Food, fuel or funding? – the global quandary

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Primary producers could have much to gain by moving towards production of energy from renewable biomass; the technology for which is closer than ever.

Opportunities to sell renewable energy and bio-fuels may yield new revenue streams for farmers and demand for biofuel feedstock could help improve prices for food commodities.

Farmers, we are told, have a responsibility to feed the world. The way the issue is presented by politicians, governments and global leaders implies that it is a moral issue for farmers.

The most recent manifestation of this is the 'food or fuel' debate generated by the demand for biofuels and the decision, by mainly US and Canadian growers at this stage, to use land suited for food production to produce biofuel feedstock; in many instances grain suitable for human or livestock consumption. This is at odds with the position held by some that it is unethical to use 'good food', or food-producing land, to produce fuel when there are millions of people starving.

This apparent conflict might be eased by developing technologies that enable motors to use alternative fuels sourced from, say, algae or waste products, rather than food-quality grains. While many would see this approach as helping address the 'injustice' of using food for fuel, the real issue is the ability of people to pay for food.

It costs money to produce food, so what is being done about global poverty? Enable the 'starving millions' to buy food and they would soon cease to be starving, because there is no doubt food production can be increased. The issue is not growing sufficient food, but problems with food distribution and an inability to pay.

Global hunger is not a problem farmers can fix as long as extreme disproportionate wealth distribution and the mechanisms perpetuating it remain in place. This is a global ethical issue that can be addressed only by world leaders, world banks, power brokers and tycoons, not farmers.

In the global picture farmers are mere pawns, because growing food is only a small part of the equation. The real challenges are getting the available food to where it is needed and making sure the potential recipients can pay for it.

Farmers can and will grow food as long as there is demand for it and they can receive a realistic price for their efforts and risk-taking. They cannot be reasonably expected to sell food for less than it costs to produce; just as no company with significant overheads can supply a product to consumers who cannot afford to pay more than the cost of production.

This perspective makes it clear farmers have no obligation to 'save the world' by producing more food. In fact, such an initiative would fail – is failing – because of the underlying issues around affordability and distribution.

Nor should producers feel guilty about using resources generated on their properties to address their energy needs as a means of staying in business and maintaining their capacity to produce food for those who can afford it.

Economics and humanity

People starve because of the inequitable distribution of wealth, not because there is not enough food to go around. In fact, According to Julian Cribb, Adjunct Professor of Science Communication at Sydney's University of Technology, for the first time in human history the world is throwing out more food than it consumes.

Despite this, the United Nations Food and Agriculture Organisation (FAO) estimates that almost one billion people suffer severe under-nourishment and six million children die of hunger every year.

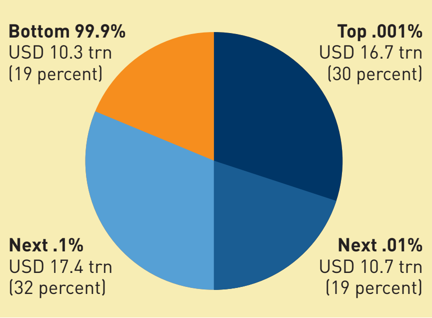

FIGURE 1:
THE GLOBAL DISTRIBUTION OF WEALTH, 2012.

Global data show conclusively that wealth assets are flowing to a minority of ultra-rich individuals at an alarming rate, with less than 1% of the global population owning more than 80% of the planet's total wealth in 2012 (Figure 1).

The problem of hunger is unlikely to be resolved in the foreseeable future, with financial tycoons, governments and economists continuing to promote growth and the number of people on the planet predicted to reach nine billion by 2050, although this population growth seems unlikely to translate into more people with the capacity to pay for food.

In the current world market structure, securing a profitable grain price increasingly depends on crop failure somewhere else in the world.

However, growing demand from wealthy countries and consumers for alternative products such as eco-fuels, fibres, bio-plastics, pharmaceuticals, conservation and carbon is creating new opportunities for farmers.

Wealthy people can afford a variety of products other than commodity foods, and agribusinesses that strategically diversify into production of premium food lines and non-food products for wealthy niche markets will gain advantages over farmers who produce only food commodities for masses of people who don't have the capacity to pay for them.

The production of non-food products for farmer self-sufficiency and for new markets also reduces supply to the food marketplace. This is likely to drive food commodity prices up; as evidenced in the 'corn to ethanol' scenario.

From a business perspective, activities that drive up the price of commodities have the potential to deliver much better returns to farmers. They also, through 'free market' mechanisms, help keep the poor hungry.

There is a humanitarian imperative to

ensure that all people have reasonable access to food, but this responsibility is invariably loaded onto farmers, who bear the brunt of assertions from politicians, urbanites and big business that they will need to find new ways to grow and deliver food to meet the challenge of feeding an ever-increasing world population.

The real issue is how politicians, urbanites and big business will ensure poor people can afford food when every fundamental of the 'free market economy' works against this outcome.

