Sustainable liquid biofuels in New Zealand

Can sustainability standards help distinguish
the good from the bad?

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Thesis

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Abstract

Concerns surrounding the environmental and social impacts of biofuel production have led to the rapid development of biofuel sustainability assessment schemes internationally. The New Zealand government is currently developing a voluntary biofuel sustainability reporting scheme. This thesis assesses the extent to which a sustainability standard could support the domestic biofuels industry, and avoid negative environmental and social impacts associated with biofuel production. It describes the current scope of the domestic biofuel industry, discusses relevant environmental and social concerns relating to biofuel production, and reviews international literature surrounding sustainable biofuel initiatives. From a study of the literature New Zealand biofuels appear more sustainable than most, although direct and indirect land-use change should be included for feedstocks from energy crops. Impacts vary across feedstocks and production methods, and each biofuel must be considered in its own merit. Qualitative semi-structured interviews were undertaken with key stakeholders from industry, relevant government agencies, non-governmental organisations, and biofuel experts to discuss the potential for a domestic biofuels sustainability standard. The majority of stakeholders interviewed supported the development of a government-led sustainability standard, which would include principles addressing greenhouse gas emissions, food security and biodiversity loss. There is good evidence to support the movement towards mandatory sustainability requirements, as soon as this is feasible. In the future, biofuels should be supported by technology-neutral policies (such as carbon-pricing) which reward their benefits, rather than indiscriminately promoting biofuels. The development of enforceable sustainability standards is crucial if biofuels are to contribute to a future low-carbon transport sector in New Zealand.

Keywords: biofuel production, sustainability standards, greenhouse gas emissions, biodiversity loss, food security

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Acronyms

BANZ	Bioenergy Association of New Zealand
BSO	Biofuels Sales Obligation (NZ)
CEN	European Committee for Standardization
C	Consultant participant
CO ₂	Carbon dioxide
DLUC	Direct land-use change
EECA	Energy Efficiency and Conservation Authority (NZ)
ERoEI	Energy Returned on Energy Invested
ETS	Emissions Trading Scheme
EU	European Union
FME	Fatty acid Methyl Ester
FAO	Food and Agriculture Organisation of the United Nations
F.T	Fischer Tropsch
GATT	General Agreement on Trade and Tariffs
Gg CO ₂ -e	Gigagram (1,000 tonnes) of Carbon dioxide equivalent
GHG	Greenhouse gas
GM	Genetic Modification
Ha	Hectare
I	Industry participant
ILUC	Indirect land-use change
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standards Organization
LCA	Lifecycle Assessment
LCFS	Low Carbon Fuel Standard (California)
LFTB	Liquid Fuels Trust Board
MED	Ministry of Economic Development (NZ)
MfE	Ministry for the Environment (NZ)
MoT	Ministry of Transport (NZ)
MoRST	Ministry of Research, Science and Technology (NZ)
NGO	Non-governmental organisation/participant
N ₂ O	Nitrous oxide
NZEECS	New Zealand Energy Efficiency and Conservation Strategy
NZES	New Zealand Energy Strategy
OECD	Organisation for Economic Cooperation and Development

PJ	Petajoules (10^{15} joules)
RED	Renewable Energy Directive (EU)
RFA	Renewable Fuels Agency (UK)
RFS	Renewable Fuel Standard (US)
RFTO	Renewable Fuels Transport Obligation (UK)
RSB	Roundtable on Sustainable Biofuels
SBN	Sustainable Business Network (NZ)
SKM	Sinclair Knight Merz
TBT	Technical Barriers to Trade
UCO	Used Cooking Oil
UK	United Kingdom
UNEP	United Nations Environment Programme
WTO	World Trade Organisation

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Introduction

1.1 Context of the research

When this thesis began in November 2008, the New Zealand government had recently introduced a Biofuels Sales Obligation (BSO), which required oil companies to introduce biofuels into the transport fuel mix. The primary objective of the obligation was to contribute to climate change mitigation strategies. When the Biofuel Bill was first introduced, concerns were voiced that the legislation did not address whether biofuels would come from sustainable sources (Oliver, 2008). The Parliamentary Commissioner for the Environment made a submission in which she called for the Bill to be scrapped, emphasizing that to meet the obligation would likely require importation from countries where it would be difficult to ensure supply of sustainable biofuels (Wright, 2008). While the Bill contained a provision for an Order of Council which could later establish environmental standards for the biofuels which were sold, many submitters wanted the legislation to include sustainability criteria. An amendment was made to include a requirement for establishing mandatory sustainability requirements around greenhouse gas (GHG) reductions, protection of biodiversity and food security. The Ministry of Economic Development (MED) began work on developing these, with the aim that they would be in place by June 2009 (MED, 2008).

With the change of government following the elections in December 2008, the BSO was repealed, and later replaced with a Biodiesel Grants Scheme, which provided a tax incentive to domestic producers. One key reason given for the repeal was that in the absence of workable and practical sustainability standards, the obligation might have caused oil companies to import biofuels from unsustainable sources (Brownlee, 2009; N. Smith, 2009). Work on developing biofuel sustainability standards was transferred to the Energy Efficiency and Conservation Authority (EECA), who continued developing a voluntary reporting scheme, due to be released in December 2009. In June 2009 the Sustainable Biofuel Bill was put forward by a Private Member of Parliament. This Bill intended to ensure that all biofuels used in New Zealand would meet the sustainability principles present in the repealed BSO legislation. At the time of writing, this bill had passed its First Reading before the House, and public submissions were to be heard before the Local Government and Environment Select Committee.

Biofuels have recently become a major global policy issue, primarily driven by attempts to increase energy security, combat climate change and stimulate domestic agricultural development (Londo & Deurwaarder, 2007; The Royal Society of London, 2008). As a result of these issues, many countries view biofuels as having a key role to play in the transition away from fossil fuels. Numerous governments are implementing domestic policies to encourage biofuel production, such as regulations mandating blending percentages or exemptions from fuel taxes (REN21, 2009; Worldwatch Institute, 2007). Current biofuel production is concentrated in Brazil, the United States, and the European Union (EU) (OECD, 2008; Taylor, 2007). Table 1.1 shows the ten leading biofuel producing countries. Global production is growing rapidly, and is expected to quadruple by 2020 (Dufey, 2006). In 2005, global biofuel production was 0.8 EJ, or approximately 1% of total road transport fuel consumption. One estimate suggests that by 2050, conventional biofuel production could rise to 11% of total demand for liquid transport fuels (Doornbosch & Steenblik, 2007).

Table 1.1 Top 10 Countries for Biofuel Production, plus EU, 2008

Country	Fuel ethanol	Biodiesel
	(Billion litres)	
1. United States	34	2.0
2. Brazil	27	1.2
3. France	1.2	1.6
4. Germany	0.5	2.2
5. China	1.9	0.1
6. Argentina	-	1.2
7. Canada	0.9	0.1
8. Spain	0.4	0.3
9. Thailand	0.3	0.4
10. Columbia	0.3	0.2
EU Total	2.8	8
World Total	67	12

Note: Ethanol numbers are for fuel ethanol only. Table ranking is by total biofuels.

U.S. and Brazil ethanol figures rounded to nearest billion litres. *Source:* (REN21, 2009)

There has been much recent debate internationally regarding the environmental and social impacts of biofuels. Biofuels expansion has gained a bad reputation in the media for causing destruction of rainforests, reducing biodiversity, exploiting the labour and land rights of the poor and contributing to the recent escalation in food prices

(Chakraborty, 2008; Ewing, 2008; Grunwald, 2008; Monbiot, 2007; Walsh, 2008).

There is also concern that biofuels are failing to achieve policy objectives, such as reduce GHG emissions. Production of some biofuels has been shown to result in an *increase* in GHG emissions, particularly once emissions caused by land-use change are included (Fargione, Hill, Tilman, Polasky, & Hawthorne, 2008; Searchinger et al., 2008; Zah, Böni, Gauch, Hirschler, & Lehmann, 2007). Many international critics believe biofuel policies may cause more harm than good, by encouraging environmentally and socially destructive production practices (Bailey, 2008; Doornbosch & Steenblik, 2007; Monbiot, 2007). However, biofuels can be produced from a range of feedstocks, and the specific biofuels selected, and where and how they are grown will determine their environmental and social impacts. Advanced technologies hold potential for producing biofuels which: do not require arable land or as many inputs; utilise waste-feedstocks; and may produce significantly higher yields (Sims, Taylor, Saddler, & Mabee, 2008).

There is currently a lack of distinction in the market between ‘good’ and ‘bad’ biofuels. Concerns over the sustainability of biofuels have only become a policy issue in the past decade, leading to the rapid introduction of certification and monitoring systems. Multiple governments and organizations are developing, or have recently developed, criteria and indicators that may be useful for understanding how biofuel production and use affect sustainability and the environment (Zarrilli, 2008). However, the majority of these schemes are in the early stages of development, and no clear consensus has yet emerged around how to ensure sustainability of production (Van Dam et al., 2008). Developing robust sustainability requirements could allow consumers and suppliers to be able to distinguish between environmentally destructive or beneficial biofuels. Poor biofuels would be exposed as unsustainable, while sustainable producers should benefit. Legislation for sustainability is a new, rapidly evolving area, with for example the EU currently in the process of developing bioenergy sustainability standards. The New Zealand government is also developing a voluntary sustainability reporting scheme for the domestic biofuel industry, indicating the political significance of this issue. Yet little is known about whether such a scheme is desired by industry and NGO stakeholders, which criteria are relevant, and what form the scheme should take. There has also been little opportunity to explore how the government intends to implement the scheme or the affect this will have on a burgeoning domestic industry.

1.2 Background on biofuel production process

The term ‘biofuel’ can refer to any fuel derived from biomass. Biofuels are considered renewable because the biomass can be grown and replaced within a short timescale, unlike conventional fossil fuels which are unable to be replaced within human timescales. The main biofuels on the market today are: bioethanol, biodiesel and biomethane (Sims et al., 2008). This study focuses on the liquid biofuels, biodiesel and bioethanol, since these are the most common forms of biofuels, and can be readily used as a fossil fuel substitute. Both fuels can be used either in their pure form or blended with petroleum products, and can be used in conventional combustion engines with little modification¹. Although biofuels can also be used for stationary applications, such as in boiler and generators, this thesis concentrates on liquid transport biofuels for road transport (rather than aviation). For the rest of this document, the term ‘biofuel’ is used to refer to biodiesel and bioethanol as road transport fuels.

Biofuels can be produced from a range of feedstocks. First generation biofuels are produced by proven technology from conventional feedstocks such as agricultural crops, vegetable oils or animal fats. Second generation biofuels generally refer to advanced technologies still under development (Sims et al., 2008).

1.2.1 Bioethanol

Bioethanol (or ethanol) is by far the most widely used biofuel, accounting for 94% of global biofuel production (Dufey, 2007). Ethanol is commonly made by fermenting sugar feedstocks, such as sugar beets or sugar cane. Starch crops like corn, wheat and other cereals can also be used, but first require conversion into sugar, and then ethanol. This grain-to-ethanol process can produce a useful by-product of protein-rich animal feed, although this depends on the feedstock. The majority of plant biomass however, is not sugars or starch, but cellulose, hemi-cellulose and lignin. While lignin cannot be converted to sugars, both cellulose and hemi-cellulose can, but the process is difficult and expensive (Taylor, 2007). Research is currently focused on developing processes which would allow a low-cost, efficient way to convert cellulosic material into ethanol. While current production of cellulosic ethanol is small, significant research and

¹ Since biomethane is a gas it requires different storage and engine technology in order to act as a transport fuel substitute.

development is occurring in this area, with the first demonstration plants currently being built (Sims et al., 2008). The use of cellulosic material would allow for utilisation of a wider range of feedstocks including waste materials like crop residues, forestry wastes, municipal solid waste and recycled paper, as well as purpose-grown grasses and short rotation forestry.

1.2.2 Biodiesel

Biodiesel is typically produced by transesterification - a chemical process which converts a vegetable oil or animal fat into a Fatty acid Methyl Ester (FME). FME biodiesel can be produced from a range of feedstocks including vegetable oils (such as sunflower, soy, or rapeseed oil), animal fat and used cooking oil (UCO). The process involves reacting filtered oil with methanol and a catalyst (usually Potassium Hydroxide). The oil molecules are broken up and re-form as esters and glycerol, which are then split and put through a purification process. The primary end products are esters (biodiesel) and glycerine. If the biodiesel is produced from an oilseed, the residual oil matter can also be made into a protein rich 'seed cake', which can be utilised as animal feed (Taylor, 2007).

1.2.3 Advanced technologies

There are a number of other advanced production pathways under development, such as gasification of biomass-to-liquid synfuel; hydrogenation of vegetable oils; biomass pyrolysis; and the harvesting of micro-algae for biodiesel (RFA, 2008). However, many of these technologies are only at the research and development stage, and are unproven at a commercial level (Sims et al., 2008).

1.3 Contribution of this research

1.3.1 Research purpose

This study was driven by concern with the bad publicity surrounding biofuels, and a suspicion that the variation amongst feedstocks and production practices was largely being ignored. Formulation of the research objectives took place during the record high food prices of 2008, which sparked riots in several developing countries. Biofuels were implicated as one of the main causal factors contributing to escalating world food prices -despite the scale of their impact being unclear (Elliott, 2008; FAO, 2008a; World Bank, 2008a), and biofuel policies were coming under increasing levels of scrutiny. Many consumers were becoming concerned about the impacts of biofuel production, and were unsure whether to support them (SKM, 2008a). This research explores how a sustainability standard might alleviate some of these concerns, and prevent New Zealand from producing unsustainable biofuels. Such a standard could also provide more transparency to the domestic industry, and provide consumers with information which could encourage their choice of ethical biofuels.

The purpose of this thesis is to provide a voice to stakeholders which will hopefully speed the development of implementable sustainability standards in New Zealand. The research seeks to explore the perspectives of government, environmentalists and industry, with the hope that a consensus may emerge which will enable biofuel production to proceed in a truly sustainable way.

1.3.2 Aim of this thesis

This thesis seeks to answer the following question:

To what extent could a sustainability standard support the New Zealand domestic biofuels industry, while avoiding negative environmental and social impacts associated with biofuel production?

The objectives of the research are to;

1. Determine the current scope of biofuel production in New Zealand and describe the current policy framework;
2. Undertake a review to determine the sustainability impacts of New Zealand biofuels in comparison with imported biofuels;
3. Undertake a review of existing international biofuel sustainability standards; and
4. Examine the views of key stakeholders in the New Zealand biofuel sector concerning a biofuel sustainability standard. This will focus on;
 - a) The extent to which a sustainability standard is desired by key domestic stakeholders;
 - b) Stakeholder views on sustainability criteria most appropriate to the New Zealand biofuels industry;
 - c) Possible strategies for the implementation of a sustainability standard; and
 - d) Stakeholder views on what broader policy solutions could be implemented to encourage a sustainable biofuel industry in New Zealand.

1.3.3 Process for examining research questions

The thesis is organised as follows:

- Chapter Two details the methodology selected to explore each objective
- Chapter Three reviews the current domestic context, outlining the scope of the domestic industry and policy context
- Chapter Four provides an overview of the main social and environmental concerns surrounding the impacts of biofuels, alongside an assessment of their relevance to a New Zealand industry
- Chapter Five presents the results of a literature review which outlines international best practice pertaining to biofuel sustainability standards
- Chapter Six presents the results of interviews conducted with key individuals in the biofuel industry, environmental NGO sector and government to discuss the development of a domestic biofuel sustainability standard. Interview material was analysed using grounded theory techniques, observing the emergence of common opinions and themes
- Chapter Seven provides an analysis and discussion of the empirical and literature-based results.

1.3.4 Scope

Policy issues relating to biofuels is an emerging area, with many questions to be answered. Much of the international debate covers topics outside the scope of this research, such as the economic competitiveness of biofuels; the relevance of biofuels to the aviation sector; and the technical feasibility and yields of various biofuel feedstocks. This thesis focuses only on supply side issues relating to domestic production of biofuels for liquid transport fuels for road vehicles. While demand side issues are equally important for a sustainable industry, they are beyond the scope of this study.

Chapter 2

Methodology

This chapter describes the methodology used for author positionality, disciplinary context, and research design. It then presents the specific methods selected to address each objective, and the limitations of the study.

2.1 Methodological Approach

2.1.1 Positionality and Disciplinary context

This research was motivated out of concern for the increasing controversy surrounding the environmental and social impacts of biofuel production, and the need for production methods to be transparent to existing and future biofuel consumers. An assumption underlying this research is that a sustainability standard could prevent unsustainable biofuel production, provide information to consumers, and act as an effective marketing tool for sustainable biofuel producers. While it is recognised that research cannot be fully value-free, there has been an attempt to minimise author bias in the representation of stakeholder views and the subsequent use of those views to build a set of recommendations that benefit from the expertise of key stakeholders in the biofuels sector.

The study has taken a pragmatic approach to a specific policy issue, and is primarily concerned with exploring the problem, and potential of a proposed solution. The topics covered in this thesis span three broad disciplines: environmental science, the social sciences, and environmental policy. The sustainability of biofuels is a pertinent issue in the environmental science arena, which discusses relevant issues such as climate change and energy security, renewable energy technologies, and their impacts on the environment. The main social science concerns addressed in this study include the effects of biofuel expansion on the poor, and as a driver of food insecurity. Social science research strategies are also used in the application of grounded theory, and representation of stakeholder perspectives through semi-structured qualitative interviews. Lastly, the discipline of environmental policy is drawn upon to examine the policy drivers behind biofuels, to compare the best international practice surrounding

policy approaches to securing sustainable biofuels, and to assess broader policy options for encouraging a sustainable industry.

2.1.2 Research design

This study employs a qualitative empirical research strategy to build an understanding of the perspectives and context in which the research is conducted. This is appropriate to the objectives of this study, as it allows for the collection of a rich data set arising from the experience and expertise of key stakeholders. A grounded theory approach is used, which is by far the most widely used framework for analysing qualitative data, and suits the research questions of this thesis (Bryman, 2004). The inductive nature of grounded theory allows for an exploratory approach, as theory is generated and enhanced through the collection of data. Grounded theory is also recursive, meaning that data collection and analysis proceed in tandem (ibid.).

2.2 Research Process

2.2.1 Method for Objective One: Scope of Biofuel Production in New Zealand

Objective One: Determine the current scope of biofuel production in New Zealand and describe the current policy framework (Chapter 3)

- How much biofuel is currently being produced in New Zealand, and from which feedstocks?
- What are the main potential feedstocks of a future domestic industry?
- What is the biofuel policy context in New Zealand?

To meet Objective One, a literature review was undertaken to assess the scope of the New Zealand biofuel industry and domestic policy context. The results of this research are presented in Chapter 3, which outlines the main feedstocks being used and researched in New Zealand, and gives a brief history of the New Zealand biofuels industry, with a focus on recent events in policy development. Material for this section came principally from a review of government and private agency publications, domestic newspapers, and the Bioenergy Association of New Zealand (BANZ) website,

although some information came from personal communication with research participants.

2.2.2 Method for Objective Two: Sustainability of Domestic Biofuels

Objective Two: Undertake a review to determine the sustainability impacts of New Zealand biofuels in comparison with imported biofuels (Chapter 4)

- What are the international sustainability concerns surrounding biofuel production?
- Are these concerns relevant to New Zealand biofuel production?
- Which New Zealand biofuels appear the most sustainable?

A literature review to address Objective Two is presented in Chapter 4, which examines the environmental and social impacts associated with biofuel production internationally, and those relevant to a New Zealand industry. Material for this section came from relevant academic journals, publications by foreign government departments and international bioenergy related organisations, alongside domestic government reports.

2.2.3 Method for Objective Three: International Biofuel Standards

Objective Three: Undertake a review of existing international biofuel sustainability standards (Chapter 5)

- What is the scope of initiatives being used internationally to encourage sustainable biofuel production?
- What are the lessons emerging from international initiatives that can contribute to a New Zealand strategy?

A conceptual framework for Objective Three is provided in Chapter 5, which explores existing international biofuel sustainability standards. Sources for this chapter came from a wide body of literature including academic journals, publications from foreign and domestic government departments, various international organisations and newspaper articles.

2.2.4 Method for Objective Four: A New Zealand Biofuel Sustainability Standard – Stakeholder Perspectives

Objective Four: Examine the views of key stakeholders in the New Zealand biofuel sector concerning a biofuel sustainability standard (Chapter 6).

- To what extent is a sustainability standard desired by key domestic stakeholders?
- Which sustainability principles do stakeholders consider most appropriate to the New Zealand biofuels industry?
- What possible strategies do stakeholders suggest for implementation of a sustainability standard?
- What broader policy solutions would stakeholders like to see implemented to encourage a sustainable biofuel industry?

To meet Objective Four, qualitative semi-structured interviews were undertaken with key New Zealand biofuel experts. The purpose of this objective was to gain an understanding of the perspectives of different stakeholders in the sector around developing a biofuel sustainability standard. The methodological approach detailing participant selection, interview protocol and data analysis can be found in Section 6.1.

2.3 Limitations

2.3.1 Limitations of the research approach

Grounded theory advocates beginning research with an open mind, free from preconceived notions of what might emerge from the data. Yet in reality, this is difficult, as what we ‘see’ when we conduct research is conditioned by many factors, including our knowledge of the subject being studied. Furthermore, the requirement to form a research proposal at the start of this thesis necessitated formulation of a specific research question, a practice often discouraged in grounded theory. Nevertheless, it can actually be desirable to bring this knowledge to our research, as it helps form a more focused investigation, and build upon the work done by others (Bryman, 2004).

Qualitative research is often criticised for being too subjective, as the results presented are reliant on what the researcher thinks is significant and chooses to concentrate on

(Babbie, 2001). While some advocates of grounded theory imply that categories and concepts await discovery within the data, this neglects the role of the researcher in the generation of knowledge around themes of particular relevance to society or an industry. Semi-structured interviews are also difficult to replicate since they lack rigid structure and are reliant on the interviewer's ingenuity (Bryman, 2004). Another common criticism of research which uses grounded theory is that the findings are often specific to the social phenomena being researched and less applicable to the generation of theory (ibid.). While this is valid, the rich understanding gained through case-study research makes it well suited to addressing practical application.

2.3.2 Limitations of this study

The small interviewee sample set of this study limits the scale of statistical analysis and the generalisations that can be drawn. Yet the stated purpose of the empirical research component of this thesis is to understand the views of a specialised set of people. In turn, the views of this set of people arises from their experience as practitioners in a specialised field, in which case the gathering of their views is useful from a public policy point of view.

Oil company participants were under-represented in this study, due to three representatives choosing not to take part. This study also failed to include any farmer or forester participants, who could have enriched the dialogue around sustainable production practices. This research focuses on building up a contextual understanding for policy development, and does not assume that the views of each stakeholder category are comprehensively representative of their subsector.

The use of semi-structured interviews limits the replicability of this research, but was necessary to draw out the diversity of meaning and opinions of stakeholders. The interpretive nature of qualitative research means that the researcher's perspective will be inherent from the outset – and this perspective has been declared. Whilst coding is necessary to sort through large amounts of data, there is a risk that by fragmenting transcripts the context of respondents' comments will be lost or misinterpreted during the process. In this study, this risk was minimised by checking quotes with participants to ensure they were used in correct context.

Chapter 3

New Zealand Context

This chapter examines the current scope of biofuel production in New Zealand. It begins by summarising the existing status of domestic biofuel production as well as potential sources for advanced future feedstocks. It then outlines the recent policy history relating to biofuels, as well as the key drivers pushing market development in New Zealand. Lastly, it looks at possible barriers to uptake in the market.

