

## Arcus Insight

### Industry Outlook Report

#### Major challenge facing the Bio Fuels sector

Biofuels offer a number of benefits over conventional mineral fuels, which make them attractive as alternatives for the transport sector. The benefits include greenhouse gas reductions which will contribute to domestic and international targets, potential air quality benefits (albeit limited), the diversification of the fuel sector and an additional market for agricultural products. Some of the key challenges faced by the industry include the need to access sufficient capital to carry out their recruitment and business development plans (to attract and retain the best and brightest minds, and to drive the development of their products and services beyond the early stages of R&D and testing); and overcoming the shortage of locally available skilled and experienced personnel.

The other challenges around leading will also be addressed. We know that many companies are founded and run by scientific experts, entrepreneurial in spirit but are not necessarily experienced in managing and growing a business. Corporate skills must be attracted to the sector. To fulfill the promise of their innovative visions and bring new, globally competitive biotechnology products and services to market, Canadian companies must have the means to attract, develop and retain skilled, experienced workers. It is those workers and their skills that will subsequently draw what the investment companies require. HR needs capital; capital is attracted by strong HR; and HR is ultimately the engine of progress in any company.

Several international papers identify liquid biofuels and hydrogen as the most promising candidates for tomorrow's low carbon transport fuels. In the longer term, significant use of biofuels could offer large carbon savings. Biofuels also have the advantage that, unlike other potential future low-carbon transport fuels such as hydrogen, they can be used as direct substitutes for conventional fuels without the need for new vehicles or refuelling infrastructures. They can be used neat in some circumstances, but are more commonly used as a blend (usually up to 5 percent) with conventional fossil fuels.

#### Environmental Performance

Whilst biofuels clearly offer a number of environmental benefits, the possible expansion of biomass production could also have other effects that need to be taken into account. These include possible impacts on land-use, landscape, biodiversity and soil structure.

Research to date into some of these impacts has shown that increased biofuel production from a broad mix of arable crop feedstocks would have a broadly neutral effect on the farmed environment. Direct replacement of cereal crops with oilseed rape would have no significant effect. However, replacement of spring grown break crops by an expanding winter oilseed rape or cereal area could have a negative effect on crops diversity and farmland birds. Growing biofuel crops on un-cropped land or replacement of natural-regeneration set-aside with biofuel crops would, on balance, be environmentally detrimental due to increased use of nitrogen and pesticide use and reduction in biodiversity. Environmental damage could be minimized by avoiding large-scale block-cropping and introducing a percentage of non-crops habitat, for example on headlands. As technology improves and sources of feedstocks widens for bioethanol production there would be no significant effect on the farmed environment.

#### Future developments

The processing efficiency of conventional biofuels is unlikely to change radically over future years as this is a technology that has been in place for a number of decades, but it is reasonable to expect incremental improvements in efficiency (e.g. 1-5 percent per annum). Farmers in some markets have suggested that crop yields could be considerably increased through improved farming methods and selective breeding. This could potentially reduce the cost advantage of imports and make domestic production competitive. There are also a number of developments on the processing side that offer the possibility of reducing costs and/or improving environmental benefits.

For example, a number of oil majors are currently exploring the possible use of biomaterials (in the short term rapeseed and other vegetable oils, in the medium to long term other forms of biomaterial)

in conventional oil refineries. The product of this process would be conventional diesel or petrol - the only difference would be that the inputs to the process would be a mixture of mineral and bio-products.

Potentially, this could have a number of advantages. It could give a lot of the benefits of conventionally processed biofuels without the cost and complication of separate fuel blending and distribution arrangements. It would avoid the current need for vehicles to be adapted to run safely on higher blends of biofuels; and it would avoid the possible fuel quality concerns associated with small-scale independent production. It would also allow considerable economies of scale.

However, there is work to be done on assessing the viability of this option, including understanding the carbon benefits and how they compare with conventional methods. In parallel, some governments are investigating how it might make fiscal arrangements to deal with this production technology should it prove viable. In the longer term there are prospects for future technological developments to allow the production of cheaper biofuels from low-grade source material including grasses, straws, wood and even organic waste. There is considerable interest in these new technologies, and much exploratory work has been undertaken in different parts of the world.

For example, Shell has made a significant investment in Logen, a company that is using an enzyme based process to break down low value ligno-cellulosic feedstocks (such as straw) to produce bioethanol. Gasification is a further promising technology that could potentially produce biofuels from a wide variety of wastes - which could have the double benefit of low cost inputs and creating a market for more waste products.