Farming system

Notwithstanding the need for fundamental change to the world system to enable the poor to obtain sufficient food, farmers continue to look for ways to reduce input costs, improve their efficiency and provide affordable food and other products.

Producing fuel or generating electricity from on-farm resources is one way of limiting production and transport costs.

Energy is an important farm input, and before the mechanisation of agriculture, farmers used part of their land to grow pasture and fodder for working animals such as horses and bullocks. This simple system of putting pasture aside for working animals functioned well for the farmers of the day and provided an alternative to buying fodder (fuel for animals) from merchants.

Today, buying inputs including fuel and electricity attracts all sorts of fees and charges. Selling commodities also attracts a range of costs including transport and margins for middlemen. Being self-sufficient in energy production would go a long way towards reducing input costs, provided the cost of on-farm energy production is less than the cost of buying it from a supplier that can take advantage of proprietary technologies and economies of scale.

The ability to make practical use of biofuel technologies on averaged-sized farms has so far been limited by cost, scale and labour requirements.

However, technology is advancing rapidly and renewable biomass energy solutions are forecast to become a significant component of Australia's renewable energy portfolio. There are several prospective options that should enable agribusinesses to adopt renewable energy and bio-fuel technologies in the not-so-distant future and may also create significant employment for regional communities during construction and on-going operation (Figure 2).

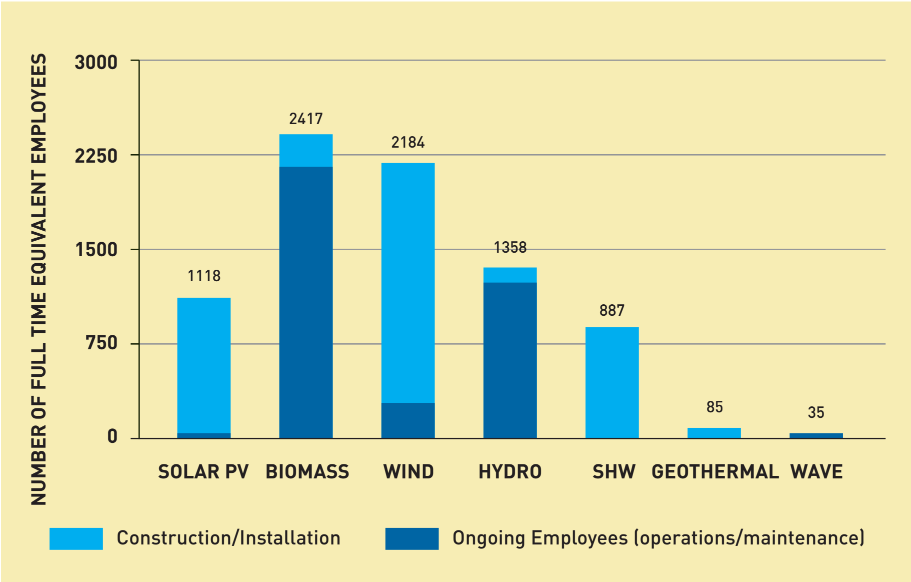

FIGURE 2: **CONSTRUCTION JOBS AND ONGOING EMPLOYMENT FOR AUSTRALIA'S MAIN RENEWABLE ENERGY INDUSTRIES. SOURCE: CLEAN ENERGY COUNCIL. CLEAN ENERGY AUSTRALIA REPORT, 2010.**

Agribusinesses, particularly in the animal manure management and biomass waste sectors, have demonstrated that self-sufficient bio-energy solutions to offset fossil fuel prices can pay dividends. Golden Cockerel, a large poultry producer in Queensland is currently constructing a biomass-to-energy plant that will have the capacity to supply 6,000 houses with electricity generated from chicken litter.

While diverting waste into energy is usually the most economically sound source of bio-energy, dedicated agricultural biomass crops may also be used profitably, depending on circumstances.

Using grain for biofuel production appears to put energy production in direct competition with food production, but there is potential to use less productive land to produce dedicated low-input biomass crops for fuel or energy production. These biomass crops can provide weed control and rotational benefits for the food production system and may be less susceptible to seasonal conditions such as frost or dry finishes that can adversely impact on the yield and quality of food crops.

Biofuel technologies

There are two 'generations' of biofuel technologies.

'First Generation' technologies use feedstock that could otherwise be used as a food commodity. Making ethanol from corn is a First Generation biofuel technology.

Technologies such as pyrolysis and gasification that can use waste biomass such as weeds, nut shells, cereal husks, residues such as chicken litter from animal production or non-food vegetation such as mallee, are described as Second Generation.

There are already policies in place to encourage the production and use of alternative transport fuels in Australia. The Energy Grants (Cleaner Fuels) Scheme provides 38.143 c/L for the domestic production of renewable diesel and there are concessional excise arrangements in place for gaseous fuels produced from biomass.

However, around the world, most of the renewable bio-energy plants using feedstocks such as corn, straw and manures are high-capacity stations owned by large companies or co-operatives and are usually priced well out of the reach of most individual farmers.

