

Supervised Dissertation (841F8)

What are the barriers to operationalising and expanding temporary renewable energy capacity at UK music festivals?

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Summary

An exploratory case study of TRET operationalisation at UK music festivals is produced in response to the paucity of information currently available on TRET. Key stakeholder interviews and UK music festival energy data is analysed. The current operationalisation of TRET is contextualised through an indicative TRET capacity map, and an overview of UK music festivals energy demand and supply. Current literature on RET is utilised to produce an analytical framework. Via a comparison of the barriers to RET and TRET afforded by the analytical framework, the first typology of barriers to TRET is proffered as an answer to the research question.

Table of Contents

| | |
|--|-----------|
| Introduction | 6-9 |
| Method..... | 10-24 |
| What is the existing capacity of TRET available for UK music festivals?..... | 11-13 |
| How does the existing deployment of TRET compare to UK music festivals' existing energy demand?..... | 14-17 |
| What are the barriers to increasing TRET deployment? | 18-20 |
| Data collection techniques..... | 21-24 |
| What is the existing capacity of TRET available for UK music festivals?..... | 25-26 |
| How does the existing deployment of TRET compare to UK music festivals' existing energy demand?..... | 27-28 |
| What are the barriers to increasing TRET deployment? | 29-50 |
| Analysis of barriers identified through the literature on RET..... | 35-51 |
| Analysis of barriers identified in interviews responses..... | 36-50 |
| Discussion and opportunities..... | 50-57 |
| Conclusion..... | 57-58 |
| Appendices..... | 59-71 |
| Appendices A Julie's Bicycle Energy Data | |
| Appendices C Power Providers Forum Contact List | |
| Appendices B Questionnaires | |
| Bibliography..... | 72-76 |

Abbreviations

IPCC – International Panel on Climate Change

kW/kWhs – Kilowatt / kilowatt hours

MW/MWhs – Megawatt / Megawatt hours

PPF – Power Providers Forum

RET – Renewable energy technologies

TRET – Temporary renewable energy technologies.

WVO – Waste vegetable oil bio-fuel

List of tables

Figure 1 Litres of diesel per audience day

Table 1 Renewable TRET response rate

Table 2 Bio-fuel TRET response rate

Table 3 UK Festival promoter response

Table 4 Renewable-TRET indicative capacity

Table 5 Bio-fuel- TRET indicative capacity

Table 6 Summary of assumptions and results for festival energy demand

Table 7 Extrapolated CO₂e emitted and avoided by UK music festivals

Preface

The author explores this question as the primary researcher for Julie's Bicycle, a leading sustainability consultancy in the creative industries, whilst completing an internship with the firm. This article responds to the demand for information on TRET by the Power Providers Forum (PPF)¹. Through increased understanding of TRET capacity and operationalisation, it is hoped that the identification of the barriers established in this article will further the use of TRET at UK music festivals.

This articles principal source of data is provided from interviews with key stakeholders in the UK festival industry. To contextualise current TRET use energy data collated by Julie's Bicycle is analysed. Finally current literature on RET is utilised to construct an analytical framework.

The author is indebted to a number of contributors for the production of this article. Julie's Bicycle has assisted greatly with support, insight, and access to data. This dissertations supervisor, David Ockwell, has been a source of advice and direction throughout. Finally, this author would like thank all the PPF contacts interviewed for giving up their time so generously for the purposes of this research.

¹ The PPF was formed in 2011 to collaborate on solutions to scaling up TRET provision to UK festival and entertainment industries, and to increase demand for TRET solutions in this market.

Introduction

Increases in global average temperature since the mid-20th century are very likely the result of increases in anthropogenic greenhouse gases (GHG) (IPCC 2007). Leading scientific research reveals atmospheric carbon dioxide levels at an 800,000 year high of approximately 379ppm CO₂e (IPCC 2007). A growing consensus of expert opinion suggests an atmospheric carbon dioxide level of 485ppm CO₂e as an irreversible tipping point beyond which it is likely a series of macro-climatic shifts will catalyse a self-sustaining cycle of rapid global warming. Within this context the Intergovernmental Panel on Climate Change (IPCC), a scientific institution formed under the auspices of the UN to advise policy makers, maintains it necessary to remain below a 2°C average global temperature to avoid potentially catastrophic climatic developments. Recent empirical evidence presents global temperature increases and atmospheric carbon concentrations tracking trajectories that exceed both these benchmarks at an increasingly accelerated rate (IPCC 2007).

GHG emissions resulting from the provision of energy have contributed significantly to the increase in atmospheric GHG concentrations (IPCC 2011). Demand for energy and the subsequent CO₂e emissions associated with climate change continue to grow at an unrelenting pace (IEA 2010). Accepting the reality of climate change, there is an urgent need for the diversification of the energy mix in favour of more efficient use of natural resources. Renewable energy technologies (RET) are crucial for lowering GHG emissions from the energy system whilst simultaneously satisfying the global demand for energy services (IPCC 2011). RET have significant potential to mitigate climate change, whilst also contributing to social and economic development, energy access, and secure energy supply (IEA 2010). These combined factors have brought the development of RET to the forefront of the political, public and academic arena.

Increasingly, questions regarding how to reduce anthropogenic contributions to climate change have become more commonplace, and non-state actors (e.g. businesses, non-governmental organisations, individuals) have progressively become involved in climate

change mitigation and adaptation initiatives. One such dynamic space is the UK music festival industry. Within this sector there is a *“growing consciousness that socially responsible activities should become the modus operandi of business in the 21st century”* (Laing & Frost, 2010, p261). The number of UK music festivals has increased vastly in recent years, conveying the increasing importance of the sector (Gursoy, Kim and Uysal, 2004; Wilks 2009). The overall licensed capacity of UK music festivals increased by 60% between 2004 and 2009 (UFA 2009), with the Guardian reporting that around 12 million people would attend UK music festivals in 2008 (The Guardian, 2008). The environmental impact of UK music festivals is significant. GHG emissions associated with live music performances equal approximately 400 000t CO₂e per annum (Bottrill et al, 2010).

UK music festivals are increasingly keen to embrace the environmental concerns of the public (BBC News, 2010). Recycling initiatives are widespread. In 2008 Glastonbury recycled 193.98t of composted organic waste (Glastonbury, 2011) similarly T in the Park recycled over 60% of its waste (T in the Park, 2011). Travel to festivals is also being tackled, for example Shambala festival provides subsidised coach travel from 6 cities and free bio-fuel shuttle buses from public transport links (Shambala, 2011), whilst tHe Big Chill festival provides prizes for users of a car share scheme called goCarShare (tHe Big Chill, 2011). Carbon offsetting is another area of festival development, with T in the Park becoming the world’s largest carbon-neutral festival in 2006 through work with carbon offset schemes using The CarbonNeutral Company (T in the Park, 2011). Furthermore, UK music festivals are undertaking audits of their green credentials to benchmark and improve performance; for example the Industry Green certification based on four principles of environmental good practice: commitment, measurement, reduction of impacts and disclosure (see Julies Bicycle, 2011). Other sustainable awards for festivals include the YOUROPE (European Festival Association) Green ‘n’ Clean award and The Greener Festival UK Festival awards.

The research question for this thesis focuses on a previously unexplored mitigation initiative employed by UK music festivals. UK music festivals are an important market and application domain for temporary renewable energy technologies² (TRETs). This article is an exploratory

² TRET are defined by this article as mobile off-grid low carbon and renewable energy technologies. These include bio-fuel, solar, wind, kinetic, and hydrogen cell technologies.

case study to identify and understand the dynamics present for TRET within the setting of UK music festivals. Although focused on a UK music festival case study the barriers and opportunities established for TRET are of broader pertinence and can act to forge nuanced insights. There is a paucity of information and a lack understanding of TRET as a mitigation initiative in general. This ignorance is conspicuous when juxtaposed with the numerous policies, countless strategic documents, and vast academic literature concerning how to increase the operationalisation and expansion of RETs. Research into this area is further warranted by the wider applications possible for TRET. Consider, for example, any dynamic space where grid access is not feasible, outdoor occasions from domestic e.g. weddings and sporting events to the international e.g. refugee camps and field hospitals. The potential of TRET to make a useful contribution to global GHG mitigation is considerable.

The author is ideally placed to explore this research question, working on this project as the primary researcher for Julie's Bicycle, a leading sustainability consultancy in the creative industries, whilst completing an internship with the firm. This article also responds to the demand for information on TRET by the Power Providers Forum (PPF). The PPF, initiated and convened by Julie's Bicycle, was formed in 2011 to collaborate on solutions to scaling up TRET provision to UK festival and entertainment industries, and to increase demand for TRET solutions in this market. The PPF consists of the key stakeholders in the fields of UK music festival promotion, temporary TRET providers, and sustainability consultancies.

The overall research question for this article provides the first substantive exploration of TRET within the context of UK music festivals. In order to answer the overall question thoroughly this article will address each of the following three **sub-questions**;

1. What is the existing capacity of temporary TRET available for UK music festivals?
2. How does the existing deployment of temporary TRET compare to UK music festivals' existing energy demand?
3. What are the barriers to increasing temporary TRET deployment?

The first two sub-questions do not address the overall research question directly. The first two sub-questions provide the context in which the overall research question is to be set.

Unlike established research fields this context must first be constructed. Logically, if this article seeks to identify the barriers and opportunities to utilising and increasing TRET capacity at UK music festivals, it is first necessary to apprehend the current capacity of TRET and compare this against UK festival energy demand and UK festival energy supply. The first sub-question, therefore, establishes the existing capacity of TRET available for UK music festivals producing the first indicative capacity map of TRET capacity in the UK. The second sub-question identifies UK music festival energy demand and energy supply, including the current TRET operationalisation at UK music festivals.

With the current context for TRET at UK music festivals established the third sub-question section goes on to address the overall research question directly. Consequently the principal sections of this thesis are introduced whilst addressing the third sub-question. This thesis is the first substantive exploration of TRET, accordingly there is no pre-existent TRET literature with which to engage. Therefore, the initial act in this section is to provide an analytical framework with which to engage and to ground this thesis academically. A literature review of barriers to RET is presented and a typology of five broad barriers to RET established. Following the literature review, the typology of barriers to RET is utilised as the analytical framework within which to situate the barriers to TRET operationalisation and expansion, identified through the primary research undertaken by the author. Via a comparison of the barriers to RET and TRET afforded by the analytical framework, the first typology of barriers to TRET is legitimately proffered.

The final section of this thesis offers discussion and opportunities for increasing TRET provision. This section deliberates on the preceding analysis and presents the opportunities for increasing TRET provision as suggested by the research. It is not in the scope of this work to address all the opportunities for overcoming the barriers to TRET; instead the main opportunities as perceived by the author are presented for future consideration.

Method

Yin states that if “...*the existing knowledge base may be poor, and the existing literature will provide no conceptual framework or hypotheses. Such a knowledge base does not lend itself to the development of good theoretical statements, and any new empirical study is likely to assume the characteristics of an exploratory study*” (2003; p.30).

As highlighted in the introduction there is a paucity of information on TRET, accordingly this research is an exploratory study. More specifically this thesis uses an exploratory case study research strategy that focuses on understanding the dynamics present for TRET within the setting of UK music festivals. As an exploratory case study the author adopts a research strategy comprising an all-encompassing method – covering the logic of design, specific approaches to data analysis, and data collection techniques (Yin, 2003). As a pioneering piece of research the methods are described in depth thus supporting any future attempts at repetition and validation.

Three **sub-questions** as presented in the introduction are explored in this article. Therefore, the methods section explicates the specific methodological approach to answering each of the sub-questions, before concluding with an overview of the data collection techniques.

Method - What is the existing capacity of TRET available for UK music festivals?

The initial task of this research is to map the capacity of bio-fuel and renewable generation currently available to UK music festivals. It was not in the scope of this research to identify the capacity of all TRET providers in the UK; therefore an indicative capacity was calculated.

The indicative capacity was produced from quantitative data provided by TRET providers of their capacity either in the form of Litres for bio-fuel or kW. The capacity established from the respondents themselves is assumed to be robust. As power providers it is of critical importance that they establish an accurate measure of the capacity that they provide.

