“Down the track….”

James Dale

Centre for Tropical Crops and Biocommodities,

Queensland University of Technology
• where can the Australian sugarcane industry be by 2020?

• what should we be doing **now** to ensure we get there?
• what are going to be the big global influences between now and 2020?

• how will these impact on the Australian sugarcane industry?

• how can we take advantage of these influences for the Australian sugarcane industry?
World Oil Price and Supply

- We are using oil at an infinitely more rapid rate than it is being made at!
World Oil Price and Supply

• We are using oil at an infinitely more rapid rate than it is being made at!

• The current oil price surge is being driven by increasing demand and concerns over the geographical location of majority oil supplies

• By 2020, there will be significantly less oil and very probably greater demand

• new discoveries slowing, harder to extract

• Crude oil → petrol, diesel, tar, chemicals and fertilizers, plastics…..→ increased prices with reduced supply
Climate Change (Global Warming)

- atmospheric temperatures are rising
Climate Change (Global Warming)

- atmospheric temperatures are rising
- $\text{CO}_2$ levels are increasing
Climate Change (Global Warming)

- atmospheric temperatures are rising
- CO₂ levels are increasing
- consequences by 2020
  - greatest impact in the tropics and sub-tropics
  - greater extremes of climate (drought, floods, temperature)
  - increased biomass
Biotechnology and Genetic Modification

- current limited acceptance but increasing

Global Area of Biotech Crops
Million Hectares (1996 to 2005)

Increase of 11%, 9.0 million hectares or 22 million acres between 2004 and 2005.

Source: Clive James, 2005
Biotechnology and Genetic Modification

- current limited acceptance but increasing
- another major new technology for crop development
Biotechnology and Genetic Modification

• current limited acceptance but increasing
• another major new technology for crop development

- 9000 BC: domestication and selection
- 1650s AD: hybridisation
- 1850s AD: agricultural chemicals
- 1980s AD: genetic modification
- 2030s AD: ??????
Biotechnology and Genetic Modification

• current limited acceptance but increasing
• another major new technology for crop development

• By 2020, GM will be a standard technology for crop development:
  - new traits
  - new products
Tropical Crops and Biocommodities

Genetic Modification

Biofuels
 Biomaterials

Climate change adapted cultivars

Genetically modified cultivars

Keynote address at 28th Conference of the ASSCT, Mackay, May 2006
Biofuels and Biomaterials

Replacements for oil-based products

Bioethanol

• currently from sucrose and grain but not sustainable from grain.

“One of the goals of this initiative is to accelerate research and make cellulosic ethanol cost-competitive by 2012, offering the potential to displace up to 30 percent of our nation’s current fuel use by 2030.” USA DoE Biofuels Initiative
Biofuels and Biomaterials

Replacements for oil-based products

Bioethanol

- currently from sucrose and grain but not sustainable from grain.

- cellulosic bioethanol: the conversion of cellulose and hemicellulose into fermentable sugars
  - corn stover, wheat straw, sugarcane bagasse and trash
  - fast growing trees (poplars, salix, eucalypts)
Biofuels and Biomaterials

Replacements for oil-based products

Biomaterials (from non-GM sources)

• biomass fractionation primarily into lignin and cellulosic material

  ➔ cellulose converted into fermentable sugars for bioethanol production

  ➔ derivatisation of lignin into replacements for many currently petro-chemical based products
Biofuels and Biomaterials

Replacements for oil-based products

**Biomaterials** (from GM crops)

- proteins (high value/low volume)
  - therapeutics, vaccines, medical proteins
- proteins (moderate value/high volume)
  - food additives, industrial proteins
    - (cellulases, proteases)
- bioplastics
Climate change adapted cultivars

• genomics era: identifying genes and traits from model and crop species

• abiotic stress genes are becoming available:
  - drought tolerance
  - water use efficiency
  - nutrient use efficiency
  - cold tolerance, heat tolerance, salt tolerance

• not necessarily sugarcane genes: model plants, other crops, extremopiles, wild relatives
Biotechnology and Genetic Modification

- insert sugarcane genes by conventional breeding;
- insert non-sugarcane genes by genetic modification
- an additional technology for cultivar development rather than a replacement
- at least 7 years from transformation to commercial release
Keynote address at 28th Conference of the ASSCT, Mackay, May 2006
Sugarcane: 2006

Conventional Sugarcane

Sugar

Ethanol

Food

Bagasse

Energy

Keynote address at 28th Conference of the ASSCT, Mackay, May 2006
Sugarcane: 2010

Conventional Sugarcane

Sugar

- Ethanol
- Food

Bagasse

- Cellulose
  - Ethanol
  - Pulp Products

- Lignin
  - Novel Products

Energy
Sugarcane: 2015

Conventional Sugarcane

Sugar

Ethanol

Food

Cellulose

Ethanol

Bagasse

Energy

High Biomass Cane

Lignin

Novel Products

Pulp Products
GM Sugarcane: 2010

GM Sugarcane

- Sugar
  - Ethanol
  - Food
- Bagasse
  - Energy

Modified Trait

Keynote address at 28th Conference of the ASSCT, Mackay, May 2006
GM Sugarcane: 2012

GM Sugarcane

- Modified Sugars
- Sugar
  - Ethanol
  - Food
- Bagasse
  - Energy

Modified Trait

Keynote address at 28th Conference of the ASSCT, Mackay, May 2006
GM Sugarcane: 2014

- Modified Sugars
- Sugar
  - Food
  - Cellulose
    - Ethanol
    - Pulp Products
- Bagasse
  - Lignin
    - Novel Products
- Biomaterials
  - Energy

Modified Trait
GM Sugarcane: 2016

GM Sugarcane

Climate change adapted cultivars

Modified Sugars

Sugar

Bagasse

Biomaterials

Modified Trait

Food

Cellulose

Lignin

Energy

Ethanol

Pulp Products

Novel Products

Ethanol

Tropical Crops and Biocommodities

Keynote address at 28th Conference of the ASSCT, Mackay, May 2006
Where can the Australian sugarcane industry be by 2020?

• a robust industry producing a wide range of bio-based products
  - sugar
  - molasses and cellulose derived ethanol
  - derivatised lignin products
  - new biomaterials
• a robust industry based on sustainable production
What should we be doing now to ensure we get there?

• the industry has available world class R&D capacity and facilities (QUT/SRI, UQ, BSES, CSIRO, CRC SIIB…)

• significant funding and R&D management is available through a wide range of sources including SRDC, SRL, industry, Federal and State schemes.

• pulling these resources together will deliver an Australian sugarcane industry that is highly internationally competitive: investment in and development and implementation of new technologies