Queensland Biofuels Mandate Response

Regional centres and hubs for biorefinery development should be linked to a vision with long term planning and commitment for the selection of products and markets.

To respond to some of the questions without a plan and subsequent checklist is like having pieces of a jigsaw puzzle with no knowledge of what the picture may be – what is it that Qld aspires to be recognised for?

New technologies and associated entities aspire to be within a positive environment with a vision that demonstrates commitment to achieve certain global recognition.

Qld has many attributes and strengths, but is also limited in many enabling features and characteristics such as hubs, parks, incubators, facilitators and mentors that have funding support, market connections and vision for a biobased economy beyond biofuels.

The key issues for any biobased economy is availability of feedstock in sufficient sustainable quantities at the right price. This is a reflection of certain crop requirements for land, fertiliser and irrigation and the capital and resource requirements.

There are several opportunities available now with Qld in a position to be first to market with a high yielding crop that has no pests and diseases in Australia, grows in marginal land with no additional fertiliser or water and has yields that rival those of sugar cane. Qld has the first global trials of this agave crop that has attracted numerous visits from overseas entities and countries, especially Brazil that is looking for new sugar crops for ethanol.

AusAgave has trialled agave production in Qld for 8 years with exceptional results and the ability to grow in traditional pastoral country and in fact many drought areas of central Qld. Agaves are a perennial CAM plant that grows in marginal areas yielding high quantities of industrial sugars and fibre – no need for power or water for irrigation. Due to the flexibility of agaves, it allows a more planned approach to establishing designated areas for biomass production that can provide positive enhancement of certain regions.

Establishing an ethanol economy based on a biofuels mandate, especially at a low rate will take too much time to capture the moment that could position Qld as the leader in this area. The time is here and now for establishing a bio based industry in Australia as the market is small and investment opportunities limited.

My concern is that a focus on the biofuels mandate is doing just that – keeping the focus on biofuels with no recognition or promotion of the market potential beyond biofuels. Global evidence shows that even with mega investment, there are few technology companies that can build a future based on biofuels, where the margins are small and capital requirements are large. Most have moved to establish 'co-products' of higher value in order to tolerate supplying a biofuels industry.

There is a need to target 'beyond biofuels' (BB) so that increased availability of ethanol promotes ethanol usage, rather than trying to engineer a BB future from a biofuels mandate.

My experience in this area, albeit in another industry, is that stakeholders have great difficulty in moving from 'business as usual' to one requiring changes and the required changes are only implemented in an incremental manner as their business models do not encourage first movers.

There needs to be a step change from the present, and this is most often from SME's that are the risk takers in new areas, unless there is supporting government or market input which can be

channelled through hubs, parks, incubators and the like. There is certainly opportunity for the Qld and Federal governments to implement progress through joint R&D and demonstration sites.

Funding for this focus is more often problematic as facilities like ARENA are a disincentive for funding new technologies and products, as funds must be spent up front, and that is unlikely without an investor, and if the SME had an investor then why use ARENA apart from recouping funds. The funding mechanisms available need to be more user friendly to actually encourage entrepreneurs - the government could help facilitate working with CEFC or similar to give a guarantee to the supply chain.

The other common entities that operate in this area are the universities and AusAgave has worked with 3 in Qld for the last 6 years. Although there has been good outcomes, the general response towards them in the area of partnering private companies is one of mediocrity, as not all the requirements fit their R&D based focus. An example involved the Brazilian EMBRAPA, one of the biggest research organisations in this sugar/biofuels area who put many millions of dollars on the table for joint R&D in Australia initially with QU and CSIRO, but as these Australian researchers had to work through AusAgave, a private company they were not interested. This has caused us to undertake work overseas in Brazil and Mexico when our preference is to work here in Australia.