The TRET providers are separated into two groups, one of bio-fuel TRET (n=6) providers and the other of renewable TRET (n=18) providers. These two groups are then divided once more into subsections based on the amount of capacity offered by TRET providers. This differentiation is based on prior broad demarcations utilised by Julie's Bicycle. Bio-fuel TRET respondents were divided into small (0>10,000L) medium (10,000>100,000L) and large (100,000>L). Renewable TRET respondents were divided into small (0>2kW) medium (2>20kW) and large (20>kW). As these groups were based on prior demarcations made by Julie's Bicycle the accuracy of the populations as an input factor is assumed robust, although the initial grouping and a temporal element³ create reasonable uncertainty.

Within each subsection the capacity of at least a third of the total population was established for bio-fuel TRET and renewable TRET capacity. The respondent of a particular subsection is then used as an indicative sample for the size of the capacity offered by the other power providers within this group. In the case of multiple respondents an average capacity is calculated. The established capacity or average of capacity is then aggregated across the entire population of that subsection, to provide an indicative total capacity for the subsection. With over 30% of the populations' capacity explicitly established it is

³ TRET energy providers may have increased or decreased their level of capacity.

assumed that the aggregated capacity is sufficiently accurate as an indicative indication of TRET capacity available to UK music festivals.

The size of the populations employed for both bio-fuel and renewable energy are the greatest source of model sensitivity. For example, if the total population of bio-fuel was inaccurate by one third and these companies were included in the large subsection, this could result in a more than 100% increase in the indicative bio-fuel TRET capacity. However, with the small population size in total and Julie's Bicycle's knowledge of the industry, it can be assumed with reasonable confidence that the population employed for bio-fuel is accurate.

The same is not true for the subsection of small providers of renewable TRET. In contrast to the other subsections the very small nature of the companies included in the small renewable TRET population makes it reasonable to assume that population may be invalid. However, as the capacity produced by this subsection is so small it would take a significantly larger population to change the indicative renewable TRET capacity markedly. If the small subsections population was increased by 50% the total indicative capacity for renewable energy would increase by 14.75% only.

All the subsections within the two overarching groups, bio-fuel TRET providers and renewable TRET providers, are aggregated to provide a total capacity for that particular group. This provides the first indicative map of the capacity of bio-fuel TRET and renewable TRET generation in the UK (Table 4, Table 5).

There are two major limitations to the indicative capacity maps produced by this article. Firstly an accurate incorporation of the temporal dimension to TRET was not included in the indicative capacity maps. It was not possible in the scope of this work to ascertain how demand fluctuations for TRET capacity would impact upon the availability of renewable TRET capacity to UK music festivals. For example, if there are twenty festivals over one weekend this would drastically affect the level of renewable TRET capacity available to any one festival depending upon the level of demand from each of the other festivals. Secondly the bio-fuel TRET capacity does not convey the total bio-fuel TRET available to UK music festivals. The bio-fuel TRET providers based their available bio-fuel capacity on the supply

provided to UK music festivals in 2010. Thus no indication of the total bio-fuel that any one provider may be able to access was conveyed. The implications of these limitations are discussed further in the main body of the text.

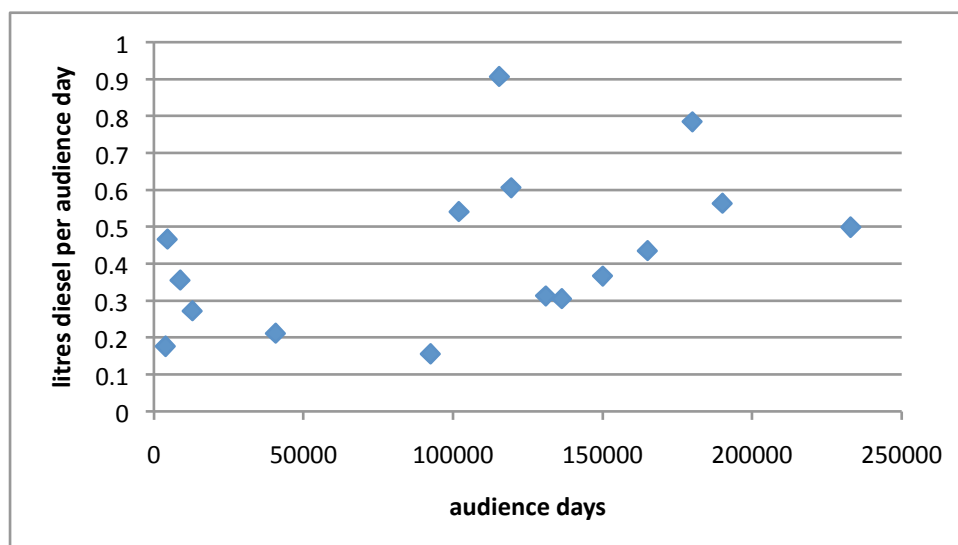
Method - How does the existing deployment of TRET compare to UK music festivals' existing energy demand?

Festival energy demand

Energy data that Julie's Bicycle collected through audits, Industry Green certification and the Industry Green tool, from various outdoor events between 2008-2010, was used to address this question (Appendix A). Using only reliable data for UK music festivals during 2010 (n=17) the following information was extracted and used to aggregate an estimate for the UK music festival energy demand and energy supply. All of the festivals that provided data were powered by mobile generators, with no mains electricity used.

Estimation of total energy demand focused upon diesel and bio-fuel demand. Diesel and bio-fuel consumption were combined to consider total fuel use at UK music festivals. The graph below charts the litres of diesel (including bio-diesel) per audience day according to festival size (audience days), upto events of 250,000 audience days. This graph demonstrates that there are two broad groups of UK music festivals: small-medium sized festivals (>100,000 audience days) and large-major festivals (<100,000 audience days), with the smaller-medium sized festivals tending to be more energy efficient than the large-major UK music festivals.

Figure 1. Litres of diesel per audience day



Therefore two averages of litres of diesel per audience day were used to aggregate the results to cover the entire UK music festival industry to improve the reliability of the aggregation: 0.273 litres diesel per audience day for small-medium festivals (n=6) and 0.546 for large-major festivals (n=11). Midpoints for small-medium and large-major were calculated. Assuming an even distribution of audience days for festivals, with the following ranges for the two groups small-medium 3000-100,000 and large-major 100,000-250,000, the midpoints were 51,500 and 175,000 audience days respectively.

The size of the UK music festivals sector was estimated at 500 festivals in total, with 437 small-medium and 63 large-major in 2007⁴.

The averages of litres per audience day are then multiplied by the average number of audience days midpoints and then again by the number of festivals for each group respectively. This calculation produced the estimated total energy demand for UK music festivals. The total diesel (including bio-fuel) litres used by UK music festivals was also converted into kWh to allow for the consideration of the source of energy use. This work utilised Defra/DECC conversion factors (2010, Table 11) for diesel litres per tonne and kWh per kg. The net conversion of kWh/kg is calculated under laboratory conditions. As this is not the case in operation in the field the assumption was used here that the onsite generators run at 40% efficiency.

Festival energy supply

Julie's Bicycle energy data recorded 9 of the 17 UK music festivals' bio-fuel consumption. According to advice from Julie's Bicycle, only bio-fuel from waste vegetable oil is to be reported as bio-fuel, to discourage uptake of bio-fuels such as palm oil⁵. For the purposes of carbon reporting, Julie's Bicycle assumes that WVO biodiesel is 0kgCO₂e/litre and that virgin oil and blends are equivalent to diesel.

⁴ First Step 2007; UK Music Industry Greenhouse Gas Emissions for 2007
www.juliesbicycle.com/wp.../04/jb-first-step-e-execsummary.pdf

⁵ For example see 'Oil giants destroy rainforests to make palm oil diesel for motorists' Times Online 2009
<http://www.timesonline.co.uk/tol/news/environment/article6796876.ece>

Over all of the 17 festivals, 12% of diesel used was WVO bio-fuel. This proportion could be applied to estimate biodiesel use across all UK music festivals. However, Julie's Bicycle may attract a skewed sample of festivals: those more likely to have adopted bio-fuel. Therefore the assumption was made that the sample was twice as likely to adopt bio-fuel as the average, resulting in an approximate average uptake of bio-fuel of 6% across all UK music festivals. On advice from Julie's Bicycle it was also to be assumed that the average use of bio-fuel will not be wholly waste vegetable oil (WVO). The assumption was made that half of UK music festival bio-fuel consumption is WVO and half diesel-palm oil blends. Thus 3% WVO bio-fuel rate is used to estimate the bio-fuel TRET capacity currently operationalised at UK music festivals. The bio-fuel TRET capacity was also converted into kWhs using the conversion method outlined above.

The bio-fuel capacity established by this article is very similar to the assumed 6% average uptake of bio-diesel across UK music festivals estimated from Julie's Bicycles' energy data. This adds support to the aggregation methods used to provide the indicative capacity above. It was decided to adopt the 3%WVO assumption suggested by Julie's Bicycle as the bio-fuel TRET capacity identified in this article does not separate out WVO and half diesel-palm oil blends.

Julie's Bicycle energy data included renewable electricity use reported by 4 of the 17 festivals in kWhs. The 4 festivals were used as an indicative sample with the reported renewable electricity use (kWhs) calculated as a percentage of their energy use (litres of diesel converted into kWhs). Although the festivals that request audits from Julie's Bicycle or use the IG tool may be more likely to use renewable energy than the average, this effect is tempered by under-reporting due to the difficulties in estimating how much power a renewable energy installation provides in the field. Therefore the proportion of renewable TRET operationalised, as a percentage of their total energy use (kWhs), was applied to the total energy use of all UK music festivals. This calculation produces an estimate for the total operationalisation of renewable TRET provision at UK music festivals for 2010.

The above explication of UK festival energy demand and energy supply is limited by the quantity and quality of energy data provided to, and collected by Julie's Bicycle. This

necessitates assumptions described above resulting in only an estimate of UK music festival energy demand and supply. However, this is the most comprehensive energy data set available for the UK music festival industry and was only accessible to this work due to the links between the author and Julie's Bicycle.

Method - What are the barriers to increasing TRET deployment?

Literature Review

This article produced an analytical framework through an analysis of the current literature for barriers to RET operationalisation and expansion. A broad literature review yielded more than 300 references.

To identify the relevant literature, key word searches were conducted in a number of databases and Journals.

- Information Sciences Institute Web of Science
- International Journal of Sustainable Energy
- Journal of Energy Policy
- Science Direct
- World Wide Web (Google).

Journal of Climate Policy Searches of these database and Journals for barriers to TRET produced no relevant findings. The approach utilised searched the terms *temporary* or *mobile* and *renewable(s) technology(ies)* or *energy* and *electricity*. These searches were also used with the additional term *barrier(s)*.

Attention was, therefore, focused toward barriers faced by RET. Two general approaches to searching the databases were used; however each database required small variations in search technique based on the databases structure. The initial strategy used the terms *renewable* and *barrier(s)*. The second used the term *renewable(s)* and *policies or policy*. For both the first and second strategy the term *energy* and *UK* were included to focus the search towards more relevant documents.

The 300 documents were then narrowed down using the following criteria:

- Documents with a focus on developing countries (e.g. India and China) were excluded, because these countries have substantially different market and policy conditions compared with industrialised nations such as the UK.
- Documents related to industrialised countries other than the UK were included but only when the barriers identified were not country specific, i.e. barriers had to be general enough to apply to renewable energy matters in the UK.

Articles were considered that addressed a variety of renewable energy technologies including wind, solar etc. In addition, documents cited within the references of the narrowed list were considered.

The vast proportion of literature reviewed focused in depth on particular aspects of RET, such as finance, or focused on the relative merits of various legislative methods for increasing the proliferation of RET. This literature was commonly too focused on a particular aspect of RET for it to produce a framework for analysing TRET. To construct the broad typology of barriers to RET utilised by this article, the barriers that were common to these articles were identified. Often these broad barriers justified the introduction of renewable policy that the academic articles subsequently analyse. Although barriers are quite situation-specific in any given region or country (Beck & Martinot, 2004), the underlying barriers identified through this method are common to RET in the UK and other countries. A typology of the following five barriers was identified.