### Appraisal of Policy and Financing Gaps

The main support for biofuels has, to date, been through fuel duty incentives in most countries in Europe. They are also exploring input taxation methods for biofuels that could enable the mainstreaming of production through existing oil refineries, should this emerging technology prove viable. Governments in some countries are also exploring the possibility of allowing enhanced capital allowances for production facilities. For example, as a result of Government policy, the UK market is continuing to grow. With the current measures in place, the UK has achieved as much as 12 million litres a month. Below is a sample illustration of land involved in supplying RTFO for 2010 in the UK (source: National Farmers' Union)

	Petrol	Diesel
Estimated 2010 Demand	19 million tons	22.5 million tons
5% by volume (RTFO)	1.2 billion litres of bioethanol	1.35 billion litres of biodiesel
Feedstock Required	3 million tons of wheat	2.7 million tons of OSR
Land Involved	375,000 ha (8t/ha)	840,000 ha (3.2t/ha)

However, it is not yet certain to what extent these measures will enable UK industry to grow beyond production from limited supplies of WVO, along with some imports which can be sold at a premium. The biofuels industry has consistently made the case that increased Government support would be required to make production from high value crops economic - either through duty incentives of the order of 25-30 pence per litre, or through some form of regulatory obligation.

### Comparison with Other Carbon Abatement Options

As a result of the high production cost differences between fossil and biomass derived fuel, biofuels currently present a relatively expensive method of carbon abatement when compared with options in other sectors. It is, of course, possible that the costs of biofuel production may fall in future, particularly if new technologies come on-stream or if there are economies of scale resulting from increased production. But the same also applies to carbon saving options in other sectors. Among low carbon generation technologies, onshore wind, waste and landfill gas and offshore wind were considered to be the lowest cost. These were followed by nuclear, marine technologies, energy

crops for electricity power generation and carbon capture and storage. The transport options considered, which included hydrogen, were among the more expensive options, exceeded only by photovoltaics. However, within the transport sector, biofuels presented one of the most cost-effective options.

### Policy options for promoting biofuels

Most EU governments are already supporting biofuels by means of fuel duty incentives. There are a number of ways in which further support to biofuels could be offered in order to deliver future targets. The two major options are through either fuel duty or through some form of regulatory mandate or obligation. There are a number of other support mechanisms that could contribute to the policy framework, and these are also discussed briefly, but they do not of themselves appear adequate to bridge the financing gap.

### Fuel Duty

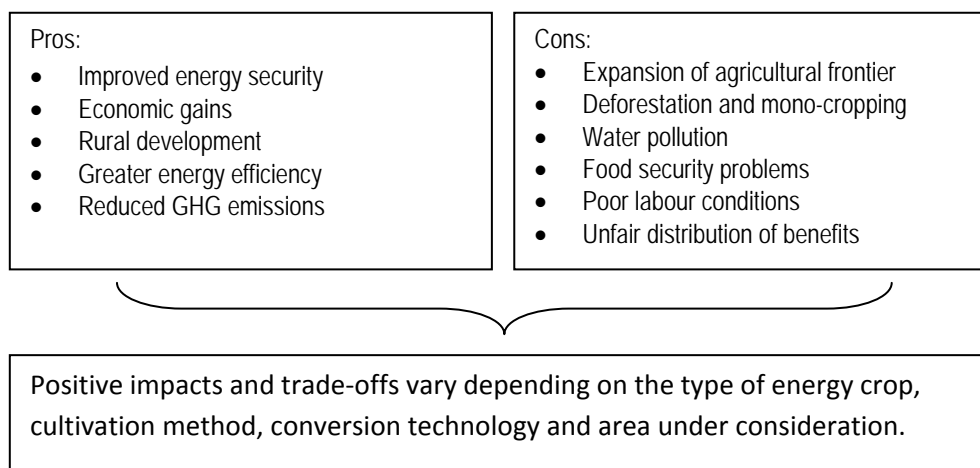
This is perhaps the most widely used method of incentivisation, and many other countries have taken this option. When set at an appropriate level, experience has shown (e.g. introduction of low-sulphur fuel) that the industry can be very responsive to this economic signal in introducing new fuels. A substantial increase in the fuel duty incentive per litre could certainly be expected to boost sales of biofuels, and could have a rapid impact.

One disadvantage of this approach is that the Government would have little certainty over the amount of its revenue losses to supporting biofuels - which could potentially be very high. In addition, the fuel duty regime is fairly indiscriminate in terms of the source or quality of the fuel; imports are as eligible for the duty incentive as domestically produced fuels; and fuels produced to poor environmental standards are just as eligible as those produced to a high standard (provided they meet the necessary fiscal specification). In the shorter-term in particular, higher levels of fuel duty differentials could simply result in cheaper imports.

One option the Government could explore with a view to reducing the long-term costs would be to announce a period of higher duty incentives followed by a period of gradually lowering incentives - a 'stepped approach'. This could potentially provide a helpful boost to the sector, whilst limiting the cost.

### Relations between bio-energy and sustainable development

This section explores the relations between bio-energy and sustainable development. Our research indicates the relations are varied and complex:



## Air quality

In LDCs, household air pollution is a major killer of women and children. Crop-based biofuels can substitute to traditional forms of fuels usually used in the poorest countries, such as charcoal, fuel wood and paraffin. Intensive biomass production can harm air quality. In Brazil burning of sugarcane fields prior harvest contaminates Sao Paulo. In Indonesia, clearing fields for large-scale palm oil plantations provoke regional haze.

