Department of **Employment, Economic Development and Innovation**

Discussion paper:
Strategic directions for development of the Queensland bio-based industrial products sector
July 2010

Tomorrow's Queensland: strong, green, smart, healthy and fair

Toward 2 Tomorrow's Queensland

Queensland Government

Contents

Foreword

Bio-based products are emerging worldwide as a valuable new industry.

Oil and other fossil fuels still power the world's cities and industries and are used to make the vast majority of our chemical products. But diminishing oil reserves and the effects of greenhouse gases and climate change means we must develop cleaner, greener, renewable alternatives.

Bio-based products fit that description. In the future, plants such as sorghum, algae, sugarcane, short rotation woody crops and forest waste will be transformed into plastics, industrial chemicals and aviation fuels.

Queensland is well placed to become a leader in this new industry. We have established a world class network of research facilities including the Institute for Molecular Bioscience, the Australian Institute for Bioengineering and Nanotechnology, the Queensland Brain Institute and the Institute for Health and Biomedical Research, Coopers Plains Health and Food Science Precinct and the soon-to-be-completed Boggo Road Ecosciences Precinct. We have expertise in crop development and biotechnology, a stable economy, and are strategically located in the region. In fact, this discussion paper proposes that Queensland become a leading producer of bio-based products in the Asia Pacific region by 2020.

There are many reasons to get behind this new industry. Australia is using more energy and producing more greenhouse gas emissions than ever before. By using Queensland-grown sustainable biofuels we will reduce our emissions and protect our sensitive ecosystems, leading our way towards a greener and healthier future. This industry will also provide a secure source of energy, reduce our dependence on petroleum, generate thousands of green jobs, particularly in regional Queensland, and provide new export opportunities.

Bio-based industrial products have the potential to provide energy alternatives, increasing energy security while reducing greenhouse gas emissions.

We encourage you to have your say on the development of Queensland's bio-based industrial products sector.

The Hon Anna Bligh
Premier of Queensland

Timothy Mulherin MP
Minister for Primary Industries, Fisheries and Rural and Regional Queensland

The Queensland Government would like your comments and feedback in regards to the following questions.

Your views are sought on this important issue. You are invited to provide responses to the 15 questions below, as well as any other relevant comments.

Question 1: Have the challenges relating to non-feedstock inputs been fully identified? If not, what other challenges do you foresee?

Question 2: Will the proposed action adequately address the non-feedstock input challenges? If not, what further actions are required?

Question 3: In terms of information about resources, what information is required and at what level of detail?

Question 4: Have the challenges relating to feedstocks been correctly identified? If not, what other challenges do you foresee?

Question 5: Will the proposed actions adequately address the feedstock challenges? If not, what further actions are required?

Question 6: Have the challenges relating to processes been correctly identified? If not, what other challenges do you foresee?

Question 7: Will the proposed actions adequately address the process challenges? If not, what further actions are required?

Question 8: What is required to attract investment and particularly international investment in Queensland's bio-based industrial products sector?

Question 9: What is required to facilitate translation of research into commercially viable processes?

Question 10: Have the challenges relating to products been correctly identified? If not, what other challenges do you foresee?

Question 11: Will the proposed actions adequately address the product challenges? If not, what further actions are required?

Question 12: What other matters need to be addressed to provide a context to ensure that bio-based chemicals can be commercially competitive with petrochemical alternatives?

Question 13: Have the challenges relating to markets been correctly identified? If not, what other challenges do you foresee?

Question 14: Will the proposed actions adequately address the market challenges? If not, what further actions are required?

Question 15: What other actions need to be undertaken in order to develop a market for bio-based industrial products manufactured in Queensland?