1. Lack of funding or financing
2. Lack of experience / trust among banks and investors
3. Administrative or legal barriers
4. Infrastructure barriers
5. Social acceptance

By indentifying these five barriers the author does not intend to suggest that demarcations exist between these five sets of impediments. In reality these five barriers exist in an integrated nexus. They are treated separately in this article to make the barriers easier to identify and for the purposes of comparison. In the literature review it is clear that barriers identified may fit into one or more category.

Analysis of barriers identified in interviews responses

In the absence of literature related specifically to TRET, the typology of five broad barriers to RET is utilised as an analytical framework for further consideration of TRET. The barriers to operationalisation and expansion identified from the interview responses (data collection methods below) are situated against this typology of barriers. Through this approach similarities and differences to the barriers to RET and TRET are determined.

Data collection techniques

Interviews

To gain the necessary quantitative and qualitative data for this research two semi-structured questionnaires were formulated to guide interviews (Appendix C). One questionnaire was produced to guide interviews with UK music festival promoters and the other for interviews with TRET providers in the events sector. Each questionnaires design was produced with the assistance of Julie's Bicycle, Kambe events (festival promoter), and Firefly Solar (TRET power provider). The contributors knowledge of the subject matter ensured that the composition of the questionnaires was commensurate with the aims of the research and that the respondents would be able to provide the information required. In addition each questionnaire was piloted through a test interview prior to distribution.

There are advantages of basing an interview upon a semi-structured questionnaire; greater consistency of questioning provides more reliable results, the auditor can clarify questions, verify that answers are understood, and to seek clarification and elaboration of answers. Crucially interviews also provide a greater depth of information from respondents than questionnaires.

The questionnaires were first emailed to the sample population. Phone calls were made to the entire sample population to arrange phone interviews based on this questionnaire. Interviews lasted between 15-45 minutes depending on the respondent. All the information provided in the interviews was anonymous thus providing respondents with an opportunity to share their honest opinions of the barriers to TRET operationalisation and expansion.

Sample population and completion rates

The population to be interviewed was drawn from the PPF initial contact list (Appendix B). The PPF contact list was drawn up by Julie's Bicycle and cross checked with the contacts held by A Greener festival, another sustainability consultancy focused solely on the UK music festival industry. The PPF contact list was then distributed to all the parties listed and

extra contacts drawn from their knowledge of the industry. Through these methods it is reasonable to assume that the PPF contact list contained all the relevant TRET power providers. This is also supported by the relatively small number of TRET that were identified in total (n=18).

Baruch (1999) identified a response rate of 36.1% as a guide for questionnaires involving top management; this study surpassed this level using the more time consuming method of interviews. The vast majority of these interviews took place with senior management representatives. Of the TRET providers (n=18) a total of nine interviews were conducted, representing 50% of the total population of TRET identified on the PPF contact list. There are two groups of TRET provider distinguished in this article; bio-fuel TRET providers and renewable TRET suppliers. Of the bio-fuel providers 50% were interviewed in total from a small total population of six, and 50% of renewable TRET providers also completed interviews from a larger population of 12. This is an excellent completion rate.

Table 1 Renewable TRET response

| Subsection | No. of Respondents | Total population |
|-------------------|---------------------------|-------------------------|
| Small (0>2kW) | 4 | 10 |
| Medium(2>20kW) | 1 | 1 |
| Large(20>kW) | 1 | 1 |
| Total | 6 | 12 |

Table 2 Bio-fuel TRET response

| Subsection | No. of Respondents | Total population |
|--------------------------|---------------------------|-------------------------|
| Small (0>10,000L) | 1 | 2 |
| Medium (10,000>100,000L) | 1 | 3 |
| Large(100,000>L) | 1 | 1 |
| Total | 3 | 6 |

The PPF contact list also included small-medium and large-major UK festival promoters. All the small-medium and large-major UK festival promoters on the PPF contact list were interviewed (n=6). These six respondents were split evenly between small-medium (n=3)

and large-major (n=3). This research managed an optimum response rate of 100% of the UK music festival promoters included on the PPF contact list. This is not surprising as these respondents are stakeholders actively engaged with the PPF.

Table 3 UK Festival promoter response

| Size of festival promoter | No. of respondents | No. on PPF contact list |
|---|---------------------------|--------------------------------|
| Small – medium (0>100,000 audience days) | 3 | 3 |
| Large – Major (<100,000 audience days) | 3 | 3 |
| Total | 6 | 6 |

This article estimates there are 500 UK music festivals; 437 small-medium and 63 large-major. It is important to note that two of the three large-major UK festival promoters interviewed together promote 20% of licensed festivals capacity in the UK (UFA, 2009) promoting 12 large-major festivals. Therefore of the 63 large-major UK music festivals, this article interviewed the promoters responsible for a total of 13 large-major UK music festivals, or 20.6%. This is a substantial proportion of the large-major UK music festivals. The small-medium promoters promoted one festival each and therefore only 0.6% of the total sample population of 500 were interviewed. This is a very small proportion of the overall sample.

To supplement the small-medium UK music festivals interviewed via the PPF contact list a mail-out was distributed by the Association of Independent Festivals to their contacts. This included a web-link to an online version of the questionnaire used to guide the interviews. This author was not privileged to the Association of Independent Festivals contacts and therefore interviews were not an option. The use of a web-based questionnaire was suboptimal to interviews discussed above, although recent academic work suggests the substance of data produced by web-based questionnaires is equivalent to that produced by paper-based questionnaires (Denscombe, 2006). However, the quality of information

provided from the web-based questionnaires was very poor in comparison to the interview data, thus adding further justification to a method based on interviews.

In total the web-based survey generated a further 10 questionnaire responses. Therefore, the responses of 13 small-medium UK music festivals were available for this research, a total of 2.6% of the overall population of 500.

What is the existing capacity of TRET available for UK music festivals?

Here the indicative capacity of TRET available for UK music festivals established by the primary research of this article is presented (Table 1 and Table 2). This is the first indicative map of the capacity of bio-fuel TRET and renewable TRET generation in the UK.

Table 4 Renewable-TRET indicative capacity

| Subsection | No. of Respondents | Total population | Total capacity (peak KW) |
|-------------------|---------------------------|-------------------------|---------------------------------|
| Small (0>2kW) | 4 | 10 | 15 |
| Medium(2>20kW) | 1 | 1 | 18 |
| Large(20>kW) | 1 | 1 | 30 |
| Total | 4 | 12 | 63 |

Table 5 Bio-fuel- TRET indicative capacity

| Subsection | No. of Respondents | Total population | Total capacity (Litres supplied) |
|--------------------------|---------------------------|-------------------------|---|
| Small (0>10,000L) | 1 | 2 | 10,000 |
| Medium (10,000>100,000L) | 1 | 3 | 300,000 |
| Large(100,000>L) | 1 | 1 | 400,000 |
| Total | 3 | 6 | 710,000 |

The total indicative renewable TRET capacity available for all UK music festivals is 63kW. However the indicative renewable TRET capacity is of limited use as a basis for further analysis. Firstly as identified in the methods one limitation of this indicative capacity map is that the temporal element is not considered. Without the incorporation of the temporal dimension it is not possible to produce a level of renewable TRET capacity available for any particular UK music festival. Secondly the renewable TRET capacity is 63kW at peak supply;

that is renewable TRET can provide 63kW in total, at peak capacity. An issue however, is how often the renewable TRET operates at peak capacity whilst in operation. There is no information available from renewable TRET suppliers about the average kWhs produced over a certain period that would provide a more accurate representation of the capacity that can be expected to be delivered to UK music festivals. Renewable TRET providers do not provide accurate measurements of their electricity generation in the field.

The practical use of the bio-fuel TRET capacity identified here is also limited. The indicative capacity exhibits how much bio-fuel TRET capacity was provided to UK music festivals in 2010. There is no indication, however, of how much bio-fuel is available to UK music festivals in total. Furthermore, the bio-fuel capacity does not indicate any relationship between the levels of supply of bio-fuel TRET capacity and the demand of UK music festivals. To produce an accurate depiction of bio-fuel TRET capacity available to UK music festivals it would be necessary to establish how much of the total bio-fuel available in the UK is accessible to bio-fuel TRET suppliers. From the responses in the interviews it was not possible for bio-fuel TRET suppliers to produce this information, if indeed they can access this information.

The two TRET capacities identified above are the most accurate indicative capacities that could be produced within the scope of this research. They identify the total renewable TRET capacity available in the UK and the level of supply of bio-fuel TRET to UK music festivals in 2010. Further than this their application is limited. The TRET capacities produced by this research therefore do not provide a satisfactory answer to the sub-question of the existing capacity of TRET available to UK music festivals. Addressing the sub-question above encountered problems that could not be known prior to this research. The indicative capacity may not be accurate but the problems identified are important in answering the overall research question of this work. The issues identified above are explored further in the analysis of barriers to TRET provided by interviews that is included further in the article.

How does the existing deployment of TRET compare to UK music festivals' existing energy demand?

The Table 4 provides an oversight of the UK music festivals existing energy demand. The calculations outlined in the methods produce an estimated total energy demand of 12million litres of diesel by UK music festivals during 2010. The litres of diesel consumed produced 48,360MWh of electricity equivalent. The UK energy demand of UK music festivals in 2010 generated approximately 31,573t CO₂e. UK music festivals have a sizable existing energy demand with an equally sizeable emissions total.

Table 6 Summary of assumptions and results for festival energy demand

| | Small-medium | Large-major | Total |
|--|--------------|-------------|------------|
| Average litres of diesel per audience day | 0.273 | 0.546 | |
| Number of festivals | 437 | 63 | |
| Average number of audience days | 51,000 | 175,000 | |
| Litres of diesel consumed | | | 12,181,501 |
| MWh of electricity equivalent | | | 48,360 |

Table 5 establishes the current contribution of TRET supply to UK music festivals energy demand. Bio-fuel TRET is the much larger of the two forms of TRET provision. Utilising the 3% WVO bio-fuel rate described in the methods 365,445L of bio-fuel TRET is operationalised at UK music festivals producing 1451MWh electricity equivalent, and mitigating 976t CO₂e. The bio-fuel TRET capacity explicated by this article is close to double this 3% WVO bio-fuel figure, however, as the indicative bio-fuel capacity identified by this article is not solely WVO bio-fuel the assumptions outlined in the method are held constant. Bio-fuel TRET operationalisation at UK music festivals is therefore, a small but appreciable contribution towards meeting energy demand.

In contrast to this the operationalisation of renewable TRET makes a miniscule contribution towards the energy demand UK music festivals. Using the calculation outlined in the methods the estimate for the total operationalisation of renewable TRET provision at UK music festivals for 2010 is just 0.026% of the total energy supply. Current renewable TRET operationalisation contributes just 12,575kWhs or 12.6MWhs and mitigates just 2t CO₂e.

Table 7 Extrapolated CO₂e emitted and avoided by UK music festivals

| | Results |
|--|---------|
| Tonnes of CO ₂ e from diesel use assuming 3% WVO biodiesel | 31,573 |
| Tonnes of CO ₂ e avoided due to WVO biodiesel | 976 |
| kWh of renewable energy used | 12,575 |
| Tonnes of CO ₂ e avoided due to renewable energy (avoided diesel use) | 2 |

It is noticeable here that the two forms of TRET are operationalised to vastly differing extents. The proceeding analysis of the barriers to TRET operationalisation and expansion will provide us with an understanding of why this is the case.

At 12 million litres and 48,360MWhs the energy demand of UK music festivals established by this article is significant, consequently the emissions of 31,573t CO₂e is considerable. The overview of current UK music festival energy supply highlights that the total TRET operationalisation contributes just 0.026% of this energy supply. It is clear that as an application domain there is a large scope for increased use of TRET at UK music festivals. Indeed the limited nature of TRET operationalisation in general at UK music festivals adds further justification to the overall research question of this work. If we wish to increase TRET operationalisation it is crucial that barriers towards this end are explicated.