3.1 Domestic Production

New Zealand's current demand for liquid road transport fuels is 6.1 billion litres per annum: 3.2 billion litres of petrol and 2.9 billion litres of diesel. Roughly two million litres of fuel ethanol is currently sold in New Zealand a year (about 0.06 percent of petrol sales) and about one million litres of FME biodiesel (about 0.03 per cent of diesel sales) (PCE, 2010). Gull Petroleum was the first oil company to sell biofuels commercially in New Zealand; introducing a 10% bioethanol-petrol blend in 2007. Gull estimates between 15,000 and 20,000 New Zealand motorists are using their biofuel-blend every week (Datamonitor, 2009). In March 2009 Mobil began trialling a B5 biodiesel blend at selected sites in the Bay of Plenty region, which contains up to 5% biodiesel sourced from tallow, blended with fossil diesel (BANZ, 2009). While little biofuel is currently being sold commercially in New Zealand, the industry is growing, with 55 biofuel-related companies registered in January 2009 (BANZ, 2009). However, a recent survey found that only 2% of New Zealanders are currently using biofuels (ShapeNZ, 2009).

3.1.1 Current Domestic Sources

Biofuels are currently being produced in New Zealand from feedstocks which include whey, tallow, rapeseed oil, and used cooking oil (UCO). Due to the small levels of production and few industry players, accurate data on levels of biofuel production are commercially sensitive and were inaccessible during this study.

Whey

Whey is being used in New Zealand to make commercial ethanol. It is a by-product of the dairy industry, which produces large quantities of whey during the manufacture of cheese and casein. Whey is a versatile by-product, and the economic viability of using it as a fuel is very dependent on whether higher prices can be obtained for its other uses. Anchor Ethanol produces approximately 20 million litres of ethanol annually, with the bulk of this being used in beverages, industrial solvents, cosmetics and pharmaceuticals. Whilst most domestic ethanol is currently exported for other uses, Anchor Ethanol also supplies Gull Petroleum with fuel ethanol, and it is thought that within the next few years 20% of production could supply transport fuel (BANZ, 2009).

Tallow

Tallow is an animal fat, formed as a by-product of the meat processing industry. Approximately 150,000 tonnes of tallow are produced annually in New Zealand, which would equate to enough biodiesel to supply 5% of the country's annual diesel consumption (Hale, West, Giltrap, Denne, & Hole, 2006). However, there is competition for the resource, with the majority currently exported to Asia for use in soaps and processed food products. There are currently several domestic biodiesel producers using tallow including; Biodiesel Oils, Ecodiesel Ltd, NZ Ester Fuels and Flo-Dry Engineering (BANZ, 2009).

Rapeseed Oil

Rapeseed oil (or canola) is a brassica crop that produces seeds with an oil content of 40–46% (Hall & Jack, 2008). Alongside oil extraction, the crop also produces a protein-rich meal cake, a valuable by-product which can be sold as stock food. Rapeseed has been identified as a significant feedstock for biodiesel production in New Zealand, most suited to being grown on the Canterbury Plains. Biodiesel New Zealand, the largest domestic biodiesel producer, is set to manufacture 4 million litres of biodiesel in 2009 from rapeseed grown in the South Island, as well as UCO (BANZ, 2009).

Used Cooking Oil (UCO)

UCO is being utilised as a biodiesel feedstock by several suppliers including; Envirofuels, Envirocar, NZ Ester Fuels and Biodiesel New Zealand. The total New Zealand resource of UCO is estimated to be around 5-6 million litres per annum, and is largely sourced from major urban centres (Hall & Gifford, 2007).

3.1.2 Potential future feedstocks

Since biofuels are an emerging industry, many technologies are still at the research stage. This section details some of the New Zealand companies involved in developing potential future feedstocks.

Agricultural Energy Crops

Potential agricultural energy crops include grains, starch crops, oil seed crops, beets and perennial grasses. Sugarcane is not suited to the New Zealand climate, and other sugar crops are not currently grown in New Zealand due to being uneconomic (Hall & Gifford, 2007). Perennial grasses, such as miscanthus or switchgrass, could become important future feedstocks in New Zealand for production of cellulosic ethanol (Hall & Gifford, 2007). Trials of miscanthus are now underway in the King Country (BANZ, 2008). *Jatropha*, an inedible, oil-yielding large shrub which can be grown on marginal or arid soils, is being trialled in Northland (BANZ, 2009). Although it will be two years before the plants bear fruit and despite opportunities for intercropping with stock, it is thought to be uneconomic since the crop requires manual harvesting.

Purpose-grown Forestry

While not currently economic, purpose-grown plantation forests may allow for large scale biofuel production in the future. Wood can be converted into liquid biofuels via a variety of pathways which are in various stages of research and development (Hall & Jack, 2008). A study which overviewed potential bioenergy options for New Zealand found that growing 2.5-2.8 million ha of medium- to long-term rotational forests on marginal land could meet projected domestic liquid fuel demand in 2040 (Hall & Gifford, 2007). However, a sufficient purpose-grown forestry resource does not currently exist, and would require establishment of plantations. Fast-growing tree species like eucalypts, acacia and willow also offer potential as short-rotation bioenergy crops (Hall & Gifford, 2007). When willows are cut they sprout and re-grow shoots which can be harvested annually. Short-rotation forestry crops can offer a more favourable energy balance than agricultural crops when converted to ethanol. They also offer a range of co-products which can make the process more economic, such as lignin for the production of biopolymers and xylose for food sweetening, with secondary uses as fuel in cogeneration plants (heat and energy generation) and stock fodder (MoRST, 2007). Willow is being used overseas as a dedicated energy crop, and trial plots have

been planted in the Taupo region to test its suitability for New Zealand. An Auckland company, Biojoule (now part of Purepower Global) has said it will make cuttings of *Salix* (a varietal of willow) available to farmers in 2009, to supply their cellulosic ethanol production facility (BANZ, 2009).

Wastes and residues

Many agricultural crops produce residues (leftover stalks) that are cultivated into the ground at the end of cropping. Cellulosic ethanol technology can now transform cereal straw, and other plant wastes into ethanol. Removing up to 50% of this straw material should not negatively impact soil quality (Hall & Gifford, 2007). If this technology becomes commercially viable, a market for agricultural residues may emerge.

Residual forestry waste could prove to be a potential resource for future biofuel production, providing up to 8-10% of annual liquid fuel demand from the 1.7 million hectares of pine plantation forests in New Zealand (Hall & Jack, 2008). The technology to convert forest residues into ethanol via enzymatic hydrolysis, or biodiesel using a gasification-Fischer Tropsch pathway are both under development (Hall & Jack, 2008). However, most of this resource is already being used on-site as fuel for wood-burning power plants. Furthermore, residues also face the logistical challenge of transporting distributed biomass for central processing. A feasibility study found that residual biomass would only be viable in a few regions, due to the dispersed distribution of wood-waste and high cost of recovery (Hall & Jack, 2008).

Waste industrial gases are also being investigated as a potential feedstock for biofuel. LanzaTec NZ Ltd is developing technology that can be retrofitted to industrial facilities to generate ethanol from the carbon monoxide component of waste flue gases (MoRST, 2007). The technology is also able to make synthetic gas that can be produced from waste cellulosic biomass and municipal waste by gasification to produce ethanol.

Algae

Algae looks promising as an advanced generation feedstock which can be converted into biodiesel, biogas, bioethanol, and bio-oil (Hall & Jack, 2008). There is potential for algae to be cultivated from municipal wastewater and agricultural effluent streams.

Whilst algal biofuel production alone is unlikely to be economic, the value of co-benefits such as wastewater treatment, and co-products like bioplastics and fertiliser, could improve this. Although there is currently no commercial production occurring in

New Zealand, two companies; Aquaflow Bionomic Corporation and Solray, are exploring the opportunity to extract liquid biofuels from algae grown in effluent from sewage ponds or other organic wastes (MoRST, 2007). Aquaflow Bionomic Corporation were the first company globally to extract microalgae-derived crude oil, was successfully refined into diesel and jet fractions (Hall & Gifford, 2007).

3.2 Policy drivers

New Zealand faces the same global challenges which have led many other countries to explore alternative fuels, namely: the threat of climate change and associated costs of mitigation, and concerns over future energy security.

3.2.1 Addressing climate change & Kyoto obligations

Our climate system is changing, and there is now mounting evidence that this is very likely due to anthropogenic causes. Climate scientists expect the Earth's average temperature to increase by between 1.1 and 6.4°C this century (IPCC, 2007b). The global emergence of climate change as a major issue has led to the development of policies that encourage reductions in GHG emissions. The Kyoto Protocol is an instrument of the United Nations Framework Convention on Climate Change. Established in 1997, the Protocol came into force in 2005, and contains a specific goal for participating industrialised countries to collectively reduce their emissions to 5% below 1990 levels for the First Commitment Period (2008-2012). New Zealand ratified the Protocol in 2002, and has made clear its intention to play its part in the global response to climate change. Under the Kyoto Protocol, different countries have different binding emission reduction targets in relation to their 1990 base year emissions. New Zealand is required to reduce its 2008-2012 emissions to 1990 levels, or take responsibility for emissions that overshoot this target by purchasing international carbon units.

New Zealand's gross GHG emissions (excluding carbon removals from forestry) has increased by 22.1% between 1990 and 2007 (MfE, 2009b). With the application of the Kyoto Protocol accounting rules New Zealand can offset gross emissions by taking into account the carbon absorbed by forestry sinks. Due to a large plantation forestry estate, New Zealand is projected to meet its Kyoto Protocol obligation for the first commitment

period as net emissions (including removals from forestry) are currently projected to be below 1990 levels for the First Commitment Period. However, by 2020 forestry is expected to become a net source of emissions when relatively large areas of production forests planted in the 1990s are harvested (MfE, 2009b).

New Zealand faces further obstacles due to a unique emissions profile, with almost half of emissions coming from the agricultural sector², and a significant proportion of these from methane (MfE, 2009b). Since reducing emissions from the agricultural sector is proving difficult, reducing emissions from other sectors such as the transport and electricity sectors becomes even more crucial.

The transport sector makes a significant contribution to New Zealand's GHG emissions profile. In 2007, the transport category (dominated by road transport) was responsible for 45.6% (14,877 Gg CO₂-e) of emissions from the energy sector, or 19.7% of total emissions. By 2007 emissions from the road transport sector had grown by 76.2% compared with 1990 levels (MfE, 2009b). The New Zealand government calculated that meeting the Biofuels Sales Obligation in 2012 would reduce CO₂ emissions by approximately 1.08 to 1.12 million tonnes, leading to savings of approximately \$17.2 to 17.9 million of New Zealand's Kyoto protocol liability (NZ Parliament, 2007)³.

3.2.2 Increasing Energy Security

New Zealand, like most other nations, is highly dependent on fossil fuels- reliant on oil for over half of its consumer energy and 99% of its transport energy (Taylor, 2007). Energy demand for liquid fuels and road transport in New Zealand is currently 6.1 billion litres per annum (PCE, 2010), and is projected to increase by 40% by 2030 (MED, 2007). Since New Zealand's proven oil reserves are small, the great majority of oil must be imported. This growing demand is making New Zealand increasingly dependent on the world market, leading to a vulnerable reliance on often politically unstable oil-exporting countries. Adding to this insecurity is the fact that oil prices are becoming increasingly volatile (Hall & Jack, 2008; Hirsch, 2005; Taylor, 2007) and potentially subject to a plateau or peak in global oil production in the next decade (IEA,

² Emissions from agriculture are typically 11% of total emissions for developed nations (MfE, 2009b).

³ This would vary depending on the feedstock used, as some biofuels have better GHG savings than others (FAO, 2008b; Hall & Jack, 2008; Zah et al., 2007).

2008; Sorrell, Speirs, Bentley, Brandt, & Miller, 2009). A recent survey found that 77% of New Zealanders rate rising fuel prices as the most serious problem facing them and their families, ranked ahead of the cost of living, the global economic recession and climate change (ShapeNZ, 2009). If widespread oil shortages or higher oil prices occur before alternative fuels are in place, this could lead to devastating consequences for New Zealand society.

Biofuels offer an opportunity for New Zealand to increase its energy security due to their potential to be produced domestically. One study suggests it could be theoretically possible for New Zealand to be self-sufficient in transport fuel supplied by cellulosic ethanol produced from sustainably managed forests (Hall & Gifford, 2007). Unlike hydrogen or electric vehicles, liquid biofuels lack many traditional barriers to entry, since they are readily interchangeable with current technology and blendable with current fuels. The distribution of fuels can be more easily accommodated by existing infrastructure for petroleum fuel distribution and retailing. Low percentage blends are already being dispensed in many service stations around the world (Fulton, Howes, & Hardy, 2004). The shift to a renewable liquid fuel source is just one option the New Zealand government is exploring in an attempt to secure greener, more secure energy sources, and it is likely that biofuels will provide a small proportion of the solution (MED, 2007).

3.3 Importing

While international trade in biofuels is currently quite small, this is expected to grow rapidly to meet the ambitious biofuel targets set by many countries (Kaditi, 2009; Londo & Deurwaarder, 2007). Comparatively low production costs in the developing world have created a price incentive which is driving an emerging international market (Zarrilli, 2008). Brazil currently produces the cheapest ethanol from sugar cane, and their success could be mimicked in other tropical countries. Many developing countries have a competitive advantage from lower land and labour costs, a more suitable climate, and a longer growing season. The lower production costs in these countries mean cheaper biofuel imports may undercut domestic production in New Zealand.

Importing biofuels may represent a credible option for lowering New Zealand's GHG emissions. Importing biofuels would contribute to energy security to a small degree as

a result of the diversification of sourcing fuel, yet New Zealand would remain reliant on foreign fuel. The development of a domestic biofuel industry would clearly bring a higher level of fuel independence and energy security as well as economic benefits. While some feedstocks, such as Brazilian ethanol, rate well environmentally (Barber, Pellow, & de Aragao Pereira, 2008; Granda, Zhu, & Holtzappple, 2007; Zah et al., 2007), there are valid concerns that importing biofuels may support unsustainable production practices, resulting in a wide range of environmental and social impacts (Wright, 2008).

3.4 Policy history

During the oil price shocks of the 1970s, the use of biofuels for liquid transport attracted serious consideration by the New Zealand government. In 1978 the government established the Liquid Fuels Trust Board (LTFB) to investigate ways of reducing the country's dependence on imported transport fuels. The LTFB funded investigations into different indigenous feedstocks, such as lignite, natural gas, and biomass, and into different fuels, such as methanol and rapeseed oil. Recommendations made by the LTFB ultimately led the government to promote compressed natural gas as an alternative transport fuel. However, during this era several whey-to-ethanol plants were also established around the country, and the excise tariff for fuel ethanol was removed. Overtime as oil prices fell and continued to stay low, many of the biofuel projects were abandoned, and the LFTB was eventually disestablished in 1987. However, the three whey ethanol plants remained in business, serving industrial and beverage markets (PCE, 2010).

More recently- the global challenge of climate change has meant biofuels have returned to the public agenda. The New Zealand Energy Strategy (NZES) and the New Zealand Energy Efficiency and Conservation Strategy (NZE ECS) are two statutory documents which provide long-term direction for energy policy in New Zealand. Both strategies directly support the use of biofuels to reduce GHG emissions from New Zealand's transport sector. The NZE ECS (EECA, 2007) includes a specific objective to introduce renewable transport fuels, with a target that as much as 80% of the New Zealand vehicle fleet will be capable of using at least a 10% biofuel blend, or be electric powered by 2015. The vision is that by 2050, biofuels will make up 13% of our transport fleet, with fossil fuels reduced to 2% of the market (see Fig 3.1).

EECA began a biofuels work programme in 2001 to meet the NEECS indicative renewables target of 2 PJ by 2012 for the transport sector, equivalent to about 1 % of current transport energy use. The low target was set at this level to stimulate a domestic biofuels industry. Despite having this target since 2002, and a number of government initiatives to encourage voluntary uptake, there was no transport biofuels being used in commercial quantities in New Zealand prior to 2007. By 2005 it was found that the voluntary target was not being met, and the government began investigating the potential for a mandatory biofuels sales target (MoT, 2005).

Figure 3.1 Light vehicle fleet composition in 2050 under a low carbon transport future

Source: (MED, 2007, p. 34)

In 2007, the Labour government in power introduced the Biofuels Sales Obligation (BSO), requiring oil companies to introduce biofuels into the transport fuel mix by 1 October 2008. The obligation level was set at 0.53 % in 2008, increasing to 2.5% of annual petrol and diesel sales by 2012. The government's primary objectives for encouraging biofuels were to contribute to long term climate change objectives and environmental sustainability (MED, 2008). In December 2008, a newly elected National government repealed the obligation. The Minister of Energy and Resources, Gerry Brownlee, stated three reasons for the repeal (Brownlee, 2009). Firstly, there was concern that in the absence of workable and practical sustainability standards, the obligation might have led to oil companies importing biofuels from unsustainable sources (this is discussed further in Section 5.2.3). Secondly, there was concern about the uncertain costs that might have been placed onto consumers, as oil companies had indicated that the obligation would cause a fuel price increase of between 2-8 cents/litre.

Lastly, the government believed biofuels should be introduced gradually and when they offer cost advantages, and that this would only happen through a market-based approach rather than a mandatory approach.

Historically in New Zealand, bioethanol sales do not incur associated excise tax like the petrol it substitutes, whereas biodiesel incurred the same road user charges as mineral diesel, giving ethanol producers a distinct competitive advantage (Brownlee, 2009). In May 2009 the Government announced a new Biodiesel Grants Scheme to stimulate the biodiesel industry in New Zealand, offering biodiesel comparable tax treatment with bioethanol. The \$36 million dollar fund will be spread over three years and provide grants at a maximum rate of 42.5 cents per litre of biodiesel. The grant is only available to domestic biodiesel producers selling to New Zealand consumers, and to be eligible biodiesel must be manufactured in New Zealand (EECA, 2009).

The government has also recently developed a domestic Emissions Trading Scheme (ETS). This will introduce the international carbon price to the New Zealand economy. Under the scheme, from July 2010, oil companies will need to buy carbon units to cover the emissions which are created when the oil they sell is combusted. However, during the transition phase (ending in December 2012) participants will only be required to surrender one unit for every two tonnes of CO₂ equivalent emitted, and a fixed price option of \$25 per tonne of CO₂ will be offered in order to insulate obligated sectors from any upward trends in the international carbon price (MfE, 2009a). Biofuels are considered 'carbon neutral' under Kyoto, so any oil companies which supply a biofuel component will lower their carbon liability under the ETS, which may assist their competitiveness. However, all biofuels currently sold in New Zealand are blended with petroleum fuels, and this will dramatically dilute the effect of a carbon price on biofuel uptake.

3.5 Possible Barriers to uptake

The biggest barrier to uptake biofuels currently face is that they cost more than fossil fuels. Price has a huge influence on consumers' fuel choice (VandeVelde, Verbeke, Popp, Buysse, & Van-Huylenbroeck, 2009), and it appears that New Zealanders are not prepared to pay more for biofuels. Results from a recent survey found that while a price cut of up to 10 cents per litre would trigger 29% of people to switch to biofuels, a cut of

more than 10 cents per litre would be needed to prompt a further 38% to start using them (ShapeNZ, 2009). However, few biofuels are currently competitive with oil, with many producers reliant on rising oil prices to gain market entry. Any future rise in carbon price, and oil price increases arising from changes in global oil production may change the price competitiveness of biofuels with respect to petroleum fuels in the coming years. However, rising oil prices would both raise the price of biofuel production (since fossil fuels are an important input in the production process), and lift agricultural commodity prices due to an increase in biofuel demand (Doornbosch & Steenblik, 2007).

Another barrier to the uptake of biofuels is the lack of consumer awareness. New Zealand motorists are typically ignorant about biofuels, or conservative concerning what they fuel their car with. In 2005 only 39% of motorists were aware of biofuels (UMR Research, 2005). A recent survey found that only 2% of New Zealanders are currently using biofuels, with 66% unsure whether their vehicle can run on a 10% blend (ShapeNZ, 2009). Attitudes voiced in this survey included concerns that using biofuels may damage vehicle engines, and that biofuels are too new and unknown. Of those New Zealanders that are aware of biofuels, many are undecided about whether to support them. In 2005 64% of the respondents who were aware of biofuels supported the sale of biofuel blends in New Zealand, while 5% opposed and 31% were unsure (UMR Research, 2005). The majority of the media coverage surrounding biofuels (both internationally and in New Zealand) has been negative, despite many of the sustainability concerns not applying specifically to domestic feedstocks. Concerns have been raised over the environmental and social impact of biofuel production, and awareness of these issues has influenced the public perception of biofuels.

The potential for biofuel uptake in New Zealand is also dependent on the compatibility of the vehicle fleet. This fleet is dominated by ageing, petrol-fuelled vehicles. New Zealand lacks a domestic vehicle manufacturing industry, so all vehicles are imported, which makes technology uptake reliant on technological developments in other countries (MFE, 2007). Being largely reliant on imported used Japanese vehicles means it could take up to ten years before vehicles capable of running on higher biofuel blends begin to be imported (MED, 2007). This process could be sped up if car manufacturers

were offered incentives to introduce flexi-fuelled vehicles to New Zealand⁴. Without incentives, flexi-fuel vehicles are unlikely to be introduced until higher biofuel blends are being sold commercially, whilst oil companies may delay investing in biofuel infrastructure until their introduction.

3.6 Summary

The New Zealand biofuel industry is still in its infancy, with little production currently taking place. Biofuel sales make up less than 1% of New Zealand's liquid fuel consumption, with Gull being the only oil company selling biofuels on a commercial scale. Despite this, the number of biofuel producers is growing, and there is a broad range of companies researching second generation technologies. Current feedstocks being used in New Zealand include used cooking oil, tallow, whey and rapeseed oil. The scope of future feedstocks is more diversified and may include a range of agricultural crops, residual forestry and agricultural waste, purpose-grown forestry, algae, and waste industrial gases. A domestic biofuels industry could help New Zealand meet its Kyoto obligations by reducing the transport sectors GHG emissions. It could also increase energy security, by diversifying the transport mix, and providing domestically produced liquid fuels. Imported biofuels may be produced at a lower price, and could contribute to meeting GHG reduction targets in New Zealand, but would be less effective in contributing to national energy security. In 2007 the government put in place a mandatory sales obligation, requiring biofuels to make up 2.5% of transport fuels by 2012. This obligation was repealed in 2008, and replaced with a domestic Biodiesel Grants Scheme. The introduction of an Emissions Trading Scheme should also contribute to making biofuels more cost-competitive. There are several potential barriers to biofuel uptake. Most significantly, many biofuels are currently not price competitive with fossil fuels at current oil prices, and require the consumer to pay a premium. There is generally a lack of consumer awareness about biofuels, with many cautious that their use may result in engine damage. There has also been significant controversy in the media surrounding biofuels sustainability, which could influence consumer acceptance.

⁴ Flexi-fuel vehicles can run on any combination of petrol and ethanol, allowing consumers the freedom to choose whichever fuel was cheapest. In 2003 Brazil's auto industry introduced flexi-fuel vehicles, subsidized by the government. Combined with high fuel prices, these cars dramatically increased demand for ethanol in Brazil (Worldwatch Institute, 2007). Today, around 90% of Brazilians own flexi-fuel vehicles (Gura, 2009).