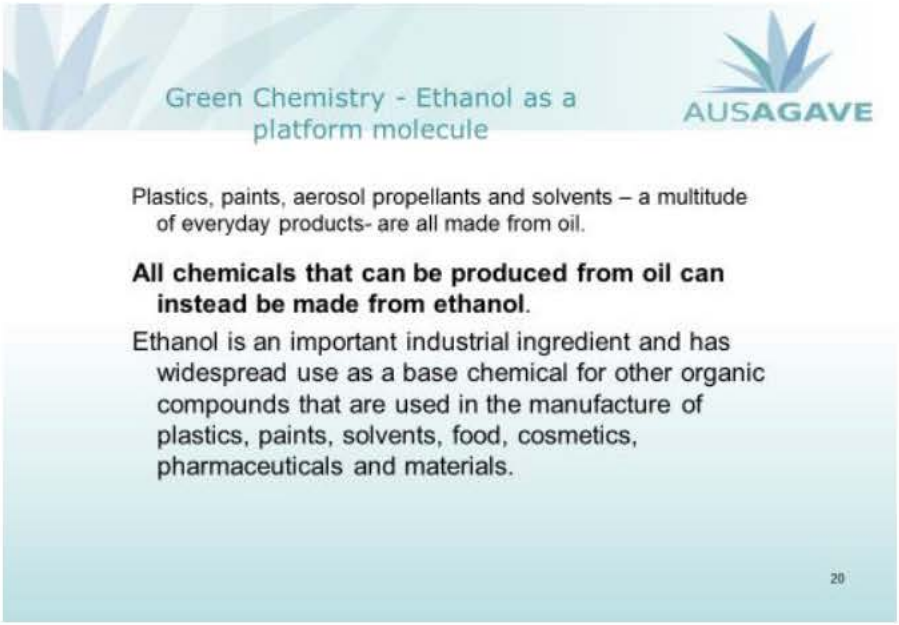
Unfortunately many within the university system believe they are the centres of knowledge and have difficulty working alongside SME's with new ideas and new technology, however if they have developed technology, the ability to spin this out and commercialise it seems to work OK.

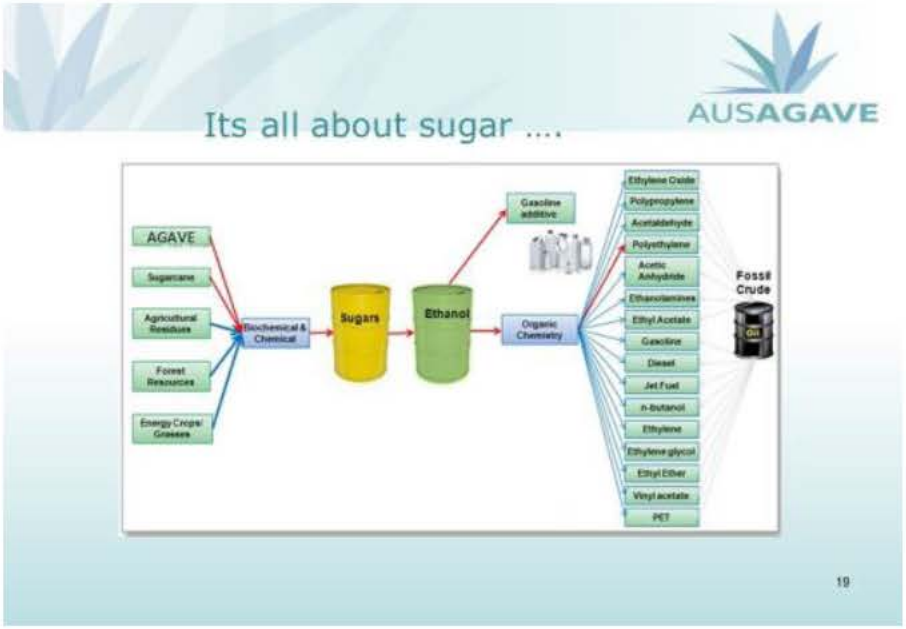
Public recognition and promotion of ethanol as a precursor for other value add products would broaden the debate and understanding of the role for an ethanol industry beyond biofuels, especially if there were incentives to plant an area of biomass feedstock with high sugar and ethanol potential – an attractant or the bait for investors and new technologies.