What are the barriers to increasing TRET deployment?

The initial act in this section is to provide an analytical framework with which to engage. A board literature review of barriers to RET is presented below.

Analysis of barriers identified through the literature on RET

The argument for supporting RETs through policy intervention has been laid out by numerous bodies including the IEA, World Energy Council and OECD (IEA, 2008; UNDP, 2000) government reports (PIU, 2002) and the Stern Review (2007). The majority of the literature concerning “barriers” to permanent low carbon and renewable technologies focuses on the relative merits of different policies aimed at increasing their proliferation. The UK has introduced various policies⁶ with the intention of increasing RETs electricity provision. The majority of the literature addressing renewable policy in the UK focuses on the merits of the Non Fossil Fuel Obligation (1989) and the Renewables Obligation (2002) (Mitchell & Connor, 2004; Mitchell et al, 2006; Goss & Heptonstall, 2010; Fuchs & Arentsen, 2002; Toke & Lauber, 2007; Lipp, 2007; Ringel, 2006; Wood & Dow, 2011). More recently a radical overhaul of UK electricity consumption and production has been proposed by the Electricity Market Reform (EMR, 2011) White Paper, the UK Renewable Energy Roadmap (RERM, 2011), and the Microgeneration Strategy (MGS, 2011).

The numerous policy and strategy documents represent a policy landscape in a constant state of flux reviewing and altering legislative methods to increasing the proliferation of RETs. The latest proposed changes of the EMR, RERM, and MGS (2011) make it impossible to *“determine the direction in which UK renewable energy policy is going, or how it will work and how well it will perform”* (Wood & Dow, 2011; 2240). This article does not seek to analyse the goals or merits of previously introduced, or proposed policy initiatives. This article instead identifies the underlying barriers to RETs that these policies try to overcome.

⁶ Policies include: the Non Fossil Fuel Obligation (1989); Renewables Obligation (2002); Sustainable Energy Act (2003); Energy Act (2004); Climate Change and Sustainability Act (2006); Energy Act (2008); Climate Change Act (2008); Green Energy Act (2009). Available at www.legislation.go.uk

A typology of five broad underlying barriers is identified through the literature. Each is discussed in turn below.

Lack of funding or financing

The barrier of funding and finance refers to RETs difficulty in achieving funds or capital. Funding or finance as a barrier to RETs relates to the price of RETs in relation to prices of competing non-renewable energy sources. The greatest barrier to the adoption of RETs is their lack of competitiveness despite cost reductions over recent years (Gutermuth et al, 1998).

A major barrier to RETS is the problem of externalities. Externalities refer to the external costs of electricity generation from fossil-fuel based technologies not internalised into accounting and financial calculations, i.e. the costs of the environmental and human health impacts of conventional technologies that are not reproduced in electricity production costs (Owen, 2006; Beck & Martinot, 2004; Dinica, 2006 Neuhoff, 2005). This reflects the methodological difficulties in establishing the full extent and scale of the consequences of energy produced by fossil fuel generation (Owen, 2006; Beck Martinot, 2004; Dinica, 2006). Externalities associated with electricity production have been estimated, leading to the conclusion that electricity from coal or oil would double, and the cost of electricity production of gas would increase by some 30%, if external costs were taken into account (ExternE). The externalities in electricity production costs make conventional generation appear deceptively cheap and make the costs of RETs appear uncompetitive.

Methods used for the cost assessment of energy projects act as a barrier to finance and financing of permanent RETs (Awerbuch, 2003). The accounting and financial assessment methods used by traditional engineering approaches for electricity projects are dated (Awerbuch, 2003; Beck & Martinot, 2004). Traditional engineering economics utilise arbitrary discount rates for fuel costs and operating expenses in calculating the levelised electricity generating costs, whilst not accounting for important financial and risk characteristics associated with the costs of conventional electricity projects (Awerbuch, 2003; Beck & Martinot, 2004).

These factors establish market competition as a major hurdle where the high capital costs and low rates of return make RETs uncompetitive in deregulated electricity markets based on short term prices (see Blyth, 2006). Even though RETs lower fuel and operating costs may make them cost-competitive on a life cycle basis, higher initial capital costs can result in RETs providing less generating capacity per initial level of investment than conventional sources (Beck & Martinot, 2004; Reddy & Painuly, 2004; Goldman et al, 2005). Therefore, RET investments generally require higher levels of financing for an equal amount of capacity (Beck & Martinot, 2004; Goldman et al, 2005; Guttermuth, 1998; Neuhoff, 2005). If the renewable resource is limited (e.g. a wind plant that can only operate when the wind blows), then cash flows and margins will be lower when compared to conventional plant, and, thus put pressure on overhead and maintenance costs (Goldman et al, 2005). This can make them more difficult to finance, to the extent that their revenues are limited by the price of electricity (Goldman et al, 2005).

Lack of experience and trust amongst banks or investors

Investment risks are also identified as a key hurdle to gaining finance and investment for RETs (see Dinica, 2006). Most financial institutions do not have significant experience in evaluating renewable energy resource risks and are typically averse to financing new areas (Sonntag-O'Brien & Usher, 2004; Wohlgemuth & Madlener, 2000). In addition to the market competition outlined above, RETs present risks in terms of both credit worthiness and technology (Goldman et al, 2005).

Credit worthiness refers to the amount of debt a project can raise, and is a function of the projects expected capacity to service debt from a cash flow. Many RETs lack sufficient verification, testing and acceptance in the market place, and therefore struggle with credit worthiness (Goldman et al, 2005). Again, as with market competition the deregulated short term electricity market militates against RETs ability to produce a fair cash flow (Beck & Martinot, 2004). Furthermore, the price of electricity is currently low due to public subsidies received by fossil-based and nuclear generating capacity prior to electricity market

liberalisation (Goldman et al, 2005; Dinica, 2006). This negatively affects the level of debt a project can finance thus making project financing more difficult to obtain (Goldman et al, 2005).

Technology risk is a particularly prominent issue for plants employing new technologies, that are manufactured by an early stage company, and that carry high costs because of their innovative, less mature nature (Goldman et al, 2005). Initial capital costs for new technology are likely to remain uncertain until several full commercial-scale plants have been built. Low carbon and renewable energy technologies frequently have no information on which to base comparisons, or no experience or track record in the market (Goldman et al, 2005; Sonntag-O'Brien & Usher, 2004; Wohlgemuth & Madlener, 2000). For emerging RETs such as carbon capture and storage and tidal power these uncertainties are particularly acute.

Scholars have identified that problems posed the finance, market competition; investor confidence; technology risks and credit worthiness are often related to the innovative nature of RETs (Tsoutsos & Stamboulis, 2005; Foxon et al, 2005). Processes of economic development, technical interrelationships and institutional rigidities can hinder technological shifts to innovative technologies such as RETs (Kemp, 1994; Schot, Hoogma and Elzen, 1994; Schot, 1998). It is identified that niche markets are important for the further development of innovative technology, allowing relatively crude new technologies to be improved and adapted to user needs whilst sheltered from mainstream competition (Kemp, 1994; Kemp et al, 1998, 2001). Economic analysis and innovation systems literature support the proliferation of innovative technologies via processes of learning, whereby technology deployment generates cost reductions and efficiency gains (Arrow, 1962; Arthur, 1989; Pierson, 2000). Without regulatory incentives low carbon and environmental technologies are likely to fail to bridge the gap between R&D laboratories and demonstration projects, and market introduction, commonly referred to as the "valley of death" (Tsoutsos & Stamboulis, 2005; Foxon et al, 2005). Proponents argue that the importance of learning and of market deployment is not just an area of academic interest; it is an empirically proven phenomenon (Goss & Heptonstall, 2010; Neuhoff & Seller, 2006; IEA, 2000).

Administrative or legal barriers

Planning is immensely important to the energy system (Goss & Heptonstall, 2010). Legal and organisational frameworks have been optimised over the years for fossil fuels based electricity generation. RETs have not been adequately addressed in spatial planning or in approval procedures (Beck & Martinot, 2004; Kofoed-Wiuff et al, 2006; Truscott, 2009). Approval procedures for RETs are lengthy, troublesome and costly (Truscott, 2009; Kofoed-Wiuff et al, 2006). The European commission states that *“Requirement imposed by the numerous authorities involved (national, regional and municipal) often lead to delays, investment uncertainty, a multiplication of efforts and potentially greater demands for incentives by developers in order to offset investment risks or the initial capital intensity of the project”* (EU 2005, RE Comm., p.12-13). Frequently the lead times for permits are unnecessarily long. In 2011 an on-shore wind farm scheme in the UK was finally rejected after being proposed initially seven years ago (BBC News, 2011). Furthermore, of the 25 GW of RETs capacity in the pipeline 14.2 GW are still at the planning stage with a likelihood that 30% of the projects may be abandoned (HoC, 2010).

The barriers of a suboptimal approval process are exacerbated by the fact that transaction costs of projects do not vary significantly between project sizes. As a result pre-investment costs, such as permitting, consultant and legal fees have a proportionately higher impact on the transaction costs of RET generation which is typically smaller than conventional generation (Kofoed-Wiuff et al, 2006; Sonntag-O’Brien & Usher, 2004).

The final administrative and legal barrier is that of spatial planning. The administrative framework has been developed for existing fossil fuel based technologies and is not yet tailored to the needs of RETs (Neuhoff, 2005; Kofoed-Wiuff et al, 2006). Spatial planning traditionally anticipates specific areas for industrial development, these plans often have to be revised for the location RETs such as wind and bio-energy (Neuhoff, 2005). In addition, planning departments and inspectors can be unfamiliar with low carbon and renewable energy technologies, and there is frequently a lack of established procedures for managing siting and permitting (Beck & Martinot, 2004). The European Commission attributed permits related to spatial planning as a major factor in the overall period needed for project

development (EU RE Comm, 2005). And as can be seen from above, the time lag caused by administrative and legal barriers can lead to project failure.

Infrastructure barriers

Infrastructure barriers to RET are based on constraints to connecting generation to the electricity system. Access to the electricity grid represents a major barrier for both existing and future RET projects (HMG, 2009). The emergence of a 12GW renewable generation connection queue in Scotland with some projects having connection dates beyond 2018 is evidence that the existing access arrangements are an impediment to RETs (Baker et al, 2009).

Transmission access is a major barrier (Beck & Martinot, 2004; Goss & Heptonstall, 2010; Baker et al, 2009). In the UK, grid connection, or Transmission Entry Capacity is granted to a new generator once the GB System Operator (National Grid Electricity Transmission) has assessed, and implemented, the transmission system reinforcements required for new generation capacity. Critically, the assessment of the reinforcements necessary is founded on the basis that the network must be able to cope with the maximum rated output of the new plant. This is suited to conventional thermal generation that would run at close to peak output during times of high demand, but not for RETs. In practice the variable or intermittent generation of many RETs (e.g. solar and wind) would result in these RETs operating well below rate capacity for most of the time (Krohn et al, 2009; Goss & Heptonstall, 2010). These transmission access arrangements require RETs to pay for a level of transmission reinforcement that is well in excess of what may be required (Goss & Heptonstall, 2010). It is argued that priority access to the grid at a reasonable and transparent price is essential to the development of RET generation (Beck & Martinot 2004; Kofoed-Wiuff et al, 2006; Baker et al, 2009). RETs are exposed to grid extensions and reinforcements in addition to grid connection investments (EU, 2005: 14, RE Comm.). As Baker et al assert *“Current arrangements result in a situation where incumbent fossil fuel generation has indefinite access to the electricity markets at the expense of renewable generation”* (2009, p6).

Social acceptance

Social acceptance is a prerequisite for the introduction of RETs and new public infrastructures. Several features of RET brought social acceptance into the fore: renewable energy plants tend to be smaller-scale than conventional fossil fuel based power plants, increasing the number of siting decisions that need to be taken; renewable energy conversion tends to be characterised by lower energy densities, the relative visual impact (per MWh of output) tends to be higher; and finally renewable generation conversion also tends to take place closer to the site of consumption (the backyard) increasing its visibility and bringing the environmental impact closer to residential areas (Wustenhagen et al, 2007).