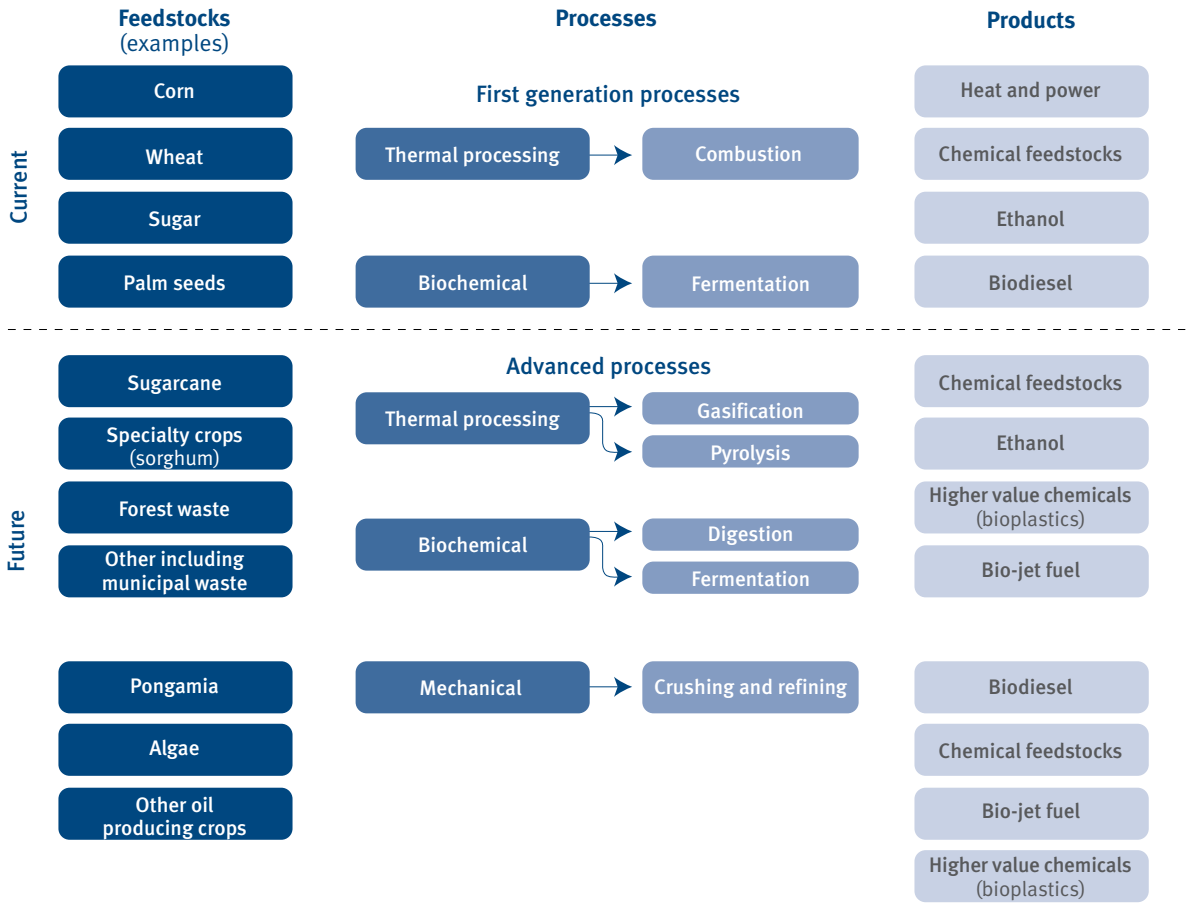
Executive summary

The emergence of a bio-based industrial products sector

Bio-based industrial products are defined as industrial and consumer products manufactured from renewable materials using advanced processes. Historically, the bio-based products sector has produced transport fuels for domestic purposes using first generation processes involving the fermentation of corn and sugar.

The emergence of advanced technologies for converting lignocellulosic materials (fibrous, woody biomass) and extracting oil from plants, such as pongamia and algae, enables the production of sustainable aviation fuels, renewable diesel and higher value platform chemicals such as those used to produce bioplastics.

Diagram 1 First generation and advanced pathways to bio-based industrial products



Bio-based industrial products have the potential to provide energy alternatives, increasing energy security while reducing greenhouse gas emissions. However, first generation bio-based industrial products have limited capacity to achieve targets for substituting fossil fuels, climate change mitigation and economic growth. This has highlighted the opportunities to develop new feedstocks, advanced process technologies and products.

The advanced bio-based industrial products sector is relatively immature, with significant scope for increasing production efficiency, as technical challenges are overcome. Although this will take some years, bio-based industrial products that currently are not economically viable are expected to be commonplace in the future. Expert opinion suggests that advanced bio-based industrial products will be cost-competitive with petro-chemical alternatives within 10 years.

Queensland markets for bioenergy and bio-based chemicals are currently limited. However, there is evidence to suggest that markets are emerging, driven by stronger demand for transport fuels due to international mandates and incentives, public interest in cleaner energy alternatives, and the growth of chemical and plastics manufacturing in Asia. Drawing on Queensland's natural assets, the State has an opportunity to position itself in the emerging bio-based industrial products sector. Establishing a biobased industrial products sector in Queensland supports the Government's climate change strategy (*ClimateQ: Towards a Greener Queensland*), the *Queensland Renewable Energy Plan*, *Queensland Biotechnology Strategic Plan 2005–2015* and the 100,000 jobs target. It also complements the Queensland Government's *Toward Q2: Tomorrow's Queensland* strategy for a Queensland that is strong, green, smart, healthy and fair.

Your vision for the bio-based industrial products sector

Community and industry input is being sought to consider the potential value of and support for a strong bio-based industrial products sector in Queensland. The State would stand to benefit from this sector through the utilisation of non-arable land, bioremediation of coal seam gas water, carbon dioxide bio-sequestration, development of new regional industrial opportunities, diversification of agricultural industry, and sustainable energy independence.

This discussion paper has been prepared to inform the community and stakeholders of current capabilities in the bio-based industrial products sector in Queensland and to seek your views on the challenges identified and the proposed solutions and actions.

Charting a course for Queensland's bio-based industrial products

Over the coming years renewable biomass will increasingly be a substitute for non-renewable resources such as oil, coal and gas. Renewable biomass can be obtained from primary sources such as specialty crops, grasses, trees and marine algae, and from household, industrial and agricultural waste such as vegetable peelings, sawdust, used vegetable oils, bagasse and wheat straw.

Bioprocesses convert these materials into a range of products, including renewable fuels, plastics, paper and chemicals that are ecologically sustainable. As oil prices increase and technologies improve, these will also become economically competitive with their non-renewable counterparts. To facilitate uptake of these products, the bio-based industrial products sector will need to identify local comparative advantages, help vertical integration of research, investment and industry activities, and ensure market awareness and product differentiation.

The national and international scene

Internationally, bioethanol and biodiesel transport fuel production is dominated by Brazil (sugarcane), United States (corn) and Europe (rapeseed). This is due to the well developed infrastructure, logistics, research and development and supply chains in these areas.

The majority of Australian first generation biofuels are produced primarily from:

- C-molasses (from sugar refining) at CSR Sarina near Mackay, and
- cereal wheat starch at Manildra flour mill in New South Wales.

The State has an opportunity to build on its world-class expertise in crop development– in particular the established and efficient sugarcane industry and associated infrastructure.

Production of sustainable jet fuels presents a particular challenge and opportunity for Queensland. Rising jet fuel prices are putting severe pressure on airline companies, creating an incentive for bio-jet fuel research. The worldwide aviation industry consumes 250 billion litres of Jet A-1 annually. Since 2008, there have been six successful test flights using biofuel-jet fuel blends, with Boeing being involved in four of these.

While there are no specific government programs in Australia to develop sustainable aviation biofuels, the Federal Government's second generation biofuels research and development program (Gen 2) is aimed at encouraging development of sustainable transport fuels, including aviation fuels.

Most lignocellulosic ethanol research and development is currently taking place in the United States of America, but there is interest in Northern Europe (with its large forestry resources), and in Brazil (sugarcane bagasse). To date, there are no commercial cellulosic ethanol production plants and only a few pilot plants operating in the world.

Current challenges are focused on progressing from laboratory research to pilot and demonstration plant, and then to commercial production. Major projects that aim to develop commercial scale production using sweet sorghum are currently under way in India, the United States and South Africa.

Internationally, considerable biochemical research and development has been aimed at production of platform chemicals for manufacture of bio-plastics, mainly using corn as the feedstock. In the future, the sector will need to transition to using non-food feedstocks to minimise impacts on food production capacity. Queensland has the potential to take a strong position in this sector having both access to non-food biomass and substantial research expertise in this area.

