Just Biofuels?

Mapping dimensions of energy justice in relation to an international liquid biofuel supply chain

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Abstract

It is argued in this thesis that it is morally right to identify and address matters of energy justice associated with renewable energy technologies - and thus biofuels. Equity appraisals, as defined in this thesis, can help to identify social and environmental burdens caused by the implementation of these technologies and where they exist, thus helping to understand the extent to which global sustainable development ideals to reduce inequalities are being achieved. This study is the first equity appraisal of an internationally-traded (Brazil-UK) liquid biofuel (sugarcane bioethanol), across both sites of production and consumption, conducted in a manner advocated by energy justice and environmental justice theories. Furthermore, this study provides the first empirical insights in this context of the ways that principal dimensions of energy justice can interrelate and specifically how matters of procedural justice and recognition can drive distributional changes in outcomes amongst people connected and affected to a transnational liquid biofuel supply chain. Primary qualitative data collected from people living in producer and consumption localities revealed that the nature and geographical patterning of issues differed from the views of transnational governance actors and experts. Rather than the majority of burdens lying with those living in Brazil, and UK-based consumers largely indifferent and unaffected, this research found both positive and negative equity issues affecting people at both ends of the supply chain. Matters of recognition and procedural injustice were found to be affecting consumers, affecting their abilities to engage effectively with their liquid biofuels purchases that could help drive the consumption of more sustainable, just and socially acceptable biofuels. Conversely, higher levels of recognition of local communities and associated impacts in this particular Brazilian production locality were found to be improving social and environmental outcomes for residents. This research highlights the importance of situated, contextual, primary qualitative data for equity appraisals of liquid biofuels and other renewable technologies. It is argued that these types of appraisals should be conducted more systematically in the field to supplement existing forms of appraisals, support decision-making processes and improve the chances of achieving energy justice in relation to renewable energy technologies.

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Chapter 1: Introduction

In this chapter, reasons are provided as to why this research is needed. Current, major global energy challenges are sketched out and the research gap this thesis addresses is explained. The rationale for this thesis is followed by specific research aims and objectives. In the final sections of this chapter, the research questions are defined and an outline of the thesis structure provided.

1.1 Why is this research needed?

Increasing evidence of diminishing stocks of fossil-fuels, such as oil, coal or gas, and the environmental degradation the combustion of these fuels are causing are driving major transformations in the energy sector (Skea et al. 2011). For example, there is increasing evidence that combustion of fossil-fuels to produce power is increasing levels of greenhouse-gas (GHG) emissions that are contributing to climatic changes and ocean acidification (IPCC, 2014; Miller and Spoolman, 2009; Skea et al. 2011). For these reasons, and increasing competition for fossil-fuel reserves as a result of rising global demand, renewable energy technologies have therefore become widely regarded as essential, alternative and more sustainable ways of providing energy for industrial or domestic consumption. This is because of their ability to harness naturally replenishing sources of energy, such as from wind, solar, geothermal, tidal or biomass (Miller and Spoolman, 2009; Skea et al. 2011). For example, the European Union's (EU's) Renewable Energy Directive (EC, 2009) seeks to ensure 20% of all energy consumed in the EU is produced by renewables by 2020. This policy has led to a further "substantial body of (supra) national policies and measures" across member countries and beyond (Bickerstaff et al. 2013, p1).

In addition to renewable energy technologies being regarded as means of reducing environmental impacts and increasing energy security, in the context of growing global demand, renewable energy technologies can also be considered essential for underpinning sustainable economic development and improvement to human qualities of life through access to energy for those

currently 'disconnected'. For example, access to sustainable forms of energy can help reduce global social, economic and environmental inequalities through increased provision of health, education, economic, leisure, communication, transport or cultural services (Bickerstaff et al. 2013; Skea et al. 2011; UN, 2012). Reducing social inequalities, improving access to energy for all and addressing the North/South divide are fundamental sustainable development aims (WCED, 1987). Rio+20's 'Sustainable Energy for All' initiative aims to help drive poverty eradication globally and provide access to energy for the approximately 1.4 billion people that currently remain without it (UN, 2012).

Moral and ethical arguments for ensuring that renewable energy technologies help reduce social and environmental inequalities are therefore identified within the above, opening paragraphs (i.e. Bickerstaff et al. 2013; UN, 2012; WCED, 1987). In fact, ethical studies such as the Nuffield Council on Bioethics's (NCB's) report (2011, p105) argues that "there are strong reasons to consider the reduction of GHG emissions as a benefit and reducing the rate of global warming may be described as a common good". However, moral and ethical reasons for increasing the use of renewable energy technologies in general are accompanied, in the NCB's (2011) report by a particular set of conditions that seek to ensure that social and environmental inequalities are not exacerbated or driven by these implementations. For example, the NCB (2011) advocates a moral duty to develop biofuels due to the global challenges the energy sector faces subject to certain conditions. The NCB (2011, p105) says the benefits overall need "to be offset against the burdens on some segments of society to enable this to happen." The NCB's (2011) 'Principle Number 5' (NCB, 2011, p105) specifically calls for 'distributional justice' as a result of renewable energy technology implementations as they state the "[c]osts and benefits of biofuels should be distributed in an equitable way".

Reasons are therefore stated above as to why it is important to base the development of renewable energy technologies on principles of equity and justice (in this thesis, matters of equity and justice are also referred to as equity issues). Additionally, existing energy research has shown that taking account of equity issues can also increase the social acceptability of renewables. This is

because existing research has found that people tend to be more supportive of renewable energy developments and implementations when they are considered more equitable (Devine-Wright, 2005; Gross, 2007; UN, 2012; Upreti, 2004; Parkhill et al. 2013; Skea et al. 2011; Wustenhagen et al. 2007; Walker and Cass, 2007; Walker et al. 2010). For example, Devine-Wright (2005) found support for local renewable energy development consistently high where the benefits were perceived to be spread more equally, such as where local communities were engaged in the design and implementation process with developers, and the energy was used locally or the profits put back into local community projects. Gross's (2007) study found that perceptions of fairness in decision-making processes relating to an energy technology's implementation (i.e. procedural justice) influenced the extent to which people accepted the outcomes' legitimacy as well as influencing the outcomes themselves (i.e. distributional justice). This indicates that people want assurances that renewable energy technologies are designed in ways that maximise the social and environmental benefits of investments into these systems, to improve human qualities of life of people connected and affected, as well as help to meet renewable energy targets and carbon reduction strategies. This existing body of research also indicates that energy publics are not purely passive recipients of these systems but also want to be included in decision-making processes associated with the design and implementation of these schemes.

Despite the arguments given above, as to why appraisals of equity issues (which are referred to in this thesis as equity appraisals) are important for renewable energy technology implementations, the extents to which environmental or social inequalities are exacerbated or reduced as a result often remain unknown. This is because less attention tends to be given to social and equity issues within dominant forms of renewable energy appraisals, as they tend to focus on technical, economic or environmental aspects of the technology (Adams et al. 2013; Bickerstaff et al. 2013; Bowen, 2002; McLaren, 2012; Sovacool, 2014b; Sovacool et al. 2015; Walker et al. 2005). For example, Adams et al (2013, p93) argue that "equity issues rarely feature in these analyses because assessments may be carried out by researchers from a single discipline or may employ specific modelling packages".

In today's world of disparate energy systems and energy technologies that circulate transnationally (Bickerstaff et al. 2013; Leach et al. 2010; Skea et al. 2011), affected communities and stakeholders often live far apart but are connected by the impacts associated with energy production, the production of the energy technology itself or its components, the technology's implementation or its consumption. Therefore, being able to demonstrate procedural and distributional justice related to specific energy technologies is important, as argued above, but also complex and requires new ways of thinking and approaching energy justice research (Bickerstaff et al. 2013).

Liquid biofuels provide an excellent example of a disparate, renewable energy technology that spans and connects communities across geographical and cultural boundaries. Biofuels are renewable energy technologies considered able to make significant contributions to carbon-reduction targets in the transport sector (NCB, 2011; Skea et al. 2011) but it will be argued here that, as yet, the ways in which social or environmental inequalities are alleviated or exacerbated remain largely unknown. For example, initially, biofuels were hailed as being able to bring a range of benefits including a contribution to renewable energy targets and economic development for developing countries – particularly in rural areas. However, despite the range of feedstocks and technologies biofuels encompass, some forms or instances of production have been found to inflict injustices on some people who are already the most vulnerable or living in poverty (NCB, 2011). In addition, there have been widespread concerns that first-generation biofuels may displace food crops, bringing food security issues including price rises which would be hardest to bear by those already at risk of going hungry (i.e. Ewing and Msangi, 2009; Fairhead et al. 2012; Hodbod and Tomei, 2013; NCB, 2011; Robbins, 2011; Rosillo-Calle and Johnson, 2010; Zulbeman et al. 2012).

Based on the arguments made earlier in this introductory text, as to why equity appraisals are important for renewable energy technologies and their consumption, these trade-offs need to be better understood if they are to be substantiated and issues addressed. However, as yet, biofuels have not received academic attention to explore equity issues (Creutzig et al. 2013;

Hodbod and Tomei, 2013; Mohr and Baush, 2013; Sovacool, 2014a). This research not only addresses this knowledge gap but also conducts an equity appraisal in the way that energy justice literature advocates. For example, recent energy justice research and associated literatures stress the importance of moving beyond purely 'distributional analyses' (i.e. which can be seen advocated by the NCB (2011) above) (Bickerstaff et al. 2013; Walker, 2012). Environmental and energy justice research highlights the necessity to broaden the focus from the way specific impacts, risks or burdens are shared so that the drivers of distributional injustices might also be understood (Bickerstaff et al. 2013; Walker, 2012). These literatures indicate that integrated equity appraisals are required to reveal the ways in which some stakeholders might be recognised and included more than others in decision-making processes as well as the distribution of associated benefits and burdens as a result of the use of the technology, i.e. the appraisal seeks to identify matters of recognition and procedural (in)justices alongside distributional (in)justices. This thesis argues that it is via these types of appraisal processes that policies and practices might be re-shaped by stakeholders engaged with, connected to or affected by renewable energy technologies to increase the extent to which they are more sustainable and just than the energy technologies they are replacing.

It is argued in Chapter 2 that currently we do not understand the exact nature of these trade-offs or injustices in relation to internationally-traded liquid biofuels used in UK transport because an integrated academic study of equity issues, in the nature described above, has not yet taken place and dominant forms of liquid biofuels' appraisal in the field (most commonly relating to their sustainability) do not adequately include social or equity issues (Blaber-Wegg et al. 2015). Understanding the dynamic range of equity issues associated with a liquid biofuel is complex because of the rapidly changing social, economic and environmental conditions in which they are set. Also apparent is the importance of context and recognition of plural notions of justice, as the NCB (2011, p105) state:

> "Developing policies to ensure that the costs and benefits of biofuels are distributed in an equitable way is not straightforward … it is important to note that costs and benefits relevant to equity extend

> well beyond purely financial losses or revenue. The costs and benefits of biofuels production may be complex and interrelated and accumulate in different ways and in different contexts ….”

In this thesis it is argued that while equity matters are not systematically taken into account within sustainability appraisals of liquid biofuels in the regulatory domain it is impossible to compare particular biofuel products in terms of their sustainability or equity. This means it is impossible to determine the extent to which they are more or less sustainable than each other within the broader context of sustainable development ideals outlined above (WCED, 1987) and UK-based consumers and public-sector policymakers are left unable to exercise purchasing preferences or make informed choices over which liquid biofuels to support, incentivise or accept. It is argued here also that this limits the extent to which consumers could help shape them into the sustainable and just forms of renewable energy they have the potential to become and consumers are more likely to want (i.e. Devine-Wright, 2005; Gross, 2007; Leach et al. 2010; Parkhill et al. 2013; Skea et al. 2011; Wustenhagen et al. 2007; Walker et al. 2010).

In summary, this interdisciplinary research is needed because it helps fill knowledge gaps in energy justice academic literature as well biofuels-related policy formation. It builds on energy justice related research to increase understandings of the way equity issues relate, how matters of recognition and procedural injustices can drive distributional injustices and how equity appraisals of specific renewable energy technologies might be conducted to help drive their sustainable and just development. Specifically, this research conducts a unique study that draws social science research methods, and sustainability, participation, Science and Technology Studies (STS), environmental justice and energy justice literatures to demonstrate how an equity appraisal might be approached in relation to liquid biofuels, to consider the way equity issues might be identified, defined and analysed. The aim of this research is to ultimately contribute to work being done to develop more environmentally and socially sustainable biofuels and renewable energy technologies in general.

1.2 Research aims

This research aims to conduct in-depth qualitative research to identify matters relating to the principal dimensions of energy justice (equity issues) associated with an international liquid biofuel (bioethanol) that is produced overseas and consumed in the UK as a transport fuel. By doing so, this research aims to contribute to energy justice literature by providing an empirical insight into the ways in which principal matters of energy justice interrelate and specifically, how matters of recognition and procedural justice drive distributional outcomes or injustices in relation to international liquid biofuel supply chains.

1.3 Research objectives

The objectives of this research project are to:

1. Establish the ways in which academic literatures, particularly those from the fields of environmental justice and energy justice, recommend conducting an equity appraisal to adequately take account of matters of equity and justice in relation to a renewable energy technology.
2. Establish current theoretical and empirical understandings of equity issues relating to liquid biofuel supply chains from existing literatures, including those relating to energy justice and biofuels.
3. Develop a case study on an international liquid biofuel supply chain feeding UK consumption through which to explore associated equity issues and drivers of distributional injustices.
4. Conduct an initial stage of primary qualitative data collection with transnational governance actors and experts in the field to:
    a) Understand the field and identify a case study supply chain.
    b) Identify the types of stakeholders connected to and affected by the case study supply chain (and thus who should be included in an equity appraisal).
    c) Establish how transnational governance actors and experts in the field recognise themselves and others in the chain and the ways in which they perceive them to be affected.

d) Identify matters of recognition and procedural injustices that may be drivers of particular outcomes or distributional injustices.

5. Conduct an equity appraisal via qualitative research, centred around in-depth interviews, to establish the equity issues affecting key stakeholder groups in and around sites of production and consumption including the ways in which matters of recognition and procedural (in)justice are driving particular distributional outcomes or injustices.
6. Use these findings to make policy recommendations that might make liquid biofuels used in UK transport more sustainable and just.

1.4 Research questions

In line with the research objectives, the research questions are:

1. Why and in what ways are equity issues important for the sustainable development of liquid biofuels used in UK transport?
2. Who are the people affected by the production and consumption of a liquid biofuel used in UK transport?
3. What are the equity issues affecting these people and how are matters of recognition and procedural justice effecting the distribution of benefits and burdens associated with this biofuel?
4. What implications do these findings have for biofuels-related policies?

1.5 Thesis structure

An overview of the thesis structure is presented here to highlight the ways in which each chapter's content helps address the research objectives and research questions defined in sections 1.3 and 1.4.

Chapter 2: Energy Justice

In chapter 2 existing published literature is reviewed to establish the importance of understanding equity issues associated with renewable energy technologies in general (and thus liquid biofuels used in UK transport, which are specifically looked at in chapter 3). This therefore provides the basis for answering research question 1 (as stated in section 1.4). Normative,

instrumental and substantive arguments for understanding equity issues relating to all affected stakeholders connected by the production and consumption of renewable energy technologies (and thus liquid biofuels) are presented.

Also in chapter 2, the ways in which energy justice theory defines equity issues in terms of distributional justice, procedural justice and matters of recognition are presented. This is followed by an examination of how energy justice theory can be operationalised to prescribe an equity appraisal of a particular liquid biofuel (thus attending to the first research objective as stated in section 1.3). For example, the literature review identifies that an equity appraisal of a biofuel needs to be able to identify the broad and diverse range of stakeholders involved or affected and give adequate recognition to their perspectives of the ways in which they are affected. Equity appraisals should also collect primary qualitative data from these people allowing for regional contexts and different notions of justice. These requirements for an equity appraisal are taken forward into the research methods presented in chapter 4.

Chapter 2 concludes with a review of existing energy justice research to date in terms of the types of technologies studied. It is via this review that the knowledge-gap in relation to a study of equity issues associated with an internationally-traded liquid biofuels is exposed.

Chapter 3: Liquid biofuels

Chapter 3 provides the second part of the literature review in this thesis (to complement chapter 2). Liquid biofuels are defined before examining the nature of consumption within the UK's transport sector. The policy drivers of this consumption are identified alongside the controversies and debates that have surrounded the sector. Chapter 3 therefore builds on the arguments made in chapter 2 as to why equity issues are important for understanding the sustainable development of liquid biofuels, helping attend to the first research question defined in section 1.4. In addition to the moral arguments for ensuring equity and justice in relation to the sustainable development of biofuels, relationships are identified between opposition to biofuels and demands for

the equitable sharing of costs and benefits amongst people affected – particularly people who are likely to be most vulnerable to exploitation as a result of increased consumption of biofuels in the UK.

Chapter 3 also attends to the second research objective stated in section 1.3 as it reviews existing theoretical and empirical understandings of equity issues relating to liquid biofuels in academic literatures. In chapter 3, the reasons why biofuels provide the basis of an ideal case study for this research are given, such as the lack of situated, context-specific evidence to date in relation to biofuels and equity issues.

Chapter 4: Research Methods

In chapter 4 the research methods for this thesis are presented, responding to the prescription of requirements for conducting an equity analysis presented in chapter 2, drawn from energy justice related literature. A research design is explained that enables research objectives numbers 3 to 5 (defined in section 1.3) and research questions 2 and 3 (defined in section 1.4) to be achieved. For example, the research methods explain how a first stage of research was conducted to identify a (Brazilian-UK) sugarcane bioethanol case study supply chain and the types of stakeholders connected to it (and each other). The research methods in chapter 4 also explains how the stakeholders' physical localities were identified in and around the sites of production and consumption in order to inform the second stage of research where people affected were visited in order to identify equity issues associated with this supply chain from their perspectives. Finally, an explanation of the techniques used to analyse the qualitative data (applicable to both stages of research) to help answer the final two research questions (stated in section 1.4) is provided (i.e. data analysis that helps identify the equity issues associated with the case study international liquid bioethanol supply chain, the procedural and recognition-based drivers of associated distributional injustices and implications of these findings for biofuels-related policies).

Chapter 5: The case study supply chain

In chapter 5, the first set of empirical results (from the first stage of research) are presented. These results identify and define the people affected by the production and consumption of a liquid biofuel used in UK transport, such as a supply chain of the case study type, from the perceptions of the governance actors interviewed during the first stage of research. The findings presented in this chapter thus attends to the fourth research objective (defined in section 1.3) and the second research question (defined in section 1.4). The findings also help attend to the third research question (also defined in section 1.4) as it draws out perceived equity issues associated with a supply chain of the case study type and therefore issues that are likely to be found during the second stage of research. The types of stakeholders identified and presented in chapter 5 are those that are included in the equity appraisal conducted during the second stage of research.

Chapter 5 also provides details of physical location of stakeholders and the nature of the stakeholders' connections to a liquid bioethanol supply chain of the case study type including their roles and responsibilities (from their own perceptions and that of others). What is demonstrated in chapter 5 is the broad and diverse set of stakeholders and types of appraisal that currently take place in relation to liquid biofuels used in UK transport and thus the complex configuration of equity issues that are likely to exist. In addition, emergent procedural and recognition-based injustices become apparent that are embedded into biofuels-related policies and practices which, from the perceptions of transnational governance actors, are driving the distributionally unjust outcome that the majority of social and environmental burdens are borne by producer regions.

Chapter 6: Findings from site of production (Brazil)

The fifth research objective (defined in 1.3) and third research question (defined in section 1.4) are attended to across chapters 6 and 7. This is because the equity appraisal conducted during the second stage of research covers both

sites of production and consumption and the findings from these individual sites have been separated across these two chapters.

In chapter 6, empirical findings are presented from the second stage of research conducted with people at the production end of the supply chain. This stage of research enabled the collection of qualitative data that helped identify that recognition of local communities by the bioethanol producer, within their own corporate social responsibility (CSR) and sustainability policies, are working alongside regional laws and practices to help drive a range of more positive social and environmental outcomes for residents and workers than might be expected (i.e. when compared with biofuels-production in developing countries from academic and grey literatures as discussed in chapter 2). Additionally, it is evident that these findings are different to the ways in which transnational actors and experts described likely impacts associated with the production of bioethanol overseas (as presented in chapter 5). These similarities and differences are discussed, highlighting the ways in which matters of recognition and procedural justice are defining matters of distributional justice in this region and across the chain.

Chapter 7: Findings from site of consumption (UK)

In a similar way to chapter 6, findings from the second stage of research are presented to help attend to the fifth research objective (defined in 1.3) and third research question (defined in section 1.4). In chapter 7, however, results are presented from interviews with stakeholders living in and around a site of consumption in the UK. The collection of qualitative data in this locality also helped identify equity issues and their interrelationships, specifically the way in which matters of recognition and procedural justice are affecting UK-based consumers. For example, despite the lack of attention (i.e. lack of recognition) this set of stakeholders received in academic literatures, grey literatures, transnational governance actors' and experts' narratives during the first stage of research (chapter 5), consumers interviewed felt they were experiencing a range of procedural injustices which excluded them from being able to engage more effectively and proactively in decision-making processes relating to ways in which they might consume liquid biofuels. Again, the findings from the

situated, contextual qualitative data collected at this stage are discussed to highlight the ways in which matters of recognition and procedural injustices affect distributional outcomes and injustices.

Chapter 8: Discussion and conclusions

This final chapter discusses the findings presented across the literature reviews in chapters 2 and 3 and the empirical findings in chapters 5, 6 and 7. The conclusions drawn help to answer the final two research questions posed in section 1.4, i.e. questions 3 and 4 that seek to identify the equity issues affecting people connected to (and affected by) an international liquid bioethanol supply chain and the procedural and recognition-based injustices that may be driving distributional injustices in order that policy recommendations can be made. This also thus attends to the fifth and sixth research objectives (as stated in section 1.3).

The final discussion and conclusions highlight matters of recognition and procedural (in)justices that are affecting matters of distributional justice to particular stakeholders across this case study supply chain. For example, evidence that higher levels of recognition within the producer's own CSR practices and Brazilian laws are helping achieve more positive social and environmental impacts for local communities and workers at this particular site of production in Brazil are identified. In addition, the lack of recognition – or misrecognition - of consumers in the UK is shown to be limiting the ways in which these stakeholders can engage effectively with liquid biofuel supply chains in general, which could help drive more just or sustainable practices across biofuel supply chains (and the sector) more broadly. An important procedural injustice is also highlighted as a result of this research as information and evidence-bases relating to particular biofuel products are found to be inadequate to help stakeholders understand equity issues in relation to liquid biofuels and thus engage or participate effectively with the fuel, supply chain and others affected. This is shown to limit the extent to which individual stakeholders can carry out their own roles and responsibilities in relation to the production and consumption of biofuels and help ensure the more sustainable (and just) development of liquid biofuels in UK transport.

Finally, in chapter 8, reflections on this research project are presented alongside opportunities for future research opportunities.

Chapter 2: Energy Justice

In chapter 1, arguments were introduced as to why this research is needed and it is essential that socially and environmentally just renewable energy technologies are implemented if they are to meet the aims of sustainable development ideals. This chapter now presents more detailed normative, instrumental and substantive arguments that build on this introduction, to emphasise the importance of investigating equity matters in relation to sustainable energy systems' developments, including from a purely moral standpoint. Due to the inherently socio-technological nature of energy systems (Walker and Cass, 2007; McLaren et al. 2013), academic literature from the fields of public participation, science and technology studies (STS), energy justice and environmental justice are used to provide rationales for including equity issues in the appraisals we use to inform technology choices.

The chapter then contains a review of conceptual understandings of energy and equity issues to date, defining the term 'energy justice', and demonstrating how these matters are underpinned by theories of environmental justice. This helps explain why these concepts are used as the key theoretical grounding for the approach taken in this research project, which aims to open up and explore equity issues relating to an internationally traded liquid biofuel in order that the causes of social and environmental inequalities – matters of distributional justice – might be understood and addressed.

The literatures reviewed in this chapter identify deficits in understandings of equity issues relating to energy technologies in general and specifically in relation to biofuels (which are then defined and discussed further in chapter 3) and thus clearly outlines the contributions this research makes.

This chapter concludes with a set of 'requirements' that can be used to conduct an equity appraisal of a liquid biofuel, in the spirit of energy justice research, drawing on this part of the literature review.

2.1 Energy and equity: key concepts and rationales

It can be argued that equity is important in relation to energy technologies and energy systems because they are "interconnected, integrated systems that link social, economic and political dynamics" (Miller et al. 2015, p30) to their design and operations. Therefore energy technologies and energy systems are fundamentally part of social systems and 'socio-technical' in nature (Leach et al. 2010; Lutzenhiser, 2014; McLaren et al. 2013; Miller et al. 2015; Sovacool, 2014b; Sovacool and Dworkin, 2015; Stirling, 2008; Walker and Cass, 2007). For example, Walker's (2007, 2008) studies argue that people feel particularly connected to an energy technology or system when engaged in its development or they can see the benefits shared across those involved or affected, therefore individuals' connectedness to an energy technology can be shaped and (re-)defined by the social connections and socio-technical arrangements formed around it. Other research suggests that changes to the ways in which energy systems are configured or how the energy is used depends on perceptions of roles and responsibilities for associated impacts (Shippee, 1980; Sovacool and Dworkin, 2015). The ways in which energy systems are perceived as just or unjust can affect lack of trust and investment decisions, thus influencing incumbent or new energy pathways (Greenberg, 2014).

A body of academic literature has thus emerged seeking to understand these socio-technical relationships - concepts from which are used in this chapter to structure arguments as to why social and equity issues are essential for the development of sustainable and equitable energy technologies and therefore why they should be included within associated appraisals that inform our energy choices. However, before presenting these arguments, it is important to define what is meant here by the term 'appraisal'.

Appraisal is used throughout this thesis to refer to the wide range of decision-making processes, judgements and evaluations made by people in their everyday lives, through their connections with the technology as well as more formal, expert-driven or centralised assessment processes. This definition views appraisals as being distributed in nature, in the way that 'technical

assessments' (TAs) and 'social appraisals' are defined by Ely et al (2014) and Stirling (2008) respectively. For example, Ely et al (2014, p506) define TAs as "a broad set of practices aimed at informing, shaping and prioritising technology policies and innovation strategies, by deliberately appraising in advance their wider social, environmental, and economic implications". TAs are described by these scholars as a range of practices that sit within a wider set of formal and informal social appraisals, which Stirling (2008) defines as a diverse set of social processes that promotes the gathering and re-production of knowledges to inform decision-making or associated institutional commitments.

What is clear is that individuals (or groups of individuals) constantly conduct appraisals, formally and informally, to evaluate and compare social and environmental implications of new technologies compared with existing ones (Ely et al. 2014; Fiorino, 1990; Leach et al. 2010; Sovacool and Dworkin, 2015; Stirling, 2008). Therefore, appraisals of energy technologies are often used to: (i) understand the ways in which social and environmental systems are affected by the energy's production and consumption; (ii) help people make choices about which technologies to employ (or consume) based on the ways in which they improve or exacerbate social or environmental conditions; and (iii) through these processes, help shape the technologies into the sustainable and equitable energy systems that people have been found to prefer (Devine-Wright, 2005; Gross, 2007; Parkhill et al. 2013; Upreti, 2004; Walker and Cass, 2007; Walker et al. 2010; Wustenhagen et al. 2007; Walker, 2012). Rationales used for increasing participation in energy appraisals therefore appear pertinent and could be extended to rationales for including social and equity dimensions in energy appraisals, which are presented next. Fiorino (1990) defines these in terms of normative, instrumental or substantive rationales.

Normative rationales

A normative rationale argues that attending to equity issues is 'the right thing to do' based on a given set of ethics and values (Chilvers, 2009). Sustainable development ideals outlined by Brundtland in 1987 (WCED, 1987) provide normative arguments for ensuring equity in the energy systems developed and implemented (Sovacool and Dworkin, 2015). There is a moral duty to improve

qualities of life in the development of energy technologies and systems, to reduce social inequalities, poverty and environmental damage both for this and subsequent generations. Equity and justice are fundamental components of the concept of sustainable development in terms of both inter- and intra-generational equity (Sovacool and Dworkin, 2015; Walker and Bulkeley, 2006; WCED, 1987) and thus for an energy technology or system to be judged as 'sustainable', it should follow these ideals.

Core sustainable development aims and objectives span environmental, economic and social dimensions – often termed 'the three pillars'. These dimensions enable human development that can improve qualities of life, reduce poverty and social inequalities without degrading or depleting natural resources faster than they can be naturally replenished (WCED, 1987). Understanding equity issues associated with energy technologies is important because they can bring benefits to some, in terms of energy supplies, while causing environmental damage (locally and elsewhere), degradation of ecosystem services and social instability for other environments and people in the system (Sovacool and Dworkin, 2015). It is crucial to ensure that sustainable energy technologies do not inadvertently cause or exacerbate social or environmental inequalities because they are poorly designed or implemented (Sovacool, 2013), however, this is impossible without seeking to understand the ways in which these impacts are distributed (Sovacool and Dworkin, 2015; Walker, 2012).

Energy services themselves have the potential to reduce social inequalities and improve qualities of life because energy systems underpin essential services and infrastructures necessary for human development, for example health, education, economic, transport and communications services and networks (UN, 2012). Currently, approximately 1.4 billion people (UN, 2012) or one-quarter of the world's population (Sovacool, 2013) live in homes without reliable or affordable access to energy, affecting their health, education, cultural and employment prospects. Thus, recognising the critical contribution of energy to human development, in 2011 the United Nations established the Sustainable Energy for All (SE4ALL) initiative, which has three objectives – one

of which is to provide universal access to modern energy services by 2030. Recognising the interconnectedness of social and environmental goals, the UN's Sustainable Energy for All (SE4ALL) also aims to double the share of renewable energy in the global energy mix, and double the rate of improvement in energy efficiency, also by 2030.

Access to energy therefore has the power to help reduce social disparities and the development of sustainable energies is crucial to support this goal both in the short and longer-term. Tackling inequities such as access to energy and the North/South divide have always been apparent in the sustainable development ideals. The UN's SEA4ALL initiative restates the need for a 'green economy' to help drive poverty eradication globally, built on just and sustainable renewable energy technologies. The adoption of sustainable energy technologies is therefore an essential component to underpinning sustainable economic development whilst tackling global social, economic and environmental inequalities. This issue has been explicitly recognised by the UN's (2012, pp24-25) SE4ALL statement, which argues:

> "Energy is central to nearly every major challenge and opportunity the world faces today … be it for jobs, security, climate change, food production or increasing incomes … access to energy for all is essential."

Recent research relates social divide and inequalities to a wide range of negative social issues and costs including health problems, crime rates and population rises – all of which threaten the socio-economic stability or 'social sustainability' of a region (Wilkinson and Pickett, 2010). In fact, this instability could also threaten the long-term sourcing of energy supplies from a production region or the sourcing of components required to manufacture the technologies that generate the fuels or energy resources. Niven (2005) also suggests poverty eradication and the reduction of social inequalities can help achieve greater political security (Niven, 2005). These issues are therefore not only fundamentally interconnected with sustainability ideals but, as Niven (2005) argues, are in everyone's interests to take account of when pursuing development activities – of which energy generation most often underpins.

Substantive arguments

A substantive rationale can be described as seeking to achieve better outcomes as a result of a given set of procedures, or seeking outcomes at a deeper level by including a full spectrum of knowledges and perspectives. In this way, substantive rationales can be used to increase understandings and social learning, thus the processes change outcomes or the ways in which people behave (Funtowicz and Ravetz, 1993). For example, in relation to renewable energy technologies, they may seek to shape implementations in different ways, based on these increased, broader understandings of related issues, impacts and sustainability ideals.

A substantive rationale for including social and equity matters in energy choices therefore seeks inclusion of a wide range of knowledges and perspectives, which are given equal attention and respect (Fiorino, 1990), to helping to socially shape technologies and build more equitable outcomes as a result. Publics' needs, knowledges and values are thus foregrounded within the selections made (Sovacool, 2014a). Furthermore, opportunities for new knowledges, understandings, 'social learning' (Berkes, 2009) and trust (Stoknes, 2014) are made, where those engaged learn from other perspectives. These new understandings may penetrate deeper and wider into communities and institutions, as those engaged become 'gatekeepers', influencing perspectives of others in their peer groups and networks. Further, these processes can help people feel more engaged and encourage them to take responsibility for the impacts of their energy choices and consumption as they gain new information, learn from others and apportion less blame to others in light of their new understandings of their role in the system (Sheppee, 1980; Sovacool and Dworkin, 2015). In this way, equity appraisal processes can be regarded as opportunities for 'trojan horses', which allow a wider set of perspectives to infiltrate dominant and more closed assessment processes (Stirling, 2011). This, however, involves appraisal processes that allow cultural shifts, the re-

framing of choices, product service re-designs and the changing of habits (Grant, 2007).

In this way, decision-making, design or innovation processes themselves have the potential to influence broader and deeper changes over time, effecting the nature and distribution of outcomes that could help energy systems become more sustainable and just. Indeed, in relation to energy systems, studies have found that people feel more connected to an energy technology where they are more engaged in its development, or they can see the benefits shared across those involved or affected (Walker 2007, 2008). However, fundamentally, for these more substantive benefits to be realised, it is crucial that the process allows recognition and inclusion of a full spectrum of knowledges and perspectives (Blackstock et al. 2007; Funtowicz and Ravetz, 1993; Laird, 1993; McLaren et al. 2013; Rowe and Frewer, 2000; Sovacool, 2014a; Stirling, 2008).

What is apparent here, is that peoples' needs and concerns are allowed to shape decisions about particular courses of action and innovation pathways - i.e. the selections of energy technologies and the ways in which they are implemented. Based on existing energy research (Devine-Wright, 2005; Gross, 2007; Parkhill et al. 2013; Upreti, 2004; Walker and Cass, 2007; Walker et al. 2010; Wustenhagen et al. 2007) energy systems that are perceived to be more sustainable and just have gained higher levels of public support. Equally, systems that are considered just tend to gain more trust, which can affect the degree to which individuals choose to invest in particular energy choices (Stoknes, 2014). Therefore, inclusion and engagement with a broader set of peoples affected, including those at local levels, is likely to influence and shape future energy technologies' developments and pathways. In fact, a plethora of examples of more substantive benefits achieved through energy technology implementations can be drawn from community energy studies and literatures (Hargreaves, 2012; Hargreaves et al. 2013; Hielscher et al. 2013; Maartiskainen et al. 2013; Seyfang et al. 2013a; Seyfang et al. 2013b). These studies show much broader engagement, learning and knowledge-sharing as a result of people designing and implementing their own community energy schemes than might be typically experienced from centrally-driven energy schemes.

Hargreaves (2012) for example shows the way energy projects have been linked to other, broader sustainability initiatives and goals, relating to local food production and distribution, green spaces, anti-poverty or active citizenship.

It will be shown later, in the next major section, that these matters align neatly with concepts already embedded in energy justice literatures; matters of recognition, procedural justice and distributional justice (defined in section 2.2). For now, a key message here, is that achievement of normative and substantive outcomes (as a result of an energy technology's implementation) requires participatory approaches that allow normative and substantive rationales to be heard (Ciupuliga and Cuppen, 2013; McLaren et al. 2013), as well as active recognition of diverse societal values on the part of governing actors. This requires the recognition and inclusion of the spectrum of knowledges and perspectives advocated by Funtowicz and Ravetz (1993) and Stirling (2008). However - as will be discussed next - 'instrumental' motives are often dominant (Ciupuliga and Cuppen, 2013; McLaren et al. 2013).

Instrumental arguments

An Instrumental rationale can be described as a means of achieving particular ends to a pre-defined agenda or particular set of interests (Irwin, 2006). This is a complex issue in relation to energy as major, global energy challenges associated with meeting current and future energy demands within the confines of environmental limits were outlined in chapter 1 (Skea et al. 2011) and thus public opposition to renewable energy technologies can be costly - temporally, financially, environmentally and socially (Skea et al. 2011; Sovacool, 2014a). Resistance to the implementation of these technologies is regarded as a significant barrier to meeting global renewable energy targets to reduce environmental degradation fossil-fuels have been found to cause (Skea et al. 2011). However, in line with sustainable development ideals and the findings from existing energy research (discussed further in this section), it is essential that renewable energy technologies are implemented that can demonstrate they are sustainable and just (as discussed in section 1.1). Miller et al. (2015) note the increasing attention to energy choices by publics and the protests that have confronted every major form of energy technology in recent years.

An instrumental rationale for including social and equity matters in appraisals of energy technologies would be to win favour amongst different stakeholders for particular types of energy implementation, for example to increase the uptake of renewable energy technologies by increasing their social acceptability. The danger is that, as Bickerstaff et al (2013) note, social acceptability is sought at late stages of renewable energy developments or implementations, regardless of broader local social, environmental or economic impacts, via public participatory approaches or consultation processes employed at a superficial level. This might include seeking to gain trust and channel the smoothest pathway possible for the implementation of a pre-determined energy system, which may include the targeting of the most marginalised or vulnerable social groups (Bickerstaff et al, 2013). The primary motives here may be to implement renewable energy technologies as quickly as possible, meet pre-defined national/international renewable energy targets, enhance profits for some stakeholders or maintain power in energy provision (i.e. the EU's RED (EC, 2009)) (McLaren et al. 2013; Walker et al. 2010).

A range of energy studies have shown that instrumental approaches can actually erode publics' trust and acceptability of renewable energy technologies (Devine-Wright, 2005; Gross, 2007; Walker et al, 2010). For example, publics' opposition to the siting of some renewable energy technologies have tended to occur where installations have been perceived to be driven by instrumental processes such as agencies or institutions seeking rapid adoption of pre-defined and pre-designed energy systems. An example of this is the siting of wind turbines where local communities have only been engaged with during the site planning stages of development. What is clear from existing studies relating to the social acceptability of renewable energy technologies is that publics' oppositions relate to perceptions of injustices; either the process relating to the energy system's design, selection or implementation is regarded unfair or the distribution of associated risks or burdens amongst peoples affected are deemed unjust (Devine-Wright, 2005; Gross, 2007; Parkhill et al. 2013; Upreti, 2004; Walker and Cass, 2007; Walker et al. 2010; Wustenhagen et al. 2007; Walker, 2012). These matters will be defined and discussed further in the next section, in terms of distributional and procedural injustice(s) respectively.

However, what these studies also show is that stakeholders are more likely to embrace renewable energy installations that can demonstrate they are genuinely more environmentally and socially just than the energy technologies that are being replaced providing the decision-making processes are fair and outcomes are equitably distributed (including where outcomes are less desirable for themselves). Therefore, even public or private sector stakeholders seeking to increase the uptake of renewable energy technologies are more likely to smooth pathways for implementation if they take account of equity issues, engage stakeholders meaningfully at the early stages of a system's design and include a wide range of knowledges and perspectives within genuine and effective participatory approaches (i.e. as advocated by Blackstock et al. (2007), Ciupuliga and Cuppen (2013), Funtowicz and Ravetz (1993), Laird (1993), McLaren et al (2013), Rowe and Frewer (2000) and Stirling (2008)). Furthermore, these processes have the potential to achieve more substantive outcomes while increasing the social acceptability of renewable energy technologies in the way formerly exclusive or closed decision-making processes can be infiltrated (Stirling, 2011), leading to new understandings that might find more mutually just and beneficial solutions.

The point here is that there is a danger that instrumental approaches can override normative and substantive goals, resulting in impacts that work against broader sustainable or energy justice ideals. To avoid this occurring, it is necessary to include and recognise a wide range of knowledges, perspectives and impacts in energy developments at a much deeper level than a purely instrumental approach might allow, helping participants to shape the nature and design of the energy system under construction and helping achieve more sustainable and substantive outcomes (Ciupuliga and Cuppen, 2013; Funtowicz and Ravetz, 1993; McLaren et al. 2013; Stirling, 2008).

What starts to emerge from the discussion above, however, is that the three rationales for including equity issues within appraisals of renewable energy technologies need not be mutually exclusive. For example, scholars such as Grant (2007), Hutchins and Sutherland (2008), Frynas (2009), Porter and Kramer (2006), Visser (2010) and Young and Tilley (2006) suggest that mutually

beneficial, sustainable economic, social and environmental outcomes are possible across private, public, civil society sectors actors and consumers. However, again, this is subject to actors engaging with each other openly and in the manners outlined above (i.e. as advocated by Blackstock et al. (2007) etc). Important roles and responsibilities are identified for the private sector by Grant (2007), Hutchins and Sutherland (2008), Porter and Kramer (2006) and Visser (2010) to achieve these more just, sustainable and substantive outcomes as a result of their operations through their Corporate Social Responsibility (CSR) strategies as well as via the ways in which they engage with their broader set of stakeholders. In relation to liquid biofuels (to be discussed through chapter 3) these matters are particularly relevant because they are already being used in large quantities but are fluid in nature, can be produced via a range of sources and practices and individual products have the potential to be selected on the basis that they are more sustainable or just than others.

CSR can be defined broadly as the commitment of a business to ethical behaviours that contribute to economic and sustainable development ideals, including the improvement of human qualities of life (Metaxas and Tsavdaridou, 2012). CSR has increasingly become a priority for business leaders globally because of the way they are increasingly held to account by governments, activists, the media and consumers in relation to the social or environmental consequences associated with their business operations (Porter and Kramer, 2006). This also applies to businesses within the energy sector (Streimikiene et al. 2009) and is particularly relevant here due to the fact that the manufacture and implementation of renewable energy technologies rely on private investment (DECC, 2013), for example from manufacturing companies, shareholders, energy providers and consumers and investment levels are influenced by perceptions of trust (Greenberg, 2014).

Grant (2007) and Hutchins and Sutherland (2008) talk of strong linkages between social sustainability and CSR, recognising that companies are often the mainstays within communities - thus social responsibility of a business goes much further than responsibilities to deliver profits to its shareholders or provide fair and safe working conditions for its employees (UNEP, 2013). There

are deeper responsibilities, which are perhaps even more pertinent in global renewable energy systems, which frequently impact people in producer regions, such as developing countries. This is particularly the case of liquid biofuels, such as bioethanol, which is frequently used in UK transport but produced overseas (this is explained and discussed in more detail in chapter 3). Equally, a renewable energy technology or its components may be manufactured by companies overseas that operate in these regions or the energy may be delivered by private sector businesses as part of large-scale, dominant infrastructures (Adams et al. 2013). Therefore, if companies wish to gain support for the renewable energy technologies in which they have heavily invested, they need to be able to demonstrate how their investments in these renewable fuels are more socially and environmentally just than the fossil-fuels they are replacing. If companies can show their operations, practices or the technologies themselves are (re-)shaped and re-designed in ways that genuinely benefit wider communities and environments affected, via the recognition and inclusion of affected voices, their products are likely to be more socially acceptable.

Porter and Kramer (2006) specifically highlight opportunities for businesses if they see themselves *within* society rather than pitching themselves against it. Porter and Kramer (2006, p92) argue that:

> "Corporations are not responsible for the world's problems, nor do they have the resources to solve them all. Each company can identify the particular set of societal problems that it is best equipped to help resolve from which it can gain the greatest competitive benefit. Addressing social issues by creating shared value will lead to self-sustaining solutions that do not depend on private or government subsidies. When a well-run business applies its vast resources, expertise and management talent to problems that it understands and in which it has a stake, it can have a greater impact on social good than any other institution or philanthropic organisation."

Visser (2010) talks about this in terms of 'CSR 2.0' or a new 'Age of Responsibility', where businesses need to see CSR as much more than a set of net positive or negative impacts on society and the environment. However, to

support these plans and strategies, drawing on earlier points from scholars such as Funtowicz and Ravetz (1993) and Stirling (2008), businesses require supporting practices, i.e. skills, tools and methods that can facilitate effective participatory approaches and the production of new knowledges via engagement with a diverse range of stakeholders. Again, however, this requires that consumers, local communities, public, private and civil society sector agencies and institutions are willing to work together and are open to being engaged in appraisal processes that take account of the ways in which different people are affected. This includes allowing the re-framing of choices and design pathways that might allow products, technologies or systems to be re-designed and re-shaped accordingly to matters of equity and justice (Grant, 2007; Leach et al. 2010).

Looking across the matters discussed here, it is imperative that equity issues are taken account of within the design and implementation of renewable energy technologies and systems and this requires transparent, inclusive approaches that identify and include stakeholders affected, take account of their knowledges and perspectives to promote mutual learning and the re-shaping of energy technologies and systems as necessary to achieve the types of implementation that people want and which are more socially and environmentally just. It is only via these mechanisms that the broadest range of stakeholders affected might experience better outcomes and more substantive and sustainable renewable energy provision might be achieved.

2.2 Concepts of energy Justice

This section defines the term 'energy justice' and demonstrates how environmental justice theory provides the concepts on which energy justice research is based. Firstly, the principal dimensions of energy justice are identified and outlined before looking at the ways in which these concepts have been employed in energy justice related studies to date (section 2.3). This helps establish the nature of current knowledge in the field. What becomes clear is that energy justice concepts span individual dimensions of justice and that energy justice research advocates integrated equity appraisals capable of exploring the relationships between these fundamental and interconnected

dimensions of justice. Furthermore, this section shows how energy justice research can support people connected to energy systems (including decision-makers, appraisers, producers and consumers) to become more engaged, responsible and accountable for the design and use of sustainable and just energy systems (Sovacool and Dworkin, 2015; Stoknes, 2014).

Energy justice is defined by Sovacool and Dworkin (2015, p436) as an energy system that "fairly disseminates both the benefits and costs of energy services and one that has representative and impartial energy decision-making". In 2014, Sovacool and Dworkin also referred specifically to energy justice requiring inclusive decision-making processes that treat people and communities with equal respect (Sovacool and Dworkin, 2014). It is this definition that is employed in this thesis because it encompasses the individual, principal dimensions of justice defined and advocated by environmental justice and energy justice theory. These principal dimensions of justice include procedural justice, recognition and distributive justice (Angleson et al. 2009; Schlosberg, 2007; Sikor, 2013; Sovacool and Dworkin, 2015; Walker, 2012). These dimensions provide definitions of equity in terms of the way decisions are made, such as who is included and excluded (i.e. procedural justice), how different peoples and perspectives are recognised and given adequate respect (i.e. justice as matters of recognition) and the distributional nature of risks and burdens associated with a particular phenomenon or 'intervention [1]' (distributional justice) (Angleson et al. 2009; Sikor, 2013; Sovacool and Dworkin, 2015; Walker, 2012; Walker and Day, 2012). Leading researchers in the fields of environmental justice and energy justice have already found these concepts (or dimensions of justice) helpful to analyse equity matters in relation to energy systems in order to inform decision-making and policymaking. For example, Bickerstaff et al. (2013), McLaren (2012), Sovacool and Dworkin (2015) and Walker and Bulkeley (2006) found these concepts helpful to facilitate critical engagements with the relationships between energy developments, environments and societies (Mclaren, 2012; Walker and Bulkeley, 2006).

[1] 'Intervention' is used here to describe a range of social or environmental phenomena including activities such as policies, plans, developments or the siting of particular technology implementations.

The types of risks, burdens benefits or costs people may experience as a result of an intervention can be defined, in environmental justice-related literature, as impacts on their capabilities to access fundamental requirements for their well-being or decent quality of life (Nussbaum, 2011; Reitinger et al. 2011; Sen, 1999; Walker, 2012). These capabilities span matters of procedural justice, recognition and distributional justice. For example, fundamental capabilities include the ability for a person to take part in decisions that affect their lives, a person's capability to be treated with respect and their capabilities to access sufficient nutrition, shelter, education and meaningful employment (Sen, 2005; Nussbaum, 2011). However, as this section explains, environmental justice theory indicates that it is not only important to define risks and burdens and reveal how they are shared amongst people affected through environmental justice-related research. It is essential that the inquiry seeks to understand the relationships between the three dimensions of environmental justice so that the drivers of injustices might be understood (Walker, 2012). For these reasons, the focus of this section (and the thesis) is to define procedural justice, recognition and distributional justice and understand the ways in which existing environmental justice literature understands their relationships. This discussion takes place within the context of the development of environmental justice and energy justice related research and literatures.

Environmental justice research and literature emerged from local civil society groups and movements in the USA during the 1990s, initially concerned with the ways in which environmental or social impacts were shared. For example, early studies related to the risks and burdens experienced by some social groups associated with pollution or siting of toxic waste facilities (Sikor, 2013; Walker, 2012). In other words, environmental justice was primarily concerned with distributional justice or the social patterning of costs and benefits as a result of a particular phenomenon or intervention (Dobson, 1998; Edwards, 1995; Gross, 2007; Holifield et al. 2010; Schlosberg, 2007; Schlosberg and Carruthers, 2010; Sikor, 2013; Stephens, 2007; Walker and Bulkeley, 2006; Walker, 2010; Walker, 2012). Environmental justice research is often considered geographic in nature, due to its spatial aspects, and increasingly

international (Sikor and Newell, 2014; Tschakert, 2009; Walker and Bulkeley, 2006).

The initial focus of environmental justice on distributional justice soon broadened to address injustices in decision-making processes, including equality and respect, individual and community recognition and participation - matters of procedural justice and recognition (Dobson, 1998; Edwards, 1995; Gross, 2007; Holifield et al. 2010; Schlosberg, 2007; Schlosberg and Carruthers, 2010; Sikor, 2013; Stephens, 2007; Walker and Bulkeley, 2006; Walker, 2010; Walker, 2012). This broadening out of environmental justice theory, beyond inquiry into the geographical patterning of environmental risks or burdens, was because researchers realised that the value of research findings are diminished if drivers for these injustices remained unexamined (Walker, 2012; Walker and Day, 2012). It has become widely recognised that matters of recognition, procedural and distributional justices are closely interrelated and specifically, in relation to energy technologies, scholars advocate that decision-making and appraisal processes need to be "informed and interrogated by justice questions in a much more comprehensive and integrated manner" (Bickerstaff et al. 2013, p13). This is because closer attention to the full spectrum of equity issues in terms of procedural justice, recognition and distributional justice can help to understand the nature of their interrelationships and, specifically, identify the ways in which procedural injustices and misrecognition drive distributional injustices (Sovacool, 2015; Walker, 2012; Walker and Day, 2012). In this way, an equity appraisal supports more informed decision-making processes to improve the potential of achieving higher levels of sustainable and just energy systems.

Procedural justice is the term used to describe concerns related to fairness in decision-making processes, such as the ways in which decisions are made, who is involved and who has influence (Schlosberg, 2007; Walker, 2012). For example, the NCB (2011, p65) argues that it is unethical that people whose interests are "profoundly and involuntarily shaped by a political decision" are excluded from engagement with associated decision-making processes (specifically in relation to biofuels). Procedural justice thus encompasses

fairness in participatory processes and inclusivity. It also includes access to adequate, common bases of information for all those affected by a decision to enable them to engage effectively with the process and participate meaningfully, which includes learning about the others' perspectives and interests (Laird, 1993; Sovacool and Dworkin, 2015; Walker, 2012). Walker (2012) also discusses at length the need for transparency and clarity around the ways in which evidence-bases are produced and their limitations because of the way forms of 'claim-making' can embed uneven power relations, influence decisions and reform procedural injustices.

Recognition, as a distinct environmental justice concept, digs deeper into matters of procedural justice. For example, Walker (2012, p10) defines recognition as "who is given respect and who is and isn't valued". Thus, recognition is concerned with the *ways* in which particular stakeholders are acknowledged in decision-making processes rather than who is included and excluded per se. This is important as an individual may be included in a decision-making process but their voice or perspective may not be given adequate value or respect by others (Tschakert, 2009; Walker, 2012). This may be due to the way they are perceived by others or their knowledge and perspectives valued (Walker, 2012). This form of injustice can be referred to as 'misrecognition' (Walker, 2012). Fraser (1990, 2001, 2009) and Lister (2002) in fact argue that 'participatory parity'[2] is more important than inclusion alone and that it requires reciprocal recognition and respect amongst participants. Young (1990) argues that respect and recognition affects a person's or group's ability to participate in their community or forms of governance. Furthermore, scholars such as Walker and Bulkeley (2006), Schlosberg (2007), Bryant (1995) and Tschakert (2009) argue that people excluded from a system, or people who are not recognised or sufficiently heard, are often the people most negatively affected by particular projects, policies or plans. McLaren et al's (2013) study of equity issues in relation to carbon capture and storage (CCS) concludes that the lack of recognition of some stakeholders within CCS decision-making processes is likely to significantly hinder the chances of just outcomes.

[2] Nancy Fraser's work (1990, 2001, 2009) introduces participatory parity as a specific concept to describe fairness or equality in participatory practices.

Schlosberg (2007) argues that issues that manifest themselves across both distance and difference can be accounted for specifically through injustices relating to recognition or participation (and thus procedural injustice).

Figure 1 below depicts the main interrelationships between recognition, distributional injustices and procedural injustices including specifically matters relating to participation. Figure 1 is based on Walker's (2012, p65) diagram[3] and helps demonstrate that while each dimension of justice is distinct in its own right, the existence of one can be explained by an injustice in the others as they interact and are mutually reinforcing (Schlosberg, 2007; Walker, 2012). What environmental and energy justice literatures therefore make clear is that an equity appraisal of an energy technology must be able to (i) identify equity issues in relation to all three principal dimensions of environmental justice and (ii) explore the relationships between these dimensions to help understand the reasons why distributional injustices occur (i.e. the procedural injustices or matters of recognition that drive these outcomes). Furthermore, the literature identifies that higher levels of recognition, procedural justice and participatory parity are important for distributional justice. Attention now turns to explore more closely the relationships between effective participation and matters of recognition, procedural and distributional justice.

[3] Walker's (2012, p65) diagram does not explicitly name procedural injustices, focussing on the interrelationships between recognition, participation and distributional injustices. Here it is slightly adapted and extended to explicitly refer to procedural injustices and participatory parity.

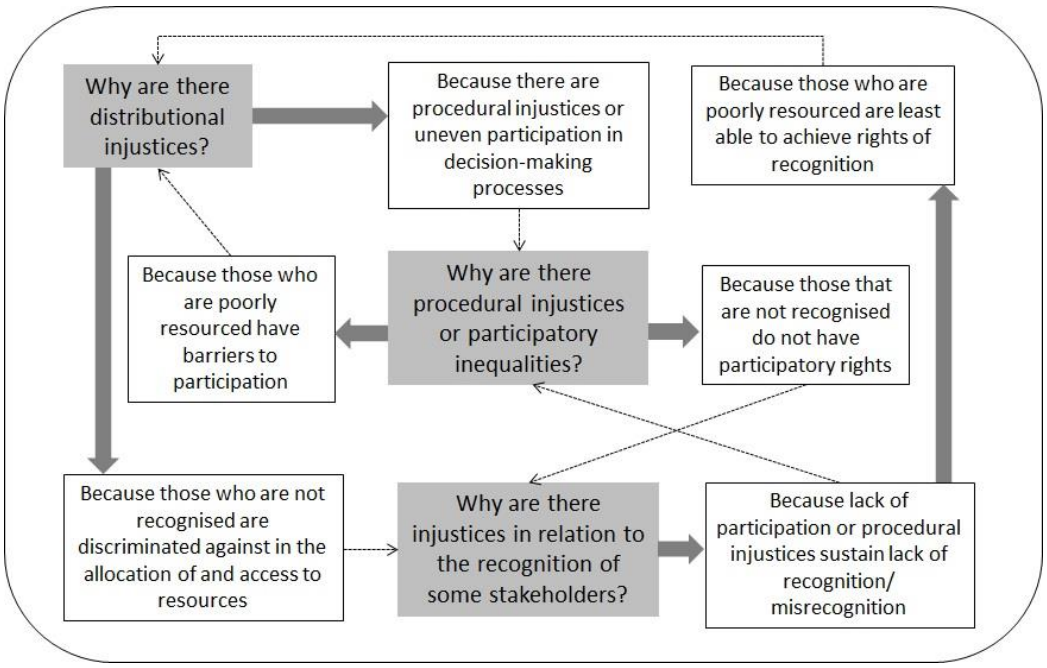


Figure 1: Interrelationships between the three principal dimensions of environmental justice and matters relating to participation.

Walker (2010) suggests participatory methods have the potential to improve the quality of 'distributional analysis' (i.e. appraisals that seek to understand distributional justice) because they promote interaction between different forms of knowledge. Tschakert and Singha (2007) showed that where community participation is avoided, for example to the favour of more 'effect-based' studies, opportunities for constructive collective learning are lost. Stewart (2001) and Tschakert (2009) also argue that well-designed participatory practices can encourage discussion and learning and lead to more substantive, equitable and sustainable outcomes. This is because these spaces of engagement can promote shared knowledges, perspectives and mutual learning (Tschakert, 2009). Sovacool (2010, 2014) advocates open research methods, with inclusive and participatory modes of data collection, which can improve decision-making processes by increasing the democratic rights of citizens and help include ethical and moral concerns that are frequently raised by lay-people. Schlosberg (2009) also suggests that appraisals that are inclusive and cater for plural notions of justice can increase participatory democracy, tackle issues of power and help to include a variety of cultural norms and social

discourses. Participatory democracy and appraisals 'done well' can help identify and tackle equity issues including matters of recognition (Schlosberg, 2009).