Wustenhagen et al (2007) defines three broad dimensions of social acceptance, namely socio-political acceptance, community acceptance, and market acceptance. Firstly socio-political acceptance is social acceptance on the broadest and general level, including; acceptance by the public, key stakeholders, policy makers, and acceptance of environmental policies and technologies. There is broad socio-political acceptance of RETs evidenced by the proliferation of environmental policy designed to assist RETs identified above. Furthermore, opinion polls have shown that the majority of people tend to agree with the idea of public support for RETs (Eurobarometer, 2003; POST, 2007). Wustenhagen et al (2007) asserts that many of the barriers to renewable implementation in general can be perceived as a manifestation of a lack of social- political acceptance, such as financial procurement and spatial planning systems, such as those identified above.

The second dimension of social acceptance is community acceptance. As suggested by the planning issues outlined above there is more opposition when one moves from the global support of RET to localised investment and siting decisions (Bell et al, 2005). Resistance to RETs has been explained by the Not-In-My-Back-Yard (NIMBY) syndrome, whilst others suggest this is an over-simplification of people's motives (Bell et al, 2005). Community acceptance includes procedural justice, distributional justice and trust. Issues that may affect community acceptance include a fair decision making process including all

stakeholders (Gross, 2007), and the trust between the local community and the outside investors and actors (Huijts et al, 2007).

Finally, Wustenhagen et al (2007) argue that market acceptance, or the process of market adoption of innovation can be perceived as an element of social acceptance. This is particularly the case for smaller scale RETs and innovative RETs. Wustenhagen et al (2007) utilise innovation literature, discussed above, where innovative technologies such as RETs struggle to displace embedded technologies that have benefited from processes of economic institutional and technical learning (Kemp, 1994; Schot, Hoogma and Elzen, 1994; Schot, 1998). Market acceptance also includes consumers and investors. Scholars have noted the path dependencies of large energy firms (Hirsh 1989) and the cognitive barriers within and between firms with regards to barriers to taking up environmental and sustainability issues (e.g. Bansal and Roth, 2000; Bentsen & Sorensen, 2010).

Analysis of barriers identified in interviews responses

The literature review above has identified a typology of five barriers to RET.

1. Lack of funding or financing
2. Lack of experience and trust among banks and investors
3. Administrative or legal barriers
4. Infrastructure barriers
5. Social acceptance

In this section the barriers to TRET operationalisation and expansion identified in the interviews responses are analysed against this typology. Similarities and differences between TRET and RET are emphasised. It is determined by this analysis that the typology of barriers utilised as the analytical framework is broad enough to encompass almost all the barriers to TRET provided to by the interviewees. The typology is broad enough to be used for both TRET and RET but this does not indicate that the issues for TRET and RET are similar.

In each category of barriers the issues for TRET and RET are substantively different. This is explicated in the analysis below.

One barrier to TRET could not be encompassed by the typology developed from RET literature. This barrier was mentioned by the interviewees but also became apparent whilst addressing the first sub-question of this article. It was not possible for this article to establish an accurate TRET capacity available to UK music festivals. A barrier to the operationalisation and expansion of TRET is an accurate capacity measurement. Therefore, in addition to the typology developed from the RET literature above a sixth barrier exclusive to TRET is also included.

6. TRET Capacity

Further comment on the typologies used and developed in this article will follow in the discussion.

Funding and Finance

Those that fund and finance the use of temporary TRET are in this case study, UK music festivals. Funding and finance as a barrier to TRET relates to the price of TRET in relation to prices of competing non-renewable energy sources. For the UK festival market the competing non-renewable energy source is that of conventional diesel based electricity generation. The environmental externalities in conventional electricity generation that make RET uncompetitive (Owen, 2006; Beck & Martinot, 2004; Dinica, 2006; Neuhoff, 2005) are common to conventional diesel based generation at UK music festivals. The costs in terms of environmental and human health impacts of diesel based generation at UK music festivals is not reproduced in its electricity production costs.

It can be argued that funding and financing is a more significant barrier for temporary TRET than for RET. If traditional engineering economics were adjusted as Awerbuch (2003) suggests in the literature then RET would become competitive, similarly RET is competitive if life cycle costs are included in financing calculations (Beck & Martinot, 2004; Reddy & Painuly, 2004 Goldman et al, 2005). Life cycle costs do not apply to TRET by their very nature. Conversely, temporary TRET providers must try and generate funding and financing from consumers, in this case UK music festival promoters, repeatedly. Each year UK music festival promoters decide upon their energy mix, and decide whether or not to pay extra for TRET. This can be evidenced by the fact that one UK music festivals had decreased their use of TRET due to the recession.

All bar one UK music festival promoters interviewed identified cost as the major barrier to expanding the use of TRET at their festivals. Correspondingly, all the TRET providers interviewed determined funding and financing to be a major barrier to increasing capacity and operationalisation at UK music festivals.

Funding and finance was less of a barrier for bio-fuel based TRET. Bio-fuel based TRET is the most cost competitive form of TRET. This helps to explain the divergence between the level of operationalisation between bio-fuel TRET and renewable TRET. The majority of festival promoters do employ some bio-fuel capacity. Nevertheless cost and therefore funding and finance remain a barrier.

“The main barrier is the cost. It is considerably more expensive than conventional supply. In some cases it can produce a 40% increase in the energy bill. Some people ask about its supply but it is too expensive and deters them. At the moment fuel prices are increasing so it makes it even more difficult to finance additional costs.” (Large-major festival promoter)

Cost is a more significant barrier for renewable TRET. Renewable TRET are more expensive than conventional generation and bio-fuel TRET and offer much less generation capacity for the expense. There is much less generation capacity provided by renewable TRET per level of investment. This is a particularly significant barrier for large-major UK festival promoters.

“The major barrier to other renewables is cost and technology performance. Renewable energy technologies are not developed enough to supply the large stages with large power demands of festivals such as these. The problem is price and it is a struggle to get funding for these expensive technologies.” (Large-major festival promoter)

Further support for funding and financing as a barrier to renewable TRET is provided by the three small-medium festivals interviewed. The small-medium festivals interviewed currently operate at close to one hundred percent on TRET, mostly bio-fuel. Their goal is maintain this level of capacity whilst decreasing bio-fuel TRET and increasing renewable TRET. However, even for these ardently eco-festivals cost is a major barrier to using renewable TRET.

“The main barrier is the expense. It is the most significant barrier. Cost is the main barrier in moving from bio-fuel to renewable technologies. 100 kW of bio-fuel would cost around the same as 1kW of solar.” (Small-medium festival promoter)

All the TRET providers interviewed for this research identified funding and finance as a major barrier to increasing their TRET capacity and its operationalisation.

“It is difficult to get finance. People are often unwilling to pay the extra for renewable energy. This has forced [the firm] to reduce prices. Cost of building and components are expensive. The cost limits demand.” (Large renewable TRET provider)

“Companies will always choose the cheapest option and that is conventional diesel. It is customer driven and until customers are willing to pay the price premiums for fuel it [demand] is unlikely to increase.” (Medium bio-fuel TRET provider)

One large-major festival promoter, however, was an exception from all the other large-major promoters interviewed. This festival provider would increase its use of TRET to 100% of energy generation if the supply was available. The cost was not perceived as a barrier at all. If the supply was available this promoter would be willing to increase the cost of their festival tickets to enable an increase in TRET provision. This festival promoter highlighted the prestige of the festival itself and the high level of demand for tickets as reasons why this would be achievable. Nevertheless, this large festival promoter appears to be an exception that proves the rule.

Lack of experience and trust among banks and investors

In the literature it was determined that investment risks and lack of experience evaluating RET was a major barrier (Sonntag-O’Brien & Usher, 2004; Wohlgemuth & Madlener, 2000; Goldman et al 2005; Dinica, 2006). The more established the RET the less likely that trust / experience among banks and investors would be a barrier. Similarly the barrier of experience / trust among banks and investors for TRET was based upon the type of technology employed.

Lack of experience / trust amongst banks and investors was not a barrier for bio-fuel TRET providers. None of the respondents for bio-fuel TRET determined this as a barrier to increasing their capacity. Bio-fuel TRET provision is mostly a case of fuel substitution,

substituting conventional diesel for bio-fuel diesel, as such it does not present the same investment risks that may apply to other forms of TRET provision. Although, it is worth noting that all the bio-fuel providers interviewed for this article were established firms (10 years or more) that chose to rein-vest their own profits rather than seeking investment from third parties.

Forms of renewable TRET are also becoming more established. The large renewable TRET provider identified that although funding by investors was a problem at the start for the company, trust / confidence by banks and investors has now been established.

“Finance was difficult to gain at the beginning. However, now the bank has experience with the firm it is much less of an issue and we have recently had a new loan request accepted”
(Large renewable provider)

This may indicate that with the much smaller levels of investment required for TRET than RET it may be sufficient that trust / confidence from banks and investors is achieved by the firm rather than the technology employed by the firm. However, even for established firms the level of interest was raised as a barrier for investment.

“There is no sustainable funding available to my knowledge, sustainable meaning a realistic rate of interest on a loan for example” (Small renewable TRET provider)

This barrier was much more significant for the less established temporary TRET. These TRET share many of the characteristics of RET that struggle with third party investment (Goldman et al, 2005). These TRET are emerging technologies, manufactured by an early stage company with high capital costs.

“The technology and kit is currently a barrier and capital investment is required. Currently we are an emerging technology in a niche market with high capital costs. This has deterred investors.” (small renewable TRET provider)

Critically this firm identified that only through this investment would there technologies get onto a scale and cost range that would be attractive to UK music festivals.

Legal and administrative barriers

The literature identified that spatial planning and approval procedures are a barrier to RET causing extended periods of delay and creating project uncertainty (Neuhoff, 2005; Beck & Martinot, 2004; Kofoed-Wiuff et al, 2006; Goss & Heptonstall, 2010). There are no legal and administrative barriers to operationalising TRET. Not one UK festival promoter identified legal and administrative barriers as a significant barrier.

“There are no legal or administrative restrictions that would limit our use of bio-fuel and renewable technologies; it is not a consideration when we discuss these technologies”
(Large-major festival promoter)

Similarly there were no legal and administrative barriers for renewable TRET providers interviewed. The renewable TRET power providers operate temporary mobile units producing electricity from renewable public goods, (wind, sun etc.) therefore one would not expect legal or administrative restrictions.

The only respondents that identified legal and administrative barriers were bio-fuel TRET providers. The longest serving bio-fuel provider noted initial significant administrative and legal complications. The legal and administrative barriers were created by the way that bio-fuel was classified and taxed. However, this barrier has since dissipated as the government became familiar with bio-fuel as a new fuel source. The legal and administrative terrain has adapted to bio-fuel.

In contrast to RET where legal and administrative issues pose a barrier to operationalisation and expansion, it is the lack of legal and administrative assistance that poses a barrier to TRET. Numerous TRET providers highlighted that there is no support in developing their

businesses. This is not so much government legislation or policy that may increase funding rather simply help in developing the businesses of TRET and providing advice.

“Starting this business was like being dropped into a forest and left to fight my way out. There is no help or advice provided.”(Large biofuel TRET provider)

“We are currently working on a business model to attract investment. This is difficult. There is no help or support available.”(Small renewable TRET provider)

Infrastructure barriers

The infrastructure barriers established from the literature namely transmission access and costs of reinforcement and grid extension (Beck & Martinot, 2004; Goss & Heptonstall 2010; Baker et al, 2009) do not apply to TRET. TRET do not connect to grid. However, infrastructure issues peculiar to TRET are a barrier. Infrastructure issues are dependent on the arena within which a technology is employed; in this case the infrastructure is that of the UK music festivals.

The energy infrastructure of UK music festivals is not a significant barrier to bio-fuel TRET. The infrastructure of UK music festivals is based on conventional generator based energy supply, so called ‘plug and play’ energy generation. Bio-fuel TRET is also a form of ‘plug and play’ generation utilising a low carbon fuel alternative.

