THE POWER BEHIND FESTIVALS

A guide to sustainable power at outdoor events

What's the point of this guide?

Power has significant implications for the practical, economic and environmental success of any event. With rising fuel costs and an increasing awareness of sustainability, the industry is asking for more knowledge, understanding and expertise on sustainable power at festivals. After 18 months of exploration and consultation, the Green Festival Alliance (GFA) has created **The Power Behind Festivals guide**.

This guide won't tell you how to run your festival or why you should care about climate change. What it will do is give you sector-specific knowledge, ideas and tips you need to save fuel and increase your energy management skills, reducing your carbon footprint and cutting the unnecessary costs as a result.

In fact, we think you can make fuel savings of at least 10% as a result of implementing ideas in this guide. We've included a healthy sprinkling of examples to show you how it's already being done and links to where you can find further help or advice.

Who is this guide for?

This guide is for anyone involved in the organisation of festivals. Regardless of the size of your festival, the nature of your audience or your role, you will find information on how you can limit the fuel consumption of your event.

We include specific advice for festival organisers, procurement managers, power suppliers, human resource managers, outside contractors, site managers, artistic directors and bookers.

This guide will help you to:

- Better understand temporary power at outdoor events
- Reduce power demand and fuel consumption
- Consider renewable and hybrid power options
- Reduce carbon emissions
- Structure contracts to promote fuel efficiency
- Mitigate the risk of significant last-minute costs
- Identify potential budget savings
- Improve your event's green credentials
- Engage with your audience about energy

Tackling attitudes and methods around power will require collective action across organisations and the industry. Throughout the guide we take the approach that we need to work together, fostering relationships and joining up thinking.

How has this guide come about?

This guide is the third part of the Powerful Thinking campaign. It follows the Power Behind Festivals Report (2011), and the research done by the Green Festival Alliance in the Summer of 2012. It is the result of extensive research from many stakeholders into the state of our industry and the current, most pressing obstacles to success.

> *"This guide is an essential aid to the industry, and the first of its kind for power. Whilst the business case for new technologies is still emerging at larger scales, festivals are taking the lead in finding new and innovative ways to use resources intelligently, employ renewable systems and reduce emissions.*
>
> *Melvin Benn, Managing Director, Festival Republic.*

> *"This Guide will provide information and hopefully some inspiration to those who will have to balance the competing elements of expediency, practicality, lack of expertise and cost when setting out the requirements for their events to enable them to achieve the most sustainable but practical infrastructure.*
>
> *Bill Egan, Head Olympic Design Engineer, Aggreko.*

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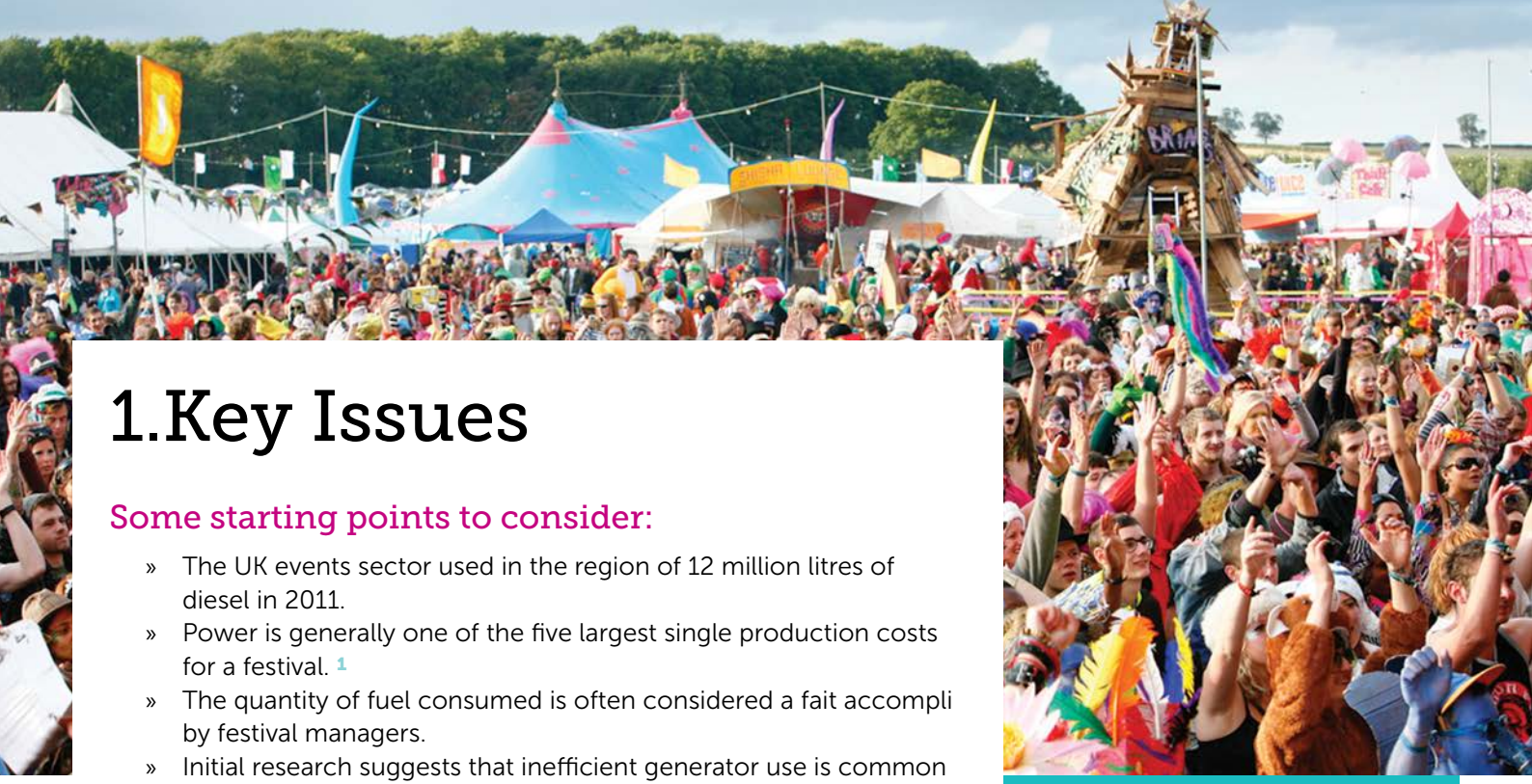
> *"Optimising fuel efficiency has the potential to benefit us all - reduced climate impacts, longer generator life and saved money. But this needs an integrated approach championed by those in the most senior decision making positions at festivals, where all those involved in the supply and distribution of fuel are maximising energy efficient performance.*
> *Alison Tickell, CEO, Julies Bicycle.*