The government promotion of beyond biofuels is part of the commitment and guarantee that some industry players and banks will look for in order to become involved. This could be extended to include certain quantities of biomass available for new technologies or investments.

A starting point for a new industry would be to establish a checklist or matrix of 'real' feedstocks, technologies and markets that will satisfy potential ethanol demands at the same time addressing the environmental, financial and community concerns. A comparative look at the sugar contenders could be as simple as comparing requirements and costs for risk and outcomes such as this simple slide comparing agave and sugar cane.

The next step could involve considering potential products through an EOI or conference process where interested companies could register and in effect be introduced or matched with feedstock suppliers.





The state's economy will grow more from the industries and investments beyond biofuels.

AGAVE
Sugars & Fibre

feedstock for

advanced bio-fuels / bio-energy / bio-chemicals

June 2015

Agaves in Australia

AUSAGAVE

1910 Childers

2010 Ayr

AGAVES

AUSAGAVE

- **Sugar and fibre rich crops**
  - Platform precursor for multiple uses
- **Drought proof (CAM) perennials**
  - Reliability, carbon footprint/offsets
- **Water Use Efficiency (CAM)**
  - 7 x C_3 plants and 3 x by C_4 plants

- **Non-invasive with no pests or diseases in Australia**

Crop Requirements

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Conditions	Sugarcane	Agave
Land competition	High (optimal land)	Low (marginal land)
Climate	Tropical	Tropical – Semi-arid
Chemicals	High	Low
Fertilizer	High	Low
Water/Irrigation	1600 mm/a - irrigation	500 mm/a - rainfed
Ethanol Yield	8,000 L/ha/a	11,000 L/ha/a
Number of operations	Many	Few

2014 harvest

AusAgave progress

AusAgave is the first commercial entity to invest significant funds in selected agaves for large scale commercial production in locations far removed from traditional locations and cropping systems. AusAgave outsourced the R&D to five Australian Universities to achieve independently verifiable data over the last 10 years.

AusAgave has access to mechanization solutions including planting, harvesting and processing of the biomass. By controlling the mechanization of the crop, AusAgave is the only company in the world to be able to take Agave to large scale production.

By selecting enhanced varieties and adapting agricultural cropping systems, AusAgave has been able to reduce the cropping cycle to 5 years while improving the yields. AusAgave does not aim at reducing the cycle further as a key feature of Agave's is the incredible flexibility of a maturing perennial crop.

AusAgave has access to both pups and tissue culture production of more than 50 varieties adapted to different locations. AusAgave has also developed protocols to ensure the crop remains disease free.

High yields with minimal variability, high flexibility in terms of organisation and logistics, and the ability to grow on land not optimal for conventional crops are the keys to Agave viability, making it the most productive, sustainable and efficient feedstock for commercial scale biomass production.

AusAgave Summary

- Australia through AusAgave is recognised for global leadership
- Thinking beyond biofuels – long term value is in biobased economy including chemicals and biomaterials.
- AusAgave research independent – prior to this, there was a lack of robust analytical field data available restricting new industries.
- Mechanisation – reliance on cheap labour restricted agave expansion but now can provide total mechanisation from nursery for scale up.
- Earlier maturity – selection of improved varieties and introduction of cropping systems has reduced time to harvest by 50%
- Availability of proven planting stock – what to plant and where to source the planting material – more than 50 varieties in gene bank nursery and sophisticated yield prediction modelling
- Modern field ops – GIS real time