Chapter 4

Key Environmental and Social Concerns

This chapter addresses the range of environmental and social impacts associated with the production of biofuels. It reviews international literature relating to the sustainability of biofuels, before discussing the relevance of these issues to a New Zealand industry (Objective Two).

4.1 Environmental concerns

A shift to renewable fuels has typically been viewed as good for the environment since it avoids the use of fossil fuels. Fossil fuels are considered unsustainable primarily because their combustion generates vast quantities of carbon dioxide (CO₂), a greenhouse gas; and their consumption is depleting fossil fuel reserves which will not be renewed over human timescales. In contrast, biofuels are considered a renewable source of energy that shows potential for delivering GHG savings.

While GHG emissions are significantly lower for many biofuels compared to fossil fuels, this is often offset by very high environmental impacts caused during production (Scharlemann & Laurance, 2008; Zah et al., 2007). Production of first-generation biofuels has rapidly become controversial, gaining a reputation in the international media as catalysing a number of environmental and social issues, including:

- a) the destruction of rainforests,
- b) escalation of food prices,
- c) excessive application of fertilizer,
- d) an increase in GHG emissions, and
- e) a reduction in biodiversity

(Chakraborty, 2008; Ewing, 2008; Grunwald, 2008; Monbiot, 2007; Walsh, 2008).

Recognition that the overall environmental impacts of certain biofuels can very easily exceed those of fossil fuels is growing, with many authors stressing the importance of considering more than just GHG savings when selecting biofuel feedstocks (Doornbosch & Steenblik, 2007; Groom, Gray, & Townsend, 2008; Scharlemann & Laurance, 2008; Zah et al., 2007). Yet the environmental impacts of biofuels can be reduced by taking proactive measures. In principle, most biofuels can be produced in a sustainable way, but this is dependent on the raw materials and production technologies chosen. The specific biofuels selected, and where and how they are grown, will dictate their environmental impacts (Zah et al., 2007).

Comparing different biofuel feedstocks can be difficult, as each biofuel has specific benefits and costs, and the feedstocks which appear ‘greener’ can easily change depending on which criteria are considered. The Swiss research institute EMPA (Zah et al., 2007) undertook a study to compare the total environmental impact and GHG emissions of 26 biofuels, produced from a wide range of crops, with fossil fuels. They found that most biofuels reduced GHG emissions by more than 30% compared with fossil fuels. But nearly half of the biofuels exhibited greater aggregate environmental costs than fossil fuels, such as: soil acidification; excessive fertiliser use; biodiversity loss; air pollution caused by slash-and-burn agriculture; and increased toxicity from pesticides. The biofuels which fared best were those made from waste products, as well as cellulosic ethanol produced from grass or wood. However, the exclusion of many second generation biofuels and the impacts of indirect land-use from the analysis limits extrapolation of these findings.

4.1.1 Greenhouse gas emissions

Well-to-wheel emissions

In recent decades global attention has focused on mitigation of, and adaptation to, human-induced climate change. To avoid “dangerous anthropogenic interference with the climate system” the Intergovernmental Panel on Climate Change (IPCC) has recommended that GHG emissions peak in the next decade and be reduced by 60-80% by 2050 (IPCC, 2007a). Lowering the predicted emissions trajectory will

require application of a range of mitigation strategies and technologies across varying sectors including: energy conservation, renewable energy, enhanced natural sinks, nuclear energy, and fossil carbon management. Each strategy can form a ‘stabilization wedge’ in the overall stabilization triangle, which is the volume of avoided emissions required by 2050. However, no single technology or sector will suffice, and addressing the climate change mitigation challenge will require parallel exploration of multiple approaches (Socolow, Hotinski, Greenblatt, & Pacala, 2004). Adapting the transport sector is expected to be particularly challenging, but it is hoped that biofuels can offer a low carbon fuel option.

Biofuels’ reputation as ‘carbon neutral’ stems from the assumption that the CO₂ emitted in combustion is equivalent to the CO₂ recently absorbed as the biomass grew. However, this equation fails to include the GHG emitted during cultivation, processing and transportation. A lifecycle assessment (LCA) calculates these ‘well-to-wheel’ emissions, as well as crediting a proportion of emissions to the various by-products produced. Relative to fossil fuels, nearly all biofuels reduce GHG emissions, but some feedstocks outperform others (FAO, 2008b; Zah et al., 2007), as shown in Fig 4.1.

Note: Excludes the effects of land-use change

Figure 4.1 Range of estimated GHG savings of selected biofuels relative to fossil fuels

Source: (FAO, 2008b)

Many authors emphasize the variation in GHG emission reduction that occurs across different biofuels (Dufey, 2006; Scharlemann & Laurance, 2008; Wright, 2008). The UK Renewable Fuels Agency estimates that: current biodiesel technologies generally achieve a 40-50% emissions saving compared to that of conventional diesel; current bioethanol technologies vary more, from –20% to 80% depending upon the feedstock and production process; GHG savings for advanced technologies are more uncertain, but have been estimated at between 80-90% where residues are used as feedstock (RFA, 2008). Brazilian bioethanol currently has the highest GHG savings of any 1st generation feedstock with typical reductions of between 70-90% (FAO, 2008b).

Zah et al. (2007) found that the largest percentage of GHG emissions typically occurred during agricultural cultivation of biofuel crops, although this varied significantly between feedstocks. In tropical zones some biofuels are being produced on recently cleared rainforest areas, particularly in South East Asia, and the clear cutting and burning of rainforest releases huge quantities of CO₂ (as well as reducing biodiversity levels). Agricultural emissions also stem from farm inputs such as fuel, fertiliser and pesticide use. The application of fertiliser, required by crops like corn or rapeseed, can emit significant amounts of nitrous oxide (N₂O), a GHG significantly more potent than CO₂, which also damages the stratospheric ozone layer (Bailey, 2008; FAO, 2008b; Scharlemann & Laurance, 2008). Waste and residue substrates exhibited significantly lower GHG emission profiles in the EMPA study mentioned above, with the lowest emissions coming from UCO (Zah et al., 2007). The study found that both fuel production and transport of fuel did not produce significant GHG emissions. However, this may differ for more geographically isolated countries like New Zealand, where importing distances are greater.

For biofuels to be an efficient fuel, the amount of energy required to produce one unit of biofuel should be less than the energy contained in that same unit (Dufey, 2007). This is sometimes called the energy returned on energy invested (ERoEI). One study suggests inefficient production of corn ethanol in the United States may consume more energy than the fuel produces (Scharlemann & Laurance, 2008). The energy source used to process the feedstock is scarcely discussed in the literature, but can have significant effects on the GHG emissions profile. Most of

the energy used to process biofuels in the United States comes from fossil fuels, with coal mainly being used to provide either electricity and/or heat to the conversion plant (The Royal Society of London, 2008). In the production of ethanol from sugarcane, use of the 'bagasse' (crushed stalk) as an energy input reduces the need for fossil fuel inputs, greatly decreasing the GHG emissions of the process (Granda et al., 2007; Taylor, 2007). This method can actually produce surplus electricity, which can then be sold back to the grid (Bailey, 2008). Brazilian sugarcane produces significant GHG savings due to high yields and the use of bagasse as an energy input. In contrast South African sugarcane is often inefficiently produced by using an electric boiler with grid electricity predominantly fuelled from coal (RFA, 2008).

While research on GHG emissions for biofuels is improving, there remains a range of uncertainties in methodologies. LCA methodologies differ in where boundaries are placed and how they distribute the impacts across co-products, and tend to be highly assumption specific, so estimates for one country may not apply to the same feedstock in another (Taylor, 2007). Improvements in measurements are needed to account for N₂O emissions resulting from fertiliser inputs. Many accounting methods also fail to account for any co-products produced, such as high protein stock feed (that would otherwise require additional cultivation of land), which could dramatically improve the emissions reductions potential of 1st generation biofuels (RFA, 2008). Finally, biofuel LCAs typically assume that no land-use change (either direct or indirect) has taken place, yet this is rarely the case, and can have huge ramifications on the GHG emissions profile, as discussed in the next segment.

Emissions from land-use change

A range of studies have shown that where feedstock is produced without land-use change most biofuels achieve net GHG savings compared to their fossil-fuel equivalent (E4tech, 2008; FAO, 2008b; RFA, 2008; Zah et al., 2007). However, this scenario rarely reflects reality, since in most cases biofuel production stimulates land-use change, either directly or indirectly. Direct land-use change (DLUC) is defined as land-use change that occurs on the land being used to create the feedstock. Indirect land-use change (ILUC) occurs when the production of biofuels displaces activities (typically food production) to other areas, where they

cause land-use change (IEA, 2009). While it is relatively straightforward to calculate the emissions caused by DLUC, this is a much more difficult task for ILUC. While land-use change can be detected at a global scale, it is not feasible to relate this change to one driver or location (ibid.).

Direct land-use change

Increased demand for biofuels has motivated some farmers to directly convert more forest and grasslands into cropping, which can result in significant changes in carbon stocks. Most lifecycle analyses fail to account for the effects of this land-use change which can include the loss of above ground carbon (in vegetation and litter) in forests, grasslands and wetlands, and below ground carbon released from soil and roots; or the lost opportunity of ongoing sequestration and maintenance of higher per hectare carbon stocks from maturing forests and grasslands. When this ‘carbon debt’ is included, biofuels grown on converted land may become greater net GHG emitters (at least in the short term) than the fossil fuels they displace (Fargione et al., 2008).

Where land-use change for biofuel production has decreased the carbon stocks and/or decreased the net sequestration rate, then the net emissions from the biofuel crop will be greater than prior to the land-use change. Because existing land already provides carbon benefits in storage and sequestration, biofuels can only reduce GHG emissions if doing so *increases* the carbon sequestration of the land (Searchinger et al., 2008). As land generates more biofuel over years, the reduced emissions from its use will eventually offset the carbon debt from land-use change, but this ‘payback period’ may take decades or even centuries for some feedstocks (see Table 4.1). However, the extent to which ILUC causes deforestation or the release of GHG has caused vigorous debate, and some authors argue that the approach taken in the aforementioned studies was insufficiently robust to support their conclusions (Eisentraut, 2010; Goldemberg & Guardabassi, 2008; Sylvester-Bradley, 2008).

Table 4.1 Illustrative GHG savings and payback times for biofuel feedstocks causing land-use change.

Fuel chain	Assumed country of origin	% GHG saving excluding impacts of LUC	Carbon payback (years)	
			Grassland	Forest
Palm to Biodiesel	Malaysia	46	0-11	18-38
Soya to Biodiesel	USA	33	14-96	179-481
Sugarcane to bioethanol	Brazil	71	3-10	15-39
Wheat to bioethanol	UK	28	20-34	80-140

Source: (E4tech, 2008)

Perennial crops such as palm oil have an advantage over annual species, since they will sequester carbon while they grow and simultaneously produce oil for biofuel (Groom et al., 2008). Biofuel expansion which results in changes in land-use, such as clearing tropical forests and peatlands, or even displacing existing croplands for biofuel cultivation, risks releasing enough GHG emissions to negate any intended future climate benefits (Searchinger et al., 2008; The Royal Society of London, 2008). One report suggests avoiding cultivation of land which would require greater than 10 years to pay back the carbon debt (RFA, 2008).

Searchinger et al. (2008) propose that letting excess croplands revert to forest and grassland may be more beneficial for GHG savings than cultivating them for biofuels.

Indirect land-use change

Land-use change can also occur indirectly, when farmers diverting existing croplands into biofuels inadvertently displace crops or pasture that may need to be grown elsewhere. The displacement of food crops by energy crops can trigger higher crop prices on the global market, which act as an incentive for other farmers to clear more land to replace food and feed crops. The location of ILUC is uncertain, and outside the control of the biofuel producer or consumer (Cornelissen, Dehue, & Wonink, 2009).

This situation presents a challenge in the form of ‘carbon leakage’, where interventions to reduce emissions in one geographical area can lead to an increase in emissions in another. For example, many authors cite how expansion of

subsidised corn production in the United States has led to a reduced soy harvest, with high soy prices accelerating destruction of Amazon rainforest for conversion to agriculture (RFA, 2008; Scharlemann, 2008; Searchinger et al., 2008). Another example is how EU biofuel targets are diverting domestically produced oil crops into biofuels. This has increased the need for importation to the European food market, largely met by palm oil sourced from South-East Asia, where it is stimulating significant deforestation and land-use change (Bailey, 2008; Zarrilli, 2008). ILUC is extremely difficult to quantify since market effects move across borders and commodities, but it will have significant impact on GHG savings. Many studies fail to account for land-use change emissions because mechanisms do not yet exist to accurately measure this (Sheehan, 2009).

Minimising the impact of land-use change

There are multiple ways to minimise the carbon emissions caused by land-use change. Some agricultural techniques can preserve soil carbon, such as avoidance of excess tillage. A relatively short payback period could be expected on land which has been judged to have low carbon content, such as land which has recently been used for cropping and managed with techniques that are less favourable to soil carbon accumulation and storage. The issues surrounding land-use change highlight the benefits of using idle and marginal lands for cultivation, or targeting waste and residual feedstocks and less land-intensive technologies such as algae cultivation. The potential of marginal land must be investigated, since it is expected to produce a reduced yield, may be limited by water supply and would probably require incentives for significant uptake. The carbon stocks and biodiversity values of marginal land will vary, with a British report suggesting that site-specific assessments of land suitability may be necessary (RFA, 2008). Intensification of use on current arable land was also suggested as a mechanism for freeing up large areas of land currently in use inefficiently (RFA, 2008).

Policy to address ILUC is still in its infancy, but a number of countries have attempted to monitor this issue. Within the EU, the Renewable Energy Directive will provide a report on ILUC by 2010 with steps to minimise impacts. In California, compliance of the Low Carbon Fuel Standard will be assessed using lifecycle analysis, which will include modelling the effects of ILUC (IEA, 2009).

To address ILUC over the long-term, an integrated global approach to land use must be developed, covering food, feed, forestry and energy production, and coupled with a global and comprehensive GHG management regime. With such a comprehensive approach, separate consideration of ILUC would become unnecessary once all land uses are encompassed within the system boundary (IEA, 2009).

4.1.2 Biodiversity loss and habitat destruction

The rapid expansion of biofuel production is currently threatening areas of high biodiversity such as peatlands and rainforest in some developing countries. In Indonesia and Malaysia large areas of rainforest have been cleared to make way for palm oil plantations for biodiesel (Ardiansyahi, 2006; Fargione et al., 2008). In Brazil, while most sugarcane is grown far from the Amazon rainforest, there is substantial pressure to expand sugar plantations into neighbouring cerrado grasslands, alongside a simultaneous expansion of soy plantations (Groom et al., 2008). Forests provide a wide range of ecological benefits and the clear cutting or burning of rainforest leads to significant losses of biodiversity and habitat, soil protection, carbon stores and hydrological functioning. Many species are threatened as natural habitats are converted to bioenergy crop monocultures such as oil palm plantations, which make a biodiversity-poor low-carbon substitute for forests (Scharlemann, 2008; Stone, 2007). While agricultural expansion is a key driver of deforestation, biofuels are only one of a range of drivers inducing land-use change. The issue of deforestation is urgent, with the United Nations Environment Programme (UNEP) estimating that at current deforestation rates 98% of all Indonesian tropical forest may be destroyed by 2022 (Londo & Deurwaarder, 2007).

4.1.3 Agricultural impacts

Many of the environmental impacts of biofuels can be attributed to the agricultural cultivation stage (Zah et al., 2007). Large-scale biofuel production has adopted the agribusiness model, growing monoculture crops which require high levels of irrigation, fertiliser and pesticide use. The sustainability of these practices have been questioned, since growing crops like this over many years can

lead to detrimental effects on the soil and local water quality and supply (Friends of the Earth, 2008). While these impacts are not unique to biofuel production, it remains important that just like any other crop, biofuels should be cultivated with environmentally-friendly practices (Groom et al., 2008). In particular, the use of water for second generation biofuel crops, alongside growing water constraints, will be a critical issue in the future (Eisentraut, 2010).

4.2 Social concerns

4.2.1 The 'food vs fuel' debate

Biofuels are currently produced from conventional food crops, and increasing demand for biofuels has been implicated in the recent escalation of food prices (Bailey, 2008; Grunwald, 2008). In August 2009, raw sugar prices reached a 28 year high, blamed on demand for ethanol production in Brazil, coupled with a dramatic fall in sugar production in India (Radio NZ, 2009). During the past three years food prices have risen by an estimated 83% (World Bank, 2008b). A range of factors were linked to these events, including: failed harvests, increased food demand, increased oil prices, climatic events, speculation in commodity markets, and rising demand for biofuels (Elliott, 2008; FAO, 2008a; Nimmo-Bell & Company, 2008). Increased demand for biofuels has led to rising prices for some food commodities, notably oilseeds (World Bank, 2008b), but the scale of these effects is both complex and uncertain, as impacts appear to be regionally variable in their scale and severity. While some suspect the actual impact of biofuels to be small (Barber et al., 2008; Nimmo-Bell & Company, 2008), the Food and Agriculture Organization (FAO) suggested that increased demand for biofuels was one of the leading factors behind food price increases (FAO, 2008a), and research from the World Bank blamed biofuels for contributing to 65 % of the price increases (Mitchell, 2008). Rising food prices have a disproportionate impact on the poor because they spend a higher proportion of their income on food (Bailey, 2008; De La Torre Ugarte & He, 2007). The urban poor are most vulnerable, since they are unlikely to reap financial benefits from the expansion of the biofuel industry.

Developing countries hold some comparative advantages for biofuel production, so there is potential for farmers producing and trading the crop to benefit from an

increased crop price and achieve a higher standard of living (Eisentraut, 2010). Yet poor farmers often lack sufficient access to land, investment capital, credit, infrastructure or inputs to take advantage of higher market prices. Growing biofuel feedstocks can offer substantial income to poor farmers in developing countries, but this requires national investment in processing, collection and distribution networks (Leturque & Wiggins, 2009). Current biofuel mandates in industrialised nations often occur alongside subsidies and import tariffs which limit the ability of developing nations to compete with developed country biofuel suppliers (Dufey, 2007; Leturque & Wiggins, 2009). There is also broad concern for how rapid expansion by agribusiness in some regions has resulted in poor working conditions for those employed, and involuntary displacement of people due to land-grabbing (Bailey, 2008; Cotula, Dyer, & Vermeulen, 2008; Peskett, Slater, Stevens, & Dufey, 2007).

A further concern is that first generation biofuels may compete directly with arable agricultural land dedicated to food and fibre production. The global demand for food and feed is projected to rise (despite expected improvements in yield)⁵, and increasing demand for biofuels may significantly add to this pressure. In 2006 biofuels accounted for 13.8 million ha or 1% of global agricultural land. If all countries' biofuel mandates are achieved by 2020, biofuels will require an estimated additional 56-166 million ha (RFA, 2008). The RFA study concluded that there was probably enough agricultural land to meet demand up to 2020, although biofuels may represent between 11 and 83% of the additional land requirement. While there are potentially large areas of land available for agricultural expansion, a high degree of uncertainty remains around these estimates. Despite global demand for food and feed increasing, biofuel policies have emerged in some regions as a response to a decline in domestic agricultural production, where arable land is being left idle.

Not all biofuel production results in displacement of food or feedstock production, and many can produce edible co-products. Rapeseed produces rape meal as a co-product and using wheat as a feedstock also generates dried distillers grains and solubles (Andrew & Forgie, 2008; Nimmo-Bell & Company, 2008). These

⁵ The world population is projected to grow from 6 billion in 1999 to 9 billion by 2043, with most of this increase occurring in developing countries (U.S. Census Bureau, 2009).

products can be used as high protein animal feed, meaning potentially fewer crops need to be grown specifically for animal fodder. Furthermore, cereal crops generally require less land than many protein-rich crops currently used to produce feed. So by displacing fodder crops with biofuel feedstocks (and co-products), net land requirements could be dramatically reduced (RFA, 2008). This implies that 1st generation biofuels could outperform advanced technologies' GHG savings once avoided emissions from co-products and straw utilisation are considered.

Advanced feedstocks have the potential to avoid competition with food if they are not grown from food crops, and do not compete for arable land. Biofuels produced from wastes and residues would not compete with food production, unless wastestreams are already used in food products. Additionally, their use in biofuel production could lower other environmental impacts and costs associated with waste treatment and disposal. Some potential biofuel feedstocks, such as the nitrogen-fixing shrub *Jatropha*, can be grown in semi-arid conditions on land not suitable for high yield agriculture. However, the yield per hectare on marginal lands is likely to be significantly lower (Rajagopal, 2007). The suitability of marginal land also varies, with some areas serving other functions such as providing subsistence agriculture, fulfilling important ecosystem functions, and acting as carbon sinks or habitat for certain species of wildlife (Bailey, 2008). In the absence of specific targeted policies, commercial production of traditional crops that require arable land will probably continue to dominate the future biofuels feedstock mix (RFA, 2008).

4.2.2 Genetic Modification

Genetic modification (GM) could play a large role in improving future biofuel crops. Potential areas of research include developing more favourable characteristics with respect to: biomass yields; starch or oil output; fertiliser requirements; improved resistance to pests; cell-wall lignocellulose characteristics that make the feedstock more amenable for processing; or inclusion of traits enabling crops to be cultivated with minimal external inputs on marginal land (Doornbosch & Steenblik, 2007; The Royal Society of London, 2008). The use of GM in biofuels could benefit the environment if it reduced the use of pesticides, or amount of land required by increasing crop productivity. However, it could also result in reductions in biodiversity, and selection of pesticide-resistant pests and

weeds. While biofuel crops would not be grown for public consumption, there are risks of cross-contamination of crops, or that biofuel by-products fed to stock would enter the food chain (Verbeke, 2007).

The use of GM for food crop improvement is already widely in use, but has been controversial, particularly within Europe. Many consumers are concerned with the risks to health, safety and the environment, the uncertainty around outcomes, and the unpredictability of host genome responses to disruption in GM techniques currently in use. These fears are often coupled with ethical and moral concerns surrounding GM. GM was rarely mentioned in literature addressing biofuel sustainability concerns. A notable exception was a paper which stated that European public attitudes to the use of GM in biofuel crops appears positive (Verbeke, 2007).

4.3 Advanced technologies

There is a common assumption that first generation biofuels will soon be replaced by second generation technologies still in development. Several authors felt that advanced biofuels might be more sustainable, since they promise improvements in GHG savings and energy yields/ha and a shift towards waste substrates, algae, and crops which do not require arable land for cultivation (Doornbosch & Steenblik, 2007; Groom et al., 2008). Advanced biofuels have been on the horizon for 35 years, but always appear to be five to ten years away from commercial deployment. Because these technologies are typically more expensive than fossil fuels at current oil prices, they may require policies which favour their development to achieve market penetration (Doornbosch & Steenblik, 2007; Londo & Deurwaarder, 2007; RFA, 2008). If biofuel and climate change policies rewarded fuels which specifically reduced GHG reductions, then advanced biofuels might attain a competitive advantage (Londo & Deurwaarder, 2007) (See Fig 4.1).

4.4 Issues relevant to New Zealand

Whilst biofuels have attracted much controversy over sustainability concerns, not all the issues discussed above are applicable to New Zealand biofuels. The main sustainability issues relevant to domestic feedstocks are discussed below.

4.4.1 GHG emissions

Well-to-wheel emissions

A recent study by Scion (the New Zealand forestry Crown Research Institute) compared the GHG benefits of several biofuel feedstocks to fossil petrol and diesel, and found that biofuels produced from purpose-grown forests could provide a 60-90% reduction in GHG emissions (Hall & Jack, 2008). This study found tallow to be the worst performing feedstock, although even this achieved a 47% reduction in GHG emissions. The results are presented in Fig. 4.2. However, this analysis had a bias towards forestry feedstocks, and neglected to include data on UCO, whey, and several other advanced feedstocks for comparison.