In addition to research conducted at the University of Queensland (UQ) and James Cook University (JCU), sustainable production of bio-based industrial products from microalgae is being researched by the South Australian Research and Development Institute (SARDI), the Victor Smorgen Group, Murdoch University and CSIRO.

Flinders University is also exploring the microalgae biodiesel and biorefinery concept and a National Collaborative Research Infrastructure Strategy (NCRIS) funded demonstration scale microalgal biodiesel production facility has been established in Adelaide. Murdoch University is also developing and overseeing large-scale open pond algae projects in Australia, China and India.

Opportunities for Queensland

While Queensland initially has advantages in the bio-based industrial products sector as an efficient producer of sugarcane, there are several additional options for going forward regarding both feedstocks and technologies. Queensland could be well-positioned to develop a reputation in using non-food feedstocks such as sorghum, forest and municipal waste and oil crops such as pongamia and algae.

Development of high-yielding biomass crops (potentially by using genetic modification techniques) that will grow in otherwise non-arable or marginal land is a promising option in light of an increasing global population and pressure on food supplies. Opportunities are not limited to production as development and licensing of technologies in this area is likely to provide substantial economic benefits.

Queensland Government initiatives and investments in recent years have helped develop the research infrastructure, expertise and skilled workforce needed in this area. This builds on Queensland's long list of advantages including: a stable economy and Government, natural advantages, low operating costs, highly skilled workforce, secure and robust regulatory environment, intellectual property protection, modern seaport infrastructure and the State's strategic Asia Pacific location.

The State has a potential opportunity to build on its world-class expertise in crop development – in particular the established and efficient sugarcane industry and associated infrastructure. Current research capacities are focused on converting sugarcane to biofuels through developing efficient cellulosic processes, combining traditional plant breeding with genetics to develop new high performing 'energy' canes and using sugarcane as a green factory for production of biocommodities such as polymers, enzymes and higher value products.

Case study

Furfural plant at the Proserpine Sugar Mill: exploring the versatility of sugarcane

In an Australian first, Queensland's Proserpine Sugar Mill is transforming sugarcane waste into the platform chemical, furfural, which can be used to replace hydrocarbon based chemicals in a range of applications. An exciting new use is in transforming softwoods into the equivalent of various tropical hardwoods.

Furfural is a liquid chemical that is produced from lignocellulosic material (woody, fibrous plant waste biomass). Furfural is a bio-based industrial platform chemical previously used for manufacturing perfumes, nylon, spandex and other chemicals. New uses for furfural

Production of sustainable jet fuels presents a particular challenge and opportunity for Queensland.

include as a solvent in petrochemical refining to produce synthetic rubber, in resins used in manufacturing fibreglass, some aircraft components and automotive brakes and in converting softwood timber to high value timber for flooring and luxury boats.

Commencing operations this year, the Prosperpine Sugar Mill's furfural production facility is the first of its kind in Australia. The Mill uses the SupraYield® process to produce furfural from the bagasse that is left over from sugarcane production. It is the first facility in the world to use the SupraYield® process, which is owned by the Mill and patented in many countries around the world. This technology offers Queensland the opportunity to be at the forefront of the industry, exporting approximately 95 per cent of the plant's furfural production to Asia, the US and Europe.

Furfural is capable of being a major platform chemical for the manufacturing of products currently derived from petrochemical sources, offering a cost-competitive, renewable and environmentally friendly alternatives.

Queensland's investment in a greener future

The Queensland Government and its partners have made significant investments that have laid the foundations for this sector. New funding initiatives include:

- $2 million (2010 Smart Futures Fund grant) to the Queensland Sustainable Aviation Fuel Initiative. This brings together aerospace manufacturers, airlines, oil processing companies and fuel manufacturers to develop a foundation for Queensland in the sustainable aviation fuel industry. The University of Queensland-led initiative brings together some of the largest names in global aviation and the US green energy company Amyris. Other Queensland partners include: Mackay Sugar, Brisbane-based IOR Energy and James Cook University.
- $1.48 million (2010 Queensland Government's Smart Futures Fund) to the High Efficiency Microalgae Biofuel System Project. This project is led by the University of Queensland Institute for Molecular Bioscience and aims to develop low cost, high productivity 'photo-bioreactors' which can produce green algae for use in a wide range of biofuels.
- $1 million (2010 Smart Futures Fund) to the Carbon Mitigation for Queensland Power Generation project. This project is a James Cook University led partnership with MBD Energy Ltd to establish a one hectare algal biomass display plant specially designed to sequester carbon dioxide from coal-fired electricity generation.
- $6.5 million investment by the Queensland Government to establish the Queensland Alliance for Agriculture and Food Innovation (QAAFI) in partnership with the University of Queensland. The institute will capitalise on new science platforms in areas such as genomics, materials science and advanced systems modelling to create new innovations for Queensland's food and agribusinesses.

Examples of previous Government support include:

- The BSES Limited/DuPont research and development alliance which focuses on increasing sugarcane production through development of improved varieties and planting technologies. A further focus is in the area of efficient biomass utilisation.
- BSES Limited's Cane2Fuel research program was awarded $1.3 million from the Australian Government's $15 million Second Generation Biofuels Research and Development Grant Program.
- The Centre for Tropical Crops and Biocommodities at the Queensland University of Technology which has partnered with Syngenta to establish the Syngenta Centre for Sugarcane Biofuels Development, supported through Queensland Government funding of $2 million.
- The Mackay Renewable Biocommodities Pilot Plant, to which the Queensland Government has provided $3.1 million.
- The Queensland Government funded $166,000 to support the first stage of the James Cook University algae demonstration facility at Townsville which aims to produce biodiesel for transport and industry.
- $9 million through the Office of Clean Energy to establish a $120 million co-generation power plant at Mackay Sugar Ltd's Racecourse Mill.
- $1.4 million towards the Australian Institute of Biotechnology and Nanotechnology and Korean Advanced Institute of Science and Technology partnership aimed at developing processes to produce bio-based industrial products from Queensland sucrose.