THE BIOECONOMY

R&D And Therefore Innovation Occurs In Cycles

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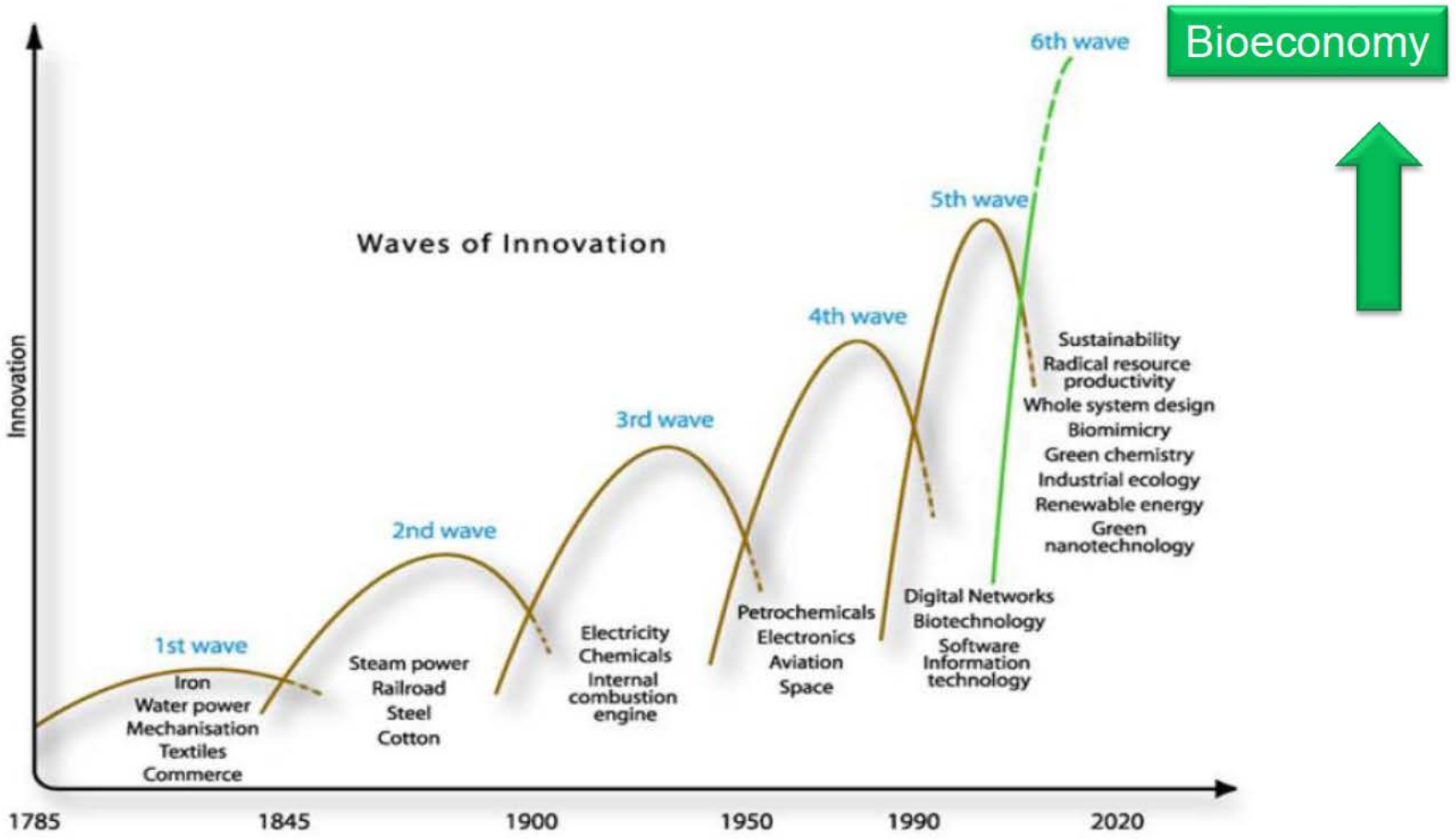
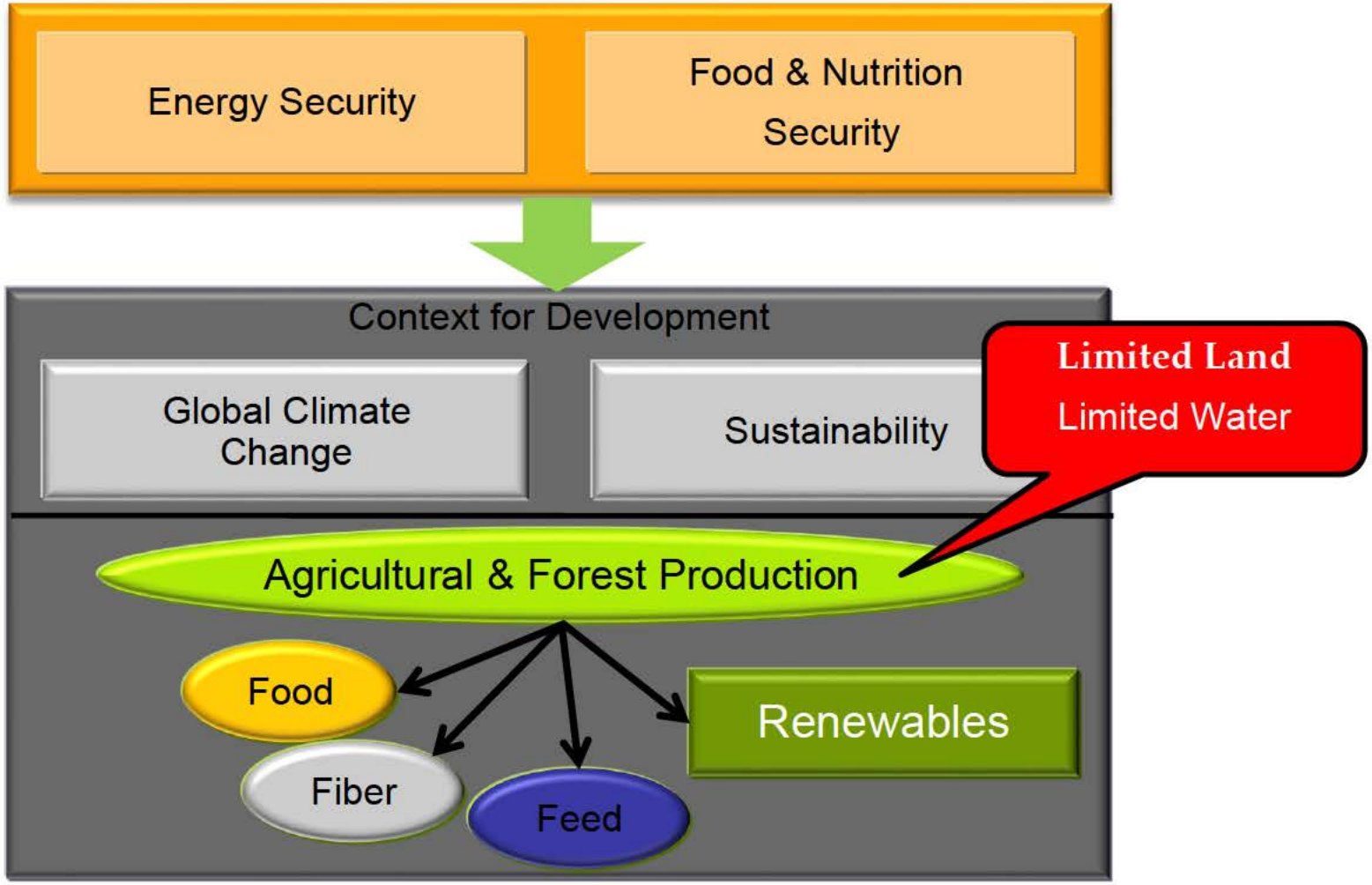