Biomass is also costly to transport, and in Australia the concept of a big central bio-energy plant receiving biomass from the surrounding catchment has significant challenges due to the relatively low intensity of biomass production.

Downsizing bio-energy production or developing mobile bio-energy plants would open the way for farm businesses to engage bio-energy, and several technology

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ideal for use in traditional engines designed for gasoline or diesel fuels (Figure 2, below left).

We often hear about new breakthroughs in the production of liquid bio-fuels, but in most cases the fuels produced from these processes need to be cleaned, modified, blended or upgraded if they are going to be used successfully in traditional IC engines, whether in vehicles or machinery.

Fuel upgrading processes are generally quite expensive and the inability to readily use bio-fuels produced on farm as direct substitutes for gasoline and diesel has meant many conceptual biomass-to-fuel projects have not been viable. This is not because the bio-fuels produced aren't any good but because they have characteristics that differ from gasoline and typical diesel fuels.

IC engines have very specific fuel requirements based on features such as the stroke and rev range of the engine.

The amount of time a fuel takes to fully combust is relative to the size of the fuel molecule, which determines how quickly oxygen from the air can combine with the carbon in the fuel. As an analogy, one kilo of wood chips will burn more quickly than a one kilo log of the same wood simply because the air can infiltrate around the chips.

A really fast-burning fuel like hydrogen would be completely expended in a conventional IC engine well before the piston has traversed a long-stroke cylinder, resulting in a loss of power and stalling at low revs. On the other hand, a heavy oil in a short-stroke engine would not fully combust during the relatively fast engine cycle, resulting in poor energy efficiency and lots of smoky emissions.

Many biofuels such as methane and ethanol burn too quickly for use in a standard IC engine, whereas the bio-oils produced from algae, chemical, thermo or catalytic processes can be too slow to burn.

A farm pursuing energy self-sufficiency might produce a range of bioenergy fuels, such as quick-burning methane, from a piggery, and a slow-burning vegetable oil from canola, but it is not practical to have a different type of IC engine for every possible biofuel opportunity.

FIGURE 3: **THE CYCLONE MARK V IS A REVOLUTIONARY 21ST CENTURY STEAM ENGINE.**

An engine with the flexibility to efficiently use a range of fuels without the need for any modification opens the window to simple, farm-based bio-fuel production or being able to buy the cheapest fuel available in the retail market at the time.

The Cyclone 'all-fuel' engine is such an engine (Figure 3, left).

Extensive due diligence has been performed on the Cyclone engine by Raytheon Integrated Defence Systems for use in long-range unmanned submarines and the Cyclone will be used in an attempt to set a new 'in class' 320 km/h land speed record at Cape Canaveral with two-time NHRA racing driving champion Nelson Hoyos at the wheel.

SANTFA will seek to test the Cyclone Mark V engine in Australian agricultural applications during 2013. Anyone interested should contact carbon@santfa.com.au

Cyclone Mark V 'all-fuel engine' specifications

Max power @ 3,600 rpm	100 HP (75kW)
Max torque @ 1 rpm	1050 Nm
Thermal efficiency	33% (including fuel combustor)
Dimensions	66 x 66 x 60 cm (incl. combustor and condenser)
Dry weight	57kg (142 kg incl. combustor and condenser)
Lubrication	Closed loop deionised water
Required BTU @ 75 kW (full)	835,000/hr (approx. 21 L/hr petrol)
Required BTU @ 22 kW (cruise)	250,500/hr (approx. 6.3 L/hr petrol)

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companies are preparing to commercialise farm-scale or mobile units for bio-energy production.

Generating heat for use at a feed mill or processing plant is the cheapest and easiest form of bioenergy to produce. Making electricity is more complicated and more costly in terms of capital and operating costs, but it is nevertheless achievable with current technology.

The problem with producing electricity on-farm is that unless there is significant demand at the site for the power generated, the economics do not always stack up because electricity is difficult to store or transport. Selling electricity into the grid as it is produced has not usually paid enough to justify the capital of an electric bio-energy plant.

In cropping, and many other farming systems, producing transportable liquid or gaseous fuels to offset fossil fuel costs appears the most useful biofuel option.

Gaseous and liquid fuels can be stored and transported, so can be marketed more easily than electricity, but with current technology are harder to make, especially from Second Generation feedstocks.

US company Cool Planet Biofuels, which is backed by some of the biggest companies in the world including British Petroleum (BP), General Electric (GE) and Google, is developing a community-scale second-generation liquid biofuel plant that is scheduled for commercial release within the next three years. The plant will have a capacity of 4.5 million litres of a fuel a year, with the payback period for the purchase price calculated to be only two to three years.

However, 'fuels ain't fuels'. Many liquid biofuels have combustion characteristics quite different from those of petrol or diesel and so are not well suited to use in conventional internal combustion engines.

This has prompted development of the Cyclone 'all-fuel' engine that will run efficiently on a range of fuels with quite different combustion characteristics.