## Impact on production systems

Intensified competition for land leads to intensified pressure on environment. Monocropping and biodiversity loss may occur due to large scale cultivation. Water consumption and reduced water flows may be affected. Water quality due to agrochemicals and sediment may degrade. There is also land degradation, due to monoculture and use of agrochemicals. Or there may be a positive side of more environment friendly crops and use of less fertile/unproductive lands. Some of these problems may be more relevant to less developed countries. But the lessons learnt can help Canada avoid some costly mistakes in other countries. The answer depends on the type of crop, cultivation system, soil types, available technologies and water availability. Policies will play a key role in orienting the impact of future biofuels and bio-energy crops on agriculture.

## Costs

Large-scale development of biofuels may have higher economic costs compared to conventional fuels but economic costs differ according to the type of biofuel, the country of provenance and the technology used. For example, tropical crops are competitive for bioethanol production but high levels of agricultural support in ICs may undermine the benefits biofuels can provide for most cost-efficient developing countries. Moreover alternative fuels traded in large quantities could drive down oil prices in the medium to long term. So, cost differentials need to be addressed through policy incentives (e.g. lower taxes), market incentives (carbon markets) and technology improvements

## Social Issues

### 1. Fuel versus Food

Thesis 1: Large-scale biofuel production will lead to food security problems, especially in the poorest developing countries. Examples include:

- In China conversion of corn production induces soaring pork meat prices
- Malaysia and Indonesia set 40% of oil palm plantation for biofuel production
- Philippines government acknowledges pressure of biofuel on food

Thesis 2:

Large-scale production of biofuels does not imply food security tradeoffs. Arguments include:

- Enough land available to accommodate bio-energy production because biofuels will not totally displace oil-based fuel.
- Possible synergies between fuel and food production as some crops can be grown on very degraded land too marginal for food crops and can even promote land restoration
- Food shortages and famine are related more to poor distribution, conflicts, shortage of jobs and disposable income to buy food than to agricultural production

Large-scale production of biofuels does not imply food security tradeoffs. Fuel will essentially compete with food when:

- food crops are used for fuel production
- fertile lands are grown with fuel crops
- value added is not locally distributed

### 2. Employment

Bio-energy production has a positive impact on employment and livelihoods, when cultivation involves small-scale farmers and conversion takes place nearby the sources of biomass in rural areas.

In China, the liquid biofuels programme is expected to create 9 million jobs leading to significant increases in income generation and rural development. Most bio-ethanol-related jobs in Brazil involve

low skilled and poor workers in rural areas and the quality of the jobs is better because of lower seasonality and increasing wages over time.

**But there are risks:**

- Tariff escalation in ICs encourages export of raw or unprocessed material
- Large scale cultivation (soya, oil palm, jatropha) undermine employment effect
- Most profitable economic models may discourage pro-development practices

**Equity**

The possibility of international bio-energy value chains being controlled by upper segments agents raise the question of *equity* in the whole organizing process. For example, Cargill and ADM control about 65 per cent of the global grain trade, will it happen to the trade of biofuels feedstocks? Production process can easily be separated from conversion and transport process, extracting most of the value added off production. Potential social benefits of bio-energy depend on the pro-poor/small farmer nature of the technology needed to produce it and to the technology used to convert it. Bio-fuel is but one option in using biomass and producing bio-energy.

**Rural community development, regional issues and biofuels**

Biofuels are currently produced almost entirely from grains and oilseeds, which has generally meant corn and soybeans in Canada. Construction and investment in ethanol refineries and biodiesel plants have skyrocketed in the last few years, resulting in over 5 billion gallons of North American production in 2006, with another 3–6 billion gallons of new and planned construction and expansion.<sup>1</sup> Concern is mounting about the impact of biofuel production on the environment and existing agriculture markets that supply the industry. The limitations of current feedstocks to meet our fuel needs are clear: even if we turned the entire harvested North American corn crop into ethanol, it would equal less than 15 percent of North America’s current annual vehicle fuel use.

At the regional level, there are differences to be noted. It would seem those differences have to do with the degree of biotechnology activity (i.e., pace and volume of growth in companies and the associated HR challenges) and with stage of development: companies more heavily involved in R&D need skills and resources to mature and commercialize; companies already engaged in manufacturing and production require the means to penetrate the market and capitalize on opportunities while negotiating regulatory intricacies.

With the recent growth in these key areas, job seekers wanting to enter these sub-sectors need to understand employers’ requirements. Employers need skilled talent to strengthen their capacity. Our best practice approach on this project will help identify these requirements and provide a comprehensive understanding of the industry and how its development impacts human resource considerations for Canada.