However, for these types of benefit to materialise, in relation to the implementation of an energy technology, McLaren et al (2013) stress the need for stakeholders to be able to shape the terms of their participation in processes that shape the systems' design and implementation. Furthermore, other scholars highlight a number of elements which effective participatory processes require in order to achieve substantive benefits. Scholars such as Laird (1993), Blackstock et al. (2007) and Rowe and Frewer (2000) define these elements in terms of principles such as inclusion, transparency and opportunities for knowledge-exchange and learning across lay-persons and experts. Again, it is important to note that for effective participation to take place it is considered essential by these scholars that common bases of adequate, objective information is made available for all those involved (Laird, 1993; Walker, 2012). These scholars also talk about skilled facilitators who can ensure objective, common bases of information for all stakeholders about the topic of deliberation and process-related mandates (i.e. instructions relating to the process as well as the mandates participants have to influence the final decisions and outcomes).

It is evident that effective public participatory practices are required to facilitate the dynamic, changeable, heterogeneous and plural notions of justice that environmental justice literature advocates (Schlosberg, 2007; Walker, 2010). Plural dimensions of justice have already been defined, as environmental justice concepts, but plural notions of justice are also apparent in terms of the ways in which different people perceive themselves affected. Sikor (2013) and Walker (2012) argue that there will always be more than one claim for 'just' resource allocations depending on what is at stake and that equity appraisals are best viewed as a means of bringing forward information that helps understand these different claims. Questions such as 'is this just' or 'is this good' will never be resolved because it will always be open to reasoning, revision and challenge, as Walker (2012, p221) argues:

> "A more open and dynamic understanding of environmental justice does not imply that there cannot be agreements, progress and resolutions of problematic situations along the way. But these will never finally resolve inequality and injustice always and forever, and in any case the terms in which these situations are understood will be dynamic rather than static and frozen in time."

Clearly, notions of justice presented as results from an analysis are likely to differ in various ways according to who you perceive to be affected, where these people are and the particular set of circumstances they find themselves to be living within. Walker (2012, p11) says that environmental justice is fundamentally "situated and contextual, grounded in the circumstances of time and place, hence defying universal definition". This draws attention to the importance of understanding the social and environmental contexts in which equity issues are set, if they are to be better understood. Context is regarded as essential for understanding equity issues in environmental justice-related literatures and this has also been highlighted in some recent studies of energy technologies and carbon reduction policies (McDermott, 2013; McDermott et al. 2013; Schroeder and McDermott, 2014). Furthermore, claims about the distribution of social or environmental impacts (or indeed any associated matters of justice or injustice) that are not based on evidence from this full range of perspectives, knowledges and experiences must be considered inadequate to inform effective participatory or decision-making processes (Walker, 2012).

Sovacool (2010) and Stirling (2008) talk about the ways in which studies can be closed down because of the scope of the study, the way it is conducted, or the way it is framed. These matters can affect the quality of the research findings and work against ideals for recognition and matters of procedural and distributional justices. For example, Walker (2012) finds various levels of importance placed on stakeholders by different environmental justice authors and researchers. Stephens (2007) indicates that for some, emphasis might be placed on future generations, 'everyone' or particular sectors of society based on ethnicity, income or geographical location (including rural/urban areas, nations or districts). Sovacool (2010, p903) considers closed research styles to

limit access and ownership, centralise the research process and lead to "rigidity in dictating programme goals and preferences".

Environmental justice literature also highlights the way list-based approaches can close down or frame a study in a particular way. For example, Sen (2005) resisted publishing a defined list of capabilities for a range of philosophical, epistemological and practical reasons. These reasons include the difficulties in collating a list or assigning weightings when judgements and trade-offs between different capabilities are subject to given contexts. This, Sen (2005) argues requires continual public reasoning to define optimum outcomes for peoples' capabilities in any given set of circumstances therefore recognising that different lists might be required for specific assessments, evaluations or critiques in any given contexts. For example, Sen (2005, p159) argues, it is important to not focus entirely on one list when others may be more relevant for other purposes:

> "We may have to give priority to the ability to be well-nourished when people are dying of hunger in their homes, whereas the freedom to be sheltered may rightly receive more weight when people are in general well-fed, but lack shelter and protection from the elements."

Schlosberg (2007), Stewart (2001) and Tschakert (2009) also talk about the risks of using list-based approaches in terms of the 'paternalist trap'. The paternalist trap is defined as being where the use of a list or a pre-defined framework risks imposing a set of values by an outsider, or they might limit or guide the visions of the participant rather than allowing the individual to define - in their own terms - the ways in which they perceive themselves to be affected.

This section has defined energy justice, drawing on energy justice and environmental justice literatures and concepts, highlighting the pluralistic nature of equity issues both in terms of the different dimensions of equity and justice within the appraisal process itself, as well as the ways in which different stakeholders are affected. Allowing for plurality and different notions of justice within energy justice research therefore requires attention to recognition and procedural justice within the appraisal process itself as well as in relation to the

ways in which individual stakeholders are affected by a particular energy technology under scrutiny. This section makes it clear that environmental justice literature indicates that an effective equity (or energy justice) appraisal of an energy technology needs to be able to (i) identify equity issues in relation to all three principal dimensions of environmental justice (distributive justice, procedural justice and recognition), allowing for plural notions of justice to be revealed, (ii) understand the situated social and environmental contexts in which these equity issues are set and (iii) explore the relationships between individual dimensions of environmental justice to help understand the reasons why distributional injustices occur (i.e. be able to identify procedural injustices or matters of recognition that drive the distribution of outcomes). Furthermore, the literature identifies the importance of open research methods that can uphold matters of procedural justice and participatory parity in order that more substantive outcomes might be achieved, including more sustainable and equitable energy technologies.

In the next section, existing energy and equity studies, tools and methods are explored to consider the methodologies used, framings, scope and coverage of environmental justice dimensions in relation to particular energy technologies. Through this exploration, it becomes apparent that existing studies of energy technologies do not include an equity appraisal of an internationally traded biofuel in the way that the environmental justice literature reviewed here advocates.

2.3 Appraising energy justice

In this section, existing empirical studies of equity issues in relation to energy technologies are reviewed. In addition, the various methods and tools employed in the field for appraising equity (i.e. equity appraisals) are also examined. This review helps consider the nature of existing evidence in relation to energy-related equity issues and thus existing knowledge in the field. Ways of approaching an equity appraisal of a biofuel are also considered (biofuels are defined, explored and considered specifically in relation to current understandings and appraisals of equity in chapter 3). It is through the examination of the framings of existing studies in this review, and the

methodologies used and coverage of different dimensions of justice that the gaps in knowledge in relation to equity issues associated with renewable energy technologies in general (and especially biofuels) are exposed. These findings align with broader reviews of energy and equity research that have been conducted in works such as Sovacool (2014a, 2014b) and the findings of Sovacool et al (2015).

As this review identifies, gaps in understandings of equity issues associated with energy technologies exist because of the limitations in appraisal approaches, compared with the requirements for equity appraisals identified in section 2.2, or because of the type of technology studied. This section therefore builds on the findings so far in this chapter to argue that in-depth, integrated[4] and context-specific equity appraisals of internationally-traded biofuels are urgently needed. Furthermore, these equity appraisals need to help engage and connect those affected and allow plural notions of justice to be revealed to promote distributed understandings of equity issues and promote more sustainable and equitable outcomes associated with biofuels.

Recent, cutting-edge studies into energy justice demonstrate moves towards more systemic and distributed understandings of equity issues, recognising the important relationships between different dimensions of environmental justice and the complex and dispersed nature of energy systems today. For example, Bickerstaff et al (2013, p13) argue that energy justice needs to be embraced as a "more challenging, variable and contested terrain, recognizing that matters of values and ethics cannot easily be reduced to metrics and direct trade-offs". This set of recent, cutting-edge energy justice research (summarised in Bickerstaff et al. 2013's collection of research outputs from the InCluESEV project) includes calls for 'whole systems approaches' (WSAs) or 'whole systems perspectives' (WSPs). These approaches seek to understand equity issues associated with whole energy systems, from design to implementation (Adams et al. 2013; McLaren et al. 2013). Furthermore, these whole-systems appraisals seek to holistically assess impacts associated with these energy

[4] Integrated in the sense that it allows equity issues across all three principal dimensions of environmental justice to be identified and explored (i.e. matters of recognition, procedural justice and distributional justice) including the way they interrelate.

systems or their component parts across environmental justice dimensions as well as international boundaries (Adams et al. 2013). The WSP explicitly uses environmental justice components and language as points of analysis (Krieger et al. 2011) whereas the WSA uses particular themes as lenses through which to analyse an energy system for equity issues (Adams et al. 2013). Both these approaches draw attention to the need to help meet current research gaps in relation to equity issues and injustices associated with energy technologies, to tackle multiple objectives, by promoting identification of and engagement with a wide range of stakeholders (McLaren, 2012). Energy technologies studied to date through these types of approach include micro-technologies and CCS (Adams et al. 2013; McLaren et al. 2013).

Including the above, to date, the majority of empirical, energy justice type studies relating to a specific technology or product have collected primary qualitative data from stakeholders within a single geographical site. For example, qualitative data has been collected from communities living within close proximity of the point of energy generation such as people living in and around large-scale wind turbines (i.e. Devine-Wright (2005), Gross (2007), Walker (2008), Walker and Cass (2007) and Walker et al (2010)) or nuclear power (Butler and Simmons, 2013). Adams et al's (2013) study of micro-technologies also focuses primarily on qualitative data collection from people who generate and consume the energy produced in one geographical location. With the CCS example (McLaren et al. 2013), a technology still under design and development, distant populations are considered more in terms of future generations than people involved in the manufacture of component parts.

Walker and Cass' (2007) and Walker's (2008) studies of wind-energy demonstrate that people feel more engaged, connected and supportive of an energy technology where they perceive the project to be distributionally and procedurally just. For example, a conventional, utility-owned energy project was defined as being developed by a distant and closed institution, where neither the process nor outcome is deemed locally focused. Because of this, Walker et al's (2008) study finds the local community 'disconnected', disengaged, less trusting and less supportive of the system. The energy

generated by this wind farm was produced for the national grid rather than the locality, producing economic returns for distant shareholders rather than people local to the installation. Alternatively, Walker et al's (2008) study determined a community project as one being entirely driven and implemented by a group of local people, which brings collective benefits to local communities. An example case study from this research is a village hall refurbishment involving the installation of a ground source heat pump and small wind turbine, organised entirely by the village hall committee and installed to a large part by local people and with an end result of a collective resource at the centre of village life. Therefore, energy research to date suggests that an energy project can be demonstrated to be procedurally and distributionally just, stakeholders are more likely to be supported. However, this is particularly challenging in light of the dispersed nature of energy technologies. Thus, equity appraisals that help engage and connect distant stakeholders, help them to recognise others and understand the way others are affected, and promote information sharing amongst these people are required to achieve the more substantive, sustainable and equitable outcomes suggested by environmental justice literatures reviewed in section 2.2.

As discussed in section 2.2, energy equity appraisals can be regarded as information-gathering tools by which the widest range of stakeholders and audiences in the system can engage with available options, re-frame the requirements and choices available, learn from each other about the needs of different communities and environments and ways in which they may be affected by the socio-technical energy systems implemented. In this way, Leach et al (2010) note the frequent failure of existing appraisal processes to promote these distributed appraisal practices and benefits, allowing issues to be raised and viewed to collectively seek actions by one or more of the stakeholders involved to address the issues raised. The appraisal tool or method needs to be sensitive to the dynamism and complexities of social systems (Leach et al. 2010; Macombe et al. 2013) and socio-technical energy systems to find more sustainable pathways – often which are formerly hidden (Leach et al. 2010). It is again apparent here that effective participatory

processes are required to support more open equity appraisals, such as defined by Laird (1993), Blackstock et al. (2007) and Rowe and Frewer (2000).

Adams et al (2013) attribute gaps in knowledge of equity issues - and thus broader sustainability implications - due to appraisals being conducted within single disciplines or because they use methods with limited scope or criteria. Specific examples are given such as life-cycle assessment (LCA) and cost-benefit analysis (CBA). These tools or methods only partially represent the three pillars of sustainable development, equity matters or the social and environmental context in which the assessment is set. These types of sustainability appraisals, in general, often use modelling tools and packages, concentrate on numerical and statistical data or are based around assessing particular environmental impacts such as carbon emissions, natural resource usage or pollutants (Adams et al. 2013) – i.e. they do not seek to open up the process to more distributed decision-making and appraisal, or collect qualitative data through participatory methods as formerly advocated in environmental justice literature (sub-section 2.1.1). An example of this is provided by Baourakis et al (2014), drawing on evidence from the food and agricultural sector. Here, Baourakis et al (2014) highlight the way analyses and certification schemes focus on modelled data that limits environmental and social analyses or coverage. Many sustainability assessment tools or schemes do not specifically seek to identify and connect stakeholders across the entire supply chain or life-cycle, nor understand the distribution of equity issues amongst them, in the way that a whole-systems approach or integrated equity assessments advocate (i.e. Adams et al. 2013; Bickerstaff et al 2013;). As Walker (2012) states, findings will always depend on the boundaries drawn at the outset of the assessment, what indicators are used and what is included or not, affecting the claims made by the resulting 'evidence-base'.

A plethora of appraisal tools employed to help guide decisions and operationalise sustainability ideals have been commissioned and conducted by a diverse set of actors such as government agencies, commercial corporations, civil society organisations, research institutes, certified experts or citizens, consumers and members of the general public (Ely et al. 2014; Hutchins and

Sutherland, 2008; Leach et al. 2010; Morrison-Saunders et al. 2014). However, despite the reasons given at the beginning of chapter 2, as to why equity issues are important within sustainability appraisals and the sustainable development of energy technologies and systems in general, these matters are frequently missing from research or assessments of energy technologies in the field (Adams et al. 2013). This, until recently, has led to a lack of academic literature containing comparative assessments of energy technologies, systems or futures on the basis of justice (Bickerstaff et al. 2013).

The literature suggests that historically appraisals frequently only partially cover sustainable development ideals, favouring one dimension more than others (i.e. either the social, economic or environmental dimension), often to the exclusion of justice and equity issues (Bickerstaff et al. 2013; Bond and Morrison-Saunders, 2009; Creutzig et al. 2013; Hodbod and Tomei, 2013; Sovacool, 2014a; Sovacool, 2014b; Sovacool et al. 2015). This artificial separation of social, environmental and economic factors, which is not apparent in reality, challenges the quality of information produced and the degree to which results might be regarded representative of the true nature of sustainability issues (Mohr and Baush, 2013). In addition, some studies focus on specific types of inequalities or issues such as access to energy services, impacts on future generations, or localised (environmental or economic) impacts and their distribution within one locality (McLaren, 2012). Leach et al (2010) provide examples different sustainability appraisal approaches, noting their production of incomplete knowledge and frequent failure to be able to deal with complex and dynamic systems or equity. Equity appraisal tools and methods therefore are needed which can explore, open up and broaden out equity issues, both in terms of the people that are included (Ely et al. 2014; Stirling et al. 2007; Stirling, 2008) and the types and nature of issues identified (Leach et al. 2010). Furthermore, as already discussed, these tools and methods need to help examine the relationships between different dimensions of justice to help understand injustices that are driving forces for distributional injustices.

A recent development in the energy field is Boucher and Gough's (2012) ethical matrix, which they applied to Carbon Capture and Storage (CCS[5]). This framework was developed for scoping particular ethical (and thus equity) issues of an energy system. The 'ethical landscape' described by Boucher et al (2012) is seen as a 'complex-, dynamic- and context-dependent social reality' that helps shape whether and how a technology may develop. Boucher et al (2012) uses the identification of particular actors' or agencies' ethical framings as a means of describing an 'ethical landscape' for CCS. The types of ethical and equity framings that became apparent as important for CCS development, through Boucher et al's (2012) analysis, are identified as justice (intergenerational, social, environmental and financial), well-being, autonomy, honest, trust, naturalness, competence and social values. These 'themes' identify the ways different peoples would be affected by a CCS implementation.

Clear limitations of Boucher et al's (2012) initial exercise using the matrix are stated by the authors. For example, it is a desk-based study using secondary data to draw up the framework. However, the work demonstrates the usefulness of ethical framings of a technology as an effective means of directing particular lines of enquiry with stakeholders about ethical (and thus equity) issues. This can be particularly powerful at grassroots level where actor participation, deliberation and 'bottom-up' analysis can be promoted to help inform selection, design, planning or development decisions. Opportunities for participatory methods to help identify the framework as well as form the basis of deliberative exercises with wider publics are apparent. To identify stakeholders at different stages of the process from production to disposal, this framework would require the mapping of the product's supply chain. Otherwise, it is unclear how this might be applied to an energy technology which is already in use in large quantities, flowing through different stakeholders, communities and geographical settings in the way that a liquid biofuel for transport does currently. As with WSA, no specific, prescriptive method for identifying stakeholders is included and thus the method draws on

[5] Boucher et al (2012) describe the term 'CCS' in terms of covering a range of technologies that can reduce carbon emissions from various industrial processes, including energy generation itself.

social science research methods, knowledge and experience (including networking) in the field.

2.4 Energy justice conclusions

Normative, instrumental and substantive arguments (Fiorino, 1990) have been provided as to why it is important to identify and address equity issues in relation to the development of biofuels and renewable energy technologies more generally. However, to realise the benefits of taking account of equity issues within appraisals of renewable energy technologies, such as more sustainable and equitable outcomes, equity appraisal tools require methods that are open, inclusive, transparent and fit for purpose (Sovacool, 2010; Stirling, 2011). For example, it is clear from the environmental justice, energy justice, public participation, STS literatures reviewed that an equity appraisal of a biofuel needs to (i) identify and include all stakeholders involved or affected by the biofuel's production and consumption, (ii) give adequate recognition to these peoples' perspectives and the ways in which they are affected, (iii) collect primary qualitative data from all stakeholders to cater for regional contexts and plural notions of justice and (iv) use environmental and energy justice theories to analyse the relationships between matters of recognition, procedural justice and distributional justice that emerge so that drivers of environmental and social injustices might be understood and recommendations be made for changes in policies and practices that can help develop liquid biofuels that are both sustainable and just. Chapter 4 will demonstrate how this set of criteria for equity appraisals have shaped the research methods used in this project. However, first, the next chapter goes on to look closely at liquid biofuels used in UK transport in order to define the nature of these specific forms of renewable energy and demonstrate that equity issues (as defined in this chapter) remain largely unknown. The chapter also identifies widespread concerns over the injustices that these fuels may be driving which emphasises the need for this type of study.

Chapter 3: Liquid biofuels

Taking into consideration the findings in chapter 2, examination now turns to particular types of renewable energy technology; liquid biofuels used in transport. Compelling arguments were provided in chapter 2 as to why understanding equity matters are important for the sustainable development of renewable energy technologies and in this chapter it is demonstrated that this is particularly pertinent to biofuels. The biofuels industry is rapidly developing, therefore it is essential that the ways in which these fuels decrease or exacerbate environmental and social inequalities are understood. However, understanding the nature of equity issues is complex where people affected are geographically dispersed and culturally distinct – circumstances that apply to the global nature of most energy technologies today and particularly in the case of liquid biofuels commonly used in UK transport.

Firstly, biofuels are defined, demonstrating the array of feedstocks, production methods and types of fuel the term 'biofuels' encompasses. This is followed by an exploration of the nature of opposition and debates that have surrounded their development, which demonstrates the ways in which the nature of this controversy relates to broader findings in equity and energy literatures. For example, what is demonstrated is the basis for concerns relate to perceptions of inequities in terms of matters of recognition, procedural or distributional justice. Finally, reviews of the current state of knowledge about equity issues relating to biofuels are provided, based on evidence from academic studies and commonly conducted 'sustainability' assessments in the regulatory domain. What is clearly demonstrated is that equity appraisals in the manner advocated by environmental and energy justice literatures do not currently exist and thus evidence of equity issues relating to individual biofuels, and specifically bioethanol, is lacking. This emphasises the novel contributions this research makes to academic knowledge and policy-making in relation to biofuels developments and consumption in the UK.

3.1 Liquid biofuels defined

Biofuels are fuels produced from renewable, organic resources, particularly plant biomass (EFC, 2007) or organic material produced (recently) by living organisms (EA, 2009, p10; Rowe et al. 2008). Strictly speaking, biomass, refers to the total weight of all the living things in an ecosystem, although it has become a term associated with the use of plant and crop material for making biofuels (Miller and Spoolman, 2009). The term biofuels is generally applied to liquid transport fuels created from biomass, whereas bioenergy tends to be used to describe power generation from biomass. Biomass includes the biodegradable part of agricultural, forestry or industrial wastes, residues or products. This includes biodegradable parts of industrial and municipal wastes (EEA, 2002 in Feehan and Peterson, 2003). Put simply, biomass is any biological material – including specifically grown corn, sugarcane, switchgrass, and oilseed crops – that can be converted into bioenergy or biofuels (EFC, 2007) for use in heat, power or transport.

In 1999, biomass from agricultural, forestry and waste sources provided over 63% of the EU's renewable energy and is widely regarded as having significant potential as a renewable and sustainable source of energy (EEA, 2002 in Feehan and Peterson, 2003; NCB, 2011; Skea et al. 2011). Biomass is widespread, diverse and renewable, contributes to the security of energy supplies through diversification of energy sources, feedstocks, modes and scales of production. It can be locally produced, close to points of consumption. Biomass can produce low-carbon energy sources, including electricity, thus contributing to greenhouse gas (GHG) emissions reduction targets (discussed later in this section). Well managed biomass and biofuels production and energy crop cultivation have therefore been considered as a means of reducing carbon emissions while bringing a wide range of benefits such as watershed protection, habitat and amenity value, rehabilitation of degraded areas and alternative markets for agricultural production, thus contributing to agricultural diversification and rural development (including in the global south) (BIOFRAC, 2006; Feehan and Peterson, 2003; IEA, 2011; NCB, 2011; Skea et al. 2011; UNICA, 2010; WTO, 2014).

Biofuels produced from food crops are known as first-generation fuels whereas second-generation fuels are considered those made from wastes, crop residues and non-food crops, including lignocellulosic biomass (EC, 2011; Eisentraut, 2010). Lignocellulosic biofuels are produced from all plant biomass, including the lignin and cellulose, instead of just the sugary, starchy or oily parts from which first-generation biofuels are produced. This is important since first-generation biofuels rely on feedstocks which are also used for food production (NCB, 2011). Second-generation fuels, or advanced biofuels, yield more energy per unit mass of feedstock than first-generation crop but require far more sophisticated processing (NCB, 2011). Second-, third- or fourth- generation fuels are considered more sustainable than first-generation biofuels since they do not compete with food crops; however these remain emerging technologies not yet widely deployed on commercial scales (NCB, 2011). According to the ECF (2014) biofuels from wastes and residues could supply 16% of road transport fuels in 2030 and deliver GHG savings in excess of 60%. Biobutanol is regarded a promising advanced biofuel as it has a higher energy content than bioethanol and can be produced in a similar fashion from similar feedstocks[6] (NCB, 2011).

The drive to develop and implement these fuels, alongside other renewable and sustainable sources of energy, has arisen because of a number of factors including concerns over the depletion of fossil fuel stocks (such as oil and gas) which have been dominant sources of energy to date in industrialised nations (NCB, 2011; Skea et al. 2011). These concerns have been coupled with raised awareness of the widespread environmental damage the combustion of fossil-fuels is causing, such as their contribution to climate change (NCB, 2011; Skea et al. 2011). Policies and targets have been set at European and UK levels to promote the use of renewable energy such as the European Union's (EU) Renewable Energy Directive (RED) and the UK's Renewable Energy Strategy (DECC, 2009; EC, 2009). As a result of this legislation, the UK is obligated to source 15% of its final energy demand from renewable energy by 2020; this will contribute to the EU's overall target of 20% of energy demand sourced from

[6] Rather than using a yeast fermentation step the process typically uses the bacteriam *Clostridium acetobutylicum*

renewables by that date. Furthermore, the EU's RED mandates that 10% of the fuels used in the transport sector must come from renewable energy by 2020 (EC, 2009).

Globally, the transport sector consumes approximately 61% of all oil extracted (IEA, 2009) and therefore the use of renewables in the transport sector is a key part of carbon reduction strategies. The Renewable Transport Fuel Obligation (RTFO) set a UK target for 5% of the UK's energy for transport to be sourced from renewables by 2013 (which was met during that year) contributing to the targets set out in UK's Renewable Energy Strategy (DECC, 2009; DfT, undated a; DfT, 2013) and the EU's RED (EC, 2009). Renewable transport fuels are expected to come from biofuels as they are considered to offer the only widely available alternatives to petroleum and diesel fuels within the timescales given (Skea et al. 2011). This is mainly due to the fact that they are usable within existing infrastructures with few adjustments required; for example, they are compatible with internal combustion engines, can be retailed via existing filling stations and would require minimal consumer behavioural changes (Cottes, 2013; EC, 2011; NCB, 2011; Robbins, 2011; Skea et al. 2011). However, the RTFO's definition of biofuels that can be used in UK transport to meet the aims of the EU RED and the UK's Renewable Energy Strategy now include biogases and liquid biofuels (DfT, 2015a). These policies are the primary drivers of increasing biofuels in transport to meet renewable energy targets, although the Fuel Quality Directive (FQD) (EC, 1998) has also been a significant influence. This is because the FQD promotes the use of a biofuel element in fuels as part of its main aims to reduce GHG emissions and improve air quality (EC, 1998).

The main types of biofuels currently consumed in UK transport are bioethanol and biodiesel which form part of mandatory blends with unleaded petrol and diesel respectively (Rowe et al. 2008; DfT, 2015b). Bioethanol is an alcohol produced through the fermentation of sugars or starches from plants such as sugarcane, sugar beet, wheat or corn (NCB, 2011). Biodiesel is mainly produced from vegetable oils such as oilseed rape, soybean, sunflower and oil palm though a chemical process called 'transesterification'; however, the majority of

biodiesel consumed in the UK comes from used cooking oil (DfT, 2013; NCB, 2011).

The production processes for these first-generation biofuels involve three main stages; upstream, midstream and downstream (NCB, 2011). Upstream involves the cultivation of the feedstock and includes transportation of biomass to the conversion facility. The midstream process involves the conversion of the feedstock into biofuel, which includes pre-treatment and processing. The downstream process involves trading, blending, distribution, marketing, retailing and consumption (NCB, 2011).

Today, imported bioethanol is the most commonly consumed biofuel in UK road transport (DfT, 2013b) mainly as a result of blending mandates. Liquid biofuels are an exemplar of today's world of increasing international trade and globalisation of energy technologies and products, where communities are connected and affected across cultural and geo-political boundaries (Micheletti, 2003, p ix). Supply chains feeding UK consumption are many and complex. They can involve domestic and overseas suppliers, are typically long, complicated and subject to rapid change since bioethanol is a globally traded commodity on the open market (Garvey and Barreto, 2014). Production involves a diverse range of feedstocks, therefore supply chains adapt rapidly according to changes in market prices or regional environmental, socio-economic or climatic conditions. Domestic production may increase due to announcements by the Department for Transport (DfT) of a £25 million allocation to advanced (i.e. second-/third-generation) biofuel projects. This is expected to enable the construction of demonstration-scale waste to fuel and other advanced biofuel plants within the UK (DfT, 2013a). This new commitment to advanced biofuels from wastes or bi-products of the food system and non-food crops is likely to forge further changes to the industry, sector and markets. There also appears to be scope for higher levels of biogas to be used in commercial transport fleets (AEA, 2011). Furthermore, recent reports suggest that there are considerable resources within Europe that lie untapped such as the conversion of wastes from farming, forestry, industry and households for the production of advanced, low-carbon biofuels (ECF, 2014;

NNFCC, 2014). The National Non-Food Crops Centre (NNFCC) (2014, p10) for example, claims that "if all sustainable waste from farms, forests, households and industry were used for transport fuels, there could be sufficient fuel to displace about 37 million tonnes of oil annually by 2030" which is equivalent to an estimated 16% of transport fuel demand by that time.

A report by the ECF (2014) suggests that it is feasible to develop a European bio-based industry, which would secure up to 38,000 permanent jobs in the rural economy and a further 3,700 jobs in biofuel refineries, in addition to considerable returns in net revenues to the agricultural and food sectors. According to these reports, economic figures suggest that these forms of biofuel can be competitive cost-wise with those currently used in transport. For example, the NNFCC (2014, p10) suggests that "once deployed at scale, advanced biofuels from agricultural and forest residue feedstocks would require little or only a modest additional incentive to stimulate production at prices comparable to that of current crop-fuelled technologies."

These reports are industry-led and it remains to be seen whether these estimates are accurate, but the strategy advocated would appear to offer more stabilised energy supplies for the transport sector than the current, dominant bioethanol supply chains that are feeding UK consumption. This is because these supply chains operate within dynamic markets, as already described, and because the feedstocks and fuels are traded as agricultural commodities and thus can be subject to rapid price changes or supply disruptions, i.e. due to fluctuations in crop yields. For example, fluctuations in global markets and supply chain disruptions due to shortages of supply and increasing demand for ethanol globally (including as a result of blending mandates) have already been reported (PON, 2011b; PON, 2012; PON, 2014a; PON, 2014b; Robbins, 2011).

In summary, what is evident here, is that bioethanol, alongside other liquid biofuels, is fluid not only in its physical properties, but also in the way it flows through geographies; bioethanol is traded as a global commodity with operations that spread across national boundaries (Garvey and Barreto, 2014). These mainly imported biofuels, feeding UK consumption (DfT, 2013a) - led by

UK and European policies (DECC, 2009; EC, 2009) - connect different peoples such that the impacts of actions by some stakeholders can be felt in communities much further afield. This poses serious challenges for equity appraisals that seek to include and recognise all affected stakeholders and allow the pluralistic and holistic identification and exploration of equity issues that environmental justice, energy justice, STS and public participation literatures advocate (discussed in chapter 2).

3.2 Controversy, debate and equity

Biofuels are regarded by many as being able to contribute significantly to meeting the global energy challenges described earlier in this thesis, particularly in relation to decarbonisation of the transport sector, improved energy security or economic development for the rural poor (Cottes, 2013; Green, 2012; EC, 2011; Matthews, 2007; Mol, 2007; NCB, 2011; Robbins, 2011; Skea et al. 2011). Liquid biofuels for transport are not new technologies, for example there is considerable experience and history of consumption in Brazil (Sovacool, 2010). However, biofuels have never before been promoted on such a large scale and this huge increase in production, to meet growing global demand, has raised wide-ranging concerns over associated uncertain environmental and social effects (Robbins, 2011; Hodbod and Tomei, 2013). Controversies have been fuelled by unsustainable practices, social or environmental injustices associated with some biofuels, leading to generalisations that have caused adverse publics' perceptions of all biofuels (Clancy, 2008; Gnansounou, 2011; Mohr and Baush, 2013; Hodbod and Tomei, 2013; Smeets et al, 2008).

However, the vast array of feedstocks, production methods and scales means that making judgements about the true nature of associated environmental and social impacts is not simple (Childs and Bradley, 2007; Rutz and Janssen, 2013) – each will have its own story to tell. Generalised adverse perceptions of biofuels affects levels of investment in the sector (Bennett, 2011; Berti and Levidow, 2014; Rutz and Janssen, 2013) and reports of UK capacity not being fully exploited and investment going abroad to overseas production facilities (FT, 2014; WEETF, 2014), thus potentially hindering UK-based developments of

second- and third-generation biofuels and technologies. This section demonstrates the range of opinions identified in published literatures, discusses the nature of concerns and opposition against biofuels – and from which types of stakeholder groups they derive - as well as highlighting the lack of grounded evidence relating to the impacts of specific biofuels on affected stakeholders.

Firstly, what is clear from biofuels-related literatures reviewed is that the majority of published literature raises concerns about negative environmental and social impacts felt by people living in producer regions. This review does not seek to discuss in detail the plethora of issues raised in academic and grey literatures, however, it does aim to provide an overview of the range of issues and concerns raised – mainly for people living in and around sites of biofuel production in developing countries who may already be disadvantaged or living in poverty (EC, 2013; FAO, 2013; Green, 2012; IISD, 2012; Mohr and Baush, 2013; Mussatto et al. 2010; NCB, 2011; Phalan, 2009). The cultivation of biofuels often occurs in developing countries because of land or feedstock availability, favourable climatic conditions or inexpensive labour costs (compared with, say, Europe) (Rutz and Janssen, 2013) and associated concerns include the effects of biofuels' production on the production of food, food availability or food prices (i.e. food security) (Ewing and Msangi, 2009; Fairhead et al. 2012; Rosillo-Calle and Johnson, 2010; Zulbeman et al. 2012). Other concerns include land-use change, land-grabs, deforestation and biodiversity loss which can lead to the displacement of local communities or indigenous peoples (International Land Coalition, 2012; RFA, 2008; Searchinger et al. 2008). The types of stakeholders at the centre of these concerns tend to be local communities in producer regions, specifically farmers and their families, smallholders or farm-workers - for example as a result of concerns over harsh or unfair working conditions or breaches of land-rights (Clancy, 2008; Garvey and Barreto, 2014; Green, 2012; Rutz and Janssen, 2013). Concerns have also been expressed over increased concentration of ownership in the sector as bigger agro-businesses with higher access to finance and information flourish to the detriment of smaller-scale operations, exacerbating social disparities (Hodbod and Tomei, 2013).

Concerns relating to the types of issues described above vastly dominate published literatures and what is evident therefore is that bases of opposition derive mainly from concerns that some people may bear more of the negative impacts than others, particularly as a result of the global North exporting risks and negative impacts to those in the global South. Oxfam (2007, p2) argue that it is "unacceptable that poor people in developing countries bear the costs of emissions reductions in the EU". Green (2012) talks of the need for farmers' and other citizens' groups' voices to be heard in the development of biofuels and their technologies if biofuels are to realise purported benefits.

Conversely, there is a sprinkling of evidence starting to emerge in the literatures that point towards less negative impacts. These are much less visible in the literatures but Martinelli et al (2011) found that in Brazil the Human Development Index (HDI) is often higher in municipalities where larger sugar and ethanol production mills operate. This indicates that some of the economic or rural development benefits offered by biofuels are being realised even when larger agri-businesses dominate production. Rutz and Janssen (2013) concluded that producers meeting sustainability certification standards in Brazil would not necessarily exacerbate negative impacts for smallholders and can help drive improvements in the sector and Oxfam (2007) found improved livelihoods for around 25,000 families where the first biodiesel co-operative was launched in Brazil in 2005. Oxfam's (2007, p2) report found that:

> "Under the right conditions, biofuels offer important opportunities for poverty reduction by stimulating stagnant agricultural sectors, thus creating jobs for agricultural workers and markets for small farmers."

Clancy (2008) talks of the positive outcomes the Social Fuel Seal has had in Brazil, where smallholders are an integral part of biodiesel production. The Social Fuel Seal is a biofuel sustainability initiative administered by the Brazilian Ministry of Agrarian Development which promotes the participation of smallholder farmers in biodiesel feedstock (the Seal is awarded to biofuel producers who purchase a specified share of feedstock from smallholder farmers) (BEFSCI, 2010). This, Clancy (2008) says has been an effective and positive marketing instrument for the industry. Clancy (2008) talked of the

tendency in the (particularly non-academic) literature to over-generalise as to whether biofuels are 'pro-poor' or not. Clancy (2008) thus expressed the need for more specific, ground-level, qualitative evidence of impacts relating to particular biofuels and impacts in different regions and contexts – sentiments echoed by Hodbod and Tomei (2013). Existing evidence bases relating to the social and environmental impacts of biofuels associated with people affected will be looked at more closely under section 3.3.

Another major point to be made from the literature review is that consumers of biofuels have received much less attention amongst scholars than people in producer regions. However, of the few studies that were found, it is evident that uncertainties relating to the true nature of impacts of biofuels - on consumers or other people and environments in producer regions - have led to major policy disruptions. This has occurred where consumers have become aware of biofuels blended in the fuels they purchase at the pump and, as a result, have expressed high levels of opposition due to the lack of accompanying information or assurances of associated impacts. For example, in Australia and Germany, once consumers became aware of their biofuel purchases in petrol and diesel, the true nature of associated impacts were questioned which led to step-changes in the speed at which higher-level blends were rolled-out (Niven, 2005; PON, 2011; SOI, 2011; UNICA undated).

In Australia, concerns over the damage bioethanol blends might have on car engines led to large-scale public opposition, causing a step change in the way biofuels in transport fuels were rolled-out. Fears from consumers over potential damage to vehicles caused oil companies to avoid retailing 10% fuel blends in Australia despite Government targets for E10 (Niven, 2005). The same was seen in Germany, when widespread concerns about effects on car engines and car warranties caused high levels of opposition, resulting in a slower roll-out of E10 (PON, 2011; SOI, 2011; UNICA undated). Damage to equipment and infrastructures fuels fears and uncertainties over the ability of biofuels to genuinely contribute to higher levels of sustainability in the transport sector – for example, replacements might off-set the carbon savings calculated for using these fuels over their fossil-fuel counterparts. As will be

seen in the next section, these impacts may not have been considered in dominant appraisal processes of biofuels. What these examples also show, is that as more people become aware of the biofuel content in their fuel, they are more likely to raise questions if they are uncertain of the effects on their car engines or indeed other, wider sustainability issues. Currently, labelling at the pump does not yet happen in the UK, indicating that many people may be unaware of their ethanol purchases in blended fuels. Rutz and Janssen's (2013) study also indicated that knowledge of biofuels amongst consumers is generally low and perceptions are frequently influenced by specific impacts associated with one type of biofuel produced in a particular region.

Yan et al's study (2013) suggests a diverse range of factors affect the degree to which various ethanol blends affect vehicles' performance or its components - and whether these are positive or negative. Therefore, these issues remain uncertain. Differences in vehicle types, ages, engine designs, ambient temperatures and drive cycles can affect the impacts of ethanol in vehicles – all of which have financial implications for consumers (Yan et al. 2013). In the UK, nearly all vehicle manufacturers specify a maximum ethanol blend in petrol of E5 - if a vehicle owner chooses to use a higher blend than the manufacturer recommends, the vehicle's warranty becomes null and void (Biofuel Cities, 2008). Niven (2005) suggests that, in some cases, higher-level blends might be a better policy option if sold for use in flex-fuel vehicles only, rather than in lower blends across all fuels. On the other hand, Yan et al (2013) suggests improved efficiencies on lower blends can be realised and therefore this may be a better policy option.

Taking account of existing energy studies discussed in 2.1, recognition, inclusion and engagement with UK-based consumers could promote connectedness between consumers and a biofuel product, as well as other stakeholders connected to the technology through its production and consumption. For example, in the way that Walker and Cass (2007) and Walker (2008) suggest. As Sovacool (2014a) argues, individuals and choices matter – they influence patterns of energy consumption. Manik et al's (2013) study of biodiesel from palm oil in Indonesia also recommends that stronger participation of

consumers can help drive more sustainable pathways for biofuels by demanding that biofuels meet a sustainability criterion that spans the three pillars. The success of the Social Fuel Seal in Brazil, for biodiesel, indicates that ethical consumerism is possible in relation to fuel supplies (Clancy, 2008). Sharing information with consumers about biofuels, allowing consumers to make choices about their fuel purchases and how they wish to utilise these technologies, offers opportunities for consumers to help shape them into sustainable and just products that people want. This is in line with arguments for distributed appraisals, such as those discussed in 2.1, citing scholars such as Stirling (2008), Leach et al. (2010) and Ely et al. (2014). Engaging with consumers in this way may also help promote ethical consumption and find mutually-beneficial, sustainable and just solutions for consumers, producers and energy providers who invest in these technologies (and thus help provide essential components and infrastructures) – in the way that Porter and Kramer (2006) and Grant (2007) advocate.

In the UK, some concerns by organised groups are already starting to emerge, such as the Motorcycle Action Group (MAG) which has branches across the country. MAG have a campaign against the use of ethanol in petrol due to the effects on both modern and historic motorcycles and their National Committee is campaigning for better labelling and warnings at the pump as well as continued supplies of zero/low ethanol petrol (MAG, 2012). The Federation of British Historic Vehicle Clubs (FBHVC) is also keeping an eye on developments, investigating concerns and recommending possible solutions to members, such as the replacement of some elastomers, plastics and composite components with compatible alternatives (FBHVC, 2014). The FBHVC regularly attends meetings with the DfT and British Standards Institute (BSI) on these issues (FBHVC, 2014) to enable them to keep abreast of changes and disseminate information to its members. A recent report by 'What Car?' into the effects of E10 – in light of the lack of UK-focused research – suggests consumers will start to see the effects on their wallets once the blends are higher due to infrastructural costs (What Car?, 2014). This is a complicated landscape and while it is beyond the scope of this study to provide more detail about the extent of possible damage to particular vehicles, there is mixed evidence and

uncertainties about the effects of these blended fuels on vehicles. However, the AEA Technology Plc's (AEA, 2011) report for the DfT states that *no* motorcycles and mopeds are suitable for 10% bioethanol blends (E10). Also, the Society of Motor Manufacturers and Traders (SMMT) (2013) suggest that over 12% of the existing UK vehicle fleet may be incompatible with E10 because they are petrol engines older than 2001 - and the % of older cars in the fleet is rising.

Barnett (2011) acknowledges the rise in ethical consumerism but argues that people often feel unable to engage with alternative consumption activities, despite having information available. This may be because alternatives might be more resource-intensive (in time or money) or consumers may feel that they should not have to adapt because it is the responsibility of governance actors to ensure goods are ethically produced (Barnett, 2011). It is evident that increases in consumption of biofuels in the UK have not been through consumer demand; consumption has been driven by government blending mandates and UK-based consumers. Therefore, if policy-makers are taking on the role – as the driving 'consumer' body – then it could be argued that they need to be responsible for ensuring associated policies and governance mechanisms ensure ethical production. This would mean that biofuel certification schemes and standards, that assure access to European and UK markets, would need to ensure equitable and sustainable production. What is clear is that neither one thing nor the other is happening currently; consumers are not able to take part in shaping biofuels into sustainable and equitable fuels by being ethical consumers but the government, having taken on this role, is also not fully ensuring the fuels are sustainable and equitable either because their policies are not ensuring associated governance frameworks and appraisal processes ensure equity issues are catered for. UK-based consumers are currently unable to choose *not* to consume bioethanol or biodiesel unless they change their vehicle to an electric vehicle, use only public transport (which most commonly also consumes biofuels in their fuel blends) or walk/cycle everywhere. These actions require firstly knowledge that a biofuel is in the fuel they purchase and secondly, knowledge of the impacts associated with the particular biofuel element. If choice between products is not possible, then

more radical lifestyle changes are required to avoid these purchases. Therefore, perhaps the consumer is right to expect responsibility for sustainable consumption of biofuels to ultimately lay with governance actors, such as through sustainability standards legislation - for example, via the EU RED or corporate social responsibility (CSR) policies.

What is evident, is that the dominant biofuels policies which promote consumption of bioethanol to meet UK and EU renewable energy targets (DECC, 2009; EU, 2009) appear to have closed down options and alternative pathways that more distributed appraisals might have achieved. Consumers have been unable to engage in these decisions and if Germany and Australia's examples are anything to go by (PON, 2011; SOI, 2011; UNICA undated), once more people become aware of their biofuel purchases, more questions may be raised and higher levels of controversy and opposition may become apparent.

Lack of choice for consumers in the transport sector is nothing new, as Sovocool (2013) argues, as this has been the case since the rise in use of motorised vehicles and oil (Sovacool, 2013). Victor (2009) talks about power and inequalities in terms of decision-making processes that allow existing power relations and dominant infrastructures to be reinforced, to the exclusion of other more radical and alternative policies. Suffice to say, current biofuels policies appear to promote larger-scale production and benefit existing producers and incumbent infrastructures which underpin daily lives and transport practices in the UK today. Yan et al (2013) states the importance of providing information and evidence to consumers in order that they can make informed choices. However, by offering this choice, complications and costs are brought to the fore in terms of how retailers and forecourts are able to manage this issue. In addition to possible corrosion issues to pumps and distribution equipment with increased ethanol blends, space on the forecourt is an issue and therefore smaller retailers may be unable to offer a range of legacy fuels (for older vehicles, for example) alongside higher ethanol blends (AEA, 2011). Larger retailers, if able to offer more pumps and more choice, are also likely to pass on related costs to consumers. However, in the USA, there have been moves towards blender pumps, which allow consumers to select

from a range of blending levels to suit his or her particular vehicle (BYO Ethanol, 2015; National Petroleum News, 2009). Another option is for targeted use of biofuels in specially adapted vehicles in public transport, which could also offer alternatives to blending biofuels in all petrol or diesel. Such schemes have been reported as being more environmentally and economically beneficial than promotion of biofuels in private transportation (Kliucininkas et al. 2011). Although these matters are not investigated here in depth, the point is that technological advancements are emerging to help deal with some of the issues raised above.

What is clear is that evidence about social and environmental impacts associated with particular biofuels – and the way these impacts are shared – appears urgently needed. Evidence-based information could help mitigate or substantiate claims about particular biofuels, help people engage around solutions to mitigate negative impacts or help verify and disseminate information about positive outcomes which could help allay concerns, inform policy decisions, promote ethical consumerism or allow the nature of good practices to be understood and replicated across other fuels. This information could therefore be used to inform the types of discussion and engagement advocated in sections 2.2 and 2.3, to help achieve the substantive outcomes that biofuels might have the potential to achieve. In fact, there have been calls for biofuels' sustainability criteria defined in the RED (EU, 2009) to be extended to limit fuels on the market to those where the distribution of risks and benefits are shared equitably amongst those affected by their production and consumption (NCB, 2011; Oxfam, 2007). The Nuffield Council on Bioethic's (NCB) (2011, p73) substantial consideration into ethical issues surrounding biofuels came up with 6 principles for the practical implementation of biofuels development, one of which is that "costs and benefits should be distributed in an equitable way". The NCB (2011, pp73-76) concluded that, under these conditions, there is an ethical duty to develop biofuels but biofuels must "do better – or significantly better – than fossil fuels with respect to environmental protection and that they respect sustainability standards". In addition, "the values of solidarity and common good call for the protection of the vulnerable and a commitment to distributive justice similarly calls for the fair distribution

of benefits" (NCB, 2011, p76). However, this would rely on information produced from equity appraisals, in the way advocated in chapter 2.

The sentiments of the NCB are echoed by scholars such as Dauvergne and Neville (2010), Creutzig et al (2013) and Hunsberger et al. (2014). Phalan (2009) says that the worst impacts of biofuels' development and deployment can be avoided by deploying them strategically, such as where the benefits to society outweigh their costs. However, without understandings of these benefits and risks it is difficult, if not impossible, to compare and make informed strategic decisions about the most equitable and sustainable ways in which to develop these fuels. UNEP's (2009a, p5) report on assessing biofuels raises the complexities of the task and the challenges, saying:

> "… simplistic approaches are unlikely to deliver a sustainable biofuels industry nor one that can contribute to the climate change challenge and the improvement of farmers' livelihoods."

It is evident that a wide set of interrelated factors need to be considered and included when trying to determine the merits of one biofuel over another and that opinions are divided about the true nature of impacts associated with these fuels. This section has summarised the nature of controversies and opposition to biofuels, as well as complex uncertainties associated with the impacts of these fuels across different stakeholder groups from published literatures. This review has demonstrated the majority of attention of academic literature to impacts in producer regions and the lack of recognition of consumers and associated issues in relation to the consumption of biofuels, which work against environmental justice principles and exclude opportunities for these perspectives to help shape biofuel production and consumption pathways into the equitable and sustainable fuels they could become. The next section will now examine existing studies of biofuels to identify the current state of knowledge of equity issues of biofuels in academic literature and the regulatory domain to consider the way in which equity issues are currently understood in relation to environmental justice principles outlined in 2.1.

3.3 Appraising biofuels

This section argues that, in the spirit of energy justice principles outlined in 2.1, equity issues in relation to specific biofuels largely remain unknown because in-depth, inclusive appraisals that engage with local communities affected by the production *and* consumption of biofuels do not yet exist or occur systematically in the field (Blaber-Wegg et al. 2015). In 2012, the International Institute for Sustainable Development (IISD) echoed the NCB's (2011) fears that the impact of biofuels policies at all stages of their production and consumption are not fully understood and have not been analysed. Niven's (2005, p549) rhetorical question relating to his own research into bioethanol seems pertinent:

> "should the policy of ethanol enrichment of gasoline be implemented on the basis of ideology or 'political correctness', because it is 'seen' to be environmentally sound on the basis of rudimentary arguments (assisted by industry lobby groups who stand to make large, protected profits from the policy), or should it be implemented only on the basis of an honest, rigorous technical appraisal of the environmental, human health, economic and political consequences, both positive and negative, without the influence of lobby groups? Even if the policy of ethanol enrichment is preferred … the decision-makers should have the ability to make an informed decision, knowing the consequences of their actions."

Hodbod and Tomei's (2013) systematic review of academic research into social impacts of biofuels suggest that social and environmental impacts are likely to be unevenly spread amongst stakeholders but there is a lack of grounded evidence of the nature and distribution of equity issues relating to specific biofuels. Hodbod and Tomei (2013) argue a desperate need for local level impacts to be studied, to understand better equity issues associated with particular fuels, arguing that knowledge is based generally on evidence gathered 'at a high level' (just 17 out of 582 academic papers on the social impacts of biofuels actually presented primary data at household or community level). Of the 17 reviewed, all were focussed on the production end of the supply chain and 10 found that increasing social disparity in these regions became evident (Hodbod and Tomei, 2013). Claims about some issues, relating to some biofuels, are often not substantiated; for example, food security is often quoted as being threatened by biofuels production and yet research by

Obidzinski et al (2012) and Lima et al (2011) found that only 1.3% of palm oil in Indonesia and 6% of soy is used for biofuels production and the increase in uses of these materials has largely been due to manufacture of other products (food, cosmetics etc). Academic literature also suggests social and equity are missing generally from sustainability appraisals or studies of biofuels (Afionis and Stringer, 2012; de Andrade and Miccolis, 2011; Blaber-Wegg et al. 2015; Creutzig et al. 2013; Hunsburger et al. 2014; Mohr and Baush, 2013; Mohr and Raman, 2013; Ribeiro, 2013; Silva Lora et al. 2011). Hunsburger et al. (2014) suggest this is because social issues have been an afterthought in terms of dealing with impacts of biofuels' production (and associated policies that drive increases in biofuels' consumption). Gasparatos et al (2015) suggest that while piecemeal understandings exist of social and equity issues, decisions about how to manage trade-offs that will always be apparent in these systems are impossible. Equally, impacts associated with biofuels production can be positive or negative depending on a range of factors such as feedstock types, regional and socio-economic contexts associated with their production and associated institutions, markets and policy instruments (Gasparatos et al. 2015; Hodbod and Tomei, 2013). Therefore, context is everything and without these understandings, it is impossible to implement policies that might govern and regulate specific biofuels to prevent negative impacts and protect those who might be most vulnerable to adverse effects.

Likewise, Sovacool's (2014a) study of 15 years of energy research found only 12.6% utilising qualitative research methods and these were mainly studies relating to electricity generation or energy efficiency (including demand-side management). Although attention to bioethanol and biodiesel has rapidly increased in the last 15 years, these topics did still not feature in the top 5 technologies studied (Sovacool, 2014a). Manik et al's (2013) study used qualitative research methods to explore social issues associated with palm oil biodiesel in Indonesia. Although this study did not specifically include qualitative data collected from consumers, Manik et al's (2013) findings suggests that more equitable pathways for palm oil biodiesel might be found where consumers have more access to information about this biofuel and can exercise choices that demand it is more sustainably-produced.

All biofuels supplied in the UK must meet the sustainability criteria set out in the EU RED (EC, 2009) and the FQD (EC, 1998; EC, 2009) (as defined in section 3.1). The EU RED focuses on increasing the use of renewable fuels in transport, such as by increasing the biofuel element in petrol and diesel sold at the pump, whereas the FQD was designed specifically to improve the quality of fuels, reduce greenhouse gas emissions and improve air quality (EC, 1998). However, the sustainability criteria that fuels consumed in the UK must meet (and indeed the UK) to comply with these acts are the same (DfT, 2015a). This is managed under the RTFO. The sustainability criteria focus on environmental factors (Ponte and Daugbjerg, 2015) such as the reduction of greenhouse gas emissions compared with fossil-fuels or pollutants, including restrictions relating to the sourcing of biofuels from land with high carbon stocks and/or biodiversity (DfT, 2015a; EC, 2015a). EU member states are, however, required to report on some social criteria periodically (such as impacts of biofuel production on food availability, land-use rights and international labour conventions) (EC, 2009; German and Schoneveld, 2012).

To demonstrate compliance with the EU RED and the FQD, and count towards renewable energy targets, biofuel suppliers must certify their product(s) against an EU-approved sustainability certification standard. These are called voluntary sustainability certification schemes (VSCSs) because biofuel suppliers can choose which scheme to use to demonstrate their compliance with the EU RED and FQD (EC, 2015b). Some VSCSs go further than the basic sustainability criteria laid out in the EU RED and FQD and this is discussed in more detail during the remainder of this chapter. In the UK, the process by which liquid biofuels used in transport demonstrate compliance with the sustainability criteria set out in the EU RED and FQD is managed and monitored under the Road Transport Fuels Obligation (RTFO) (DfT, 2013b). Between April 2014 and April 2015, over 1,356 million litres of biofuels were supplied and 75% were reported as meeting the required sustainability requirements (DfT, 2015b).

There are 19 approved VSCSs that biofuel suppliers can use to demonstrate compliance with the EU's and UK's sustainability requirements for biofuels (i.e. the criteria laid out in the EU RED, RTFO or FQD) (DfT, 2015a; EC, 1998; EC,

2009; EC, 2015b). The criteria each VSCS uses to assess the sustainability of a biofuel vary considerably; some extend to cover wider social or environmental concerns than the EU RED, RTFO or FQD regulations stipulate whereas others focus on the minimum statutory requirements (Blaber-Wegg et al. 2015; German and Schoneveld, 2012; Ponte and Daugbjerg, 2015). By their very nature, all VSCSs focus on sites of production (Blaber-Wegg et al. 2015) and none cater for the way an equity appraisal should be conducted according to energy justice and associated literatures (discussed and defined in chapter 2). VSCSs also rely heavily on calculations from life-cycle assessments (LCAs) but LCAs are environmentally-focussed and used to demonstrate the amount of energy and natural resource inputs and resultant output of emissions – thus do not cater for social and equity issues (Adams et al. 2013; Blaber-Wegg et al. 2015; German and Schoneveld, 2012). The points raised above highlight that the nature and extent of equity issues that might be identified via these schemes are limited. A report by the International Energy Agency (IEA) in 2014 showed that the most commonly used VSCSs in the field are those that meet the lowest-level statutory sustainability criteria necessary to meet the RED, FQD and RTFO regulations (IEA, 2014); the most prolific being the International Sustainability and Carbon Certification (ISCC) scheme, which is environmentally-focused (DfT, 2013b; Ponte and Daugbjerg, 2015). The ISCC's only social impact coverage relates to 'good management practices' (EC, 2013).

The reason the RED does not extend to social issues is put down to legal issues related to the World Trade Organisation (WTO), which will not be investigated in depth here, but suffice to say, the responsibility of covering social sustainability issues is left to the private and civil society sectors through VSCSs (Ponte and Daugbjerg, 2015). Indeed, more robust schemes have emerged from multi-stakeholder initiatives that seek to cover wider social and economic concerns in local communities in producer regions including the Global Bioenergy Partnership (GBEP), Bonsucro and the Roundtable for Sustainable Biomaterials (RSB). These took longer to develop than the more targeted Greenergy scheme, but they are generally considered to be more comprehensive (German and Schoneveld, 2012; Mohr and Baush, 2013; Mohr and Raman, 2013; Ponte and Daugbjerg, 2015). However, these schemes are

also more difficult to meet and far fewer producers are thought to be currently certified against these schemes (Ponte and Daugbjerg, 2015). For example, only 38 producers in total (out of 441 in Brazil alone) have met the Bonsucro standard[7] (Bonsucro, 2014). What this highlights is that there are mutual dependencies on actors across the public, private and civil society sectors for governing the social, environmental and equitable impacts associated with biofuels, as noted by Ponte and Daugbjerg (2015).

On the whole, it can therefore be argued that existing methods for appraising biofuels tend to focus on environmental impacts rather than on social or economic concerns (Diaz-Chavez, 2011; Ribeiro, 2013; Rutz and Janssen, 2013). Furthermore, the review of existing VSCSs by Mohr and Baush (2013) found these instruments ineffective to address indirect or macro effects concerning social sustainability issues, including matters of equity, despite the potential they have for driving improvements in the sector (Rutz and Janssen, 2013). Furthermore, as all these schemes are focussed on stakeholders at the site of production, they exclude other affected stakeholders along the chain, i.e. consumers (Blaber-Wegg et al, 2015).

Drawing on the range of findings across this chapter and chapter 2, it is clear that equity assessments of biofuels need to be able to meet the following criteria:

- Identify, include and recognise adequately all affected stakeholders (or at least, the widest set of affected stakeholders possible), as well as the ways in which they are affected, from the fuel's production to its disposal (i.e. to uphold the principles of procedural justice and recognition).
- Collect primary, situated qualitative data from the widest set of affected stakeholders possible to allow them to voice the ways in which they are experiencing these impacts, as well as draw on secondary quantitative data and documentary evidence to enable regional contexts and plural notions of justice to be catered for.

[7] Statistics verifying the number or percentage of producers meeting particular schemes globally were not available.

- Identify matters of recognition, procedural justice and distributional justice and the ways in which they are related, to identify drivers of distributional injustices.