> *"It's essential that we find greener, more sustainable ways to power whatever we want to get up to outdoors, whether that's a festival, a standalone performance or a TV or film shoot. Quality research and a joined-up approach across all sectors wanting to find a low carbon, cost-effective future for location work is vital. We will be sharing this guide with colleagues across the BBC to raise awareness of the issue and hopefully drive change.*
> *Richard Smith, Sustainable Production Manager, BBC.*



1.Key Issues

Some starting points to consider:

- The UK events sector used in the region of 12 million litres of diesel in 2011.
- Power is generally one of the five largest single production costs for a festival. [1]
- The quantity of fuel consumed is often considered a fait accompli by festival managers.
- Initial research suggests that inefficient generator use is common at events in the UK.
- The main cause of fuel wastage is lack of information about requirements and lack of communication between contractors and festivals, festivals and suppliers.
- Power can represent up to 70% [2] of an event's 'core' carbon footprint (core excludes audience travel and transport).
- Fuel costs are rapidly rising, and the energy market is forecast as increasingly volatile.
- The festival sector has a unique opportunity to contribute to carbon reduction, showcase new technologies and engage with audiences.

The language of energy can be complex. We've included a section at the end to equip you for conversations with power suppliers. Your power supplier may also be happy to explain the basics.

Fact: Shambala Festival in Northamptonshire, capacity 10,000, reduced fuel consumption and fuel costs by over 20% between 2011 and 2012 by using many of the ideas set out in this guide.

What is energy efficiency?

Energy efficiency is simply the process of doing more with less. The goal is to accomplish the same tasks and functions as before while using less energy. In the context of this guide, let's take it that 'efficiency' means the amount of usable power (kW hours) generated per litre of fuel consumed. Generators consume a baseline of fuel even if they are not employed at capacity, and the 'fuel consumed' versus 'power generated' relationship is not linear. Efficiency is therefore largely determined by load. A good rule of thumb is that around 70-80% load is perfect (optimum). Going downwards, anything between 80% and 50% load is still good (reductions in efficiency are marginal), but as you go down from 50% to 25% efficiency reduces. Below 25% is what we call the 'danger zone' – low efficiency – and below 10% you need to really start thinking about better ways to manage your power.

Some Background:

In 2012 the Powerful Thinking project monitored power at 8 festivals and consulted with festivals and power companies to provide a 'snapshot' of how generators were being used.

[1] The five largest single production costs tend to be power, sanitation, staging, fencing and trackway for many outdoor events.
[2] Based on a sample of 14 large festivals which submitted data to Julie's Bicycle for 2011. Measures includes energy, water and waste related emissions. These figures do not include emissions resulting from production transport, merchandise, paper use or catering. Although the sample size is too small for these figures to be extrapolated for the entire industry, these are useful initial findings.