“Infrastructure is not a problem at all as it runs just like conventional diesel.” (Small bio-fuel TRET provider)

“Infrastructure barriers only apply to renewable technologies. Bio-fuel is a simple plug and play generation.” (Large-major festival promoter)

Logistically bio-fuel TRET requires a high level of management of equipment with service intervals reduced by a half compared to conventional diesel generators, requiring separate

fuel lines and fuel tanks, and the obvious expense these entail. Nevertheless, these are minor issues relatively speaking.

Infrastructure barriers were a major barrier for renewable TRET. These infrastructure barriers led some UK festival promoters to question the suitability of renewable TRET for festival use in general. Many respondents remarked that renewable TRET was not suited to large power demand over short time periods.

“Matching supply with demand is a problem for wind and solar [renewable TRET]. Especially as many firms operate individually with different kit that can be incompatible when brought together onsite. This is a lack of internal awareness. Complete closed system solutions are much better in this regard; however there is a lack of these providers.”(Small-medium festival promoter)

UK music festivals respondents noted that renewable energy technologies are nowhere near the scale that could be used to provide the energy demand for many small-medium UK festivals let alone large-medium festivals. One respondent noted how it may be useful for a festival of 3000 people but definitely not for a festival of 60,000. Even the smaller festivals of around 3000 admitted that the scale of renewable power provision was sometimes an issue.

“Often venues must be scaled down to allow for solar energy provision that is quite restrictive. There are very few renewable provides that can provide more than 1.5Kva which is a very small amount.”(Small-medium festival promoter)

However, renewable TRET providers disagree. Two renewable TRET providers explicitly stated that supply and demand can be matched effectively and that their kits can be compatible with other forms of generation.

“Infrastructure on site is not an issue as the our generators can be used with any other generator sets” (Large renewable TRET provider)

“Its modular nature means it’s very easy to perfectly match supply with demand, and the batteries can be refilled anywhere” (Small renewable TRET provider)

Rather than being unsuited to the UK music festival infrastructure these renewable TRET providers cite inadequacies in this infrastructure as the barrier to their operationalisation and expansion. Renewable TRET providers highlight the inefficiencies of the UK music festivals infrastructure itself as a barrier. All the renewable TRET providers believed that UK music festivals must improve the efficiency of their power usage and the efficiency of their equipment.

“It will require more effort and going into greater detail of how power is used and less power wasting on the part of organiser of events” (renewable TRET provider)

“The main barrier for our company is the efficiency of usage by end user, caused by lack of understanding and poor planning and poor quality equipment”(renewable TRET provider)

Correspondingly one bio-fuel TRET providers noted that their equipment was often used inefficiently due to the poor information provided by UK music festivals of their energy use.

“We require information on the electrical draw from clients, accurate information on this is a big problem, and is laziness on the client’s part. Under-loaded generating capacity is hugely uneconomical, inefficient and produces more emissions. This can reduce generating capacity to less than 10% efficiency.”(Large bio-fuel TRET provider)

Social acceptance

In the literature Wustenhagen (2007) produced a three pronged typology for social acceptance; community acceptance, socio-political acceptance, and market acceptance. To determine social acceptance and awareness as a barrier for TRET the responses from the interviews will be considered against these three dimensions.

We start with community acceptance. Community acceptance refers to the acceptance of the siting of RET by local stakeholders, including residents and local authorities. Community acceptance included notions of procedural justice, distributional justice and trust. This is not a barrier for TRET. Siting TRET does not affect local stakeholders or invoke the notions of trust and justice of RET siting, by their nature TRET are mobile and transient.

Socio-Political acceptance as a barrier to TRET is more complex. Westerhagen (2007) divides socio-political acceptance into four categories; public acceptance, key stakeholder acceptance, acceptance of technologies and policies, and acceptance by policy makers. Firstly, public acceptance is not an issue for TRET. The UK music festival promoters interviewed highlighted the support from the public as a major justification for their current TRET operationalisation, despite the financial stumbling blocks.

“Bio-fuel and renewable energies are part of festivals attempts to increase their environmental offer in general, and there is a lot of public support for this.”(Large-major UK festival promoter)

Furthermore, the small festival promoters interviewed were ardently environmental. In addition to any altruistic considerations these festival promoters had identified a demand for this type of festival and the environmental message they support.

Similarly, key stakeholder acceptance is not a barrier to TRET operationalisation or expansion. All the UK festival promoters support TRET and operationalise TRET, although to differing extents. The existence of the PPF itself can be appreciated as evidence of key stakeholder acceptance. Consisting of UK festival promoters, TRET providers, and consultancies the PPF is trying to drive forward the operationalisation and capacity of TRET.

Acceptance of the technologies and policies of TRET does not apply at all as there is public support for TRET and there are no policies. Socio-political acceptance as a barrier to TRET operationalisation and expansion concerns acceptance by policymakers. In contrast to the numerous strategic documents and policies concerning RET touched upon in the literature analysis, this research has determined that there are currently no policies concerning TRET.

This is a major barrier to TRET and was highlighted by UK festival promoters and TRET providers alike.

“There is no policy or legislation concerning the use of bio-fuels or renewable technologies at music festivals. There is a crucial need for overarching government policy. Legislation would definitely increase the demand for these types of services.” (Large-major festival promoter)

The final dimension of Wustenhagen’s (2007) social acceptance typology is market acceptance. This includes acceptance by both consumers and investors. Market acceptance is a complex issue for TRET. Market acceptance as a barrier to TRET differs between bio-fuel TRET and renewable TRET. Bio-fuel has the acceptance of all UK music festival promoters. This is not the case for renewable TRET. Although, supported by the majority of UK festival promoters it does not necessarily have their acceptance. Considering the innovation literature outlined above it could be suggested that there exists a ‘technological regime’ at UK music festivals including economic, technical and institutional rigidities (Kemp, 1994; Schot, Hoogma and Elzen, 1994; Schot, 1998) that hinder the acceptance of renewable TRET.

“Bio-fuel is the only viable alternative to conventional diesel. Renewables are not suited to this environment [UK music festivals]” (Large-major UK festival promoter)

“Unlike bio-fuel renewable energy technologies are not developed enough to supply the large stages with large power demands of festivals such as these.” (Large-major UK festival promoter)

Smaller festivals interviewed that are ardently environmentally friendly in their outlook are also aware that renewable TRET do not have the full support of the market. These festivals are more supportive of renewable TRET but this may be assisted by their smaller energy draw.

“There are awareness issues as a barrier to renewable technologies. Many major festivals are not backing renewable technologies because they do not consider it a viable form of energy provision.” (Small-medium UK festival promoter)

Market acceptance is also a barrier to TRET from the investors’ perspective. It is established above that investment in renewable TRET is hindered in some cases by the technology employed. However, there are barriers to increasing bio fuel TRET that can also be linked to innovation and organisational change literature.

“Much of this [adoption of bio-fuel] relies on the rest of the company. The events department is much more up to speed and clued up on bio-fuel than the rest of the firm who focus on conventional diesel.” (Bio-fuel TRET provider)

“Awareness is also a key issue. Competitors do not fully understand the benefits and the ease of using bio-fuel. They are not willing to spend the time and effort to get involved. It is still clouded in mystery, our competitors don’t understand there’s nothing to it (Bio-fuel TRET provider).”

The existence of path- dependencies (Hirsh 1989) and cognitive barriers (Bansal and Roth 2000; Bentsen & Sorensen 2010) within and between companies exist that affect the adoption of bio-fuel TRET.

TRET capacity

Renewable TRET suppliers express their capacity in kW at peak production. Thus the indicative capacity for renewable TRET identified for this article is a total of 63kW. However, this is not an accurate measure of the capacity that may be expected to be delivered.

Renewable TRET do not provide information on the level of generation they supply over the course of a festival. Neither UK music festivals nor TRET providers accurately measure the supply of renewable TRET whilst in operation in the field. The level of demand for renewable TRET is diminished as the capacity provided via this form of energy generation is very poorly understood.

“Renewable providers do not properly articulate how their generation will work. No standardised way for wind and solar to say what it offers in terms of generation. It is almost impossible for small scale renewable to show what they can provide in kWhs. Suppliers need a common and easily understood language to represent their product and capabilities. A standardised framework.” (Small-medium UK festival promoter)

“They are expensive and you don’t get a proper indication of what they can deliver, this stops us using them (renewable TRET) for any more than a tokenistic gesture.” (Large-major UK festival)

Contrastingly, the amount of energy provision provided by bio-fuel TRET is well understood. There plug and play energy generation allows for a simple calculation of the kWhs produced like those applied in the methodology for this article. Bi-fuel does however, have a separate capacity barrier. Again as identified in the first sub-question of this article we do not know what amount of bio-fuel is available to bio-fuel TRET suppliers. Two large-major festival promoters explained how they had tried to increase their bio-fuel TRET operationalisation but that the bio-fuel TRET provider did not have the supply.

“If we could we would run our whole festival on bio-fuel and raise our ticket prices to cover the extra cost, but there is not that amount of bio-fuel available.” (Large-major festival promoter)

“We wanted to increase our use of bio-fuel more this year but the extra bio-fuel supply from our provider was not available”. (Large-major festival promoter)

This may indicate that the bio-fuel TRET is already being operationalised to its full extent. However, two of the three bio-fuel TRET providers also supply conventional diesel. These bio-fuel TRET providers may therefore have perverse incentives not to supply bio-fuel, for example, it has already been noted that there are infrastructure issues to bio-fuel TRET that providers may not wish to engage with. An accurate bio-fuel capacity map must pair the overall level of bio-fuel available in the UK alongside and supply chain logistic element that

may affect its supply. Until an objective level of bio-fuel TRET capacity can be produced the balance of power will remain with power providers and the level of operationalisation may remain in their hands rather than matching demand.

Discussion and opportunities

The amount of TRET capacity operationalised at UK music festivals is very little compared to the total overall energy use of UK music festivals. As discussed above this equates to just 3.026% of the total energy consumed and mitigates just 928t CO₂e of the 31,000t CO₂e produced by UK music festivals in energy generation. The barriers to operationalising and increasing the use of TRET established by the interviewees' are clearly considerable. The operationalisation of TRET at UK music festivals is minimal; however, it is an accomplishment that despite the barriers above, there is TRET operationalisation at UK music festivals. UK music festivals are operationalising non-cost competitive TRET in recognition of the environmental agenda.

"[UK music festival] was set up as a green festival, with sustainability at its centre. Bio-fuel and temporary renewable energy technologies are the way forward." (Small-medium festival promoter)

"We use bio-fuel and renewables because we are concerned with environmental issues just as those who attend the festival are increasingly aware of climate change as an issue" (Large-major festival promoter)

UK festival promoters have made the choice to operationalise TRET of their own volition with no legal requirement to do so. Some smaller festivals have based themselves on an environmental ethos, whilst medium and large festivals have acted in response to public awareness and support.

The support of UK music festivals has been a major factor in the development and use of TRET in the UK. The majority of TRET providers interviewed stated their main reason for starting to supply TRET as awareness of environmental issues. However, these respondents also noted a gap in the market as a rationale for their supply of TRET. The gap in the market identified by TRET suppliers was formed primarily by the demand of UK music festivals.

“[the firms] use of bio-fuel is customer led. We were first asked to look into using bio-fuel [a UK music festival]. This was [the firms] first service of bio-fuel. From this initial exposure other UK music festivals have asked us to supply bio-fuel.” (Large bio-fuel provider)

“Most of the demand for our services comes from UK music festivals apart from the obvious environmental reasons we saw a gap in the market.” (Renewable TRET provider)

Furthermore, from the interviewees' responses it appears that UK music festivals demand for TRET is set to increase. All the TRET providers predicted that the demand for their services from UK music festivals would increase. Correspondingly the majority of UK music festival promoters expected that their demand for TRET would increase year on year. Regardless of the barriers to operationalisation and expansion identified in this work, operationalisation of TRET at UK music festivals seems set to continue.