These projects leverage significant Government investments in research infrastructure including the:

- $105 million Queensland Bioscience Precinct
- $82 million Australian Institute for Biotechnology and Nanotechnology (AIBN)
- $76.6 million Australian Tropical Science and Innovation Precinct
- $7.8 million Australian Tropical Forest Institute
- $1.5 million Centre for Marine Microbiology and Molecular Genetics
- $15 million Queensland University of Technology Renewable Biocommodities Plant
- $3.5 million CRC for Sugar Industry Innovation through Biotechnology (SIIB).

Queensland has world-leading research expertise in non-food feedstocks such as sorghum, forest and municipal waste and oil crops such as pongamia and microalgae.

A greener outlook

Scoping a bio-based industrial products sector

Current research and development provides a platform to capitalise on emerging markets for advanced renewable fuels, high value materials and bio-based chemicals. The recently established Mackay Renewable Biocommodities Pilot Plant and Townsville Algae Biodiesel test plant provide capacity for continued exploration of advanced bio-based industrial processes and the subsequent commercialisation and technology licensing opportunities.

International focus on developing bio-based jet fuel and the need for a refuelling hub in this region create an incentive for bio-jet fuel development that links with Queensland research. One driver of this is current directives in the European Union which specify a percentage of biofuels to be used in aircraft landing within the Union. Queensland's climate, agricultural expertise and proximity to the Asia Pacific region provide significant advantages for development of this product.

Case study

Sustainable Aviation Fuel: Cleaner, greener, renewable bio-jet fuel

Fuelling planes with cleaner, greener, renewable jet fuel derived from oil seeds, algae and sugarcane is closer to reality as a result of Queensland research.

Aviation accounts for two per cent of the world's total greenhouse gas emissions. Cleaner bio-jet fuels offer the largest single opportunity to reduce emissions while ensuring long term fuel security for the sector.

The Sustainable Aviation Fuel Initiative brings together the University of Queensland, Mackay Sugar, Brisbane based IOR Energy and James Cook University. These agencies are partnering with aviation organisations including Boeing and Virgin Blue and the US green energy company Amyris to develop the technology for bio-based aviation fuel.

The Queensland Government has committed $2 million towards this project through the University of Queensland's Australian Institute for Bioengineering and Nanotechnology (AIBN).

In addition to this project, CSIRO, together with stakeholders from the Australasian aviation industry, government and non-government sectors, is convening

the Sustainable Aviation Fuels Road Map study. They have invited the Queensland Government to participate in the pursuit of sustainable jet fuels in Australia. This world-first study is mapping the pathways and challenges to accelerate the development and commercialisation of a sustainable aviation fuels industry in Australia and New Zealand. The study is examining whether a cost-effective bio-derived jet fuel that doesn't have any detrimental environmental or social impacts can be produced.

Australia is well positioned to develop a bio-based industry to produce high value products alongside renewable fuels, which would help ensure the production of biofuels is viable and profitable. Plastic production is the largest sector of the global petrochemical industry and bioplastics comprise 10-15 per cent of this market at present. This share is predicted to increase to 25-30 per cent by 2020.[1]

Queensland could be positioned to capitalise on concerns about the use of food crops to produce bioenergy by developing technologies using non-food feedstocks to produce biofuels and high value bio-based industrial products. Queensland has world-leading research expertise in non-food feedstocks such as sorghum, pongamia, bagasse and other lignocellulosic materials and microalgae.

Australia has a potential competitive advantage in microalgal biodiesel development due to high solar radiation, warm climate, substantial acreages of non-arable land, excess saline water and research expertise in algal biology, aquaculture and engineering.

It has been estimated that producing 10 per cent of Australia's diesel from microalgae, which would require about 1,000 km^2 of non-arable land, could generate $1.9 billion per annum.[2]

Case study

Introducing the green mini-factories

Microalgae, the small, aquatic plants will be used as mini-factories to sequester carbon dioxide (CO_2) from power stations and convert sunshine into biodiesel and animal feedstocks.

Algae technology offers the opportunity to use land and water resources that are unsuitable for any other use and thus complement rather than compete with other biomass based fuel technologies. Most notably, algae can deliver substantial environmental benefits through sequestering carbon emitted by polluting industries like coal fired power stations and aluminium smelters.

MBD Energy, an Australian company, has successfully partnered with one of the world's leading algal research teams, based at Townville's James Cook University (JCU). They are developing a 5,000 square metre test facility capable of producing 14,000 litres of oil and 25,000 kilograms of algal meal from every 100 tonnes of CO_2 consumed. The proof-of-concept facility, supported through Queensland Government funding of $166,000, was designed to optimise and implement world-leading technologies in the cost-effective production of algae biomass from carbon sequestration.

MBD Energy is collaborating with JCU to establish the first algae-to-biodiesel pilot plant using algae photo-reaction technology adjacent to the Tarong power station. The one hectare proof-of-concept pilot plant has the potential to capture up to 700 tonnes of carbon dioxide annually and has been supported through a $1 million 2010 Smart Futures fund grant. These initiatives use algae to reduce greenhouse gas emissions, reduce fossil fuel dependence at the same time as delivering sustainable, biodegradable livestock feeds, biodiesel and bioplastics.

1 Helmut Kaiser Consultancy (2007) *Bioplastics Market Worldwide 2007-2025*.
2 Australian Academy of Technological Sciences and Engineering (2008) *Biofuels for Transport: Roadmap for Development in Australia*.

The bio-plastic sector comprises approximately 10-15 per cent of the global plastics industry – a market that is expected to increase. Queensland has the potential to develop and produce higher value platform chemicals for the expanding market in the Asia Pacific.

The development and production of higher value bio-based chemicals in Queensland to replace petroleum-derived products also has an expanding market potential due to the proximity to an emerging chemical and plastic manufacturing industry in Asia.

Co-production of higher value products, bio-remediation projects using carbon dioxide from power stations for algae production and possible bio-remediation of coal seam gas water would contribute to the economic and environmental viability of this sector.

It has been suggested that by 2020 Queensland could be recognised as a leading producer of bio-based industrial products and technologies in the Asia Pacific region. This sector would be built on a sustainable regional industry, development and commercialisation of intellectual property and attraction of international businesses and partnerships.