When the findings of this section are considered alongside the criteria listed above, it is evident that the most commonly used tools and methods for assessing the sustainability of biofuels in the field do not adequately cater for an equity appraisal and are unable to uphold the key principles of recognition and procedural justice within the appraisal process itself (i.e. they do not ensure recognition or inclusion of all affected stakeholders including consumers). In addition, the most commonly used tools and methods reviewed in this section (for assessing the sustainability of biofuels) exclude the opportunity to promote sufficient engagement between stakeholders across locations in the supply chain from production to consumption which might help re-shape or re-define processes to mitigate injustices. The most commonly tools and methods for conducting assessments of individual biofuels' sustainability also do not allow for a broad range of social and equity issues to be identified, defined and discussed by participants, i.e. the majority used list-based approaches of particular issues to look for which work against the non-paternalist procedures advocated by Schlosberg (2007), Stewart (2001) and Tschakert (2009) (if they include social dimensions of sustainability at all). It can therefore be argued that currently, social and equity issues are not fully understood for individual biofuel products consumed in UK and European markets.

3.4 Biofuels conclusions

Despite arguments for the benefits and importance of conducting an equity appraisal of a renewable energy technology in chapter 2, what has been seen in this chapter is that equity issues in relation to particular liquid biofuels frequently remain unknown. This is because dominant biofuel appraisal tools used in the regulatory domain have been found to only partially represent equity and there has been a lack of attention to equity appraisals of biofuels to date within academic studies. Biofuels developments are driven by the need for sustainable, renewable energy in transport and yet commonly-used tools and appraisals only partially cover sustainability and equity ideals, or they fail to recognise and include the broadest set of diverse, affected stakeholders possible.

Reviews of academic literature identify that more grounded, context-dependent evidence of the way different peoples and environments are affected by the use of biofuels is currently needed to help understand associated equity issues (Afionis and Stringer, 2012; de Andrade and Miccolis, 2011; Blaber-Wegg et al. 2015; Creutzig et al. 2013; Gasparatos et al. 2015; Hodbod and Tomei, 2013; Hunsburger et al. 2014; Mohr and Baush, 2013; Mohr and Raman, 2013; Ribeiro, 2013; Silva Lora et al. 2011; Sovacool, 2014a). This is particularly pertinent to bioethanol, which is fluid not only in its physical properties, but also in the way it flows through geographies as it is traded as a global commodity across national boundaries (Garvey and Barreto, 2014). Imported bioethanol feeding UK consumption (DfT, 2013a) is driven by UK and European policies (DECC, 2009; EC, 2009), connecting different peoples such that the impacts of actions by some stakeholders can be felt in communities much further afield. This poses serious challenges for equity appraisals that seek to include and recognise all affected stakeholders and allow the pluralistic and holistic identification and exploration of equity issues that environmental justice, energy justice, STS and public participation literatures advocate (discussed in chapter 2). It is this knowledge-gap that this thesis contributes to, by conducting an equity appraisal of a liquid biofuel, to identify equity issues in the way these literatures advocate and help identify cases of procedural injustice or misrecognition as drivers of distributional injustices.

Environmental and energy justice theories suggests that matters of recognition and procedural injustices will be found to drive distributional injustices associated with internationally traded liquid biofuels. In fact, these issues are already beginning to emerge from the biofuels-related literatures reviewed in this chapter. For example, matters of distributional justice are apparent as the wide range of negative environmental and social impacts associated with increased consumption of biofuels in the global North appear loaded towards the production end of the chain, in the global South (Garvey and Barreto, 2014; Mohr and Baush, 2013; Mohr and Raman, 2013; Mussatto et al. 2010; NCB, 2011; Phalan, 2009; RFA, 2008; Rosillo-Calle and Johnson, 2010; Rutz and Janssen, 2013; Searchinger et al. 2008; Zulbeman et al. 2012). Procedural injustices are also emerging as drivers of these distributional outcomes, as European blending mandates (implemented by a particular set of stakeholders in the global North) are increasing demand for biofuels produced outside the EU. Matters of recognition are also emerging because of the lack of engagement with or acknowledgement of local communities in producer regions as well as consumers. Information for consumers appears lacking and they are unable to choose between the types of biofuels they purchase, which prevents them from engaging adequately with debates and decision-making processes or exercising purchasing preferences which could help drive more sustainable and equitable outcomes. These findings will be explored further throughout the empirical findings presented in chapters 5, 6 and 7, from the in-depth, qualitative and interpretative methodology set out in the next chapter.

Chapter 4: Research Methodology

This research is set in a dynamic, real-world context, where no extensive and comprehensive historical data exist in relation to equity issues associated with an internationally traded liquid biofuel, in the way defined and argued by energy justice related literatures reviewed in chapter 2. For example, environmental and energy justice, public participation and STS literatures reviewed helped identify criteria for an equity appraisal of a liquid biofuel, i.e. the appraisal needs to be able to (i) identify and include all stakeholders involved or affected by the biofuel's production and consumption, (ii) give adequate recognition to these peoples' diverse perspectives and the ways in which they are affected, (iii) collect primary qualitative data from all stakeholders to cater for regional contexts and plural notions of justice, and (iv) use environmental and energy justice theories to analyse the relationships between matters of recognition, procedural justice and distributional justice that emerge so that drivers of environmental and social injustices might be understood and recommendations be made for changes in policies and practices that can help develop liquid biofuels that are both sustainable and just.

In this chapter, an explanation is provided of how the criteria listed in the paragraph above (i.e. items (i)-(iv) above drawn from literatures reviewed in chapter 2) have driven the research design and methodology employed in this thesis. For example, the first two criteria informed the design of a first stage of research (discussed in detail in 4.2) to help map a liquid biofuel's journey from production to consumption and disposal, identify the geographical locations where these processes take place and identify all types of stakeholders affected by this supply chain in these regions. This stage of research ensured that people from these stakeholder groups and their perspectives were adequately included and recognised in this equity appraisal process. The second two criteria above informed the design of the second stage of research (presented in 4.3) where primary qualitative data was collected to identify and analyse

equity issues associated with the case study supply chain. However, firstly, the chapter opens with an explanation of the case study research design overall.

4.1 The research design

This research takes an embedded case study design because case studies are the preferred method to answer, explore or explain 'how' and 'why' research questions, in the manner of this project (Yin, 2009) (Table 2). Case studies also offer the opportunity for 'real world research' (Robson, 2002), allowing context to be explored and understood (Flyvberg, 2006), which is an essential part of this research and its unique contribution to knowledge of equity issues and their interrelationships in relation to specific liquid biofuel supply chains. A case study was also an ideal method for this in-depth research because behaviour and events relating to a supply chain cannot be controlled, which rules out conducting an experiment. Also, a case-study allows a flexible approach to the research (Robson, 2002) and the use of interpretive social science inquiry as techniques for data collection and analysis in this research project (detailed in 4.4).

Table 1: Research methods and their suitability for different theses (Yin, 2009).

Method	Form of Research Question	Does the research require control of behavioral events?	Does the research focus on contemporary events/phenomena?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/No
History	How, why?	No	No
Case study	How, why?	No	Yes

Helping attend to the criteria identified for an equity appraisal in chapter 2 (listed in section 2.4 and re-iterated in the introduction of this chapter above), a case study allows different types of data to be integrated. For example multiple forms of evidence such as primary qualitative data and secondary data from existing academic studies and grey literature (Flyvberg, 2006; Yin, 2009). This component of the research design helped provide context in which the primary

qualitative data are set, which was identified in chapter 2 as an essential component for conducting an equity appraisal.

The embedded case study design allowed the study to have multiple units of analyses (Yin, 2009) (Figure 2 below). For example, the supply chain being the 'case' and particular stages of the chain the embedded units of analysis (where data were collected at each geographical site). The embedded design therefore allowed the site of production and processing (in Brazil) and the site of consumption and disposal (UK) to become individual units of analysis with the overall case study design. The benefit of this approach allowed the data collected at individual units and locations to be analysed and also viewed holistically across the chain.

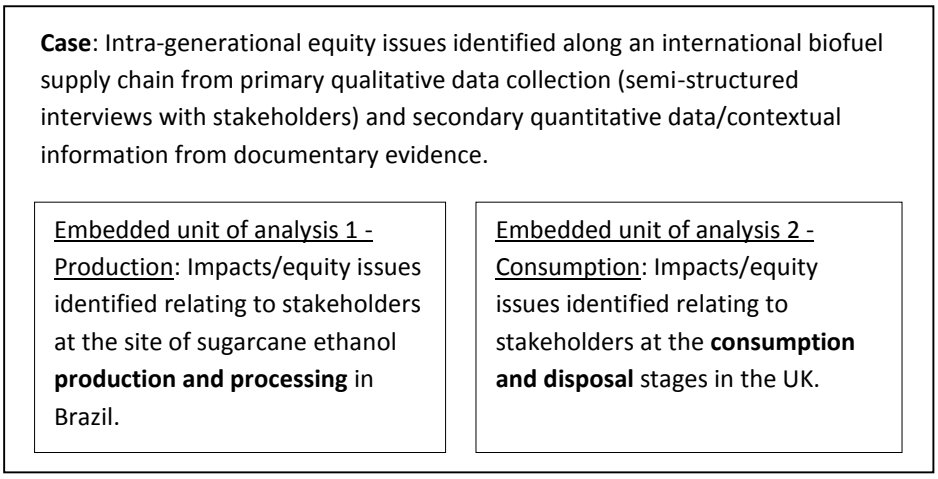


Figure 2: Embedded case study design for this research.

In this particular case, the production and processing of liquid bioethanol took place in one geographical location (this is explained in chapter 5) and so in this research project, the first unit of analysis is called collectively 'production'. Equally, as disposal of the fuel takes place via combustion in vehicle's engine, the site of consumption and disposal are the same and therefore the second unit of analysis, for simplicity's sake, is called 'consumption'.

It is recognised that distribution of the bioethanol forms an important part of its supply chain and will affect stakeholders throughout these processes. However, it is not included as a separate and individual unit of analysis in this research design because of the highly integrated nature of this particular supply chain (presented and described in detail in chapter 5) and the time and

resource constraints associated with this in-depth qualitative study. However, the distribution element of the supply chain was covered, at least in part, from views at either end of the supply chain (i.e. within the two units of analysis; production and consumption). Stakeholders involved in the distribution of the fuel were however included at both stages of research (these two stages of research are described in detail in sections 4.2 and 4.3). All the stakeholders interviewed at these sites are listed in sub-sections 4.3.1 and 4.3.2. This approach allowed contextual information about the distribution stage to be included in the results but, as will be explained in the case study description (sub-section 4.2.1) and the empirical results presented in chapter 5, due to time and resource constraints and the highly integrated nature of the case study supply chain, this approach was valid. For example, the shipping of the fuel and its effects on workers and communities may indeed enrich the study and cater for full recognition within the process but, in addition to the time and resource constraints, the containers carrying bioethanol were found to be shipped as part of larger cargos with many other goods and therefore only partially contribute to local-level impacts within this stage. It was considered that this research design allowed sufficient (and the most important) units of analysis to draw out equity issues and examine their interrelationships and drivers of distributional injustices. In addition, this approach also catered adequately for spatial and cultural distance. The focus on sites of production and consumption as units of analysis was also because the literature review in chapter 2 indicated that the main equity issues, and the greatest inequalities between stakeholders, were likely to be found at these sites.

To attend to potential issues often associated with case studies, including validity, reliability and non-systematic procedures (Flyvberg, 2006; Yin, 2009), a number of features were adopted in this research design. Similar methods were employed at each unit of analysis (i.e. sites of production and consumption) and multiple sources of evidence reviewed to improve the rigour of the research. For example, similar stakeholder types were defined and identified at each stage of the chain to provide a consistent approach and aid comparisons between findings across the chain. To deal with potential bias (Yin, 2009), participatory research methods were used ensure inclusivity and

diversity amongst stakeholders and to identify equity issues at each unit of analysis. This also helped allow for difference as well as consensus and plurality across notions of justice (discussed and defined in chapter 2). The embedded case study design also helped allow for different communities or collective entities within each unit of analysis (Yin, 2009). A case study can be regarded as time-consuming and can produce massive, unreadable documents (Yin, 2009), therefore to mitigate this, steps were taken to condense narrative while covering the issues sufficiently. Diagrammatical representations were also used to help illustrate issues and demonstrate their distribution amongst people affected (figures 11 and 24, pages 171 and 231 respectively).

Another criticism is the extent to which you can generalise from a single case study. However, as Thomas (2011) says, an exploratory case study of this nature makes no assumption at the outset that if the inquiry were repeated by different people at a different time, similar findings would result. For example, issues raised at a particular moment in time are dynamic and vary according to a range of factors. It is therefore acknowledged here that this type of research design explores issues at a given time, to help stakeholders understand equity matters and consider what further actions could be taken to mitigate negative impacts or replicate positive issues across other stakeholders (for example, across other similar supply chains). Condemning case studies on the basis that generalisations cannot be made is one of the five misunderstandings about case studies reported by Flyvberg (2006), who finds case studies a valid and useful way of conducting qualitative social science inquiry.

Having provided an overview of the research design in general, the next sections describe the way two stages of research adopted in this research design were used to meet specific research objectives outlined in chapter 1.

4.2 Stage 1 research

Two stages of research were adopted for this thesis. This section explains the research methods used to collect mainly primary, qualitative data during the first stage of research conducted between September 2011 and August 2012. This stage of research helped attend to the third and fourth research objectives

(defined in section 1.3) and research questions 2 and 3 (defined in section 1.4). Therefore, the aims of stage 1 research were to develop a case study on an international liquid biofuel supply chain feeding UK consumption through which to explore associated equity issues and drivers of distributional injustices. In addition, the aims of stage 1 research included conducting an initial stage of primary qualitative data collection with transnational governance actors and experts in the field to:

a) Understand the field and identify a case study supply chain (i.e. building on the literature reviews presented in chapters 2 and 3).

b) Identify the types of stakeholders connected to and affected by the case study supply chain (and thus who should be included in an equity appraisal).

c) Establish how transnational governance actors and experts in the field recognise themselves and others in the chain and the ways in which they perceive them to be affected (in relation to themselves and others).

d) Identify matters of recognition and procedural injustices that may be drivers of particular outcomes or distributional injustices.

Stage 1 research thus paved the way for the second stage of research (defined in section 4.3). The ways in which secondary quantitative and qualitative data from published literatures and documentary evidence were used to understand the context in which the case study supply chain is set are also explained throughout section 4.2.

Firstly in this chapter, the way the case study supply chain was identified during the first stage of research is outlined (sub-section 4.2.1). This is followed by an explanation of how stakeholder categories were defined and individual stakeholders identified for the in-depth research at stage 2 (sub-section 4.2.2).

4.2.1 Case study supply chain identification

To help identify a typical, major liquid biofuel supply chain feeding UK consumption for this case study, quantitative data from published literatures were reviewed. For example, a review of DfT published data (collected through

the RTFO) (DfT, 2011) was conducted to help understand key liquid biofuel supply chains. In December 2011, the RTFO placed legal obligations on biofuel refiners, importers or suppliers of over 450,000 litres of road transport fuel per year (liquid fossil or liquid or gaseous renewable) to meet biofuels' sustainability criteria laid out in the EU RED (DfT, 2013b) for all biofuels consumed in the UK. This mechanism therefore provided the most comprehensive data-source for large-scale biofuel supplies entering the UK. Imported bioethanol, produced from Brazilian sugarcane, was considered the most typical example of an international, liquid biofuel feeding UK consumption within the transportation sector at that time because it was the most prolific within mandatory blended, liquid fuels sold at the pump (DfT, 2012). Bioethanol sales represented 60% of this market compared with 36% for biodiesel (DfT, 2013). For these reasons, a sugarcane bioethanol supply chain was the preferred option for the basis of this case study. Also, it allowed an equity analysis of an internationally traded fuel that connects communities in producer regions in the global South with consumers in the UK. Impacts to people in developing countries have also tended to be the focus of concerns and opposition against these types of biofuels (outlined in chapter 3) and therefore a site of production in the global South was particularly pertinent to the aims of this research project.

In addition to the RTFO, systematic internet searches were conducted to establish bioethanol suppliers in the UK and a high number of small-scale suppliers of biofuels across the UK were found, either through their listings as RTFO account-holders or advertising their services online (found through internet searches). A spreadsheet containing over 180 suppliers was collated. After informal conversations with contacts in the field (other academics/researchers, NGO practitioners, staff from the RTFO and suppliers themselves) it was evident that individual supply chains were complex because suppliers could purchase bioethanol on the open market from a range of other suppliers/producers and therefore approaching a large-scale supplier who may have a more integrated supply chain and full chains of custody, might be the best route forward in finding support for this research.

Imports from Brazil were thought likely to continue and grow to meet EU and UK targets and a Brazilian-EU partnership has been set up which includes aims to learn from Brazil's sustainable energy strategies (Europa, 2007). With ethanol being a major part of Brazil's sustainable energy strategy, it is likely to involve the use of bioethanol within EU policies and targets. However, initial conversations with some large-scale suppliers, researchers and experts in the field established that due to poor harvests and the increased price of sugar, the Brazilian-UK supply chains had significantly decreased, casting doubt over whether this could still be regarded as a typical supply chain. However, this reduced trade was considered a temporary situation with the likelihood that trade would increase again significantly in the years to come because of the nature and scale of the operations in Brazil (evident from the literatures reviewed and presented in chapter and because Brazil is such a major, global producer of bioethanol and the trade partnerships put in place as mentioned above (Europa, 2007)). Continued demand for bioethanol by UK- and European consumers was also likely through policy blending mandates.

Access to data was a key consideration of this project and it was thought that a Brazilian-UK supply chain would be ideal because of Brazil's long-term experience of bioethanol production for domestic markets and overseas exports (Bergquist et al. 2012; Chaddad, 2010; ISO, 2011; Machado and Walter, 2011; UNICA, 2013). This meant more data would be available on this example supply chain (and others like it). There has also been much interest in published literatures about social and environmental impacts associated with this trade (reviewed and discussed in chapter 3). For example, 'The Ethics of Biofuels' report (NCB, 2011) (a report that significantly influenced the nature of this research) specifically includes a case-study of Brazilian sugarcane. Also, as Brazil is a developing country, it allowed contrasting communities that are culturally and geographically distinct to be the focus of the study. A Brazilian-UK supply chain was also preferable for this thesis because collaboration has taken place before between the UEA and a Brazilian University (the Instituto de Pesquisas Tecnologicas (IPT) in Sao Paulo, Brazil) and therefore existing contacts and willing collaborators were available to help facilitate the research. Professor Amarilis Gallardo at the IPT was positive about conducting some

collaborative research of the nature proposed by thesis. On this basis, it is considered that it provided a good opportunity to explore equity issues associated with a globally-traded biofuel – i.e. bioethanol.

Identifying an individual, 'focal' product on which to base the case study, and its supply chain proved difficult initially. This is because bioethanol is a traded commodity on global markets and some suppliers were not keen, or able to, identify exact sources. However, being able to trace biofuel supplies has become a requirement of the RTFO since the time this research commenced, thus future studies might be more easily initiated. Finding suppliers keen to work with a PhD researcher and provide and source data to help with this case study was not easy. However, inspired by Ian Cook's (2004) 'follow the thing'[8] research that tracked a papaya's supply chain, a local Sainsbury's supermarket retailer was contacted (knowing at this stage that all unleaded petrol being sold in the UK was blended with bioethanol as part of the mandates). Sainsbury's promote themselves on the basis of their ethical purchasing and it was thought that they might be supportive of this type of study.

A call to the local filling station confirmed that the fuel was purchased via Sainsbury's Head Office in London, where all the fuel sold on their forecourts is purchased and distributed across the UK. A call to Sainsbury's Head Office confirmed that the liquid bioethanol element in unleaded petrol sold at the pumps was purchased from a distribution company called Greenergy, who sourced the fuel on Sainsbury's (and other UK supermarkets' behalves). Greenergy have become one of the largest fuel distributers in the UK today, with over 10 billion litres of fuel supplied each year and moving from just holding 4% of the UK market to 28% in 2013 (Greenergy, 2014). Greenergy also pride themselves on the transparency of their supply chains and adherence to sustainability laws and standards as defined in the RTFO and the EU RED. In fact, Greenergy had been the first company to set up a VSCS (the Greenergy standard included in the review of these schemes in chapter 3) (Greenergy,

[8] It should be emphasised here that this research is not a study in the vein of Ian Cook's (2004) work but his 'follow the thing' method inspired the way this supply chain was initially identified and tracked.

2014). A telephone call to Greenergy confirmed they were happy to release details of their supply chain, sourced on behalf of their supermarket clients.

It was evident from these conversations that Sainsbury's uses Greenergy to source and supply their biofuel elements of their fuel sold at the pump due to Greenergy's assurances of attention to compliance with the EU RED and the RTFO from their suppliers. The Sustainability Officer at Greenergy's Head Office in London confirmed the majority of its purchases of bioethanol at that time came directly from a particular mill in Sao Paulo in Brazil, the Usina Sao Joao (USJ). The conversation established that USJ cultivated and processed sugarcane to create bioethanol on its own land. Sugarcane is transported from fields in trucks or tractors and processed on-site through large, industrial processes, producing two bi-products; vinasse and bagasse. Vinasse is a pulp waste which is put back onto the fields for irrigation and fertilisation. Bagasse, the fibrous waste, is used for producing electricity on-site. Greenergy took custody of the bioethanol it purchased from the USJ and blended it with unleaded petrol in the tankers while in transit. In the case of the USJ, the fuel was collected, blended and taken to the Port of Santos in Brazil where it was shipped in large containers to the Vopak holding facility on The Thames in London. From London it was distributed to supermarket retail outlets, one of which has become the focus of thesis and the chosen site of consumption within the UK. Thus, the whole case study supply chain, and especially the distribution of the fuel, turned out to be relatively straightforward and highly integrated. All these aspects of the supply chain were verified during the second stage of research.

Having identified a complete supply chain on which the case study could be based it was then possible to see that the production and processing stages of the supply chain could be combined into one single unit of analysis in the embedded case study design (thus referred to throughout the thesis as 'production') and consumption and disposal processes could be combined into one single stage to be called 'consumption' because the fuel is disposed of in the vehicle's engine as part of its consumption. This has already been discussed in relation to this research design in section 4.1.

The highly integrated nature of this supply chain, described above, aided this research and helped justify the lack of inclusion of detailed attention to the distribution aspect of this particular case study supply chain. For example, due to time and resource-constraints, visits to the ports of Santos and on the Thames would not be possible; the budget availability only allowed in-depth research at two sites (sites of production and consumption). Had in-depth research been possible in and around sites affected by the distribution of the fuel, it would have been possible to explore issues relating to affected communities. However, the percentage of impacts that could be attributed to the distribution of this particular container would have been difficult to establish and thus the distribution activities associated with this supply chain was only covered by inclusion of interviewees with views across the chain in stage 1 (i.e. transnational governance actors with views across the chain) and actors that actually manage the distribution processes in stage 2 (discussed in section 4.3). It is recognised however that a future study could include the examination of impacts to these affected communities, in and around the ports, which could potentially enrich the study and provide more in-depth coverage of the distribution stage. Full details of the people included (and interviewed) within the first stage of research are presented in sub-section 4.2.2. These people primarily had views across the supply chain and included those involved with distribution of the fuel. During stage 2 research, people involved in managing the biofuel's distribution from the perspectives of the production or consumption sites were interviewed.

On the following page, figure 3 summarises and introduces diagrammatically the case study supply chain outlined in this section. This is described more fully in chapter 5, which presents the first set of empirical results and context in which this particular supply chain is set.

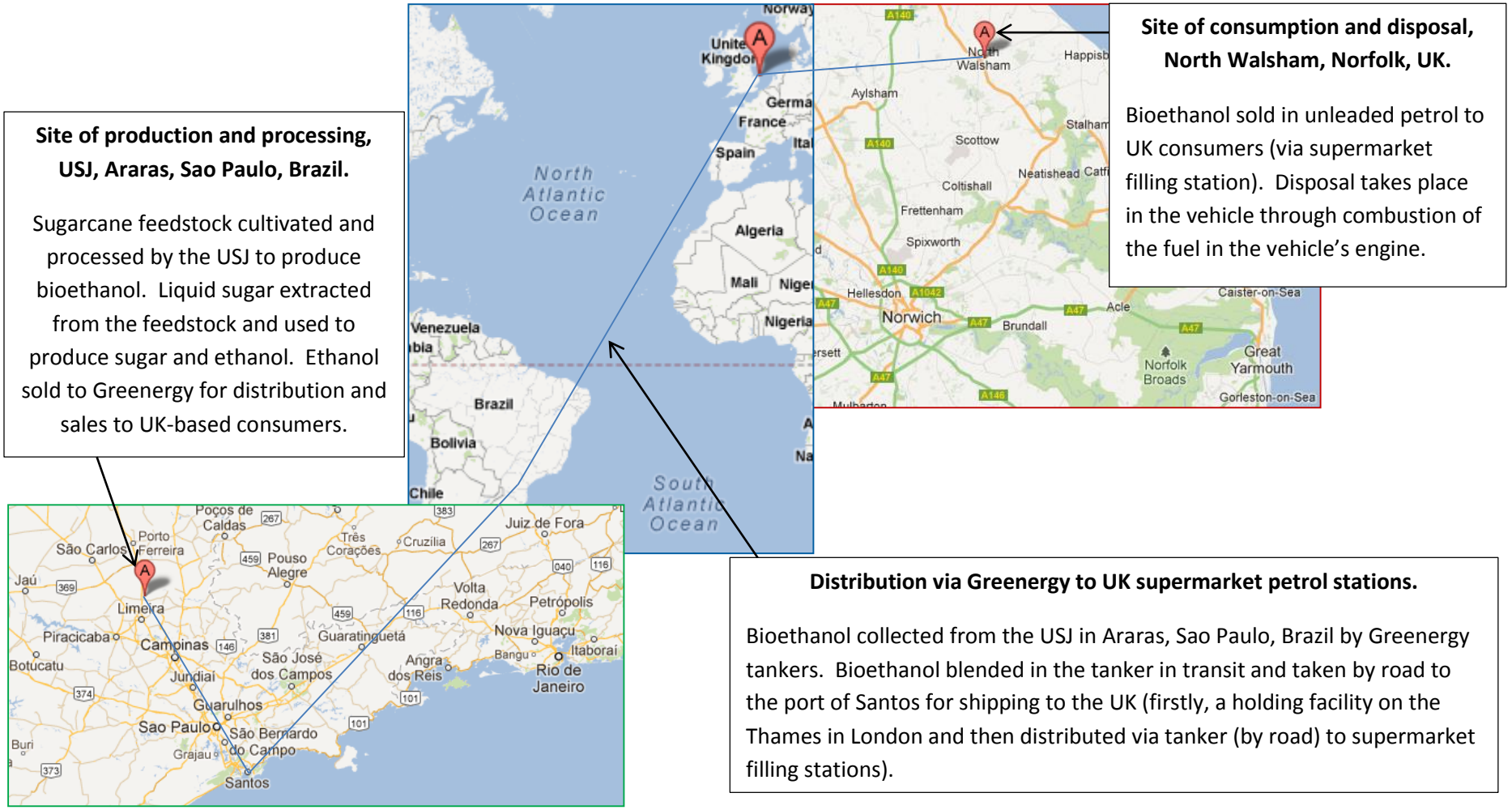


Figure 3: The case study supply chain (map imagery provided by Google Maps (2015a, 2015b)).

4.2.2 Stakeholder analysis

In order to identify equity issues in relation to those affected or involved in the production and consumption of bioethanol, it was necessary to determine who and where these 'stakeholders' are. To aid comparison of results between stakeholders at particular stages of the supply chain, and ensure a consistent method or framework within each stage, the types of people to be interviewed were structured according to stakeholder categories. For example, initially broad stakeholders categories were taken from published guidelines that suggest the types of stakeholders that might be affected by supply chains (UNEP, 2009; UNEP, 2013). These were used to draw up a list of stakeholder types that could be used to guide and structure research at each stage of the chain. From these types of publication, guidance from social science disciplines and advice from supervisors, individual stakeholder types were set within four over-arching categories; public, private, research and civil society sectors. During stage 1 research, sub-categories where developed under each high-level heading. This process informed the construction of the following table (Table 2) which provides a list of, and definitions for, the main public, private and civil society sectors used in this research project. These are particular social groups within the main sectors likely to be involved in or affected by the production and consumption of bioethanol. The use of these categories is used to structure and present details of the actual interviewees included in this research later in this chapter.

Table 2: Definitions of stakeholder categories used in this thesis.

Sector	Sub-category	Description/examples
Public		The part of the economy which is owned by the State (Oxford English Dictionary, 2012). Includes organisations (businesses or industries) controlled or owned by a national Government, thus providing a public service in some way.
	National Government	Relating to countries of sites of production and consumption for this case study supply chain.
	Local Government	Operating in vicinity of sites of production and consumption for this case study supply chain.
Private		The part of the economy which is not under direct state control (Oxford English Dictionary, 2012). Organisations in this category will primarily be driven by profit-making activities for company owners and shareholders.
	Trade Associations	An association organised and funded by businesses within a particular sector or industry, formed to further their

		collective interests, especially through negotiations with governments or trade unions or via advertising or promotional activities.
	Workers	Sugarcane cutters, production, processing, retail workers
	Local traders	Traders within the vicinity of the site of production or consumption for this case study supply chain.
	Smallholders/small-scale producers	From the agricultural sector in and around sites of production and consumption.
	Shareholders / foreign investors	In the main production, distribution and retail companies in this supply chain.
	Fuel Distributers/ Traders	Relating to this case study supply chain and product.
	Suppliers	To production, distribution and retail companies identified in this case study supply chain.
	Biofuel auditors	I.e. self-employed auditors of VSCSs to demonstrate compliance with the EU RED (employed/self-employed) in relation to this particular case study supply chain.
Civil society		Conceptualised here as the sector that includes all organisations and groups of people that exist outside of the private and public sectors and associated spaces of engagement. Civil society includes individuals as well as formal and informal groups or Civil Society Organisations (CSOs). Specific classifications of different societal groups or associations within this sector are included below.
	Non Government Organisations (NGOs)	Because this research project spans international boundaries, an international definition of NGO has been sought. A range of definitions were found but for this thesis NGOs are classified as any non-profit organisation which is not Government controlled and seeks to raise funds or resources for activities to promote social or environmental 'goods' such as poverty alleviation, human rights, reducing human suffering, or environmental conservation or protection (UN, undated; Willetts, 2006). They can have paid or voluntary members. This includes some standard setting organisations for complying with the EU RED such as multi-sector organisations like Bonsucro.
	Voluntary organisations	Entirely voluntary organisations, such as community groups or associations.
	Trade Unions	Although trade unions may operate within a particular private space, sector or industry, they do not necessarily lobby for the benefit of the industry itself – rather, they lobby for individual members as well as the collective for improved social conditions across a range of issues and human rights concerns (i.e. equal opportunities, sexual harassment, fair pay, pensions, sick pay etc). Some unions also extend across a range of companies or organisations within both public and private sectors.
	Other civil society/ non-profit-making org	Any other not-for-profit or Government-owned organisation that does not fit into the categories above operating in the civil society sector.
	Consumers	This category can include local residents who are also consumers of the specific product (i.e. they have been identified within the locality of the point of sale) as well as members of larger-scale, organised consumer groups.
	Local Community	Local residents not necessarily consumers (i.e. including non-drivers, younger or elderly people).
Research		Includes academic institutions and organisations not directly

comm-unity		funded by a private sector company (i.e. conducting R&D for a specific company).

In this research design, stakeholders are defined as those people who represent the interests of others in groups to which they belong. They tend to come to the process with predefined interests and specialist/formal knowledges (Chilvers, 2007). This description therefore best describes people from institutions and agencies. The term 'publics' is given to those who represent only themselves and are potentially representative of different groups that make up civil society. These people tend to enter the process with little prior interest and sophisticated lay knowledges (experiential or local) in relation to the issues under discussion (Chilvers, 2007). In this thesis, when the term 'stakeholders' is used to the different social groups, for simplicity, it spans both these spaces. 'Publics' within this research project best describe individual residents and consumers within the local community and therefore primarily only represent themselves. These have been included under a 'Local Community' heading. Consumers from particular, organised consumer-groups are defined separately under a 'Consumer' heading.

The 'stakeholder analysis' in this thesis does not seek to assign levels of importance to particular types of stakeholder, which some stakeholder analyses advocate (EC, 2006). For example, the ESTEEM manual (which provides guidance for stakeholder analysis of renewable energy projects) (EC, 2006) advocates that once stakeholders are identified, they are ranked in order of their influence for the successful outcome of the project. This manual advocates the targeting of stakeholders deemed most important or influential to gain support for the project and therefore adopts an instrumental approach. To avoid this, equal importance is assigned to all stakeholders and their accounts of the ways in which they feel affected by the case study biofuel in this thesis to uphold the contextualised and plural notions of justice described in the environmental and energy justice literature review (chapter 2). Furthermore, consideration of how to deal with 'trade-offs', i.e. how to deal with the findings of this type of equity appraisal, manage or re-shape processes accordingly to mitigate injustices is a matter for all stakeholders affected.

Rating stakeholders more or less important at the outset of a stakeholder analysis is considered in this thesis to risk bias being embedded into the process, affecting the inclusion or exclusion of different social groups or issues.

From the stakeholder types, companies and agencies identified in Table 2, assisted also through existing contacts and networks, people were contacted via email, telephone and Skype to build a complete list of stakeholders connected to the supply chain and others like it. Agencies and individuals were identified via 'snowballing' research methods (Denscombe, 2003) where interviewees identified also met a specified set of criteria. These selection criteria were shaped according to the research objectives and included that interviewees during this stage of research should (i) have knowledge or experience related to the production and/or consumption of bioethanol (in order that a better understanding of the case study supply chain and others like it can be understood and actors potentially involved or affected can be identified) and (ii) allow for a range of diverse experiences and knowledge of the production and consumption of bioethanol that span public, private and civil society sectors. This helped ensure good coverage of all types of stakeholders affected by the production and consumption of bioethanol, in the manner advocated by energy justice research (chapter 2) and help identify individuals that should be included for interview during the second stage of in-depth research (explained in section 4.3).

The target numbers of people to interview for each stakeholder type was guided by literature review. For example, Cooke and Crang (1995) talk about reaching 'theoretical saturation' for this type of study, which is the point at which people within the 'community' you are researching are raising the same things and nothing new is emerging from the interviews/data collection. However, Guest, Bunce and Johnson (2006 in Mason, 2010) suggest that the idea of saturation is useful only at a conceptual level, providing no guidance for estimating sample sizes for robust research. Mason (2010) reviewed a range of studies and found that for qualitative research that draws on a grounded theory approach, around 30 interviews on average (across the different stakeholders) were common. Charmaz (2006 in Mason, 2010) suggests that 25

participants are adequate for smaller projects and Green and Thorogood (2009 in Mason, 2010) state that experience shows that in most interview studies little new comes out after 20 or so people are interviewed. As a real minimum, Atran, Medin and Ross (2005 in Mason, 2010) suggest that in some of their studies, no new information was gained after as few as 10 informants had been surveyed. On this basis, a target of around 10-15 individual interviews with stakeholders with views across the chain for stage 1 research was set. However, table 3 overleaf provides a list of the actual transnational governance actors and experts interviewed during this stage of research and demonstrates that this target was exceeded, in part because of the nature of this particular study and multiple sites involved. This helped strengthen the findings and richness of the issues identified.

The interviewees identified and interviewed (table 3 overleaf) were conducted face-to-face where at all possible and recorded using a dictaphone (subject to participants' prior consent). Some interviews had to be conducted via Skype or telephone, backed up by email conversations (as a last resort) as per the details shown in table 3. All interview recordings were transcribed in full. Where meetings were not recorded, notes were taken and completed in full directly after the interview. Some interviews took place on location, as specified in table 3, which were either at the participant's work premises, or in the office of a 'partner' research institute.

Table 3: Summary of stakeholder categories and individual interviews completed during stage 1 research.

	Interviewee code	Affiliation	Role/position and Country in which they are based	Date (length of interview, mode)	Sub-totals
Private sector	PD	NFU Sugar	Board Member, UK.	18.05.12 (30 mins, face-to-face, on location)	**5**
	DP	Farmer	Farm owner, UK.	18.05.12 (30 mins, face-to-face, on location)	
	PL	Greenergy	Sustainability Officer, UK.	30.05.12 (59 mins, telephone)	
	RK	Sainsbury's	Buyer (fuel), UK.	20.03.12 (20 mins, telephone)	
	G	UNICA	Senior Advisor to President for International Affairs, Belgium/Brazil.	25.05.12 (50 mins, Skype)	
Research Community	JT	University College London (UCL)	Doctoral Candidate (Biofuels: Case Study: Guatemala), UK.	16.05.12 (47 mins, Skype)	**4**
	JH	UEA	Doctoral Candidate (Biofuels: Case Study Ethiopia), UK.	29.05.12 (35 mins, face-to-face, on location)	
	CB	University of New Hampshire	Researcher, USA.	24.02.12 (45 mins, Skype)	
	LM	World Wildlife Fund (WWF)	Bioenergy Co-ordinator, UK.	17.05.12 (41 mins, Skype)	
Civil Society	EL	ProForest	Senior Project Officer (Biofuels), UK.	11.05.12 (57 mins, Skype)	**5**
	KE	Oxfam	Economic Policy Advisor, UK.	24.07.12 (60 mins, Skype)	
	CA	Solidaridad	Project Officer, Brazil.	08.08.12 (40 mins, telephone + emails)	
	IM	Transitions Brazil	Project Officer, Brazil.	08.08.12 (45 mins, face-to-face, on location)	
	BR	Bonsucro	Auditor/researcher/advisor (involved in standard-setting), UK.	08.05.12 (59 mins, Skype)	
Public Sector	VG	Department for International Development (DfID)	Livelihoods Advisor-Agricultural Adaptation to Climate Change, UK.	02.08.12 (20mins, Skype + emails),	
	RB	European Commission	Renewables and CCS Policy Officer, DG Energy, Belgium.	30.06.12 (57mins, face-to-face, on location)	**3**
	DF	Department for Environment, Food & Rural Affairs DEFRA)	Civil Servant, UK.	01.08.12 (email only)	
				Grand Total:	**18**

During this stage of research, interviews were conducted via semi-structured interviews. According to Yin (2009), qualitative data can be collected from interviews within a case-study design in a number of ways; in-depth interviews, focused interviews and surveys. In-depth interviewing techniques as part of the semi-structured interviews conducted used in this research project allowed open questions to be asked and then interviewees to be probed further about matters raised and their opinions about particular issues as opportunities arose. Therefore, not only did this stage of research identify the types of stakeholders connected to the case study supply chain or others like it, this work also helped identify the ways in which interviewees talked about these people. For example, it allowed the collection of data relating to the ways interviewees perceived themselves and others to be affected by their connection with the supply chain. This helped map out the distribution of impacts that these interviewees felt was likely to exist, based on their knowledge and experience of the field, and the particular procedural injustices (or matters of recognition) that were driving particular outcomes. The findings of this research are presented in chapter 5. The way the research methods aided this data collection can be seen via the types of questions that were used to help structure the interviews. For example, during the first stage of research, the following questions were used (see also Appendix 1):

- What is your professional background and nationality?
- What is your understanding of the supply chain being used in this case study? (ie Do you know much about it specifically or in general, or are you more familiar with just part of it?) Please outline at what stages you are mainly involved and where these stages are located. Describe briefly your professional role, involvement or connection with this supply chain.
- What other organisations, institutions or people/communities do you think are involved and affected mainly in this trade and where are they located?
- How are you affected by the production and consumption of bioethanol (/ this fuel)?
- How does this involvement contribute to your capability and opportunities for education, employment, health, access to resources (as defined by the interviewee – can be basic/essential/environmental etc) or well-being?

- Do you see or experience these as positive or negative effects, benefits or burdens?
- How do you feel the other people identified above are affected by their involvement? How do you think it might contribute to their capability and opportunities for education, employment, health, access to resources or well-being?
- Do you regard these as positive or negative effects?
- For the things you have identified as positive or negative effects, how do you think they might be addressed or built on? Who do you think could do this or be responsible? How do you think these issues are currently being addressed / how should they be addressed in the future?
- Do you have any other comments you would like to add?
- I am currently identifying interviewees that need to be included for the next stage of research. This will also involve semi-structured interviews. Is there anyone in particular you think it would be good for me to speak to and include in this thesis (this might be organisations, 'stakeholder groups' or individuals)?

These sample questions (above) acted as a guide to interviews but a flexible approach was taken in the way that Davies (1999) advocates. For example, Davies (1999, p5) says that researchers can "introduce new topics and supplementary questions not included on the list, and respondents are encouraged to expand on a response, or digress, or even go off the particular topic and introduce their own concerns".

Each semi-structured interview was held between 30 minutes and one hour and a half in length. Timings varied according to the knowledge, interest or engagement of the interviewee, or the time they had available. Background, introductory information was provided and discussed about the study and the bioethanol produce (where necessary) at the beginning of the interviews, plus time for 'ice-breaking' and discussion of ethical considerations such as what will happen with the data. Also a consent form was used to outline data protection and ethical considerations associated with the thesis. Examples of this type of information and forms used for these purposes are provided in Appendix 1.

Finally, the data analysis conducted at this stage used a process of coding to draw out issues identified in the interviews and key themes which could be mapped across the different types of stakeholders and stages in the supply chain. This method of coding and analysis for qualitative data was inspired by well-established social science research methods, such as those described in Flowerdew and Martin (2005). From the interview transcripts, key themes of potential equity issues were identified and listed. For example, transcripts were read through and as particular issues statements or comments were made they were highlighted and notes were put in the margins to describe the type of issue raised. This way, later, data could be sorted into these themes or codes for further analysis. Codes/themes were generated from a mixture of energy justice theory (i.e. using the principal dimensions of energy justice) and bottom-up analysis of the types of issues mentioned by interviewees as important points. Sample interview transcripts from stage 1 research are supplied in Appendix 3. In order to substantiate or contextualise the claims made by interviewees, published academic and grey literatures were re-visited, including media reports and publications from agencies across civil society, private and public sectors.

Data analysis involved the use of software tools such as Microsoft Excel, Word and NVivo 9.0 as well as the manual methods described in the previous paragraph. Manual methods also involved transcripts being printed, sections highlighted and cut out and attached to flip-chart paper to help organise the themes. The manual methods were used as a means of helping visualise the data and themes as they were shaping – purely a personal preference to help manage and analyse the data and complement the work using NVivo.

Based on the description of techniques used for data collection and analysis above, this research drew on abductive research methods. For example, although the research perceived that equity issues might exist, the research did not have preconceived ideas at the outset about what they might be or the ways in which they were connected. The research was exploratory in nature and limited former judgements were made about what might be found. Although there were some preconceived ideas that matters of recognition and

procedural justice may be driving distributional outcomes, based on the literatures reviewed in chapter 2, there were no prior assumptions of what these might be. Findings were related back to the literature review to help consider the implications of the findings that emerged from interviewees' narratives, such as for future policies and appraisals of biofuels and energy technologies more widely. An abductive approach also seems fitting because a purely inductive approach is practically unachievable (Thomas, 2011). Also, deductive approaches test a pre-defined hypothesis and this is not fitting with this particular research design, or indeed its aims and objectives. Thomas (2011) argues that a case study uses an abductive research method because abduction involves making a judgement concerning the best explanation for the facts collected. An abductive approach therefore seems most fitting with this research design.

Following the interviews described in Table 3 (earlier in this section), and the research methods described here, the following people, organisations and agencies were identified for inclusion in the second stage of in-depth research (tables 4 and 5 below and overleaf). This was because the interviewees during stage 1 research recognised these as being specifically connected to, and thus affected by, the case study supply chain or others like it, based on their own knowledge and experiences of working in the field. Actual interviews conducted are described in the next section (section 4.3).

Table 4: Stakeholder types and specific organisations identified during stage 1 research for inclusion in the second stage of research at the production end of the chain (Brazil).

Sec -tor	Sub-category	Actual groups
Public	National Government	Brazilian National Government – officers/policies for biofuels, environment, economic development sectors.
	Local Government	Local Government in Araras, Sao Paulo, Brazil; officers working in health, education, economic development, social issues/inclusion and the environment sectors.
Private	Workers	Sugarcane cutters, production and processing workers at the USJ and in small-scale organisations/farms supplying the USJ.
	Local traders	Local traders and businesses of different types operating within the local economy in Araras, Sao Paulo, Brazil).
	Smallholders/ small-scale producers	Smallholders and small-scale producers within the agricultural sector in and around Araras, Sao Paulo, Brazil.
	Shareholders / foreign investors	Shareholders and investors connected to the USJ in Araras, Sao Paulo, Brazil.
	Fuel Distributers/	Employees/representatives of distributer company – Greenergy

	Traders	(based in Brazil and UK).
	Suppliers	To the USJ.
	Biofuel auditors	Bonsucro and Greenergy auditors (to which USJ complies).
Civil society	NGOs	Transitions (Brazil), Solidaridad, Reporter Brasil.
	Voluntary organisations	APPA (local community environmental conservation organisation with voluntary members set up by people in the community)
	Trade Unions	FERAESP (largest union of rural works in Brazil), UNICA
	Other non-profit-making orgs	
	Consumers	Domestic consumers of bioethanol in Brazil (organised/official consumer groups/published documents/evidence).
	Local Community	Families of production workers, women, older people, people from lower socio-economic groups, children/young people, individual consumers.
Research Community		University of Sao Paulo (USP), Instituto de Pesquisas Tecnológicas (IPT), UNIARARAS (local University in the town of Araras, Sao Paulo, Brazil), EMBRAPA.

Table 5: Stakeholder types and specific organisations identified during stage 1 research for inclusion in the second stage of research at the consumption end of the chain (UK).

Sec -tor	**Sub-category**	**Actual groups**
Public	National Government	DEFRA, DECC, DfT.
	Local Government	District Council councillors and officers (economic development, renewable energy)
Private	Workers	Retail workers for Sainsbury's (filling station North Walsham and Head Office staff)
	Local traders	Local businesses of different types operating within the local economy, in and around North Walsham, i.e. British Sugar.
	Smallholders/small-scale producers	Smallholders and small-scale producers within the agricultural sector in and around North Walsham.
	Shareholders / foreign investors	Shareholders and investors connected to Sainsbury's.
	Fuel Distributers/ Traders	Employees/representatives of distributer company – Greenergy (based in Brazil and UK).
	Suppliers	To Sainsbury's (ie Greenergy/USJ).
	Biofuel auditors	*Production end mainly – although could explore in relation to UK produced bioethanol.*
Civil society	NGOs	Transition Towns (Norwich), Greenpeace, Biofuelswatch, Friends of the Earth
	Voluntary community orgs.	University of the Third Age (U3A)
	Trade Unions	NFU, *Sainsbury's workers union?*
	Other non-profit-making orgs.	Downstream Fuels Association
	Consumers	Domestic consumers of bioethanol in UK (organised/official consumer groups/published documents/evidence).
	Local Community	Women, older people, people from lower socio-economic groups, children/young people, individual consumers and residents in North Walsham, UK.
Research community		UEA

4.3 Stage 2 research

This stage of research was conducted between April and November 2012 and focused on interviews with people from the stakeholder groups identified in the first stage of research (described in section 4.2). This second stage of research attended to the fifth research objective (defined in section 1.3) to conduct an in-depth stage of situated, primary qualitative data collection and answer the third research question defined in section 1.4. This stage of research therefore aimed to establish equity issues affecting people connected to the case study supply chain, the distribution of these issues amongst them, and matters of recognition and procedural justice driving these outcomes.

Guided by stage 1 findings, stage 2 interviewees were selected on the basis that they live or work in or around the sites of production (Araras, Sao Paulo, Brazil) or consumption (North Walsham, Norfolk, UK), they are affected by or connected to the case study supply chain and the production and consumption of this bioethanol product, they are of the stakeholder category identified as being important to include in this stage of research and they allow for diversity and inclusivity within the qualitative data collected and range of interviews conducted. Equally important, was the willingness of interviewees to participate. Attention was also given to ensure diversity within the stakeholders categories themselves, such as age, socio-economic status and gender.

This stage of research also employed snowballing techniques (Denscombe, 2003) to help identify and enlist agencies and individuals for interview that matched the above criteria across public, private, research and civil society sectors. This meant that specific interviewees were enlisted through the recommendations of others. Because of this, the list of stakeholders outlined in tables 5 and 6 (presented at the end of sub-section 4.2.2) were revised and expanded during the second stage of research (i.e. on arrival in the localities of Araras and North Walsham). The final set of interviewees, interviews conducted and associated research methods are detailed in sub-sections 4.3.1 and 4.3.2 respectively. However, to avoid repetition, research methods relating to the data collection and analyses for this stage (which apply to both individual sites) are now explained.

As for stage 1 research (section 4.2), the research methods at this stage were designed to cater for the mainly situated, qualitative data collection and analysis. Secondary quantitative and qualitative data was also drawn from academic studies, company documents, news articles, reports and local and national policy documents relating to demographics and biofuels. These data were used to help provide regional and local contexts for the sites of production and consumption applicable to this case study supply chain and to consider particular issues that emerged. These research methods contributed to the rich set of research findings contained in this thesis.

For both sites of production and consumption, semi-structured interviews were used to collect the primary, qualitative data from interviewees. This allowed open questions to be asked and interviewees probed further in relation to specific issues raised (Yin, 2009). Each semi-structured interview was held between 30 minutes and one hour and a half in length. Timings varied according to the knowledge, interest or engagement of the interviewee, or the time they had available. A basic set of underlying questions were used to guide the interviews at each stage. For stage 2 the underlying questions to help guide the semi-structured interviews were as follows (copies of the guidance provided for participants, including the types of questions that would be asked, are also provided in appendix 2):

- How are you connected to the production and consumption of this particular bioethanol product? For example, how would you describe your professional role in this process? What are the main stages you are involved with?
- How are you affected by the production and consumption of this particular bioethanol product (i.e. this supply chain)? These effects may be professionally and/or personally (i.e. outside of work). For example, how does your involvement with this supply chain affect your opportunities for employment, training/skills, education, health, family life, community life or well-being? Please say whether they are positive or negative effects.

- Are these effects experienced on a day-to-day basis or in the longer-term? (If longer term, please provide an estimate of the timescale you are thinking of)?
- How do you think others are affected by the production and consumption of this particular bioethanol product (ie this supply chain)? These effects may be professionally and/or personally (ie outside of work) and may be people or social groups you have identified earlier. For example, how does their involvement with this supply chain affect their opportunities for employment, training/skills, education, health, family life, community life or well-being? Please also say whether you perceive them to be positive or negative effects.
- Are these effects experienced on a day-to-day basis or in the longer-term? (If longer term, please provide an estimate of the timescale you are thinking of)?
- Of the issues raised (to yourself and others in the chain), which do you think are the most important and why?
- How can learning from the good practices be promoted across the biofuels industry, or how might the negative impacts be addressed?
- Who do you think should be responsible for this?
- How much responsibility do you think it is of Business/the Industry?
- How much responsibility do you think it is of the Government?
- Feel free to add any other comments you would like to make.

The questions above acted as a guide and, as for stage 1 research, this second stage of research adopted a flexible approach to the interviews to allow new topics and supplementary questions to be included (Davies, 1999). This allowed interviewees to discuss an issue of particular concern to themselves in more depth.

All interviews at this stage were conducted face-to-face, on location (either interviewees' homes, offices or public places) and all were recorded via a dictaphone and fully transcribed using either MS Word or directly into Nvivo 9.0. A sample interview transcript from stage 2 research is provided in appendix 4. The interviews were conducted to allow background, introductory

information to be provided and discussed about the study and the bioethanol produced (where necessary), time for 'ice-breaking' and discussion of ethical considerations such as what will happen with the data. An example of the background information to the project and the consent forms are provided in appendix 2.

As described in 4.2.2 for the first stage of research, targets of 10-15 individual interviews per site (i.e. production and consumption) were set based on guidance from Mason (2010)) but again, as will be shown in sub-sections 4.3.1 and 4.3.2, these targets were exceeded contributing to the rich set of findings presented in chapters 6 and 7.

As for stage 1 research, data analysis was conducted using a process of coding, inspired by Flowerdew and Martin (2005) to draw out issues identified in the interviews and key themes which could be mapped across the different types of stakeholders within each stage of the supply chain. This entailed identifying key themes of equity issues from the interview transcript as well as codes drawn from energy justice theory (i.e. relating to the three principal dimensions of justice defined in chapter 2). For example, transcripts were read through and as particular issues statements or comments were made they were highlighted and notes put in the margins to describe the nature of the issue raised. Samples of the coding structures that emerged in this stage are provided in appendices 6 and 7. In order to substantiate, contextualise or discuss the claims made by interviewees, published academic and grey literatures were re-visited, including media reports or publications from agencies across civil society, private and public sectors.

As for stage 1 research, the data analysis at the second stage of research involved software tools such as Microsoft Excel, Word and NVivo 9.0 as well as manual methods. These included those described in the previous paragraph as well as transcripts being printed, sections highlighted and cut out and attached to flip-chart paper to help organise the themes. The manual methods were used as a means of helping visualise the data and themes as they emerged, as a means of helping manage and analyse the data and complement the work carried out via the NVivo software. In line with the first stage of research, this

stage drew on abductive research methods as described by Thomas (2011) (sub-section 4.2.2) due to the exploratory nature of this research and its research objectives (section 1.3).

4.3.1 The site of production

Further to the research methods described at the beginning of this chapter (above) and the research methods described for stage 1 (presented in 4.2) this section presents details of the actual stakeholders interviewed at the site of production in Araras, Sao Paulo Brazil (table 6 later in this section). Table 6 also provides more detail about the nature of each interview. However, firstly, this section provides some regional context to this particular site of production.

The first major, contextual points are that the Sao Paulo state of Brazil, where the case study mill is situated, produces the majority of Brazilian sugarcane bioethanol (UNICA, 2013); 60% of national sugarcane production occurs in Sao Paulo state (Egeskog et al. 2014). Also, sugarcane bioethanol production is inherently connected with the sugar industry in this region. In fact, mandates that stipulated at least 5% of anhydrous ethanol should be blended with petrol were first introduced in 1931 to reduce impacts of Brazil's dependency on oil while taking advantage of sugar surpluses (CIFOR, 2011).

Sugarcane and sugar production is one of Brazil's earliest recorded large-scale economic activities with sugarcane plants first brought to Brazilian shores by the Portuguese in the 1500's (Chaddad, 2010; Machado and Walter, 2011; UNICA, 2013). The fertile soil, tropical climate and African slave labour led to rapid expansion of the industry. Brazilian producers then turned to also producing fuel ethanol for domestic markets and Brazil has become the world's major bioethanol producer and exporter onto world markets (Bergquist et al. 2012; ISO, 2011).

Bioethanol production was initially heavily subsidised by the government to promote greater energy independence and resilience to external shocks in fuel markets, such as the oil crisis in the 1970's (Chaddad, 2010; CIFOR, 2011). The Programa Do Acucar e Do Alcool (Proalcool) programme, initiated in 1973, made major public sector investments into the industry specifically in response

to the oil crisis (CIFOR, 2011). Petrobras, a state-owned fuel company dealing in oil, biodiesel and sugarcane bioethanol production, has established partnerships with private sector companies to support the development of the national ethanol industry, offering guaranteed ethanol contracts over 10 years for a minority stake in projects (Lane, 2012). Furthermore, Petrobras is involved in the joint-venture to build a pipeline linking the hub of sugarcane processing in Sao Paulo to shipping ports where up to 3.17 billion gallons of ethanol (around 40% of Brazil's total bioethanol production) can be transported annually (Lane, 2012).

The site of production for this case study supply chain is placed within the Sao Paulo state which has lower levels of poverty compared with other parts of Brazil (Smeets et al, 2008). The USJ sits at the edge of the city of Araras, some 100 miles North of Sao Paulo City. Araras has approximately 120,000 inhabitants (IBGE, 2013) with lower levels of poverty and social divide in this municipality compared to other parts of the state; the incidence of poverty in this municipality is 13.9% compared to the highest level across Sao Paulo state of 67.84% (Pirapora do Bom Jesus) and Sao Paulo city which has 28.09% (IBGE, 2013). The GINI coefficient (which is widely used to measure income inequalities) is 0.41 compared to the highest of 0.47 (in Aracatuba) and Sao Paulo city's 0.45 (IBGE, 2013) (0 being perfect equality and 1 being maximum inequality of income). Araras is well developed with high levels of transportation and communication infrastructures, a hospital, health services, private and public schools, a University, a local Government office and a vibrant local economy (figure 4 overleaf) (CityBrazil, 2008).

Figure 4: The city of Araras (CityBrazil, 2008).

The USJ mill itself is a large operation, involving large-scale agricultural processes (figures 5 and 6 overleaf and page 109) where the sugarcane feedstock is produced, on its own plantations, and processed to manufacture sugar and fuel ethanol (bioethanol) by its own processing equipment. As the USJ produces both sugar and bioethanol it can be considered typical of the type of large-scale businesses that now dominate Brazilian sugarcane production. The USJ now produces approximately 650 thousand tons of sugar of various specifications, 280 million litres of ethanol and 350 thousand MW of electricity annually using the fibrous waste from the processing operation (sugarcane bagasse) (Grupo USJ, 2012b). The production process is highly mechanised (Grupo USJ, 2012b). In 1944 there were 120 employees and by the 1970's there were some 4,000; expansion partly due to the Brazilian Government's promotion of ethanol for transportation fuels, to reduce reliance on fuel imports in response to the oil crisis at that time. Many of the workers were seasonal, migrant workers to help manually cut (harvest) the sugarcane. However, today, there are around 2,000 workers employed by the USJ and the number of migrant workers has reduced (Grupo USJ, 2012b).