Figure 4.2 Greenhouse gas benefits of New Zealand biofuels

Source: (Hall & Jack, 2008, p. 5)

EECA is currently developing default GHG values for UCO, tallow and rapeseed oil (BANZ, 2009). While no figures are available for domestic UCO or whey,

international studies suggest waste and by-product substrates typically provide significant GHG reductions since the upstream emissions associated with farming are either not included, or assigned on the basis of economic value, energy content or mass (Hall & Jack, 2008; Zah et al., 2007). There have been several LCA studies conducted for domestic rapeseed oil, calculating GHG reductions of 42% (SKM, 2008b), 47% (Campbell & McCurdy, 2008) and 62% (Andrew & Forgie, 2008; Hall & Jack, 2008)⁶. Overall, New Zealand feedstocks appear to achieve significant GHG savings, and their performance compares favourably with international values (see Fig. 4.1).

Emissions from land-use change

It appears that all New Zealand feedstocks have the potential to result in significant ‘well-to-wheel’ GHG emission reductions (see Fig. 4.2). However, none of these studies included emissions associated with land-use change, a factor most relevant to purpose-grown crops and forestry. Cultivation of crops for biofuels inevitably leads to land-use change. While conversion of forest to agricultural land is associated with an increase in GHG emissions, converting land from grazing to biofuel feedstock production typically corresponds with a transition away from ruminant livestock grazing (a methane source), and may lower GHG emissions. In New Zealand, rapeseed will most likely be grown on land previously farmed for sheep and beef pasture in the Canterbury and Waikato plains, which has become uneconomic (Hall & Gifford, 2007). Further research is required to ascertain whether this would result in significant carbon emissions from DLUC. ILUC could also occur as land elsewhere is converted into pasture or cropland to meet the displaced demand.

4.4.2 Biodiversity loss and habitat destruction

New Zealand biofuels are unlikely to impact on land of high conservation value or cause the conversion of indigenous biodiversity. The New Zealand conservation estate is protected by law, and indigenous forest on private land is protected under the Forest Amendment Act (1993), which prevents clear felling and only permits timber harvesting by means of sustainable forest management techniques. The

⁶ The variation in values can be attributed to differences in LCA methodologies, boundaries and values attributed to co-products.

New Zealand ETS also restricts deforestation of plantation forests, since owners of forested land planted prior to 1990 will be required to surrender emission units if they deforest and introduce a new land use, such as agriculture. Furthermore, Kyoto and ETS rules make it more difficult now to convert regenerating bush to plantations because of the carbon liability that would incur as a result of the clearing.

4.4.3 Agricultural impacts

Rapeseed is the only agricultural crop currently being grown for biofuels commercially in New Zealand. The potential environmental impacts from growing rapeseed are no different from growing other types of arable crops. The main impacts include wind erosion and loss of soil fertility, which can be reduced by no-till cultivation techniques, and returning straw to the soil (Andrew & Forgie, 2008). Rapeseed requires fertiliser use, which will trigger associated N₂O emissions, and poses a risk for eutrophication of waterways. In dry conditions, such as the Waikato and Canterbury Plains, it also requires irrigation to improve yields (Andrew & Forgie, 2008; Hall & Gifford, 2007), which could create stress on water availability in these areas. As with other agricultural crops, any use of pesticides could also have significant effects on soil toxicology and non-target species (Zah et al., 2007).

4.4.4 Manufacturing impacts

Most of the international literature focuses on the environmental impacts of feedstock cultivation. Since few New Zealand feedstocks are currently produced from crops, addressing impacts associated with the manufacturing process may be more relevant to the domestic industry. During the manufacture of biodiesel several waste products are produced, including methanol, potassium hydroxide and significant quantities of glycerine. Whilst glycerine can be utilised in many cosmetics, foods and medicines, large scale global production of biodiesel has saturated the glycerine market⁷ (Taylor, 2007). Irresponsible disposal of these

⁷ Research is being undertaken to assess other end-uses for glycerine, including use as a boiler fuel or as an animal feed supplement.

waste products, along with wastewater generated by biodiesel plants could lead to pollution of nearby waterways or sensitive sites (S. Smith, 2008).

4.4.5 Social concerns

International concerns around biofuel expansion leading to exploitative labour practices and human rights abuses are perhaps less applicable to a domestic industry, as these practices are already illegal under New Zealand law. The ‘food versus fuel’ debate arguably holds more relevance, although New Zealand is not reliant on subsistence agriculture, and farmers typically grow crops based on economic factors, rather than food security concerns. It appears unlikely that New Zealand biofuels currently compete with domestic food production for domestic consumption. Both tallow and whey are by-products which can be used in food and non-food products, but neither are considered food staples. Tallow can be used as a food additive, but is more likely to be utilised in soap, biodiesel or candle production (MED, 2008). Whey can be made into lactose powder, but is primarily used to produce ethanol, which is used in beverages, pharmaceuticals, perfumes, food additives, inks, and as an industrial solvent. The situation for rapeseed (canola) is more complex as it has traditionally been grown in New Zealand to produce cooking oil, and as a fodder crop for stock (Andrew & Forgie, 2008). If this production was diverted into biofuel production, it could result in a reduction in canola supply for fodder or cooking oil. In addition, large scale cultivation of rapeseed for biodiesel will result in competition for arable land with cereal crops and grazing (Hall & Jack, 2008). However, a multi-year cropping cycle often involves fallowing, where the land is left vacant to recover its nutritional properties. Rapeseed can be grown as a rotational ‘break crop’ crop, fulfilling the same function as fallowing. In some instances farmers use other food crops to fulfil this function (such as peas), so here, cultivating rapeseed would result in direct displacement of a food crop (MED, 2008). However, the cultivation of rapeseed produces a valuable co-product of meal, which can be used as animal fodder, meaning that growing rapeseed produces both a food and a fuel.

4.4.6 Use of Waste and by-products

The New Zealand biofuel industry is currently dominated by the use of waste and residue feedstocks, such as UCO, whey and tallow. Many scientists advocate the use of waste feedstocks for biofuel production, which are considered to have a lower environmental impact than purpose-grown crops (Groom et al., 2008; RFA, 2008; Zah et al., 2007). Using wastes such as UCO has the advantage that the feedstock has a negative economic value, and would otherwise require disposal. Converting whey into ethanol allows recovery of a wastestream, and is actually cheaper than the cost of treatment and disposal (Gibbons, 2007). However, turning by-products into biofuels may have complex displacement effects, since waste feedstocks commonly have alternative uses. In the case of whey, ethanol has a range of diverse uses, and New Zealand currently exports most of what it produces to overseas markets. Tallow is another example, where the majority of New Zealand tallow is exported to Asia for use in soap and candles. As a consequence of increasing tallow-biodiesel production, this export supply could be reduced, which may indirectly result in an increase of unsustainable palm oil production to meet demand (Dale, Howes, Miller, & Watson, 2008). While many wastes have several advantages, they are limited in their scalability, and can only provide small-scale solutions for the transport fuel mix.

4.4.7 Advanced technologies

A recent study commissioned by Scion research institute suggests that utilising advanced technologies could provide numerous environmental advantages over agricultural crops (Hall & Gifford, 2007). Fast-growing tree species like eucalypts, acacia, and willow could help with nutrient and sediment capture from agricultural crops, waste-water refining, riparian planting, and erosion control. Plantation forestry for bioenergy could be established on marginal land, and does not require irrigation, fertiliser or pesticides. During their lifecycle, plantation forests provide erosion control, sediment reduction, improved water quality and some flood mitigation (Hall & Jack, 2008). Yet during harvest, logging can damage the forest understory, disturb species habitat, result in soil disturbance and runoff into waterways, and lower the overall soil carbon through time. Monoculture plantations cannot provide the full spectrum of ecosystem services

present in native forest, and will only support limited levels of biodiversity. There is concern over the invasive nature of some biofuel species, which may have ramifications for New Zealand's biodiversity if such plantations are established in lieu of native vegetation (Hall & Gifford, 2007). The spread of exotic tree species (such as *Pinus contorta*) would have to be carefully managed to ensure they did not become a pest (as some currently are in high country grasslands for example). Algae is a future feedstock which may pose fewer environmental impacts. It can be grown on existing municipal wastewater and agricultural effluent streams, provides the considerable co-benefit of wastewater treatment, and does not require arable land.

4.5 Summary

Biofuels have become controversial over concerns that they may not result in net GHG emission reductions, alongside issues surrounding the environmental and social costs of their production. Whilst most biofuels achieve significant GHG savings when compared to fossil fuels, there is considerable variation in the level of reductions produced by different feedstocks using different production technologies. Furthermore, lifecycle analyses generally fail to account for emissions caused by land-use change, which can be significant. Conversion of rainforest and peatlands into biofuel crops in developing countries has led to habitat and biodiversity loss in some areas. Most of the environmental impacts can be attributed to the agricultural cultivation stage of biofuel production. Cultivation of biofuel monocultures, which require irrigation, pesticides and fertiliser use, can negatively impact on local soil and water quality. Increasing demand for biofuels has been implicated in the recent escalation of food prices, yet the scale of these effects is uncertain. Utilising waste feedstocks and advanced biofuel technologies might alleviate some of these concerns, as they do not compete with arable land, require fewer inputs and may produce higher yields. However, advanced technologies are still under development, and are not currently available commercially.

While there are numerous issues relating to sustainable biofuel production, not all are relevant to a New Zealand industry. New Zealand feedstocks are typically more sustainable, with negligible impacts on biodiversity and food security, or

issues related to social exclusion. Domestic biofuels appear to offer significant opportunities for GHG reductions, yet emissions associated with land-use change need to be taken into account for a robust comparison. Many domestic feedstocks are produced from waste or by-products which exhibit lower environmental impact than purpose-grown crops. The cultivation of rapeseed will have associated impacts on local soil and water quality, similar to impacts caused by other agricultural crops. While advanced biofuels may promise better GHG savings, and require less inputs and land, many are far from commercialisation, and their introduction will inevitably also bring new challenges for sustainability.

Chapter 5

Setting standards to encourage sustainable biofuels

“We cannot afford to abandon biofuels as part of a low carbon transport future. Equally, we cannot continue producing biofuels which are ultimately more environmentally and socially damaging than the fossil fuels they seek to replace”

Ed Gallagher, Chair – The Renewable Fuels Agency

(RFA, 2008, p. 7)

Since the emergence of biofuels as a climate change mitigation strategy, there has been growing popular concern around their sustainability, alongside doubts over their climate benefits. The previous chapter showed how the environmental and social impacts of biofuels vary according to feedstock and production methods, and not all biofuels have a low carbon footprint. Many authors have called for policies which encourage best practice in feedstock production and refining (Fargione et al., 2008; Gibbons, 2007; Groom et al., 2008; RFA, 2008). Setting standards and establishing certification schemes are possible strategies which can help ensure sustainable production. This chapter addresses Objective Three by giving a brief overview of some current initiatives in relation to biofuel sustainability standards being undertaken by different stakeholder groups, analysing the benefits and drawbacks of such schemes, and reporting on the possible ramifications for World Trade Organisation (WTO) compliance.

5.1 Standard Development

In recent years, the number of sustainability certification schemes and standards being developed has grown, due to increased consumer demand for sustainable choices (Kaphengst, Ma, & Schlegel, 2009; Verbeke, 2007). Development of sustainability standards or certification typically follow the same formula (Zarrilli, 2008). Principles are first established, which describe the objectives of the standard. These principles are then translated into more specific and measurable criteria. Each criterion requires the development of indicators, which are minimum parameters by which criteria become

measurable. Precedents for sustainability standards already exist for agricultural and forestry products, which often exhibit significant overlap of principles, criteria and indicators with biofuel frameworks. To avoid a duplication of effort, many groups have been advocating a ‘Meta-standard Approach’ which seeks to make maximum use of existing standards where they overlap with criteria relevant to biofuel production. Compliance with a meta-standard is achieved through certification with an existing ‘qualifying standard’, which must share the majority of the principles and criteria desired (Kaphengst et al., 2009). The criteria being suggested for biofuel sustainability standards are diverse, covering a range of environmental, social and economic considerations, and there appears to be little consensus about what should be included (Buchholz, Luzadis, & Volk, 2009; Delzeit & Holm-Mueller, 2009; Van Dam et al., 2008).

5.2 An overview of sustainability initiatives

A wide variety of stakeholders have begun initiatives that attempt to ensure biofuels are produced sustainably. Numerous projects are currently underway internationally, in various stages of development, from the discussion phase to full implementation. Key actors involved with developing criteria or standards include: national governments and regional groupings (the EU in particular); companies; non-governmental organizations (NGOs); and international organizations (Van Dam et al., 2008). Various approaches to implementation are under development, ranging from voluntary to mandatory schemes, across a local, national or international level. Four prominent approaches to the implementation of biomass sustainability standards are discussed below.

5.2.1. Voluntary multi-stakeholder initiatives

In this approach, a group of governments, companies and other concerned stakeholder groups voluntarily adopt standards and certification schemes. Issues surrounding the production of commodities have resulted in the establishment of Roundtables, where all stakeholders along the supply chain are represented. These include the Roundtable on Sustainable Palm Oil, the Better Sugarcane Initiative and the Roundtable for Responsible Soy (which are all crops that can be used as biofuel feedstocks). These initiatives tend to focus on improving environmental and social standards of producers within the industry, often by creating voluntary codes of good practice. Precedents for

this kind of certification exist for a wide range of products including forestry, agricultural products and electricity.

In 2007 the Roundtable on Sustainable Biofuels (RSB) was formed, with the aim of achieving global, multi-stakeholder consensus around the principles and criteria of sustainable biofuels production (RSB, 2009). The RSB organised a series of global stakeholder workshops to collect feedback on draft biofuel sustainability principles from farmers, companies, NGOs, experts, governments, and inter-governmental agencies. Interested stakeholders were invited to join Working Groups and suggest criteria for achieving these principles, as well as rewording for the draft principles themselves. The RSB then produced 'Version Zero', a first draft of a globally-applicable standard for sustainable biofuels (RSB, 2008). The 11 draft principles are highly aspirational, and viewed by RSB as an ideal scenario towards which stakeholders should be progressing (Zarrilli, 2008). The second round of global stakeholder feedback finished on March 31st 2009, with nearly 900 participants from over forty countries providing feedback. The group's eventual aim is to develop a complete certification scheme (RSB, 2009).

Another global voluntary initiative is the 'Sustainable Biofuels Consensus', which has concentrated on reaching a consensus on an approach for the sustainable trade, use and production of transport biofuels (GBEP, 2008). In March 2008, a group of international biofuel experts met and adopted a pact to progress sustainable free global trade in biofuels. They encourage other biofuel stakeholders to adopt this consensus, and to help achieve this goal they promised to utilize every opportunity to stimulate initiatives that implement the consensus on a global scale.

5.2.2. Private label with higher standards than those mandated by law

As part of a voluntary scheme it is possible to develop an eco-label to certify those biofuels that meet higher standards than those mandated by law. An eco-label identifies products or services deemed to meet environmental leadership specifications within a specific category, based on lifecycle considerations (Environmental Choice New Zealand, 2009). Environmental labels are designed to inform consumers of the relative environmental impacts of the products they purchase, promoting products that cause less damage to the environment. Eco-labels are implemented by an impartial third party,

such as government or private institutions. In New Zealand, the Environmental Choice label provides an independent guide for consumers who want to purchase products that are better for the environment. Canada is currently employing a national eco-label, EcoLogo, to promote sustainable biofuel consumer choice (Zarrilli, 2008). The label is an independent, third party, green certification organisation which serves a wide range of products and services, but has formulated specific criteria for biomass.

5.2.3. Government regulation for (minimum) biofuel standards

While many national governments are promoting biofuels, only a few have taken initiatives to ensure they are produced sustainably. Below are some of the notable exceptions:

The Netherlands

The Dutch government has been a front-runner in the development of bioenergy sustainability standards. In 2006, the “Sustainable Production of Biomass project group” (also referred to as the Cramer Commission, in reference to the chair, Minister Jacqueline Cramer) was established. They published influential reports, and examined bioenergy sustainability based on six framework themes and nine basic criteria (see Table 5.1). The group employed a “Meta-standard” approach, seeking out existing standards which shared relevant criteria. They found that the biodiversity, environment, and social well-being themes shared similarities with numerous other standards, but there appeared to be no applicable standards for GHG, competition with food, and local applications of biomass and prosperity, so the commission made their own. They also developed methodology for calculating GHG savings. The commission made a distinction between reporting which could be undertaken at the company-level, and macro-level factors such as land-use change, which required regional or national monitoring by government. When writing the framework the group consulted broadly, involving parties from the private sector, social organizations, financial institutions and Governments. It also worked closely with work being undertaken in the United Kingdom, resulting in similar testing frameworks. The final report from the project group was released in March 2007, but the national obligation for sustainability reporting has been suspended while waiting for progress at the EU level (Zarrilli, 2008).

Table 5.1 Themes and Principles developed by the Cramer Commission

Theme 1: Greenhouse gas emissions

- (1) The greenhouse gas balance of the production chain and application of the biomass must be positive.
- (2) Biomass production must not be at the expense of important carbon sinks in the vegetation and in the soil.

Theme 2: Competition with food and local applications of biomass

- (3) The production of biomass for energy must not endanger the food supply and local biomass applications (energy supply, medicines, building materials).

Theme 3: Biodiversity

- (4) Biomass production must not affect protected or vulnerable biodiversity and will, where possible, have to strengthen biodiversity.

Theme 4: Environment

- (5) In the production and processing of biomass, the soil and the soil quality are retained or improved.
- (6) In the production and processing of biomass, ground and surface water must not be depleted and the water quality must be maintained or improved.
- (7) In the production and processing of biomass, the air quality must be maintained or improved.

Theme 5: Prosperity

- (8) The production of biomass must contribute towards local prosperity.

Theme 6: Social well-being

- (9) The production of biomass must contribute towards the social well-being of the employees and the local population.

Source: (Zarrilli, 2008)

The United Kingdom

In the United Kingdom (UK), supply of biofuels is encouraged through a duty derogation and the Renewable Transport Fuels Obligation (RTFO), administered by the Renewable Fuels Agency (RFA)⁸. The RTFO requires 2.5% (by volume) of transport fuel to be delivered from renewable sources by 2008/09, rising to 5% by 2013/14. Fuel suppliers that fail to achieve their obligation must pay a buy-out penalty. The obligation was introduced to assist the UK in meeting its requirements under the EU Renewable Energy Directive. To ensure these targets are met from sustainable sources, the UK has

⁸ The Renewable Fuels Agency is an independent non-departmental body with the aim to help the UK to achieve its renewable transport fuel targets sustainably.

introduced the world's first Carbon and Sustainability reporting scheme (RFA, 2009a). The RFA supplies certificates to biofuel suppliers that voluntarily submit reports on both the net GHG savings and the sustainability of their biofuels. The RFA separately monitors the indirect effects of biofuels which are beyond the control of individual suppliers, such as land-use change or changes to food prices. The agency regularly reports on the company performance, recognising both excellent and under performers. The government has set stretching targets for the level of carbon and sustainability performance expected from all transport fuel suppliers claiming certificates.

The RFA has calculated default lifecycle values for GHG savings for the main biofuel feedstocks supplying the UK market. Suppliers can gain an estimate of carbon intensity relative to the level of data they supply, with accuracy increasing as more information is supplied (see Fig 5.1). The sustainability reporting mechanism consists of seven principles, and is based on a Meta-standard Approach. Existing voluntary agri-environment and social accountability schemes have been benchmarked against the RFTO Meta-standard, and those meeting the required level of sustainability become 'qualifying standards'. Suppliers are able to use any qualifying standard. Biofuels produced from by-products such as tallow, UCO and whey, are not required to report on their sustainability, since it is reasoned that biofuel producers could have little influence over the sustainability of the production process of the original product. They must still report on their fuels carbon intensity.

Figure 5.1 Hierarchy of default values used in UK GHG Calculation Methodology

Source: (RFA, 2009a)

A report commissioned to investigate the indirect effects of biofuels production, the Gallagher Review (RFA, 2008), has had significant influence on UK policy development. It concluded that whilst biofuels should not be abandoned, their production should be slowed until adequate controls to address sustainability concerns can be implemented and proven to be effective. This report's findings convinced the government to slow the proposed rate of increase in the obligation, leading to the 5% target being set for 2013/14 rather than 2010/11. The review concluded that it should be possible to achieve a genuinely sustainable industry but this requires robust, comprehensive and mandatory sustainability standards. Higher targets beyond 2013/14 should only go ahead if biofuels are shown to be sustainable.

Voluntary Carbon and Sustainability reporting in the UK is seen as an essential 'stepping-stone' towards the future introduction of a mandatory quality assurance scheme. The UK has indicated that by 2011/12 it aims to introduce mandatory criteria, subject to EU and WTO agreement (RFA, 2008). The government aims to reward biofuels under the RFTO with the carbon savings they offer by April 2010. By April 2011, biofuels will have to meet appropriate sustainability standards to be eligible for these rewards.

Germany

On 1 January 2007 the Biofuel Quota Act came into force in Germany, aiming to progressively increase the biofuel share from 6.25% in 2009 to 8% from 2015. The German Federal Government recently passed a biofuel sustainability ordinance, which contained criteria that refer to minimum GHG savings, protection of natural habitat, and sustainable cultivation of agricultural land. Macroeconomic effects were excluded from the ordinance due to impracticality and WTO restrictions. Under this ordinance, future biofuel producers will qualify for fiscal and administrative support only if certain sustainability criteria are adhered to (Van Dam et al., 2008).

The European Union

On a supranational level, the European Union (EU) has introduced a Renewable Energy Directive (RED), which includes a target for 5.75% of energy in the transport sector⁹

⁹ This is not limited to biofuels and includes all renewable transport energy sources, including hydrogen and electricity.

coming from renewable sources by 2010 in each country, rising to 10% by 2020. The new Directive should be implemented by Member States by early in 2010. RED requires sustainability reporting for biofuels in the EU. The directive states that biofuels must deliver a minimum carbon saving of 35%, rising to 50% for old plants and 60% for new plants later, and should not be produced in highly biodiverse areas, on land with high carbon stock, or land which was former peat-land (RFA, 2009b). While no social criteria will be included, the directive will require the European Commission and member states to monitor for macro-level effects on food security, land-use change and commodity prices. Only those biofuels which meet the criteria can contribute to national targets and obligations, and be eligible for policy support. RED proposes extra incentives for biofuels made from wastes, residues, and ligno-cellulosic material. Several EU member states are simultaneously developing sustainability standards for biofuels. It seems likely that once the EU-wide scheme is in place, it will replace these national standards, including those already in operation.

United States

In the United States the Renewable Fuel Standard (RFS) requires a minimum of 9 billion gallons of renewable fuel in transportation fuel by 2008 (approximately 34 billion litres), rising to 36 billion gallons in 2022 (approximately 137 billion litres). The definition of “renewable fuel” is restricted, and does not apply to biomass harvested from newly cleared or cultivated land. Only fuels that comply with the new definitions will count towards satisfying the RFS. The law also specifies an annual increase in the production of advanced technologies, such as cellulosic ethanol. The Environmental Protection Agency is obligated to report to Congress on the environmental impacts of the RFS.