Taking Queensland's clean and green products to the world

Overcoming challenges

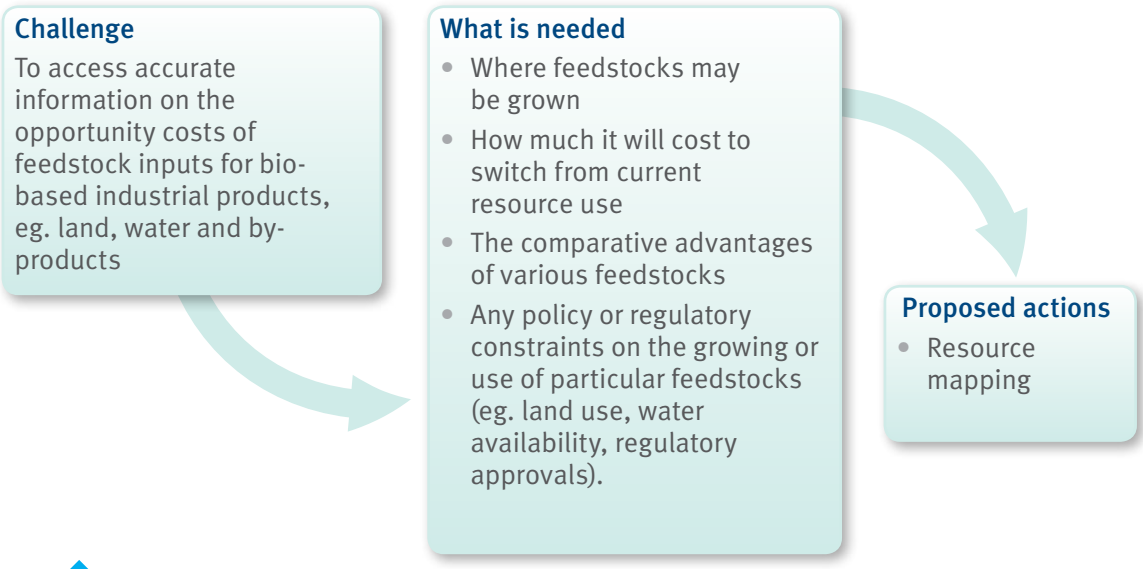
There is no clear candidate for best technology pathway in the production of advanced bio-based industrial products. Furthermore, there is no consensus on the likely choice of feedstock. The Government's role is to create an environment conducive to investment, leaving decisions around feedstock, process technologies, products and markets to commercial agents.

Preliminary consultations have highlighted non-feedstock inputs, feedstocks, processes, products and markets as elements presenting the key hurdles to developing a bio-based industrial products sector in Queensland. This discussion paper aims to identify additional challenges, suggest possible actions and propose a way forward to achieving this goal.

Non-feedstock inputs

A range of inputs are required to produce bio-based industrial products. These include land, water and carbon dioxide (CO_2). The bio-based industrial products sector is developing advanced processing technologies utilising non-food feedstocks such as sorghum, pongamia and microalgae which can be grown on non-arable and marginal land, use brackish water including possibly coal seam gas water and CO_2 from the coal-fired power industry. Advice from potential investors has indicated that in order to make investment decisions, they require information about what resources are available and their location.

Diagram 2 Non-feedstock inputs



Feedback...

The Queensland Government would like your comments and feedback in regards to the following questions. Further opportunities for feedback are highlighted throughout this discussion paper.

Question 1: Have the challenges relating to non-feedstock inputs been fully identified? If not, what other challenges do you foresee?

Question 2: Will this action adequately address the non-feedstock input challenges? If not, what further actions are required?

Question 3: In terms of information about resources, what information is required and at what level of detail?

Feedstocks

Further identification and development of suitable and reliable high energy feedstocks that do not compete with food resources still requires substantial research and development. This also provides an opportunity for product market diversification for the sugarcane industry, providing more certainty for Queensland producers in the current economic climate.

Case study

Pongamia trees: using plantations to reduce petroleum reliance

The humble pongamia tree could be the environmentally-friendly, low cost answer to our reliance on petrochemical based fuels.

Pongamia is a legume tree that bears non-edible seeds containing oils and fatty acids suitable for biodiesel production. Pongamia is an emerging potential feedstock as it can be grown on poorer quality land, particularly on that with high levels of salt.

Queensland-based Bioenergy Research Pty Ltd (BER) has teamed up with The University of Queensland's ARC Centre of Excellence for Integrative Legume Research (CILR) to identify and develop commercially viable genetic strains of the pongamia tree in Australia. BER has trial plantations around Queensland, including on the Sunshine Coast, Elimbah and Roma.

The Roma pongamia trial plantation, in conjunction with Origin Energy and the CILR , is irrigated by coal seam gas (CSG) water that has been desalinated in Origin's $20 million reverse osmosis facility.