On the other hand, it may be regarded atypical as, in the face of a high number of take-overs and mergers in the industry, the USJ remains in the hands of the Ometto family who have a long history of sugarcane production in Brazil, owning and running this particular mill since the early 1900's (Grupo USJ, 2004). Caterina Ometto and her husband arrived in Brazil from Italy in 1887 and from an initial 15 hectares of land, the Ometto family grew sugarcane, building their first mill to process cane and distil liquor in 1914 (Grupo USJ, 2004). The USJ may also be considered atypical as it meets higher level sustainability standards than those imposed by the RED; the USJ is only one of just 38 mills that meet the Bonsucro standard (Bonsucro, 2014) which has been developed with multi-stakeholder input and covers a wider range of sustainability ideals across the social and environmental matters. This also shows that the USJ recognises and includes local communities perhaps more than other mills who may only meet lower level sustainability certification schemes (i.e those reviewed in Chapter 3).

Figure 5: The Usina Sao Joao (USJ) (Grupo USJ, 2012a).

Figure 6: USJ's sugarcane processing plant (Source: author).

A large Nestle factory in Araras is supplied with sugar by mills in this area (including the USJ). Figure 7 below shows sugar awaiting distribution from the USJ to Nestle and other clients. One local resident talked about the high level of sugarcane production for the Nestle factory in Araras, where the sugar is used to make chocolate powder (of which is 80% sugar).

Figure 7: Sugar awaiting distribution at USJ (Source: author).

Stakeholder interviews conducted

Data collection at the production end of the chain, in Brazil, was assisted by contacts developed at the Instituto de Pesquisas Tecnológicas (IPT) which is based on the campus of the University of Sao Paulo. Two Brazilian PhD research students in the field of biofuels attended interviews where the interviewee only spoke Brazilian Portuguese to assist with translation. These students also helped identify a self-employed interpreter who lives in Araras. They also helped arrange some of the interviews where language problems were an issue. As these colleagues were all native Brazilian-Portuguese speakers and residents of Araras or Sao Paulo they also had specific regional and cultural knowledge relating to this research.

Actual interviews conducted are presented in table 6 overleaf. As described at the beginning of this chapter, these interviewees were identified via existing contacts and networks and an element of snowballing to ensure coverage of key stakeholder types identified in the previous stage of research. Six weeks were spent in and around the site of production and processing in Araras, Sao Paulo, Brazil for the purpose of data collection and this stage in the supply chain. Air transport was used to travel to Sao Paulo city, Brazil, from the UK and public transport such as buses and trains (underground in Sao Paulo city) was used to move around the State and reach the city of Araras where the Usina Sao Joao (USJ) mill is situated. Hotel accommodation and the renting of spare rooms were organised from the UK prior to travelling to Brazil.

Interviews with workers and the local community were not organised or set up by the mill itself. Difficulty was experienced in getting access to the mill or getting management staff to make time to meet me or let me onto the mill's premises. However, a fortunate contact was made with the local bank manager in Araras, via a personal contact made through a friend in Sao Paulo. This contact proved extremely fruitful as the local bank manager helped me gain access to the mill.

Following a site visit and tour of the plantation and production facilities, an independent visit was made to the site to the School (funded by USJ and on the mill's site which is part of 'the colony' or housing provided for workers). While

visiting the school with an interpreter (privately commissioned and who drove me to the site) we managed to talk to workers who had just finished their shift. These workers took us back to their house to meet their family (their children attended the USJ-funded school). As we left, we managed to talk to some sugarcane cutters (seasonally employed staff) and once spotted by the mill's security, we had to leave. These impromptu interviews help provide evidence of the quality of the data in that these people were very keen to talk to us and very open (and proud of their jobs and the facilities provided by the USJ).

Table 6: Summary of actual interviews completed in Araras, Sao Paulo, Brazil.

	Stakeholder sub-category*	**Interviewee code**	**Affiliation**	**Role/ position**	**Date (length of interview, mode)**	**Sub-totals**
Private sector	Sugarcane cutters	CL	USJ	Seasonal manual cutter (migrant worker)	26.08.12 (30mins, face-to-face)	17
		HJ	USJ	Seasonal manual cutter (migrant worker)	26.08.12 (30mins, face-to-face)	
	Production and processing workers	EV	USJ	Mechanical Engineer	26.08.12 (30mins, face-to-face)	
		LZ	USJ	Mechanic	26.08.12 (30mins, face-to-face)	
		IV	USJ	Logistics Manager	26.08.12 (40mins, face-to-face)	
	Local traders	AE	HSBC	Bank Manager	22.08.12 (20mins, face-to-face)	
		SE	English Teaching	Business owner	24.08.12 (20mins, face-to-face)	
		TX	Taxi Company	Taxi driver	19.08.12 (20mins, face-to-face)	
		HA	Hair-dressers	Hairdresser	24.08.12 (30 mins, face-to-face)	
	Large and small scale producers	DU	USJ	Sustainability Manager	24.08.12 (60 mins, face-to-face)	
		SR	USJ	Operational Manager	24.08.12 (60 mins, face-to-face)	
		PA	Farmer	Owner	25.08.12 (60 mins, face-to-face)	

		PF	Farmer	Foreman	25.08.12 (30 mins, face-to-face)	
		GR	Usina St Maria	Quality Assurance Manager	24.08.12 (30 mins, face-to-face)	
	Fuel distributers/traders	NE	Greenergy	Director of Greenergy Bioethanol	30.08.12 (Emails)	
Research Community		EF	University Sao Paulo (USP)	Doctoral Candidate (Bioethanol)	10.08.12 (50 mins, face-to-face)	**2**
		RC	USP and Law School Riberao Preto	Lecturer, Author and local Lawyer	19.08.12 (60 mins, face-to-face)	
Civil Society	NGOs	FC	Solidaridad	Project Officer	10.08.12 (48 mins, face-to-face)	**12**
	Voluntary Orgs	AG	APPA (local community group)	Member	22.08.12 (45 mins, face-to-face)	
	Trade Unions	FT	FETAESP	President	14.02.13 (50 mins, face-to-face (by Brazilian colleague)	
	Families of workers	HR		Son of USJ Worker	19.08.12 (30 mins, face-to-face)	
		FA		Wife of USJ Worker	26.08.12 (40mins, face-to-face)	
	Women	AF		Wife of local bank manager	19.08.12 (45 mins, face-to-face)	
		VA		Taxi driver	20.08.12 (30 mins, face-to-face)	
	Older people	IB		Elderly resident and author	24.08.12 (60 mins, face-to-face)	
	People on lower incomes	GI		Part-time driver (local farmer)/ retired	26.08.12 (45 mins, face-to-face)	
	Young people	MA		Student	20.08.12 (40 mins, face-to-face)	
		AD		Student	23.08.12 (40 mins, face-to-face)	
		LU		Student	23.08.12 (40 mins, face-to-face)	
Public Secto	Local Governme nt / public	AN	Hospital	Doctor and Cardiologist	28.08.12 (60 mins, face-to-face)	**8**

	services	MR	School	School Principal	27.08.12 (45 mins, face-to-face)	
		SP	School	School Principal	27.08.12 (48 mins, face-to-face)	
		IO	School	Pedagogical Co-ordinator	28.08.12 (40 mins, face-to-face)	
		DH	Health Dept	Health Worker	20.08.12 (40 mins, face-to-face)	
		SI	Dept for Communities/Social Inclusion	Social Inclusion Officer	20.08.12 (40 mins, face-to-face)	
		EO	Dept for Education	Education Officer	20.08.12 (25 mins, face-to-face)	
		RB	Dept for Envnmt	Environment Officer	20.08.12 (50 mins, face-to-face)	
					Grand Total:	**39**

*Identified during stage 1 research.

Everyone in the table above are considered consumers of bioethanol, within their general blended fuel purchases, but none are specifically listed in the table as consumers of the specific bioethanol product from the USJ because the focus of this stage is the fuel's production. Sales of bioethanol from USJ for internal markets have not been tracked. The focus on this end of the chain was production of liquid bioethanol for supply to the UK market, i.e. in relation to this particular case study supply chain.

Findings from this stage of research are presented and discussed in chapter 6.

4.3.2 The site of consumption

The context within which this site of consumption, in terms of the way consumers in the UK (including in this site) purchases bioethanol in blended fuels sold at the pump, has already been discussed in chapter 3. This supply chain is typical of these market conditions. The beginning of this section, however provides specific context in relation to the actual region where consumption takes place for this particular case study before going on to present details of the actual interviews conducted.

As stated in 4.2.1, the sale of bioethanol occurs via a Sainsbury's filling station in the town of North Walsham, which sits centrally in the district of North Norfolk and the county of Norfolk, UK (Figures 8 and 9 overleaf). The Sainsbury's filling station is now the main transport fuel retailer in the small market town of North Walsham, with an average week producing in the region of £200,000 worth of transactions, generated from approximately 8,800 customers, purchasing over 150,000 litres of litres petrol (Sainsbury's, 2014). With a population of around 12,000 inhabitants in North Walsham itself (ONS, 2011), it can be deduced that the majority of people are purchasing their fuel locally and from this outlet.

The County of Norfolk itself is a large, predominantly rural, county in the East of England. North Walsham still has a weekly market and is well serviced with education facilities such as playgroups, nurseries, Primary and Secondary Schools, a College and a Sixth Form Centre. It has a good transport network with buses and a train service from the town itself into Norwich, plus main roads into Norwich and to the Coast. A market is still held in the marketplace weekly (Figure 9 overleaf).

The main industries in North Walsham are manufacturing, construction and retail (ONS, 2011). Surrounding areas are largely agricultural land and a significant quantity of this land is used to grow sugarbeet that is sold to British Sugar to produce sugar or ethanol. North Norfolk is highly supported by tourism due to its coastal setting. Younger people between 15 and 44 tend to move out of the area for work or study and higher numbers of people over 45 tend to move into the area than in other regions (ONS, 2011). The North Norfolk district has a higher number of older and retired residents than the National averages (ONS, 2011).

Figure 8: North Walsham Town Centre (TourNorfolk, undated).

Figure 9: North Walsham marketplace (NNDC, 2008).

The incidence of deprivation for North Norfolk as a whole is lower than the national average, however, North Walsham and its surrounding parishes have some of the highest levels of deprivation in the Country (DoH, 2012). Although relative, this is the opposite to the findings for the site of production in Brazil (discussed in sub-section 4.3.1) where the city of Araras has lower levels of poverty than its surrounding areas. North Walsham has an estimated 21.5% of households living in poverty compared with the lowest in the County of 10.4% and the highest of 38.7% (Norfolk Insight, 2008). Whilst it has not been possible to obtain a GINI coefficient for North Walsham, the indices of multiple deprivation in 2010 found parts of North Walsham to have a score of 8,194 (where the highest score in England is 32,482 and given for the least deprived and 1 being the score allocated to the most deprived) (Norfolk Insight, 2010). This places North Walsham on the border of the upper quartile in terms of the highest level of deprivation in relation to the rest of the Country.

Stakeholder interviews conducted

It is within this context above that the stakeholder interviews conducted (presented in table 7 below) are set. The research methods have been detailed at the beginning of this chapter. The site of consumption, North Walsham, UK, was visited by car on an ad-hoc basis to meet interviewees as and when the interviews could be arranged. All the interviews were face-to-face, as described earlier in this chapter, via semi-structured interviews.

Table 7: Summary of actual interviews completed in North Walsham, North Norfolk, UK.

	Stakeholder sub-category*	**Interviewee code**	**Affiliation**	**Role/ position**	**Date (length of interview, mode)**	**Sub-totals**
Private Sector	Retail workers	FS1	Sainsbury's	Filling Station Manager	03.10.12 (20mins, face-to-face)	9
		FS2	Sainsbury's	Filling Station Manager	03.10.12 (20mins, face-to-face)	
		JM	Sainsbury's	Commercial Manager	03.10.12 (45mins, face-to-face)	
	Local traders and businesses	KM	Kelly's Motors	Owner	20.11.12 (45 mins, face-to-face)	

		RD	Business-man	Owner	23.11.12 (59 mins, face-to-face)	
		MS	Starlings Transport	Manager	13.09.12 (30mins, face-to-face)	
	Large and small scale producers	JA	Farmer	Owner	13.09.12 (45mins, face-to-face)	
		RL	British Sugar	Agricultural Manager	01.10.12 (50mins, face-to-face)	
	Fuel distributer/ trader	TS	Downstream Fuels Association	Chief Executive	01.11.12 (40mins, Skype)	
Research Community		TO	UCL	Doctoral Candidate	(50mins, Skype)	1
Civil Society	NGOs	MH	Greenpeace	Co-ordinator of local branch	17.12.13 (50 mins, face-to-face)	16
		CW	Transition Towns	Member of nearest local group	14.11.12 (40 mins, face-to-face)	
	Voluntary organisations	CU	University of the 3rd Age (U3A)	Member	19.11.12 (45mins, face-to-face)	
	Trade Union	JS	NFU	Chief Advisor renewable energy	20.02.13 (40 mins, telephone)	
	Non-profit-making organisations/ charities	RS	Kitale School Foundation (Café)	Manager	09.11.12 (40 mins, face-to-face)	
	Biofuel Activists	AB		Campaigner/ Researcher	13.12.12 (58mins, face-to-face)	
	Consumers: women	SC		Resident	19.11.12 (45mins, face-to-face)	
		SD		Resident	23.11.12 (59 mins, face-to-face)	
	Consumers: older people	VE		Retired resident	06.12.12 (50mins, face-to-face)	
		DF		Retired resident	06.12.12 (50 mins, face-to-face)	
	Consumers: people on lower incomes	SK	Kitale School Foundation (Café)	Part-time Worker/volunteer	09.11.12 (20 mins, face-to-face)	
		MK	Kitale School Foundation (Café)	Part-time worker and single mother	06.12.12 (35 mins, face-to-face)	

	Consumers: young people	JE		Local Resident	13.12.12 (30 mins, face-to-face)	
		CP	Paston College	Student	19.12.12 (40 mins, face-to-face)	
	Consumer	RM		Local Resident	01.11.12 (50 mins, face-to-face)	
		GF		Local Resident	19.11.12 (45 mins, face-to-face)	
Public Sector	Local Government	VU	District Council (NNDC)	Councillor	19.11.12 (40 mins, face-to-face)	**5**
		JW	County Council	Transport Manager	28.11.12 (45 mins, face-to-face)	
		GJ	NNDC	Councillor	19.11.12 (40 mins, face-to-face)	
		AH	NNDC	Green Party Member	01.10.12 (45mins, face-to-face)	
		SO	NNDC	Sustainability Officer	24.11.12 30mins, face-to-face	
					Grand Total:	**31**

**Plus 2 participatory workshops held with Paston College A Level Geography students.*

The findings from this stage of the second stage of research are presented in chapter 7.

4.4 Conclusions

No former study has attempted to collect primary, qualitative and contextual data from a distributed set of stakeholders connected along an international biofuel supply chain in the way this project does. This research design takes into account the set of requirements identified for conducting an equity appraisal associated with a renewable energy technology (in chapter 2), in accordance with energy justice, public participation and STS theories. The research design allowed pluralistic notions of justice and equity issues to be identified and explored across dimensions of justice such as matters of recognition, procedural and distributional justice in line with the research aims and objectives presented in chapter 1. Furthermore, the design allowed these matters and their relationships to be explored via this in-depth, interpretive and qualitative case study of an internationally traded and commonly used

liquid biofuel in the UK transport sector. A key part of this research was the collection of primary, contextual and qualitative data from stakeholders experiencing particular impacts at local levels, to allow them to define for themselves the ways in which they experience impacts and equity issues. It is from this unique set of data that consideration has been given to the ways in which matters of recognition and procedural justice are driving the distribution of outcomes associated with liquid biofuels used in UK transport.

Social science research methods have been described in this chapter that helped collect and analyse data, and energy and environmental justice concepts have been used to conceptualise and analyse equity issues. Chapters 5, 6 and 7 will now provide summaries of the empirical research findings from stages 1 and 2. What is evident, is that these research methods have allowed context-dependent, nuanced equity issues to emerge, which can be explored and discussed to make recommendations for policy changes that might help bring about the development of more just and sustainable liquid biofuels for consumption in the UK transport sector.

Chapter 5: Mapping the case study bioethanol supply chain

In chapter 3 it became clear that biofuels-related literatures are dominated by concerns about distributional injustices as people in producer regions bear the majority of social and environmental burdens as a result of Europe's policies to increase the consumption of liquid biofuels in transport. What also became clear is that the production of bioethanol for these purposes was found to have a number of key characteristics; the majority of bioethanol is produced via large-scale production processes overseas and imported, and consumption is driven by mandatory blending with unleaded petrol rather than demand from end users at the pump. This contextual information is built on in this chapter as the first set of empirical results from data collected during the first stage of research are presented (methods of which are defined in 4.2), helping meet the fourth research objective (defined in section 1.3).

The first section of this chapter presents the types of stakeholders connected to, and affected by, the case study supply chain based on transnational governance actors' and experts' knowledge in the field and supply chains like the one selected for this study. What these results clearly demonstrate is the "complex configuration" of actors that Ponte and Daugbjerg (2015, p96) purport to be responsible for governing biofuels. This provides empirical evidence, for the first time in energy justice literatures, of the wide and diverse set of distributed, formal and informal appraisals taking place in relation to an international liquid biofuel supply chain as a result of individual stakeholders' connections with the chain. What these empirical data also reveal, also for the first time in relation to a supply chain of the case study type, are the ways in which transnational governance actors and experts in the field recognise themselves and other stakeholders in the chain. This includes their perceptions of their own roles and responsibilities and that of others. The results also highlight the information and evidence-bases on which their knowledge of biofuels (and the wide-range of appraisal processes) rely.

Another set of major empirical contributions to the thesis are provided in this chapter, in section 5.2, as the equity issues from interviewees' perspectives are presented. These are presented in terms of the distributional injustices perceived to exist by interviewees at this stage of research and the recognition-based and/or procedural injustices that interviewees felt were driving these distributional outcomes. Perceptions of distributional injustice in relation to supply chains of the case study type are exposed as interviewees conclude that the most significant environmental and social burdens are likely to be borne by people living in producer regions. The results also highlight perceptions of UK-based consumers by governance actors which may be affecting the extent to which consumers are included in or able to participate effectively in associated decision-making processes.

5.1 Stakeholders, connections, roles and responsibilities

The diverse range of stakeholders identified as being connected to supply chains similar to the case study type (detailed in sub-section 4.2.1) are summarised in figure 10 overleaf. Figure 10 therefore summarises the results from the first stage of research which identified the stakeholders responsible for associated social and environmental impacts at sites of production and consumption because of their connections to the supply chain. The summary includes actors at national and global levels which are ultimately connected to local levels (i.e. sites of production and consumption). This diverse set of stakeholders are the types of people that should be, therefore, included in an in-depth equity appraisal (as advocated in the criteria drawn up from literatures reviewed in chapter 2). These results therefore helped shape the nature of the interviewees conducted in the second phase of research. Figure 10 is followed by more detail about these stakeholders, firstly in table 9 (which provides more detail about the nature of their connections, which are coded as per the definitions provided in table 8). This is followed by discussion of how particular stakeholders were recognised by others throughout sub-sections 5.1.1-5.1.7.

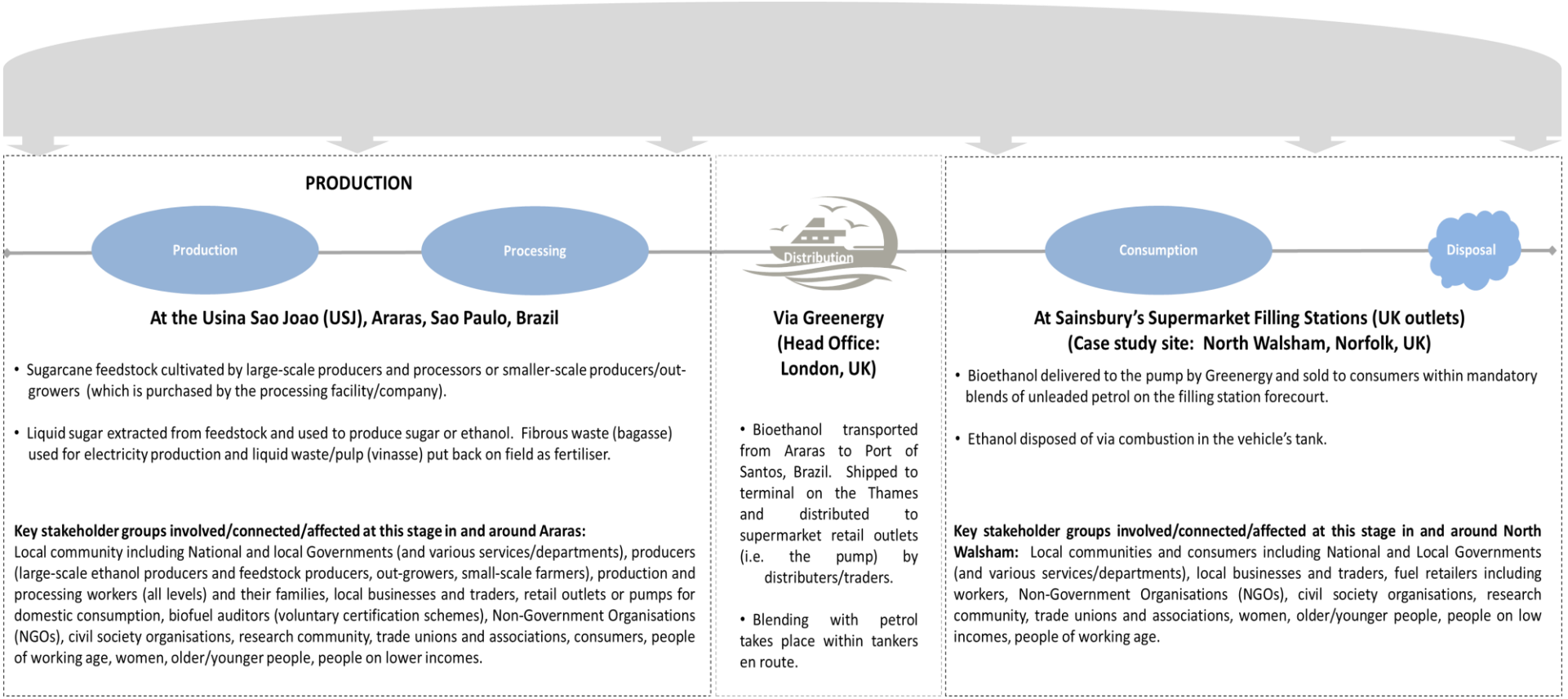


Figure 10: Overview of the case study supply chain including the key stakeholders involved/affected from the perspectives of transnational governance actors and experts in the field and literatures reviewed.

Table 9 now takes the stakeholders identified at sites of production and consumption (displayed in figure 10) and provides more detail about the nature of their connections with a bioethanol supply chain (of the case study type). What this shows is the wide range of distributed forms of formal and informal decision-making and appraisal processes taking place by these types of stakeholders in relation to a biofuel of this type. To aide analysis and presentation of the results, the interactions particular stakeholders are thought to have with the supply chain have been coded. These codes are defined in table 8, drawing on categories taken from Smith and Stirling's (2007) typology of actor practices in socio-technical regimes.

The categories assigned in table 9, and defined in table 8, do not seek to be exhaustive as the interviewees will all have partial perspectives on the recognised actors and their connections with the chain. Stakeholders may also have more than one type of interaction. It is also recognised here that the interactions assigned to actors are a little problematic because they may overlap and there is likely to be variation within each stakeholder group. For example, peoples' roles within a single institution or agency may affect the type of interaction being made and the extent to which a more active or passive interaction occurs. However, the intention here is to add more colour and description to the ways in which different stakeholders may mainly connect with supply chains of the case study type according to the actors interviewed during this stage of research.

Table 8: Codes and definitions for types of interactions used in table 9 (the way stakeholders are perceived to connect to the chain by actors interviewed and literatures reviewed during stage 1 research).

Type of interaction (Code)	Definition	Sub-codes
Appraisal (AP)	Actors are assessing or reviewing the system (or part of the system) in some way, actively making judgements about it – for example its costs, benefits or level of sustainability. This is separated from discursive commitment because it describes a more active, deliberative or participatory process, which may use a particular method, tool or framework (i.e. sustainability criteria for example). Appraisal is used as a means of knowing and understanding the system (Smith and Stirling, 2007, p354) and this process may include the application of formalised methods or tool such as life-cycle assessment, impact assessment, or a sustainability assessment scheme for biofuels(such as a VSCS to meet the mandated criteria set out in the EU RED). This interaction includes actively seeking information provided by one of these tools as well as more informal processes where perceptions or judgement about the sustainability of the biofuel by the actor is based on knowledge or information produced from one of these methods or tools by others.	
Discursive commitment (DC)*	Actors that support or oppose the system due to a particular belief or discourse (Smith and Stirling, 2007, p354). This includes in relation to an actor's professional role, such as a policy or strategy relating to their employment.	Active (A)
		Passive (P)
Material commitment (MC)*	Actors participate in and reproduce the system through deployment of some sort of resource (i.e. investing or purchasing) (Smith and Stirling, 2007, p354).	Active (A)
		Passive (P)

*Passive (P) and active (A) sub-codes have been applied to these interactions to help describe the level of agency or responsibility being expressed by the actor; they help indicate whether the actor interacts in a largely unconscious or passive manner, without seeking to change or disrupt the system, or whether they actively participate or make a conscious decision to interact, which may bring about changes or reinforce the system's legitimacy/operation (Mallett, 2007; Rogers, 2005; Wustenhagen et al. 2007). An example of a passively discursive commitment would be to generally support the theory of renewables in general, or biofuels, or choosing not to protest against a particular technology or its implementation. An example of active, material commitment could be an actor contributing to the UK's energy supply and demand solutions by investing time or money to generate their own energy through installation of small-scale technologies (Sauter and Watson, 2007).

Table 9: Summary of stakeholders and their main interactions with a typical bioethanol supply chain, like the case study supply chain, from the perspective of transnational governance actors. This table includes stakeholder types, institutions and transnational governance actors with an indication of appraisals taking place formally and informally based on interviewees' statements. * Stages = Stages of chain at which these institutions/actors mainly interact (or are the focus of their decisions; P=Production, C=Consumption. **Level at which actors and institutions mainly interact; I=International N=National L=Local. *** Columns with darker shading help to highlight more conscious/formal and active interactions as opposed to passive commitments (see table 8 for code definitions).

	Actors	**Level****	**Main types of interaction*****					**Stages of chain ***
			AP	**DC (A)**	**DC (P)**	**MC (A)**	**MC (P)**	
PUBLIC SECTOR	International governmental organisations: European Commission, European Parliament, World Bank, the United Nations (including departments such as the Food and Agricultural Organisation (FAO))	I	✓	✓		✓		All
	UK Government Department of Energy and Climate Change (DECC), DEFRA, Department for International Development (DFID), the Treasury, DFT (particularly those involved in the RTFO/Renewables Obligation/Renewable Energy Strategy).	N (UK)	✓	✓		✓		All
	Brazilian Government (domestic consumption and exports)	N (Brazil)	✓	✓		✓		P and C
	Local Governments (UK and Brazil) and Services such as education/health/environment/social/ transportation services	L	✓	✓		✓		P and C
TRADE UNIONS	Sugarcane Industry Association (UNICA) (Brazil)	N (Brazil)	✓	✓		✓		P
	Downstream Fuels Association (DFA) (UK)	N (UK)	✓	✓		✓		C
	National Farmers Union (NFU) and NFU Sugar (UK)	N (UK)	✓	✓		✓		P
	Trade Unions for Workers (Brazil – mainly concerned with employment issues/rights)	N (Brazil)	✓	✓		✓		P
RES-EARCH	Academic institutions such as University College London (UCL), UK, University of Sao Paulo (USP), Brazil, Institute for Technological Research/ Instituto de Pesquisas Tecnológicas (IPT), as well as institutions such as the International Food and Policy Research Institute (IFPRI)	L/N/I	✓	✓				All but mainly P

CIVIL SOC.	Non-Governmental Organisations (NGOs): Oxfam, World Wildlife Fund (WWF) Bonsucro, Solidaridad, Transitions Brazil, ProForest, voluntary/non-profit-making orgs/charities and community groups	L/N/I	✓	✓		✓		Mainly P
PRIVATE SECTOR	Fuel distributors/traders	N/I	✓	✓		✓		All
	Petrochemical companies (in response to mandatory blending in transport fuels)	L/N/I				✓		
	Car manufacturers (in response to mandatory blending in transport fuels – i.e. vehicle designs)	L/N/I				✓		
	Retailers (i.e. Supermarket chains filling stations or other fuel retailers)	L/N	✓	✓	✓	✓		All
	Retail workers (on filling station forecourts)	L			✓		✓	C
	Foreign investors/shareholders	L/N/I		✓		✓		All
	Producers/biofuel suppliers (large-scale ethanol producers and mills with processing equipment)	L/N	✓	✓		✓		P
	Production workers (Brazil)	L		✓		✓		P
	Out-growers/local farmers (smaller-scale feedstock producers)	L	✓	✓		✓		P
	Biofuel auditors (private, independent consultancies)	L/N/I	✓	✓		✓		P
	Local traders in and around sites of production and consumption	L		✓	✓			P and C
CONS. (UK)	Consumers (UK): All types such as younger people, older people, commuters/workers, those of lower incomes etc. This is a particularly large and diverse stakeholder category but is used here primarily to describe end-users (i.e. individual consumers) at the pump.	L					✓	C
FAMILIES/ LOCAL RESIDENTS	Families of production workers , men of working age, older people, younger people, women, people on lower incomes	L		✓				P

What these results show is that the diverse range of actors perceived to be connected to a supply chain of this type are mainly associated with particular parts of the supply chain; only a few actors perceive themselves or others to engage with (or have interests relating to the whole supply chain). This highlights a disconnect between particular stakeholders and their knowledge or awareness of others in the chain, from their perceptions, and the ways in which their actions ultimately determine environmental or social impacts on others in the chain (or indeed the ways in which others can engage with the supply chain). For example, perceptions of interviewees at this stage of research were that consumers and retail workers in sites of consumption mainly passively accept bioethanol in their daily routines and connections with the fuel. Consumers were thought not to be actively making any decisions, formally or informally, about their bioethanol purchases. This was thought mainly because bioethanol was a 'hidden' form of renewable energy, purchased within mandatory blends of petrol and the lack of information or labelling at the pump. What is also apparent in table 9 is that agencies and institutions are more likely to use formal appraisal processes and methods of biofuels, or seek information produced from such tools, in order to assess the nature of social and environmental impacts on others associated with the supply chain. Based on the findings in chapter 3, regarding the coverage of sustainability, equity and energy justice ideals by the most commonly used appraisal processes in the field, this means that policy or governance-related interactions with bioethanol occur without evidence or understandings of the ways in which social and environmental inequalities are improved or exacerbated by these fuels. These emergent findings indicate procedural and recognition-based injustices that have an impact on the ways in which actors are able engage with bioethanol supply chains of the case study type and the ways in which they are able to carry out their own roles and responsibilities for distributional outcomes.

The following sub-sections examine these points further, to supplement the data presented in table 9, in order to explain in more detail how particular interviewees recognised themselves' and others' connections with a liquid biofuel supply chain of this type. The text includes the ways in which people

perceived their own roles and responsibilities as well as discussion of the ways in which these perceptions are likely to impact particular types of stakeholders.

5.1.1 The public sector

All interviewees (including public sector interviewees) perceived the UK Government's connection with supply chains of this type to be primarily in relation to policy decisions that promote the use of renewable energy in transport fuels. For example, policies that prescribe the use of liquid biofuels through blending mandates such as the RED and FQD. In addition, interviewees perceived that public sector actors' connections with the supply chain are governing roles with responsibilities to regulate, monitor and reduce negative social and environmental impacts associated with biofuels. This included a role to ensure fairness in the distribution of social and environmental outcomes, and thus equity, amongst people affected – wherever they are geographically located. The primary ways in which these actors engage with the supply chain, in order to carry out their governing and regulatory roles, were thought to be through formal methods of appraisal. Again, this is important when the review of dominant forms of formal biofuels appraisals in chapter 3 is considered, i.e. that they do not include ground-level, primary data that might reveal social and environmental impacts across all stakeholders connected to liquid bioethanol supply chains from sites of production to sites of consumption.

Public sector interviewees openly stated that their knowledge of particular biofuel supply chains (and their impacts) was limited (including the case study type) despite their professional role in enacting or helping formulate governmental policies or strategies relating to increased biofuels' consumption in UK transport. This was because they felt they viewed these types of operations from a high level and the information on which they based their knowledge or perceptions of social or environmental outcomes tended to be based on general information or reports provided to them as part of their job. Public sector interviewees felt themselves to be unaffected, personally, by their interactions with the type of case study supply chain other than the material/career-related benefits they received via their employment (i.e. they did not recognise themselves as consumers). Public sector interviewees saw

their professional discursive commitments guided by policies and their roles within their institutions.

Some public sector agencies were thought to commit material resources to biofuel supply chains of the case study type (by five interviewees across public, private, research and civil society sectors) because of the work they did to help incentivise the take-up of biofuels. Examples of these agencies (including inter-governmental organisations) included the European Commission, European Parliament, the United Nations (including individual departments such as the FAO), the World Bank and national governments. The extent to which the public sector is fulfilling their role in terms of ensuring distributional justice as a result of their material or discursive commitments was questioned by civil society actors. These interviewees particularly felt that associated policies were driving negative issues and burdens to those in producer regions overseas. For example, one civil society interviewee said that "we can justify our consumption with this policy in place but then impacts are out-sourced to developing countries" (Civil Society interviewee KE, July 2012).

Although all interviewees saw primary responsibility for ensuring distributional justice largely resting with the public sector, all interviewees also felt that close relations and interactions between public, private and civil society sector organisations were particularly important to help achieve this goal. This supports recommendations made in the literatures reviewed in chapter 2 for equity appraisals to help engage actors across the sectors. For example, scholars such as Grant (2007), Hutchins and Sutherland (2008), Frynas (2009), Porter and Kramer (2006), Visser (2010) and Young and Tilley (2006) indicate that mutually beneficial, sustainable economic, social and environmental outcomes can be achieved but there is a crucial role for the private sector alongside the work of governmental agencies. In addition, NGO interviewees and academics specifically raised the importance of the interests of wider communities to be adequately recognised, included and represented in associated decision-making and appraisal processes to help address potential power and procedural (in)justices. Stirling (2008) identifies that close private and public sector relationships that are exclusive can close down appraisal or

decision-making processes, thus working against energy justice aims to adequately recognise and include all affected stakeholders. This may be particularly an issue where, as Ponte and Daugbjerg (2015) recognise, there are now complex, mutual dependencies between these sectors in relation to the governing of biofuels. This aligns with fears expressed by NGO and academic interviewees, who felt that procedural injustices risk distributionally unjust outcomes. They felt that open and inclusive decision-making processes help to hold decision-makers and powerful actors accountable to wider publics. This issue is explained here by this civil society interviewee:

> "You hear how the sugar industry has a history of political influence … they are big employers, big landowners … they often have a lot of clout basically … they begin to grow internally and attract money from the outside - they are very, very big businesses, and I would ask questions about how far are these benefits spread where you've got a concentration of ownership and where you've got very powerful elites who are often, at least in other countries, hand in glove with Government?"
>
> Civil Society Interviewee BR, UK, May 2012

In addition to the roles between public sector and other sectors, an NGO interviewee also raised an important point about inter-agency working within the public sector, for example between government departments and agencies at local, national and international levels. This interviewee explained this issue in relation to land-grabbing in Brazil:

> "[D]espite the efforts of certain federal ministries, particularly those tasked with protecting the rights of indigenous groups or managing agrarian reform, they are often obstructed perhaps by politicians at a state level … they just have an interest in growing the economies in those states … I think there are a lot of tensions and potential conflicts between the political establishments in Brazil."
>
> Civil Society Interviewee BR, UK, May 2012

In summary, the key findings in relation to the public sector are that:

i. Public sector governance actors were regarded most responsible for overseeing the consumption of bioethanol (in relation to a supply chain of this type) in UK markets to ensure distributional justice.

ii. By their own admissions, public sector actors' partial knowledge and understandings of the ways social and environmental outcomes are distributed are drawn from appraisal processes that in chapter 3 have been found to be inadequate to assess or evidence these matters (i.e. their judgements and ways in which they uphold or drive associated policies and governance mechanisms are not based on equity appraisals in the manner advocated in chapter 2).

iii. All interviewees saw the importance of private and public sector interviewees working closely to ensure distributional justice but from the perspective of NGOs and researchers particularly, this risked the closing down of decision-making processes that work against energy justice ideals (i.e. adequate recognition of and engagement with stakeholders affected and the fair distribution of associated social and environmental outcomes). Therefore, from the perspectives of NGOs and the research communities in particular, it was important that civil society groups and wider communities were adequately engaged to ensure procedural justice and ensure the accountability of dominant and powerful public and private sector actors.

5.1.2 The private sector and its workers

The literature reviews in chapters 2 and 3 and the findings above highlighted an important role for companies to mitigate negative impacts to workers, and deliver sustainable outcomes for local communities and 'energy justice'. For example, as discussed in chapter 2, through their CSR policies, strategies and practices. It has already been noted that all interviewees regarded the relationship with the public and private sectors to be important for the sustainable, equitable development of biofuels. As noted in chapter 3, this relationship is particularly important in relation to the development, supply and consumption of biofuels because these practices occur within the private sector and rely on the investments these corporations make. From the interviewees' perspectives discussed above, the other sectors are regarded as being involved via their powers to regulate, critique and influence the behaviours that occur within the private sector domain. Therefore, on the whole, the consensus of all interviewees (except the private sector interviewees) was that the private sector responds to measures and standards that the government

policies/requirements impose (i.e via the RED, FQD or VSCSs) rather than by their own choice. Therefore, while all interviewees saw a strong relationship between the private and public sectors, all interviewees other than the private sector regarded this relationship to be 'top-down'.

All interviewees felt that private sector actors including producers, traders and biofuel processors were positioned to be the largest social or economic beneficiaries in the system. However, private sector actors talked about the high degree of risk that producers' and processors' connections carried as part of their involvement with (and investments in) this trade. For example, the cost of investments required to meet more stringent sustainability laws and standards, which were not subsidised or incentivised by governments despite the policies they enacted and enforced nor necessarily paid for by the consumer.

The interviewees from UNICA and Greenergy talked about the considerable efforts the sector was making to ensure compliance with sustainability regulations, form partnerships with agencies from other sectors and take part in discussions to help shape more sustainable, positive and just outcomes across peoples and environments affected by the production and consumption of bioethanol in blended fuels. This was verified by NGOs who were working alongside businesses to help set up, shape and audit VSCSs such as the Greenergy and Bonsucro schemes (confirmed by interviewees from the WWF and ProForest, for example).

It was only the private sector interviewees that talked about the importance companies placed on accountability to wider audiences, i.e. their own customers, investors and stakeholders. The interviewee from Greenergy talked of the considerable risks they carried in relation to their own operations and the importance of transparency and compliance with legislation. He said that there were two angles to this in that firstly, their company's success was built on the fact that they were transparent in their supply chains and thus their clients, such as the large supermarket retailers, could defer responsibility for compliance with regulations and sustainable and ethical sourcing via the service Greenergy offered. For example, this ensured the fuels they supplied on their

forecourts were compliant with regulations such as the RFTO, the FQD and the RED. However, what this also meant they carried high levels of risks by taking on this responsibility, because any non-compliance or negative issues that became apparent to consumers or shareholders could be blamed directly on Greenergy and their reputation (and client-base) could be destroyed overnight. The interviewee said "our biggest customers are Tesco and Sainsbury's and they are public facing companies, so any risk or association with any kind of a fraudulent or bad supply chain would have a massive impact on our sales. Tesco could basically drop us like a hot potato. So you have to manage the risks as completely as possible" (Private Sector interviewee PL, UK, May 2012). To ensure biofuel suppliers were compliant with European biofuels sustainability regulations (i.e. in the RTFO, FQD and EU RED), private sector actors such as Greenergy rely on suppliers being compliant with a VSCS, which her confirmed relies on mainly quantitative, environmentally-focused and formal appraisal tools and methods (such as those reviewed in chapter 3).

A public sector interviewee talked about the powerful positions large-scale producers of sugarcane who had processing equipment to make bioethanol occupied in the sector. He perceived a range of small-scale producers feeding these private sector actors such as large-scale sugarcane producers with processing equipment to produce bioethanol. He talked about the:

> "Industrial scale monoculture production of biofuels feedstock, mainly sugarcane, with a growing smallholder out-grower sector who are smallholder farmers with more diversified agricultural interests. Some out-growers [are] forming into cooperatives to overcome obstacles of purchase from many individual producers. [The] supply chain generally feeds up through large scale commercial processors either directly to the Brazilian market or increasingly to the export market for mainly US and EU consumers - largely to satisfy European and American biofuels mandates and renewable fuel obligations."
>
> Public sector interviewee, DF, UK, May 2012

Production workers, certainly at the more lower-skilled or manual levels of work, were felt only to be connected through their employment and therefore the types of decisions they make on a daily basis relate more to the need for

work, keeping their jobs or levels of income, employment rights or conditions. All interviewees recognised these people as being directly affected by, and thus particularly vulnerable to, impacts caused by the practices of businesses and public sector regulations.

Two private sector interviewees also referred to the large number of individual companies connected to the supply chain through their involvement in supplying equipment or machinery, or its maintenance (particularly now due to higher levels of mechanisation). A programme was referred to by one interviewee in terms of the ways businesses such as John Deere and Singenta, have been working with trade associations and unions to re-train unemployed sugarcane cutters as mechanics, machinery operators or drivers.

The key findings in relation to the roles of the private sector therefore are that:

i. Interviewees were agreed that a wide range of actors exist within the private sector, all of whom have particularly important interactions with supply chains of this type. These range from powerful positions relating to large-scale producers and processers of bioethanol to vulnerable positions of production workers.
ii. Private sector actors were the only interviewees that talked about the importance demonstrating sustainable and just practices to wider audiences such as their own customers (i.e. supermarket chains/retailers of the fuel) and shareholders as well as the public sector (to demonstrate compliance with the RTFO, FQD and the RED). Consumers (end-users) were also regarded important (for those 'in the know') but due to the nature of the way biofuels are purchased (i.e. through mandatory blending) they felt that the majority of consumers did not know they were purchasing biofuels.

5.1.3 Consumers (UK)

Although all interviewees mentioned UK consumers as being end-users, connected to bioethanol supply chains of the case study type, consumers were not talked about as experiencing any particular positive or negative social or environmental impacts and they were not thought to be actively making any

particular judgements about their fuel purchases. This was because of the mandatory blending of bioethanol in the UK into all unleaded petrol sold at the pump (as discussed in chapter 3), the lack of labelling and the inability to choose between different bioethanol products on the market (such as fuels that adhered to higher-level VSCSs or the most basic). A private sector interviewee talked about the inability of consumers to choose between fuels as a factor that was affecting the degree to which producers could demand a higher price for their fuel, such as if they met a higher standard such as Bonsucro, which went further than the mandatory sustainability criteria in the RED (EC, 2015a), FQD (EC, 1998) or RTFO (DfT, 2015a). All interviewees thought that the majority of UK consumers are largely unaware of the ethanol they were purchasing when filling their vehicle (unless they were activists or had particular knowledge of the industry). For these reasons, consumers in the UK appeared to be considered by all interviewees to be a homogenous group of actors that were passively accepting bioethanol through their fuel purchases. This interviewee says:

> "I think one of the most attractive things about biofuels is that it doesn't really need significant technological or socio-economic change and that corresponds to the … um … I wouldn't say apathy but obviously more of a lack of awareness perhaps amongst consumers that really anything's changed."
>
> Civil Society interviewee BR, UK, May 2012

The way the majority of interviewees talked about UK consumers indicate consensus of them being mainly recipients of information and the energy supplied in general – not as participants in the system. The only recognition they receive is in terms of them being a largely uncaring, disconnected or unaffected set of stakeholders.

In terms of Rogers (2005) five stages of innovation adoption, from the perspectives of all interviewees at this stage of research, UK consumers were considered to be largely at the first stage of 'knowledge' and generally uninspired to actively seek further information about the ethanol content (unless they are activists or have a particular knowledge or interest in biofuels

or renewables). Thus, consumers were largely felt to be engaged with the supply chain by passive material commitments by transnational governance actors and experts in the field. This is summarised by this interviewee, based in Brussels. She felt that:

> "[P]eople don't know that there's biofuels in their fuel … they don't see biofuels as renewable. If you asked people what are the renewables used in the UK there is no way that they would include biofuels…. consumers don't have access directly you know, it's not like, say, certified Fairtrade coffee in the supermarket. I can choose if I want to pay a little bit more or if I want to buy a regular coffee. But for fuel I don't have this choice…."
>
> Private Sector interviewee G, UK, May 2012

Again, all interviewees talked about consumers in terms of them being 'reactionary' to the system, primarily in response to price rises or as a result of specific types of information, such as media reports. For example, an NGO interviewee said "I think people have been very animated by the biofuels debate but not through their own experience of the commodity or the supply chain, more from the media or campaigns by NGOs really" (Civil Society interviewee BR, UK, May 2012).

5.1.4 Trade associations

Interviewees were agreed that trade associations were highly influential in relation to the production of sugarcane bioethanol in Brazil. The main, most influential trade association being UNICA, the Brazilian Sugarcane Industry Association. This UNICA representative described UNICA's role in the sector:

> "[T]he focus of our work is to provide information to opinion leaders (policymakers, media, NGOs, academics and to some extent the related industries to our sector) about our sector, basically across the three pillars – economic, environmental and social. The second objective is to monitor and participate in discussions in USA and Europe and in Asia on legislation that will have an influence on our sector. We engage very proactively with the stakeholders to provide the right information about our sector and about Brazil in general. Brazil is still poorly known abroad. People don't usually have an idea

about the size of the Country, where the productions are located … obviously we report to our members about what is going on."

Private sector interviewee G, Brazil, May 2012

UNICA thus was regarded as playing an advocacy role for the sector. The UNICA interviewee and an NGO interviewee talked about their close working relationships with trade unions, working together on a range of programmes and projects. For example, RenovAction which is a program set up with Federação dos Empregados Rurais Assalariados do Estado de São Paulo (FERAESP) (the union for rural works in the state of Sao Paulo) (Chaddad, 2010). This re-training for sugarcane cutters and manual workers, to enable them to gain other skills and employment either within or outside of the sector, had become important due to increased mechanisation of the harvests; unemployed sugarcane cutters could be re-trained to become mechanics, drivers of harvesting/agricultural machinery or they can re-train to enter other local industries deemed important by particular communities.

Noticeable exceptions to interviewees' narratives were trade associations at the consumption end of the chain. Only private sector interviewees recognised trade associations in relation to UK sales of bioethanol. The Sainsbury's representative named the Downstream Fuels Association, which represents the interests of UK fuel suppliers and distributers. Two other private sector interviewees named relevant UK trade associations to be the National Farmers Union (NFU) and NFU Sugar. No public, civil society or research interviewees recognised or named trade associations as being key stakeholders connected to a supply chain of this type.

5.1.5 Trade unions

All interviewees recognised that trade unions played a role in relation to a bioethanol supply chain of the case study type via their representation of members' interests, i.e. in relation to production workers. Again, the interviewees focussed on the production end of the supply chain when trade unions were mentioned. Trade unions for workers were talked about mainly in relation to the production end of the chain and the power they have in Brazil to influence employment rights and standards. A researcher and the UNICA

interviewee recognised two important trade unions; FETAESP is the largest rural workers union operating in the east of the Sao Paulo state and FERAESP is the Federation of Rural Workers of the State of São Paulo, operating in the west of the state. FERAESP appears to work most closely with the federal Government and UNICA, whereas FETAESP is more closely aligned with state governance. One interviewee thought this may be due to their political views as each of the unions appear to work closely with the levels of Government who have the same political party persuasion. Unions were thought by interviewees to be effective mainly within larger-scale mills and operations, having increasingly influential and powerful political relationships with the public sector, such as described by this civil society interviewee:

> "I think, in my experience they are tremendously influential - especially in the sugarcane industry - because where you have a big, central mill that has a huge factory, it tends to create a decent opportunity for a trade union because you've got that kind of working environment that suits it, and in lots of other countries the unions that have grown out of the sugarcane industry have you know, are quite political parties."

Civil Society Interviewee BR, UK, May 2012

5.1.6 The research community (UK/ Brazil)

Academic interviewees regarded themselves as largely important 'critics' and producers of knowledge relating to social and environmental impacts associated with sector. They were regarded as having the potential to provide scientific evidence of impacts and new methods for bringing this type of information forward – such as through new frameworks, methods or appraisal tools. The University College London (UCL), the University of Sao Paulo (USP), Institute for Technological Research/ Instituto de Pesquisas Tecnológicas (IPT), Brazil and the International Food and Policy Research Institute (IFPRI) were specifically mentioned as important institutions connected to bioethanol supply chains of this type by research interviewees. Researchers also regarded themselves as largely beneficiaries in the system, for example, this interviewee said:

> "[I]t's been useful for me to attach myself to a topical issue in terms of getting funding, getting a job, access to people to be able to deliver that research because as a contentious industry seeking to gain more credibility they are perhaps more open to outsiders than perhaps other industries. So, as much as vulnerable people in the global south suffer, you know, there are a [wealth] of critical academics that benefit professionally from their plight."
>
> Civil Society interviewee BR, UK, May 2012

All interviewees felt that the research community played an important role in making information available to policymakers and decision-makers in the biofuels sector, to support the formation of associated regulations and help provide evidence about the social and environmental impacts (and their distribution) amongst people affected.

5.1.7 Civil society organisations

All interviewees recognised NGOs to be extremely active in the biofuels sector, for example organisations such as Oxfam, WWF, Bonsucro, Solidaridad, Transitions Brazil, ProForest. NGOs and voluntary or non-profit-making organisations, charities and community groups were thought to be extremely active in the sector and connected to this type of supply chain in terms of their aims for poverty reduction, environmental protection, sustainability in general and community development. Engagement with the development of biofuels VSCSs were thought by interviewees across the sectors to have provided a means of connecting to and influencing the sector and its impacts. All interviewees felt these connections had given them a voice in the system to highlight issues such as the need for sustainable agriculture, food security issues and the need for inclusion of local communities' interests in developing countries to avoid distributional injustices associated with the sector. All interviewees thought civil society groups were thus making active discursive commitments in the system.

> "If the industry and the controversy or debate hadn't been prominent we would have been working anyway in the field … so it hasn't actually generated more work, per se, but it was something that ProForest were keen to remain involved with and the company

is having a positive influence through our involvement with the standard."

Civil Society interviewee, UK, EL, May 2012

A number of other NGOs particularly prominent in Brazil, working in this sector, identified from interviewees and published literatures are Solidaridad, Landless and the Pastoral Land Commission.

The key observation here was that civil society interviewees saw themselves as having opportunities to influence the sector through their engagement with private and public sectors, such as via the setting of VSCSs, which was increasing the extent to which local communities' interests were recognised and thus increasing procedural and distributional justices. ProForest's work with the standard setting and auditor training for the Bonsucro and Greenergy schemes were exemplars of this, as was Solidarid's involvement with UNICA in relation to joint initiatives relating to impacts on workers as a result of changes in the industry (confirmed by the these interviewees).

5.1.7 Local communities

When referring to local communities and their connections with a supply chain of this type, all interviewees across the sectors talked about communities in terms of the production end of the chain. Residents in these regions were regarded as being connected to the supply chain by the impacts they might experience in relation to the production of the fuel, including mainly negative impacts such as reduced access to natural resources, food or energy.

All interviewees felt it was important for local communities in the producer regions to be recognised, included or represented within the system, such as through biofuels' governing mechanisms (i.e. mandatory and voluntary sustainability criteria). This was regarded as important in order to help manage social and environmental impacts caused by European and UK policies that are driving increased consumption of liquid biofuels in transport. However, researchers and civil society interviewees felt that the extent to which this happens is limited because of the mandatory sustainability criteria in the EU RED or because the majority of suppliers were likely to be going for the most

easily met VSCSs (i.e. such as the ISCC and those reviewed in chapter 3). However, the private sector interviewees talked about some producers going much further than the stipulated, mandatory sustainability criteria which would achieve better social and environmental outcomes for local communities and production workers but this was not currently rewarded by the price they could demand for their fuel.

A few public sector, private sector and academic interviewees mentioned specific potential benefits or costs for local communities from the economic development bioethanol production could achieve in particular regions. However, as discussed under the public sector (sub-section 5.1.1), the extent to which social and economic benefits might be shared across local communities were thought to depend on public and private sector regulations and policies, including CSR strategies. For example, a public sector interviewee (DF, August 2012) talked of the "potential financial benefits for those employed directly in the supply chain and secondary financial benefits for the communities where those individuals spend their money" but that these relied on "governance and practice in each locality". For example, negative consequences and costs might be where people at sites of production lose access to resources, environmental damage or higher prices locally as a result of resources being used for biofuels production.

What has become apparent here is that from the perspectives of transnational governance actors and experts in the field, local communities connected to a bioethanol supply chain of this type were located in Brazil and were a large, diverse set of mainly vulnerable people, i.e. vulnerable to the practices of the public and private sectors' policies and practices. NGOs saw themselves as agents to increase the representation of local communities, who were talked about in terms of local residents, families of workers, smallholders and local tradespeople in the producer region. A noticeable exclusion across all actors was any reference to impacts that might be felt by local communities in the UK as a result of a supply chain of this type.

5.2 Perceived equity issues

This section builds on section 5.1, where perceptions of particular stakeholders and their connections with the supply chain were summarised (from the situated perspectives of interviewees at this first stage of research). The findings presented here show the types of equity issues governance actors at this stage of research perceive to exist in relation to a supply chain of the case study type and others like it. These are the issues that featured most commonly in the interviews and thus are considered to be the most significant equity issues associated with a bioethanol supply chain of the case study type. The reader is reminded that equity matters are defined in this thesis in terms of principles of distributional justice, procedural justice and recognition (defined further in chapter 2, section 2.2) (Sikor, 2013; Walker, 2012). For example, distributional injustices are regarded to exist where some people bear more environmental or social burdens than others (in relation to an energy's production and consumption). Procedural injustices are regarded apparent when some people are excluded from associated decision-making processes or they are unable to participate effectively. This may be due to the inadequacy of available information, for example. Misrecognition or recognition-based injustices are apparent if some affected types of stakeholder's perspectives are not recognised or given adequate respect.

It was clear from the results at this stage of research that, from the perspectives of transnational governance actors and experts in the field, a key distributional injustice that will be apparent in relation to a supply chain of the case study type is that the majority of environmental costs and burdens are borne by people in producer regions overseas. The nature of these costs and burdens are discussed in sub-section 5.2.1. In sub-section 5.2.2 the main drivers of this distributional injustice, from the perspectives of transnational actors and experts, are discussed. These drivers are discussed in terms of matters of recognition and procedural injustices. The themes are not ordered by significance (as outlined in chapter 4, my role as a researcher is not to make a judgement on whether one issue is more significant that another; that will depend on situated perspectives, i.e. who you are, where you sit in the chain

and the nature of your connection to it). A summary diagram of the equity issues discussed in the following sub-sections and their distribution across people in sites of production and consumption is included in this chapter's conclusions.

5.2.1 Distributional injustices

The main distributional injustice revealed from the perspectives of transnational governance actors and experts was that, in general, the majority of any negative impacts, risks and burdens associated with bioethanol production were borne by people living in producer regions, such as in developing countries. This was because the interviewees realised that the main source of bioethanol consumed in the UK was produced overseas from sugarcane feedstock at the time the interviews took place. However, there were mixed opinions regarding the extent or nature of the environmental and social effects on local livelihoods and communities. These matters are now discussed in turn.

Natural resources and land availability

Sugarcane production relies on ecosystem services such as air, water and fertile soil and land availability and thus, if mainly exploited for sugarcane production, could leave local residents vulnerable to a wide range of associated negative impacts (International Land Coalition, 2012; RFA, 2008; Searchinger et al. 2008). Interviewees at this stage of research felt a key distributional injustice in relation to a supply chain of the case study type is that ecosystems in producer regions will bear the majority of burdens. For example, a researcher and an NGO interviewee (both UK-based) raised soil degradation and soil erosion as issues relating to large-scale sugarcane production as a result of intensive farming and over-exposure to chemicals in the field. The NGO interviewee felt this as a particular issue for small-scale farmers who rent out land to larger-scale producers and, once returned, the land is exhausted. This therefore reduces the value of the land.