TRET use is set to continue and increase at UK music festivals regardless of the barriers determined through this article. Nevertheless there are opportunities to accelerate the adoption of TRET by engaging with these barriers. UK music festival promoters and TRET providers agreed that some form of government policy concerning TRET provision would be crucial to significantly increasing TRET operationalisation. Indeed policy support of TRET seems conspicuous in its absence. As noted in the above analysis the legal and administrative barrier to TRET was a lack of any form of legal or administrative support to TRET providers. More than one TRET provider noted that support from government in the form of advice or business development could help increase TRET capacity and use.

“There is no guidance support or funding from government. Starting up was being dropped in the middle of a forest and left to fight your way out.”(Bio-fuel TRET provider)

“Government policy can also provide a path for others to follow, and increase investment and numbers of providers of bio-fuel and renewable capacity.”(Bio-fuel TRET provider)

Support in the form of legal and administrative help from government is but one role that the government could play in supporting TRET expansion at UK music festivals. There is currently a catch 22 situation for TRET operationalisation. UK music festival promoters assert that a reduction in cost of TRET would be central to significantly increasing operationalisation, whilst TRET providers assert that only increased TRET operationalisation would result in a lowering of costs. Some form of government support in the form of policy would be able to break this cycle and increase TRETuse.

“There is a crucial need for overarching government policy. There is nothing at the moment. We would support any policy to develop this area [TRET provision]” (Large-major festival promoter)

Government legislation could either take the form of regulatory based policy or market based instruments⁷. Regulatory legislation could place a requirement on UK music festivals to procure a certain level of energy from TRET, for example a mandatory requirement for 10% TRET energy provision. One UK music festival promoter supported the introduction of regulatory legislation in support of TRET operationalisation. This festival promoter highlighted that medium and large UK music festivals would easily be able to pass the costs that mandatory TRET provision at UK music festivals would incur onto consumers of UK music festivals. This is due to the high level of demand for these events from consumers of UK music festivals that creates an inelasticity of demand.

Types of regulatory instruments include standards (including planning instruments), licensing, mandatory management plans and covenants. Types of market based instruments: include trading schemes, offset schemes, subsidies and grants, accreditation systems, stewardship payments, taxes and tax concessions.

“[the festival] would have no issues in increasing our provision of TRET if the capacity was available and we would support any regulatory requirements for our sector to do so”. (Large festival promoter)

“Festival promoters should be encouraged to use renewable energy technology. This encouragement could possibly be policy led. If demand were to increase then [the firm] could increase their renewable provision.”(Renewable TRET provider)

Further research into the inelasticity of demand of UK music festivals could establish a size threshold over which regulation regarding TRET provision would be enforced. Such a regulatory policy may have the dual benefit of inducing large-major and festivals to address their energy inefficiencies, which is evidenced by the different levels of fuel use per audience day utilised for small-medium and large-major in the methods for this article.

However, any moves to introduce regulatory legislation in the support of TRET would first have to tackle the barrier of TRET capacity. In addressing the first sub-question of this article, and again in the analysis of the responses from the interviews TRET capacity is identified as a barrier. TRET capacity as a barrier would make the introduction of any form of regulatory policy impractical. More accurate indicative capacity maps should be produced. For renewable TRET a temporal dimension should be included in a capacity map, as well as a more accurate capacity measurement, for example average kWhs per day. One respondent’s suggestion of a standardised framework for expressing renewable TRET capacity is definitely an opportunity that renewable TRET providers should seek to accomplish.

Similarly for bio-fuel TRET, capacity is a major barrier. An accurate portrayal of how much bio-fuel is available including an assessment of supply chain and infrastructure barriers should take place. It is not possible to assess how much bio-fuel a UK music festival may be able to employ. Crucially the demand for increased bio-fuel TRET operationalisation is already above supply. Two large-major festival promoters explained how they had wanted to increase bio-fuel TRET but were not able to do so due to a lack of supply. Without an

accurate bio-fuel capacity map, the balance of power lies with the power providers who may have perverse incentives for not reporting the level of availability accurately.

Market based incentives may be a more practical measure to promote TRET. One interviewee noted that a large RET provider has discussed with OFGEM the possibility of TRET accessing the current market based instrument supporting RET, namely the Renewables Obligation. Metres measuring TRET output would allow for the award of Renewable Obligation Certificates then to be traded on the market. However, the respondent noted that these talks had amounted to nothing. It is unlikely TRET will be able to access the market based policies in support of RET. One ROC (value approximately £30) is awarded for 1MWh of electricity produced by renewable sources. However, the capacity of TRET outlined by this article is so small that this method would not make a significant contribution to finance, for example the total renewable TRET generation at UK music festivals would be eligible for 12ROCs in total. Market based policy instruments should they be employed would be better to provide subsidies, grants, and tax concessions. The precise form that these market incentives should take is beyond the scope of this article but this is an area that should receive further attention.

“There are no incentives for bio-fuel capacity; [the firm] has never received any grants or development money. This deters established suppliers getting involved in the market.” (Bio-fuel provider)

To support the funding and finance of renewable TRET one provider suggested that connecting TRET supply to the grid during the winter would provide an opportunity to increase funding and finance. This is related to the fact that TRET are operationalised at UK music festivals during the summer but largely lay dormant during the winter. TRET grid connection would necessarily involve an agreement and some form of framework provided by OFGEM. However, this would encounter a variety of technical barriers including grid connection and licensing issues and more research into the detail of any proposal would need to be provided before this could be suggested as a realistic opportunity.

As discussed in the literature there is academic support for the support of RET through regulatory incentives. This same literature can also be used to justify the support of TRET. Regulatory incentives are the way to bridge the gap between R&D laboratories, demonstration projects and market introduction, commonly referred to as the 'valley of death'. There should be a recognition of UK music festivals as a hotbed for innovations in TRET.

Strategic Niche Management literature suggests that niches act as protected spaces away from the forces of the open market provide a learning environment in which various stakeholders cooperate and exchange information, experience, and knowledge. Niches facilitate an interactive learning process and support the incubation of new technology (Schot, Hoogma, and Elzen, 1994; Kemp et al, 1998; Schot and Geels, 2008). Kemp et al (1998) defines niches as "...protected spaces for the development and use of promising technologies by means of experimentation, with the aim of 1) learning about the desirability of the new technology, and 2) enhancing the further development and the rate of application of the new technology" (p186).

UK music festivals may fulfil this definition. Through the research of this article it is clear that UK music festivals demand is supporting the innovative development TRET. One of the large bio-fuel providers interviewed explained how the investment and learning that their firm had accrued through bio-fuel provision to UK music festivals had attracted interest from a multi-national RET manufacture. This firm are now working alongside the R&D department of this manufacturer as part of the manufacturers work on offshore wind farms. This is an example of cross learning between TRET and RET. Another firm, this time a temporary renewable provider explained how they are currently working on the first mobile biomass stage to be made available on the market. Whilst the first company supplying hydrogen cell TRET has used a UK music festival trial for three years to develop their technology.

Finally, support for TRET at UK music festivals may form part of an effective communication strategy for climate change. Nuanced academic literature advises strategic opportunities for communication efforts as an approach that can achieve public engagement with climate

change; potentially bridging the divide between top-down and bottom-up approaches (Ockwell, 2009). Effective Communication presents a win-win-win scenario; increasing demands for action, facilitating the public acceptance of regulation, and stimulating grass roots action (Ockwell, 2009). An effective strategy must achieve meaningful engagement in all three facets of: understanding, emotion, and behaviour (Lorenzoni et al, 2007; Ockwell, 2009).

This thesis suggests that UK music festivals may provide an ideal delivery mechanism for an effective communication strategy on climate change. Music festivals provide an opportunity to educate and shape concerns of those in attendance (Wilks, 2009; Larsen and O'Reilly, 2005). Music festivals are short in duration however in this time there is an alteration in contextual factors. Organisations already recognise that music festivals provide a more easily influenced social group. A report for media agency Target Media by Eyeball noted that "Going to a festival...makes the target audience far more open minded, allowing sponsors and advertisers a better chance to get their message across" (MarketingWeek, 2011).

Utilising UK music festivals as a delivery mechanism for an effective communication strategy on climate change is also supported by insights from social anthropology. The concept of 'liminality' is actualised at UK music festivals (Wilks, 2009). Liminality refers to "in-between situations and conditions that are characterized by the dislocation of established structures, the reversal of hierarchies, and uncertainty regarding the continuity of tradition and future outcomes...such liminal conditions of uncertainty, fluidity, and malleability are situations...where lived experience transforms human beings cognitively, emotionally, and morally" (Horvath et al, 2010). As Larsen and O'Reilly (2005) state "There is a sense in which the music festival acts as an emancipatory structure, or experiential resource...(people) experiment with different ways of being" (p10).

"Renewable TRET is only a tokenistic gesture towards our energy demand but the public seem to really enjoy and engage with these venues" (Large-major UK festival promoter)

"When we are at festivals we frequently engage with the public, its all part of the service we are looking to offer." (Renewable TRET provider)

UK music festival promoters and TRET providers indicate that the public engage with TRET whilst at UK music festivals. Tackling the barriers identified in this article and increasing TRET energy provision at UK music festivals as part of a communication strategy may have a broader impact for social acceptance and awareness of climate change issues in general. This is an area that should definitely receive further attention.

Conclusion

The realities of climate change have led to increased efforts to mitigate anthropogenic contributions to atmospheric GHG concentrations. A substantial proportion of emissions result from energy use. Given their ability to simultaneously lower emissions from the energy system and satisfy energy demands RET have justifiably received much attention in the political, public, and academic arena.

Progressively non-state actors are adopting mitigation initiatives. Often these mitigation initiatives find solutions that work in specific contexts. Such “bottom up” initiatives are forming the basis of the energy revolution necessary to tackle the realities of climate change (IEA 2010). It is therefore crucial that we identify, understand, and nurture these mitigation initiatives. The focus on RET although important should not detract from our engagement with other mitigation initiatives and we should act to increase our knowledge of these whenever they become apparent. This article stands as an attempt toward this end.

This article addresses the mitigation initiative of TRET. Julie’s Bicycle a leading sustainability consultancy in the creative industries, and the Power Providers Forum, a group of key TRET stakeholders initiated and convened by Julie’s Bicycle identified that a lack of information and understanding of TRET was hindering the adoption of TRET. Utilising industry data

provided through Julie's Bicycle and undertaking interviews with key TRET stakeholders this article explored the dynamics of TRET within the application domain of UK music festivals.

Analysis of UK music festival energy demand and supply determined that the current use of TRET at UK music festivals is very small, contributing just 3.026% of UK music festival total energy demand. TRET small operationalisation is further justification for the research undertaken for this article. From a position of identifying and understanding the barriers to TRET this research has found that there is considerable scope for expansion of TRET in the domain of UK music festivals.

This article set out to establish the barriers to TRET operationalisation and increasing TRET use at UK music festivals. Succeeding an analysis of interviews responses against an analytical framework drawn from existing RET literature, this article proffers a typology of six barriers to TRET use. This typology is the answer to the overall research question.

1. Lack of funding or financing
2. Lack of experience / trust among banks and investors
3. Administrative or legal barriers
4. Infrastructure barriers
5. Social acceptance
6. TRET capacity

As a pioneering piece of work this article did not want to attempt to rank barriers or suggest which is the most substantial, although this could be the goal of further research on TRET. Rather this initial venture into TRET as a mitigation initiative proffers this typology as a contribution towards our understanding of TRET. The methods for this work are comprehensively presented and the author would welcome any future attempts at replication and validation. Furthermore, insights from this article and the typology produced may have pertinence for the application of TRET in other domains.

Finally, although the TRET typology above is very similar to the RET typology constructed as an analytical framework for this work, the issues that apply to RET and TRET are substantively different in each case. Thus TRET and RET should remain separate in any

future considerations of barriers and opportunities to increasing their use. Similarly, future deliberations on TRET may wish to separate TRET into two distinct categories. Although, the broad typology of barriers proffered for TRET can encompass all the hurdles to increasing bio-fuel TRET and renewable TRET the issues for each group are substantially different. Further research in the field of TRET may produce more refined results if it were to focus on one or the other of renewable TRET and bio-fuel TRET.