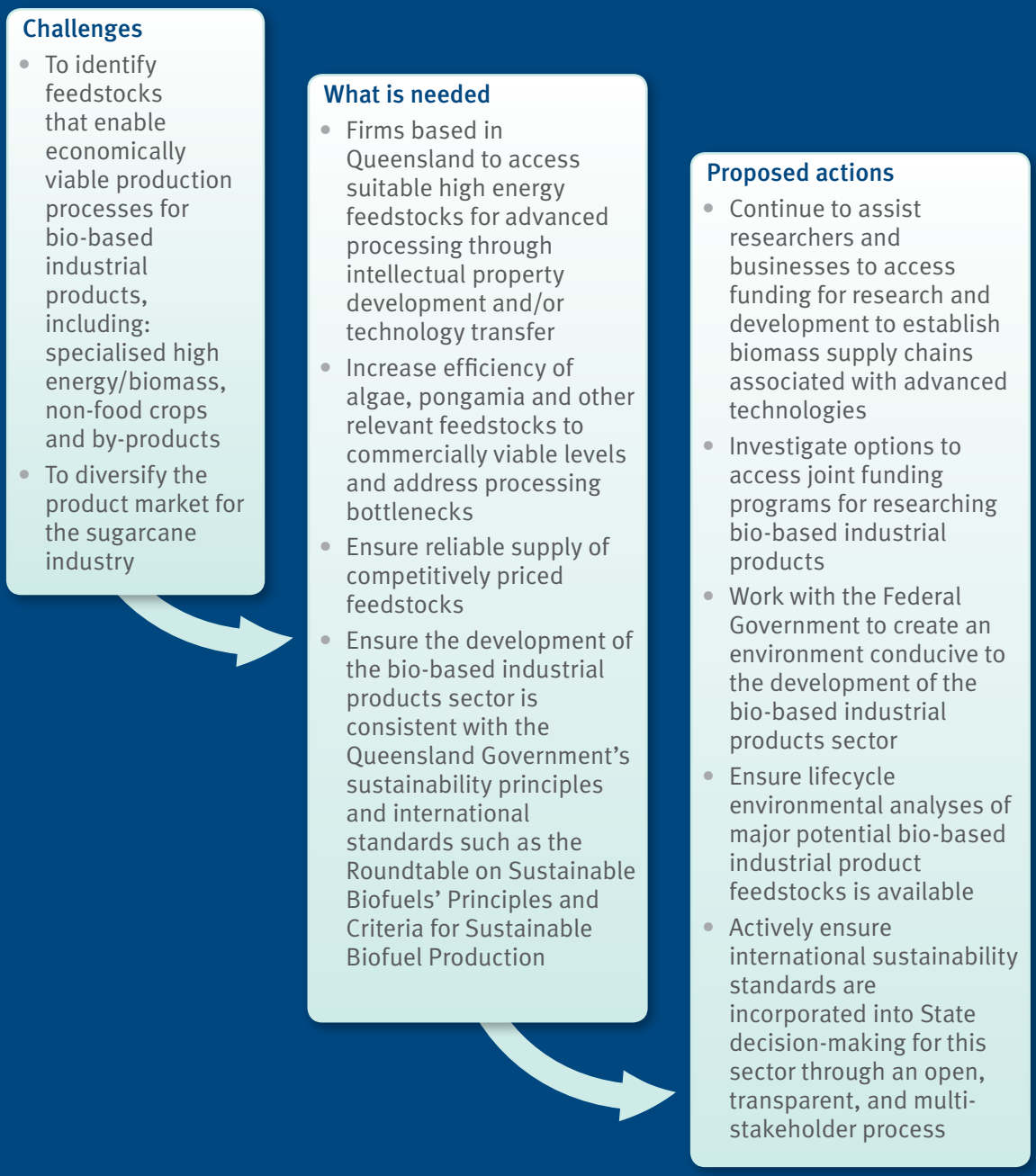
Advanced production of bio-based industrial products will require access to biomass such as sugarcane bagasse. However, with the Renewable Energy Certificates associated with using bagasse for co-generation facilities and the need for alternative fuels for sugar mills, the buying out of bagasse is not currently economically viable. Secondly, economically efficient cellulase enzymes required for the conversion of lignocellulosic biomass to bio-based industrial products are not yet available.

The production of bio-based industrial products needs to be sustainable at each stage of the process. This includes the production, transport and processing of feedstock, waste management and supply of final products to market. Product selection and design should anticipate the wastes and artefacts that may be produced during further processing and end uses and aim to minimise their impacts.

Key considerations to embed sustainability into production processes are as follows:

- resources are used efficiently and energy embedded in the process is not excessive
- feedstock production does not degrade the landscape or ecosystems where it is produced. Primary production capability for future generations is protected
- the processing facility does not place excessive stress on resources, including water and infrastructure, in the economic hinterland in which the facility operates
- feedstock production does not result in adverse impacts on surface or ground waters
- contaminants released from production of feedstock and final products do not cause environmental harm
- waste production is minimised and those wastes produced do not leave a legacy for future generations.

Diagram 3 Feedstocks



Feedback...

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Question 4: Have the challenges relating to feedstocks been correctly identified? If not, what other challenges do you foresee?

Question 5: Will these actions adequately address the feedstock challenges? If not, what further actions are required?

Advanced processing technologies

Currently scientists are exploring a range of advanced processing technologies. With no clear technology leader, the ability to test various technologies in a piloting environment is crucial. Queensland-based pilot and demonstration facilities will generate local expertise, provide data specific to the Queensland environment and significant know-how ensuring that a Queensland bio-based industrial products sector is economically viable.

Case study

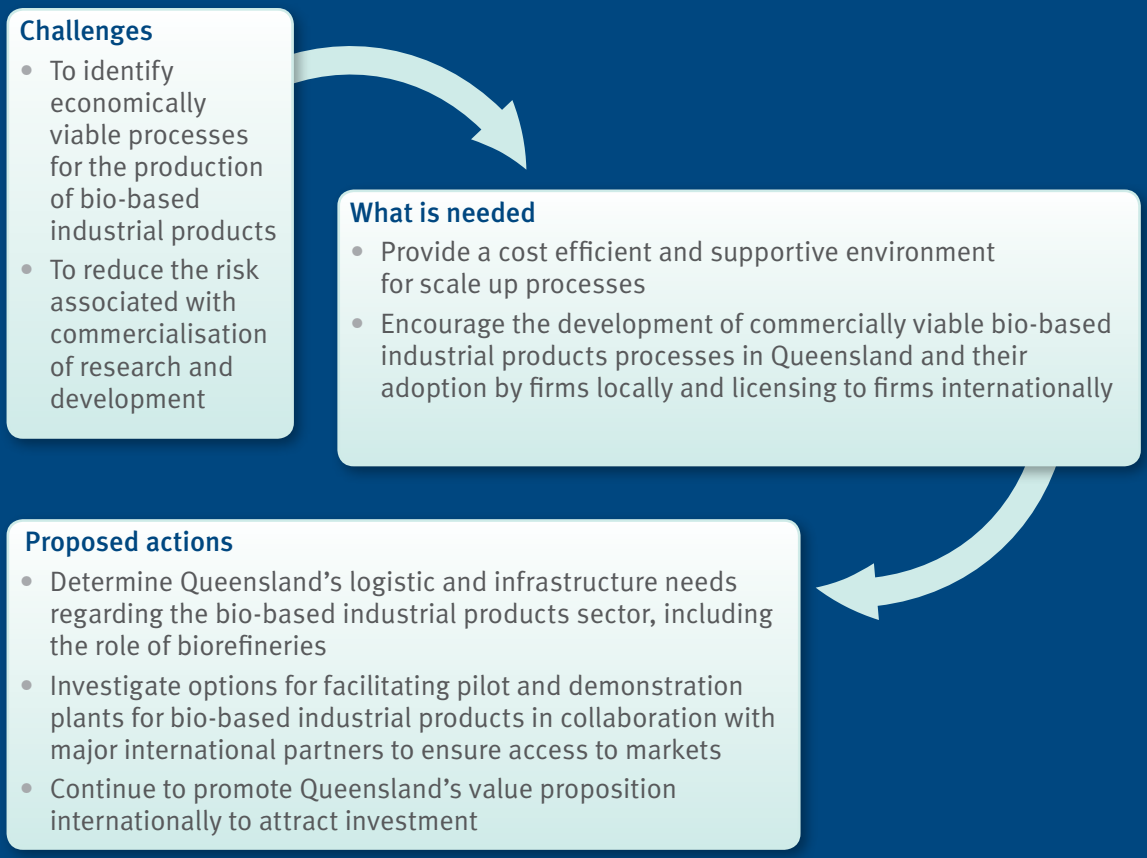
QUT's Mackay Renewable Biocommodities Pilot Plant: driving research and development