Impacts to local water resources were also regarded by two UK-based research and civil society interviewees as important issues of concern, particularly relevant to large-scale bioethanol production. Over-extraction and pollution of

natural water resources were raised as issues, the latter as a result of mills dumping wastewater into local rivers or leakage of chemicals into groundwater. However, in relation to Brazil, the UNICA representative said that national regulations were reducing risks to water resources degradation and that practices had increased to put waste pulp (from processing the sugarcane) back onto the land (to reduce irrigation and act as a source of soil fertilisation). This UNICA representative explained:

> "In the areas that mainly produce sugarcane, in the Central areas of Brazil where 90% of the production takes place, production is not irrigated at all. We use the residue of the ethanol production, what we call the bagasse, we expel it in the fields as organic fertilizer - because it is liquid it supplies moisture for the cane. There is no extraction of freshwater to irrigate the field. In the North East where 10% of the production takes place there is some irrigation. But in the Central parts, 90% cane production and no irrigation. We are in the perfect location for sugarcane because sugarcane needs the rainy season to grow and the sunny season to concentrate the sugar – this is exactly what we have in the Central South."
>
> Private sector interviewee G, Brazil, May 2012

All interviewees felt that large-scale sugarcane bioethanol production could have direct or indirect impacts on deforestation, land-use change and land acquisition if not adequately controlled by governing mechanisms or legislation. These appear valid concerns in light of Taheripour et al's (2010) attribution of land use changes in Brazil to biofuels mandates in the USA and Europe. These issues, the interviewees said, could have knock-on effects such as the displacement of local communities or indigenous peoples. However, again, little concern was raised by interviewees in the private sector regarding direct land-use change in relation to sugarcane bioethanol production in the Sao Paulo state. This was because the area has a long history of sugarcane production and it has been this way for centuries for the production of sugar. Sugarcane in Brazil currently occupies approximately 2.9% of Brazil's total arable land (UNICA, 2013) and is also used to produce vast quantities of sugar (a food crop) so it is difficult to attribute these changes directly to bioethanol production or the biofuels industry. However, the research and civil society

sector interviewees raised concerns over indirect land-use change as a result of displaced crops or the expansion of sugarcane production into surrounding States. This was because, the civil society interviewee (LM, UK, May 2012) said, "from the experience we have had, at least in Brazil, there is no large-scale burden associated with sugarcane production. Now if you add land-use change to that, then you may have a different situation. Because obviously there is an expanding sugarcane industry and this takes away land from something else, which may be driving deforestation."

However, all private, civil and public sector interviewees noted that strict regulations in Brazil were being imposed to help control agricultural expansion into conservation areas and those of high biodiversity value, such as the Sugarcane Agri-ecological Zoning (ZAE Cana) which came into force in 2009 (USDA, 2011). This regulates the expansion of sugarcane to protect the environment while supporting the sustainable growth and development of the sugarcane sector. This law defines designated areas available for sugarcane expansion, which excludes all Brazilian native biomes (USDA, 2011). One UK-based interviewee however raised questions about the quality of monitoring and enforcement saying that Brazil had problems ensuring the legal reserves set are met, saying "these are basically reserves that sugarcane producers should have established but basically haven't" (Civil society interviewee LM (UK), May 2012). Again, this highlights the need for strong monitoring and governance roles for the public sector, as highlighted in section 5.1.

Another issue relating to land in Sao Paulo is that local communities, particularly those on lower incomes or non-landowners, were being affected by high land prices. A UK-based NGO representative felt this was due to increasing pressures on land as a result of the success of large agro-businesses in the region (60% of sugarcane production occurs in Sao Paulo (Egeskog et al. 2014)). This had the potential to bring higher costs of living across the property market, increase social divide and concentration of land ownership. However, the interviewee also recognised that higher land and property prices in Sao Paulo state may also be a result of other prominent businesses, industries and developments in this area generally. Published news reports and articles

confirmed that the Sao Paulo state has become a particularly wealthy area with Sao Paulo city being a commercial hub for Brazil and rising house and land values in the state has been reported widely in this region and across Brazil in general (BBC, 2014; Reuters, 2012).

Economic development

All interviewees thought that large-scale production processes were bringing increased levels of economic and social development in Brazil. A Brazilian-based NGO and the UNICA representative talked about increased investments into health, education and social services in areas of Brazil where industrial-scale production of bioethanol occurred, aligning with Martinelli's (2011) findings (chapter 3). The interviewee, from UNICA, said that "if you look at the map of the HDI[9] of Brazil you will see that where the index is higher it is exactly where agro-business has developed; where business activity develops in a rural region you will see that a few years after, the HDI of this region will increase dramatically" (Private sector interviewee G, Brazil, May 2012). In addition, this interviewee talked of wider benefits for local communities, other than those directly employed in the industry, as other local trades and businesses benefit from the increased economic development in general.

Three interviewees across civil society, private and public sectors also felt that large agro-business often support other local trades and businesses, including services associated with transport, accommodation for workers or visitors. They said that procurement of consumables relating to the agro-business' operation, if sourced locally, can also contribute to the local economy. Also, they said that employees spend income locally on food, household goods or leisure activities. All interviewees, across the sectors, recognised these dynamics as positive and beneficial to local communities and employment opportunities although it was clear that they all felt this depended on strong governance mechanisms across private and public sectors, including CSR strategies in the manners advocated by Grant (2007), Porter and Kramer (2006) and Visser (2010) as well as sustainability related legislation (such as in the EU RED, RTFO and FQD (DfT, 2015a; EC, 2009; EC, 1998) (discussed in chapter 2).

[9] Human Development Index (HDI)

There was consensus across interviewees that the benefits that could come from this type of development is not necessarily uniform across all producer regions (i.e. within or outside of Brazil).

Monoculture and specialisation

It was the civil society, public and research actors that tended to talk most about the dangers of higher levels of monoculture and over-specialisation, which can drive negative changes to local rural communities, including the loss of smaller-scale farming. These interviewees talked about particular social impacts such as the loss of small-scale farming skills and knowledge, food security issues (particularly for local residents) and the effects on local residents employed in the industry if the industry failed. As one researcher said, the income generated would be sorely missed across employees and other local businesses. The interviewee also talked about specialisation in terms of the range of employment on offer, which could be exclusive to people of particular age-groups or gender:

> **"**[W]hat you're seeing is the transition from people who were previously subsistence farmers to people who are common salaried workers, so the type of work they are doing is obviously not a secure thing … their work as farm labourers, you know, its hard work, back-breaking, poorly paid contract work so [there is] an increased fragility in household subsistence – because they're losing access to land, they're becoming dependent on money, which increases their vulnerability … the other interesting thing about monocultures is that they will only hire men in their prime – say from 16 to 40 – so once you're over 40 it becomes increasingly difficult to find work and because you've lost your land, you're in a pretty dire situation really."
>
> Research sector interviewee, JT, UK, May 2012

Food security

Civil society and research interviewees were those that tended to raise issues of food availability and food security at the production end of the chain as a result of biofuels production in general or the loss of smaller-scale agriculture. This may be because these issues featured more strongly in their area of research or the interests of their agencies. One interviewee from Solidaridad spoke of evidence of less food availability and higher food prices in rural areas

"because of the loss of smaller-scale food production as the farmers rent or sell land to the larger producers of sugarcane" (Civil Society interviewee IM, Brazil, July 2012). She said that this resulted in food being brought into the area, which was more expensive.

All interviewees raised potential issues relating to food security as a result of biofuels production, highlighting the fact that these could be potentially felt by everyone in the supply chain, no matter where located. For example, a civil society interviewee explained that if biofuels contribute to a "7-10% increase in the price of food and you are spending 90% or 95% of your available income on food, then obviously that's a significant impact" (Civil Society interviewee LM, UK, May 2012). A public sector interviewee talked about food price volatility and its effects on different stakeholders in the supply chain:

> "Food price volatility is problematic - everyone loses. High prices support investment in production and the food exporting countries and farmers benefit but the urban poor and food importing countries suffer. In the case of low prices, no investments in agriculture take place, farmers and food exporting countries suffer while urban poor and food importing countries benefit. The global picture can look simple - but it isn't. There are always considerable variations regionally and a range of factors that contribute to food price volatility."
>
> Public sector interviewee RB, Brussels, June 2012

However, all interviewees except the Solidaridad and Oxfam interviewees recognised that biofuels production (and sugarcane bioethanol production in particular) is a wider agricultural system and the degree to which these impacts occur depends on a wide range of complex and context-specific factors – points which can be seen across associated literatures reviewed in chapter 3, such as Childs and Bradley (2007), Ewing and Msangi (2009), Fairhead et al (2012), Rosillo-Calle and Johnson, 2010 and Rutz and Janssen (2013).

Seasonal migration

All interviewees mentioned concerns relating to social and environmental implications in producer regions as a result of high levels of seasonal migration apparent in the sugarcane industry, such as impacts on local communities, from

increased pressures on local infrastructures, services and natural resources. Two private sector interviewees, a researcher and two civil society sector interviewees talked about the huge influxes of workers that traditionally enter the Sao Paulo state around harvest time from neighbouring states. "5-600,000 sugarcane cutters arrive to work in the fields; 40% of these are migrant workers" (Private sector interviewee G, Brazil, May 2012). However, to some degree this is starting to change. A private sector interviewee said this was because national laws in Brazil were driving higher levels of mechanisation in the sector, to reduce environmental and health impacts for local communities associated with field-burning (which is required for manual harvesting) (Abex et al. 2007; ELLA, 2009; UNICA, 2015). The UNICA representative verified that:

> "[I]n Sao Paulo you have 60% of the sugarcane production of Brazil – we have signed a protocol in 2007 with the state of Sao Paulo – with the Government – to anticipate the legal deadline for the elimination of sugarcane burnings. So elimination of sugarcane burning, pre-harvest burning, means mechanisation … you can't cut manually sugarcane if you don't burn … in 2014 around 90% of the harvest will be mechanised … you have about 10% of the area that today machines cannot go, so for these areas you have until 2017 to eliminate the burnings."
>
> Private sector interviewee G, Brazil, May 2012

Where seasonal migration does occur, however, the Greenergy representative and two civil society interviewees suggested that it can contribute to local economies (as the workers spend a proportion of their income locally).

Workers

All interviewees, except those from the private sector, raised concerns about high levels of unemployment as a result of increased mechanisation (outlined above) and thus negative impacts for particularly lower-skilled or manual workers. This NGO interviewee talked of the impacts of mechanisation (explained above), saying that "even according to UNICA, the union for the millers, they are shedding thousands of jobs a year, even in an industry that's growing significantly in output terms" (Multi-stakeholder NGO interviewee (UK based), May 2012). However, the interviewee went on to recognise that, bearing in mind this is the hardest and lowest paid work in the industry,

mechanisation can bring improved working conditions and salaries for those retained in the industry:

> "[T]he labour they do retain is perhaps more highly skilled than before, as they're using heavy machinery now and perhaps getting paid better than before."
>
> Multi-stakeholder NGO interviewee (UK based), May 2012

Higher wages for sugarcane cutters than other parts of the agricultural sectors was also found by Smeets et al (2008). A private sector interviewee also talked about programmes that provide opportunities for professional development, re-training cutters to become mechanics for the farm machinery or drivers. This also improved the chances of longer-term contracts and higher wages. This interviewee explains:

> "[P]art of the workers are re-trained to stay in the industry, for instance to drive the harvesters, to be mechanics … and all these jobs are more qualified than the others – I can't see any other job that can be less qualified than a sugarcane cutter – to be honest. So this provides higher qualifications for the workers and better jobs. Then the workers that cannot stay in the industry, because we can't re-employ everyone, we are providing training for jobs that are needed in that community where they live."
>
> Private sector interviewee G, Brazil, May 2012

All interviewees also talked about concerns for the exploitation of sugarcane production workers in developing countries in Brazil in general as a result of bioethanol imports. Concerns of interviewees were that sugarcane production is renowned to involve particularly hard labour and the Brazilian sugarcane industry had become notorious for associated issues for its workers (Clancy, 2008; Garvey and Barreto, 2014; Green, 2012; Rutz and Janssen, 2013). Private sector interviewees, although recognising these matters as an issue in the past, felt that recent, stringent labour laws in Brazil (Coslovsky, 2014) and the introduction of VSCSs were beginning to improve these matters considerably (these matters are discussed further under sub-section 5.2.2). The improvements for workers (especially sugarcane cutters) recognised by the few

interviewees above were noted as shorter working hours, fair salaries, contracts and general health and safety conditions. This interviewee from UNICA noted that:

> "[T]he Brazilian legislation is strict for social issues - it's very tough. In 2009 we assigned, together with the Government and labour unions, a protocol to improve the working conditions of the sugarcane cutters. It is voluntary but goes beyond the Brazilian legislation. Today more than 50% of the industry have signed and implemented the protocol, so they are in a phase where they will start audits."
>
> Private Sector interviewee G, Brazil, May 2012

Access to health and safety equipment and fair salaries are well covered across even the lower level EU-accredited VSCSs (outlined in chapter 3). The importance of legislation to protect workers' rights and improve their working conditions was talked about by all interviewees across the sectors. An interviewee from UNICA talked about Brazilian national laws which legislate regular breaks and shelter for sugarcane cutters and enforcement in relation to these regulations:

> "The Ministry for Labour, they have created a special passport for the sugarcane industries with inspectors that are dedicated to inspect sugarcane fields and industries. This is how it is enforced. They are very effective."
>
> Private sector interviewee (Brazil based), May 2012

Historical cases of child labour, forced labour and excessive working hours in Brazil were also raised by all interviewees, across the sectors, although there was consensus that these issues were being eradicated due to the high level of regulations that now exist in Brazil both within National laws and the EU VSCSs. A civil society interviewee talked about higher wages in the sugarcane industry compared with other parts of the agricultural sector saying that "perhaps by our standards [the sugarcane cutters get] quite poor wages, although again I understand especially in Sao Paulo the wages for cane cutters

might well be higher than farm labour or jobs in other sectors" (Civil society interviewee BR, UK, May 2012).

Another positive note in relation to workers in the industry was that all interviewees thought there were now many opportunities for professional staff. Increased employment opportunities included those related to management opportunities, sustainability standards within producer companies and positions for auditors of VSCSs. All interviewees felt there were increased job opportunities across the research, private and civil society sectors (such as NGOs) due to the attention the industry has attracted and these jobs could be found at all stages of the supply chain. These opportunities however, alongside re-training schemes for sugarcane cutters, will only be accessible for people with higher levels of education. This civil society interviewee notes that:

> "One of the main communities that I think has emerged out of biofuels has been, I guess you could call it, a regulatory community - organisations like Bonsucro, certification bodies … people like me as well and you that have got funding out of it to comment and analyse biofuels … so I think at both ends of the chain there is a case to make that there's an invisible economy."
>
> Civil Society Interviewee BR, UK, May 2012

The Greenergy representative also talked about professional development in the sector in relation to capacity building in the sector through the learning and knowledge-transfer occurring as a result of sustainability legislation:

> "ProForest basically train mills how to comply with the standards and then commission an independent auditor to conduct the official audit ... But because it was basically a consultant from Oxford going to Sao Paulo, we got him to train up capacity in Sao Paulo on the Greenergy standard … they took over from ProForest about a year and a half ago … I mean, you need domestic capacity to communicate with people and from an economic point of view it didn't make sense to keep sending Oxford people down there."
>
> Private sector interviewee (UK based), May 2012

Energy security

The increase in bioethanol imports into the UK raised matters of energy security for UK-based consumers for two interviewees in the private and civil society sectors. This is because the dominant focus of blending mandates in policies, as discussed, are driving imports to meet demand for bioethanol in the transport sector. Because this policy relies on agricultural commodities, of which there is increasing demand globally, these interviewees suggested this is a risky policy in the long-term. A Brazilian-based agricultural and sugarcane production specialist said that ultimately there needs to be diversity in the system to increase food and fuel security; over-reliance on one form of biofuel and mode of production does not bode well for security of supplies. She said "[t]he truth is that really, security, be it food or fuel, is about diversification of sources and suppliers" (Private sector interviewee g, Brazil, May 2012).

One civil society interviewee also talked about the huge domestic market for bioethanol in Brazil, including for aviation fuels, and reduced supplies recently due to poorer harvests and higher sugar prices. She worked on a project that was concerned with how to meet growing demand and explained that "[c]urrently, an issue is the fact there is insufficient bio-ethanol to feed Brazil's own domestic market – let alone produce sufficient quantities to satisfy a new, huge market for aviation; there is discussion therefore around how to meet the demands of the aviation sector" (Civil Society interviewee, CA, Brazil, May 2012).

5.2.2 Procedural and recognition-based drivers of distributional injustices

Blending mandates

There was consensus amongst the interviewees that EU and UK mandatory biofuel blending mandates are a major, powerful force influencing the size and shape of the biofuels industry, its markets and sites of production overseas (Taheripour et al. 2010). Chapter 3 highlighted that the blending mandates set out in the EU RED, RTFO and FQD (EC, 2009; DfT, 2015a; EC, 1998) are the dominant over-arching policies responsible for increasing the use of renewables (and thus liquid biofuels/bioethanol) in European and UK transport. As a result, all interviewees thought that these dominant European biofuels policies in the

transport sector were driving bioethanol imports from overseas and the types of distributional issues and injustices discussed in sub-section 5.2.1. A UK-based farmer said that UK production of bioethanol (such as from sugar-beet) is possible and efficient (as demonstrated at the Cantley and Wissington plants in the East of England) but currently extremely limited because of restrictions relating to the EU's sugar reforms (which limits the amount of sugar beet that UK farmers can produce) and lack of infrastructure (there are only four sugar factories now in the UK capable of sugar and ethanol production) (British Sugar, 2010). He said that he felt, due to these reasons and the quantities required to fulfil UK demand, the bioethanol had to be sourced from overseas currently.

Particular aspects of the ways in which these policies were implemented and are now governed raised specific matters of procedural injustices and lack of recognition for transnational actors and experts in the field interviewed during this stage of research. For example, civil society, research and public sector interviewees agreed that these policies were set, administered and overseen by UK and European policymakers in line with their own agendas (i.e. to increase the use of renewables in transport). Therefore, only the interests of a small number of the total number of affected and connected stakeholder types identified in section 5.1 were fully represented in associated decision-making processes. The extent to which other stakeholders' interests are represented, such as local communities in producer regions, was questioned.

All interviewees felt that EU and UK blending mandates favour and promote large-scale production practice. Increasingly, they felt, the sector is seeing the dominance of powerful, large-scale businesses already operational in the sugar and fuel industries. These perspectives were verified by Bergquist et al (2012), Chaddad (2010), the National Agriculture Confederation (in CIFOR, 2011) and Machado and Walter (2011) who talk of the concentration of these markets over time. These reports show that although 70% of sugarcane producers are small-scale farmers, roughly 80% of Brazilian ethanol production is concentrated in the hands of industrial-scale producers because of the expensive, industrial-scale processing equipment required to process the sugarcane into sugar or bioethanol (National Agriculture Confederation in

CIFOR, 2011). Larger-scale producers were perceived by all interviewees to be more likely to have access to finance, information and technical expertise that is required to implement such processing equipment.

Representation and inclusion of small-scale producers' interests in policy decisions relating to mandatory blending (including the monitoring and governance of impacts as a result of these policies) were raised as particular issues of recognition or procedural injustices amongst all interviewees except those from the private sector (which the reader is reminded, did not include small-scale producers at this stage of research). For example, a researcher explained that "small-scale producers are the people who I think are most affected by the expansion of sugarcane but impacts to these people are missed out of certification schemes" (Research Sector interviewee JT, UK, May 2012).

Civil society and public sector interviewees talked about the high costs of seeds, crops and equipment that were needed to compete in these settings, affecting the extent to which smaller-scale and domestic producers can engage and compete in the sector. A public sector interviewee talked about the need for support and investment in small-scale production, saying that:

> "Smallholders and out-growers tend to be more innovative but they need tools and investment … there is often less knowledge and don't have the skills to manage production in the most efficient way or know how to compete with larger-scale production or access markets (if they can) … There needs to be investment in the smallholders and out-growers. The question is how to mobilise the potential …? Investment by governments here is very important."
>
> Public sector interviewee RB, Brussels, June 2012

A public sector interviewee in Brussels (RB, June 2012) confirmed that future EU policies were likely to promote the development of second- and third-generation technologies, which produce biofuels from wastes and residues (EC, 2011; ECF, 2014; Eisentraut, 2010) and bring opportunities for alternative models and scales of production. However, she said, these would also incur significant set-up costs and thus these policies are likely to continue to influence and shape biofuels markets unless promotion is matched with fiscal support.

All interviewees thought that further divides between large and smaller-scale producers were widening but one civil society actor raised concerns that sustainability standards could be pushed too high, raising issues of power and influence that large mills could exercise to further secure their positions in the market. Private, public and civil society interviewees thought that laws and standards were now more stringent for biofuel crops' production than in other parts of the food or agricultural sector (as a result of national laws as well as the EU VSCSs). The Greenergy representative talked about knowledge-sharing that was becoming apparent amongst Brazilian producers to comply with certification schemes and access European markets. Whilst this might be regarded a positive step, it is likely to be occurring amongst larger-scale bioethanol producers. The Greenergy interviewee said that compliance with the Greenergy and Bonsucro certification schemes were growing as producers asked auditors how they could access European markets:

> "[T]he answer was always that they needed to be certified against the Greenergy or Bonsucro standard. So they took it as a positive sign and took it up voluntarily so we've been able to replicate the good things from the mills that Greenergy bought directly from. Now we have no idea of how many mills that we don't buy from are selling to Europe because of the compliance. In one region there was a plantation manager who was head of the audit when Greenergy audited the mill, and he became a consultant for all of the neighbouring mills and taught them how to comply with the standards."
>
> Private sector interviewee PL, UK, May 2012

As discussed in chapter 3, VSCSs are the means of governing the consumption of bioethanol (and biofuels) in UK transport including the assessment and monitoring of impacts associated with their production. Private sector interviewees felt that these schemes, set up and administered by multi-sector organisations or private sector companies with NGO inputs (such as ProForest with the Greenergy scheme) to help ensure the sustainability of these fuels were actually acting as drivers of increased concentration of ownerships and changes in livelihoods for smaller-scale producers in Brazil. This was because,

they said, of the high financial costs and burdens these procedures were placing on producers – particularly raising issues for small-scale producers. The UNICA representative explained that "certification has a price; you have to pay for the audits and the process, change your practices, spend time and resources collecting the data and the information you need to supply to the auditors – the mill has to cover all these expenditures" (Private sector interviewee G, Brazil, May 2012). Thus, these procedures, she said, were unjust because consumers (who all interviewees felt were largely unaffected by and unaware of their bioethanol purchases, as discussed in section 5.1) do not help meet the costs of more sustainable production practices. The UNICA representative explained:

> "If you want to sell in the EU your fuel has to be certified, it's just an access to market. If you respect very high standards for sustainability practices or if you go for the minimum you get exactly the same price for your product. There's not a premium for a Bonsucro versus a Greenergy versus some other standard. The buyers, they want to put all the responsibility on the shoulders of the producers, they want to claim they are buying sustainable products but they don't want to pay higher prices. There are not even commitments to buy certain volumes of those sustainable products. So you know, Europe is very vocal on sustainable practices, on legislation, on the respect of certification, but the problem is there is no commitment."
>
> Private sector interviewee G, Brazil, May 2012

It was clear that the private sector interviewees felt that public sector and civil society governance actors were responsible for setting sustainability regulations but not providing subsidies or fiscal support to help producers adapt and comply and this was exacerbating issues for producers – particularly those less able to access investment, resources or support. Civil society and public sector interviewees felt that small-scale producers were particularly vulnerable and less able to access information about the schemes or know how to comply; "smallholders and out-growers tend to be more innovative but there is often less knowledge, they tend to have lower levels of education in developing countries" (Public sector interviewee RB, Brussels, June 2012).

Interesting matters of procedural injustice and recognition thus emerged from the perspectives of transnational governance actors and experts in the field in

that although all interviewees felt that the development of VSCSs for biofuels to comply with blending mandates had created a space for NGOs to work alongside those from other sectors, to increase the representation of local communities' interests (including smallholders), the extent to which these interests were fully represented or impacts monitored remains questionable. In section 5.1 it was apparent that NGO interviewees felt they played an important role in helping to increase the representation and recognition of local communities in producer regions (which would include smallholders) in associated decision-making processes (i.e. thus increase procedural justice via their involvement). For example, one civil society interviewee said "I don't see biofuels as wrong but I don't see large-scale production as the only model we should use" (Civil society interviewee KE, UK, May 2012). NGO involvement in the setting up of VSCSs had indeed broadened the coverage of the types of issues assessed as far as transnational governance actors and experts interviewed could see. However, the very procedures they were setting up were still driving unjust outcomes across particular sets of stakeholders, i.e. consumers versus smallholders and local communities in producer regions. Therefore, the ways in which they are recognised and represented may not be helping to decrease social and environmental inequalities amongst affected stakeholders.

Also, in chapter 3, it was shown that the methods of appraisal (including the auditing of VSCSs) do not adequately cover, or collect primary data relating to, social and equity issues across the full range of affected stakeholders in producer communities (or indeed across the supply chain). Limitations of the schemes were also discussed by a few interviewees, from the research and civil society sectors, in terms of subjectivity, inclusivity and control over the audits; who gets considered or interviewed and how much time is actually taken up on the assessment. These matters therefore raise specific issues relating to procedural injustices such as who is included and excluded and the ways in which their interests are recognised and represented by those in positions of power in these processes.

Before moving on to discuss evidence-bases and information sources as a particular form of procedural justice, it is worth highlighting that all interviewees felt that VSCSs, and sustainability laws and regulations in general relating to bioethanol production in Brazil, were 'a force for good' and were needed. Furthermore, they felt that these schemes were also beginning to achieve some benefits for particular stakeholders in producer regions. For example, improvements in conditions for workers directly employed in the industry (these matters were discussed under 5.2.1). What is apparent here, is that blending mandates and associated sustainability governance mechanisms have some procedural injustices built in to their frameworks such as inadequate recognition and representation of local communities' and small-scale producers' interests. In addition, these procedures are affecting the distribution of impacts across affected stakeholders. For example, UK-based consumers, large-scale producers and workers directly employed in the industry in Brazil appear to be largely benefitting from international bioethanol supply chains of the case study type while UK-based sugar producers (and sugar-beet farmers), local communities and smaller-scale producers in Brazil are less able to benefit from the increased trade.

Evidence-bases and information

A major issue raised consistently by all interviewees was that information about the sustainability of liquid biofuels and the ways in which associated social and environmental impacts are distributed amongst affected stakeholders on the ground is limited and insufficient. This specifically raises particular matters of procedural injustice in the way that Laird (1993), Blackstock et al (2007), Rowe and Frewer (2000) and Walker (2012) stipulate. For example, these scholars discuss the importance of objective, common-bases of information for all affected stakeholders (which include the full range of knowledges and perspectives) to help ensure effective participation amongst them can take place within associated decision-making processes (discussed in chapter 2, section 2.2). What emerged here was that currently, as identified in sub-section 5.2.2, transnational governance actors and experts felt, unanimously, that there is insufficient knowledge, or representation, of the true nature of social and environmental impacts (and their distribution) associated with

international bioethanol supply chains and therefore, this significantly hinders the quality of associated appraisal processes (including the full range of distributed forms of formal and informal appraisal processes that take place in the field identified in 5.1).

Also in section 5.1, public sector actors were defined by interviewees as having a duty to ensure fairness and equity, such as the reduction of social and environmental inequalities, as a result of the promotion and sustainable development of liquid biofuels. However, in the review in chapter 3 of liquid biofuels' sustainability appraisals and in section 5.1, it has been shown that these actors rely on governance mechanisms and formal appraisal methods (i.e. VSCSs) which do not adequately cater for the full range of social or equity issues to be assessed (Blaber-Wegg et al. 2015; German and Schoneveld, 2012; Hodbod and Tomei, 2013). There remains a lack of inclusion of local communities in terms of evidence of the impacts that affect them at local levels in producer regions (Clancy, 2008; Hodbod and Tomei, 2013).

All interviewees during this stage of research felt that information relating to specific liquid biofuels frequently only partially covered sustainability issues, or it failed to represent the complexity and diversity amongst biofuels in the system. Private sector interviewees vented frustrations that the considerable complexity and diversity in the biofuels sector, discussed in chapter 3, in relation to the wide variety of feedstocks, technologies and production methods in the industry, were not reflected in published information such as through the media or specific NGO or activist campaigns. The diversity in the industry means that very different social and environmental issues are raised by the production of particular biofuels, depending on the contexts in which they are set. Despite this, private sector interviewees (and indeed a few public, private and civil society interviewees) thought that biofuels tended to be referred to as a homogenous entity. For example:

> "Biofuels is the kind of catch all category … everyone knows that there are good and bad biofuels but people are prepared to keep talking about biofuels knowing that they are not all equal … I think the day that we can say clearly what are the good ones and what are the bad ones the whole debate will calm down a bit."

Private sector interviewee G, Brazil, May 2012

These interviewees recognised diversity amongst biofuels such as dedicated energy crops vs biofuels from wastes, large production methods vs small scale farming, regional environmental conditions/natural resources availability, land-use change or acquisition. In addition, inputs vary across particular points of global supply chains, such as corporate or governmental policies and legislation. Diversity can exist even when two products use the same type of feedstock or are produced in the same country, a matter referred to by this interviewee:

> "[E]ven if you were looking at the same commodity … bioethanol from Brazil and bioethanol from Madagascar you would still have differences. Mills in Brazil tend to be large plantations often owned by the mills whereas in a lot of other countries … you look at India, you'll have one mill supplied by a government determined area and you might have 30,000 smallholders there. A hugely different kettle of fish and you have a huge amount of different issues … in Brazil, there is not much [land] conversion but I still think there are issues … if you go to East Africa there are issues linked to conversion and freshwater impacts."

Civil society interviewee LM., UK, May 2012

Published information through the media was thought by private sector interviewees to have focused on biofuels and food security issues. Furthermore, the general public in the UK were thought to rely mainly on the media for information about biofuels because of the current lack of labelling at the pumps (this matter is returned to later in this section). One NGO representative said "I think people have been very animated by the biofuels debate but not through their own experience of the commodity or the supply chain, more from the media or campaigns by NGOs really" (Civil society interviewee BR, UK, May 2012).

NGOs in particular were thought to have targeted biofuels in general as drivers of food security issues. This was also recognised by a civil society interviewee, which highlights the ability of some stakeholders, with limited specific

knowledge of biofuels, to influence publics' perceptions through their information campaigns

> "I mean I'm not a biofuels specialist. But we are interested in biofuels because of the emerging poverty impacts, particularly around food and land, because that's what our campaign is on at the moment. "

Civil society interviewee KE, UK, May 2012

It is worth reflecting on this a little more, drawing on a particular example in relation to palm oil. Palm oil is mainly imported in the UK for food or other products (as the main source of oil for biodiesel in the UK is from used cooking oil (UCO) (DfT, 2015b). However, this interviewee refers to the attachment of their agency's agenda onto the biofuels debate being a powerful instrument to help achieve their own aims:

> "We've been working on product sustainability for many years. We're interested in sustainability for all palm oil, it's not just limited to biofuels, but with the biofuels mandate in particular it's quite an easy target. I mean it won't solve everything, but scrapping the mandate will go a long way towards tackling hunger and it's very rare that you'd have something so straightforward in development policy - so it's kind of ideal for an advocacy impact target. "

Civil society interviewee KE, UK, May 2012

The point here is that public perceptions about some biofuels, exacerbated by the homogenous treatment of biofuels in general, has knock-on effects for the rest of the industry. A few interviewees across private and civil society sectors recognised the need to produce information on a 'case by case' basis with high levels of stakeholder engagement to understand sustainability issues better and contexts at regional and local levels. In this way it was thought that more specific and balanced information could be produced to support policy decisions in relation to particular biofuels. One private sector actor (heavily involved in the setting of sustainability certification schemes and standards) also talked about the need for flexibility in the system to deal with different biofuel products:

> "We have published a strategy for biofuels supply chains, which basically says we need to understand what works and what factors are at play in each supply chain first, in each region, and to keep it simple."
>
> Private sector interviewee PL, UK, May 2012

This, however, is not easy. As already identified throughout chapters 2 and 3, individual supply chains can be complex and difficult to track (although now the RTFO requires UK biofuel suppliers to verify their entire supply chains as part of reporting mechanisms). Interestingly, even the organisations that have been effective in disseminating information about biofuels in their advocacy work admitted their lack of ability to distinguish between 'good' and 'bad' biofuels as a result of the lack of evidence about social and environmental impacts in relation to particular biofuels and feedstocks:

> "I find it very hard to pin down to particular countries … data is often only available for the EU as a whole … there are huge data gaps … even where there is validated data in the EU for individual countries once you begin to import and export within the EU this is not captured … I know that the biggest market for Brazilian ethanol is the EU - but I wouldn't have knowledge of specific supply chains. You cannot see Brazilian soy production in isolation from Uruguay and Argentina - it's all around the same area so it's all interconnected"
>
> Civil Society interviewee, LE, UK, July, 2012

What was clear is that all interviewees, at some point, mentioned food versus fuel issues and so these issues rated high amongst their perceptions of biofuels. These, all interviewees said, were issues that dominated media stories about biofuels. However, these concerns were also soon qualified by all interviewees as they acknowledged the diversity amongst biofuels, as already discussed, and the considerable complex factors that contribute to food security issues and rising food prices. Therefore, the exact relationship between food security and the production of biofuels, particularly sugarcane ethanol, quickly became debateable. Biofuels were acknowledged by all interviewees as being part of a

wider agricultural system – a system which has major sustainability issues, inefficiencies and inequalities in its own right – and not least because of the unfair distribution of food. Due to the diversity of biofuel types already mentioned, it was considered difficult – if not impossible – to determine the extent to which particular fuels consumed in the UK pose food security issues. The following interviewee talks about multiple factors affecting food prices and the significant effect of energy prices.

> "[F]ossil fuel prices and various market forces mean that the price of fossil fuels still have higher impacts on food prices than bioenergy and biofuels. I mean, I think to single out biofuels – yes it's part of the mix – but as far as I know, fluctuations associated with fossil fuel prices still have a higher impact than the biofuel targets."
>
> Civil Society interviewee LM, UK, May 2012

All interviewees felt the most pressing issues overall were unsustainable levels of consumption and significant food and agricultural wastes in the system and all agreed that 'food versus fuel' debates risked diverting attention from these other fundamental issues that urgently need addressing. For example, this civil society sector interviewee said that:

> "The FAO report suggests that around one-third of all food is wasted - in developing countries it's before processing and in developed countries it's after processing."
>
> Civil Society interviewee LM, UK, May 2012

These issues and complexities were thought across interviewees as being lacking in often simplistic publications or media attention relating to biofuels. With respect to sugarcane bioethanol production specifically, it has been seen that, in Brazil, sugarcane has been produced and used primarily for sugar production for centuries. If the bioethanol market were to collapse, or if sugar prices rise on the market, producers divert to sugar production where there is more profit and a consistent and buoyant market. There is no evidence to suggest that the amount of land used to produce sugarcane would decrease. Brazilian mills adapt levels of production of each according to market prices;

"depending on the market they will produce more ethanol or more sugar" (Civil society interviewee, CA, Brazi, July 2012). The link between production of sugar and bioethanol was also evident within UK production and in other countries. A private sector interviewee made the point that British Sugar had installed its bioethanol plant to use surplus sugar (Interviewee, DP, UK, May 2012). The interviewee elaborated by going on to talk about the flexibility of storage at this plant that processed sugar beet and enabled the holding of liquid sugar in large holding tanks to adapt production of particular end products according to demand, such as a range of sugar products that can supply companies for chocolate making or fizzy drinks manufacture. This highlights the efficient and integrated nature of bioethanol production, its use of wastes and inherent links with the sugar industry. He said that in order to store excess sugar from the sugar-beet it was stored in large tanks at the Wissington plant, "it goes through the process into sugar and left as a thick juice, and there are a number of advantages, one because then they can divert it into bioethanol or divert it into granulated sugar or caster sugar or all the other sorts of products such as icing sugar" (Private sector interviewee, DP, UK, May 2012). One research sector interviewee talked about sugarcane refineries in Guatemala producing fuel ethanol or alcohol, perfume, cosmetics or industrial goods depending on the market prices at any given time. The ability to switch production according to market prices is thus extremely attractive to producers because there is a consistent market for sugar and diversification offers them much more security.

Another issue relating to information availability appeared to be the ways in which the term 'sustainability' was used amongst interviewees and the understandings of what social issues relating to sustainability meant. In some cases, sustainability was used in relation to purely environmental issues and at other times, it was used to include social issues but mainly in relation to directly employed workers (particularly manual workers). Only a few public sector, civil society and research interviewees raised issues relating to wider communities under the social pillar of sustainability. This is reflected in this quote:

> "[M]ills in Brazil tend to be large plantations often owned by the mills. So it's a very straightforward supply base. In terms of social impacts, it's limited in some ways."

This is concerning if this is the way in which local communities are represented and it also highlights that the wider range of social and equity issues relating to local communities in producer regions largely remain uninvestigated or unknown. In addition, there was consensus across all interviewees regarding the differences in standards across certification schemes and the different definitions being used of 'sustainability' in the field. Thus, information published on the basis of biofuels meeting these standards can be misleading, as noted by an NGO interviewee who said "[i]t's a mistake to talk about sustainability criteria in general. I mean, do they mean the legal, minimum, requirements?" (Civil Society interviewee LM, UK, May 2012).

What was clear here is that all interviewees, to some greater or lesser degree, raised interconnected issues relating to published sources of information about biofuels. This included the fact that some stakeholders have more access to publish and disseminate information than others, some stakeholders rely on information sources that are only partially representative of the true nature and complexity of impacts relating to specific biofuels and some stakeholders are thought to have less opportunities to access information. Stakeholder groups more able to receive, share and disseminate information were thought to be research, private and public sectors and NGOs. Those with less ability to access information were thought to be people in producer regions such as local communities and small-scale farmers/producers.

5.3 Discussion and conclusions

These results demonstrate the broadest and most diverse set of actors connected to an international liquid bioethanol supply chain, like the one to be used in this case study, from the perspectives of transnational governance actors and experts. In addition, the results show for the first time the nature of these connections including the ways in which these stakeholders perceive their own roles and responsibilities and those of others. It is clear that a wide range of distributed formal and informal appraisals and decision contexts are taking place by these stakeholders, which will influence their understandings of

their connections to the biofuel, their connections to others in the chain and any social and environmental consequences ultimately associated. This is particularly important because it is these understandings that ultimately determine the nature of the policies and practices that take place in relation to liquid biofuels consumed in the UK and the ways in which the production and consumption of biofuels might be re-defined or re-shaped to ensure sustainability and energy justice. For example, because of the socio-technical nature of the energy system itself as discussed in chapter 2, section 2.1 (i.e. Miller et al. 2015; Sovacool and Dworkin, 2015; Stirling, 2008; Walker and Cass, 2007).

The importance of these points can be demonstrated by examples drawn from the findings presented in this chapter. Firstly, it is clear from the findings discussed in section 5.1 that governance actors felt that the public sector is responsible for ensuring sustainability and equity in relation to the policies it is putting in place to increase the use of biofuels in transport (i.e. via the mandatory blending of biofuels in petrol and diesel as stipulated in the RED, FQD and RTFO). However, the findings in this research show that the nature and extent of equity issues are not included or assessed within the formal types of biofuels appraisal processes used by public sector actors in order to make judgements about the sustainability, social and environmental outcomes associated with the use of the fuel. Furthermore, it is evident from these findings that a distributional injustice is thought to exist in relation to supply chains of the case study type because the majority of negative social and environmental costs are thought to be loaded towards sites of production. These individual matters were discussed through section 5.2.1 and an overview of the way the equity issues are perceived to be distributed by governance actors interviewed at this stage is summarised in figure 11 (at the end of this chapter).

The way that information relating to the sustainability (and equity) of bioethanol (and liquid biofuels more broadly) is produced and shared amongst affected stakeholders therefore currently works against ideals for effective participation and procedural justice, which is advocated by Blackstock et al

(2007), Sovacool and Dworkin (2015) and Walker (2012), for example. These matters affect the degree to which public sector governance actors can fulfil their roles to ensure energy justice in relation to liquid biofuels and bioethanol. Equally, the extent to which responsibilities of private sector actors and NGOs can be carried out is diminished by comprehensiveness of information available about sustainability and equity issues associated with particular fuels. For example, the private sector requires information that can be used within its own CSR strategies and campaigns that demonstrate the social and environmental outcomes associated with its practices to shareholders and consumers. NGOs are shown in these findings to be regarded as a means of increasing the representation of local communities, including small-scale farmers, within VSCS setting and policy-making processes to help ensure better social and environmental outcomes. And yet the bases of both these sectors' appraisal processes have been found to lack comprehensive coverage of equity issues as defined in energy justice terms.

The findings presented in this chapter (i.e. in terms of the broad set of stakeholders, roles and responsibilities and distributed appraisal contexts identified) are also significant because they also indicate that consumers are largely unable to actively engage or participate effectively in the system (and thus fully take on their own roles and responsibilities in relation to the consumption of liquid biofuels) because they are largely unaware of the biofuel content within the fuel they purchase at the pump. In fact, consumers were perceived by governance actors and experts (interviewed at this stage of research) to be a disconnected and unaffected set of people who are unwilling to take responsibility for impacts overseas, such as by paying higher prices for more socially and environmentally sustainable biofuels.

The lack of recognition for consumers' interests by experts in the field and governance actors interviewed in this stage of research may be because the perceived impacts associated with consumers may be less critical than the types of impacts that people in producer regions, such as developing countries, might experience. However, while this form of procedural injustice remains, consumers are excluded from meaningful engagement with supply chains of

this case study type which might help to drive the development of more just and sustainable liquid biofuels. For example, this might be through purchasing preferences expressed at the pump or consumers' input at the design phase of particular uses of biofuels and modes of production and consumption (i.e. other than via mandatory blends). Consumers are thus prevented from adequately taking on the responsibilities that those from the private sector felt were necessary and which may also support the aims (and roles) of other stakeholders such as public sector and civil society actors. In this way, it is more likely that mutual environmental and social benefits might be achieved (i.e. as discussed in chapter 2, drawing on works from Manik et al (2013), Porter and Kramer (2006) and Grant (2007), for example).

Multiple, situated notions of justice are also apparent in these results, substantiating claims made in environmental justice, public participation and energy justice literatures (reviewed in chapter 2) that an equity appraisal of a supply chain of this nature requires in-depth study capable of attending to plural notions of justice and context (i.e. Stirling, 2011; Walker, 2012). For example, some interviewees (across all sectors) perceived production workers to be benefitting from improved employment laws (Coslovsky, 2014) and sustainability laws (such as eradication of field-burning (Abex et al (2007) and agricultural zoning (USDA, 2011)) while others (particularly researchers) talked about continuing exploitation, harsh working conditions and impacts associated with mechanisation. Interviewees talked about Brazilian producers being beneficiaries of increased trade between the UK and Brazil, such as via VSCSs that ensured access to markets, whereas from the perspective of a small-scale producer, this may not be the case as they are unable to meet the costs associated with VSCS compliance. What is clear, therefore, is that primary data collection from those affected at ground level is urgently required in order to understand (and be able to represent) these situated perspectives better and work towards energy justice in relation to liquid biofuels. What is also clear is that any potential benefits for local communities and workers overseas depend on strong governance mechanisms and the outcomes of decisions and practices adopted by stakeholders within both the public and private sectors. These are

all matters that will be discussed in chapters 6 and 7, which present the findings from the in-depth study carried out during the second stage of research.

In summary, what is clear from these results is that the full range of stakeholders, decision contexts and equity issues would not have been identified within dominant methods of formal, liquid biofuels appraisals (i.e. such as VSCSs reviewed in chapter 3). Furthermore, because there has not been a study of this type in the field of energy justice, these results contribute empirical evidence to the field in terms of the procedural and recognition-based injustices that may be driving distributional injustices in relation to liquid biofuels consumed in the UK.

What is also clearly shown here is that the most common information bases used to support decision-making processes relating to liquid biofuels (and bioethanol) only partially represent associated equity issues. In fact it has been identified that interviewees agreed that, from their perspectives, the exact nature of equity issues are not fully understood and the extent to which these types of supply chain exacerbate or reduce social or environmental inequalities remain largely unknown. All interviewees referred to the lack of ground-level, primary and contextual data relating to particular liquid biofuels and thus lack of knowledge about the ways in which associated social and environmental impacts are distributed amongst the full range of stakeholders affected by supply chains of this type. The next chapters will allow comparison between the perceptions of injustices drawn from this stage of research with perspectives from people living 'on the ground' within sites of production and consumption.

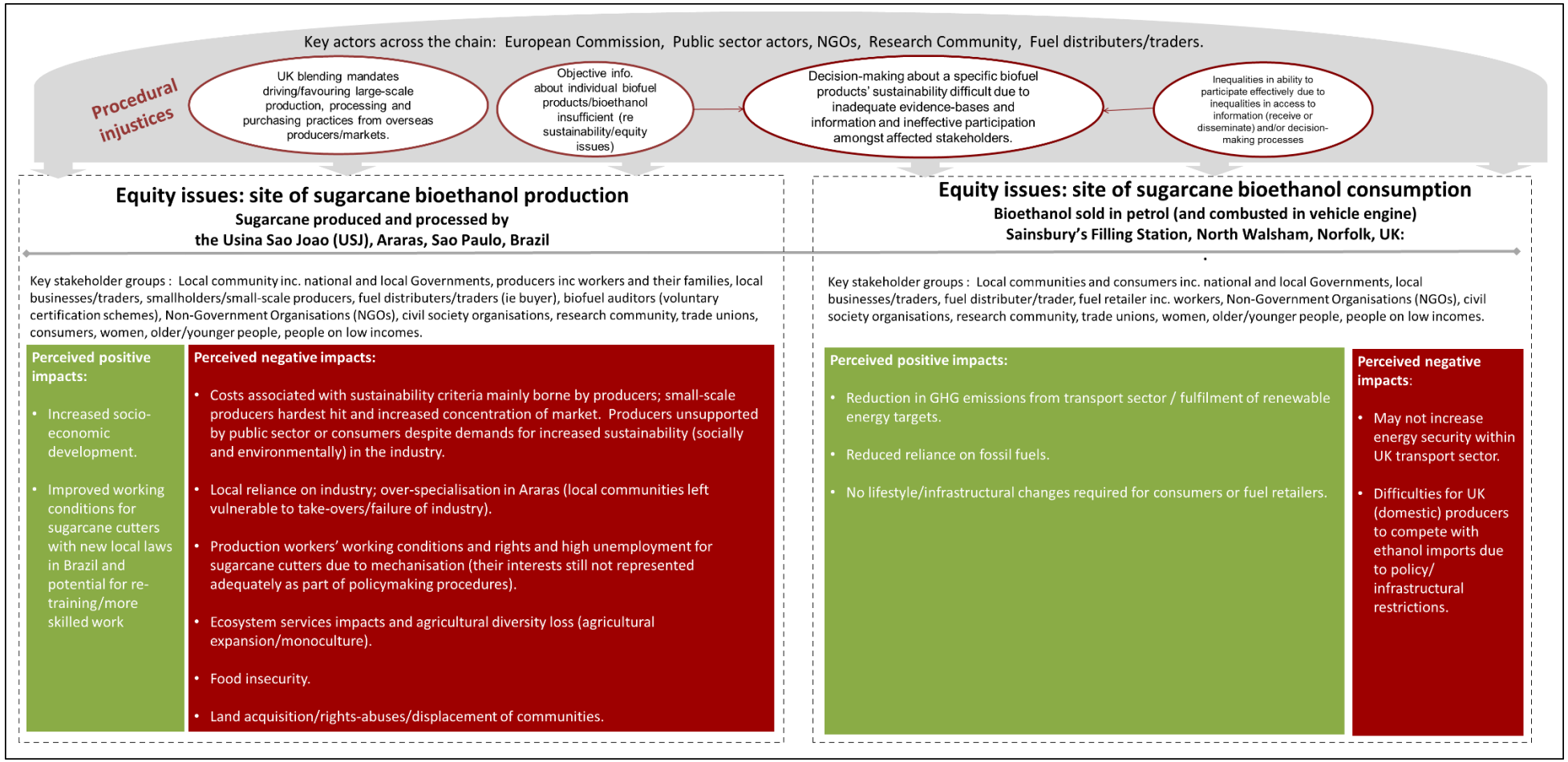


Figure 11: Distribution of equity issues related to bioethanol supply chains from the perspective of governance actors interviewed in research stage 1.

Chapter 6: Equity issues at a site of production and processing (Araras, Brazil)

Common discourses around the way impacts are distributed amongst different stakeholders at different parts of the supply chain have been identified in chapters 2, 3 and 5. For example, people in producer regions were deemed to be bearing the majority of the risks or costs, particularly smaller-scale producers, while consumers in the UK are largely unaffected or beneficiaries of the system (except in relation to questions about the extent to which biofuels offer increased energy security for the UK transport sector). However, there were also indications in the literatures reviewed in chapter 3 that conditions for some workers and local communities in producer regions are improving because they are attracting higher levels of recognition or inclusion in some VSCSs and Brazilian national laws.

These issues are now discussed in this chapter, alongside a range of other equity issues, as a result of in-depth qualitative interviews conducted with people living in and around Araras, i.e. from the perspectives of people living at the production end of the chain. As described in chapter 4, this is where the bioethanol commences its journey for distribution in the UK. The people interviewed here are those from the wide range of stakeholder groups identified at the supply chain mapping stage of research (described in Chapters 4 and 5). What the qualitative coding analysis in this chapter shows is that some of the equity issues transnational governance actors and experts perceived to exist (i.e. in chapter 5) were substantiated by the claims of residents in Brazil while other assumptions were contested by these findings. For example, more wide-ranging benefits to local communities and workers in this region were found than were expected, based on the findings from the first stage of research. Due to the unique circumstances of this particular supply

chain, involving attention to higher VSCSs, adherence to stringent national laws and a long-standing ethos of CSR by the mill, these findings show that where local communities are recognised within associated policies, laws and standards, it is possible that some benefits can be realised for peoples and environments in producer regions (in the ways suggested by Manik et al. (2013), Porter and Kramer (2006) and Grant (2007). The perceptions of residents in Araras were that the distribution of outcomes at the site of production were directly as a result of the recognition of their interests (social and environmental) by the USJ within their own CSR policies (including their commitment to higher-level VSCSs) and local (national) laws. As with chapter 5, these findings are presented and discussed in ways that demonstrate these relationships.

6.1 Equity issues and their interrelationships in Araras

The most significant equity issues relating to the production and processing of the bioethanol in Araras from the perspectives of people living in and around the site of production are now presented. What these findings start to show is that the nature of equity issues are not as expected, when compared with stage 1 research findings. Although specific social and environmental impacts dominated interviewees' narratives (i.e. matters of distributional justice), people also talked of the way they felt associated policies or practices were driving these outcomes. This helped to identify matters of recognition and procedural justice from the perspectives of residents in the site of production. The following presentation of findings is structured in a way that helps demonstrate and discuss these relationships (i.e. between different dimensions of equity or energy justice). Again, as with the findings presented in chapter 5, they are not ordered by significance as all are regarded equally important because they were the most prominent issues raised across interviewees.

The first major theme to be discussed is the impacts that interviewees felt particular stakeholder groups were experiencing in the producer region as a result of local, Brazilian laws and European VSCSs. Particular matters of procedural justice and recognition are raised and discussed. The second major

theme discusses impacts that people in Araras felt residents were experiencing as a result of the USJ's own CSR policies and practices. The penultimate theme discusses other significant impacts that interviewees in Araras felt were issues and these are included as they particularly relate to perceptions of issues raised by transnational governance actors and experts in the field interviewed during the first stage of research (matters which have already been raised in chapter 5). These issues include matters of energy and food security and the discussion highlights the difference in situated perspectives between local residents in the producer region compared with perceptions of these issues by actors with high-level or 'distant' views across the chain (i.e. because they are based in the UK or other geographical regions outside Araras). The final theme briefly summarises who the interviewees in Araras thought were responsible for managing the distribution of environmental and social impacts and thus equity in relation to a bioethanol (or international biofuel) supply chain of this type. This is pertinent as it particularly relates to the ways in which transnational governance actors and experts perceived roles and responsibilities presented in chapter 5 (and which relates to the way individuals connected to the supply chain (including consumers) perceive themselves and their own responsibilities to ensure sustainable and just energy systems.

The results from the qualitative analysis conducted at this stage, presented here, contributes to the research aims and objectives of this thesis (i.e. those defined and presented in chapter 1, section 1.3). Specifically, the fourth research objective to conduct an equity appraisal via qualitative research, centred around in-depth interviews, to establish the equity issues affecting key stakeholder groups in and around sites of production and consumption including the ways in which matters of recognition and procedural (in)justice are driving particular distributional outcomes or injustices.

6.1.1 Social and environmental outcomes in Araras

Particular social and environmental outcomes that people in Araras described themselves as experiencing as a result of sugarcane bioethanol production in this locality are now presented and discussed. These are matters of distributional justice and have been structured here around their perceived

procedural and recognition-based drivers (from the perspectives of people living and working in Araras). The impacts and their drivers discussed here thus pave the way for the discussion of equity issues and their distribution across the entire supply chain in chapter 8's conclusions.

Outcomes as a result of Brazilian laws and VSCSs

Impacts on producers

From the perspectives of private, civil society sector actors and researchers in and around Araras (defined in table 6 in chapter 4, page 111) Brazilian laws pertinent to the sugarcane bioethanol sector, the EU RED (and FQD) sustainability criteria and the associated VSCSs were all drivers of the higher costs producers were experiencing in order to comply, remain competitive and access European markets. This, they said, was driving further concentration of the market. Their perceptions thus aligned with the views from transnational actors presented in chapter 5. These procedures (i.e. laws and standards) were therefore identified by these interviewees as drivers of particular distributional injustices because producers were left unsupported by fiscal incentives via the public sector or via purchasing preferences exercised by UK-based consumers (despite demands for compliance with these laws and standards). For example, a lecturer from a local university in Brazil described the way he felt these changes were re-defining the sector, saying that "[a] small mill, distilleries and suppliers face problems and at the end it will all be concentrated on the hands of the big groups; nowadays there are more than 400 mills all over Brazil - more than half are located in the state of São Paulo and I think they will be concentrated in 10 major groups" (Research Community interviewee RC, Araras, August 2012). He went on to say that "[t]he market has given a solution to the dignity problem and the respect to environmental issues but soon there will be no space for the small groups … how can you absorb the costs if you don't have massive production?" (Research Community interviewee RC, Araras, August 2012).

This local university lecturer, NGO representatives and a USJ manager said that even larger-scale businesses were having difficulties surviving due to

compliance with sustainability laws and standards in general, higher operating costs and risks carried by the producer. Lower levels of production due to weather conditions over the last 3 years had made things particularly difficult. A sustainability officer at the USJ explained that:

> "Lack of investments, high costs, severe weather conditions … We have 2,500 workers, equipment, high costs of machinery, etc. If there is no government support it is very difficult to maintain all of this, especially for a small producer. So the big groups are coming, such as Raizen, Louis Dreyfus, ITH, Cargill, and Bunge. They are buying the small groups that are in difficult financial situations and forming their own big companies … As we also had difficulties, we joined forces with Cargill to operate in Goiás. Cargill is our partner there but this unit here is a family owned business and it is going to be like this."
>
> Private sector interviewee DU, Araras, Sao Paulo, August 2012

The USJ representative said that producers who choose to meet the highest-level VSCSs (such as Bonsucro) are unable to demand higher prices for their fuel on the market. He said "[w]e don't have bargaining power when it comes to selling the commodity on the market … at the end, only the big groups will survive" (Private sector interviewee SR, Araras, Sao Paulo, August 2012).

Higher wages, shorter working hours, improvements to health and safety standards and re-training schemes for workers as a result of mechanisation of the harvests and local employment laws were all factors reported to have brought high costs for producers by private sector actors, NGOs and the local university lecturer (however, these matters are discussed further in the following sub-sections in relation to the benefits local laws are affecting for workers and local communities). One NGO representative confirmed that funds for these schemes mainly came from industry; the mills themselves, UNICA, large truck companies and trade unions. For example, the NGO interviewee said that mills, like the USJ, pay wages while workers are re-training and pay all infrastructure costs such as transport to training facilities and meals. Wages were regarded as being higher than the minimum wage and better than across the agricultural and construction industries in general by workers and NGOs (supported by Smeets et al (2008)). The majority of legal

proceedings taken against individual mills were considered due to these financial burdens, as explained by this trade union representative:

> "Most mills are doing OK or are good… around six mills currently have legal proceedings against them. There are around 440 mills in Brazil. These problems can often be due to financial problems, i.e. they cannot meet the cost of providing the level of benefits deemed necessary for workers."

Civil Society Interviewee FT, Sao Paulo state, August 2012

For the reasons above, Solidaridad offer support for producers (large and small) of sugarcane and/or bioethanol, to help them comply with associated national regulations and VSCSs (including financial support). The Solidaridad representative said that:

> "… the smaller ones have more difficulty complying with the laws than the big ones. If they comply with the law, the situation is perfect but the problem is, complying. They need support to increase smallholder productivity, net income and resource use efficiency ..."

Civil Society interviewee FC, Sao Paulo based, August 2012

Therefore, support for producers from the civil society sector was identified, with Solidaridad offering support for small-scale producers to form co-operatives, negotiate contracts with larger mills and help integrate supply chains between local farmers and mills that own processing equipment to produce bioethanol. This, the above interviewee said, improves the prospects of economic viability for all participants in a localised area. A small-scale farmer verified this claim and stated, that from his perspective, this model was working for him and bringing him some benefits. For example, he said that he was replacing some of his food crops (i.e. oranges) with sugarcane because he had an assured market for his sugarcane (by supplying to another local mill for processing into sugar or bioethanol). This was better for him because he had been unable to sell the food crop he was producing; there was no market for his fruit locally or regionally. He said he was replacing the orange groves with sugarcane crops (figure 12) because it wasn't worth the expense of harvesting

so the fruit was left rotting in the fields (figure 13). Also, the produce didn't have to be transported far, because it will be supplied to the local sister mill to the USJ, which reduced environmental and financial costs associated with transport. The farmer also said that his choice to produce sugarcane rather than other food crops was that "the price of corn is very low, per sack, and because of the constant demand for sugarcane (to produce sugar or ethanol for domestic markets and overseas) it carried less risk and is more sustainable for my business" (Private sector interviewee PA, Araras, August 2012).