At a state level, California has introduced the world’s first GHG standard for transport fuels. The Low Carbon Fuel Standard (LCFS) adopted in April 2009 calls for a gradual reduction in the carbon intensity of transport fuels in California to 10% by 2020 (SKM, 2008a). The regulation requires providers, refiners, importers and blenders to ensure that the fuels they provide for the California market meet an average declining standard of carbon intensity, determined by the GHG emissions over its lifecycle. The LCFS is technology-neutral and is designed to increase the use of alternative fuels, replacing 20% of the fuel used by cars in California with clean alternative fuels by 2020, including electricity, biofuels, hydrogen and other options (Young, 2009).

Brazil

Brazil is in the process of developing a national certification scheme for biofuels. So far, it has developed six preliminary principles:

- a) compliance with environmental and labour laws;
- b) adequate working conditions;
- c) sustainable use of natural resources;
- d) biodiversity protection, recovery and conservation;
- e) water, soil and air protection; and
- f) socioeconomic development of the areas surrounding the production fields

(Zarrilli, 2008).

As part of its biodiesel programme, Brazil developed the Social Fuel seal in 2003, which aims to promote social inclusion and enhance environmental sustainability. The seal establishes conditions for industrial producers to gain tax benefits and credits. In order to receive the seal, an industrial producer must purchase feedstock from family farmers and enter into a legally binding agreement with them to establish specific income levels and guarantee technical assistance and training. There have also been efforts to gradually reduce the burning of sugarcane fields, a practice which aids manual harvesting, but also releases vast amounts of CO₂, ash and other airborne particulates. In 2000 the government took steps to eliminate burning and transition to mechanised harvest in Sao Paulo, where 60% of domestic sugarcane is produced. This policy was controversial since it resulted in unemployment and caused producers to shift farms to other areas (Van Dam et al., 2008).

New Zealand

The 2007 Biofuels Sales Obligation (BSO) required oil companies to supply biofuels into the transport fuel mix by 1 October 2008. The obligation level was set at 0.53%, increasing to 2.5% of annual petrol and diesel sales by 2012. Under the obligation, the government were to implement mandatory sustainability standards- at this time a world first. The BSO specified three principles of sustainability;

- a) Biofuels must emit significantly less greenhouse gas over their lifecycles than obligation engine fuels (minimum levels of no less than a 35% reduction were specified)
- b) Biofuels must not compete with food production and not be grown on land of high value for food production

- c) Biofuels must not reduce indigenous biodiversity or adversely affect land with high conservation value

While the BSO took effect on 1 October 2008, the sustainability standards were to be put in place as soon as was practical, with an aim to be developed by 1 July 2009. In December 2008 the newly elected National Government repealed the obligation. This was partly due to concern that in the absence of workable and practical sustainability standards, the BSO might have led to oil companies importing biofuels from unsustainable sources (Brownlee, 2009).

Work had begun by the Ministry for Economic Development (MED) developing biofuel sustainability requirements methodology. With the repeal of the obligation, responsibility for developing standards shifted to the Energy Efficiency and Conservation Authority (EECA), who had been involved in developing a voluntary standard prior to the BSO under the New Zealand Energy Efficiency and Conservation Strategy (NZECS). EECA is currently developing a voluntary sustainability reporting scheme for biofuels, based largely on the UK Carbon and Sustainability Reporting scheme. It is aimed to be released in December 2009. In June 2009, a Green Party MP, Jeanette Fitzsimons, introduced a Private Member's Bill to parliament, which aims to reinstate mandatory sustainability standards for biofuels. The bill passed its first reading before the House, and public submissions are now being heard before a Select Committee.

5.2.4. Efforts for Standardisation by International bodies and Organisations

While no international agreements for biofuels exist yet, numerous international bodies have been involved in developing sustainability standards for biofuels.

The United Nations is involved in sustainability standards through several initiatives. UNEP is heavily involved with the Roundtable on Sustainable Biofuels, organising joint regional outreaches to ensure involvement of different stakeholder groups from different regions. FAO launched the International Bioenergy Platform in 2006. One of their objectives is to assist in the development of an international scheme to develop workable principles, methodologies, criteria and indicators for an international

certifications scheme. The forestry department of FAO is also working on biomass certification for forest used for energy.

The G8 Global Energy Partnership was launched in 2006, to support wider, cost effective biomass deployment, particularly in developing countries where biomass use is prevalent. The partnership is made up of Governments, intergovernmental organisations and some private sector associations. Amongst other activities, the partnership is developing GHG calculation methodologies and focusing on the harmonisation of existing methodologies. In June 2008 the partnership established a taskforce on sustainability, which aims to develop a voluntary framework on international sustainability principles for bio-energy. The International Energy Agency Bioenergy, Task 40 on International Bioenergy trade is active in research and initiatives to investigate the establishment of a global bioenergy trade. Task 40 has made certification and standardisation key priorities.

The European Committee for Standardization (CEN) provides a platform for the development of European Standards and other technical specifications by its members. These standards have a unique status, since they are also national standards in each of its 30 Member countries. Following on from the proposed RED, which mandates EU sustainability requirements for biofuels, CEN has established a new technical committee to fulfil this need. The objective is to develop a European standard for sustainably produced biomass for transport fuels and energy production by the end of 2010. The committee will define sustainability criteria, their basic requirements and ways to assess them, using the principles of the Dutch 'Cramer Commission' as a starting point (Table 6.1). While CEN recognises the advantages of forming an international standard, it is thought that a European standard could form an easier basis for first discussions.

The International Organisation for Standardisation (ISO) is the world's largest developer and publisher of international standards, whose members consist of a network of the national standards institutes of 161 countries, one member per country. In late 2008 ISO proposed a new work item; developing 'Sustainability criteria for biofuels'. This has since been approved by members, and ISO called a preliminary scoping meeting in June 2009, to establish a new project committee to take the work forward. Brazil and Germany are jointly leading the process. The first meeting discussed the best way to

organise and structure standardisation in this field (Standards NZ, 2009). It is thought that criteria will be ready for publication in 2012.

5.3 World Trade Organisation Restrictions

Sustainability standards have to comply with international trade regulations, yet biofuel standards currently fall within a gray area of WTO legislation. The Technical Barriers to Trade (TBT) Agreement requires that regulations (mandatory) and standards (voluntary) should not create unnecessary barriers to trade. Debate has arisen over whether standards which distinguish between ‘like’ products that share the same physical attributes and final use is consistent with WTO rules (Kaditi, 2009). Under the General Agreement on Trade and Tariff (GATT) there is a distinction between product and process, and import restrictions can only be placed on a product if it is itself a potential danger to health. The production processes and methods cannot typically be used as the basis for preventing or taxing imports (Lovett, 2007), so environmental trade measures which distinguish between products based on their production processes and methods may violate TBT obligations. But at present, this distinction is highly contentious, and the applicability of TBT to biofuel standards is unclear, with experts divided over whether they apply (Doornbosch & Steenblik, 2007; Kaditi, 2009; Zarrilli, 2008).

While regulations should not generally discriminate between products that compete with each other in a market, there are some stated exceptions within GATT that could be used to justify use of standards. Article XX gives countries the legal means to balance their trade obligations with important non-trade objectives such as health protection, the preservation of the environment or the protection of natural resources. Another exception stated by GATT, is a provision for National security, and it has been suggested that energy security is a vital component of this. It is also debated whether certified and non-certified biofuels can be considered “like” (identical) products, a term which is central to WTO legislation, yet not actually defined under GATT (Zarrilli, 2008).

A main concern about establishing requirements on the way a product is manufactured, is that it limits the freedom of foreign producers to produce according to the technologies they have available, and following the priorities set up by their governments. It could appear as undue interference by one country into the sphere of

discretion of another (Zarrilli, 2008). It is also feared that sustainability standards could be used as a form of protectionism for domestic producers, acting as a non-tariff trade barrier to countries that could not afford to meet the additional costs of testing, certification and conformity (Dufey, 2007). Trade-related certification schemes can also be promoted by special interest groups, to demand practices not required in their own countries (Delzeit & Holm-Mueller, 2009).

Biodiversity preservation, and more generally environmental protection, appear to naturally fall within the range of stated exceptions allowed under article XX. These, along with requiring minimum GHG savings, are thought to be feasible under WTO, but will have to be carefully formulated. Minimum demands for economic prosperity and well-being are considered impossible under WTO obligations (Van Dam et al., 2008). No provisions exist within the WTO agreements to link trade with social issues or labour standards, and any attempts to include these have been met with opposition thus far. While WTO jurisprudence has proven increasingly flexible to differentiation of products based on health and environmental effects, it appears doubtful that it will appear sympathetic to product differentiation based on how the manufacturing process affects worker's conditions or local development opportunities (Zarrilli, 2008).

New Zealand is a small, open economy that relies heavily on trade, and because of this, is typically careful to comply with WTO rules (PCE, 2010). Since a voluntary standard has fewer implications for trade than regulations, it may be chosen by countries wishing to avoid prosecution.

5.4 Benefits and Limitations of Standards

There is currently a proliferation of sustainability schemes emerging, with no clear consensus over which criteria should be included or how these are to be turned into operational indicators (Buchholz et al., 2009; Van Dam et al., 2008). Multiple standards means efforts can often be duplicated amongst stakeholders, making comparison across products or standards difficult (Kaphengst et al., 2009; Zarrilli, 2008). Co-ordinating efforts in developing a generic global standard would avoid this confusion. But due to the number of parties involved and the range of divergent positions present, reaching a global consensus may take a long time, and these standards are unlikely to be ambitious. They may also be weakly enforced due to limited jurisprudence and soft commitments

from ratifying countries. The longer a standard takes to produce, the more difficult it will be to merge it with existing standards already in place (Zarrilli, 2008). While it will take time to develop workable standards, the urgency of the issues means it is not an attractive option to wait another decade (Londo & Deurwaarder, 2007; Schmitz, 2007).

An advantage of voluntary schemes is that they allow for gradual learning and improvement, and diminish the risk of creating WTO trade disputes (Van Dam et al., 2008). To be successful, they require strong levels of commitment from conscious consumers and suppliers, since there is no obligation for the market to fulfil them. Successful voluntary schemes can demonstrate to producers that it is profitable to produce and compete when taking higher responsibility for the environment and social justice concerns. This can provide an industry-based justification for regulations that bring all producers up to the higher standard, after it has been demonstrated in practice.

The effectiveness of voluntary certification schemes is limited, since they shift responsibility for combating environmental and social crime from governments onto consumers, who often lack the awareness or ability to act. There has also been a proliferation of eco-labels, which has allowed some poor performers to hide behind 'green-wash' (Kaphengst et al., 2009). Some authors remain sceptical about whether green consumerism will work for a fuel:

“Once biofuels are at the pumps, we could be offered consumer choice for ecologically and socially sustainable fuels. However, we certainly do not have that choice on fuels derived from oil – there is not a pump for fuel from Angola, another for Nigeria and a third for Iraq – enabling selection of the political regime we top our car up from, so it seems unlikely we will have a similar option for biofuels.”

(Lovett, 2007, p. 118).

Because voluntary certification is not a multilateral requirement, it could lead to market segmentation, rather than a reduction in unsustainable production. This has occurred for sustainably certified wood products which supply the smaller, higher priced market segment, whilst uncertified resources continue to serve the larger majority of the market (Doornbosch & Steenblik, 2007). To secure urgent sustainability concerns, the development of minimum standards by governments or regions may be necessary. However, mandatory standards must remain flexible enough to be adapted to the requirements of different regions, whose laws, areas of concern, crops and cultures may

all differ significantly (Delzeit & Holm-Mueller, 2009). Implementing standards in countries with weak governmental law enforcement may also prove problematic.

The aims of certification are dependent on the motives of those formulating them (Zarrilli, 2008). Because of this, wide stakeholder involvement, especially with primary producers and employees, is desirable to form a legitimate and reliable system. Van Dam et al. (2008) advocate a multi-stakeholder approach, where everyone who is concerned with or affected by a participatory process sets the criteria, and broad consensus is achieved. While this may be ideal, attaining broad consultation and consensus can be a lengthy process, and may result in a weakened outcome if too much compromise is required to reach agreement. There remains an inescapable aspect of subjectivity in standard development and governments will have to ensure transparency and broad stakeholder participation in the process to avoid breaching WTO law.

Standards must avoid becoming a non-tariff trade barrier, caused by the additional costs of testing, certification and conformity. There are two sets of costs involved with orchestrating a sustainability standard; a) the costs of complying with the standard, which can be substantial, and b) the costs of monitoring and enforcing compliance, which should be much lower (Van Dam et al., 2008). The financial costs are strongly related to the scale of operation, the number of criteria and their strictness. Stringent requirements will add significant compliance costs, and this is likely to have a higher impact on small producers and developing countries. These groups may also be limited in their capacity to implement criteria, due to fewer resources and technical skills. To avoid creating a hurdle for a young industry, standards could be paired with incentives and assistance.

Standards must also balance the trade-off between wanting to attain genuine sustainability, and remaining realistic about what is feasible in terms of quality assurance. Many challenges remain around how to turn sustainability concerns into operational criteria and indicators. The rising international trade in biofuels will make enforcement and chain-of-custody control difficult, as feedstocks are processed into many different products, sourced from many different origins and owners, and often lack data about their production methods and processes. Preventing the laundering of illegal products between countries requires strong cooperation across borders, with the premium to cheat on criteria very high (Doornbosch & Steenblik, 2007). Many of the

social criteria lack quantifiable indicators, whilst measuring GHG emissions is an emerging science with methodologies still under development. How to measure macro-level effects, such as ILUC, food security and global commodity prices, is still being discussed, and may prove difficult to integrate into existing schemes.

While standards will not solve all the sustainability issues, they may reduce some of the worst impacts. Standards can act as a tool to both encourage sustainable biofuels production and prove it. In the future they may become a pre-condition for biofuels to be counted towards national blending targets or policy incentives. They may also become a pre-condition for consumer acceptance (Zarrilli, 2008). Yet standards have limits, and will not be successful in isolation. Tackling global environmental and social issues will require additional alternative policy solutions which set clear rules and incentives for sustainable biofuel production (Kaphengst et al., 2009).

5.5 Summary

The development of sustainability standards for biofuels has emerged out of concern over the negative impacts associated with biofuel production. There is currently a proliferation of initiatives being led by a wide variety of stakeholder groups including; governments, NGOs, companies and international organisations. This chapter discussed four prominent approaches for development and implementation of sustainability standards;

- a) Voluntary multi-stakeholder initiatives,
- b) Private eco-labels,
- c) Government regulation and
- d) Global efforts by international bodies towards standardisation.

Each of the above approaches has advantages and limitations. Standards are ultimately subjective, and will be shaped by the motives of those who participate in their formation. There is debate over whether implementing sustainability standards could be in conflict with WTO law, and this is a key concern for many governments wishing to introduce mandatory schemes. The costs of complying with standards may limit the capacity for some producers to participate. Voluntary schemes may serve to demonstrate best-practice, lower the risk of breaching WTO legislation, and allow for gradual learning and improvement. But these schemes may be less effective since they

are reliant on green consumerism, which could simply segment the market. Global co-operation is needed to ensure the sustainability of commodities which are internationally traded, yet reaching international consensus on a standard will take time. The formation of standards is typically slow, and few are currently operational, yet the immediacy of the issues requires urgent action. This is a rapidly evolving area, with many initiatives in the early stages of development. A significant challenge remains in turning aspirational principles and criteria into operational indicators. Sustainability standards can only provide a partial solution to the proliferation of unsustainable biofuels, and must be complemented by policies which encourage responsible business solutions.

Chapter 6

New Zealand perspectives on sustainability standards

In this chapter, the interview methodology is described, before the results of the stakeholder interviews are presented, organised according to major emerging themes. This is the final objective, Objective Four, to explore a participant perspective on biofuel sustainability standards as a possible solution with key stakeholders. Interviews with representatives from the biofuel industry, relevant NGOs, key biofuels experts and government officials were used to explore stakeholders opinions around whether a domestic sustainability standard would be useful, what sustainability criteria should be included, and what form such a scheme should take. Participants were also asked to suggest broader policy solutions which could encourage sustainable biofuel production.

6.1 Interview Methodology

The semi-structured interview format was chosen to provide flexibility, allowing the interviewer to respond to the direction in which participants took the interview and meant that topics covered were not unduly constrained by the researcher's own ignorance of the area (Creswell, 2007). This approach provided insight into what the interviewee saw as relevant and important (Bryman, 2004). It also allowed the researcher to gain a depth of meaning that is generally unavailable from quantitative measures (Babbie, 2001). During this research the views of the author were significantly influenced by her interactions with those being interviewed, and this has shaped the study's conclusions. The iterative nature of grounded theory allowed for questioning to be redesigned through the research process as additional issues or questions raised by participants were incorporated into subsequent interview schedules (Babbie, 2001; Bryman, 2004).

6.1.1 Participant selection

Initial informal discussions were held with key officials at MED and EECA to further define the research questions. Key informant purposive sampling was then used to select interviewees, where participants were chosen based on their relevance to the research (Hay, 2005). Such sampling is strategic and aims to select individuals with a broad, deep knowledge of the subject matter (Bryman, 2004). Participants were then selected by identifying key figures from relevant organisations from observing the occurrence of names in relevant public policy submissions and conference lists. Once identified, potential participants were approached by phone (if in or near Wellington), or by email. From then a “snowballing” approach was used where participants were asked to recommend other individuals for interviews. Of the 28 people approached, five people refused outright to be interviewed, and three others were too busy to participate. In-depth 1:1 interviews were conducted with 20 stakeholders from government, the biofuel industry (comprising biofuel producers and distributors), environmental NGOs, and independent consultants involved in the industry (Table 6.1). Consumers were not included in this sample, as the study focused on supply issues. There was a deliberate sampling bias towards non-government participants, as this thesis intends to contribute to the formation of policy by informing government of stakeholder views.

6.1.2 Interview Protocol

The interviews were performed between March and May 2009, took place in person and typically lasted around one hour. One interview was conducted via telephone due to the participant being located overseas. Interviews were semi-structured and based around seven questions that are listed in the interview schedule (Appendix A). Where requested, this schedule was sent to interviewees in advance of the interview. The wording and order of questions was regularly modified to improve clarity and suit each participant’s area of expertise. Interviews were tape-recorded and later transcribed for accuracy. Interviewees were given the option of remaining confidential or being identified either by name or as a representative from their category, as approved by the Victoria University of Wellington Ethics Committee (See Appendix B). Throughout this chapter, the category of each participant is either specified in the text or indicated by the abbreviation after their name. Many of the participants wanted to emphasize that their

responses were not representative of the organisations that they worked for, but rather represented their informed professional opinions as individuals.

Table 6.1 Interview Participants

Category One: Industry representatives (I)
1. Andrè Hamman, Director of NZ Ester Fuels and Convenor of the BANZ Liquid Biofuels Interest Group
2. Bernard Reynauld, General Manager – International, Biodiesel Oils NZ Ltd
3. Gary Brockett, CEO, Ecodiesel
4. Karl Mischewski, Sustainability Champion, Gull Group
5. Barry Blackett, BP Oil New Zealand Ltd
6. Peter Motion, General Manager of Ethanol & Industrial Sales, Fonterra
7. Andrew Simcock, General Manager, Biodiesel New Zealand
8. Sean Simpson, Chief Scientific Officer and Founder, Lanzatech
Category Two: NGO Representatives (NGO)
9. Will Dempsey, New Zealand Business Council for Sustainable Development
10. Barry Coates, Executive Director, OXFAM
11. Mark Roberts, Sustainable Business Network
12. Tim Jones, Sustainable Energy Forum
13. Sandy Gauntlett, Pacific Indigenous Peoples Environment Coalition and Oceania Focal Point Global Forest Coalition
14. Tushara Kodikara, Environment and Conservation Organisations of NZ Inc.
Category Three: Relevant government officials
15. Government Official 1 (G1)
16. Government Official 2 (G2)
17. Government Official 3 (G3)
Category Four: Independent consultants with biofuel expertise (C)
18. Angela Henderson, Business Relationships Manager, Standards New Zealand
19. June Gibbons, Environmental Scientist, URS
20. Andrew Campbell, Consultant, Fuel Technology Ltd

6.1.3 Analysis of data: Coding

Data was then analysed by coding, a common technique used in qualitative research (Bryman, 2004; Hay, 2005). The coding of transcripts entailed reviewing data, labelling component parts and organising data into emergent themes. This process is very fluid, with codes constantly revised and compared to see with which concepts they best fit. Responses were coded at increasing levels of analysis. Transcripts were initially coded in great detail, generating numerous specific codes to encapsulate the data. Notes were made in the margins about the topics being discussed, and these notes were gradually refined into codes. Memos were written on each concept after a few themes had been coded to serve as a reminder of what was meant by the term, as recommended by Bryman (2004). Some transcript lines were coded in several ways. Coding which initially was very basic, became more intricate as themes emerged from the data. This generated 90 different open codes. Selective or focused coding was then undertaken, emphasising the most common codes, and creating more selective and analytical ways of categorising the data. During this process new categories were created by combining several initial concepts. Some category labels were formed from concepts found in the literature, others were ‘in-vivo’ codes (Hay, 2005), which used phrases repeatedly used by participants (but not common in the literature). Fourteen core themes were developed, and numbered for ease of reference. The data was then re-evaluated in terms of these selected categories. The recursive nature of grounded theory allowed for ongoing revision of categorisations and theories. All similarly coded sections were electronically cut and pasted into a word document, and amalgamated into a single file. The conceptual framework developed from earlier objectives was then used to generate theory, by systematically linking well-developed related categories, which eventually became the structure of the Discussion (Chapter 7).

Selected quotes have been included to demonstrate common opinions shared by many participants, or clarify divergent views expressed by individuals. The quotes used in this thesis have been checked for accuracy with participants, and used in the same context in which they were taken from the interviews.

6.2 Sustainability issues

6.2.1 Issues attributed to domestic biofuel production

Participants were asked to name some of the broad sustainability issues associated with biofuel production in New Zealand. Fig. 6.1 shows the frequency with which specific issues were raised.

Figure 6.1 Participant views on the main sustainability issues associated with domestic biofuel production

Table 6.2 explains the central concerns expressed around each issue identified by stakeholders in Fig. 6.1.

Table 6.2 Main sustainability issues discussed by stakeholders

Name of issue	Explanation
GHG emissions	Concern with the GHG balance of the system, that biofuels might not result in significant GHG savings compared with fossil fuels
Biodiversity loss	Land conversion for biofuels could result in biodiversity loss. See a need to safeguard protected, threatened, or other valuable ecosystems and species
Food security	Biofuel production could reduce the amount of land locally available for food production, or increase the price of food
Competition for arable land	Preferring biofuels to be grown on marginal sites, or not require arable land, to avoid competition with other uses
Agri-chemicals inputs	Concern around the use of chemicals, pesticides and fertilisers in biofuel cultivation and their impacts on the surrounding environment
Waste feedstock	Opinion that waste and by-product feedstocks are more sustainable and should be prioritised above purpose-grown bioenergy crops. Their use can allow for integrated waste management, where a waste which previously required disposal gains value as a biofuel substrate.
Unsustainable imports	Concern that unsustainable biofuels, which are causing environmental and social harm overseas, will be imported for use domestically
Deforestation ¹⁰	Concern that land conversion for biofuels will result in deforestation of rainforest
Soil degradation	Concern that biofuel cultivation could negatively impact on soil fertility, causing changes in organic matter, water holding capacity, or erosion
Monocultures	Concerns around risks associated with monocultures, such as impacts on landscape and wildlife, and susceptibility to disease and pests
Indigenous rights	Believe that biofuel expansion must ensure recognition of indigenous peoples' rights, with due consideration given to spiritual values and local knowledge
Particulate emissions	Concern that biofuels production may cause hazardous emissions (other than GHG) such as SO _x , CO, NO _x , and particulates
Water management	Biofuel production could impact both the quantity and quality of water available. Effects might include depletion of surface and groundwater stores, or pollution of waterways from waste water disposal

¹⁰ Although this category is a subset of the issue 'Biodiversity loss', the frequency with which it was specifically mentioned justifies formation of its own category. Many participants mentioned the two issues in tandem.