Demands of Major Megatrends Will Drive Future Innovation

Biotechnology is central



The bioeconomy offers opportunities for:

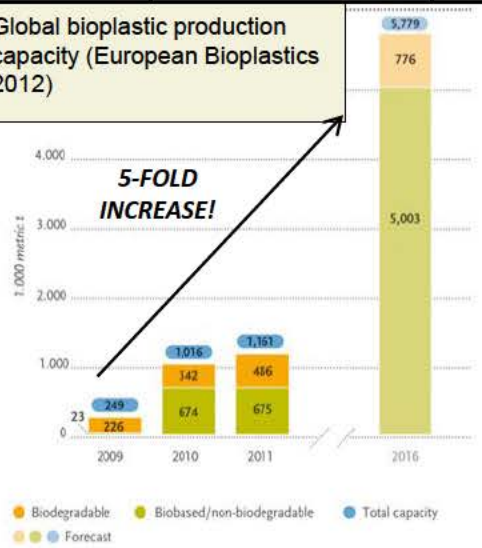
AUSAGAVE

1. Enhanced Competitiveness

- Many high value products, fast growth rates
- New crops, new revenue steams and more value extracted from biomass
- Opportunity to co-produce bioenergy, bioproducts and conventional products (biorefineries)
- No long-term subsidies required

Product	Compound Annual Growth Rate 2009-2015 (%)	Global Market Potential in 2015 (US$ Billions)
Biochemicals	5.3	62.3
Bioplastics	23.7	3.6
Wood fibre composites	10	35
Glass fibre market	6.3	8.4
Carbon fibre	9.5	18.6

Global bioplastic production capacity (European Bioplastics 2012)



The bioeconomy offers opportunities for:

2. Jobs and rural economic development

- Growing sector
- New/sustained jobs will be located near biomass resources
- Opportunities for rural/ off-grid/ mining communities
- Diversification of demand and supply chains (value-added primary processing)
- New rural and regional business models
- New value chains / business models – producers working with bioproduct companies

The bioeconomy offers opportunities for:

3. Environmental Benefits

- Meet market demand for environmentally preferable options
- Decrease net GHGs and reduce costs through fuel switching
- ‘Green’ existing infrastructure and industries
- Conversion of wastes
- Greater biodiversity through new crops / new and complex crop rotations

Biorefineries-Biochemicals-Biomaterials

- reflecting both integrated producing both fuels and chemicals, and pure play renewable chemical and companies.
- strategies in olefins, esters, isoprenoids, organic acids, styrenes, amines, glycols, aromatics, fatty acids, plastics, and sugars.
- markets in plastics and rubbers, lubricants and solvents, coatings and coolants, nutraceuticals, de-icers and insulators, fragrances and flavours
- molecules and markets in olefins, esters, isoprenoids, BTX, organic acids, styrenes, amines, glycols, fatty acids, plastics, and sugars.

Impacts on Growth of Bio-based markets

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- Consumer preference for biodegradable, environmentally friendly products
- Corporate commitment to sustainability in brand values
- Government mandates to support bio-based products to reduce pollution
- Solid interest from farming and forestry sectors in diversifying the crops and forest uses that help to stabilize and grow profitability

Green Chemistry - Ethanol as a platform molecule

Plastics, paints, aerosol propellants and solvents – a multitude of everyday products- are all made from oil.

All chemicals that can be produced from oil can instead be made from ethanol.

Ethanol is an important industrial ingredient and has widespread use as a base chemical for other organic compounds that are used in the manufacture of plastics, paints, solvents, food, cosmetics, pharmaceuticals and materials.

Its all about sugar ….