Figure 12: Orange groves (right hand side of picture) being replaced with sugarcane (left hand side) (Source: author).

Figure 13: Orange trees full of fruit but being left to waste, orange groves left unharvested (Araras, Sao Paulo, August 2012) (Source: author).

The farmer went on to say that the issues for small-scale producers were not confined to the sugarcane sector; the difficulties for small-scale producers to remain in business were an issue across the agricultural sector as a whole. He also said that his production of sugarcane did not raise issues of increased monoculture as, for him, this could be managed by rotation practices.

Another matter, in relation to the difficulties small-scale farmers were facing (and thus their resilience to the changes in the market described above) was the difficulties attracting people to work in the fields. Harvesting crops, such as oranges, was more expensive and labour-intensive than harvesting sugarcane, which could be harvested mechanically where the land was suitable (and which could potentially be harvested in partnership with the mill to which it supplied the cane). All teenage interviewees confirmed that young people (who had attended school, in particular) did not aspire to a career in farming, threatening small-scale practices as well as larger operations. Farming was connected by younger interviewees with low pay, hard manual work and limited opportunities for travel, personal development and other life experiences. Even young seasonal sugarcane cutters were found to be working between other jobs, studies or using the work as a stop-gap until something better came along.

In turn, higher levels of education and economic development appear to be having effects on the industry. All young people interviewed made it clear that they did not aspire to go into the agricultural sector or manual trades. The young people interviewed all attended local schools or colleges and they made it clear they did not aspire to working in the sugarcane ethanol industry, preferring higher levels of education, travel and other life experiences instead. Other interviewees across the sectors, age groups and genders also raised this issue and problem for the industry. Children of a production worker (foreman living on a tied cottage on plantation grounds) did not want to follow in their father's footsteps and a small-scale producer of food crops talked about the problems finding young people generally to work on the farms during harvest time. They have to recruit from further afield and those that do come for the

jobs tend to be less educated and are likely to remain so. He does still recruit some students who will do the jobs during the summer.

> "They can always find workers for causal work but often they recruit from further afield. Young people don't want to work in agriculture long-term. They tend to do it for summer jobs. You need younger people in the industry as they are stronger so this is a problem. The younger ones who are not so interested in their education will work on the farms but they tend to come from and then remain in lower education groups. Many are aged between 18 and 25."
>
> Private sector interviewee PA, Araras, August 2012

What was clear, was that with increased economic and social development evident in Brazil, higher levels of education and communication are effecting cultural shifts amongst young people and increased aspirations for other life experiences. Thus, issues for producers and particular stakeholders as a result of large- or small-scale producers are complex and depend on the contexts in which these matters sit. These interrelated issues and factors did not feature in generalised and simplistic arguments about drivers of market concentration in the first stage of research (chapter 5).

What the discussion in this sub-section shows is that despite agreement between stage 1 interviewees (chapter 5) and those from civil society, private and research sectors in Araras that high financial costs for producers were exacerbating the difficulties producers were facing to survive in the sector (particularly for small-scale sugarcane producers), the extent to which these changes are necessarily positive or negative depend on the situated perspectives of particular stakeholders. For example, with support (where needed) from other stakeholders connected to the chain, it is possible that small-scale producers can be helped to adapt and benefit from the market conditions. Likewise, large-scale producers can benefit from the feedstocks supplied by out-growers as well as access to overseas markets via their compliance with local laws and compliance with VSCSs. In fact, all interviewees in and around Araras agreed that there were benefits for producers who could comply with the higher-level schemes because it improves access to European

markets and therefore the promotion of their fuels. This had certainly been the case in terms of Greenergy, the USJ representative remarked, who preferred to purchase bioethanol directly from the USJ on behalf of its UK-based retailers/supermarkets due to the high standards it meets (the USJ meets both Bonsucro and Greenergy VSCSs).

All interviewees in and around Araras also agreed that higher standards in the sector and new regulations, in general, had benefitted the local communities of Araras, its local environment and the workers directly employed in the industry. The USJ complies with one of the higher-level VSCSs, the Bonsucro award. An interviewee from the USJ, specifically employed to work on sustainability-related policies and practices at the mill, felt that the inclusion of social issues into sustainability schemes, as well as environmental, was essential. This was because he felt that recognition of local communities and workers, and the impacts that relate to these people, can help drive improvements to their qualities of life and make the area a better place to live for everyone. In addition, he said that it helped promote a happier, more productive and stable workforce. What will be discussed now, in the next two sub-sections, are the specific benefits to workers and local residents in Araras that interviewees at this stage of research felt were being realised as a result of the implementation of Brazilian laws and VSCSs that are relevant to the sugarcane bioethanol sector.

Impacts on workers

Manual workers talked about significant improvements in working conditions, driven by employment laws relating to sugarcane. Thus, the recognition of workers (and associated impacts to them) by the Brazilian government was thought by workers themselves to be bringing benefits in their working conditions. Workers also talked about higher wages and bonuses associated with sugarcane production than across the agricultural sector in general. It was difficult to entirely separate benefits to workers as a result of local employment laws that seek to improve labour conditions (Coslovsky, 2014) and the USJ's own practices and compliance with certification schemes. For example, workers talked about the USJ's scheme of profit-sharing amongst workers from

increased production. This may be in response to problems recruiting and keeping workers, as discussed earlier. However, workers talked about better access to, and training for, health and safety equipment (all of which are covered in the laws and standards to which the USJ complies, and factors which Smeets et al (2008) found to be affecting poor working conditions in the sector).

A 19-year-old sugarcane cutter told of his experiences and how much better it is in the sugarcane industry and at this particular mill and plantation compared to his other employment in the agricultural sector. This worker had previously worked on a coffee plantation where hours were longer, pay was less, there was no shelter provided for breaks (to get out of the sun) and consideration of health and safety in general for workers by the employers was non-existent or very poor. He said that "[i]f you hurt yourself then that was that …you just have to get on with it" (Sugarcane cutter CL, Araras, Sao Paulo, August 2012). Workers also talked about other improvements, such as eradication of under-age employment in the industry, which had historically been a problem. This worker said:

> "I used to cut sugarcane when I was under age [not at the USJ] but that was a long time ago and that can't happen now. The sugarcane mills are now very strict and careful about employing anyone under age."
>
> Sugarcane cutter HJ, Araras, Sao Paulo, August 2012

The impacts to workers as a result of mechanisation (a matter raised in chapter 5) was also raised as a significant issue across all interviewees in and around Araras. Due to negative environmental effects related to sugarcane field-burning, Sao Paulo's State Law number 11.241 was introduced in 2002 to phase out these practices by 2014 (Abex et al. 2007; ELLA, 2009; UNICA, 2015). Field-burning is required for manual harvesting but significant impacts relating to air quality and respiratory problems had led to these new laws (Abex et al. 2007; ELLA, 2009; UNICA, 2015). These changes meant higher levels of mechanisation for harvesting the sugarcane in Brazil, in general, as well as at the USJ (Figure 14 below).

Figure 14: Sugarcane produced on USJ-owned land, harvested mechanically (Source: author).

The effects of this law and increased mechanisation was discussed in chapter 3 and also raised as an area of concern by interviewees in chapter 5 due to the high number of redundancies of manual sugarcane cutters in the industry. It was clear that mechanisation had, indeed, increased dramatically in the state since the introduction of this law. Once interviewee verified that "more than half of the area in the Sao Paulo state is now mechanised" (Civil Society interviewee FC, Sao Paulo based, July 2012), in line with published reports of these changes in the industry (ELLA, 2009). However, despite concerns being voiced over redundancies for manual workers by interviewees during the first stage of research, a local NGO interviewee said that, in practice, this had not raised a problem in the state of Sao Paulo. She talked about economic growth in the North easing the situation and affecting migration patterns:

> "We actually have a big problem with lack of labour. We have missing workers … even cane-cutters. This is happening a lot and a big issue. We have a huge development – economic development in the North - so people are not coming to Sao Paulo state … of-course there are migration but it is much less."
>
> Civil Society interviewee FT, Sao Paulo based, July 2012

When asked if mechanisation has meant more unemployed people in Araras (and Sao Paulo City) without work, leading to higher levels of poverty and other associated social problems, the interviewee replied:

> "No. That is what we were expecting … this was a big worry. Mills were very worried … but what has happened, we had such a lot of economic development in the other sectors - construction and in other industries, in the North - several things happened at the same time. So actually we have almost full employment in the Country …it is a very good situation – the best for the last 40 years. What has happened is that we don't have workers. We have a project with UNICA to re-train cane-cutters. The problem is that new jobs are for more skilled – the cane-cutters are very unskilled. So this is another problem … So we have to enable them to work in these new jobs and especially the new jobs that are happening in the mills … the mechanisations – you need 20 people just to operate all the system – the mechanics, drivers, and so forth. These workers are not available."
>
> Civil Society interviewee FT, Sao Paulo based, July 2012

A production worker at the USJ (management level) confirmed these dynamics, saying:

> "Mechanisation has been a good thing. It has reduced the number of people required but there had been a reduction in the number of people available to do the work. Local people didn't want to work at the mill as a sugarcane cutter - particularly the younger generation. It has created more stability in the area with less influx of migrant workers. Initially we recruited only people in the community/local area at the mill but due to the reduction of people available/willing to do the work, they have to recruit from elsewhere … mainly from the North East where there was much more poverty but this is also starting to change.
>
> Private sector interviewee IV, Araras, August 2012

One interviewee said that "a big part of the workers are hired for long-term contracts. There is much less seasonal work. There is much more stability" (Civil Society interviewee FC, Sao Paulo based, July 2012). Other NGO interviewees and workers themselves talked about improved employment

prospects and opportunities for professional development as a result of these changes. All workers also talked of higher wages (in line with Smeets et al (2008) findings) and longer term contracts in the industry (such as for lower-skilled workers and sugarcane cutters to train to be mechanics or drivers or operators of farm machinery, which has become increasingly technical).

In addition to re-training schemes, there were also more management, administration, marketing and sustainability jobs in the industry, with positions also associated with research and development. These cannot all be attributed to mechanisation of the harvest but interviewees did connect the highly technical aspects of farming with the need for more skilled workers and technological advancements generally. It is known, however, that sugarcane cutters tend to have high levels of illiteracy and therefore re-training schemes may only be accessible to those who have at least basic levels of education. One public sector worker thought that the mill could invest more in its workforce and offer educational courses in the region for this reason.

Impacts on local residents

In addition to impacts on workers, all interviewees in Araras talked about the way that mechanisation of the sugarcane harvest was bringing a range of social and environmental changes for local communities. The recognition of environmental impacts to local communities by the state within Sao Paulo's State Law number 11.241 (to eradicate field-burning and thus improve air quality) (Abex et al. 2007; ELLA, 2009; UNICA, 2015) was therefore considered a driver of changes to the way risks and burdens people in producer regions were experienced, i.e. matters of distributional justice.

All interviewees in Araras agreed that air quality had improved since the USJ had reduced these practices. Everyone in Araras talked about difficulties in relation to the significant level of pollutants in the air because "the dirt gets everywhere - it is in the air so impossible to keep things clean" (Public sector interviewee, DH, Araras, August 2012). A public sector worker in the Environment Department of the local Council also talked about the reduction of work required in terms of clean-up operations and environmental impacts that

had previously been experienced as a result of burning the sugarcane for manual harvesting.

All interviewees living in and around Araras also talked about respiratory problems in the area which were particularly prevalent during times of field-burning. Two English tutors talked about the respiratory problems their students suffered as a result of field-burning, particularly during periods of low humidity. This was echoed by an employee of the local school. A local lawyer said that:

> "There have been considerable respiratory problems in the area as a result of the burning but also from the dirt from the road as a result of the heavy traffic - trucks. The area is very hot and dry and therefore particulates remain in the air longer. However, it is much better now that there has been such a reduction in burning."
>
> Private sector interviewee PA, Araras, August 2012

A cardiologist from Araras, who works at the local hospital said it was very difficult to attribute all respiratory problems to the burning of the sugarcane, saying that "[p]eople's respiratory problems in general may not be due to the burning, there are a mixture of factors but people tend to connect it with the burning as a matter of habit" (Public sector interviewee AN, Araras, August 2012). Some respiratory conditions hadn't completely gone, he said, since the reduction in burning or they had problems when the burning didn't take place. However, he also said it was clear that the field burning did exacerbate people's respiratory problems in line with Abex et al's (2007) findings.

This cardiologist has worked as a doctor for 25 years and been based at the hospital for 16 years. He sees a range of patients – not just cardiology patients. He was a local GP and then specialised and said he treats all types of people from the local community. He also raised another health issue relating to sugarcane burning, which had improved with higher levels of mechanisation. He worked at two out of the three local hospitals and said "I used to see many burns patients, many of which were workers from the sugarcane plantations. However, now the numbers have significantly reduced" (Public sector interviewee AN, Araras, August 2012).

Other associated impacts were found to be affecting local residents as a result of mechanisation of the harvest. All interviewees except the young migrant workers talked about reduced pressures on local social services and increased levels of social cohesion and stability in the community. This Headteacher of the local state-run school talked of higher levels of educational attainment due to these dynamics:

> "The mechanisation of the harvest has brought with it a number of benefits. One of these is that there is much more stability in the staff and workforce. Before there was more 'lack of attachment' whereas now there is much more of a sense of community. This has had a positive effect on education standards, as the children and parents are more settled and are building longer-term relationships with other local people."
>
> Public sector interviewee SP, Araras, August 2012

This interviewee directly related higher educational attainment in the school to the reduced influx of migrant workers and their families during harvesting periods. Children and parents, she said, were forming relationships with their peers, getting involved with the school and there were higher levels of integration as families settled. Therefore, the reduction in numbers of seasonal workers arriving in Araras during harvesting periods was bringing about positive social impacts for local communities.

What has been seen throughout sub-section 6.1.1 therefore is that the patterning of outcomes (i.e. the ways in which risks and burdens are being shared amongst affected stakeholders and thus matters of distributional justice) are being driven by the increased recognition (and representation of) local communities and workers within Brazilian laws and VSCSs. For example, the ways in which local communities and production workers are benefitting as a result of their interests being recognised in the law to reduce field-burning and thus increase mechanisation of the harvest. However, conversely, this law and local employment laws relating to the sugarcane sector, as well as compliance with VSCSs were thought by public, private, NGOs and research actors to be bringing unjust levels of risks, financial burdens and losses of

livelihoods for producers because governance actors and consumers were not helping bear the costs associated with improved social and environmental standards. However, from a local small-scale farmer's perspective, small-scale producers faced significant challenges to their livelihoods in general (i.e. difficulties employing young, seasonal workers, lack of demand for food crops locally and regionally and the higher costs associated with harvesting) therefore small-scale producers could benefit from assured markets for sugarcane crops.

What will be seen in the next sub-section, is the way that the recognition of local communities and the local environment within the USJ's own CSR practices have, over time, helped realise the higher qualities of life and living standards those in Araras describe in relation to other regions of Brazil.

Outcomes as a result of the USJ's CSR policies

It was evident that, from the perspectives of all interviewees in and around Araras, the USJ's recognition of the impacts that would be felt by local residents, workers and the local environment as a result of their operations had resulted in a range of more positive social and environmental outcomes in this particular area than in other sugarcane production regions in Brazil. All interviewees said that the USJ had demonstrated a long history of CSR before its compliance with VSCSs and newly implemented state laws. Interviewees agreed that the USJ had invested heavily in the local communities across education, transport, environmental, health and leisure services over the years (i.e. before their compliance with the Bonsucro award). One interviewee said that "[t]he USJ, between 1964 and 2002, donated 20% of its profits annually to local community schemes and projects" (Civil society sector interviewee, AG, Araras, August 2012. He went on to say that ""Armenio Ometto, the previous owner of the mill, was a big guy for the City!" and talked of a range of improvements and a Health plan he created for the City called 'Pro Saude'" (Civil society Interviewee AG, Araras, August 2012).

A local headmistress, whose father and husband worked at the mill in a professional capacity, talked of fears that if foreign investors or a multi-national company took over the mill's operation, the level of care for the community over time might cease. She also said that there had been a decline in

investment into local community projects which may be a result of the investments the company had been making within the company itself, such as for the highly technical equipment needed for mechanisation of the harvest. This was confirmed by a local voluntary community group.

What was immediately evident from my visit to the mill was the strong sense of community on the USJ's own site. Housing was provided there for workers and their families. Ararians and migrant workers talked affectionately about 'the colony' (the name given to the space where the USJ provides housing for workers and their families (see Figure 15 overleaf)). A local voluntary community organisation interviewee confirmed the USJ had donated a great deal of land for housing development, on the site of the mill (and in the City of Araras itself). Another interviewee (self-employed English tutor) said that his family had lived at the colony when his father worked at the mill and there had always been a strong sense of community there. Interviews and visits to the workers' homes, which had not been organised by the mill, demonstrated the sense of place, community and camaraderie amongst workers and their families.

Figure 15: Housing at the USJ mill provided for workers; 'The Colony' (Source: author).

A good level of integration between migrant workers and Ararian/local employees was also evident. This was helped by the fact they supported football teams and the children attended school together at the Jose Ometto School, which the USJ had built on-site (see Figure 16 below). The USJ had also built a church on the site of the colony, where people in the community at the colony could meet.

Figure 16: 'Jose Ometto' School, funded by and on the site of the USJ (Source: author).

The Jose Ometto School was still funded by the USJ and provided space for workers' children as well as pupils from Araras. The USJ supplied transport to and from school and pays for school uniforms and encourages pupils, workers and their families to take part in community music and drama projects (in Araras itself). The school band, the Headmistress said, played regularly in Araras including at local festivals in the City. In fact, during the school visit, a local part-time teacher was bringing the band back from a community event via minibus. The school on-site also provides employment for members of workers' families. This interviewee, interviewed in her home at the colony, had lived at the colony all her married life. She was a native Ararian and now works as a teacher and playground assistant at the school. She described her experiences with the mill and its operations:

> "The sugarcane industry has provided a stable income for my family for years, my husband has worked up in to a supervisory position. It also indirectly provides me with an income through working at the school. I have many friends at the colony and my job gives me social interaction and something to do outside of the home. It is a good place to bring up children because it is safe. They have lots of room to play and can meet with other children here. And the school is extremely good - educationally and socially. They meet children from Araras and the surrounding area as they are brought in by bus."
>
> Civil Society interviewee FA, Araras, August, 2012

The USJ can be seen as supplementing educational places provided by the state. In fact, the Headmistress in the local state school confirmed that they were over-subscribed. The USJ also funds a local University, the Uniararas.

The city of Araras was regarded by all interviewees as 'a good place to live', with sufficient recreational and green spaces (see figure 17 which depicts a lake in the centre of the city and figure 18 overleaf). All interviewees also felt that Araras had a higher quality of life than other parts of the state of Sao Paulo or Sao Paulo city itself (verifying indications from the higher HDI identified in Martinelli (2011), lower levels of poverty and a lower GINI coefficient than other regions of Brazil by the IBGE (2013)).

Figure 17: Araras, Brazil (Source: author).

Figure 18: Park in Araras city centre (Source: author).

The effects of the industry on the city were regarded by all interviewees positively, socially and economically, over time and the visit to the city certainly verified a well-developed and pleasant environment in which to live. There have been many direct employment opportunities at the mill as well as in other local trades and businesses in the city which had aided its development, offering diverse employment opportunities for both men and women. For example, a local female taxi-driver talked about her aspirations to gain a driving job at the mill and the local bank manager's daughter was due to start a professional job in administration in the near future.

A local bank manager talked about macro and micro benefits of the mill's presence in Araras. He said "[t]he mill brings lots of business into Araras, as well as the dormitory towns. 40% of the local revenue, in the town, is generated by the mill" (Private sector interviewee AE, Araras, August 2012). Interviewees attributed the economic development locally directly to the mill's operation and the need for this industry to remain to help promote further development, which they talked about particularly in terms of more diversity amongst local businesses.

The economic and social benefits talked about by residents generally, as a result of the long history of CSR exercised by the USJ and the Ometto family, may be the reasons why the benefits found here may not be replicated across other sites of production. For example, Garvey and Barreto's (2014) research suggests regional variations relating to the benefits new laws and sustainability measures were bringing for workers and local communities and higher levels of HDC have already been highlighted above (Martinelli, 2011). A public sector interviewee and a local researcher also felt that the economic and social development and benefits seen in this area were not matched across the Country. The researcher said that "Brazil has seen rapid economic growth but there is not enough investment from the Government in local services. There is a big divide" (Public sector interviewee, AN, Araras, August 2012).

One negative impact as a result of the USJ's practices in the area was the high levels of specialisation. All interviewees felt the collapse of this industry would have a significant impact locally and one interviewee raised specific concerns over powers exercised in relation to the high degree of specialism in this region. One interviewee talked about the fear that Nestle and the USJ deliberately try to keep other industries out of Araras in order to maintain power over their workforce and ensure they can attract and keep sufficient levels of staff.

> "The City has become highly specialised, which brings dangers with it as it is reliant on these industries. In the surrounding areas there are more industries. More industries are developing all around but this isn't happening in Araras."
>
> Public sector interviewee SP, Araras, August 2012

A local voluntary community group interviewee described how the Ometto family had paid for roads, which clearly assisted them with transportation of their own goods but also facilitated the development of other local businesses and the City as it is today. He said there were only dirt-tracks before the USJ funded the building of the roads. However, three interviewees remarked on the damage to roads as a result of the increased number of trucks going to and from the mill.

These same three interviewees also raised the issue of air quality from dust, due to this heavy traffic on the roads, specifically associated with the USJ's operations. Figure 19 demonstrates this issue by my own observations, captured photographically. The soil was present right up to the roadside in many areas and thus exacerbates the problem with air pollution from dust as traffic passes. However, also while on location, I witnessed the USJ wetting the dirt roads within the plantations (figure 20) to try to reduce the impact of dust but this appeared to be continual and difficult problem. People living near tarmacked roads also commented on this problem due to the main roads being surrounded by sugarcane fields where the edges of roads were just soil. One other interviewee who works at the local hospital raised the issue of smells coming from the mill's operations when they process the vinasse. However, this was not something that other people raised as an issue and therefore may be highly localised.

Figure 19: Lorry barely visible on road outside Araras due to dust (Source: author).

Figure 20: Lorry wetting by-roads to try to minimise dust and air pollution (Source: author).

All interviewees across the sectors talked of the high level of contributions the mill had made to environmental schemes, including re-planting schemes. Two interviewees (one from a local voluntary group and one from the public sector) talked about the way the USJ had recruited local prisoners to help carry out the work, as part of their work within the community. One public sector worker talked of the considerable number of trees planted by the USJ throughout the city. Another said that "the mill has already planted 700,000 trees as part of the project to restore riparian vegetation" (Civil society sector interviewee AG, Araras, August 2012). This work had involved a team of over 40 people and the schemes were talked about positively by two local community members and a representative from a local environmental voluntary organisation (APPA). The USJ was considered by the APPA representative to be a pioneer in recovering riparian vegetation and when they needed people to grow and plant trees, but didn't have enough workers, they offered training schemes and started a programme as a joint venture with the City. He said that "the mill and the Mayor paid for convicts to do the work and they paid them for their food and transport to and from the Nursery" but qualified this by saying "only convicts

allowed to work on this programme were those with a good record and well-behaved" (Civil society sector interviewee AG, Araras, August 2012).

20% of the land on which sugarcane is planted now has to be kept for natural vegetation and re-instated to its original, natural state, to help improve biodiversity and protect water resources. The mill's own Nursery is used for growing plants which can be used for replacing vegetation in marginal areas, riparian vegetation or re-planting natural/forested areas. In addition to this, the area is also benefitting through a local energy company which has donated funds to enable a public sector scheme to plant more trees in the City. This local environmental, voluntary organisation (APPA) interviewee said that:

> "Sergio Lede – a Chemistry specialist – he is dead now but was heavily involved and influential in the building of the mill. He was a Director of the mill and a President of APPA [local voluntary community organisation] – so he was very influential and concerned about environmental effects of the mill's development. He worked with the mill and also for the Community. "
>
> Civil society sector interviewee AG, Araras, August 2012

There was also evidence that local water resources were being protected by some of these planting schemes, such as the re-planting of riparian vegetation. This meant that the ponds or lakes on the land owned by the mills had their margins re-planted to protect waterways from run-off from the fields. This had also helped improve biodiversity in and around the plantations (discussed more in the next sub-section). The mill funds its own nursery, called 'Projecto Margem Verde' or 'green borders' project, where natural vegetation is cultivated and returned to field edges and around waterways (see figures 21 and 22). 40 years ago, swamps were drained for planting sugarcane and trees were removed but now the swamps have been allowed to regenerate and almost 100% of riparian vegetation has now been replaced, according to the civil society interviewee (from APPA). Again, this interviewee said that "Sergio was important to the recovery of the vegetation, the protection of water", he said that "Sergio was instrumental in realising the importance of this and setting up projects" and that he "helped convince the mill that they needed to

protect their peripheral vegetation" (Civil society sector interviewee AG, Araras, August 2012). The APPA representative also talked about another positive effect associated with the replacement of riparian vegetation and natural, forested areas. This was in relation to biodiversity as an animal called the Capybara, which lives in riparian vegetation, has seen a revival. This, he said, was good for biodiversity but was also raising some concern for the USJ (as it eats sugarcane!), increased numbers could have adverse effects on other species and it may be a problem for public health as it carries the vector of Rocky Mountain Spotted Fever.

Figure 21: Projeto Margem Verde, USJ's nursery (cultivates and re-plants riparian vegetation) (Source: author).

Figure 22: Projeto Margem Verde, USJ (Source: author).

Also in relation to water resources, and the protection of waterways by riparian vegetation, was the fact that interviewees did not raise the issue of water for producing sugarcane or processing it to make bioethanol. This appeared to align with experts accounts during stage 1 and the USJ's own statements about care of local water resources. It was determined through a site visit to the USJ that sugarcane grown on their plantation is not irrigated; the vinasse, a pulp waste product from the sugarcane processing operation, is returned to the fields to both irrigate and fertilise the soil. A local lawyer however talked about regulations from Companhia Ambiental do Estado de São Paulo (CETESB), a Sao Paulo state company that controls the environment that regulates the use of vinasse because excessive use can soak the soil and cause contamination. Therefore, this brings its own challenges and is restricted to some degree. The lawyer talked about the need for regulations on the use of vinasse, which are exercised within the Sao Paulo state, to inform regulations at the Federal level (and thus inform practices across Brazil).

In addition to the replacement of riparian vegetation around waterways (to help reduce run-off), soil erosion was also thought to be minimised by sugarcane production, due to the fact that the plants remain in place for around 5 years, which reduces tillage. According to one interviewee, in the North East, where sugarcane production had commenced historically, the soil had been exhausted from sugarcane production and lack of rotation and therefore much had been learnt from this experience. Generally, producers were responsible for preserving the soil through rotation and through the use of vinasse for fertilisation. As another interviewee said, it was in the producer's interests to do this to ensure continued high yields and thus this was regularly practiced throughout Sao Paulo state. She said "[t]hey do the maths!" (Civil Society sector interviewee FC, Sao Paulo, August 2012).

One public sector interviewee talked about his concerns in relation to the high degree of monoculture in this area. He said there is too much sugarcane and he would like to see more agricultural diversity. Indeed, the roads were lined with sugarcane (Figure 23 overleaf) and this was practically all you saw as you

drove around Araras. Further expansion of sugarcane was now highly restricted.

Figure 223: Sugarcane-lined roadsides, Araras, Brazil (Source: author).

All interviewees generally felt that, through recent national legislation, the expansion of growing sugarcane was being controlled. Therefore, the production of sugarcane and other food crops was being balanced and land of high biodiversity or carbon value was being protected. However, a research-based interviewee noted the importance of enforcing and monitoring by government agencies. In relation to the USJ, no interviewees raised concerns over expansion, land-acquisition or land rights issues because sugarcane had been grown on the same land in the area for decades. The Sustainability Officer at the USJ talked about his support for agricultural zoning as he felt there was great potential for increased production of ethanol without expansion, such as through increased efficiencies in the system or technological developments. A Civil Society interviewee (NGO) talked about schemes to intensify agriculture across Brazil, in general, that were achieving extra productivity on existing lands. This, he said, was helping balance sugarcane production with other forms of agriculture:

> "Brazil must be careful otherwise it would be all sugarcane. However agricultural zoning is considered a way of managing this and sufficient legislation is in place, or coming in, to manage this. The 10% protected areas is a good thing if people comply. Agricultural expansion is a problem. There has been a 20-30% increase in cattle raising on the same amount of land in recent years. There had been intensification. Cattle farmers were also renting out spare land to mills for sugarcane production so this was seen as a good thing for both the farmer and the mill."
>
> Civil Society interviewee FC, Sao Paulo, August 2012

All interviewees mentioned the contribution to recreational facilities in and around Araras, as a result of the USJ's presence or direct funding. For example, they talked about funded sports teams and the building (by the USJ) of the local sports stadium. However, some interviewees said that they would like to see more leisure facilities specifically, such as entertainment venues for the evening and a cinema. Younger people tended to go outside Araras, into the dormitory towns for these activities. There are some bars and restaurants in Araras but interviewees generally felt there is room for growth. All interviewees wanted to see more economic development and expansion of these types of services. This interviewee put it plainly, saying "[p]eople want to see more development, they want to see more diversity in the leisure industry, they want more to do" (Private sector interviewee, SE, Araras, August 2012). This, the interviewees said, relied on the USJ remaining in operation and thus contributing further to local economic growth in the future.

Sugarcane bioethanol production in Araras has clearly affected the environment, the ecosystems and services they provide to human populations in and around the site of production. The USJ's presence has clearly affected its workers, communities and environment and the evidence from interviewees confirmed that recognition of local people and the environment had led to the distribution of impacts across local communities. Furthermore, this was a condition of the mill's ethos, long before more recent sustainability standards were enacted. Thus, it was the recognition of the impacts that the mill had on its local communities, its involvement in local community projects and

partnerships with community groups that have helped deliver these outcomes over time.

Energy and food insecurity

These two particular, potential distributive justice issues associated with this type of biofuel supply chain are included here because these were significant distributional injustices perceived to exist by transnational governance actors and experts in the field during the first stage of research (chapter 5). Matters relating to energy security for UK-based consumers and food insecurity are discussed in this sub-section also because these same issues were also repeatedly raised by interviewees in Araras. These results show that, from the perspectives of people in Araras, increased competition for sugarcane bioethanol between domestic and overseas consumers will continue thus corroborating concerns of transnational governance actors and experts (identified during stage 1 research) that this type of bioethanol supply chain may not improve energy security for UK-consumers. With regards food insecurity for those in the producer region, however, concerns voiced by transnational governance actors and experts during the first stage of research were contested due to the specific regional context in which sugarcane bioethanol production occurs (in relation to this case study supply chain).

Energy security

Interviewees across the sectors in Araras confirmed opinions of transnational actors that over-reliance on Brazilian sugarcane bioethanol may not improve energy security for UK consumers. This was because they confirmed, from their perspectives, that there is a huge domestic demand for bioethanol in Brazil and during the last few years production has decreased due to weather conditions and the price of sugar (therefore the mills have diverted production to sugar instead of ethanol). Generally, all interviewees felt that the demand for bioethanol in Brazil would continue to increase because of new markets emerging in aviation, consistent mandates for ethanol blending with fossil-fuels sold at the pump and reduced tax on cars. All interviewees said that there was also a continuous stream of young people aspiring to own their own vehicles. Therefore, this is not a market that looks in any way likely to reduce in the near or long-term futures. One NGO interviewee went so far as to say that the UK

should not increase the blending mandates now because she felt there was not enough bioethanol available globally and Brazil was importing bioethanol from US corn feedstocks. This, the interviewee said, was because US corn-produced ethanol was cheaper than Brazilian sugarcane-produced and Brazilian mills had diverted attention to the more lucrative sugar-production. A local farmer echoed these concerns, saying that demands from Europe were putting pressure on ethanol supplies for the domestic market and he was concerned that prices might rise. Clearly, this could impact domestic consumers considerably as well as have knock-on effects across the economy. A trade union representative raised concerns about current levels of ethanol available in Brazil today, saying that "[t]here is a lack of ethanol in Brazil and we don't protect our market; we can still export even when supplies are limited" (Civil Society interviewee FT, Sao Paulo state, August 2012). Therefore, he said, increased demand for ethanol overseas could affect the degree to which demands from the domestic markets in Brazil were met (i.e. presenting risks for their own energy security). A local researcher said she felt there were sufficient supplies but there was a management problem. There were huge inefficiencies in the system, she felt, and a lack of monitoring. The USJ sustainability officer thought there was considerable scope to increase productivity through technological improvements and efficiencies in production, however, overall, interviewees were in agreement that considerable competition for sugarcane ethanol from overseas markets would continue to increase.

Food security

This was a prominent distributive justice issue raised in biofuels-related literatures (chapter 3) and governance actors' and experts' accounts (chapter 5). For example, concerns have been prevalent in published literatures as to the ways in which biofuels production could pose problems for food security for people in producer regions and globally (outlined in chapter 2). From the perspectives of all interviewees in Araras, however, they felt there were no directly related food security issues in this particular locality as a result of sugarcane bioethanol production. This was because sugarcane production was regarded by all interviewees as an inherent part of the food industry itself (i.e. sugar and alcohol) and the production of sugarcane continues whether or not

there is a demand for fuel ethanol; this is the way it has been for centuries. It is only the expansion of sugarcane production (which in the USJ is not appearing to be a problem) that could potentially displace nutritional food crops but while there is such significant demand for sugar, expansion could not be attributed to bioethanol production solely. Also, the interviewees said that state laws now controlled sugarcane expansion (i.e. Sugarcane Agri-ecological Zoning (ZAE Cana) (USDA, 2011)). Also, it was reported earlier in this section that a local farmer said that other food crops had been displaced to surrounding states over time but these were felt to be more productive because of more conducive climatic and environmental conditions in these states for growing other food crops. This was echoed by all local residents. The farmer explained that the hot, dry climate of Araras meant "food crops are much more difficult to produce and not economically viable - they need much more irrigation and fertilisation than the sugarcane" (Private sector interviewee PA, Araras, August 2012). As also discussed earlier in this section is that the sugarcane pulp (vinasse) was put back on the soil for fertilisation and irrigation as part of the USJ's sugarcane production practices.

An elderly resident of Araras, who's family had been sugarcane (sugar and alcohol) producers agreed that agricultural productivity between the states in and around Araras had increased as they specialised. She said there was plenty of food production in surrounding areas, which was imported in to this region, so everyone benefitted from the trade. She said "I don't see a problem with food production because it's been this way for years here and food is still plentiful - even if grown in surrounding areas. Food prices have gone up but this is probably due to external factors - not the sugarcane/ethanol industry" (Civil society interviewee FA, Araras, August 2012). She said that although food prices had risen, so had wages, economic development and the quality of life in the area in general and so she felt it was all relative. A wife of a production worker at the USJ, a part-time driver, an employee at the local school and a member of a voluntary organisation in Araras all said that they felt sugarcane ethanol production was not the cause of food price rises. They felt other factors, such as rising demand generally and overseas (such as China) contributed to the price rises as well as local taxes.

An NGO representative also talked about the lack of concern for food production as a result of sugarcane ethanol production in Brazil because she said that if food became scarce in Brazil, food prices would go up and farmers would revert to food production; the market would re-adjust accordingly. She talked about food surpluses including the fact that rice farmers were going broke because there was no market for their rice. She talked about food insecurity as a problem of wealth and unequal distribution of food and too much waste rather than the lack of supplies.

What this shows is that situated, contextual data are important in relation to specific bioethanol (and biofuel) supply chains in order to understand the distributive justice issues and the ways in which local communities in producer regions are affected, in the ways advocated by Hodbod and Tomei (2013), Hodbod et al (2015) and Blaber-Wegg et al (2015).

6.1.2 Roles and responsibilities for governing biofuels

All interviewees in Araras talked about equally vital roles for businesses and governments if social and environmental outcomes associated with biofuels are to be properly managed and the impacts equitably shared amongst those affected. Instead of a 'top-down' relationship, where the private sector responded to requirements from the government (which was apparent in the findings discussed in chapter 5), people in Araras felt that it was important that those in the private sector were equally committed to better social and environmental outcomes and this is why the outcomes in Araras have been better than in other parts of the sector or across Brazil.

An interesting exclusion, again, is the consumer in terms of their roles and responsibilities for ensuring equity in relation to their biofuel purchases. This is because people felt that the consumption of bioethanol had been mainly imposed (in Brazil and in the UK) by governments and the market had not been consumer-driven (i.e. where consumers are considered to be end-users).

In chapter 3 it was highlighted that governing actors' abilities to carry out their roles and responsibilities is impaired because of the lack of evidence available about the way social and environmental outcomes are distributed (in relation

to the production and consumption of liquid biofuels). One interviewee in Araras, a local university lecturer, specifically raised the lack of unbiased, factual information relating to specific biofuel products as a procedural injustice. He questioned whether European policymakers were in a position to make decisions about which biofuels to incentivise or support in their attempts to increase the sustainability of transport when, he felt, there had been major misrepresentation of the biofuels industry in the media. This clearly reduced the ability for stakeholders to participate effectively in decision-making processes and certainly, he said, this was the case in relation to the social component of sustainability ideals. He said that "this sector has improved greatly [since slavery that was prevalent in the sugar industry since the colonisation of Brazil] but there are still problems and it bears this stigma … Sometimes I have the feeling that people think that all the bad stuff is in this sector - the truth is, it's all over, in every sector" (Research Community Interviewee RC, Araras, August 2012).

6.2 Discussion and conclusions

The findings in this chapter substantiate claims in energy justice literatures of the interrelationships between equity issues in terms of the individual dimensions of justice (as discussed in chapter 2 and demonstrated in figure 1). Specifically, the findings provide empirical evidence of the complex ways in which matters of recognition and procedural justice can drive matters of distributional justice in relation to internationally traded liquid biofuels. For example, these findings reveal ways that matters of recognition and procedural justice can change the patterning of social and environmental outcomes amongst people connected to (and affected by) an international bioethanol supply chain - driving improvements in the equitable distribution of benefits and burdens as well as injustices. Examples of this are demonstrated in sub-section 6.1.1 where private sector, civil society interviewees and those from the research community felt that producers are unfairly responsible for meeting costs associated with higher social and environmental sustainability standards imposed by consumers and public sector policymakers. In addition, this was making conditions difficult for smaller-scale producers, who are less able to

access support or finance to make the changes required to their working practices to meet these standards, and thus driving further concentration in the market into the hands of larger and more powerful producers (aligning with the findings of Bergquist et al (2012), the National Agriculture Confederation (in CIFOR, 2011) and Machado and Walter (2011) for example). Conversely, for residents of Araras, these changes had brought about improvements to their qualities of life. This was because, from their perspectives, the recognition of social and environmental outcomes for sugarcane-bioethanol producer localities are included within VSCSs, local laws (i.e. labour laws (Coslovsky (2014), agricultural zoning (USDA, 2011) and laws controlling field-burning (and which promote mechanisation of the harvest) (Abex et al. 2007; ELLA, 2009)), as well as the USJ's CSR policies. Thus, the recognition and representation of local communities' interests within decision-making processes (i.e. improved procedural justice) can be considered drivers of a more equitable distribution of impacts across the supply chain (and thus improved distributional and energy justice). The positive issues experienced by residents in Araras, from their perspectives, are a result of the combination of the USJ's long-term CSR policies and investment in its local community, local sustainability laws and/or the USJ's compliance with a broader and more comprehensive VSCS than the EU RED or FQD stipulates (EC, 2009). In addition, from the small-scale farmer's perspective, while he had been required to change some of his practices and crops, he was still able to benefit from changes in the market (i.e. by supplying his crops directly to a larger, local sugarcane bioethanol producer).

What these findings begin to demonstrate is the importance of in-depth, qualitative enquiry in terms of the information that can be produced from an equity appraisal, if conducted in the way advocated by energy justice and associated literatures reviewed in chapter 2 (i.e. Bickerstaff et al. 2013; Sovacool and Dworkin, 2015; Stirling et al. 2007; Stirling, 2008; Walker, 2012). This is because the perceptions of governance actors from a distance may not be representative of impacts felt on the ground; contextual, situated perspectives are needed from people at local levels to help understand the nature equity issues that may exist. The impacts of mechanisation in Araras and the benefits this was bringing across the local communities are exemplars

of the types of complex, interrelated and nuanced impacts that occur in particular regional contexts. This was also the case in terms of perceptions of food insecurity by transnational governance actors and experts which were inaccurate in relation to this particular type of bioethanol supply chain. Again, the findings in Araras are clearly more positive overall than implied by findings (and viewpoints) from the first stage of research (discussed in chapter 5).

The USJ has assured access to UK markets via its compliance with the Bonsucro and Greenergy awards and its genuine commitment to its local community and environment. Its performance ensures it's a 'safe bet' for Greenergy, as it distributes its fuel to its retailers (thus taking on the responsibility for ethical purchasing as discussed in chapter 5's first-stage research findings). This demonstrates mutual benefits when companies recognise, includes and works with its local communities, rather than pitching itself against society (in the way that Visser (2010), Grant (2007) and Porter and Kramer (2006) suggest).

People in Araras also attributed equal roles and responsibilities for private and public sector actors in relation to governing liquid biofuels, to ensure an equitable distribution of social and environmental outcomes (rather than the 'top-down' relationships suggested by governance actors and experts during the first stage of research). However, as the findings from the first stage of research show, their ability to perform these roles are significantly impaired due to the lack of information available about the ways in which individual liquid biofuel products impact on local communities, socially and environmentally (and the ways in which these impacts are distributed). This significantly impairs the chances of achieving energy justice overall.

The next chapter presents the second-set of findings from the second stage of research. These are the findings from interviews conducted in and around the site of consumption; North Walsham, North Norfolk, England in the UK.

Chapter 7: Equity issues at a site of consumption and disposal (North Walsham, UK)

In Chapter 6, a wide range of complex and context-specific issues were presented from findings through interviews with people in the producer region. Many of the distributional outcomes identified were far more positive that might have been assumed according to the literature review outlined in Chapter 2 and from interviews with transnational governance actors and experts in the field discussed in Chapter 5. Findings from qualitative data collection and analysis during this second stage of research involving stakeholders at the site of consumption and disposal are now presented. The actors interviewed at the end the supply chain are people who live or work in and around a small market town, North Walsham, in Norfolk, England.

This example site of consumption was chosen for the purpose of situating the study in the UK, ease of data collection and accessibility. Also, this rural, agricultural district of Norfolk produces sugar beet for both sugar and ethanol production and thus has at least some similarities with the production end of the chain. The filling station used for the focus of consumption in the UK is operated by Sainsbury's in North Walsham, a town described in chapter 4.

As with the previous empirical chapters, these findings are presented in themes, drawn from interviewees narratives via the qualitative data analysis described in chapter 4. Again, as with the previous two empirical chapters, these themes are organised to draw specific references to matters of recognition and procedural justice and the ways in which these drive the distribution of outcomes across those affected. What will be immediately apparent is the range of themes and issues raised that are different to those raised by people living in and around Araras. Equally noticeable are the ways in which consumers express their concerns about injustices, which show them to be markedly different to the uncaring and unaffected set of stakeholders that UK-consumers were perceived to be in the literatures reviewed in chapter 3

and by interviewees' perceptions discussed in chapters 5 and 6. Furthermore, the types of issues raised by consumers are more wide-ranging than the limited issues that consumers were perceived to be experiencing by transnational governance actors and experts in the field which again highlights the need for in-depth, contextual and qualitative enquiry to fully appreciate the ways in which particular stakeholder groups are affected.

The diverse set of people that make up the consumer stakeholder group was often imagined and referred to in the literature (chapter 3) and interviewee narratives (chapters 5 and 6) as a single consumer community which are largely uncaring, unaware or unaffected by the type of liquid biofuel supply chain on which this case study is based. However, the issues raised in this chapter show that consumers identify procedural injustices that affect their levels of awareness about their bioethanol purchases and which affect their ability to participate effectively with associated decision-making processes (i.e. lack of information (Blackstock et al, 2007; Laird, 1993)). Also, concerns were expressed in terms of distributional justice, in terms of impacts and costs for people in producer regions as well as UK-based consumers more broadly (in line with findings from existing energy justice research that showed consumers to be concerned about the way impacts are shared as a result of energy implementations, such as Devine-Wright (2005), Gross (2007, 2008), Wustenhagen et al. 2007; Walker, 2012). Consumers also questioned dominant UK policies that determine the way these liquid biofuels are consumed in transport, such as through blending, expressing preferences for other alternative practices that might help deliver more sustainable, just and socially acceptable liquid biofuels (again identifying matters of recognition and procedural injustices as drivers of particular outcomes, such as the preferences for international bioethanol supply chains of the case study type to feed UK consumption through blending mandates).

7.1 Equity issues and their interrelationships in North Walsham

It was clear that all UK-based consumers interviewed felt that bioethanol was not a technology generally associated with renewable energies in the way that more visible technologies were (i.e. wind-turbines or solar panels) (aligning with interviewees' perceptions in chapter 5). This was because bioethanol was regarded to be more 'invisible' than these other renewable energy technologies. However, once interviewees were introduced to brief information about bioethanol and the feedstock dominating UK supplies at that time (such as the focus of this supply chain[10]) they raised a range of interconnected and complex issues. Again, the issues are not organised by significance, as all the issues raised are considered equally important because they were the main themes repeatedly raised across all interviewees (and thus significant issues that emerged from the qualitative coding analysis explained in chapter 4). The following themes are highly interrelated but have been separated to (i) highlight specific forms of distributional injustice that consumers raised and (ii) discuss the matters of procedural injustice or misrecognition considered to be driving these outcomes.

7.1.1 Social and environmental outcomes in North Walsham

Energy security and domestic production of biofuels

The ways in which consumers felt themselves left vulnerable to energy insecurity (i.e. a matter of distributional injustice) as a result of a procedural injustice because of their inability to influence dominant biofuels-consumption related policies (i.e. blending mandates) are now discussed. Furthermore, the ways that consumers felt that blending mandates were causing distributional injustices in relation to UK-based biofuels producers are also shown.

In chapters 5 and 6, the extent to which renewable energy policies that seek to increase security of sustainable fuel supplies for UK transport (i.e. the UK's Renewable Energy Strategy, the EU RED and RTFO (DfT, 2015a; EC, 2009)) were questioned. For example, the extent to which blending mandates could deliver

[10] Information provided to interviewees about this research project and the case study supply chain is provided in appendix 2.

these purported benefits were questioned by both transnational governance actors and experts, if they relied on imported sugarcane bioethanol. This was because of increasing, global demand for bioethanol and agricultural commodities in general. At the site of consumption, all interviewees felt that UK transport energy security was a significant concern if it relied on imported bioethanol. This was because, they said, of increasing pressures on land availability, competition for agricultural produce in general, globally, including demand for food – all of which could result in price volatility. Interviewees soon connected production of biofuels with global agricultural markets and food production, both of which were regarded as unstable mechanisms on which to solely base UK sustainable transport policies. For these reasons, all interviewees in North Walsham felt that policies and incentives for domestic production of liquid biofuels (specifically from wastes and residues) should dominate sustainable transport policies, alongside demand-reduction measures (discussed further in the following sub-section 'food security and wastes').

A local transport company representative talked about ethanol supplies in relation to complex, interrelated cultural and lifestyle shifts associated with developing countries and Brazil specifically that would increase competition for agricultural commodities in the future. He said that:

> "In somewhere like Brazil, with their economy growing as it is, they're not going to want to export their biofuels anyway are they, in years to come? I mean, as they get more money, the classic thing is to eat more meat, isn't it? Meat production takes loads of land and the land is going to be in great demand for other things anyway."
>
> Private sector interviewee MS, North Walsham, October 2012

In chapter 6, increasing demand for bioethanol from the aviation sector in Brazil was identified and 3 interviewees in North Walsham also raised this as a particular issue in relation to future bioethanol supplies, increasing competition for the fuel and increased pressure on land availability. A local biofuels activist said:

> "The thing that does worry me about liquid biofuels is the aviation side. When you work out how much land would be needed to meet

> this demand – I think there was an article in the New Scientist that said you'd need a land area the size of Ireland just to push the % use in aviation fuels up a really small amount. I did further calculations and I reckoned you'd need 200 million hectares of additional arable land to do what they wanted with aviation fuels."
>
> Civil Society interviewee AB, October 2012

Although all interviewees showed support for UK production of biofuels they clearly stated certain caveats; that the liquid biofuel, including bioethanol, should be produced from bi-products or wastes from the agricultural or food systems. Three interviewees specifically suggested this might be through networks of district- or farm-level production facilities, like anaerobic digesters, that can turn organic matter, such as the wastes described above, into liquid biofuels and biogases for use in transport (Tickner, 2015). This is exemplified in this interviewee's statement:

> "They're making methane using anaerobic digesters. Now that's good thinking. Using waste to make fuel instead of sticking it in a hole in the ground."
>
> Local Resident, Consumer and Mechanic, North Walsham, October 2012

Three local residents questioned why the UK is importing liquid biofuels when solutions like this exist and Norfolk region is a largely agricultural area. In fact, all interviewees suggested purchasing preferences for locally-produced fuels, subject to price (i.e. if they were not significantly more expensive than imported biofuels as the cost of transport, they felt, was particularly high at present already). An NGO also raised the issue of price affecting purchasing preferences, pertinent to this area of the UK which has high levels of multiple deprivation and low incomes (DoH, 2012; Norfolk Insight, 2008; Norfolk Insight, 2010).

> "… the people who prefer to buy Fairtrade and organic produce … those are the people who are left-wing environmentally aware people who have enough money to be able to make the choice. If you're on a low income, you can't afford to make the choice. You will go for the cheapest … If the numbers stacked up to show that using

> ethanol was more environmentally friendly - genuinely - including all production and transport costs - I would pay more for it - but the numbers would have to stack up."
>
> Civil Society interviewee RM, North Walsham, October 2012

One interviewee suggested that domestically-produced biofuels from wastes might even be cheaper in the long-run, once facilities were established:

> "Why can't it be sourced locally? It must cost a lot to transport it over here. I would prefer to purchase locally produced fuel on this basis. The cost of fuel has gone up drastically since I started driving. Anything to help reduce costs would be great."
>
> Civil Society interviewee CP, North Walsham, October 2012

All interviewees felt that local production might bring a range of social and economic benefits to the region, in addition to contributions to sustainability ideals and improved energy security. These included increased economic development through employment and training, as well as waste reduction and reduced transport costs. All interviewees also felt the lack of investment into domestic production of biofuels was insufficient and short-sighted. This interviewee said that:

> "The Government is uniquely placed to help develop our own industries to manufacture and produce renewable energy technologies … we should be investing in the development of our skills and industries rather than importing them in because there is likely to be a long-term market and demand for these goods."
>
> Public sector interviewee GJ, North Walsham, October 2012

This interviewee talked about the ways in which policy incentives might drive investment in the sector and help achieve long-term gains across the economy:

> "… if they actually said we'll absorb the cost of this for 2 years it would drive the industry sufficiently it could allow local plants to be put in place to produce this stuff, you know, allow local production capacity to increase and make a profit. You could slowly allow the cost of the fuel to rise later but at least it would give the chance for

> the investment to be made in local capacity. Effectively this is what happened in Brazil."
>
> Civil Society interviewee RM, North Walsham, October 2012

Three interviewees, already working in the UK bioethanol production sector, also raised issues with UK policies that might help stimulate this market. Sugar beet, which is heavily produced in Norfolk and has similar properties to sugarcane, is a suitable product and, as identified in chapter 5, surplus sugar is used to produce bioethanol in the region currently. However, this interviewee said that government policies affected the capacity of domestic production, putting overseas producers at a competitive advantage. Domestic production, he said, required public and private investment and policy certainty, none of which is thought to be happening presently.

> "Sugar or ethanol is more expensive to produce in Europe therefore sugar beet growers are at an economic disadvantage compared with overseas (particularly tropical) producers. The British sugar industry is protected by subsidy and effectively operates in a bubble … there isn't fair competition at the moment - the market is skewed. "
>
> Civil Society interviewee JS, East of England, October 2012

Food security and wastes

Food security concerns featured heavily in interviewees' narratives and thus are discussed here. These issues significantly relate to the theme above but also highlight, and substantiate, matters of procedural justice in the way that interviewees from certain sectors (i.e. NGOs) have more ability to produce and disseminate information about specific liquid biofuels or production practices than others, which can affect the perceptions of everyone (Gnansounou, 2011). This was thought by three interviewees in the civil society and public sector to have ultimately affected the ways in which the UK market has developed, due to oppositions to biofuels that have led to policy uncertainties and reduced levels of investment. This is a matter that has been raised in chapters 3 (informed by works such as Bennett, 2011; Berti and Levidow, 2014; Rutz and Janssen, 2013), 5 and 6 and also relates to claim-making, evidence-bases and

inadequate sources of information as specific forms of procedural injustice (i.e. Blackstock et al (2007), Laird (1993) and Walker (2012) in chapter 2).

Unequal distribution of food, and food wastes, were matters which all interviewees strongly felt needed to be solved, but all equally felt that the focus on polarised and simplistic fuel versus food debates were unhelpful because of the range of interconnected factors that might affect the degree to which some biofuels may drive food insecurity. For example, a local activist said:

> "Food versus fuel is a problem but there are a whole other set of problems with food - there is enough but it's how we distribute it and the amount of waste we produce that's the problem. It doesn't mean that food versus fuel isn't an issue … but I don't think biofuels is the absolute issue …"
>
> Civil Society interviewee CW, Norwich, October 2012

As implied in the section above, interviewees favoured policies that tackled the unfair distribution of food (globally), the reduction of food waste and investment into second-generation fuels (i.e. biofuels from food or agricultural wastes) rather than crops grown specifically for fuel. An interviewee that worked directly within the sector phrased this matter succinctly:

> "The food versus fuel debate is an old and out-dated argument. Agricultural production can be expanded and up-scaled in Europe and elsewhere sustainably to provide enough food and fuel for the global population. However, we need agricultural reform in parts of the world to achieve this, better and more equitable distribution of food, increased efficiency and reduction in waste (either before or after processing). This needs investment."
>
> Civil Society interviewee JS, October 2012

A public sector interviewee and two from civil society also specifically questioned why food versus fuel debates, in relation to sugarcane, appeared to prefer feedstocks to be used to produce sugar rather than fuel. Particularly when there are significant health and social costs related to excessive sugar consumption (NHS, 2013; Quinn, 2012; SACN, 2014; Te Morenga, 2013; WHO, 2014). This appeared, to them, nonsensical. One interviewee said "[t]his

business over biofuels is a much wider issue than gets talked about - it's about the health of the population as well as energy - and a host of other things" (Civil Society interviewee CU, October 2012).

What this highlights is that all interviewees expressed frustrations with the lack of information about specific liquid biofuel products, which tend to get tarred with the same brush. This was an issue for interviewees because of the highly different types of feedstocks and production practices likely to exist in the system (also discussed in chapter 3). For example, interviewees felt that issues raised in relation to bioethanol produced from sugarcane were likely to be very different from implications of bioethanol produced from corn, which a few interviewees said they had heard about in media reports. Simplistic food versus fuel statements, they felt, were not doing the industry any good, affecting publics' perceptions and potentially levels of investments that might help develop the biofuels sector develop in the UK.

Four other interviewees raised issues of unsustainable practices in the system, such as excessive meat consumption and the associated production of animal feeds, which all related to food versus fuel debates and issues that needed tackling. Three-quarters of interviewees mentioned that strong governance was essential to control agricultural expansion, land-grabbing or displacement of food crops as a result of fuel production. However, all but four of the interviewees explicitly felt that farmers produce according to demand and what they can command a good price for and therefore distributers, retailers and consumers are ultimately responsible for controlling or curbing demand. A key message to be highlighted here is that, across all interviewees, sustainable agriculture is by far the over-arching objective and food waste needs to be eradicated first and foremost – biofuels are just one component in a much larger agricultural system. Again, two interviewees questioned the amount of land used for other 'unhealthy' crops which took up large amounts of land. This interviewee said:

> "Does sugarcane grow in areas where they grow tobacco? I mean, if we could get people to diversify from tobacco to sugarcane that would be good. If we could encourage the production of crops which

> benefit the world as a whole, rather than things like marijuana, then .... I mean the motivation to grow crops is always to do with how much income you're going to get. so if you could diversify without upsetting the ecological balance, and to the benefit of mankind ...."
>
> Civil Society interviewee CU, October 2012

In summary, all consumers interviewed felt that food security issues in relation to this particular supply chain, and others like it, were complex and other interrelated factors were matters that needed higher levels of attention than the use of bioethanol in transport – provided it could be produced from wastes, residues and bi-products of the food and agricultural sectors. Local councillors interviewed said that food versus fuel concerns are not being raised by constituents, which was thought in general to be due to lack of awareness. This, they felt, may change if labelling commences at the pumps. This aligns with experiences in Germany and Niven's (2005) findings in Australia, where higher levels of opposition and controversy emerged as more people became aware of the biofuels element in the fuels they purchased. This section has highlighted the lack of information available in relation to specific biofuel-products which would enable consumers to engage more actively and effectively in appraisal processes of biofuels than is currently possible (this is creating a procedural injustice in the way defined in chapter 2 and highlighted by Blackstock et al (2007), Laird (1993) and Walker (2012)).