Table 6.1 (continued)	
Energy inputs	Concern with the source of energy used to produce biofuels and the efficiency of the conversion plant (eg. Is production being fuelled by coal-powered electricity?)
Energy balance	Concern that the amount of energy embodied in one unit of biofuel may not significantly exceed the amount of energy required to produce it. Concerned with achieving efficient energy return on investment and energy return/ha.
Waste management	Concerning the inappropriate disposal of manufacturing wastestreams such as the residual chemicals produced in the manufacture of biodiesel
Working conditions	Concern that biofuel production may result in poor working conditions for employees. This could include failure to ensure workers' health and safety, or the exploitation of child labour
Displacement effects	Concern with the indirect displacement impacts of diverting feedstocks into biofuels (eg. Tallow used in biodiesel can no longer be made into soap, creating a displacement effect in the market)
Local employment	Belief that biofuel production should create local employment
Use of GM	Concern that biofuel production may utilise GM, which could lead to crop contamination and public health risks
Human rights	Belief that biofuel production should respect all human rights, such as gender equality, liberty rights, and the right to security, health and education
Monitoring	Concerns that it will be difficult to put monitoring systems in place for all criteria. In particular, GHG emissions will prove difficult to measure
Property rights and use	Belief that there is a need to ensure that areas being used for biofuel production have legitimate land and resource tenure arrangements and that there is fair and equal division of proceeds
Inefficient engine	Concern that biofuels will extend the use of the mechanically inefficient combustion engine, delaying investment in more efficient technological advances
Poverty alleviation	Belief that profits from biofuel production should contribute to rural development and poverty alleviation
Indirect land-use change	Concern that diverting existing agricultural land into biofuel production could result in indirect land-use change, with associated habitat destruction and GHG emissions
Participation	Belief that biofuel production should allow for inclusion of self-determined stakeholders in decision making

The only issue mentioned by over half of the participants was GHG emissions. Other issues which were commonly mentioned included; biodiversity loss; food security;

competition for arable land; use of agri-chemical inputs; and the notion that biofuels should be sourced from waste feedstocks (see Fig. 6.1).

Many Government and industry stakeholders indicated that they felt that the New Zealand biofuels industry is already sustainable (Brockett (I), G2, G3, Hamman (I), Mischewski (I)).

“This is in some respects the most frustrating aspect, is that the New Zealand feedstocks are the most sustainable. I mean you don’t have to prove that they are sustainable, they *are* sustainable.”

Hamman (Industry)

When asked about the environmental impacts of biofuels, many participants made the comment that the issues were very feedstock specific (Coates (NGO), G3, Jones (NGO), Mischewski (I), Motion (I), Simcock (I)).

“A lot of people make the point that I would also make, that...one of the problems when you’re talking biofuels is that people treat all biofuels as if they are the same, when in fact they are widely different. Both the feedstocks and the sustainability issues involved with them. And I think that in the public debate, that’s a real problem, as all biofuels seem to be tarred with the same brush basically”.

Jones (NGO)

Participants emphasised the sustainability benefits of domestic biofuels made from waste products (Blackett (I), Campbell (C), Hamman (I), Gauntlett (NGO), G1, G2, Kodikara (NGO), Motion (I), Roberts (NGO)), or second generation feedstocks such as algae and purpose-grown forests (G2, Mischewski (I)).

While the focus of the questions was on domestic issues, participants often referred to international sustainability issues. International biofuels were regularly spoken of in a negative light, and many sustainability issues such as food security, rainforest deforestation or displacement of the poor, were considered more applicable to foreign biofuel production. The government officials all agreed that many of the international sustainability concerns were not as relevant to the New Zealand context. Two officials felt that the government could provide support for biofuels produced in New Zealand without any sustainability requirements.

“We would be satisfied that the existing legal and regulatory frameworks in New Zealand, coupled with the nature of the biofuels we’re talking about being

domestically produced and locally produced, provide us on a policy level with the certainty that they are sustainable.”

G2 (Government)

6.2.2 Questioning the sustainability of other industries

Many industry participants felt that biofuels were much more sustainable than their fossil fuel alternatives (Mischewski, Simcock, Simpson). In contrast some NGO participants mentioned that particular biofuels could potentially cause equally adverse environmental impacts compared with oil (Dempsey, Gauntlett). A consultant participant thought that encouraging biofuels without requiring GHG reduction targets created a risk that biofuels would be produced with impacts worse than conventional oil (Campbell). Two participants commented that the sustainability issues around biofuels were far more complex than those related to oil extraction, due to the larger amounts of land required, and a much broader range of potentially larger impacts (Blackett (I), Gibbons (C)). It was also noted how many of the other alternatives to oil may have far worse sustainability impacts than biofuels (G3, Jones (NGO)).

Several participants commented on the irony that the same sustainability criteria were not applied to oil production (Campbell (C), G1, G3). Government officials were frustrated that biofuels are so heavily criticised, with an emphasis on making them prove their sustainability, while the sustainability of oil does not get the same level of scrutiny:

“It’s just that there is some irony in the fact that we can potentially apply really stringent sustainability requirements to biofuels, without even questioning for a minute the sustainability of the fuels they substitute.”

G2 (Government)

One industry participant was incredulous that corn ethanol was being so heavily criticised, when it could produce GHG emissions lower than oil;

“To me the standard [for comparison] should be oil. The standard should be production of petrol from oil. That’s what we’re trying to get better... Anything better than that is good. So, and I think the danger is, and certainly I think the danger in New Zealand is that we make the perfect the enemy of the good.”

Simpson (Industry)

Many stakeholders felt that biofuels were receiving a large amount of scrutiny compared with other industries, and that the same benchmark should be applied elsewhere (Brockett (I), Jones (NGO), Mischewski (I), G1, G2, G3).

“To me the question is not so much why we are putting these sustainability standards around biofuels but why *aren’t* we putting it around the other fuels. And why don’t we put them on all?”
Jones (NGO)

A government official commented that wine production causes the same impacts on displacing food production as biofuels, but has not undergone the same levels of international scrutiny (G2). Several participants commented that developing sustainability criteria for biofuels could act as a pilot for expanding standards to other industries (G1, Gibbons (C), Jones (NGO)).

6.3 A domestic sustainability standard

6.3.1 Should New Zealand develop a sustainability standard for biofuels?

Participants were asked whether they thought a sustainability standard was needed in New Zealand¹¹.

Figure 6.2 Participant views on whether New Zealand should develop a sustainability standard for domestic biofuels

¹¹ Government officials were not asked this question, as they were all involved in work developing a standard.

Fig. 6.2 shows that the majority of participants see the need for New Zealand to develop a sustainability standard for biofuels. NGO and consultant participants were unanimous that a standard was needed. Many reasoned that it would prevent unsustainable practices (Campbell (C), Dempsey (NGO), Jones (NGO)). Another participant thought a domestic standard would be beneficial to provide experiences which could offer insight and feedback towards any international standard development process (Henderson (C)). Some industry participants were keen for a standard to serve as a scoreboard where countries, companies or feedstocks could be compared and ranked (Hamman, Simcock). The two industry participants who did not feel a standard was needed differed in their reasoning. One thought that developing a standard without a mandatory requirement to supply biofuels in the liquid fuel market was pointless, as he felt oil companies would not sell biofuels voluntarily (Simpson (I)). The other did not see a need for New Zealand to be “reinventing the wheel” and felt it would be better to remain involved in the international development of standards (Mischewski (I)). Two participants thought that the concept of sustainability had already become so ingrained, that future biofuels would create less sustainability issues, and hence there would be less need for a standard in the future (G3, Roberts (NGO)).

Many participants felt that biofuels have become controversial, and the public is divided in supporting them (Blackett (I), Campbell (C), Henderson (C), Jones (NGO), Mischewski (I), Simpson (I)). Some mentioned the negative effect the media has had on consumer perceptions of the industry (Brockett (I), G1, Hamman (I), Mischewski (I), Simcock (I)). Frustration was voiced by government officials who felt that the media was quick to publicise controversial international sustainability issues which held little relevance to New Zealand biofuels (G1, G2). All three officials felt that the public were confused, and standards might serve “to distinguish New Zealand produced biofuels from the broader impressions that consumers get about biofuels, from a media which has been broadly negative or concerned about biofuels globally.”(G3). Another official reiterated this point;

“I guess in a New Zealand context talking about New Zealand biofuels, I would say it’s a problem of a mismatched consumer perception and actual reality. That’s a very different problem from the idea of biofuels internationally. So given that problem, in a New Zealand context, you just want a standard which provides consumers with digestible information which distinguishes New Zealand’s biofuels from the stuff they’re hearing about in the media, about orang-utans and rainforests and starving children in the developing world.”

G2 (Government)

Others also recognised the value of a sustainability standard as a public awareness tool to educate uninformed consumers (Campbell (C), Simcock (I)).

There was broad concern surrounding the plethora of biofuel sustainability standards emerging internationally (Brockett (I), G3, Gibbons (C), Henderson (C), Mischewski (I), Reynauld (I)). Numerous stakeholders wanted to see one global standard developed, and thought it was important that New Zealand participate in its development (Henderson (C), Mischewski (I), Reynauld (I)).

A government official emphasised the need for a global solution, arguing that a domestic standard in a global market would simply mean sending the unsustainable biofuels elsewhere, rather than halting their production. There was also broad agreement that a domestic standard should be compatible with other countries' standards (Coates (NGO), Dempsey (NGO), G1, Gibbons (C), Henderson (C), Mischewski (I)). Many industry and NGO participants wanted the standard to apply to both domestic and imported biofuels (Brockett (I), Dempsey (NGO), Gauntlett (NGO), Hamman (I), Motion (I)).

“If you have too many standards... it can cause confusion to the industry, because it is partly the regulations and policies of each government which eventually will slow down the progress and development of renewable energy. Hence I would see one standard being applied throughout the world.”

Reynauld (Industry)

Responses varied over whether New Zealand should be a leader or follower in the development of sustainability standards for biofuels. Some government officials felt it was risky being a leader as this would expose New Zealand to the possibility of breaching WTO law, and thought it would be beneficial to wait for an international consensus to emerge (G2, G3).

“The main issue in terms of a mandatory requirement is that if New Zealand were likely to move, we would likely be a first mover internationally. We would be amongst the first movers. And that's got a number of implications. It means we would be exposed to a fair whack of scrutiny from the international community in terms of how that standard is put together.”

G2 (Government)

In contrast, another participant thought that as long as there was recognition of international developments there was no reason why a New Zealand standard should not be put in place as quickly as possible (Coates (NGO)).

A consultant who believed New Zealand should take a leadership stance commented that;

“If you wait for everybody else to lead, and you’re trying to sell your product based on its clean greenness, then you lose that credibility by being at the back of the pack.”

Gibbons (Consultant)

Two consultants emphasised that the process of developing international standards is long, and convoluted, and New Zealand should not wait for these to be formed (Gibbons, Henderson). Another participant mentioned that the need is now, and there should be a sense of urgency around developing standards (Hamman (I)). A government official felt it was important to begin, saying:

“We learn by doing along the way, by improving and refining. But the main thing is just starting actually, rather than waiting for perfection.”

G1 (Government)

6.3.2 Which principles should be included?

Participants were asked which principles they thought should be included in a domestic sustainability standard. Although there was general consensus on the need to develop a standard, views varied about what this should contain. Fig. 6.3 shows the range of principles suggested by interviewees (See Table 6.2 for an explanation of the issues linked to each principle).

Figure 6.3 Participant views on principles that should be included in a domestic sustainability standard

Many participants felt that the three principles proposed by the Select Committee under the BSO were sufficient, and this can be seen by the frequency with which they were suggested by participants (Fig. 6.3).

“Food for fuel, biodiversity and greenhouse gases are in my mind pretty comprehensive in terms of the New Zealand context. They’re the major issues.”

Hamman (Industry)

Several interviewees emphasised the importance of keeping the standard as simple as possible (G3, Motion (I)).

The food for fuel issue was especially contentious and widely criticised by many participants: described as “emotional” (Motion (I)), “irrational” (Simpson (I)), and “irrelevant to New Zealand feedstocks” (Campbell (C), G3, Mischewski (I)), although some NGO participants considered it relevant to a New Zealand context (Gauntlett, Roberts). Another interviewee thought it should be included in a standard simply to prove that it was a non-issue in New Zealand (G2). It was clear that officials were concerned with how hard this principle would be to legislate, and did not feel it was a necessary criterion. A government official mentioned that the food issue has probably had more prominence in New Zealand’s development of sustainability requirements

(under the BSO) than it has internationally, due to high food prices and international media coverage of the issue at the time of policy development (G2). Another felt that biofuels have become a distraction from what really drives food prices: rising oil prices (G1).

6.3.3 If a sustainability scheme was adopted, what should this look like?

Stakeholders were asked whether a standard should be voluntary or mandatory (Fig. 6.4). The majority of participants felt that a mandatory standard was needed ¹².

Figure 6.4 Participant views on whether a sustainability standard should be voluntary or mandatory

Figure 6.4 illustrates how the personal views of government officials differ from other stakeholder groups in their responses to this question. The clear preference of government officials was to have a voluntary standard, as they believed it would have a high degree of penetration from fuel suppliers (G3), and would be easier to implement (G1, G2). One official made the remark that a voluntary reporting scheme accurately reflected the current level of government's enthusiasm for biofuels (G2). Most consultants and NGO participants felt that the standard should be mandatory. The only exception was an interviewee who felt the standard should begin as voluntary, and shift to a mandatory requirement once the industry grew or imports increased (Roberts

¹² N/A answer from two participants

(NGO)). Industry opinion was divided, although none directly supported voluntary standards. Many participants felt it was important to make the standards mandatory in order to ensure industry participation (Dempsey (NGO), Gibbons (C), Hamman (I), Kodikara (NGO)). One interviewee suggested the government link the standard to the tax incentive, so industry would have to meet the criteria to be eligible for support (Hamman (I)). Another industry participant felt it would have to be mandatory to protect against unscrupulous imports (Brockett (I)). One of the ‘undecided’ industry participants could not decide which was worse, having a voluntary standard which industry could exploit or allowing government to regulate at the risk of “wild bureaucracy” (Simpson (I)).

Several participants felt that the public were being too idealistic in what could be achieved, and needed to allow a fledgling industry room to improve. An industry participant echoed these sentiments;

“Don’t hold up some mythical technology that could reduce GHG and could replace oil, because mythical technologies are just that. They’re a myth. The technologies that we have today do something, but what they really do is provide a context within which an industry gets started and we get to improve, we settle down on the journey of improving ourselves.”

Simpson (Industry)

Other participants felt that strict standards may actually hinder the development of a domestic biofuel industry (Dempsey (NGO), G1, Jones (NGO), Reynauld (I), Simpson (I)). A government official felt that requiring such tight standards around biofuels sent a signal to the public that they are a big concern (G1). A theme brought up by many interviewees was the need to be reasonable and practical in setting expectations for levels of sustainability (G1, G3, Hamman (I), Henderson (C), Reynauld (I)).

Many participants commented on how the formation of standards is ultimately subjective (G1, G3, Reynauld (I), Simcock (I)), and can be influenced by vested interests (G3, Jones (NGO), Mischewski (I)). The use of standards as protectionist non-tariff trade barriers was mentioned by numerous participants (G3, Mischewski (I), Reynauld (I)).

Many participants discussed the difficulties of implementing standards which did not create unnecessary barriers to trade, and therefore breach WTO law (Brockett (I), G2, G3, Gauntlett (NGO), Hamman (I), Jones (NGO), Reynauld (I)).

Many interviewees were concerned with the practical difficulties of implementing and monitoring a sustainability standard. Two participants mentioned that traceability along supply chains would be difficult due to many biofuels being blended with other feedstocks before point of sale (Coates (NGO), Henderson (C)). Others commented on the difficulties in accurately measuring GHG emissions, and deciding where to place system boundaries (Gibbons (C), Simpson (I)). Multiple participants spoke about how LCA boundaries were often controversial, and could be distorted to favour certain feedstocks (Brockett (I), G1, Gibbons (C)). An oil company interviewee thought it would be difficult to avoid the chosen boundaries being contested;

“I see a lot of debate to be had, about just what process to be used...And every farmer would have a different answer. And every tallow producer would come up with a different answer.”

Blackett (Industry)

A government official mentioned heated discussions with biofuel producers about what should be included in their GHG calculations, and was aware of the risk that producers debating which feedstock was better could create further confusion for the public (G1). Another point mentioned by various participants was that a standard would need to be audited to ensure legitimacy (Coates (NGO), Gauntlett (NGO), Gibbons (C), Mischewski (I)).

6.3.4 Role of stakeholders

Interviewees were asked what role they saw their organisation having in the development of standards. Many participants assumed the standards would be government driven (Blackett (I), Dempsey (NGO), Motion (I), Reynauld (I)) or led by an independent authority linked to government (Brockett (I), Gibbons (C), Hamman (I)). Government officials seemed less convinced that a sustainability standard would have to be led by government, particularly since the repeal of the biofuel mandate. They reasoned that since there was no obligation in place, biofuels became much more like any other product, and it was questionable whether it remained the governments' responsibility to ensure their sustainability (G2, G3).

“Our advice has generally been that the role for government in terms of sustainability should be proportionate to the government’s general enthusiasm for supporting biofuels. So the BSO that turned into legislation, we would’ve been helter-skelter developing a mandatory standard...But given that that was repealed and we’ve now got a grants programme, where it’s New Zealand specific, that kind of takes away a lot of concerns already. But also that EECA is developing voluntary reporting mechanisms, is probably proportionate to the governments enthusiasm for biofuels at the moment.”

G2 (Government)

Several NGO participants felt that NGOs should act as monitors, to ensure that the standards were implemented and honoured (Coates, Gauntlett). NGOs also felt they could provide input and feedback throughout the development process (Coates, Dempsey, Kodikara). Roberts (NGO), who worked for the Sustainable Business Network (SBN), thought that his organisation could help and advise businesses with tools and methods to meet the reporting requirements. Industry did not see a large role for themselves in the development of standards, aside from providing feedback to government. The importance of industry consultation for ‘buy-in’ was stressed by several interviewees (Campbell (C), Hamman (I), Mischewski (I)). The role consultants saw for themselves was very specific to their area of expertise.

6.3.5 Preparedness

Government officials were quick to admit that they were currently not prepared to implement sustainability reporting, as they were still in the process of developing frameworks, but would be ready to implement by the end of 2009 (G1, G2). Several industry players felt ready to report on the sustainability of their biofuels, and were enthusiastic at the prospect (Hamman, Simcock). Other industry participants mentioned how they had commissioned independent research in the absence of standards to prove their sustainability (Brockett, Blackett, Hamman, Simcock). When asked if they felt prepared for a standard, an industry interviewee responded;

“Yes- we welcome it. And in fact we’ve already started our own sustainability measure in the absence of it... We’re really keen. It’s a really important scoreboard, for us as business, and as a reason for being, we’re crying out for it. Are we making a difference? You know [at Biodiesel New Zealand] we really want to. And also it [a sustainability standard] creates a scoreboard from which people

can rate themselves and say, are we just wasting our time, or are we really making a difference?”
Simcock (Industry)

One industry participant did not believe industry was ready for a reporting scheme due to the nation’s infancy in the biofuel sector (Reynauld (I)). An NGO interviewee was sceptical whether oil companies would want to report, and thought they might slow the progress (Jones). The oil company representatives both agreed that they were prepared (Mischewski (I), Blackett (I)). However, one of these interviewees pointed out that their role was as a purchaser, rather than a producer, stating that “the issue for us is to find a supplier that meets that standard” (Blackett (I)).

6.4 Consumer demand

While not a specific focus of this study, the question of consumer demand was a recurring interview theme. Many participants believed there was demand for sustainable biofuels from environmentally conscious consumers (Campbell (C), G1, Gibbons (C), Hamman (I), Reynauld (I), Roberts (NGO), Simcock (I)). In contrast, several NGO interviewees (Coates, Dempsey) thought it was overly optimistic to expect consumers to be demanding sustainable biofuels at the pump.

“Is that what they are going to be thinking about at the pump? People aren’t spending a lot of time thinking, ‘Oh, this was pumped out of the ground 40,000 miles away’. I dunno if people are necessarily thinking about sustainability all of the time.”
Dempsey (NGO)

A consultant interviewee pointed out the difficulties in shifting consumer preferences at the pump;

“A lot of people want to turn up to the pump, there it is, I’ll fuel my vehicle. Make one decision. They might have made it ten years ago. And it’s their decision. How do you change that?”
Campbell (Consultant)

An NGO participant (Roberts) disagreed with this statement, using the example of how hybrid sales have rapidly grown in recent years. He had personally encountered clients at SBN enquiring about where they could source sustainable biofuels.

While biofuel producers believed there was demand for their product, both oil companies stressed they had not experienced customers demanding biofuels:

“We haven’t had one customer come and seek us out and say we want it because it’s biofuel. We’ve just sold it, and said it’s biofuels, pretty much every car can take it except the older ones, and it says that on the pumps, so I think some people are filling up and not even noticing.”

Mischewski (Industry)

Many stakeholders, but particularly the oil company participants, portrayed consumers as cautious or conservative about which fuels they used (Blackett (I), G1, Hamman (I), Mischewski (I), Simpson (I)).

Participants had divergent views on whether consumers would pay a premium for biofuels. One industry interviewee (Reynauld) was hopeful that consumers would pay a slight premium, although other participants were sceptical that ‘price-driven consumers’ would be willing to pay more (Mischewski (I), Roberts (NGO), Simpson (I)). Some industry interviewees mentioned their reluctance to discount a product they viewed as superior to conventional oil (Hamman, Simcock), whilst others were dubious that discounting was economically feasible (Blackett, Mischewski). An NGO participant was sceptical that you would be able to sell a sustainably certified fuel at a premium (Dempsey). A consultant interviewee agreed, and was concerned that if sustainable fuels were made more expensive, it could segment the market;

“Fuel is an input and people don’t consider it as something of saying ‘Hey look, I’ve got this neat environmental sustainable thing’, going on about it. It’s a real basic input. And inputs like those go on price. And without making it regulatory you’re setting up two different price structures, the cheap and nasty and the sustainable and expensive.”

Gibbons (Consultant)

The price of oil was regularly discussed as a significant factor in the economics of biofuels (Blackett (I), Campbell (C), G2, Hamman (I), Mischewski (I), Reynauld (I), Simcock (I)). One participant thought a change in oil price would be the only stimulus the domestic industry needs to allow biofuels to move into the mainstream market (Campbell (C)). Yet the Gull oil representative (Mischewski) mentioned that from their experience biofuel prices often mimic any oil price rises¹³.

¹³ This is due to the way that oil prices influence the price of many non-oil commodities and production systems.