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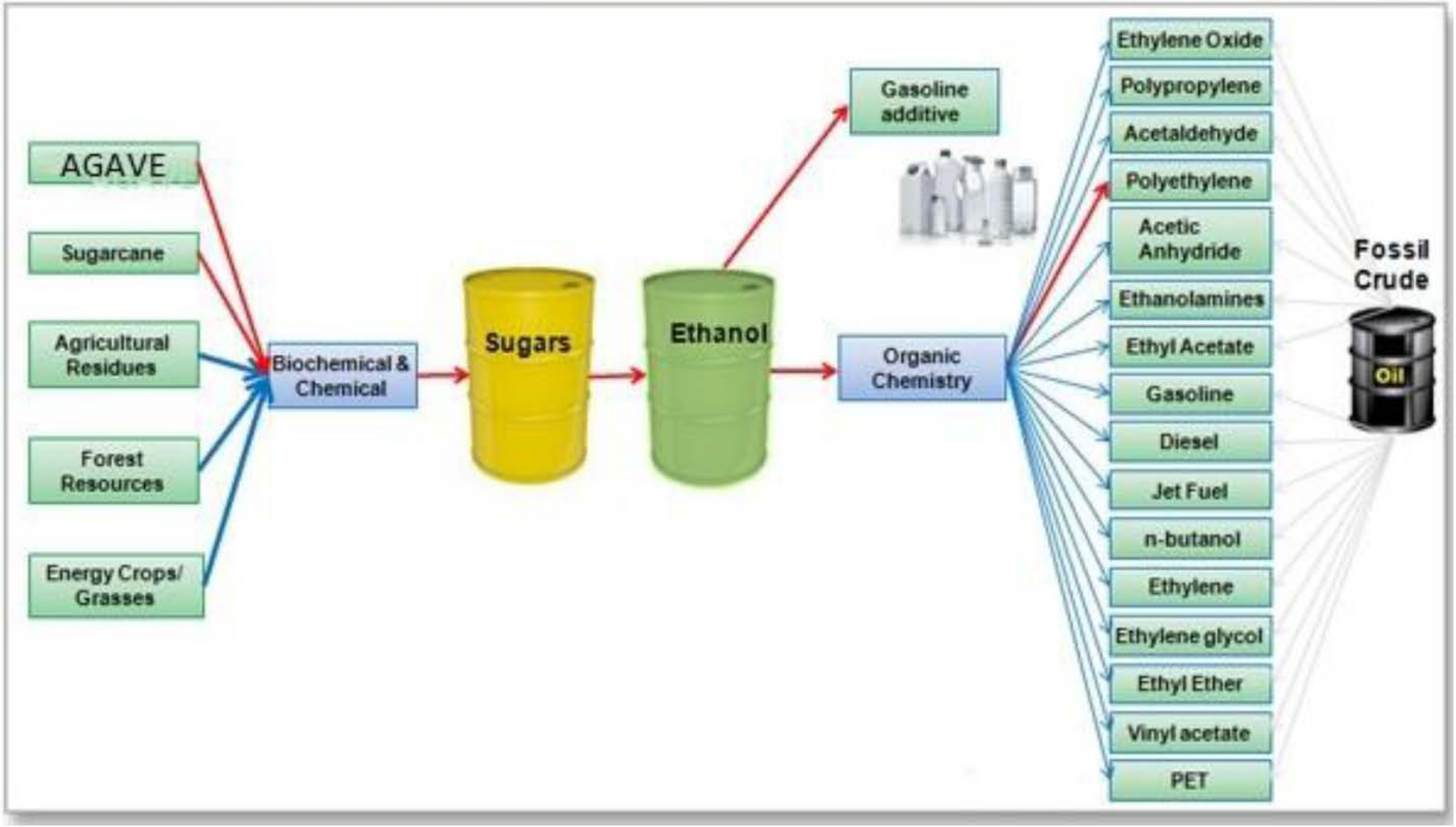

Summary

- Non Food Crops and Forestry are the Australian Opportunity
- Think beyond biofuels – long term value is in biobased chemicals and biomaterials.
- Australia has a leadership position.
- We can grow biomass and already do.
- We are open for partnerships with the world.

AUSAGAVE

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AUSTRALIA

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