Costs of higher bioethanol blends in unleaded petrol

Consumers in this stage of research talked much more about potential costs as a result of infrastructural damage or changes required to cope with ethanol blends in fuel than governance actors' and experts' accounts had suggested (chapter 5). This suggests a particular distributional injustice in terms of an unfair burden potentially placed on UK-based consumers because of changes to infrastructures (including their vehicles) without prior knowledge, consent or ability to influence biofuels-consumption related policies (i.e. raising an issue of a procedural injustice in the way defined by scholars such as Blackstock et al (2007), Laird (1993) and Walker (2012) as discussed in chapter 2).

Interviewees including garage and car owners, with knowledge and experience of these types of fuel, were amongst those who expressed concerns. The reasons for this may be that transnational governance actors and experts rely on publications which have focused on other aspects of the biofuels system (i.e. research into food security issues, land use change and land attainment). The matter was however raised by Niven's (2005) study in Australia where he talked about costs to consumers as a result of higher level ethanol blends in petrol – such as E10. These types of study were much less apparent in literature searches than findings in relation to other research into biofuels referred to above. Many interviewees at grassroots level raised questions as to the real world benefits of the current biofuels policy if replacement parts in vehicles or pumps are required to cope with this renewable fuel entering the system. Questions were raised, therefore, over the extent to which bioethanol was really offering more sustainable outcomes than other options or whether these policies are just offsetting costs elsewhere.

Higher level mandatory blending, a matter which all consumers feel they had little control over (and thus a matter of procedural injustice), was thought by a local mechanic to potentially bring costs that would hit those on lower incomes and those in more rural areas hardest. North Walsham has higher levels of poverty and income inequalities compared with the rest of Norfolk and the UK (DoH, 2012; Norfolk Insight, 2008; Norfolk Insight, 2010) and while there is public transport from North Walsham itself, it is difficult if living in outlying areas to manage social, work and educational activities without private transportation. Those that had to rely solely on public transport, were they no longer able to afford to run a car, would find their activities extremely limited if costs continued to rise, threatening the social and economic sustainability of these rural areas. The following two interviewees, at either end of the age spectrum, highlight these issues and are presented to show the ways in which higher costs of transport, potentially as a result of issues relating to higher bioethanol blends, would affect their qualities of life.

The first from an elderly resident, and the second from a young student who attends the local College but works in Norwich part-time to supplement her income while studying:

> "Living in a rural area, people are much more dependent on independent transport. I mean if you live in London you could quite happily do without a car. In fact a car is an impediment as it costs money to look after, park and store etc but if you live where I do, where there are no buses, and you lead an active life which involves going all over the place, you can't manage. You really can't. We have one or two buses but they come at the most inconvenient times and you just can't tie things in with them. You just can't fit everything in."

Civil Society interviewee CU, October 2012

> "I live in Wroxham and drive to College but I also work in the City. But it's so expensive that I might go back to public transport. But this takes more time so it's preferable to use the car. I will find it more difficult to fit everything in. It would reduce the amount of hours I could work. I work Thursdays in the city centre so when I finish College I have just half an hour to get to work - I couldn't do that on public transport so would have to lose that shift. I can't afford not to have a job. It would also affect me socially too because I wouldn't be able to do so much."

Resident, Consumer and Student, North Walsham, October 2012

Around a quarter of interviewees asked questions about costs for consumers (and society in general) associated with moves to higher blends of bioethanol in unleaded petrol, including E10. This was either due to concerns about their cars, as they had insufficient information and advice or due to other infrastructural changes. For example, higher ethanol blends have been associated with corrosion of some seals and components (FBHVC, 2014; What Car?, 2014) and would need replacing. For example, this interviewee talked about impacts he felt he was already experiencing, such as corrosion of engine parts due to the bioethanol content in fuel he purchased. He also had a number of colleagues in his classic car association to which he belongs, verifying claims made by the FBHVC (FBHVC, 2014) of these effects (discussed

in chapter 3). This interviewee was an engineer, with specific knowledge of the biochemistry of ethanol and effects on engines.

> "Bioethanol is not friendly for car engines and it plays havoc with my classic car. We have been pre-warned and we had noticed breakdown of fuel pipes more quickly since the blending - particularly on the classic car. And we aren't the only ones - we belong to a classic car club and others are having the same problems. The ethanol attacks the rubber pipes. It doesn't end there -all engines have got rubber derivatives, seals all over the place, lots of components have to have seals and it corrodes them. So in your attempt to save a proportion of GHG emissions with your bioethanol, you've used far more replacing components over a 12 month period! This is another reason we need to look at things more holistically when we consider whether things are more sustainable or not. I feel a loser in the system because of the impact on my car and I can't make a choice to put anything else in it."
>
> Private sector interviewee RD, North Walsham, October 2012

Cars over 10 years old are thought to be most susceptible to engine problems as a result of higher blends in petrol and the majority of interviewees agreed that any costs of moving to E10 would hit people on lower-incomes hardest. As the existing car fleet is naturally replaced, this might become less of an issue. However, this would take some time. Also, there were issues raised by this interviewee in relation to costs associated with providing choices of fuels (i.e. such as E10 or legacy fuels) which some consumer groups were already lobbying for (FBHVC, 2014). This could mean only larger retailers (i.e. supermarkets particularly) may be able to offer the choice whereas the smaller garages and forecourts may not have the space or resources to fund the provision of additional pumps on the forecourt. This was also a matter also raised by a Downstream Fuels Association (DFA) representative. This interviewee said the squeezing out of smaller fuel retailers was already an issue in the area:

> "When we first moved to North Walsham there were 5 filling stations but Sainsbury's have squeezed these out because of the cheaper fuels they offer. They now have the monopoly. They don't make a lot from the fuel - their margins are very low - but use it as a way of

> drawing people in and they have more buying power, so they've squeezed the independents out of the picture in North Walsham. But we're all responsible. We've helped create this monster."
>
> Private sector interviewee RD, North Walsham, October 2012

The few interviewees above that raised issues of effects on cars also then questioned the 'sustainability' benefits that these fuels offered, for example, if it meant that components and vehicles themselves needed replacing. A local garage owner and mechanic, with over 35 years' experience in the industry, talked about problems with increasing bioethanol blends and the increasing need for replacement parts as a result of these changes in the system:

> "Well how the engines are going to cope with that I have absolutely no idea. I mean they'll probably have to add more additives in to cope with it. Things have got to change … There are a lot of cars in our fleet which are going to see problems. And the newer cars are going to have to have some changes too - maybe software changes - I don't know. But you can't do that with the old engines. It's all about saving emissions isn't it? And stopping taking the oil out of the ground. It's meant to be more environmentally friendly - less emissions - that's what's driving the whole merry-go-round - what emissions we're putting up into the sky. I think they've jumped one way and are causing other problems. There is such a waste in parts. I mean they reckon when they make a CAT there are so many emissions you'd be better off not having catalytic converters. I mean to manufacture these things you need the precious or rare metals like rodium, platinum etc and they're horrible things aren't they and there are problems associated with mining them aren't there? I mean you're just moving the problem around a bit aren't you?"
>
> Private sector interviewee KC, North Walsham, October 2012

His final response highlights nicely plural notions of justice, in relation to different stakeholders and the ways in which they can be affected, but also the fact that injustices to others affects the degree to which some people accept forms of renewable energy. This mechanic said that, for him personally, these impacts bring benefits because of increased levels of trade for his business as a result of liquid biofuel blends. However, he also said that "[t]he quality of

whatever we're sticking in our tanks has to be right for everyone" (Private sector interviewee KC, North Walsham, October 2012). What is also clear is that there is indeed a need for evidence-based information on the benefits and costs of the fuels in different level blends and in relation to different vehicles, as recommended by Yan et al (2013).

Consumer ethics

What is already apparent in this chapter, is that all consumers interviewed during this stage of research felt unable to engage adequately in debates over the use of bioethanol in unleaded petrol, and liquid biofuels in transport generally, because of the lack of information available to them. The findings in this sub-section draw together some of the issues raised to highlight the degree to which all interviewees expressed their frustrations relating to procedural injustices and the inability to engage adequately in debates about liquid biofuels or express purchasing preferences.

Four interviewees specifically expressed these matters of procedural injustice in terms of unethical practices. For example, the fact that they could not choose to boycott purchasing liquid biofuels as they travelled. One interviewee said that she felt unable to 'opt out' without major costs or lifestyle changes and that this was particularly a problem for rural residents. She said "I am definitely an unwilling consumer. I don't want to purchase it but I have no choice. It completely compromises my ethics" (Civil Society interviewee CW, Norwich, October 2012). Another interviewee (a member of an NGO) said:

> "I am a consumer of unleaded petrol. As an environmentalist I try to reduce my consumption. However, I am locked into using this product. If there was a choice between ordinary petrol and one which contains ethanol, I would probably buy the ordinary. I think that despite the issues with fossil fuels, the ethanol is causing more damage when you consider all the things we've talked about, really."
>
> Civil Society interviewee AB, Norwich, October 2012

To highlight feelings expressed within the themes already covered, this interviewee also discussed this issue directly in relation to the lack of information for consumers and a matter of procedural injustice highlighted by

transnational actors and experts in chapter 5. This was a frustration especially expressed by producers of bioethanol at that stage of research. This activist said that the inability to distinguish between different biofuel products and lack of information about the sustainability of individual biofuel products was the basis for breaches of consumer ethics:

> "There is a lot of confusion about biofuels and part of the problem is that the term biofuels is used to cover such a vast range of products or sources. Biofuels tends to be a catch-all phrase … I am one of the small minority that know there is an element of biofuel in the petrol that I'm buying but I wouldn't know how much, what it is or where it comes from. I think I found out initially that biofuels were in my petrol through Biofuelswatch."
>
> Civil Society interviewee CW, Norwich, October 2012

All interviewees who had previous knowledge of bioethanol or biofuels confirmed that they had gained their information from media coverage or information disseminated by NGOs or activist groups. One interviewee suggested it was more likely that people might be more accepting of liquid biofuels if they had more information and they could exercise purchasing preferences, saying:

> "It would be good to get the public educated before they suddenly start seeing these notices on the pump [referring to E10 labelling]. The media will start promoting it then but it's always good to get people in the mind-set before these things start appearing. People always like to get the wrong end of the stick. You always get the 'anti-lobby' which are going to put forward a strong case. And these people are often very good at expressing themselves. So you need clear balanced information out there. People see the headlines, it grabs their attention, but then they often don't delve down any further."
>
> Civil Society interviewee CU, North Walsham, October 2012

Sustainable transport policies

The matters discussed here highlight procedural injustices, in the way that decision-making processes relating to sustainable transport appear to be closed

down or restricted either by who they include or what opportunities there are for a wider set of stakeholders to help shape and design other policy options. This directly affects the way the biofuels are used in transport and the ways in which associated outcomes manifest themselves across affected stakeholders. What is also highlighted by one interviewee is the misrecognition of community group members and alternative approaches to dominant, incumbent energy (or biofuels) projects by local public policymakers.

All interviewees felt, to some degree, unable to influence public sector policy options that might increase sustainability in the transport sector. As highlighted in previous sections of this chapter, all interviewees expressed some level of concern about how they were being forced into supporting a policy for increasing the amount of renewable energy used in transport when there may be other, alternative pathways. Interviewees felt they had little ability to influence alternative policies that might achieve the same or better results, other than the mandatory blending of liquid biofuels into all fuels sold at the pump. This local councillor said that:

> "If I was going for cutting down carbon emissions from transport, I would be going for cycle lanes, public transport and trains and trying to make all those things more useable. I mean there are health benefits there too - it's much better for society - much better to get people out of their cars. If I had any power at all that would be my priority."
>
> Public Sector interviewee AH, North Walsham, October 2012

All interviewees felt that there was not enough investment into alternative ways of improving the sustainable of transport, such as through cycling, trains, reduced bus and train fares, electric vehicles or vehicles that can use biogas (again produced locally from wastes as discussed earlier in this sub-section 7.1.1). Biogases were mentioned by a few interviewees as potentially being a fuel that could be used for public transport, in the way they had heard were successfully used in some other countries (e.g. in Lithuania, see Kliucininkas et al. 2011)). However, another public sector interviewee talked of frustrations relating to funding cuts for local governments and thus the lack of funds

available to invest in these types of scheme. He talked of the difficult decisions that had to be made when dealing with such a rural county as Norfolk. For example, he said Norfolk County Council spends £10m each year on getting children to school and highways issues. He said that:

> "We are in the middle of spending cuts with more expected in 2014. So our emphasis is definitely more on becoming a business rather than just a spender of everyone's taxes. We're investing into road repairs because we have roads falling apart. Then it's going on some bigger transport schemes - such as buses - and then cycling and walking schemes are kind of third in the pecking order. That doesn't mean we're not investing in those networks but it comes down to the number of people affected. We're having to be more choosy than we've ever been before. We're not investing much in biofuels at all at the moment but fuel from waste would fit the model nicely. Whether or not we've got the skills to do that internally is a different matter. We're having to whittle down our staff drastically. Forming long-term private/public partnerships or partnerships with other local authorities is a possible way of doing this."
>
> Public Sector interviewee JW, Norwich, October 2012

However, a biofuels activist thought that investments into these types of scheme might be more worthwhile than incentivising the use of bioethanol or costs associated with administering the RTFO. He said:

> "When they brought it in [the RTFO] in 2009 it was costing between £500-600m in certification schemes, administration etc. That money could be put into electric vehicles or battery storage. I feel that ultimately you need to get the science sorted out and get a really good feel for what are the best solutions. I appreciate you often need a suite of measures to tackle something like climate change but personally I would much rather see the electric storage batteries and electric vehicles being accelerated and low carbon electricity."
>
> Civil Society interviewee AB, Norwich, October 2012

A matter of recognition was specifically raised by a local councillor, who questioned the extent to which lay people were regarded by government officers and policy decision-makers. One local councillor thought that

community schemes or 'non-professional' knowledge were often not valued by local or national Governments or their Officers. She said "[t]here seems to be a particular disdain for any 'non-professional' help or community run schemes; it's as if they're tolerated" (Public Sector interviewee AH, North Walsham, October 2012).

In the way that Victor (2009) raises issues of power and inequalities in decision-making processes, which can allow the support or exclusion of particular measures to retain existing infrastructures and power relations, two interviewees specifically thought that some stakeholders had too much power over government policy development, which helped close down alternative options for sustainable transport policies. This interviewee talks about the powers of oil companies:

> "I don't think there are enough incentives out there at the moment to look at other forms of sustainable transport. We could make more progress here. A classic example is LPG. There were massive incentives years ago to change your vehicle to LPG. But now there's nothing. The only incentive is that if you drive into London you don't pay the congestion charge. And yet it burns so much cleaner than petrol and diesel and LPG is a bi-product."
>
> Private sector interviewee KC, North Walsham, October 2012

7.1.2 Roles and responsibilities for governing biofuels

In chapter 6, it was clear that the people in Araras felt both private and public sectors were ultimately responsible for ensuring energy justice in relation to liquid biofuels' production and consumption and in relation to the case study supply chain. What is interesting to note here, however, is that UK-based consumers interviewed at this stage of research were more in agreement with the views presented in chapter 5. This is because they apportioned ultimate responsibility for ensuring energy justice to governments (they made it clear that whilst the private sector had an important role to play they should be overseen by and responsive to regulations put in place by public sector governance). Therefore, UK-based consumers of sugarcane bioethanol interviewed during this stage appeared to defer responsibility to public sector

governance actors for ensuring that the biofuels sold to them were socially and environmentally sustainable and just.

These views, however, appeared to be the case because of the ways in which their purchases occurred. For example, because their biofuel purchases were imposed on them rather than by choice. Consumers interviewed during this stage of research felt unable to meaningfully engage with the system or influence any changes necessary to ensure energy justice in relation to the biofuels they were consuming. What was also universally agreed upon amongst these interviewees was their inability to hold businesses and the public sector to account due to the lack of adequate sources of information about their individual fuel purchases (and their inability to exercise purchasing preferences). Whilst this is the case, the government, they felt, had taken on this role for ensuring equity in relation to the biofuels they were consuming.

Consumers have been found to be more likely to take responsibility for their energy choices and consumption, adapt their behaviour, support or engage more actively with an energy system if they understand their own role in the system and in relation to others (Greenberg, 2014; Sheppee, 1980; Stoknes, 2014), or they can see how benefits and costs are distributed amongst those affected (i.e. Devine-Wright, 2005; Gross, 2007; Parkhill et al. 2013; Walker and Cass, 2007; Walker et al. 2010). Equally, the socio-technical nature of liquid biofuels, as an energy technology in general (Miller et al. 2015; Sovacool, Sovacool and Dworkin, 2015) means that they can only be re-shaped and re-configured by stakeholders' connections, and their understandings of these connections. Therefore, the ability of consumers to effectively engage with their biofuel purchases, and thus take on their own roles and responsibilities, is once again clearly shown to be lacking. These findings contribute to a consistent theme throughout the research findings for more information to be available to consumers (and other stakeholders more broadly) to enable them to more effectively take part in decision-making processes. Conducting equity appraisals on individual biofuel products would appear a means of contributing to information-bases and these matters will be taken up further in chapter 8's conclusions and policy recommendations.

7.2 Discussion and conclusions

The findings in this chapter show that consumers expressed concerns about distributive injustices associated with supply chains of the case study type, where impacts might be borne more heavily by people at the production end of the chain. The types of injustices raised related to environmental impacts as well as unfair/harsh working conditions affecting people in the global South. These types of impact were unacceptable to consumers interviewed, who felt unhappy about purchasing biofuels if this were the case. Other research has shown that consumers prefer renewable energy technologies to be sustainable and equitable (i.e. for example works such as Gross, 2007; Parkhill et al. 2013; Wustenhagen et al. 2007; Walker, 2012) and thus this also appears to be the case in relation to liquid biofuels. The consumers interviewed in this research project have presented themselves in markedly different ways to the unaffected, unaware and indifferent set of people that they were perceived to be by transnational governance actors and experts (chapter 5) and private sector interviewees in Araras (chapter 6). These findings clearly identify the misrecognition of consumers by other stakeholders connected to the supply chain. Furthermore, these perspectives are likely to have contributed to the procedural injustices that exclude consumers from adequately participating in decision-making processes associated with their bioethanol purchases (within the blended fuel they purchased at the pumps). For example, because 'quick fix' policies that promote mandatory blending (such as the RED and FQD) may have been introduced to avoid having to engage consumers and persuade them to change their lifestyles or practices. What is clear, however, is that the exclusion of adequate engagement by public sector policymakers with consumers and the lack of information available for consumers raises a specific form of procedural injustice and thus works against energy justice ideals. What is also clear is that this lack of engagement and ability for consumers to effectively participate (Blackstock et al, 2007) in the system reduces their ability to re-shape and re-define biofuels' production and consumption practices within UK transport and take on their own roles and responsibilities that might help liquid biofuels become more sustainable and energy just. After all, the ways in which energy systems are configured depends on peoples' knowledge

of the system, its impacts and their perceptions of their own roles and responsibilities (Sovacool and Dworkin, 2015).

Consumers challenged what they regarded as simplistic fuel-versus-food debates because of complex, gross inefficiencies, inequalities and wastes in the agricultural and food systems and the vast amount of land dedicated to growing unhealthy or less-nutritional crops or products – matters which they felt were rarely reflected in information relating to biofuels. What is evident here, is that UK-based consumers raised a range of interrelated and complex matters relating to bioethanol in mandatory blends in relation to themselves and others. They also raised concerns over distributional injustices such as potential costs for consumers as a result of blending mandates and infrastructure damage as a result of the potentially corrosive nature of bioethanol (which put into question the true sustainability benefits of biofuels when sold through mandatory blends). What is clear, therefore, is that these findings demonstrate that consumers showed a high level of support for biofuels if they can demonstrate sustainability and equity and they particularly appeared to favour systems of production and consumption closer to home, to which they could understand better and feel more closely connected, such biofuels produced locally from agricultural and food wastes and bi-products. This, again, demonstrates an interest in biofuels and a more caring and engaged set of consumers than had formerly been perceived (i.e. by governance actors and experts in the field) and a willingness to help shape alternative practices or biofuels production with a very different feel to the large-scale, distant production methods currently favoured by policies that promote mandatory blending.

Chapter 8: Discussion and Conclusions

The nature and geography of equity issues identified in relation to the case study supply chain are now discussed highlighting key conclusions and implications for biofuels-related policies. Furthermore, the contributions made to knowledge in energy justice academic literature and the biofuels sector more broadly are made explicit in terms of (i) the empirical evidence of the types of equity issues that can exist in relation to an international biofuel supply chain feeding UK consumption (and the implications of these for biofuels-related policies) (ii) the interrelationships between different dimensions of energy justice and the ways that matters of recognition and procedural justice can drive changes in the distribution of outcomes in relation to biofuels and (iii) the way that energy justice theory can be operationalised in relation to global supply chains to produce information about the distribution of social and environmental benefits and burdens amongst people affected across disparate sites of production and consumption. This is particularly salient to current debates in the field of energy justice research that seek to find ways of connecting 'whole energy systems', including disparate sites of production and consumption, to understand the extent to which energy justice is being achieved and provide ways of bridging the gaps between the interfaces of energy justice theory and practice (Jenkins et al, 2016).

8.1 The nature and geography of injustices in relation to the case study supply chain

By way of an introduction to the discussion and conclusions in this section, figure 24 overleaf provides a succinct summary of the nature and geography of equity issues identified from the second stage of research, i.e. the issues that are apparent in the UK and Brazil as well as issues that are apparent across the supply chain.

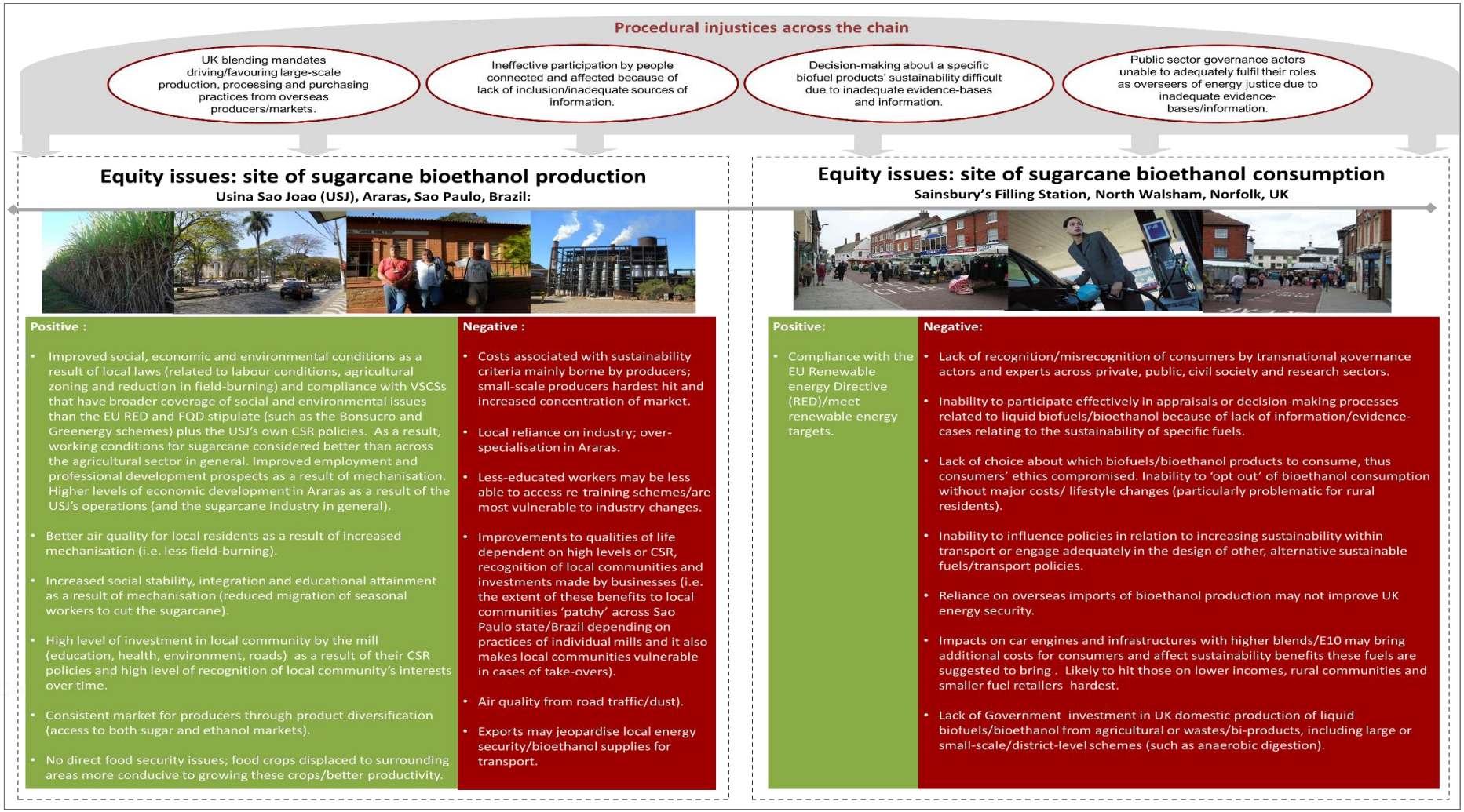


Figure 24: Summary of the distribution of equity issues across stakeholders (stage 2 data).

This in-depth, qualitative study has clearly produced an extensive and rich data set indicating a range of social and environmental impacts associated with a supply chain of the case study type from the perspectives of governance actors and people 'on the ground'. The impacts experienced are many, varied, highly interrelated and complex and an in-depth examination of each issue is not included here as the detail relating to individual issues has been provided throughout chapters 6 and 7. Rather, the focus here is on the key conclusions that can be drawn from this research.

What is clear is that the nature and geography of injustices, or equity issues, associated with international bioethanol supply chains are not well understood. This conclusion can be drawn because the findings from interviews with people living in sites of production and consumption are markedly different to assumptions drawn from the outset of this research project and during the first stage of research. The basis for this conclusion is demonstrated by re-visiting the summary of stage 1 research results presented at the end of chapter 5 (figure 11) and comparing with those presented in figure 24 on the previous page. What is evident is that the predicted distributional injustices from the first stage of research, from literature reviews and interviews with transnational governance actors and experts in the field, are not apparent in the data collected at stage 2 or apparent in the perspectives of people living in sites of production and consumption. Therefore, predictions that the majority of any negative social and environmental issues identified would be loaded towards the site of production are not represented in stage 2's research findings. This key finding from the empirical data is important for aims for energy justice, because it indicates that the extent to which energy justice is being achieved in relation to specific liquid biofuel products consumed in UK transport is likely to be unknown. What this also indicates is that the ability of individual stakeholders to make decisions about which biofuels to incentivise or support (to improve energy justice) is diminished. This is particularly the case due to the vastly different regional, environmental and social contexts in which particular biofuel products and production methods are set.

Distributional in/justices and their procedural/recognition-based drivers

It is important to consider the nature of the differences between the views of transnational governance actors and experts, about the social and environmental impacts and their distribution (in relation to the case study supply chain) and the views of people on the ground. It is by considering these differences and the reasons why these may be so, that conclusions and policy recommendations can be drawn from this research.

During stage 1 research, civil society and public sector interviewees were particularly concerned about distributional injustices because they felt that matters such as food insecurity, land-grabbing, displacement of local indigenous communities, impacts on small-scale farmers/agriculture and harsh working conditions would be felt mainly at the site of production. These interviewees also talked about unemployment due to mechanisation of the harvests, over-exploitation of water resources and ecosystem service impacts such as biodiversity loss. It was only the interviewees that had specific knowledge of the Brazilian context in which the case study supply chain is set (and some knowledge of the actual case study supply chain) that talked of rising environmental and social sustainability standards in relation to Brazilian sugarcane bioethanol production. These interviewees included representatives from UNICA, Greenergy and ProForest. During stage 2 research, these more positive perspectives of issues were verified by residents of Araras who talked about improved air quality over recent years (except dust from increased road traffic), better community relations between migrant workers and their families and local residents as a result of mechanisation and better working conditions for production workers. In relation to land-grabbing, residents talked of the way that land had been used for sugarcane production for centuries for sugar and potable alcohol prior to the production of ethanol for transport fuel. Food insecurity was not regarded an issue in relation to bioethanol production because of the land over time being used mainly for sugarcane cultivation, sugar and alcohol production (thus the land had not been used for food produce of high nutritional value prior to bioethanol production). Other food crops were grown mainly in neighbouring states that were felt more conducive to food production and recent food price rises were not attributed directly to

sugarcane bioethanol production. Expansion of sugarcane was regarded as sufficiently controlled in this area by the state. Air quality was thought to have improved, as a result of mechanisation of the harvest, which had reduced health impacts such as respiratory problems.

What this shows is that concerns of distributional injustices from the public sector and civil society sector interviewees in the first stage of research aligned with published literatures reviewed and presented in chapter 3 (section 3.2). Clearly, therefore, these issues are likely to be found in relation to other liquid biofuel supply chains. This underlines the need for equity appraisals of other liquid biofuel supply chains (recommendations made in sections 8.2 and 8.3) to help support consumers and other stakeholders engage more effectively with liquid biofuel supply chains to drive the more sustainable and just social and environmental outcomes along other supply chains that have been identified in relation to this case study. Whilst the USJ can be regarded typical in the sector in that it is a large company, operating a large-scale sugarcane and bioethanol production facility that connects to a global supply chain feeding UK consumption of liquid biofuels in the transport sector (discussed in chapter 3 and section 4.2.1), it is also clear that this case study supply chain is also atypical of the field. This can be said because it is an exemplar of good practice in the field, as the USJ has voluntarily achieved certification with one of the more comprehensive biofuel sustainability certification schemes, i.e. Bonsucro. As discussed in section 3.3, this is less common, as the most prolific certification of biofuels is with the ISCC standard (Ponte and Daugbjerg, 2015) that does not cover such a wide range of social and environmental impacts. In addition, by local residents' accounts, the USJ has exercised a high level of care for its communities and employees over time, before the introduction of VSCSs to access European markets. This may not be typical of other large production companies.

Also, the Brazilian context differs from other developing countries (Hodbod et al, 2015) and as exports of bioethanol increased to meet European demands (Afionis et al, 2014) awareness increased of negative social and environmental conditions in Brazil, including harsh working conditions associated with

sugarcane cutting and deforestation (Clancy (2008), Garvey and Barreto (2014), Green (2012) and Rutz and Janssen (2013)). In response, the Brazilian government and sugarcane bioethanol producers have looked for ways of addressing these issues and improving their reputation abroad (Afionis et al, 2014; Private sector (UNICA) interviewee G, Brazil, May 2012) in order to maintain or gain access to European markets. These responses resulted in the introduction of laws and standards, including compliance with VSCSs to improve conditions for workers and take measures to control agricultural expansion of sugarcane.

The distribution of injustices between stages 1 and 2 research varied also because of the negative issues raised by residents at the site of consumption (at North Walsham in the UK during stage 2), which were not foreseen and included during the first stage of research. For example, consumers at stage 2 provided perspectives of injustices relating to domestic biofuel production. Consumers interviewed felt that fuel blending mandates have marginalised alternative forms of biofuel production such as production from food and agricultural wastes that could be produced via distributed networks of community-level or district facilities. These forms of production were thought to have the possibility of contributing to increased use of biofuels in transport, which could contribute to increased sustainability in transport (including carbon emissions reduction). They felt this could be particularly that case if used in a targeted way that did not incur damage to infrastructures. For example, the biofuels produced from local-level, small-scale facilities could be used in local public transport. Vehicles for use in public transport services could be replaced over time with those specifically designed to take higher-level biofuel blends or even 100% biogases/liquid biofuels. Furthermore, these types of production pathways were thought to offer opportunities for stimulating local economies (rural and urban) and therefore the fact that the UK industry has been stifled, or overseas production favoured, indicates a form of distributional injustice within the UK.

A further point about this distributional injustice is that it is linked to the production and availability of information about biofuels (and thus driven by a

procedural injustice, which will be discussed further next in this chapter). This is because generalised assumptions and negative perceptions of some biofuels and their production methods can affect investment in domestic (UK) biofuels' production (Bennett, 2011; Berti and Levidow, 2014; FT, 2014; Rutz and Janssen, 2013; WEETF, 2014). This is because negative social and environmental implications associated with some biofuels can affect the social acceptability of biofuels in general (Gasparatos et al. 2015; Gnansounou, 2011; Mohr and Baush, 2013; Mohr and Raman, 2013). Clearly, the information available for individual biofuel products, on which important policy decisions might be made, significantly affects the degree to which the wide range of decision-makers connected to UK biofuels' consumption are able to make individual and policy decisions about which biofuels to accept and support (either actively or passively, as discussed in chapter 5).

Consumers also talked of other potential distributional injustices related to the biofuel blending mandates stipulated in the RED, RTFO and FQD. These related to the costs that were likely to be incurred with current and future, higher blending mandates. Concerns were raised over damage to infrastructures (such as fuel pumps and related equipment) and older vehicles which can suffer from increased corrosion as a result of the ethanol content in all fuels. Not only was this felt to increase costs for consumers, it also means that the replacement of these pieces of equipment were felt to reduce the sustainability benefits that biofuels were purported to offer.

It is clear from the discussion above that the way social and environmental impacts play out in the UK, in relation to the use of biofuels, are being driven specifically by policies that promote and favour biofuel blending mandates as instruments to increase sustainability in transport (by increasing the use of renewable energy and reducing carbon emissions) and that only a fraction of the broadest set of stakeholders connected to supply chains of the case study type (identified and discussed in chapter 5) have been responsible for implementing these policies. Furthermore, the ability of public, private and civil society sector actors who are regarded responsible for assessing and overseeing the sustainability, social and environmental impacts associated with

particular biofuel products is impaired because there is no way, currently, of being able to see how the benefits and burdens play out in relation to different biofuel products or production methods. While this is the case, it is impossible to make comparisons between which biofuels might improve the chances of increasing energy justice. It is clear, therefore, that procedural and recognition-based injustices have been found in this research to be affecting the way benefits and burdens are playing out in relation to liquid biofuel supply chains.

Consumers talked frequently about the lack of ability to exercise purchasing preferences or help shape the ways in which biofuels are produced and consumed, which could contribute to increases in renewable energy used in transport as well as economic development in the UK. The lack of recognition, and misrecognition, of consumers by transnational governance actors and experts interviewed in the first stage of research highlight the ways in which these types of stakeholder are perceived by others connected to global bioethanol supply chains. These perceptions are likely to be contributory factors to the exclusion of consumers from decision-making processes relating to liquid biofuels (for example, because they were perceived to be a largely uncaring set of 'passive' accepters of biofuels). Consumers' accounts of the lack of information available to them about the biofuels they purchase in blended fuels (including any potential impacts to their vehicles) were regarded as contributory factors to their inability to engage effectively in decision-making processes or adequately take responsibility for their purchases. These matters can be regarded procedurally unjust and diminish the extent to which bioethanol supply chains of the case study type can achieve energy justice. This is because, as discussed in chapter 2, energy justice requires inclusive decision-making processes and adequate information to allow all affected stakeholders to participate effectively in decisions related to the production and consumption of an energy source.

Increased recognition of Ararians and the impacts of sugarcane and bioethanol production on local residents by the USJ has increased distributional justice in relation to the production end of the chain. This is evident because interviewees in Araras, including workers, attributed local outcomes to the

work of the Ometto family (a family that is clearly still held in high regard amongst the local communities). While, clearly, not all local residents' views were collected in this research, the results indicate that both the USJ's policies and Brazilian laws have increased the recognition and inclusion of workers' rights and social and environmental outcomes locally as a result of sugarcane bioethanol production, and these have driven improved social and environmental outcomes felt by people in Araras. It is not suggested here that these processes have been perfect, or the most inclusive, but what can be concluded is that national policies and investments by the USJ have helped achieve mutually beneficial outcomes for both the business, the local area and its residents. For example, investments in infrastructures such as road networks, education and leisure services are likely to have contributed to the higher levels of social and economic development in Araras compared with other parts of the state (i.e. such as found by Martinelli et al (2011), Smeets et al (2008) and the IBGE (2013)).

The research findings and the ways in which matters of recognition and procedural justice have affected the patterning of environmental and social outcomes identified at both ends of (and thus across) the chain can be summarised as follows, in figure 25 overleaf.

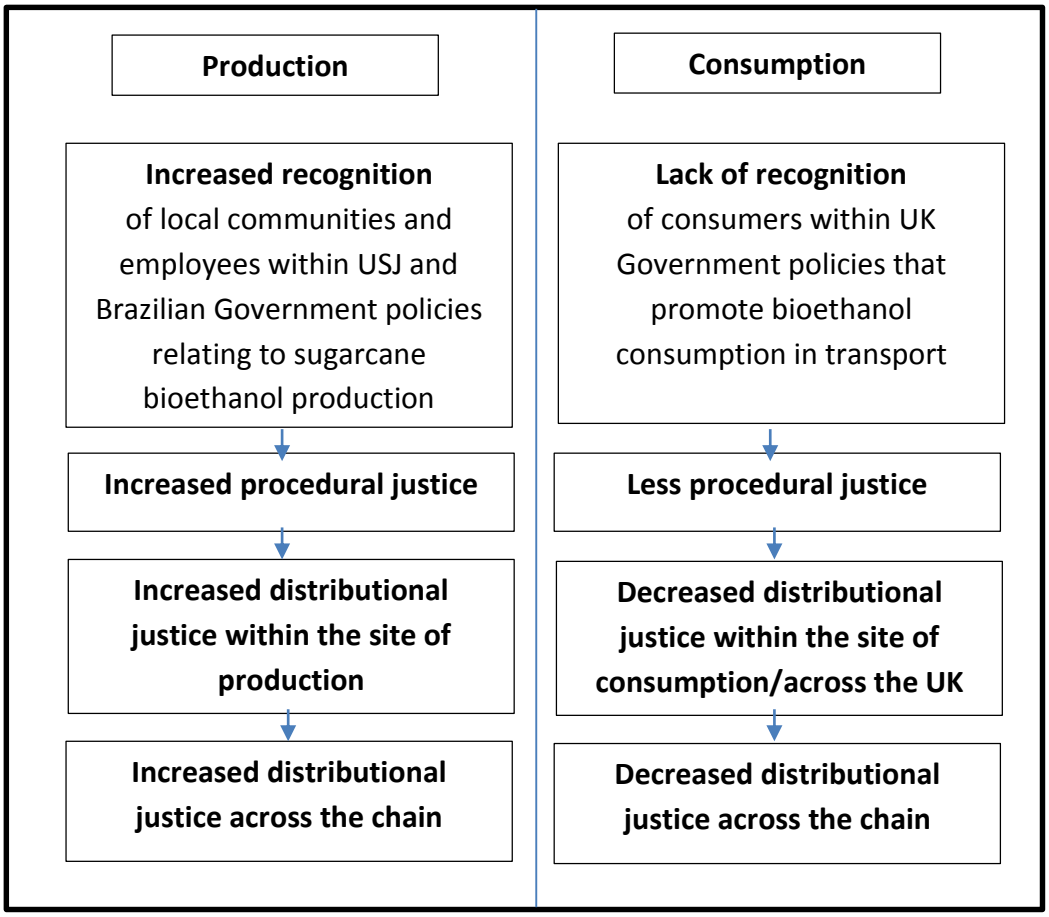


Figure 25: Interconnections between matters of recognition, procedural justice and distributional justice in relation to the case study supply chain.

Lack of information as a procedural injustice

One of the reasons that local residents in and around Araras highlighted a range of complex and interrelated issues that were more positive than expected, when compared with the perspectives of interviewees at stage 1, may be because transnational governance actors are disconnected from the views of local residents in particular production regions and they frequently rely on sources of information about biofuels which, as highlighted in chapter 3, may be only partially representative of the actual social and environmental impacts being experienced by local communities, or relevant to only some production contexts. In addition, because consumers (and issues at the consumption end of the chain) are not included in dominant sustainability appraisals of biofuels currently, a proportion of impacts or equity issues are excluded from knowledge bases used to inform policy decisions about the use of biofuels. While this remains the case, it is impossible to see how more

energy just futures can be achieved because decision-makers are unable to determine the true nature and geography of the equity issues, or social and environmental outcomes, associated with liquid biofuels.

A specific form of procedural and energy injustice has therefore been identified by this research because the information currently available to the wide range of decision-makers connected to a supply chain of the case study type is inadequate to enable them to fully participate in associated decision-making processes. The lack of information about the true nature of a biofuel's sustainability, including the extent to which associated social and environmental benefits and burdens are distributed, significantly affects an individual's ability to perform their own role for helping achieve energy justice. For example, no-one can fully take responsibility for the social and environmental consequences relating to their purchasing of the biofuel or the extent to which to support or invest in the energy system itself.

This incompleteness of data exists because it has been established that the most dominant forms of appraisals used in the biofuels regulatory domain (i.e. VSCSs and LCAs) do not produce information about the full extent of a biofuel's sustainability. This is because they do not include social issues relating to the broadest set of stakeholders across the whole energy system or supply chain. This means that because of the incompleteness of the information used in decision-making processes, those people who are 'at the table' have only partial views on the extent to which any biofuel is sustainable. It is currently impossible, therefore, to determine which biofuels are more just that others.

This is particularly an issue, and has raised as a specific form of procedural (and energy) injustice because interviewees at both the first and second stages of research felt that decision-makers in the private and public sectors, who have the most power to influence policy decisions, are mainly responsible for ensuring an equitable distribution of any associated benefits and burdens. This key finding highlights their inability to fully participate in decision-making processes and perform their roles and responsibilities to the best of their abilities and in line with the expectations of other stakeholders in the system.

Responsibility, currently, appears to be mainly falling on bioethanol or liquid biofuel suppliers/distributers, such as Greenergy, to ensure that only sustainable biofuels (as defined within the FQD and RED) are made available for sale. This is because the retailer and the UK government (i.e. through the RTFO) requires suppliers to demonstrate that the fuels they purchase are certified against VSCSs and thus compliant with the FQD and RED. In this way, the retailer and government (and indeed the consumer) can defer responsibility onto the producer. The suppliers and distributers are held accountable by retailers (such as Sainsbury's who pride themselves on ethical purchasing) who are also held accountable by their own customers and shareholders. This means that the supplier would be 'dropped like a hot potato' if they were found to be unethically purchasing non-compliant fuels, or fuels that were found to have particularly undesirable social or negative impacts. This demonstrates the ways in which pressure is exerted by the government and consumers to ensure sustainable practices along supply chains and the mutual dependencies across different stakeholders to govern the social and environmental impacts (and energy justice) associated with biofuels. Whilst this highlights that distributional injustices can be tackled via market pressures and sustainability certification it also highlights a major flaw in the system in that VSCSs have been found to be limited in terms of ensuring sustainability and energy justice and they are inadequate for providing sufficient information or evidence about which biofuels are more or less ethical or socially and environmentally just.

This said, however, it must be re-iterated that to fully improve the chances of achieving energy justice, all stakeholders in the system need to be adequately engaged and informed. The likelihood of moving further towards energy justice in relation to biofuels requires effective participation and engagement from the 'bottom-up' to the 'top-down' (Sovacool and Dworking, 2014). The first stage of in-depth, qualitative enquiry conducted in this research project (presented in chapter 5) revealed a diverse set of stakeholders connected to, and affected by, an international bioethanol supply chain (or other liquid biofuel supply chains like the case study type). These people span geographical and cultural borders and a wide range of distributed formal and informal appraisals were found to

take place as part of these people's connections with the fuel[11]. Therefore it is essential that all stakeholders are included and able to participate effectively in order to exercise their own roles and responsibilities to help move towards higher levels of energy justice in relation to biofuels.

Misrecognition

A few particular instances of misrecognition can be drawn from the research findings that have particular implications for the ways in which the distribution of benefits and burdens manifest themselves in relation to the case study supply chain as well as implications for biofuels-related policies that can be made.

The empirical results clearly demonstrate that for higher levels of energy justice to be achieved in relation to biofuels it is essential to include the perspectives of the widest range of stakeholders possible because people may make assumptions about the issues relating to other stakeholders in the system. Therefore, if only some stakeholders are able to fully participate in decision-making processes, the way they represent the issue relating to others may be flawed. These results show the ways in which both misrecognition and exclusion can lead to procedural and distributional injustices and these examples are discussed next.

Interviewees from across the sectors talked about impacts relating to production workers. From the perspectives of transnational governance actors and experts (particularly research-based and civil society sectors at stage 1) mechanisation of the harvest was regarded unjust as it led to mass unemployment for the poorest and most vulnerable people in Brazil. However, a local university lecturer in Araras talked of the undignified nature of manual sugarcane harvesting because (despite improvements in working conditions more recently in Brazil) it will always be hard labour and thus time and financial investments would be better focussed towards helping the most vulnerable, least-educated, least-skilled and poorest workers (who are those who are more

[11] As defined in chapter 1, the term appraisal in this thesis is used to describe the broad range of formal and informal appraisals that are distributed in nature, in the way that 'technical assessments' (TAs) and 'social appraisals' are defined by Ely et al (2014) and Stirling (2008).

likely to be manual sugarcane cutters and thus who are most likely to be made redundant) gain other types of employment. Also, mechanisation of the harvest has clearly been shown in this research project to be bringing a range of positive social and environmental impacts to Araras. Interviewees in Brazil, across the private and civil society sectors and workers themselves, talked about the benefits to workers as a result of professional development opportunities that mechanised harvesting was bringing, such as fixed-contracts, more skilled positions, better pay and training provision to obtain work in other sectors. A driver who had previously been a sugarcane cutter (interviewed during the second stage of research) talked about improvements for himself and his family as a result of the change to the type of work he carried out for the USJ and his preferences for his new role. Also, in Araras, young people interviewed were clear that they would not aspire to becoming a sugarcane cutter and almost any other form of skilled or non-skilled job opportunity would be preferable to sugarcane cutting or manual agricultural work. This was echoed by a young, migrant sugarcane cutter himself (who was only doing this for the summer until he could start training as a mechanic). A small-scale farmer said it was proving increasingly difficult to find workers to harvest his crops (sugarcane or other food crops). Therefore, with higher levels of education and aspirations amongst young people, and the economic development in Brazil generally, it is unlikely that in the long-term it will be possible to recruit enough young, strong people to undertake this form of hard labour. It would appear that investment into education for the lowest-skilled workers in Brazil (and those in the most deprived areas) is a better option than trying to reduce mechanisation of the harvest, however, it is only with the inclusion of perspectives from the types of people interviewed above that policies can be effected to improve energy justice in relation to biofuels.

Another point of contention amongst interviewees that highlights different perspectives and instances of misrecognition is in relation to the way that impacts associated with producers were perceived. While everyone agreed that producers had the most to gain from increased trade and compliance with increased sustainability standards (i.e. because it allows access to European markets), from the perspectives of producers it was unjust that all the costs of

compliance fell onto them, i.e. that consumers were not helping to bear the costs of their demands for more sustainable fuels. What this also means, as discussed in chapter 5, is that smaller-scale producers can be particularly disadvantaged and increased concentration of the sector is occurring (substantiated by research findings such as Bergquist et al (2012) and Hodbod and Tomei (2013), for example). However, from a small-scale producer's perspective in Araras, the assured trade for his sugarcane crop was much better than producing other food crops for which there was little demand in this particular area. The mill to which he sold his sugarcane crop could produce both sugar and bioethanol, both of which were in constant demand. He agreed, of-course, that support for small-scale farming was important but said that the threats to small-scale farming in general was due to dynamics across the agricultural sector generally (i.e. difficulties to compete with larger-scale production in general) rather than the bioethanol sector itself. This again demonstrates the need for situated perspectives and inclusion of the broadest range of people affected in decision-making processes and appraisal processes associated with the sustainable development of biofuels because clearly, high-level assumptions about the views and impacts of bioethanol production did not align with the view of this small-scale farmer in this particular case.

While ground-level perspectives may frequently be different to high-level, generalised assumptions from afar (clearly demonstrated in these research findings) it is clear from these findings that these perspectives can be connected via the type of equity appraisal conducted here. Furthermore, the nature and geography of energy justice will always be different in relation to specific supply chains, due to the wide range of social, political and environmental factors that will affect the nature of social and environmental issues associated with particular biofuels' production (Hodbod et al, 2015). It is therefore important that different perspectives are included in equity appraisals and thus the information produced can promote discussion between participants in the system as well as be able to expose particular injustices and where they lie.

8.2 Implications and recommendations for biofuels-related policies

This research contributes to energy justice literature because it provides empirical evidence of the lack of understanding of equity issues in relation to biofuels and it highlights the importance of addressing these knowledge-gaps if the development of biofuels is to be ethical, sustainable and just. The major policy recommendation here is that equity appraisals (in the manner advocated by energy justice theory as demonstrated in this thesis) are conducted more systematically in the field to help produce information that can support the wide-range of liquid biofuels-related appraisals and decision-making processes that currently take place (as identified and discussed in chapter 5). It is recommended that the most commonly-used appraisal tools (such as VSCSs and LCAs) that are used to provide information about a biofuel's sustainability are supplemented with information produced from equity appraisals in relation to individual biofuel products. This information could also support the dominant governance mechanisms for ensuring the sustainability of biofuels consumed in the UK (for example the RED (EC, 2009), FQD (EC, 1998) and the RTFO (DfT, 2015b)). For example, currently there is a requirement for member states to report biannually to the European Commission on social impacts incurred as a result of the consumption of biofuels within national borders (EC, 2009). The use of equity appraisals could provide the basis for producing these reports and could significantly improve understandings of the extent to which sustainability ideals are being achieved by particular biofuel products. The information produced could also help policy-makers make decisions about which biofuels (and production pathways) to incentivise at both the UK and European level. If implemented, this recommendation offers an opportunity to increase the chances of achieving more sustainability and energy justice within the biofuels and UK transport sectors.

Energy justice was defined in chapter 2 as an energy system that fairly disseminates the costs and benefits of energy services amongst those affected and one that has inclusive decision-making processes that attend to matters of recognition and are procedurally just. This recommendation therefore addresses a particular form of procedural (and energy) injustice that has been

identified by this research in relation to the consumption of liquid biofuels in the UK. This injustice is that the full range of actors connected to a liquid biofuel supply chain are unable to adequately and effectively participate in decision-making processes taking place relating to the sustainability of the fuel. This is because of the lack of information available about the ways in which associated burdens and benefits are distributed. While this remains the case, it is impossible to operationalise the NCB's (2011) recommendation that the benefits and burdens relating to the production and consumption of biofuels are equitably distributed. It should be emphasised here that the NCB regards this as a key requirement to ensure the moral, ethical and sustainable development of biofuels.

The more systematic application of equity appraisals in the field could also help the broadest range of stakeholders connected by biofuel supply chains engage more effectively in the design and shaping of sustainable and just biofuel production pathways - in the UK and beyond. This thesis shows how energy justice theory can be operationalised to carry out an equity appraisal to help connect people through the appraisal process as well as produce information that could help connect and engage stakeholders in any subsequent decision-making processes. The research conducted for this thesis has demonstrated that social science research methods and qualitative data can be used to produce information that could form the basis for information and engagement campaigns across different energy publics, including consumers and those in the public, private and civil society sectors. For example, in the private sector this information could be used to support CSR policies and strategies, in the public sector this information could be used to aid the governance of biofuels in the regulatory domain and in the civil society sector this information might be used to provide evidence of injustices to inform specific actions or campaigns. Most importantly, the information could be used to help improve dialogue between different types of stakeholders to improve the chances of achieving energy justice in relation to the production and consumption of biofuels. The empirical results of this research clearly demonstrate that for higher levels of energy justice to be achieved in relation to biofuels it is essential to include the perspectives of the widest range of stakeholders possible.

An essential requirement, however, for substantive benefits to be realised as a result of the more systematic use of equity appraisals in the field, is that independent, skilled 'assessors' (or facilitators) are employed to undertake this work. For example, the substantive benefits that equity appraisals might achieve could be as a result of the information produced being made available to the full range of decision-makers and stakeholders to improve dialogue between them and help broker more inclusive and effective participatory processes. This could lead to decision-making processes that promote social learning and where stakeholders are able to work together to re-design, adapt or initiate new processes to improve the chances of achieving energy justice in relation to individual biofuel products or technologies. At the very least, systematic application of equity appraisals could help comparisons be drawn across different products as patterns of persistent injustices emerge as well as promote understandings of the ways in which individual stakeholders are connected to a biofuel and to other people also connected to it. However, again, this requires skilled practitioners to avoid a 'tick-box' exercise.

It is also recommended that the equity appraisals should be conducted in periodic cycles because of the dynamic nature of the contexts in which particular biofuels supply chains are set. This would allow periodic refreshment of results which could help with monitoring and evaluation processes associated with companies' CSR strategies. This recommendation aligns with recommendations from energy justice literature, i.e. Sovacool's (2014b) calls for the need to internalise social issues into energy appraisals to help understand impacts better, reduce social or environmental costs, understand trade-offs and increase energy technologies' social acceptability. Social acceptability is included here because of the way existing energy research suggests that energy technologies that are procedurally and distributionally just are preferable to consumers and wider energy publics alike (i.e. as discussed in chapter 2). This continual, periodic process would also help build on the relationships and connections made through the initial equity appraisal process.

The recommendation for equity appraisals to be used more systematically in relation to biofuels is also made because policies and initiatives appear urgently needed that can help to promote common understandings of the aims for 'sustainability' in relation to biofuels (and renewable energies more broadly) between different stakeholders. This might promote understandings of the interconnections between social, environmental and equity issues within sustainability ideals. Clearer understandings, and agreements, of what 'sustainability' means is crucial at the outset of an energy assessment or appraisal process (Morrison-Saunders et al. 2014) and yet currently this research suggests that, in relation to biofuels, sustainability is defined and measured in different ways and heavily biased towards environmental issues. This is certainly the case in relation to the tools used to measure and report on a biofuel's sustainability (such as through VSCSs and LCAs). This thesis, using the equity appraisal method proposed and tested here, clearly demonstrates strong links between environmental, social and economic issues – which often become 'artificially separated' in appraisal processes (Mohr et al. 2013a). This was seen, for example, with regards the effects of mechanisation of the harvest in Araras. Interconnected issues of unemployment, field burning, air quality, educational attainment, community stability and cohesion and the delivery of local services were all identified in relation to this policy change. The type of social science enquiry conducted by this equity appraisal allowed these highly interconnected social and environmental phenomena to be analysed and considered as a whole.

Equity appraisals could also be used to support communication and engagement initiatives to improve understandings of different types of biofuels, across different publics, to help them to engage in associated decision-making processes and help promote the consumption of genuinely more sustainable and just biofuels that people have been shown to prefer (in this research and in line with other energy research such as Devine-Wright (2005), Parkhill et al. (2013) Walker et al. (2010) and Wustenhagen et al. (2007). Public engagement campaigns in relation to biofuels consumed in UK transport (and sustainable transport initiatives more broadly) are required to help develop, shape and invest in the domestic production of biofuels. UK-based

consumers interviewed in this research expressed frustrations over not being able to engage and participate effectively in decision-making processes relating to the ways in which biofuels are produced and consumed. Based on the findings in this research project, there appears to be a high-level of support amongst consumers for domestic, UK-production of biofuels from agricultural and food wastes. Other recent reports, such as Robbins' (2011) and Parkhill et al's (2013) studies, also support this recommendation, finding that consumers are not necessarily opposed to biofuels per se but they do want assurances that the social and environmental effects of these changes are understood, equitably distributed, and that investments in these energy technologies or fuels are genuinely bringing more social and environmental benefits in both sites of production and consumption than the technologies or fuels they are replacing.

It may be that engagement with consumers and local communities that conforms to energy justice ideals could lead to more community-shaped, local and distributed networks of biofuel production facilities that may be preferential to large-scale blending mandates using imported biofuels. This may help implement a range of distributed modes and scales of production that can contribute to the suite of renewable energy technologies needed to meet global energy challenges and increase energy security (Skea et al. 2011). This is because dominant policies that promote imported biofuels and blending mandates (for increasing the use of biofuels in transport) may not increase energy security and thus sustainability within the transport sector because of the increasing, global pressure and competition for sugarcane bioethanol (and agricultural crops or products more broadly) (based on the literatures reviewed such as PON (2014a, 2014b) and Robbins (2011) as well as interviewees' accounts during both stages of qualitative research). In addition, engagement with consumers and local communities may also lead to more targeted use of biofuels (such as in public transport). Biofuel consumption in this way could help increase the use of renewable energy in transport, in addition to dominant policies for the consumption of biofuels via blending mandates. Practices that promote the use of biofuels in public transport from domestically produced biofuels from waste products may be preferable to avoid damage to older

vehicles and infrastructures as a result of higher bioethanol blends (if introduced in order to increase the use of biofuels/renewable energy in UK transport to meet RED targets). However, these matters are ideal topics for further research.

A point that needs to be raised here, however, is the need for careful attention to the costs of conducting equity appraisals and who/which organisations would be best placed to facilitate these forms of inquiry. For example, this research highlighted that the livelihoods of sugarcane or bioethanol producers can be unjustly affected because of the costs of compliance with VSCSs or sustainability regulations in general and thus additional costs incurred in the sector as a result of equity appraisals could exacerbate further concentration of the market. Clearly, further research would be needed to identify the best ways of implementing the use of equity appraisals in the biofuels sector.

8.3 Reflections and further research

This in-depth, qualitative study of equity issues associated with a specific biofuel product at both sites of production and consumption has been extremely challenging and labour-intensive for a solitary PhD student researcher. However, it has provided a rich picture of the more wide-ranging and interconnected equity issues that exist in relation to an international liquid biofuel supply chain of the case study type. In addition, it is the connections made between both sites of production and consumption across the whole energy system in this research that provides the novelty in terms of energy justice research and in the field of liquid biofuels.