The sugar capital of Australia is home to a cutting edge research facility that will produce environmentally friendly transportation fuels and other high value products from agricultural crops like sugarcane.

The Mackay Renewable Biocommodities Pilot Plant, owned and operated by the Queensland University of Technology, is a unique research and development facility that will demonstrate the conversion of agricultural and forestry waste residues and energy crops into renewable and sustainable transport fuels and high value bio-based industrial products. These novel products include alternatives for the plastics, paint, adhesive and film/coating manufacturing industries and are currently mostly produced from petrochemical feedstocks.

The facility is located at the Racecourse Sugar Mill owned by Mackay Sugar Limited, one of Australia's largest sugar manufacturers. The facility aims to link innovations in product and process development in a factory setting with a view to generating near term commercial investment in Queensland. By undertaking such research and development, the Pilot Plant has the potential to become the nucleus of Australia's pre-eminent biocommodities precinct.

Diagram 4 Processes



Feedback...

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Question 6: Have the challenges relating to processes been correctly identified? If not, what other challenges do you foresee?

Question 7: Will these actions adequately address the process challenges? If not, what further actions are required?

Question 8: What is required to attract investment and particularly international investment in Queensland's bio-based industrial products sector?

Question 9: What is required to facilitate translation of research into commercially viable processes?

Exploring new bio-based industrial products

Historically the bio-based industrial products sector has been dominated by the production of biodiesel from tallow, used cooking oil and oil seeds, and bioethanol derived from first generation fermentation of sugar and corn. The sector is transitioning to develop bio-based industrial products from advanced technologies utilising non-food feedstocks such as bagasse, microalgae, municipal and forestry waste and specialised crops (pongamia, sorghum).

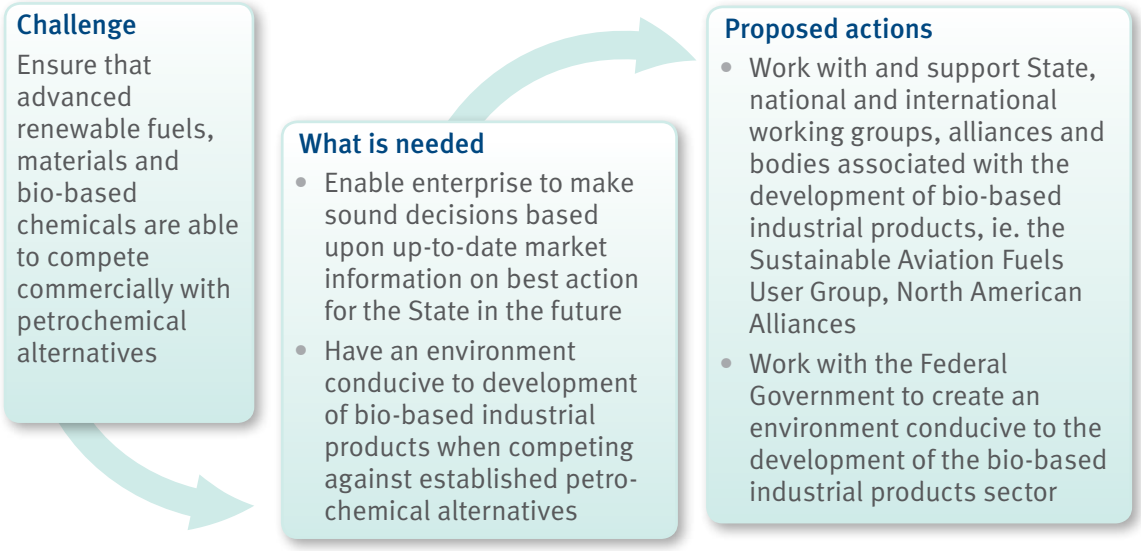
Advanced renewable fuels, materials and bio-based chemicals need to be commercially competitive with petrochemical alternatives. Currently, biofuels are effectively exempt from excise, unlike petroleum based fuels, which has contributed to fostering investment in local ethanol production.

Beginning in July 2011, the effective excise on ethanol will increase at a rate of 2.5 cents per litre each year until reaching the final excise rate of 12.5 cents per litre by 1 July 2015 compared to the 38.143 cents per litre rate for petrol. For biodiesel the excise arrangement will be phased up to 19.1 cents per litre by 2015.

The 2010 Federal Budget ensures that the domestic biofuel industry is able to develop without detrimental exposure to international competition for the next five years. However, from 1 July 2015, imported ethanol will be subject to the same excise treatment as domestically produced fuel ethanol.

The national and state policy context needs further work to be truly conducive to developing this sector. Certainty in government policy is desirable because it enables industry to identify opportunities with a degree of confidence. The recently released Henry Taxation Review and the deferral of the Carbon Pollution Reduction Scheme have provided some security to potential investors in the Queensland bio-based industrial products sector.

Diagram 5 Products



Feedback...

The Queensland Government would like your comments and feedback in regards to the following questions. Further opportunities for feedback are highlighted throughout this discussion paper.

Question 10: Have the challenges relating to products been correctly identified? If not, what other challenges do you foresee?

Question 11: Will these actions adequately address the product challenges? If not, what further actions are required?

