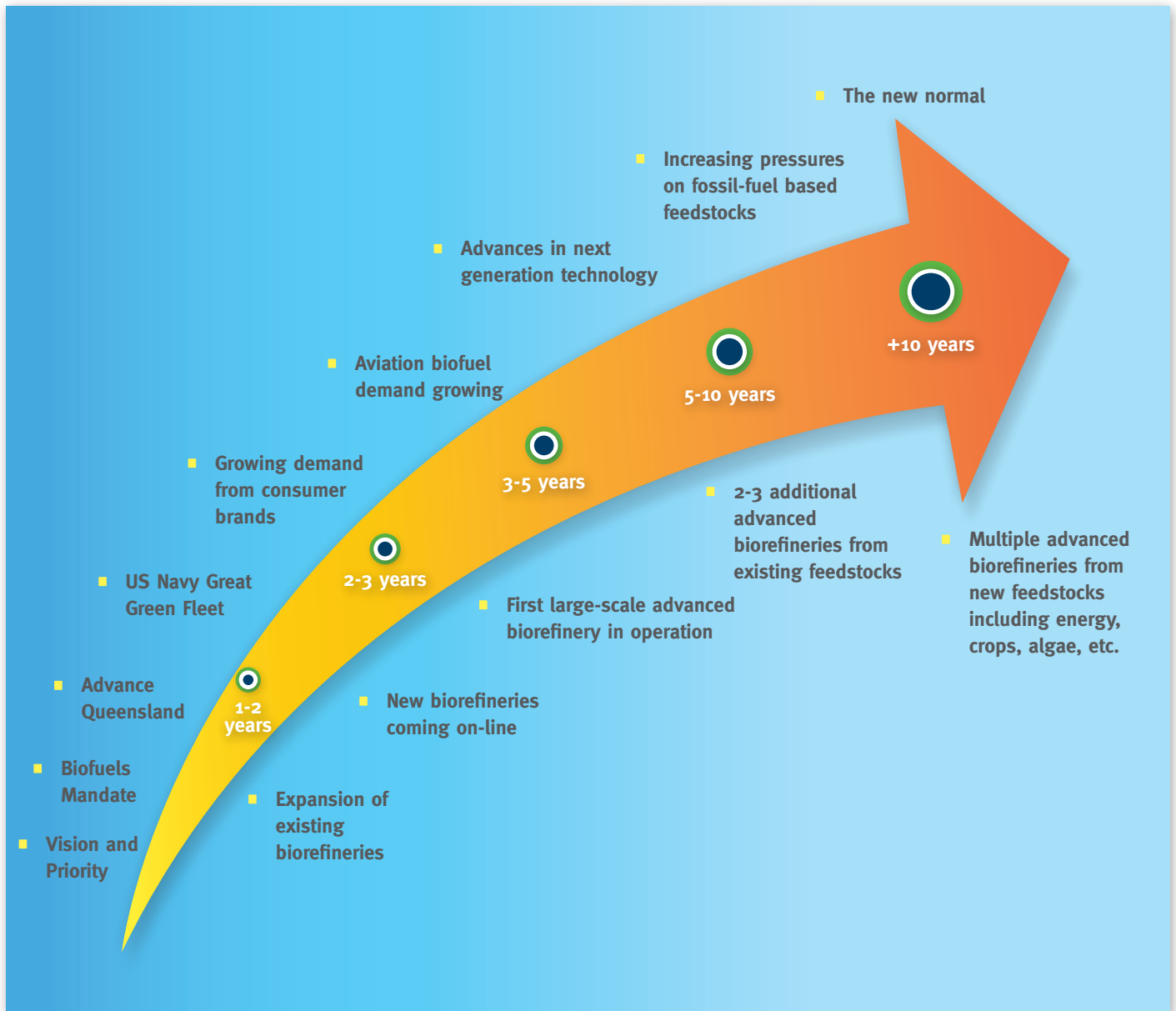


Source: Adapted from Deloitte/QUT Study





# The way forward



# Have your say

To ensure we get the settings right, the Queensland Government wants to hear from industry and community members. Your view is important to us as it will help Queensland become a part of the 'bio' boom happening globally. You are invited to provide a submission on the questions listed below, through the following methods:

- our online consultation page  
<https://haveyoursay.dsd.qld.gov.au/statedevelopment/queensland-biofutures-10-year-roadmap>
- by email to [biofutures@dsd.qld.gov.au](mailto:biofutures@dsd.qld.gov.au)
- by post to: Biofutures Project Manager, Industry Development, Department of State Development, PO Box 15009, City East Qld 4002

Please send your comments and submissions by Friday 18 December 2015.

- 1 What could a successful industrial biotechnology sector in Queensland look like in 10 years?
- 2 What are the key challenges to the development of a commercial industrial biotechnology sector in Queensland?
- 3 What should the balance be between government, industry, and research support for the development of industrial biotechnology?
- 4 What should the government's role be in the development of a commercial industrial biotechnology sector in Queensland?
- 5 What policy settings could improve Queensland's competitiveness in the development of second generation industrial biotechnology?
- 6 How important will oil and gas prices be to the rate of development of the sector?
- 7 How do we bridge the gaps between good ideas and bankable projects to realise the potential of industrial biotechnology in Queensland?
- 8 What more can government and industry do together to attract investment in this sector in Queensland?
- 9 How can we ensure Queensland's small and medium enterprises can participate and compete in the global industrial biotechnology value chain?

As part of Advance Queensland's 'Future Jobs Strategy', government is working with industry and its academic partners to develop 10-year roadmaps for emerging industries with global growth potential. These roadmaps will help identify the policies, regulations, unnecessary red tape, and policy settings that can best provide the certainty to help people invest and new industries to emerge.





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