Apprentices A Julie's Bicycle Energy Data

| Entry Name | Event Location | Event Year | Event Size | Camping | correct total audience days | Total direct tonnes | Total direct kg CO2e per audience day |
|------------|----------------|------------|------------|---------|-----------------------------|---------------------|---------------------------------------|
| | Greenfield | 2010 | Small | Y | 3828 | 0.102175 | 0.026691484 |
| | Greenfield | 2010 | Small | N | 4500 | 6.3797 | 1.417711111 |
| | Greenfield | 2010 | Small | Y | 8728 | 9.8571 | 1.129365261 |
| | Greenfield | 2010 | Medium | Y | 12850 | 9.352 | 0.727782101 |
| | Urban | 2010 | Major | N | 40664 | 27.7372 | 0.682107023 |
| | Greenfield | 2010 | Medium | Y | 92414 | 19.279626 | 0.208622352 |
| | Urban | 2010 | Large | Y | 102000 | 171.87632 | 1.685061961 |
| | Urban | 2010 | Large | Y | 115500 | 302.05497 | 2.615194545 |
| | Greenfield | 2010 | Large | Y | 119410 | 233.924858 | 1.959005594 |
| | Urban | 2010 | Major | N | 131000 | 111.7941 | 0.853390076 |
| | Urban | 2010 | Large | Y | 136300 | 165.294248 | 1.212723756 |
| | Peri-urban | 2010 | Large | Y | 150000 | 267.298878 | 1.78199252 |
| | Urban | 2010 | Large | Y | 165000 | 206.6056 | 1.252155152 |
| | Greenfield | 2010 | Major | Y | 180000 | 467.799348 | 2.598885267 |
| | Greenfield | 2010 | Major | Y | 190000 | 518.63406 | 2.729652947 |
| | Urban | 2010 | Major | Y | 233000 | 412.539052 | 1.770553871 |
| | Greenfield | 2010 | Large | Y | 680000 | 1598.899718 | 2.351323115 |

Apprentices A Julie's Bicycle Energy Data (Cont.)

| CO2e kg from energy | litres of diesel per audience day | proportion biodiesel | renewable energy kWh | litres of diesel | litres of biodiesel |
|---------------------|-----------------------------------|----------------------|----------------------|------------------|---------------------|
| 0 | 0.176332288 | 1 | 0 | 675 | 675 |
| 5611.2 | 0.466666667 | 0 | 0 | 2100 | 0 |
| 8283.2 | 0.355178735 | 0 | 0 | 3100 | 0 |
| 9352 | 0.272373541 | 0 | 0 | 3500 | 0 |
| 22979.2 | 0.211489278 | 0 | 0 | 8600 | 0 |
| 6289.176 | 0.155636592 | 0.979142043 | 520 | 14383 | 14083 |
| 153033.52 | 0.540588235 | 0 | 0 | 55140 | 0 |
| 252998.32 | 0.906363636 | 0.095524669 | 0 | 104685 | 10000 |
| 179529.008 | 0.605677916 | 0.070999945 | 0 | 72324 | 5135 |
| 109552 | 0.312977099 | 0 | 225 | 41000 | 0 |
| 111179.248 | 0.305275128 | 0 | 0 | 41609 | 0 |
| 179596.328 | 0.3662 | 0.091024941 | 100 | 54930 | 5000 |
| 173012 | 0.434848485 | 0.097560976 | 0 | 71750 | 7000 |
| 300824.448 | 0.784077778 | 0.202290022 | 0 | 141134 | 28550 |
| 285850.56 | 0.563052632 | 0 | 0 | 106980 | 0 |
| 270515.952 | 0.498888412 | 0.129042248 | 0 | 116241 | 15000 |
| 1317801.968 | 0.683417647 | 0.14805562 | 500 | 464724 | 68805 |

Appendices B PPF Contact List

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| Jim | Creed | Managing Director | Powerline | JimCreed@thepowerline.co.uk |
| Charlie | Crowsley | Event Projects & Technical Sales Support Manager | Aggreko UK Ltd. | Charlie.Crowsley@aggreko.co.uk |
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Appendices C Survey on temporary renewable energy capacity in the UK

This survey is issued to assess the current capacity of temporary renewable technologies that are available for UK music festivals. The results of this questionnaire will be used as part of a strategic document for the Power Provider's Forum, prepared by Julie's Bicycle.

If you have any questions or feedback in relation to this questionnaire please contact Joel Baker at; jb411@sussex.ac.uk.

Name of company:

Address of company:

Contact person:

Position in the company:

Contact details (tel):

(email):

1. In what year was your company founded?
2. What is the status of your company or organisation?

☐

Limited

☐

Sole trader

☐

Partnership

☐

Public

☐

Unincorporated
Association

☐

Other (please specify)

3. Do you have a statement of environmental commitment, policy, action plan, mission statement or similar?

☐

Yes

☐

No

4. Do you carry out an environmental audit(s) of your business and/or products and/or services?

☐

Yes

☐

No

5. Is the audit completed internally or by a third party?

☐

Internally

☐

Third party

6. How often is the audit conducted? _____

7. Did your company initially offer bio-fuel and /or temporary renewable energy capacity?

☐

Yes

☐

No

8. Why does your company offer bio-fuel and/or temporary renewable energy capacity?

9. Do you supply bio-fuel generating capacity?

☐

Yes

☐

No

10. Approximately how many litres of bio-fuel do you use? _____

11. How many bio-fuel compatible generators can you supply, and of which size?

12. Which bio-fuels do you use/supply?

13. Which type of temporary renewable technologies does your company supply? Please tick all boxes that apply

- ☐ Solar
 ☐ Wind
 ☐ Other (please specify)
- ☐ Kinetic
 ☐ Hydrogen cells

14. For each type of temporary renewable technologies you supply, please say what the total capacity is?

| Type of renewable technology | Total generation capacity (kW) |
|------------------------------|--------------------------------|
| Solar | |
| Wind | |
| Kinetic | |
| Hydrogen cells | |
| Other | |

15. How many UK music festivals' do you currently supply? _____

16. Which types of services do you currently offer to UK music festivals? Please describe

17. How regularly is the entirety of your bio-fuel and/or renewable capacity in operation? Please tick one box

- ☐ Consistently
 ☐ Occasionally
 ☐ To a limited extent
- ☐ Not at all

18. How do you envisage the demand for bio-fuel and temporary renewable capacity will change in the future? Please tick one box

☐

Increase vastly

☐

Increase slightly

☐

No change

☐

Decrease slightly

☐

Decrease vastly

19. Why do you envisage this future change?

20. What are your goals for expanding bio-fuel and temporary renewable capacity in the short to medium term (1-5yrs)?

21. Which types of technologies will you develop, on what scale, and why?

The five main barriers to RET are read to the reader;

1. Financial and Funding

2. Lack of experience / trust of banks and investors
3. Legal and administrative
4. Infrastructure
5. Social acceptance

22. What are the main barriers to **your bio-fuel / temporary** renewable energy capacity? Please describe

23. How do you think these barriers may be overcome? Please describe

24. Are there any geographic limitations to your available capacity? Tick as many as apply

- | | | |
|---|---|-------------------------------------|
| <input type="checkbox"/> No geographic limitation | <input type="checkbox"/> East Midlands | <input type="checkbox"/> Wales |
| <input type="checkbox"/> South West | <input type="checkbox"/> West Midlands | <input type="checkbox"/> Scotland |
| <input type="checkbox"/> South East | <input type="checkbox"/> North West | <input type="checkbox"/> N. Ireland |
| <input type="checkbox"/> London | <input type="checkbox"/> North East | |
| <input type="checkbox"/> East Anglia | <input type="checkbox"/> Yorkshire and Humberside | |

25. What are the reasons for your geographical limitations? Please describe

Thank you for completing this questionnaire. If you would like to contact Joel again in regards to this questionnaire please email jb411@sussex.ac.uk or call 07505381926. ☐

This survey is issued to assess the current position of bio-fuel and temporary renewable energy at UK music festivals. The anonymised and aggregated results of this survey will be used as part of a strategic document for the Power Provider's Forum, prepared by Julie's Bicycle.

If you have any questions or feedback in relation to this questionnaire please contact Joel Baker at; jb411@sussex.ac.uk.

Appendices C Survey of festival promoters renewable energy commitments in the UK

Name of company:

Address of company:

Contact person:

Position in the company:

Contact details (tel):

(email):

1. In what year was your company founded?
2. What is the status of your company or organisation? Please tick the appropriate box

- | | | |
|----------------------------------|---|---|
| <input type="checkbox"/> Limited | <input type="checkbox"/> Sole trader | <input type="checkbox"/> Partnership |
| <input type="checkbox"/> Public | <input type="checkbox"/> Unincorporated Association | <input type="checkbox"/> Other (please specify) |
-

3. Do you have a statement of environmental commitment, policy, action plan, mission statement or similar?

☐ Yes ☐ No

4. Do you carry out an environmental audit(s) of your business and/or products and/or services?

☐ Yes ☐ No

5. Is the audit completed internally or by a third party?

☐

Internally

☐

Third party

6. How often is the audit conducted? _____

7. Which UK music festivals do you organise / promote?

If you have varied approach for festivals you promote, please explain the differences in your answers below.

8. Why do you use bio-fuel and / or temporary renewable energy? Please explain

9. Do you have a current policy on bio-fuel and temporary renewable energy generation?
Please describe

10. How has your use of bio-fuel and temporary renewable energy changed over the last 5 years? Please describe

11. How do you envisage the demand for bio-fuel and temporary renewable capacity from your festivals will change in the future? Please tick one box

- ☐ Increase vastly
 ☐ Increase slightly
 ☐ No change
- ☐ Decrease slightly
 ☐ Decrease vastly

12. What are the reasons for the changes you have seen and predict? Please describe

13. Does your festival use bio-fuel generating capacity?

- ☐ Yes
 ☐ No

14. Which types of temporary renewable technologies does your festival use? Please tick all boxes that apply

- ☐ Solar
 ☐ Wind
 ☐ Other (please specify)
- ☐ Kinetic
 ☐ Hydrogen cells

15. Which company(s) supply your bio-fuel / temporary renewable energy capacity?

The five main barriers to RET are read to the reader ;

6. Financial and Funding
7. Lack of experience / trust of banks and investors
8. Legal and administrative
9. Infrastructure
10. Social acceptance

16. What are the main barriers to bio-fuel / temporary renewable energies at your festivals?
Please describe

17. How do you think these barriers may be overcome? Please describe

Thank you for completing this questionnaire. If you would like to contact Joel again in regards to this questionnaire please email jb411@sussex.ac.uk or call 07505381926.

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Interviews

Renewable TRET providers

| Respondent Name | Company | Date of Interview |
|-----------------|------------------------|-------------------|
| Andy Hope | Croissant Neuf | 05/08/2011 |
| Andy Mead | Firefly Solar Ltd | 03/08/2011 |
| Ben Todd | Arcola Energy Ltd | 16/08/2011 |
| Sam Medley | Medley Productions Ltd | 10/08/2011 |
| Simon Harwood | Zia Solar | 13/08/2011 |
| Tom Evans | Chain Reaction | 04/08/2011 |

Bio-fuel TRET providers

| Respondent Name | Company | Date of Interview |
|------------------|-----------------------|-------------------|
| Andy Boroughs | AB Power | 03/08/2011 |
| Charlie Crowsley | Aggreko UK Ltd | 15/08/2011 |
| David Noble | Midas Productions Ltd | 30/08/2011 |

Small-medium UK music festival promoters

| Respondent Name | Company | Date of Interview |
|-----------------|------------------|-------------------|
| Andy Hope | Croissant Neuf | 05/08/2011 |
| Chris Johnson | Shambala Festiva | 30/07/2011 |
| Dan Hurring | Sunrise Festival | 10/08/2011 |

Large-Major UK music festival promoters

| Respondent Name | Company | Date of Interview |
|------------------------|----------------------|--------------------------|
| Andrew Howarth | Live Nation Ltd | 16/08/2011 |
| Lucy Brooking Clarke | Glastonbury Festival | 30/07/2011 |
| Luke Cowdell | Festival Republic | 08/08/2011 |