6.5 The future prospects of a domestic industry

A point emphasised by many was that the New Zealand industry is very small, with virtually no current production, and few players (Brockett (I), G3, Hamman (I), Mischewski (I), Reynauld (I), Simcock (I)). Others described domestic biofuels as “boutique” (Roberts (NGO)), “gimmick” (Simpson (I)) or “niche” (Gibbons (C)). Scalability of domestic feedstocks was often mentioned, with some critical that waste feedstocks were limited by their quantities (Campbell (C), Mischewski (I), Simcock (I), Simpson (I)). In contrast, an NGO participant felt that biofuels should be limited to small-scale production, believing sustainability issues are unavoidable when produced on a larger scale (Gauntlett).

Participants differed in how they viewed the possibility of importing biofuels. Some welcomed them (Simcock (I)) or viewed them as inevitable (Blackett (I), Campbell (C), Jones (NGO), Mischewski (I)). An oil company representative (Blackett) spoke about their efforts to source ethanol (under the BSO), and how they were forced to look to Australian and Brazilian ethanol after not being able to source sufficient domestic supply. One NGO participant thought New Zealand might have difficulties sourcing biofuels from overseas due to the high demand for biofuels from other nations (Roberts). Many participants were concerned about the risk of importing unsustainable biofuels (Brockett (I), Coates (NGO), Gauntlett (NGO), Hamman (I), Roberts (NGO)). An NGO interviewee suggested New Zealand could discourage unsustainable imports by making the process of importing long, complicated and expensive (Gauntlett). A few NGO participants were hopeful that New Zealand might try to remain self-sufficient rather than importing (Gauntlett, Roberts). The possibility of exporting New Zealand biofuels was scarcely mentioned by interviewees, and it appeared that most participants did not see this occurring in the near future. However, two interviewees thought that New Zealand could become a future exporter of cellulosic ethanol from purpose-grown forests (Campbell (C), Roberts (NGO)).

There was a variety of views around the potential of advanced biofuels. Many pointed out that some technologies will not become commercial for at least 5 or 10 years, and always seemed ‘just over the horizon’ (Jones (NGO), Mischewski (I), Simcock (I)). Other participants stated that the technology (such as for cellulosic ethanol conversion), was already available (Gauntlett (NGO), Simpson (I)). There was optimism about New

Zealand developing viable second generation technologies, and both algae (Dempsey (NGO)) and forestry (Campbell (C), G2, Mischewski (I), Roberts (NGO)) were viewed as having potential. One industry participant stressed the importance of New Zealand sticking to feedstocks where they already possess expertise, such as forestry, rather than trying to compete by developing industries where other countries possess a competitive advantage (Mischewski).

6.6 Wider policy issues and options

Participants were asked how current and past policy had influenced sustainable producers, and how future policy might be improved.

When discussing previous biofuel policy, some participants stressed the need for stability, and how the industry was left in limbo after the BSO was repealed (Hamman (I), Simpson (I)). An NGO interviewee talked about “the continued flip flops in policy”, and the need for some kind of certainty (Jones). An oil company representative emphasised how a lack of stability had created problems for the industry;

“I think we’d want to see a multiparty approach, so that when there’s an election the same policy continues from one party to the next. I think that’s very, very important. And in fact I spoke about that several years ago, and the regulators didn’t think that that would change, they thought that the new government coming in would just leave it there. Didn’t happen. So really we need to have the two major parties at least, agreeing in principal that they are going to leave the legislation in place, you know improve it, but not reverse it, because that just creates uncertainty.”

Blackett (Industry)

Some participants wanted government to have a clear vision about what they were trying to achieve (Jones (NGO), Simcock (I), Simpson (I)). Others saw the need for government to clarify the policy objective around biofuels (Campbell (C), Mischewski (I), Simpson (I)). Conversely, a government official felt the policy objective was very clear;

“I think that we probably have a clearer mind than most other countries have had. That really we’re just doing it for CO₂ reduction, whereas other countries have been tied up with agricultural subsidies and farmers subsidies and all kinds of rural support type mechanisms, whereas we haven’t had that. So I think actually ours has been relatively clear on why we’re doing it.”

G1 (Government)

Much of the responses given to the question around policy focused on how to make biofuels economically viable. Many saw a clear need for government to support the domestic industry (Brockett (I), G1, Gibbons (C), Hamman (I), Kodikara (NGO), Mischewski (I), Simcock (I)). This view was summed up by an industry participant who said;

“I think certainly some sort of government incentive, or enabling framework... is essential, and I think throughout the world it’s been demonstrated through all the applications that government intervention through enabling framework is essential for the uptake of biofuels.”

Hamman (Industry)

Several industry interviewees mentioned how the industry had been on hold, waiting for the government’s next announcement (Brockett, Blackett, Hamman).¹⁴

There were various opinions on what form this government support should take. Two industry interviewees strongly advocated a biofuels mandate (Reynauld, Simspon).

“Biofuels have never been introduced anywhere by some voluntary, utopian action. That’s never happened. That’s what we’re trying to do here ...So nothing’s going to happen in New Zealand unless you have a sales obligation. Or unless you have some kind of obligation.”

Simpson (Industry)

Others were hopeful that the proposed tax incentive would make biofuels economic (Hamman (I), Mischewski (I)). A consultant participant saw a tax exemption as a good short-term solution, but believed that once it cost government too much revenue it would be removed (Gibbons). Carbon pricing was brought up by some as a policy mechanism for making biofuels economic (Campbell (C), G2, G3, Mischewski (I), Simcock (I)). Government official’s opinions were divided on whether carbon pricing would provide the stimulus required to shift towards a low-carbon transport sector. One official stated:

“So you’ve got to ask yourself in terms of the future, whether there is a role for government beyond that carbon price mechanism. If the carbon price resolves or internalises the externalities issue about the damage that GHG does, is there additionally a role for government in supporting biofuels? And I think that’s sort of open for debate.”

G2 (Government)

¹⁴ These interviews were held before the government’s May announcement of a Biodiesel Grants scheme for the domestic biofuels industry.

The oil company participants stressed the hidden added costs faced by oil companies introducing biofuels, such as extra infrastructure and storage needs, particularly for higher ethanol blends (Blackett, Mischewski). They were concerned with a lack of compatible vehicles in New Zealand able to use higher biofuel blends without modification. Two interviewees suggested that the government could require car manufacturers to be supplying flexi-fuel vehicles in New Zealand (Campbell (C), Mischewski (I)). Some participants were also concerned that selling biofuels could lead to more engine problems with vehicles, and several participants emphasised the need for government to ensure fuel quality (Blackett (I), Mischewski (I), Roberts (NGO)). An NGO participant was concerned that selling a bad quality batch of biofuel could ruin the industry's reputation:

“For me, one of the key things is quality. We’ve got to make sure that the people that are producing biofuels are making good stuff. It’s pretty easy to make poor stuff. And I’d hate to see some of the progress we’ve made so far, and people’s enthusiasm for it [biofuels], be eroded by that kinda thing...Tesco’s [a UK-based international grocery chain] had a bad batch of biofuels, and they pumped it into hundreds of thousands of customers’ cars. And within a day, these cars started conking out.”

Roberts (NGO)

This was also commented on by a government official who mentioned that the quality of biofuels is now regulated to protect the consumer (G3).

A recurring theme was that biofuels should only be seen as a partial solution to future transport needs (Dempsey (NGO), Gauntlett (NGO), Gibbons (C), Jones (NGO), Kodikara (NGO), Mischewski (I)).

“On that wider level, I firmly believe that biofuels are not going to solve our transport problems, they’re not going to solve our GHG emission problems...they’re not going to solve our security of supply questions. But they are one small step that we could take. They are an option; we may as well introduce them into the mix.”

Gibbons (Consultant)

The exception was an industry participant who envisioned 100% biofuels (or a sustainable fuel) replacing fossil fuels at the pump by 2030 (Simpson). However, other interviewees talked about the difficulties in sourcing enough biofuels to meet even a small proportion of the global demand for transport fuel (Blackett (I), Robert (NGO)). Two NGO participants used the term ‘transitional’ to describe how biofuels will probably be surpassed by emerging technology in the future (Dempsey, Roberts). Many

participants mentioned the potential of alternative solutions like electric or hydrogen powered vehicles, or demand-side solutions such as reducing inner-city parking, and promoting public transport, carpooling or fuel efficient cars (Blackett (I), G2, Gauntlett (NGO), Jones (NGO), Kodikara (NGO), Mischewski (I)). A government official mentioned how some alternative solutions are not necessarily as 'green' as biofuels;

“From a demand side, biofuels are arguably competing against other green alternatives such as electric vehicles in terms of the green transport future. You look at the other side of the equation, in a world of diminishing oil, and you're looking at biofuels to some extent competing against the complete other end of the spectrum, which is your tar sands and oil shales.”

G3 (Government)

6.7 Summary

This chapter presented the results from 20 stakeholder interviews conducted with representatives from the biofuel industry, NGOs, key biofuels experts and government officials. These semi-structured interviews explored participant's perceptions of the usefulness of establishing a domestic sustainability standard, which principles they thought should be included, and what form such a standard should take. Interviewees discussed a diverse range of sustainability issues associated with biofuel production, but GHG emissions, biodiversity loss, food security, competition with arable land, use of agri-chemical inputs, and prioritisation of waste feedstocks were the issues mentioned most frequently. Government and industry participants felt that New Zealand feedstocks are produced from sustainable feedstocks, with international sustainability concerns being less relevant to the domestic industry. Whilst industry firmly believed biofuels to be an improvement from fossil fuels, some NGO interviewees disagreed. Many participants expressed frustration that other industries, and fuels, were not held up to such high sustainability standards.

Industry, NGOs and consultant participants all agreed that New Zealand should develop a biofuel sustainability standard. Stakeholders felt that a standard would prevent unsustainable production, and educate and reassure the consumer. There was broad concern around the proliferation of standards emerging, and agreement that a domestic standard approach should be aligned with international developments.

Participants were divided on whether New Zealand should lead or follow in this area. Whilst government officials were concerned about the risks associated with being world leaders, NGO and consultant interviewees felt New Zealand would lose credibility by lagging, and that waiting for an international consensus would take too long. Several interviewees were concerned about the risk of unsustainable imports, and most felt that a standard should apply to both imports and domestic biofuels. Although the majority of interviewees felt that a standard should be mandatory, government representatives preferred a voluntary standard. While a range of criteria were suggested for the standard, many participants felt that GHG emissions, biodiversity loss and food security were the three important issues which needed to be accounted for.

There was concern over the strictness of a standard, with many interviewees stressing the need to be reasonable and practical. Both the government and industry feel prepared for the implementation of a domestic standard. When asked how future policy might be improved, participants provided a range of suggestions, with a focus on making biofuels economically viable. Numerous participants wanted future biofuels policy to have a clearer vision, and greater certainty than in the past.

The above stakeholder views offer some important insights for evaluating the applicability of a sustainability standard to the New Zealand domestic biofuel industry. These are discussed in the following chapter, along with a discussion of results from previous chapters.

Chapter 7

Discussion

The aim of this study was to explore to what extent a sustainability standard might support the domestic biofuels industry, while avoiding the negative environmental and social impacts associated with biofuel production. This chapter draws on the main findings of each of the study's objectives, and discusses their contribution to this overall aim.

7.1 Sustainability of New Zealand feedstocks

The perceived benefits and risks of biofuels may be in direct conflict, since biofuels initially promoted for their environmental benefits are now raising concerns over their potential to cause environmental and social damage (Verbeke, 2007). Concerns range from biofuels producing limited GHG reductions, to fears that biofuel expansion will lead to deforestation of tropical rainforests, escalation of global food prices and exploitation of the poor. Many authors suggested that badly produced biofuels can actually be more environmentally destructive than the fossil fuels they seek to replace (Doornbosch & Steenblik, 2007; RFA, 2008; Scharlemann & Laurance, 2008; Zah et al., 2007). While this may be the case for certain feedstocks, there are also many biofuels which show promise of providing significant GHG savings and increased energy security. Biofuels should not be viewed as a homogenous product. When discussing the impacts of biofuels it is crucial to distinguish and discuss different feedstocks and production practices individually, as these will produce large variations in their impacts. All too often the media has done little to distinguish between good and bad biofuels, meaning all biofuels have been discredited from this bad publicity. Implementing a sustainability standard could solve this issue, as it would allow for comparisons across countries, feedstocks and production processes, and highlight the variations in performance.

Many of the sustainability issues raised internationally are less relevant to a New Zealand industry, whose domestic feedstocks compare favourably with those produced overseas. Most biofuels produced domestically are unlikely to significantly impact on

biodiversity, food security, or adversely affect the poor, but land-use issues remain relevant. Current feedstocks being used in New Zealand are commonly sourced from waste or by-products, which exhibit lower environmental impacts (RFA, 2008; Zah et al., 2007). Rapeseed is the only agricultural crop being grown domestically for commercial biofuel production. While this feedstock may exhibit more impacts on local soil and water quality, this is dependent on the agricultural methods used, and is no more intensive than other common farming practices. While several foreign feedstocks have been criticised for failing to result in GHG reductions, New Zealand biofuels appear to achieve significant emissions savings (Fig 4.2). However, domestic LCA studies have not included emissions from land-use change, which has been found to significantly affect emissions profiles (Fargione et al., 2008; Searchinger et al., 2008; Sheehan, 2009), and there is an urgent need to incorporate this data into lifecycle methodologies for purpose-grown feedstocks.

Domestic biofuel production is a nascent industry in New Zealand, with little biofuel being currently produced. To date, the industry has been dominated by waste feedstocks and niche producers. Yet the existing waste feedstocks have limited scalability, and in the future, demand will either be met by importing biofuels or by developing a biofuel cropping or forestry sector. If biofuel production is to be scaled up, sustainability concerns will become more relevant, and will require closer monitoring of their impacts. Whilst the scrutiny which has occurred due to international pressure may not appear as relevant to a domestic industry, it does highlight the impacts which biofuel production can cause. New Zealand producers should be made aware of their production impacts on GHG emissions, biodiversity, land-use change, soil health and water quality.

There are multiple companies researching advanced biofuels in New Zealand. Future feedstocks may include agricultural crops, residual forestry and agricultural waste, purpose-grown forestry, algae, and waste industrial gases. While these advanced biofuels are expected to provide better GHG savings, and require fewer inputs and land, it is difficult to predict what new feedstock-specific sustainability issues may emerge from their development. Nevertheless, the sustainability debate has now become synonymous with biofuels, and it appears less likely that future feedstocks will emerge without close scrutiny of their impacts from both consumers and producers.

7.2 Developing a New Zealand sustainability standard

7.2.1 Benefits of developing a sustainability standard

A domestic sustainability standard would be beneficial to both the New Zealand biofuel industry and consumers, and is desired by key stakeholders (see Fig 6.2). NGO and consultant participants agreed that a standard was necessary to prevent unsustainable production. While it was expected that industry might view sustainability standards as a liability, most industry participants felt a standard was needed. Many recognised the potential for a standard to be used as an educational tool as part of an effort to promote biofuels. There is currently a lack of consumer awareness around biofuel sustainability in New Zealand, with a significant number of consumers undecided about whether to support biofuels (UMR Research, 2005). Publishing a standard would provide transparency for those companies already meeting a high standard of practice, as well as exposing those involved in ‘greenwash’. Sustainable producers would be able to use the standard as a marketing tool (with many already doing this with their own research claims in the absence of a standard). Whilst the industry is arguably sustainable at present, having a standard during its infancy would set a precedent, so as industry grows it has certainty around what is expected from it. It would also mean that New Zealand can avoid from the outset some of the pitfalls that have dogged the biofuel industry internationally, such as supporting biofuels which do not lower GHG or result in environmental harm.

7.2.2 Role of stakeholders

Bioenergy sustainability standards are being developed by a range of stakeholders internationally including: governments, NGOs, companies and international organisations (Van Dam et al., 2008; Zarrilli, 2008). In New Zealand, work around this issue has been government-led, in contrast to Europe where industry or NGOs have been instrumental in developing standards. The NGO and industry participants interviewed in this study generally viewed development of a domestic sustainability standard as a role for government. This was queried by government officials, who felt that without a biofuels mandate government was less obligated to ensure biofuels were produced sustainably. It does not appear that industry or NGO groups are willing or equipped to develop a domestic standard apart from government. Having a government-led standard would avoid the proliferation of competing claims, and allow for

comparability between feedstocks and companies. Consumers would benefit from knowing there is a reputable agency they can trust, which will provide them with answers to their sustainability concerns. However, a government-led standard will ultimately be less stringent than what a private standard can require. Having the government regulate industry's sustainability does not exclude the opportunity for other stakeholders to produce their own standards. Several participants felt there remains room for a complementary private eco-label approach in New Zealand, to certify 'premium' biofuel, which demonstrates leading environmental and social best practice in their production processes.

A question which arose from this study is: 'Does the responsibility to ensure the sustainability of biofuels lie with government, industry or consumers?' Perhaps the industry should be responsible for guaranteeing the sustainability of their product. Yet, when producing a fuel, producers face consumer pressure to make the product as cheap as possible, often culminating in unsustainable practices. The irresponsible practice of the international biofuel industry led to the emergence of large-scale environmental degradation and social issues, demonstrating that there remains a need to hold industry accountable. Government officials felt that without an obligation there was less of an onus on the government to ensure the sustainability of biofuels, since their uptake was no longer policy driven. One official compared it to asking whether the government was responsible for ensuring the sustainability of television sets. While this may be valid, a voluntary sustainability standard shifts the responsibility onto the consumer, who often lack the awareness or ability to act (Van Dam et al., 2008). It is questionable whether the New Zealand public is ready for this responsibility, with evidence that they remain uninformed, and unwilling to pay more for sustainable fuels (ShapeNZ, 2009; UMR Research, 2005). Whilst the environmental benefits of biofuels are considered important, the majority of the public admit that a price differential of 10 cents would not be enough to make them switch to biofuels (ShapeNZ, 2009). Others may be willing, but simply cannot afford to increase the amount they spend on fuel, which is viewed as a basic necessity. Failing to regulate for sustainability may lead to market segmentation where sustainable fuels occupy the expensive, niche corner of the market, whilst the majority of the market is taken by less unsustainable, cheap biofuels (Doornbosch & Steenblik, 2007).

The formation of standards is ultimately subjective and dependent on the motives of those formulating them (Zarrilli, 2008). Because of this, it is important that there is wide stakeholder involvement in their development, as participation is necessary for standards to be viewed as legitimate. Both industry and NGO participants in this study were willing to be involved in this process and officials appeared keen to gain feedback from stakeholders. Government officials are aware of the risk that disputes amongst producers over ‘whose feedstock is more sustainable’ could detract from the purpose of creating a standard, and create further controversy for the industry. There is a need for government to be transparent around their decisions, particularly in regard to contentious decisions, such as the selection of GHG methodology. It appears that both government and industry stakeholders are prepared for the implementation of sustainability reporting, with many of the industry interviewees eager to participate and prove their sustainability. What remains to be seen, is whether consumers are as informed and motivated.

7.2.3 The case for making a standard mandatory or voluntary

The majority of participants felt that a mandatory standard was necessary in New Zealand (see Fig. 6.4). However, all government official participants preferred a voluntary standard. This was most likely a consequence of the work they were involved in developing a voluntary sustainability reporting scheme. Voluntary standards have several advantages: they would be easier to implement, allow for learning and improvement, and would have less implications for trade under the WTO (Van Dam et al., 2008). Imposing mandatory standards, in the absence of an international consensus, could give rise to possible breaches of WTO rules, with tangible consequences such as trade sanctions (Zarrilli, 2008).

Yet the effectiveness of voluntary standards is questionable, and many participants felt that they would not prevent unsustainable imports. There is also a risk with voluntary standards that producers will choose not to participate. This risk currently appears small in New Zealand, as the majority of producers interviewed were eager to take part in a sustainability standard. Furthermore, the UK, which has been running a voluntary sustainability reporting scheme for over a year, has achieved a 69% rate of data capture (RFA, 2009b). Whilst voluntary reporting might serve as an important first step, there is

broad recognition that to prevent unsustainable production in the future, the development of minimum standards by governments may be required.

To comply with WTO rules and not be construed as a non-tariff trade barrier, a mandatory standard would have to apply to both domestic and imported biofuels. Such a standard would need to be flexible enough to be applied across different regions and countries, where laws, sustainability issues, feedstocks and cultures may all differ significantly. Because of this, New Zealand should follow best international practice when establishing standards, to ensure they will align with schemes developed by other countries. This level of regulation would be complex, and New Zealand might be best to wait for another country to lead. The EU's Renewable Energy Directive and the Californian Low Carbon Fuel Standard schemes will come into operation in the near future, and these could serve as a template for New Zealand to follow.

With international trade in biofuels rising, and the globalised nature of interactions between market commodities, the sustainability impacts of biofuels must be treated as a global issue. Without significant fiscal support, a domestic industry will struggle to produce biofuels cheaper than many developing countries, and the proportion of imported biofuels will likely increase in the near future. For a sustainability standard to be effective, it must assess these imports as well as biofuels produced domestically. Furthermore, the creation of strict policy around sustainable imports will have little impact if other countries are willing to produce or import unsustainable biofuels. A global biofuel sustainability standard is desirable, yet this level of international co-operation will take time, and it is important that New Zealand does not delay action in the meantime, as this could damage the credibility of the industry. There is an urgent need to secure the sustainability of biofuels in a fast growing market, so it is fitting that the government is aiming to have sustainability reporting in place by the end of 2009.

7.2.4 Exploring standard frameworks

EECA is currently developing a voluntary sustainability reporting scheme for biofuels, based largely on a framework developed by the UK. Choosing to adopt a similar approach to the UK Carbon and Sustainability reporting scheme offers several advantages. Following international practice helps New Zealand avoid a duplication of effort, as the government can build on work which has occurred internationally. Being

a follower rather than a leader would also protect New Zealand from being exposed to WTO law suits. New Zealand can learn from the mistakes and successes of other schemes already in operation. The UK has a much larger biofuel industry, and is at the forefront of sustainability reporting. So by modelling the UK approach New Zealand will be kept up to date with international developments surrounding sustainability reporting. The need to align any domestic standard with those being produced internationally was viewed as crucial by many participants in this study. Industry participants were also supportive of how the UK scheme allowed for flexibility around the level of data that could be reported (Fig. 5.1).

Whilst interviewees suggested numerous principles for inclusion in the standard, there was general agreement that it should include principles covering GHG emissions, competition with food and protection of biodiversity (Fig 6.3). These were the three principles that were specified under the BSO, and may have been more acceptable to participants due to their familiarity. Selecting these three principles demonstrates a practical approach, which does not try to address all possible sustainability issues, but focuses on the most urgent sustainability risks. Turning these principles into measurable and workable criteria and indicators will not be easy. While many governments have developed similar principles, most initiatives are in the early stages of development and few are currently operational. It was apparent from the work New Zealand officials had undertaken, that the food principle was particularly difficult to legislate. Some of the complexities included: accounting for rotational crops; and the facts that land-use is not static, and crop productivity is expected to increase.

Developing measurable indicators for biodiversity protection should be more straightforward, as it could be based around existing legislation protecting high-value conservation land. This approach would be less effective in countries that are failing to establish significant protected areas or ensure adequate protection of existing areas. One option may be to use the ‘meta-standard approach’ employed by the UK and Netherlands, which utilises existing sustainability standard schemes relevant to the biofuel principles. Yet, how to measure macro-level effects, such as ILUC, food security and global commodity prices, is still being debated, and may prove difficult to integrate into existing schemes.

It is relevant to note that the UK has chosen not to require sustainability reporting for waste and by-products, reasoning that while they may not be produced sustainably, biofuel producers will probably have little influence over the sustainability of the production process of the original product. These feedstocks are still required to report on their GHG emissions (RFA, 2009a). Following a similar approach in New Zealand, would simplify reporting, whilst simultaneously encouraging the use of waste feedstocks- a priority frequently mentioned by interview participants.