Question 12: What other matters need to be addressed to provide a context to ensure that bio-based chemicals can be commercially competitive with petro-chemical alternatives?

Potential for new markets

Queensland has the potential to develop a new industry to produce higher value products such as advanced renewable fuels, materials and bio-based platform chemicals. With the bio-plastics sector comprising approximately 10-15 per cent of the global plastics industry, this represents a significant opportunity. Queensland is not currently involved in chemical manufacturing. However, the emergence of a chemical and plastic manufacturing industry in Asia could jumpstart a new export market for the base materials.

Case study

Brisbane researchers take bioplastics to a new level

Queensland researchers have developed two bio-based, environmentally friendly alternatives to petrochemical compounds. The research was completed by the Cooperative Research Centre for Sugar Industry Innovation through Biotechnology (CRC SIIB).

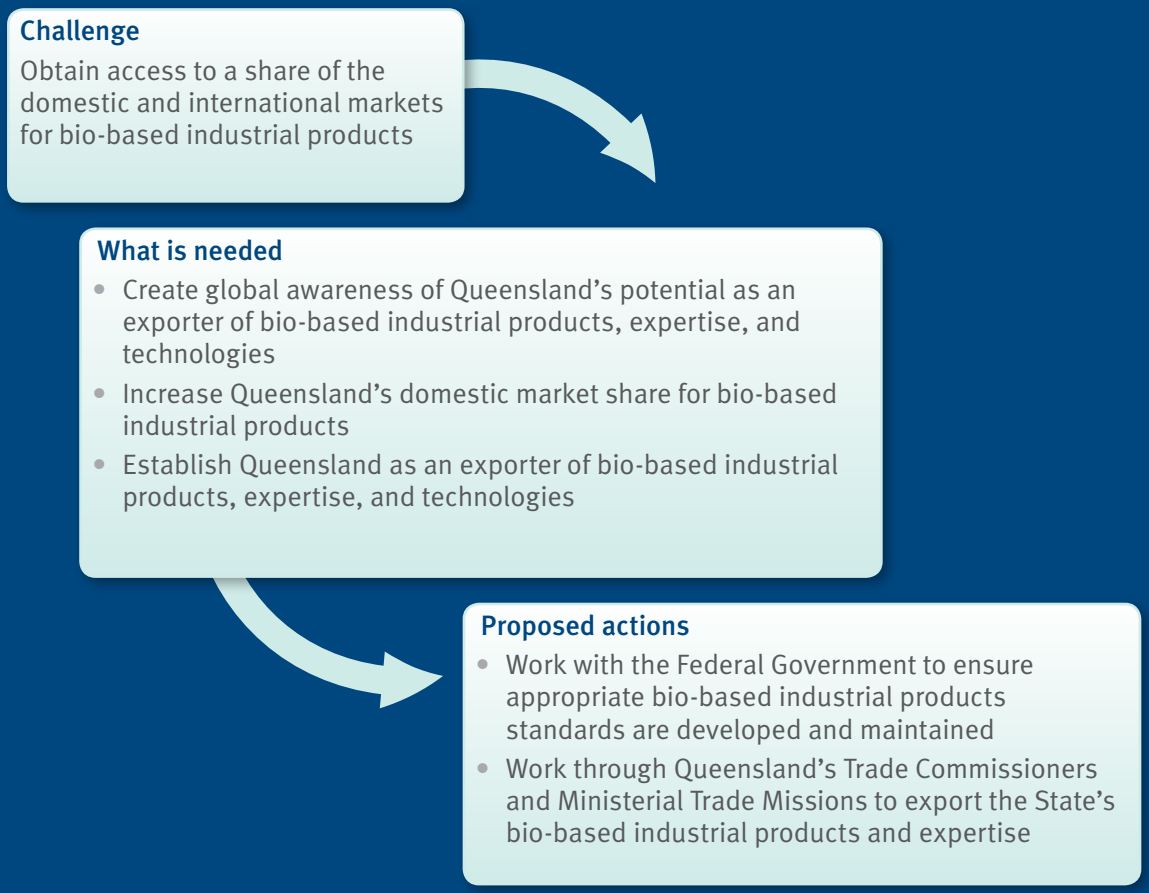
In a world-first, Brisbane biotechnologists have invented a way to use the lignin from sugarcane bagasse to produce a biopolymer known as Barrecote™.

Barrecote™ is an aqueous coating of biopolymers which renders paper waterproof. This process would allow Queensland sugarcane producers to partner with paper manufacturers to produce waterproofing for paper, cardboard boxes, containers and other environmentally friendly products. Currently, cardboard is coated with a petroleum-based wax which renders the packaging non-recyclable. Fully recyclable, waterproof paper board coated with Barrecote™ could reduce billions of tonnes of landfill around the world.

The second CRC SIIB based project involves researching ways to produce commercial amounts of the biodegradable plastic, polyhydroxybutyrate (PHB), in genetically-modified sugarcane plants. Ultimately, these plants will have the potential to produce sustainable, environmentally-friendly plastics and chemicals.

Expert opinion suggests that advanced bio-based industrial products will be cost-competitive with petrochemical alternatives within ten years.

Diagram 6 Markets



Feedback...

The Queensland Government would like your comments and feedback in regards to the following questions. Further opportunities for feedback are highlighted throughout this discussion paper.

Question 13: Have the challenges relating to markets been correctly identified? If not, what other challenges do you foresee?

Question 14: Will these actions adequately address the market challenges? If not, what further actions are required?

Question 15: What other actions need to be undertaken in order to develop a market for bio-based industrial products manufactured in Queensland?

Have your say

Bio-based industrial products are emerging as a new phase in global industrial development, driven by concerns about declining fossil fuel supplies and energy security, climate change, and possibilities for new regional industries. Queensland has the potential to benefit from the emergence of this industry but there are also possible pitfalls. Any development should take into account the full range of opportunities and the economic, environmental and social impacts, both positive and negative.

Your views are sought on this important issue. You are invited to provide responses to the 15 questions highlighted throughout this document, as well as any other relevant comments. If you have a view on this sector or information that should be considered, please respond using one of the contact options below.

Contact

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Please send your comments and submissions by ***30 August 2010***.

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