The comprehensive picture of equity issues this research has provided would not have been captured or considered within the most commonly used formal types of appraisals in the biofuels sector (such as VSCSs and LCAs as discussed in chapter 3) because they are not set up to take account of equity issues and they do not include the full range of stakeholders implicated within these appraisal processes. It is the inclusion of the full range of equity issues across the three dimensions of energy justice (i.e. recognition, procedural and distributional justice), as prescribed by energy justice theory, that has led to the

identification of social and environmental outcomes experienced on the ground. Furthermore, this has led to understandings of the distribution of outcomes and their procedural and policy-based drivers. A key take home message from the empirical work presented in this thesis, the first of its type in energy justice literature, is that there are many more nuanced and complex equity issues associated with the production and consumption of bioethanol than were assumed at the outset of this research and from the perspectives of governance actors and experts in the field. This indicates that the patterning of these types of issues across the case study supply chain are not well understood and this is likely to be the case across other transnational liquid biofuel supply chains that feed the UK's consumption in the transport sector.

A matter to be reflected on here is that if perceptions of energy justice are always contextual and situated, how might meaningful conclusions be drawn regarding any changes required to the system in question? For example, there will always be winners and losers and different perceptions of who these winners and losers are, or where injustices lie. This can be answered in part by reflecting on Sen's (2005) capabilities approach to justice in that there will always be common sets of basic needs and 'freedoms' that could provide the basis for dialogue and actions (i.e. in relation to the most profound types of injustice identified). For example, if a biofuel's production was found to be causing physical harm to workers, such as injury or even death, this would clearly be regarded an injustice or an unethical practice by other stakeholders. In terms of more 'subtle', nuanced or contested findings of injustices, a social and ethical framework (designed on the basis of requirements in energy justice literatures such as the equity appraisal conducted in this research) can help highlight different perspectives and promote discussion amongst connected stakeholders over actions to be taken. It can ensure that assumptions about what issues exist are either justified or otherwise, that people's perspectives or actual experiences of social and environmental outcomes are better understood which can help ensure that measures thought to be necessary do not turn into unfruitful or wasteful investments. For example, in relation to mechanisation of the harvest, it was found that workers and residents in the production area preferred less labour-intensive ways of harvesting sugarcane

and felt that investments to improve the situations for the most vulnerable and less-skilled workers were best diverted into stimulating local economies and creating employment opportunities elsewhere, or helping people develop skills and gain more skilled employment within the biofuels sector or in other sectors, rather than keeping manual harvesting. It has also been shown there are broader positive outcomes associated with mechanisation such as reduced field-burning, reduced burns to workers and improvements in air quality for local residents. No young person interviewed in Araras, including those working during the harvesting season, aspired to becoming a sugarcane cutter and thus campaigns to keep these forms of employment were considered unjust by some. Perceptions from afar, therefore, about the injustices of mechanisation were unfounded in relation to this study and from the perspectives of people living in the case study production locality.

Due to the global energy challenges current human populations face, it is imperative that ways are found of identifying social and environmental injustices associated with the production and consumption of biofuels in order to find ways of improving their sustainability and energy justice. There is a moral and ethical duty to develop biofuels that are sustainable and just (NCB, 2011) and therefore social and ethical frameworks are required to investigate and reveal the extent to which particular biofuels are achieving these ideals. This research has shown the way that a social and ethical framework (such as an equity appraisal like the one conducted in this research) can take an open view which does not seek to marginalise one stakeholder group over another. For example, the issues for consumers could be regarded as insignificant when compared with biodiversity loss in a site of production or harsh working conditions for sugarcane cutters which means that that the livelihoods of workers or their families are in danger. However, what is demonstrated by this research is that by using a justice framework to interrogate social and ethical issues, a more nuanced picture of issues (and their interrelationships) can help identify impacts felt at ground level as well as the procedural drivers of these outcomes (which can thus inform policy changes). The justice framework applied in this research allowed a balanced and non-judgemental view of equity issues and the ability to give equal attention and adequate recognition to all

stakeholders. Also, it has been seen that by tackling issues for some might help alleviate issues for others, such as the inclusion of issues for consumers could help improve sustainability outcomes in relation to biofuels in the UK as well as drive changes through the chain that might benefit people in producer regions. This might be through consumers being able to exercise purchasing preferences or for them to campaign for/invest in other biofuel production pathways. An equity appraisal can provide important information about injustices in the production and consumption areas (or the whole energy system) which can be made available publicly, to consumers and other stakeholders connected to these practices to help them understand their connections to a biofuel, their connections to others and their roles and responsibilities in the system. Where good social and environmental outcomes are identified in relation to particular biofuels, and are found to be just and fair, it may help them become more socially acceptable or it may identify which should be incentivised or promoted more than others. What is clear is that the type of information produced from an equity appraisal could help consumers and other stakeholders understand their connections to biofuel supply chains and take responsibility for their purchases, policies or actions. This is imperative if stakeholders are able to re-shape and re-define biofuels' production and consumption into the types of system they prefer, due to the socio-technical nature (Miller et al, 2015; Sovacool and Dworkin, 2015) of these energy systems.

To address matters identified by equity appraisals, however, and try to achieve higher levels of energy justice in relation to biofuels, it requires the willingness to do so by all affected stakeholders and this also requires their connections with particular biofuel supply chains to be better understood as well as the social and environmental consequences of these connections. It is only via these understandings that sustainability ideals and energy justice might be achieved – or at least there can be meaningful efforts to work towards these aims. Otherwise, how can it be possible to tell whether our efforts are truly achieving more sustainable and just outcomes than the technologies or processes being replaced? It is impossible to tell whether improvements in one social or environmental sphere are being offset elsewhere and it is the usefulness of an 'open' form of appraisal, such as an equity appraisal or justice

framework that helps avoid artificial separation of social and environmental issues.

What is clear is that energy justice lens in this research project has provided a useful means of approaching this challenging research topic because of its ability to take into account situated and contextual perspectives of individuals connected to each other by a particular biofuel or renewable energy system. These perspectives involve a range of different environments and political systems globally. The justice framework has allowed social and ethical issues to be looked at broadly, across the whole energy system, and identify equity issues and injustices across three key dimensions of energy justice; matters of recognition, procedural and distributional justices. Furthermore, it has been able to identify recognition-based and procedural drivers for injustices that are embedded in the policies, practices and decision-making processes themselves. In relation to biofuels, and other renewable energy technologies more broadly, these matters need to be taken seriously in order to increase the chances of more sustainable and just developments of biofuels.

An important role for equity appraisals has been identified by this research, via the social science methods employed, to support decision-making amongst affected stakeholders via improved communications. Therefore, an important area for further research is how different stakeholders and audiences would prefer information to be presented, such as by using different media, and the effectiveness of this for improved understanding of issues and achievement of substantive outcomes as a result. For example, this might include presenting the information online or using social media. Improving communication between stakeholders is an urgent challenge for impact assessments generally (Morrison-Saunders et al. 2014). After all, it can be argued that it is the *use* of the final report that is the most important part of the assessment process (Simpson et al. 2005). The ways in which different stakeholders were able to use this information within their own organisations and beyond would also be an ideal topic for further research.

A limitation of this research project is that it has not been possible to see how the information produced has been discussed between stakeholders or used to

broker conversations or actions between them. Further research opportunities therefore include evaluations of whether the use of information produced from equity appraisals does in fact help communities re-shape or develop energy technologies in ways that promote social learning and more substantive sustainable and just outcomes in relation to biofuels (or indeed other renewable energy technologies). Research of this nature would contribute knowledge to energy justice literature by helping demonstrate how equity appraisals (and their processes) have helped decision-makers engage with the system or each other across the chain. This would help test theories identified here (and by Walker (2007, 2008) and Sovacool and Dworkin (2015)) that people feel more engaged with a technology and responsible for its associated impacts if they are more actively included in related decision-making processes (including the ways in which they understand their own roles in the system and the ways in which they are connected to other affected stakeholders). There is also scope here to see how equity appraisals might be conducted in more action-oriented ways, supported by higher levels of participation such as via workshops or the use of internet-based media and communications (i.e. social media or teleconferencing).

A difficulty experienced in this research project was the semi-structured interviews conducted at the site of consumption because consumers, in general, did not know that biofuels were blended in the petrol and diesel they purchase at the pump. Therefore, it was necessary to introduce some information about the case study supply chain in order to promote discussion. This was difficult to manage to ensure there was no 'leading'. However, once the interviewee knew there was biofuel content in the fuel they purchased, they all quickly offered their thoughts and perceptions of the issues and talked freely of how they imagined issues to be apparent in relation to the case study supply chain. This can be seen in the sample transcript provided in appendix 5. Some interviewees had specific knowledge and perceptions of impacts on vehicle engines in relation to biofuels, for example, the mechanic interviewed during stage 2. The concerns amongst interviewees about the impacts of biofuels on vehicle engines has highlighted a key research opportunity to look at the effects of different biofuels on particular road vehicles in the UK and the

implications for sustainability in transport once these factors are included. This is needed to enable the costs and benefits of different biofuel options to be communicated and used to inform these strategies (Yan et al. 2013). This research could also help inform discussions about the benefits of investing in specially adapted vehicles (i.e. flex-fuel or vehicles that use biogases) for public transport, delivery/fleet vehicles and haulage. The potential social, economic and environmental benefits of implementing the use of blender pumps on filling station forecourts in the UK would also be an ideal topic for further study.

Further research into the ways in which different methods of biofuel production and consumption, such as community-led initiatives in particular, can actually achieve higher levels of energy justice would also be an ideal subject of further research. It has already been suggested by Sovacool and Dworkin (2014) that community-led initiatives are likely to achieve improved levels of energy justice and this research has indicated that there are high levels of support amongst consumers that locally produced biofuels from wastes would be preferable to large, transnational supply chains. Case studies of these types of biofuel production facilities in the UK (or indeed overseas) would offer significant research opportunities. Research into the sustainability and justice implications of locally produced biofuels from wastes used in targeted ways, such as for public transport, would also offer ideal further research opportunities.

Whilst this thesis does not provide all the answers to achieving sustainability ideals in relation to biofuels, including matters of equity and justice, the research design does show how energy justice theories can be operationalised. The nature and scope of the study has challenged some established thinking in energy justice literature to show how the three key dimensions of justice can be used as the basis to identify and explore equity issues in relation to an energy that is produced and consumed in very different regions and contexts, across national boundaries, paving the way for more 'whole systems' energy justice research. Clearly, a range of further research opportunities also exist for conducting equity appraisals on other domestic or international biofuels/renewable energy supply chains, across whole systems from

production to disposal. This would help contextualise the findings in this case study, bring broader understandings of the contexts in which these supply chains sit and significantly improve understandings of sustainability and energy justice implications associated with particular technologies. Furthermore, it would help support the wide range of appraisals and decision-making processes that take place in the energy sector (as shown in this thesis in relation to biofuels). This might be particularly useful in relation to technologies such as anaerobic digesters that make use of agricultural and food wastes (which in this research project were found to be of considerable interest to consumers interviewed).

In conclusion, a major research opportunity now exists to consider how best to mandate and conduct the use of equity appraisals within the sustainability criteria stipulated in the EU RED, FQD and RTFO to improve the chances of energy justice in relation to biofuels. A starting point would be to consider how equity appraisals might be used within the periodic reporting mechanisms of social impacts associated with biofuels to the European Commission.

Appendices

Appendix 1: Stage 1 project information, letter of consent and questions to guide semi-structured interviews.

Tina Wegg, PhD Research Student

Supervisors: Dr Jason Chilvers, Dr Gill Seyfang, Prof Andrew Lovett

Just Biofuels?

There has been considerable debate over the development and use of biofuels with controversy driven by concerns over their sustainability and effects on particular social groups. The social acceptability of renewable energy technologies have been found to increase where benefits to people affected or involved can be demonstrated to be more equitably shared amongst them.

This project aims to improve knowledge of equity issues relating to liquid biofuels currently used in UK transport through a case study of bioethanol, a biofuel produced from sugarcane in Brazil, which is blended in unleaded petrol sold in the UK. This information could help inform a range of decisions made by people affected by the production and consumption of these fuels such as which are more sustainable than others, which are more equitable, or where policies might be adapted to ensure the costs and risks to some people (i.e. stakeholders) are mitigated.

The supply chain identified for thesis involves bioethanol produced in Sao Paulo, Brazil and consumed in and around a small market town in North Norfolk, England through the sale of blended unleaded petrol sold at a supermarket filling station. The work involves conceptualising and mapping out the supply chain, identifying specific stakeholder groups involved or affected by this process, establishing the socio-economic impacts to these people (as per their definitions) and then analysing this information to see how impacts are distributed. It requires a significant amount of stakeholder engagement.

I am currently contacting people via telephone or email, identified through literature or documentary evidence, or formal and information networks of contacts in the field, to invite them to take part in my research by agreeing to be interviewed. Qualitative data will form a significant part of the data collection process, through semi-structured interviews. The first stage will involve interviews with people who have high level knowledge of the specific supply chain identified, or general knowledge and experience in the sector, to help map out the supply chain and identify equity issues that are likely to be apparent in the field. The second stage of interviews will be conducted with people identified within the different stakeholder groups directly connected to the chain, in localised areas. The selection criteria and specific nature of the interviews will be driven by the findings during the first stage of interviews.

About me

I am a PhD student at the University of East Anglia (UEA). I have a BSc (Hons) in Environmental Sciences from the UEA and my work is funded by the UK Energy Research Centre. I conducted previous research into the social acceptability of a new and emerging geothermal energy technology as part of my dissertation, for an international agency. I worked in local Government for a number of years and my role within a Local Strategic Partnership (LSP), which was formed as a result of the sustainable development movement and Agenda 21, led me back to University to enable me to improve my knowledge of environmental issues and develop my career in this field.

Consent Form - Confidential data

I understand that my participation in this project will involve taking part in a semi-structured interview that will take approximately 60 minutes of my time.

I understand that participation in thesis is entirely voluntary and that I can withdraw from the study at any time without giving a reason.

I understand that I am free to ask any questions at any time. I am free to withdraw or discuss my concerns with the researcher(s). I agree that data obtained in the interview (non-personal) may be utilised in discussion with other researchers, in any ensuing presentations, reports, publications, websites, broadcasts, and in teaching (see details in paragraph below).

I understand that the information provided by me will be held confidentially until 2013, such that only the researcher (Tina Wegg) can trace this information back to me individually. I understand that I can ask for the information I provide to be deleted/destroyed at any time and, in accordance with the Data Protection Act, I can have access to the information at any time. I understand that in all publications and discussion of the research all information I give will be made anonymous with only pseudonyms and generic identifying features (e.g. profession) utilised for identification.

I do give/ do not give my consent to have my details retained in a database until December 2013 so that I may be asked to take part in a follow up interview, or returned to on points requiring clarification **(delete as appropriate)**

I have been provided with sufficient information on the project to give *informed* consent to the interview.

I, _____ (NAME) consent to participate in the study.

Signed: Date:

If you have any queries please contact: Tina Wegg, School of Environmental Sciences, UEA, Norwich NR4 7TJ
Ph +44 (0) 7771 605 188
Email: t.wegg@uea.ac.uk

Stage 1 Questions

Please answer the following questions briefly. I have grouped the questions and commented on their purpose to provide you with a little background or contextual information.

- About the interviewee

- What is your professional background?
- What is your nationality?

- Mapping the supply chain: understanding the supply chain, its location, boundaries etc.

- What is your understanding of the supply chain being used in this case study (outlined briefly on page 1 – Brazil-UK)? (ie *Do you know much about it specifically or in general, or are you more familiar with just part of it?*) Please outline at what stages you are mainly involved and where these stages are located. Describe briefly your professional role, involvement or connection with this supply chain.

- Mapping key actors who are 'interested or affected' in the supply chain, at different stages.

- What other organisations, institutions or people/communities do you think are involved and affected mainly in this trade and where are they located?

- Understanding experiences or perceptions of equity issues in the supply chain:

- How are you affected by the production and consumption of bioethanol (/ this fuel)?
- How does this involvement contribute to your capability and opportunities for education, employment, health, access to resources (as defined by the interviewee – can be basic/essential/environmental etc) or well-being?
- Do you see or experience these as positive or negative effects, benefits or burdens?
- How do you feel the other people identified above are affected by their involvement? How do you think it might contribute to their capability and opportunities for education, employment, health, access to resources or well-being?
- Do you regard these as positive or negative effects?
- For the things you have identified as positive or negative effects, how do you think they might be addressed or built on? Who do you think

could do this or be responsible? How do you think these issues are currently being addressed / how should they be addressed in the future?

Other comments/questions.

- Do you have any other comments you would like to add?
- I am currently identifying interviewees that need to be included for the next stage of research. This will also involve semi-structured interviews. Is there anyone in particular you think it would be good for me to speak to and include in this thesis (this might be organisations, 'stakeholder groups' or individuals)?

Thank you for your time.

Appendix 2: Stage 2 Project information, letter of consent and questions to guide semi-structured interviews.

Tina Wegg, PhD Research Student

Supervisors: Dr Jason Chilvers, Dr Gill Seyfang, Prof Andrew Lovett

Just Biofuels?

There has been considerable debate over the development and use of biofuels with controversy driven by concerns over their sustainability and effects on particular social groups. The social acceptability of renewable energy technologies have been found to increase where benefits to people affected or involved can be demonstrated to be more equitably shared. This project aims to improve knowledge of equity issues relating to biofuels; specifically the distribution of socio-economic or environmental impacts across different social groups affected by the production and consumption of a particular bioethanol product and its supply chain.

Bioethanol consumption in the UK is set to increase, driven by Government renewable energy targets. Liquid biofuels, such as bioethanol and biodiesel, are regarded a means of meeting renewable energy targets in transport within the timescales allowed by European and UK policy targets because they can be used within existing infrastructures/vehicles. The results of this research will be of interest to a range of actors and institutions in the civil society, private and public sectors to inform associated policymaking. The information produced will improve knowledge of a commonly-used liquid biofuel in terms of its impacts on people affected, how the benefits and costs are shared and thus its sustainability.

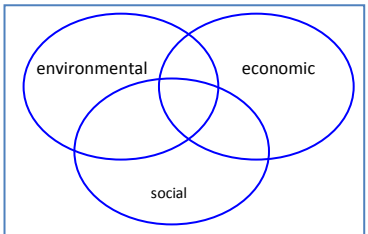
Background

Notions that Renewable Energy Technologies (RETs) can provide more sustainable forms of energy are driving their rapid development and take-up. However some RETs have been subject to considerable controversy, debate and opposition by some sectors of society. This has particularly been the case with liquid biofuels and yet these are playing an increasingly significant part of strategies to meet renewable energy targets.

Sustainable forms of energy are considered necessary because of concerns about the depletion or degradation of natural resources, through over-exploitation or pollution, caused by current dominant practices and levels of consumption. Energy provides a fundamental part of a society's ability to develop and improve quality of life, such as by providing healthier cooking facilities, lighting, heat or energy to power industries, education or health establishments. Currently, large numbers of people are without access to energy and as communities aspire and continue to develop their own infrastructures, in their particular part of the world, pressure on existing planetary resources increases.

The *Sustainable Development* agenda advocates human development in ways which improve quality of life without permanently depleting natural resources or detrimentally affecting ecosystems and their ability to function. It also promotes poverty reduction and reduced levels of social inequality so that everyone has equal access to the

resources they need and consumption doesn't disproportionately benefit or adversely affect particular people or social groups. Ultimately, everyone relies on natural environmental services, such as clean air, water, shelter and the ability to grow food. However, as levels of consumption rise, such as in response to emerging economies in developing countries, pressure on these systems increase and attempts to *sustainably* develop across environmental, economic and social dimensions is essential.



The three dimensions of sustainable development.

Equity is an under-considered, and under-researched component of sustainability. This is particularly (but not solely) true in the energy domain. Social acceptance of RETs, which affect take-up levels and the ability to meet renewable energy targets, has been shown to be affected by levels of fairness and justice. For example, the development of biofuels has raised concern over the ability to produce food and affect on food prices, which would adversely affect people living on low incomes. This would appear to be in direct conflict with sustainability ideals.

Equity, therefore, can be seen to be important to the development of RETs both in terms of decision-making about the extent to which a particular energy product or technology is *sustainable* and to the extent to which it may be deemed socially acceptable. However, as this is an area that is complex and under-researched, there is a lack of evidence of how different social groups are affected by a particular energy technology's production and consumption, which could provide useful information and evidence for decision-making, stakeholder engagement or management decisions.

Liquid biofuels, such as bioethanol, are mainly imported from overseas and Government targets to increase the mandated blending of bio-ethanol with petrol at the pump with significantly increase UK consumption. An improved understanding of the socio-economic impacts associated with its production and consumption - a fundamental component in judgements as to its level of sustainability – is therefore required.

Companies are also increasingly keen to promote their products as being sustainable, due to increasing pressures placed on them from consumers and investors. Therefore, the information and evidence that research of this type can bring forward can contribute significantly to standards and Corporate Social Responsibility (CSR) strategies.

How you can contribute

The supply chain identified for this research project's case study involves bioethanol produced from sugarcane in a small City in the state of Sao Paulo, Brazil and consumption in and around a small market town in North Norfolk, England - through the sale of blended unleaded petrol sold at a supermarket filling station.

The research involves a high level of stakeholder engagement because the main source of data collected will come from interviews with people affected by or connected to this particular supply chain and I have already travelled to Brazil to complete that stage of the interview and data collection process. I am now contacting people via telephone or email at the UK end of this supply chain to invite them to take part in my research by agreeing to be interviewed.

Your input is valuable! Would you consider being interviewed, which would take approximately one hour of your time, or do you know of someone you think I should talk to?

About me

I am a PhD student at the University of East Anglia (UEA). I acquired a First Class BSc (Hons) degree in Environmental Sciences at the UEA and my current project is funded by the UK Energy Research Centre (UKERC). I previously conducted research into the social acceptability of a new and emerging geothermal energy technology as part of my final year dissertation, for an international agency. Before returning to University, I worked in local Government for a number of years in an e-Government role and latterly as Manager for the Local Strategic Partnership (LSP). This LSP was a multi-agency organisation, of which the District Council as a lead partner, and was formed as a direct result of the sustainable development movement and Agenda 21. It was this work that stimulated my interest in the sustainability issues and led me back to University full-time to improve my knowledge and develop a career in this field. I would now like to make a contribution to the sustainable development of biofuels through my work and ultimately work in the biofuels or renewable energy sector once this project is complete in October 2013.

Consent Form - Confidential data

I understand that my participation in this project will involve taking part in a semi-structured interview that will take approximately 60 minutes of my time.

I understand that participation in thesis is entirely voluntary and that I can withdraw from the study at any time without giving a reason.

I understand that I am free to ask any questions at any time. I am free to withdraw or discuss my concerns with the researcher(s). I agree that data obtained in the interview (non-personal) may be utilised in discussion with other researchers, in any ensuing presentations, reports, publications, websites, broadcasts, and in teaching (see details in paragraph below).

I understand that the information provided by me will be held confidentially until 2013, such that only the researcher (Tina Wegg) can trace this information back to me individually. I understand that I can ask for the information I provide to be deleted/destroyed at any time and, in accordance with the Data Protection Act, I can have access to the information at any time. I understand that in all publications and discussion of the research all information I give will be made anonymous with only pseudonyms and generic identifying features (e.g. profession) utilised for identification.

I do give/ do not give my consent to have my details retained in a database until December 2013 so that I may be asked to take part in a follow up interview, or returned to on points requiring clarification **(delete as appropriate)**

I have been provided with sufficient information on the project to give *informed* consent to the interview.

I, _____ (NAME) consent to participate in the study.

Signed: Date:

If you have any queries please contact:

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The basis of the interview questions at this stage of the research (individual, localised interviews) will aim to collect the following type of information.

Stage 2 Questions

Purpose of this stage: To explore in more detail how interviewees experience and perceive the benefits and costs to themselves (and others) in the supply chain. It will also attempt to gain information about the level of importance, or value, they associate with these issues.

About you

Your name, nationality, and brief description of your current profession and professional background.

Understanding your connection with this supply chain

How are you connected to the production and consumption of this particular bioethanol product? *For example, how would you describe your professional role in this process? What are the main stages you are involved with?*

Understanding the social costs and benefits* to yourself

How are you affected by the production and consumption of this particular bioethanol product (ie this supply chain)? *These effects may be professionally and/or personally (ie outside of work). For example, how does your involvement with this supply chain affect your opportunities for employment, training/skills, education, health, family life, community life or well-being? Please say whether they are positive or negative effects.*

Are these effects experienced on a day-to-day basis or in the longer-term? (*If longer term, please provide an estimate of the timescale you are thinking of*)?

Understanding the social costs and benefits to others/general issues

How do you think others are affected by the production and consumption of this particular bioethanol product (ie this supply chain)? *These effects may be professionally and/or personally (ie outside of work) and may be people or social groups you have identified earlier. For example, how does their involvement with this supply chain affect their opportunities for employment, training/skills, education, health, family life, community life or well-being? Please also say whether you perceive them to be positive or negative effects.*

Are these effects experienced on a day-to-day basis or in the longer-term? (*If longer term, please provide an estimate of the timescale you are thinking of*)?

Importance of issues from your perspective

Of the issues raised (to yourself and others in the chain), which do you think are the most important and why?

Spreading the benefits and learning from good practices and improving on negative impacts

How can learning from the good practices be promoted across the biofuels industry, or how might the negative impacts be addressed?

- Who do you think should be responsible for this?
- How much responsibility do you think it is of Business/the Industry?
- How much responsibility do you think it is of the Government?

Feel free to add any other comments you would like to make

Appendix 3: Sample transcript (extract) Stage 1 Research

Interview transcript – BR, Tuesday 8 May 2012. Interviewer: Tina Wegg

Telephone conversation (rang via Skype and recorded by dictaphone)

Stage 1 Interview. 1 hour.

Prior to the interview commencing, BR had been asked if he was happy for the interview to be recorded, to which BR agreed.

Interviewer: (referring to a previous meeting and conversations) You know that … roughly what I am doing – do I need to give you a bit of a backdrop to what I'm doing or are you happy for us to just launch … ?

BR: Yeah … just go for it.

00:00:55

Interviewer: And obviously, I haven't sent you a letter of consent but are you happy verbally to agree to take part in this interview?

BR: Yes – that's fine, thank you.

Interviewer: This stage of my research, what I would be doing, is actually interviewing people that have specific knowledge of my particular supply chain, you know, the case study that I've identified. But I realise that your knowledge is going to be more general, I think, but …

00:01:37

BR: Yeah, I mean, I don't know the area at all or any of the businesses very well that you're looking at …

Interviewer: Yeah, no that's fine, so I think that from the point of view if we're happy to focus on your knowledge of the auditing process and the Bonsucro procedure, and that sort of thing, I think that might be sensible, if that's OK, although there may be other things you might want to drawn in from your general knowledge …

BR: Yeah, that's fine.

Interviewer: I would first ask or want to try and establish your background and where you're coming from. How would you describe your background and your role in the field?

BR: Well, I did my PhD on international trade politics of the sugar trade industry and got in touch with Olivier Genevieve that runs Ethical Sugar, a little

NGO, and had a few conversations with him and did a little report based on my desk research on Brazil for that NGO and after that was involved in the Better Sugarcane Initiative as a stakeholder representative, participated in a few teleconference interviews/meetings but they have a management committee and attended their AGM which they held in Puerto Rico. So, that's really my background …. I've done a few fieldtrips to sugarcane growing areas as part of my postdoctoral research .. um but that's the top and bottom of it really.

00:04:40

Interviewer: OK, great, that's brilliant. So, in terms of the supply chain I'm using for my case study, it runs to Brazil, so that's really good because it means that the background knowledge you have for Brazil and sugarcane feeds in nicely to what I'm doing. My supply chain runs from Sainsbury's, a filling station locally in North Walsham, in North Norfolk, through Greenergy and ends up in Araras in Sao Paulo; the Usina Sao Joao mill. So that fits in nicely to your background and knowledge.

How do you see that supply chain? Are there any general comments or remarks you would want to make about your understanding about that sort of supply chain? Such as the stages involved, the organisations or people involved?

00:06:30

BR: Yeah, I suppose the Brazilian industry has been marked by a few high profile problems such as forced labour, which has been a big one, although they've made significant strides on removing that now, or excessive working hours, or working expectations perhaps I should say for cane cutters, is another one. I've read a few reports about cane cutters being on a lot of self medication to cope with the pain, and alongside that perhaps by our standards quite poor wages although again I understand especially in Sao Paulo the wages for cane cutters might well be higher than farm labour or jobs in other sectors. There's quite a bit of concern about the expansion of the industry I suppose questions about the off-farm impacts of those particular supply chains and others like it which is what land have they moved into and who has been displaced to make way for that. My concern particularly would be where indigenous people have been displaced although again my understanding is that in Sao Paulo its just other commercial farmland that's bought up and then that displacement is almost itself displaced into other states where, you know, the soy bean farmer who they've bought the land off for example then goes and expands in [another state] or somewhere like that. So it's quite hard to track that kind of problem using the supply chain because it quickly moves away from the spatial boundary of the production site, if you like. But that's something else I'm interested in. And I guess the final thing in terms of thinking about Brazil is the

labour intensity of industry the big concern is that … again my understanding is that … even according to UNICA, the union for the millers, they are shedding thousands of jobs a year, even in an industry that's growing significantly in output terms, so, I question from the perspective of rural development I suppose, what good the industry really delivers if it is taking up masses of land and employing very little labour, albeit the labour they do retain is perhaps more highly skilled than before, as they're using heavy machinery now and perhaps getting paid better than before. But for all those that have lost their jobs or haven't benefitted or perhaps seen benefits of these training schemes that they're doing then I do wonder really whether it is trying to be a kind of progressive economic force in rural society.

00:10:41

Interviewer: So, in terms of perhaps diversity of skills or effect on the local economy, in the sense that if its got masses of people going into one industry and then they lose their jobs they have kind of got no other skills and although they've got some retraining schemes it still might be limited, I mean, where would be the other jobs if lots of other local industries have, sort of, disappeared on the basis that you've got intensive industry in one area. I guess for these people its difficult to find other employment, even if they get re-trained. Is that a fair …?

00:11:23

BR: Yeah, that would be my concern, although I have to add the caveat that I don't really know the employment situation in Sao Paulo or Brazil at all, but, um, yeah, my concern would be that where you get industrial agriculture really replicated then it puts a huge onus on migration to urban areas, um, which is problematic in other contexts. And also, I think, many people that will find employment difficult to find are those that typically migrate into the sugarcane growing areas during the seasonal harvest so, to the extent that, they just don't come any more because the job opportunities are squeezed and that's a hidden cost of mechanisation and reduced labour intensity. You know, they might have people hanging around looking for jobs, or they might just not come any more but then obviously the wages they would have sent back are now sorely missed.

00:12:53

[End of extract]

Appendix 4: Sample transcript Stage 2 Research (Brazil)

Extract of one of the interviews conducted in Brazilian Portuguese by a PhD research student from the IPT, which was translated and scribed by a Brazilian interpreter.

Interviewee RC, Stage2, Araras, Brazil 19th August 2012

RC: Mainly because I don't have the Power of Attorney to speak on behalf and I will not speak on behalf of the mill. I will talk about my previous experiences and about things I consider interesting to talk about as a professor and not directly related to the topic. Of course, my whole experience comes from the mill but I cannot talk on behalf of the mill. I would like to have this perfectly clear. What happened? When I started at the university – I have been there for two years – I'm there for a short while, I have been there for a little bit more than two years. Well, when I got there it was necessary to develop the research area, even though my research line was not really this one. It's not this one, but then I thought, I work at the mill and within different areas of this sector, in the law area and facing problems. I like field work and I always ask my student – it's interesting asking this question, but talking about sugar cane cutters and showing them these photos I ask as an exercise to them: Is this a worthy job? Is there any dignity for a human being to work like this? These photos are shocking but it's this is not the reality anymore. This is the hardest job I know, if there is any other tougher I don't know. Obviously there may be others, but I don't really know about that.

Interviewer: Do you consider this worse than working at the construction sites?

RC: Both are hard, but besides being hard, I'm telling you this because I'm back to my question. I ask my students: Do you think there's any dignity in working like this? All my students are seniors and as we are talking about dignity, I ask them: Have you ever seen a sugar cane plantation? They say: "No". Have you ever seen a worker like this? They say: No. Do you happen to know how they live? No? So, how can you make a point of view? How do you make up your connections so that you form an opinion? It's all about aesthetics. So I use these from Sebastião Salgado (* a renowned Brazilian realist

photographer) and they are all aesthetics. I'm not saying there is any dignity or not, I'm just saying that if ask them based on the photos; it's truly a matter of aesthetics. I don't know if this is correct, but at first it's like this. But this has been changed; this relationship and all the problems are linked to a historical process. I talk about this on the first chapter of my book. In which way was it historic? The sugar industry was essential to the colonization of Brazil. It could only go on because it used slaves as their workforce. It was like this for 300 years! This was spread countrywide. This sector suffered ups and downs too. The methodology used nowadays is still from the old times and the sector bears this stigma. This sector improved greatly, but there are still problems and it bears this stigma. So I make a joke. This sector needs to follow NR31 strictly in its minimal details if it is to grow sugarcane. If it is to grow soy beans, then it's not necessary. If you decide to grow corn, it's also not necessary. (*NR31: a norm that states the health and working conditions in the agriculture sector) I don't know if this stigma is because the flow of money and people is immense in this sector. Maybe that's because it's on the spotlight at the media. But sometimes I have the feeling that people think that all the bad stuff is in this sector. The truth is it's all over in every sector. It can be in a smaller amount, but it's still present everywhere. This is the way I always head with my students, by identifying problems, searching for solutions and trying to show them any possible exaggeration. It's a fact that there are serious problems happening, especially in the north area of Brazil. There are fewer problems in the southern area though. But there are still attempts to make these people work as slaves. Back to the photos, stating that this is not dignified is one thing, saying that is pure slavery is another matter. You are not contributing in anything to Brazil. You are trying to make up a scene, a performance. You set up the scene with slaves and the media and everyone will buy it. The truth is there are huge losses because of that kind of comment. This is way too serious. Accusing a company of slavery is a very serious offense. The company might have problems with extra working hours; safety at work, etc and this is one thing. These are ordinary problems; they cannot be related to slavery and this is the point of view I defend on the book. When we talk about slavery at work, we are talking about imprisonment, depriving someone from liberty,

setting someone up to work until he finishes, making him buy food that is determined and as a consequence having an eternal debt and setting him up in places he cannot leave. This is totally different from irregularities at work, when the relationship between the boss and the employee is not satisfactory. At the end, people confuse one to the other and it becomes an exaggeration. People might say: You don't really know it. I insist, I say it because I do know it. There are very serious stuff and not so serious ones. I know where the employees live and how they really live. I think people mess up a lot about this matter. Let's talk seriously about human dignity. Where do these people come from? What kind of life are they leaving behind?

Interviewer: From the northeast? From Bahia?

RC: Exactly, what kinds of working and living conditions are there?

Interviewer: Are you talking about Bahia specifically?

RC: Yes, forget about working conditions, do you know where and how they live there? In much worse conditions than in the accommodations they have at the mill. I'm not saying that the accommodations should be bad; on the contrary, they should be good. But it is like this, when they are in their hometown, they can starve or eat lizards to survive and this is considered dignified. When they get here to work, this just shows up worse because people forget that they were at the worst. I would just like to point out that the sector is improving and this is happening due to a series of reasons. You know very well what I'm talking about. Mechanization, for instance, one of the main problems of this sector, burning of the sugarcane, cutting the cane manually is another big problem, the environmental effects, the irrigation, the ethanol market; all of these are exposed in my book. Some of these will be solved in a short period of time. But I criticize the fact that no one discusses the solutions. Why do they burn the sugarcane?

Interviewer: Because of the workers?

RC: You can cut the sugarcane using two different processes: mechanization or you have to burn the straw to cut it manually. But there are two problems for the industry, because you don't have

enough production for that, which relates to economic interest. It's a fact that the workers don't accept to cut the cane with the straw, which makes it even worse and much less productive. You burn the straw to have the cane. What is going to happen when you stop this process? This is already happening here. It's already forbidden the burning in this region. This is a scenario that many mills, including São João Mill, have anticipated. We are one of the pioneers in mechanizing the crops. This happened twenty years ago, the family Ometto in Araras and in Pradópolis went to Australia and brought back this mechanization technology.

Interviewer: Twenty years ago?

RC: At about twenty years ago. Then, what happened? They set the technology industry here. The Australian industry was called *Austroff* and here it became *Brastoff*. I don't know the real names precisely. They developed here and then sold to *Kensey*. This technology that *Kensey* possesses was really brought by the Ometto family who also developed the technology. They have been traditionally working in this field. This technology has been improving and with no doubt this is the future of the sugarcane cutting. There is no other way for that. In the state of São Paulo there is a law that by 2021 – which I really criticize because it's an absurd, how could they define that in 2002? – everything will have to be mechanized. But still it was not compatible to what there was in that time. Anyway, the mills worked on the protocol and adjusted that to be enforced much before, in 2014. São João Mill has been working with mechanization for a long time and nowadays it has over 80% of its crops totally mechanized.

Interviewer: What are they planning for the remaining 20%? Are they in areas that cannot be mechanized or are less productive?

RC: We don't have serious problems about that. But you are raising another big problem. In Piracicaba, considered one of the biggest centers, there are areas that cannot be mechanized and I believe that in 10 or 15 years time there will be other crops instead of sugarcane. Therefore it won't be a big sugarcane area. There will be a

reflex on not being a big center anymore. They have a big association and a model hospital. I imagine you've heard about it.

Interviewer: Do they? No, I've never heard of it.

RC: It is from the Association of Sugarcane Growers of Piracicaba (FECAP). They have a highly reputable hospital, but soon all of this is going to be over. Am I predicting the apocalypses? Not really, if the sugarcane can only be mechanized and it's not possible to get the machines there. What will it happen? There will be no use planting sugarcane there. There will be a rearrangement of the sugarcane areas due to the fact that it's going to be forbidden to harvest without the machinery. But then São Paulo state will follow that. What about the other states? What about the northeast area? Almost every mill faces economic problems there, so I believe that these new regulations will redefine the sector. A small mill, distilleries and suppliers involved will face problems and at the end it will all be concentrated on the hands of the big groups. Nowadays there are more than 400 mills all over Brazil. More than half are located in the state of São Paulo and I think they will be concentrated in 10 major groups.

Interviewer: Do you think the mills in the northeast will no longer exist?

RC: I don't know. It's a big question mark. How can you move the economy there if it is totally dependable on the sugarcane? Brazil is an immense country full of social inequalities and distinct difficulties. Sometimes I believe that are some misunderstandings about the regulatory aspects. They are not a state matter; they are a country matter as well. So, is its application only in São Paulo state? How can they apply it countrywide? In my opinion rights mean additional costs. If you define a lot of prerequisites, like chemical restrooms, safety equipment, training, must-have stuff and etc, the entrepreneur will sum it up as additional costs. How can you absorb the costs if you don't have a massive production?

[End of extract]

Appendix 5: Sample transcript Stage 2 Research (UK)

Interview transcript – local elderly, retired resident (DF) (North Walsham).
Interviewer: Tina Wegg

15/09/12

00:00

DF: The first thing I'd like to say is that I have heard that there are problems with warranties with certain car engines if you use supermarket fuels, because they are a very inferior fuel compared with, say, like, Shell. Supermarkets seems to blend in a different way, which is perhaps due to the biofuels they blend into the fuel? So how would that affect your car engine? There must be real concern about supermarket fuels being blended for the car companies not to give a full warranty on an engine if you use supermarket fuel. They will only give you full warranty if you use other sources.

Interviewer: Can you remember what company that was, where this problem came to light?

DF: Two friends have told me on a number of occasions over recent months not to go to supermarkets to fill up with petrol because supermarkets blends are not good for your engine. It clogs up your engine and it isn't good for it. I have to say I was still taking the easy option and going down to the supermarket to get it – I don't worry too much and I don't really take too much notice of price. Wherever I need it, I go and get it. But talking to one of my friends a few days ago, she told me that they went to change their car and that's what they've been told – that certain supermarkets – sorry – certain garages and car companies will not honour the warranty if you're using supermarket fuels because it's having that impact on the engine because it's clogging up the engines …

Interviewer: This hasn't been raised before. I think it would be good to do some research into this to find out what companies are saying this and why. You don't know which company specifically that this was an issue with?

DF: I'm not sure. Although they have just bought a Jag. They were looking round at different cars and they were told this somewhere along the route.

Interviewer: OK. And it might be that the issues are with a lack of certain additives which is different to the blending of biofuels –ie the ethanol - but it's worth looking into.

DF: Yes, it may not be relevant but as you were talking about blending this came to mind. And actually, it still makes you wonder whether the blending of biofuels in the petrol has an impact on your engine.

Interviewer: The advice at the moment is that anything up to 10% is OK in any car but if you want to go higher – ie blend more ethanol – you need flex-fuel vehicles or perhaps only certain engines that can cope with this.

DF: Well I've just put in an injector fluid to put in my tank, which you put in when you're low on petrol, and that cleans the engine or the jets, it prevents clogging up. It's supposed to help when you're using not such high grade fuels. Another thing it's supposed to do is that it's supposed to clean my engine and help me get more miles to the gallon. With biofuels, would that affect the amount of miles I get from the petrol I buy?

Interviewer: I am not sure but this is something to consider as otherwise you may think you are doing something more 'sustainable' by using biofuels but you may have to use more to get the same amount of mileage from each litre.

DF: Yes, exactly, if you're not getting the performance you're going to use more biofuels to travel those miles – so are you then having to grow more crops and consuming more to travel the same amount of miles – and is that going to be beneficial?

Interviewer: If you could buy locally produced fuel – say, ethanol – because we do produce ethanol locally, from sugar beet – if you had the choice at the supermarket to purchase a locally produced fuel would that affect your decision about which fuel to purchase?

DF: Yes, I would like to do that, depending on the price. I have to say, I think it would really depend on the price. If it was just a penny or two more then I would probably say yes, I would try to do that, in the same way I do with locally grown vegetables, but I think it's very relevant, the price and the quality (again relating to the affect on the engine and the performance).

00:08:14

Interviewer: I have had other interviewees that have said they would buy locally produced or sourced fuel if they could, if they could make that choice at the pump. Part of what I've been thinking about this is that, say with the Fairtrade stuff, if you go to the supermarket you can choose to buy a coffee with the Fairtrade label and if the price is similar to the alternatives, you might think 'yes, I'll buy the Fairtrade coffee because I know the working conditions are OK' etc but we don't have that choice with fuel. We don't know what we're buying really …

DF: No, I wouldn't have had a clue there are biofuels in the petrol when I buy it …

00:08:52

Interviewer: No, the demand appears purely driven by the Government mandates for blending – it doesn't appear consumer-driven. I don't know where I'm going with that at the moment but it needs to be considered.

00:09:43

Interviewer: So, how do you feel connected to the production and consumption of bioethanol? Based on what we were saying, how would you see your connection with this process? I know you use the Sainsbury's filling station but if I were to ask you that open question, what comes to mind? What would you say? Do you feel connected to it? What part do you think you play in this process?

DF: I don't know I've ever given it a great deal of thought. I don't feel connected at all. Before having this conversation I certainly wouldn't have felt connected. But it does stimulate the thought processes and it does make you consider the part you play. And the effect on performance and your car engine of using blended fuels.

00:10:56

Interviewer: So really, apart from the fact that you are an unknowing consumer of the product, you don't consciously consume because you don't know you're consuming it.

DF: No, that's right. I don't have any strong thoughts either way. In the same way as when you hop on a plane. I don't think about the amount of fuel that's going to get me from A to B, or the quality, or how much it's costing – in terms of ozone layers or anything else!

00:11:41

Interviewer: Do you think it's part of our culture to defer any responsibility to the Government – I mean, we think well there's other people that know about things like that and can deal with that, they know what they're doing, so we don't really think about our actions and our part in that process. I was thinking about electricity – it was a conscious decision when they built the grid to stimulate consumption and now we don't really consider that when we turn on the light switch, we are playing any part in the fact that we need more power stations.

00:12:32

DF: No, that's right. It wasn't until they started putting solar panels on roofs that it started to highlight the affect more and how you could play a part in it and somehow you can feel a bit more connected to that supply. I mean otherwise you just turn something on and the supply comes in and that's about

it! As soon as you get a panel on your roof you are very aware of how much sunlight is coming in and how it's producing electric and people are getting very fixated on how much they are using, how much they are storing up, how much they are saving – so basically, that's probably advanced us lately. But we're not getting that yet with the fuel, are we? I mean, once people start bringing this to the fore then people will realise … I mean, if people could see the benefits more, I don't know how that could be done, but if you could see the benefits you and the community are getting …

00:13:42

Interviewer: Yes, that's a really good point. Do you think then on that basis, is that part of the reason why consuming locally – you know you get that feeling that when you're consuming local produce – we have more of a sense of how much we can produce locally or maybe we can see the impacts of that locally, we think that actually I can see that I'm stimulating the local economy, I'm doing the local farmer good, does it bring that connection? Why would you like to consume locally, if you could?

00:14:42

DF: Well certainly I think that if you keep everything in the community obviously the farmers are going to have more work, aren't they? It's going to be good for the farmers, other employees and stimulate the local economy. You haven't got the huge transport problems from bringing it in, so surely that's got to be beneficial, it's got to be greener hasn't it? Less emissions. It must have a knock on effect to the ozone layer, hasn't it? I was thinking that when you were talking but it just came into my head that you know we were talking about how people have become very fixated on the metres and looking at how much they had saved, I'd like to see something like that at a petrol station to say 'today we have saved ….' You know, something like a big clock so you could see it ticking along that shows the amount consumed and the amount that particular fuel has saved emissions, or whatever, but some big metre that says that x amount of green fuel has been used instead of other types of fuel. You don't have to make it fancy, but something like that so you could see that it's benefitting the community. I don't know how you'd do that … it might make people feel more connected to that fuel. You know, you go to any old pump and fill up but if you thought that you'd put some green fuel in your car and you'd contributed to something worthwhile then ... you know …

00:17:09

Interviewer: With our biofuel, when they talk about it being green or more sustainable, the way we measure this at the moment (which is part of the basis for the work I'm doing) tends to be more based on the amount of emissions we

are saving (compared with if we were using a fossil fuel). So on the one hand that's a really good thing but because we are measuring sustainability on emissions we may not have paid so much attention to the effects on people – ie the socio-economic impacts. So in other words, we might choose to purchase certain biofuels from somewhere based on the notion that we are saving emissions but we don't necessarily know the effects it's had on a local community perhaps, or land used to grow the crop etc.

00:20:58

Interviewer: What do you think the benefits are, to yourself, relating to the use of biofuels? Do you feel any benefit personally?

DF: Not at this moment in time but I would like to think that it would have benefits over time. I do think it's something that's to be put into action more. But I can't gauge it until I see it working. But then obviously you don't want to put into action something that's not going to work. That's wasted time and money – so basically I'm back to here – where we're sitting – to do the research first and see what the benefits are, how it's going to work, before we push forward to go for it in a big way. You can see, not being disrespectful to the Government, but sometimes they have gone off on a tangent, wasted billions of pounds, and a few years down the line they'll say well that hasn't worked, let's scrap that, and so the research needs to be done and put into place and consider the long-term effects. That's what I think.

00:23:09

Interviewer: Yes, and if you do a case study in this way, at least it helps to explore things in a bit more depth and bring forward evidence of what's happening, or working, on the ground. So the benefits to you might be potentially in the long-term if, for example, greenhouse gas emissions reductions and the worst effects of climate change.

00:24:00

DF: Yes, and the long-term effects on your engines as well. And less garage bills. You know, if it's a cleaner fuel and you're going to have less garage bills then that's how it's going to affect me, as well as if you're going to get more or less miles out of your car – you know, there are things that I don't know the answers to particularly so it's very hard to gauge – but if I thought it was going to have a cleaner car engine, go a few extra miles, have something that's green and obviously helps the environment, possibly have it locally sourced, then they're the types of benefits I could see for me personally.

00:24:50

Interviewer: I see, and actually they are all longer-term benefits – I mean they're not really things you can see now, you can't see these benefits and I guess it comes back to the fact that it's invisible anyway, we don't really know we're consuming it.

DF: Yes, that's right.

00:25:09

Interviewer: And then, in terms of the costs to you, you've already mentioned these might be in terms of price, effects on your car engine and car's performance or longevity – are there any other costs that come to mind for you? ….. Do you feel any concerns about food production, or the effects on food production?

DF: Yes, I suppose I do, because they are saying that land is very valuable and you've got to use that land to grow crops for food – you know, if I think there's going to be a world shortage of food – and that seems to be happening more and more – then there is that concern. Definitely. But as you say, like with helium, it was on the news, there are concerns with helium – there's quite a shortage of helium and if you run out of helium or natural resources – I don't know how you source helium – but apparently it's used for something in hospitals, in x-rays, something like that, there's some concern about the shortage of helium at the moment.

Interviewer: Well that's a good example of unsustainable practices – where we've seen resources as infinite and we can just carry on consuming without regard for natural limitations or confines. It's like with wind turbines – they need rare earth metals to make the wind turbines components – at what point do we say that actually it's consumption that's the problem – we might be able to partly find techno-fixes to carry on as normal but that's not to say that these won't have their limitations – you know, we need to consider consumption levels and our lifestyles.

00:28:08

Interviewer: Anyway, so we need to understand our impacts better?

DF: Yes, definitely.

Interviewer: The good thing about ethanol is that they are at the moment, the first generation fuels are using lots of sugarcane and sugar beet, but we do also use wheat …

DF: Wheat worries me …

Interviewer: Yes, but looking at sugarcane it does look to be quite a good and efficient process and also second generation fuels will use waste …

DF: Ah yes, waste, I was just going to say, what part of the sugarcane do they use? Are they extracting the sugar and then using the waste?

Interviewer: At the moment, the mill produces sugar or ethanol depending on the market price. So it is exactly the same practices for producing the sugar as it is the ethanol. So all these measures for biofuels, in terms of sustainability, where they have to have certain health and safety facilities for workers and all these emissions reductions have to be produced, but in the food industry we don't seem to care as much … [went on to give the example of the 19 year old sugarcane cutter who had been working on a coffee plantation, where conditions were much worse that on the sugarcane plantation] So some of the conditions on the biofuels plantations are much better now than in the food industry. I mean, do we think about this when we drink our cup of coffee?

00:31:04

DF: No, or our cocoa!

Interviewer: So anyway, from the sugarcane, they take the main part of the plant, extract the sugar and they can granulate it or produce ethanol but what they will do now, for second generation fuel, is they will produce the sugar but then use the part of the plant that is wasted – the more woody part of the plant – and produce ethanol from that. So that puts a whole different spin on it … There's no reason why the plant can't do both – produce sugar and ethanol – so the yield per land area is increased. That's another assumption that's been made – if we use more biofuels we will need to use more land, but that isn't necessarily the case.

00:33:05

Interviewer: Do you have any thoughts on what the costs and benefits are to other people in the chain? Are there any thoughts or images – what comes to mind when you think about these processes?

DF: Well, if you hadn't of told me about the conditions being better in some cases with biofuels, I would have been concerned about the effects on production workers, you know, is it slave labour? Are they getting a fair wage, are they held there in gangs? That would definitely have been one of the things I would have said or thought.

00:33:57

Interviewer: Yes, that's interesting. Although I must say that this may still be the case in some instances …

DF: I think because you've heard so much recently, in recent years, in the cocoa trade, where children are held captive from about the age of 8 and they are slaves – poor little devils – they can't escape, they've got no hope of having a better life, they're just worked all day …

Interviewer: On that note then, knowing that, do you think that a product produced in that way should be available for sale in the UK?

00:34:44

DF: No. No. But the trouble is, we don't know and I think it's overlooked. In the same way within the clothing industry, we turn a blind eye very readily, we'll buy from Primark or wherever – we don't think about how children may have been forced to mass produce, sit at a wheel, sewing machine hour in, hour out, we just want a cheap outfit – we don't think about it, go in, buy what we want – we don't think about it because it's uncomfortable if we do.

00:35:35

Interviewer: I tend to think well it shouldn't be allowed – these products shouldn't be sold – but who's supposed to do that? The Government? I guess I'm deferring my responsibility on that basis. Because I don't want to think about it, probably.

DF: Yes, absolutely, we turn a blind eye.

Interviewer: Interestingly, people in Araras weren't concerned about food production or the tensions between producing food and fuel even though they are living amongst extensive monoculture [went on to explain the orange farmer who was pulling out all his trees as he can't sell the fruit – it was rotting in the fields – no demand - so he is going to plant sugarcane instead].

00:36:35

Interviewer: And what people were saying were that because that area is so hot and dry, sugarcane thrives in those conditions, so if you're trying to grow food in that climate you will need more irrigation, more fertilizer … it costs them far more to try and produce food in this area whereas the states surrounding Sao Paulo are much better suited to food production. So food production has shifted.

DF: So that's better, isn't it?

Interviewer: Yes, and they don't irrigate for sugarcane as they put the waste pulp back on the fields which provides moisture and replenishes nutrients as organic matter in the soil. It all goes back into the land. [I talked also about Ignez who said that she had noticed food prices rising but then the local

economy was better and other conditions were better, the standard of living had gone up, and therefore it was all relative and so she wasn't concerned about it.]

00:41:31

DF: As a consumer, I don't have a full understanding of all this – I mean, I know a little more now – but I expect the Government and the Ministers, who are more genned up on this, to make those decisions for me.

Interviewer: I think this is more of an issue at this end of the supply chain.

DF: I would expect the Government to do the right thing.

Interviewer: So do you think it's unfair if the Government doesn't make these decisions or stipulate these kinds of standards?

DF: I don't know if I would use the word 'fair' but I do think they should do the responsible thing (ie to make sure we consume things with better standards) because they are there to do the job on our behalf – to do the job that we've put them there to do. They have the information there in front of them on the table to look at to make a responsible decision.

Interviewer: And they need that information ….

DF: Yes, of-course … they need all the information. I suppose that's what I think.

Interviewer: That actually leads nicely to the last question. In terms of managing these types of effects and impacts of our consumption – who do you think is responsible for that? Do you think it's Government, or Industry, or both?

DF: I think Government, firstly, but Industry must play their part. They have to work together. It's got to the stage where they have to work together. They can't go against each other – you've got to pull together haven't you?

00:44:14

Interviewer: Actually Industry has done an awful lot – I could see that in Brazil – and yes that has been in response to legislation – but in Araras, the Ometto family that owns the mill, they have done most to drive conditions and benefits in the local community in Araras. They were doing this way before legislation came into force.

DF: I have to say that it's forward thinking isn't it? If we go back to the 1920s, the Lever Brothers, who built their own village for workers and they had the

most fabulous houses and village there, and this guy is doing the same thing isn't he?

Interviewer: Yes and this was way before sustainability and corporate social responsibility was talked about. The mill has celebrated its 60 years anniversary. But there is a real sense of place – the Ometto family went to school within the community, grew up and went to school with people locally, and therefore they felt a responsibility to those around them. They donated 20% of their profits to local community projects. They improved roads, infrastructure, health services etc.

[General chat before close. Talked about evidence on a case by case basis and being able to choose between different products and fuels. Concern had been raised with residents as to whether the same sense of place and responsibility with takeovers by large transnational companies].

DF: Yes, that would concern me greatly. I mean you only need to look at Coca-Cola and how they let the Indians down terribly. You should look at that as an analogy. These big companies or corporations come in and they have no empathy, they're soul-less. I do think that would be a concern. It's very different to a small family firm who have lived in the area all their lives.

[General chat about what I found in Brazil – Sao Paulo – social divide, banks coming in, prices going up in commercial centres etc]

Close 00:52:46

[End of extract]

Appendix 6: Coding structure for stage 1

Over-arching theme	Sub-theme	Sub-category
equity issue	Distributional justice (DJ)	Availability of natural resources (inc land)
		Economic development
		Monoculture and specialisation
		Food security
		Seasonal migration
		Impacts on workers
		Energy security
	Procedural justice (PJ)	Blending mandates
		Information production/evidence-bases
	Recognition	Consumers
		Workers
		Public sector
		Private sector
		Trade associations
		Trade unions
		Research community
		Local communities

Appendix 7: Coding structure for stage 2 - Site of production and processing

Over-arching theme	Sub-theme	Sub-category	Sub-category
Equity issue	Distributional justice (DJ)	Costs for producers	Small-scale producers
		Impacts on workers / local residents	
			Housing
			Natural resources
			Land availability
			Education
			Infrastructure
			Social services
			Community cohesion
			Migration
			Employment
			Economic development
			Air pollution (inc, health impacts)
			Energy security
			Food security
	Procedural Justice (DJ)	USJ policies/CSR	
		VSCSs/European regs/blending mandates	
		National (BR) laws	
	Recognition (R)	USJ CSR policies	
		VSCSs/European regs/blending mandates	
		National (BR) laws	
		Roles/responsibilities	

Appendix 8: Coding structure for stage 2 - Site of consumption

This coding structure is vastly different from stage 1 and stage 2's site of production as the types of things people raised were much more focused around a smaller range of issues. Much of the analysis work for this site was carried out manually rather than with NVivo.

S2UK Distributional justice	Energy security
	Domestic biofuels production/industry
	Costs for consumers (inc infrastructure/vehicle engines)
	Food security
S2UK Procedural Justice	Biofuels/sustainable transport policies
	Consumer ethics/purchasing preferences
S2UK Recognition	Of consumers by others
	Policymakers
	Workers/residents site of production
	Roles and responsibilities

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