Accurately measuring the potential GHG savings of biofuels involves a variety of complex political and technical questions, some of which have not yet been entirely resolved (Sheehan, 2009). Much of the information being required is typically not reported on and will require the establishment of new reporting and measurement procedures. Providing carbon intensity default values relative to levels of data provided by producers may simplify the process, but will require monitoring to ensure accuracy of estimates. The science of measuring GHG emissions is evolving rapidly, and there is now growing recognition that well-to-wheel LCA studies fail to include significant impacts caused by land-use change (Fargione et al., 2008; Searchinger et al., 2008). Whilst calculating GHG emissions from ILUC is fraught with complexity and uncertainty, this is not a legitimate reason for excluding it from regulatory frameworks (Sheehan, 2009). If biofuels are to meet their policy objective of mitigating climate change, accurately measuring GHG emissions becomes crucial.

A standard must balance the trade-off between wanting to attain genuine sustainability, and remaining realistic about what is feasible. Biofuels is an emerging industry which has much to learn, and it should be allowed the opportunity to improve through time. Creating too strict a standard at this early stage in the development of this industry could hinder the industry by adding significant compliance costs. This is likely to have a larger impact on small producers. Yet developing a less stringent standard might limit its effectiveness, and allow unsustainable production to continue. To avoid creating an unreasonable hurdle for a young industry, a domestic standard could be paired with incentives and assistance. Monitoring and verification of a biofuel standard is essential, but could add significantly to the costs of implementation. Several participants noted that tracking and enforcing the sustainability of imported biofuels would be particularly difficult, due to their complex chains-of-custody and distance from the end-user.

To be a truly effective educational tool, results of a sustainability standard must be transparent and readily accessible to the public. Several participants interviewed suggested sustainability information could be presented much in the same way as ingredients and nutritional information are provided on food packaging. Another option is to present information on a website. In the UK, the RFA publishes monthly reports on the overall supply of biofuel under the RTFO, and quarterly reports on the performance of individual companies against the Government's carbon and sustainability targets. These reports include data on: the proportion of biofuels meeting sustainability standards; feedstock and fuel type; country of origin; previous land-use; and GHG savings (RFA, 2009b).

At the time of the interviews, New Zealand government officials were unsure exactly how results would be published, but thought that at a minimum, there would be a website consumers could refer to. The advantage of this approach is that it informs consumers but allows them to make their own judgements. However, this information would be somewhat removed from the product, and requires a high level of motivation from the consumer to research their fuel. Another option would be to provide a star or tick rating labelling system at the pump, where the information was simplified into an eco-label. This could be similar to the Energy rating label EECA developed for appliance energy efficiency. The challenge for this approach would be how to amalgamate so much information without loss of meaning. Several industry participants were concerned that providing too much information might paralyse the consumer, and were keen for a simplified approach, where certified sustainable biofuels were simply awarded a tick, or green label. A report commissioned by EECA under the BSO recommended a staged approach to publicising biofuel sustainability standards, progressing from a website to a voluntary sustainability labelling scheme at the pump or supplier level (SKM, 2008a).

7.3 Placing sustainability concerns in context

Biofuels are not competing alone with fossil fuels, as there appear to be several alternative liquid fuels that could be available in abundance at costs competitive with today's oil prices. Countries with rich coal and gas reserves are beginning to explore coal-to-liquid and gas-to-liquids synfuel production. Currently in New Zealand several companies are proposing large-scale production of synthetic fuels from lignite (PCE,

2010). Internationally there is also renewed interest in exploiting large deposits of tar sands and oil shale, although concerns exist over significant environmental impacts involved in their extraction (Leaton, Baines, O'Shea, & Footitt, 2008). Many of these fuels require large investment, and high ongoing production costs. Perhaps the most significant drawback these fuels face is that their production is very carbon intensive (Jaramillo, Samaras, Wakeley, & Meisterling, 2009; Taylor, 2007; The Royal Society of London, 2008). Oil sands extraction produces three times the carbon emissions of conventional oil production, whilst oil shale extraction produces up to eight times as much (Leaton et al., 2008). Unless carbon dioxide capture and storage technology becomes viable, many projects will struggle to achieve political acceptability.

While biofuels have become controversial for their sustainability impacts, many alternative fuels appear to present larger sustainability challenges. Participants in this study felt that biofuels were receiving an unfair level of scrutiny over their sustainability and that any standard should also apply to both oil and alternative fuels. Any balanced assessment of biofuels must take into account the relative sustainability of likely alternative fuels. Requiring a sustainability standard for all fuels, like the California Low Carbon Fuel Standard (Young, 2009), would enable consumers and investors to make informed comparisons.

Rather than being specific to biofuels, many of the sustainability issues surrounding biofuels relate to the production of most agricultural commodities. Numerous participants felt that requiring sustainability standards for biofuels, whilst ignoring other products was unfair. Other interviewees suggested that these same questions should be applied to all consumer products. Furthermore, there is some futility in restricting the import of unsustainable biofuels, if the same product can be imported for another purpose. For instance, whilst biofuel made from palm oil is undergoing significant scrutiny, New Zealand imports more than one million tonnes of palm kernel annually for supplementary cattle feed, and palm oil is being used in as many as one in ten products on supermarket shelves (Gibson, 2009). Since many biofuel feedstocks are utilised in other products, creating standards for biofuels may be missing the opportunity for a more holistic solution. Clearly we should be requiring a level of sustainability in all our consumer goods. To some extent, this task becomes overwhelming, but by extending the meta-standard approach, biofuel sustainability standards could act as a pilot for future expansion of standards to other commodities.

7.4 Linking sustainability requirements to policy

Biofuels have emerged as one policy solution towards meeting Kyoto commitments to reduce GHG emissions, while simultaneously providing better energy security for the future. Yet many countries have discovered that by setting policies that encourage biofuels, rather than the specific policy objectives desired, these policies can exacerbate the problems they sought to reduce or generate other problems (Delzeit & Holm-Mu'ller, 2009; Doornbosch & Steenblik, 2007). Ideally biofuels would be supported by policies rewarding their GHG reduction benefits and/or a mechanism rewarding their security of supply benefits (Londo & Deurwaarder, 2007). Similarly, if sustainable biofuels are desired, a sustainability standard could be linked to government support, or serve as a precondition for any future national target.

When the Biofuel Sales Obligation (BSO) was repealed in 2008, the newly elected Government reasoned that in the absence of workable and practical sustainability standards, the obligation might have led to importation of biofuels from unsustainable sources (Brownlee, 2009). Since then the government has developed a Biodiesel Grant Scheme which aims to encourage the biodiesel industry by supplying tax breaks to domestic producers (EECA, 2009). To be eligible under the scheme, producers must manufacture biodiesel in New Zealand, but can import their feedstocks from overseas. No mechanism has been put in place to prevent producers from importing cheaper unsustainable feedstocks, and processing them in New Zealand. It appears that the grant scheme, like the BSO before it, does not ensure the production of sustainable biofuels. During this study, several government officials made the remark that in the short term they believe the government can provide support for the biodiesel industry without any independent sustainability requirements, as they feel confident that the feedstocks are all currently sustainable. Yet by setting policy around encouraging biofuels, rather than an objective related to reducing GHG emissions, this policy will require regular monitoring to ensure that as the industry grows, unsustainable practices are not being supported. Linking the Biodiesel Grants Scheme to sustainability criteria would have helped strategically steer industry down a path that can be more enduring and sustainable in the medium and long term.

7.5 Broader Policy Recommendations

The domestic biofuel industry has endured recent political uncertainty, and many participants stressed the need for stability in the future. The BSO put in place in 2008 was swiftly overturned by a newly elected government after the election late that year. The repeal of the obligation negatively impacted some industry players, who had planned and invested in anticipation of the obligation. For instance, Argent Energy, a UK investor, abandoned plans to build a 60 million litre biodiesel plant in the Bay of Plenty because of what it called ‘the whims of policymakers’ (Dearnaley, 2008). Whilst the obligation was replaced with the Biodiesel Grants scheme five months later, several participants noted how domestic production had effectively been placed on hold, waiting for the announcement. This scenario highlights the importance of reaching a political consensus in future, where policies hold multi-party support, and are not at risk of being overturned after a change in government. Numerous participants felt that the biofuel industry would benefit from the government clarifying their long-term vision, which presumably would include goals around addressing climate change and lowering the national carbon liability under the Kyoto protocol and its post-2012 successor, as well as increasing energy security.

Government policies play a large role in the financial attractiveness of biofuels, because without support most biofuels cannot compete on price with petroleum products at current oil and carbon prices. Despite biofuels often being more expensive than fossil fuels, the un-priced positive environmental and social externalities they can create has inspired many governments to instigate domestic policies which encourage biofuel production. Governments may promote biofuel production by introducing capital investment incentives and agricultural subsidies. Equally they may support consumption with fuel tax exemptions, carbon-based fuel taxes, policies that encourage the purchase of biofuel compatible vehicles, or minimum sales mandates (Doornbosch & Steenblik, 2007; Gibbons, 2007). The New Zealand biofuel industry is very small, and will require significant government support for its survival. Whilst the intention to encourage biofuels has been enshrouded in equivocal policy since 2002, a voluntary biofuels target failed to trigger significant uptake. Oil company participants emphasised that biofuels are costly to introduce due to the extra infrastructure and storage they require. While Gull voluntarily introduced biofuels at their pumps as a ‘point of difference’, there has

been little indication that the other oil companies will do so without significant incentives.

The need for a stimulus package by government was stressed by many industry participants, although there was little consensus about which policy solutions they would prefer. Interviewees suggested policy measures such as reintroducing a blending/sales obligation or production tax incentives. Other participants suggested incentives or mandates for car manufacturers to encourage the introduction of vehicles to New Zealand able to use higher biofuel blends. Encouraging biofuels may require a complementary mix of policy instruments, an approach which has been successful for many top biofuel producing countries (REN21, 2009; Worldwatch Institute, 2007). Carbon pricing was optimistically discussed by numerous participants for the role it could play in making biofuels economically viable. Under the New Zealand ETS oil companies are points of obligation, and as such, displacing fossil fuels with biofuels would help to lower their carbon liability.¹⁵ A government participant commented that the establishment of the ETS could be a neutral way of encouraging all low carbon transport options, and may make other biofuel policy solutions redundant. While the recent introduction of a Biodiesel Grants Scheme may be successful in stimulating domestic industry, its short three year duration means additional policies will ultimately be required for a domestic industry to remain viable.

There is little doubt that the current reliance on fossil fuels is unsustainable, and alternatives are needed. However, like most climate change mitigation strategies, biofuels can only provide a partial solution. Achieving significant 'decarbonisation' in the transport sector will require an integrated approach which may include: low carbon fuels; more efficient vehicles; increasing the use of public transport, walking and cycling; and demand management (RFA, 2008; Wright, 2008). The cost of abating CO₂ with biofuels is very high, and far greater savings may be possible from pursuing alternative strategies which reduce demand (Bailey, 2008; Doornbosch & Steenblik, 2007). Given that biofuels can only supply part of the solution, and a much larger supply of low carbon transportation fuel is needed, the government may need to enable the widest array of technologies to compete. This could be aided by technology neutral

¹⁵ However, under its current design, the New Zealand ETS omits a cap on emissions for any points of obligation. This diminishes the incentive for oil companies to reduce fossil fuel emissions, since they can simply pass the carbon price onto all of their customers and recover that carbon liability through an increase in fuel prices.

policies, such as an ETS or a Low Carbon Fuel Standard (LCFS), which do not favour biofuels over other low carbon options. Furthermore, sustainability standards are just one of the policy tools needed to achieve sustainable biofuel production and will not be successful in isolation. When considering how to tackle global issues around natural resource use, standards have fundamental limits and can only play one part of an integrated policy approach (Delzeit & Holm-Mueller, 2009; Kaphengst et al., 2009). Alternative policy solutions which encourage sustainable production must also be introduced, setting clear rules for producers as well as introducing market incentives for consumers.

7.6 Recommendations for further targeted research

- To undertake a comprehensive study of the lifecycle impacts of biofuels produced or used in New Zealand to compare the social and environmental impacts of these feedstocks, including land-use change, and allow targeting of the best production paths. This study could replicate the approach and methodology used in the study conducted by EMPA (Zah et al., 2007);
- To investigate harmonizing domestic LCA methodologies for biofuels, including GHG lifecycle accounting methodologies;
- To further research the indirect effects of domestic biofuel production, particularly pertaining to land-use change including soil carbon, and assess policy tools for integrating these findings into future biofuels legislation;
- To assess the long-term economic viability of biofuels and compare the cost-effectiveness of biofuel policies with other carbon mitigation approaches;
- To explore technology-neutral policy approaches (such as the Californian Low Carbon Fuel Standard and the EU RED), which allow for comparison of all transport options including fossil fuels, biofuels, alternative fuels, and electric and hydrogen-powered vehicles;

- To investigate demand side issues around biofuels, in particular, the attitudes of consumers towards biofuels, and their response to sustainability concerns;
- To assess the relevance of biofuel sustainability standards to be used as a pilot ‘meta-standard’ and its applicability to other commodities;
- To research ‘best practice’ surrounding biofuel production and processing, to identify practices which could reduce GHG emissions, and other environmental and social impacts.

Chapter 8

Conclusions & Recommendations

The level of biofuel production in New Zealand is currently small, making up less than 1% of annual liquid fuel demand. Domestic biofuel feedstocks include UCO, tallow, whey and rapeseed oil. There is potential for future biofuels to be produced from wastes and residues, algae, industrial gases, agricultural energy crops, and purpose-grown forestry. The small amount of waste and residues available limits the scalability of these feedstocks, and as demand for biofuels grows, New Zealand will have to develop an energy cropping or forestry sector, or else turn to imports. Purpose-grown plantation forestry appears a likely candidate, as this could be grown on marginal land with few inputs, and New Zealand already possesses expertise in this area.

This study has shown there is variation in the environmental impacts of New Zealand feedstocks, and each biofuel must be assessed individually. Some New Zealand feedstocks offer considerable GHG savings, although the effects of direct and indirect land-use change needs to be accounted for. Many of the international concerns relating to food security, biodiversity loss, and the impact on the poor are less relevant to domestic production. It appears that the most sustainable biofuels are those produced from waste or by-products, as they avoid environmental impacts associated with the agricultural cultivation stage. Second generation feedstocks may solve many of the sustainability issues currently being debated, but will also result in new unforeseen impacts on society and the environment.

The increasingly controversial public debate around biofuels has highlighted concerns that biofuels may fail to deliver GHG reductions, and may actually be causing environmental and social damage. Biofuel sustainability standards have emerged as a solution to securing sustainable biofuel production and trade, and numerous organisations are in the process of developing and implementing schemes. Most of these initiatives include criteria around GHG, as well as a range of social, environmental and economic considerations. Despite being in their infancy, they provide valuable lessons for implementing a domestic standard in New Zealand.

The central finding of this study is that a domestic sustainability standard would significantly assist the domestic biofuel industry, by providing a layer of independent quality assurance in the domestic biofuels market. It would also simultaneously encourage sustainable production, thereby helping to avoid the negative environmental and social impacts associated with biofuel production.

This research shows that the majority of stakeholders interviewed support the development of a biofuel sustainability standard. Many interviewees felt that a standard should include principles to monitor GHG emissions, food security and biodiversity loss. It is recommended that a sustainability standard be government-led to prevent a proliferation of competing voluntary standards, and to build on the existing work undertaken by EECA and MED. The current sustainability reporting scheme being developed could evolve into mandatory standards once leading nations such as the EU take this step. This approach will allow for the alignment of a New Zealand standard with international standards, enable a process of learning-by-doing and avoid breaching WTO legislation. EECA is currently developing voluntary sustainability reporting for the industry, modelled off the UK approach, and it appears that both industry and government are prepared to implement these. The global nature of these issues means it is important for a standard to apply to both domestic and imported feedstocks, and be aligned with international initiatives.

The government's Biodiesel Grants Scheme should be modified to reward only biodiesel which meet minimum sustainability requirements. This would eliminate concerns that unsustainable imported feedstocks will be eligible for funding. In the future, the government should link biofuel support mechanisms to sustainability requirements, to provide incentives for sustainable production. Producers should be given opportunities to improve, by policies which reward best practice, alongside sustainability requirements which progressively raise expectations.

To become economically viable at the current oil price, biofuels will require support from the New Zealand government. International experience shows that biofuel industries have grown rapidly in countries that invested in a policy framework which supports their production and consumption, and are unlikely to thrive under a purely market-based approach. More important than the particular policies chosen is policy stability in this sector. This will require multi-party agreement around where biofuels fit

in the long-term vision for New Zealand's transport sector. Biofuels should be supported by technology-neutral policies such as carbon-pricing, which reward their benefits rather than indiscriminately promoting biofuels.

If encouraged appropriately, biofuels represent a chance to both reduce New Zealand's GHG emissions and increase domestic energy security, but they will not solve our energy problems alone. Biofuels must be viewed as a partial solution alongside promotion of other renewable fuels, and policies which address demand-side management of energy consumption. However, to remain a viable and enduring option at all, it is important to ensure their sustainability from a social and environmental point of view. Whilst sustainability standards cannot do this alone, they will provide a significant contribution to addressing sustainability concerns, and can help to strategically steer industry down a more sustainable path in the long-term.

Appendices

Appendix A: Interview schedule

The interview format consists of a combination of open-ended questions, one-word answer questions or questions that require interviewees to rank different issues or concepts. Questions are loosely based around the seven meta-questions below;

1. What are some of the broad sustainability issues associated with biofuel production in New Zealand?
2. Which sustainability principles should be included in a New Zealand sustainability standard for biofuels?
3. What would be the benefits and costs to New Zealand adopting a sustainability standard for domestic biofuels?
4. If a sustainability scheme was adopted, what should this look like?
5. What role do stakeholders see their organisation having in the development of standards?
6. To what extent do you think that the industry and government are prepared for the implementation of standards?
7. How has current and past policy influenced sustainable producers, and how can future policy be improved?

Appendix B: Human Ethics Committee Documents

a) Human Ethics Committee Approval

MEMORANDUM

Phone 0-4-463 5676
Fax 0-4-463 5209
Email Allison.kirkman@vuw.ac.nz

TO	Natalie Grimmer
COPY TO	Dr Sean Weaver, Supervisor
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	January 28, 2009
PAGES	1
SUBJECT	Ethics Approval: No 16423, Sustainable biofuels in New Zealand: could certification help distinguish the good from the bad?

Thank you for your application for ethical approval, which has now been considered by the Standing Committee of the Human Ethics Committee.

Your application has been approved from the above date and this approval continues until 31 July 2009. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Allison Kirkman

Convener

b) Information for Research Participants

Introduction

I am undertaking research for a Master's Degree in Environmental Studies at Victoria University of Wellington. The research project explores the sustainability of New Zealand biofuels and potential for a domestic biofuel sustainability standard. The study is focused on answering the following major question: To what extent could a sustainability standard support the domestic biofuels industry, while avoiding negative environmental and social impacts associated with biofuel production? A key component of the methodology involves obtaining stakeholder views on this topic, hence my reason for contacting you.

Research Format

The University requires that ethics approval be obtained for research involving human participants. I am inviting various members of the New Zealand biofuel industry, environmental NGOs, public servants and biofuel experts to participate in this study. Participants will be asked to give their expert opinions on the potential for the development of a sustainability standard for the New Zealand biofuel industry, and any issues that would need to be addressed for such a scheme to be successfully implemented.

I am inviting you to participate in a semi-structured interview, which will be loosely based on seven question themes around key biofuel sustainability issues, the benefits and costs of standardisation, industry preparedness and the role of stakeholders in developing a domestic sustainability standard for biofuels. These questions can be made available prior to the interviews and I anticipate that interviews will not exceed more than forty-five minutes. My intention is to record all discussions and interviews using a digital recording device for purposes of accuracy. The interviews will be transcribed by myself soon afterwards and erased on the completion of the research.

Confidentiality and use of data

My intention is to quote participants in the study, and quotes will be checked with you before the thesis is finalised. However, participants may request that their responses from the interviews remain confidential. If you require confidentiality you will be referred to as a 'representative' from your organisation, or in any other wording that you

request. Should any participants feel the need to withdraw from the research project, they may do so without question at any time before the data is analysed. Just inform me of your withdrawal no more than eight weeks after the date of the interview.

All material collected will be kept confidential, and access to the written and electronic material will be restricted to me. Only myself and research supervisor, Dr Sean Weaver, will see the interview transcripts, which will be destroyed 3 years after the end of the research. The thesis will be submitted for marking to the School of Geography, Environment and Earth Sciences and deposited in the University Library.

Access to research results

A summary of the completed research output will be available by circling 'Yes' in the Participant Consent Form (attached), or on later request. Furthermore, copies of the completed research output will be available from the School of Geography, Environment and Earth Sciences Library, and in the Victoria University of Wellington electronic database of theses.

If you have any other questions about this project, please feel free to contact me or my supervisor Sean Weaver, using the contact details provided on the first page of this sheet.

Sincerely,

Natalie Grimmer

Masters of Environmental Studies Candidate
School of Geography, Environment and Earth Sciences
Victoria University of Wellington

c) Declaration of consent from Participant

Information

I have been given, have read and understood the 'Information for Research Participants' pertaining to this research project. I have had an opportunity to ask questions and have them answered to my satisfaction.

Right of withdrawal

I understand that participation in the research project is entirely voluntary and that I may withdraw myself and any information I have provided from this project (before analysis of data) without having to give an explanation or without disadvantaging myself in any way. I will need to inform the researcher within 8 weeks of the interview.

Confidentiality and use of data (delete one)

a) Confidentiality required

I request that my identity will be kept confidential to the researcher and supervisor. I understand that the published results will not use my name and that no opinions will be attributed to me in any way that will identify me.

b) Confidentiality not required

I consent to information or opinions which I have given being attributed to me in any reports on this research. I understand that I can request the opportunity to check the transcripts of the interviews before publication and any quotes will be checked with me before the thesis is finalised.

Access to research results

I understand that the information I provide will be published in a Master's thesis at Victoria University of Wellington and go in the University's electronic repository. The information may also feature in academic, industry or local government publications and/or be presented at academic or professional conferences. I understand that the data I provide will not be used for any other purpose or released to others without my further written consent.

I would like to receive a summary of the results of this research when it is completed

Yes

No

If yes, my address is:

My email is:

Declaration

I consent to participating in this research project.

Name:

Signed:

Date:

d) Declaration of Consent from Employer

Information

I have been given, have read and understood the 'Information for Research Participants' pertaining to this research project. I have had an opportunity to ask questions and have them answered to my satisfaction.

Right of withdrawal

I understand that participation in the research project is entirely voluntary and that my employee may withdraw themselves and any information provided from this project (before analysis of data) without having to give an explanation or without disadvantaging themselves in any way. They will need to inform the researcher within 8 weeks of the interview.

Declaration of consent from Employer

a) I consent to my employee
participating in an interview for this research project.

b) I consent to information or opinions which my employee gives being attributed to them in any reports on this research. I understand that the participant can request the opportunity to check the transcripts of the interviews before publication and any quotes will be checked with them before the research output is finalised.

Access to research results

I understand that the information provided will be published in a Master's thesis at Victoria University of Wellington and go in the University's electronic repository. The information may also feature in academic, industry or local government publications and/or be presented at academic or professional conferences. I understand that the data I provide will not be used for any other purpose or released to others without my further written consent.

Name

Organisation

Signed

Date

Employer:

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