The key findings were:

1. Generators are often being run at low loads which is inefficient.
2. Lack of accurate information in advance about requirements contributes to low loads.
3. Changes to the way power systems are set up could deliver significant savings
4. Overnight power demand is generally lower than daytime

1. Generators are often being run at low loads:

Of the generators monitored at 8 events, every single system had periods of working below 25% load, and some of them operated entirely below 25%. In 60% of cases the generator was more than double the capacity required.

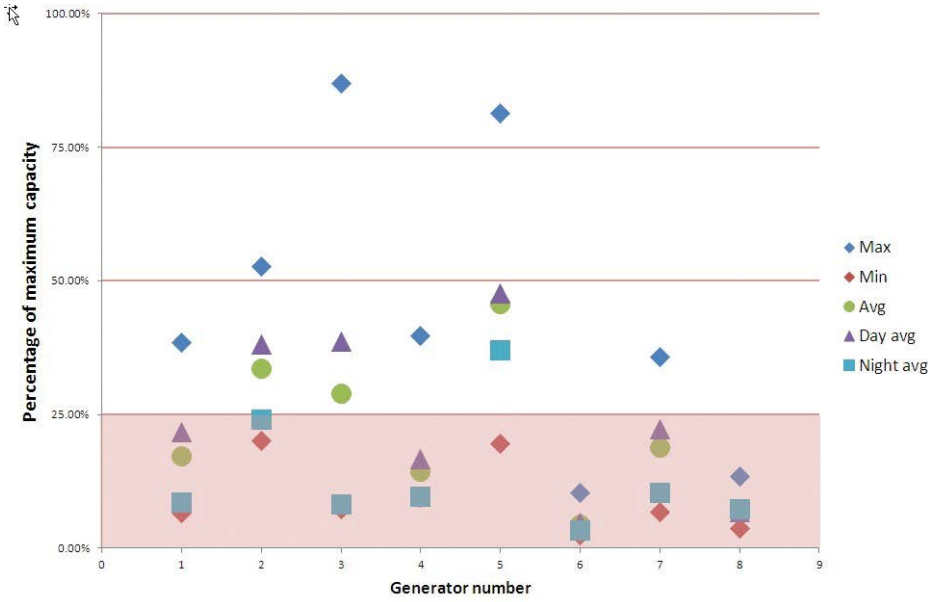


Fig 1: Loads for generators measured at 8 UK Festivals in 2012. This diagram shows the measured loads on generators for maximum (peak), minimum, average day, average night, and average total. There is a substantial variety of loads. The area coloured pink shows what we call the 'danger zone' – highlighting low loads of below 25% and the likelihood of low efficiency. It's in this area that we can best consider how efficiency gains can be made. It is recognised this is a small sample, and thus indicative

Why is this a problem?

1. If your generator is much bigger than it needs to be you may be using more fuel to deliver the same amount of power than if you used a smaller generator that is correctly sized for the job - and you may be paying more for the equipment.
2. Generators run less efficiently at very low loads, meaning that for every litre of fuel burned you get less power, or that more power is being created than is required and/or usable at that time.
3. Running generators at very low loads can cause damage and reduce the life of the machine.

Fact: If the UK's summer festivals cut their diesel consumption by 10%, over 1 million litres of diesel and more than 3,000 tonnes of C02 would be saved in one year alone.

Question: A generator needs to meet power requirements during periods of the highest demand (peak loads), so surely it must be sized to be able to cope with these periods – even if that means running below capacity the rest of the time?

Answer: Yes, absolutely. No-one wants a show-stopper as a result of trying to save a few quid. This research measured 'peak load' on the generators as part of the monitoring i.e. the most power needed at any one time. The difference between peak load and capacity of a generator is an indication of whether the generator is oversized.

Fact: At one event monitored this summer, the main stage generator was 7 times the required size to cover peak load.

2. Lack of accurate information in advance about requirements contributes to low loads

Plentiful anecdotal evidence from festival organisers and power suppliers suggests that the most common reasons for oversized generators are:

» Uncertain information about actual requirements. A contractor, trader, production manager and/or power company will often add a margin to ensure they can accommodate needs, and make sure the show can run smoothly. The result can be a chain of specifications above actual requirements leading to significantly oversized generators, rather than generators sized to allow for a moderate redundancy.

Some other reasons why this is happening

» Single Source power demands from artists, contractors and festival organisers. Artists, contractors, arts projects or festival organisers often request a dedicated power source for specific end use as it is believed to be more reliable. This is inherently less efficient as it requires more generators usually running at lower loads. Whilst scenarios are undoubtedly case-by-case, feedback suggests that in most cases generators could supply several end users safely with trips and careful system design.

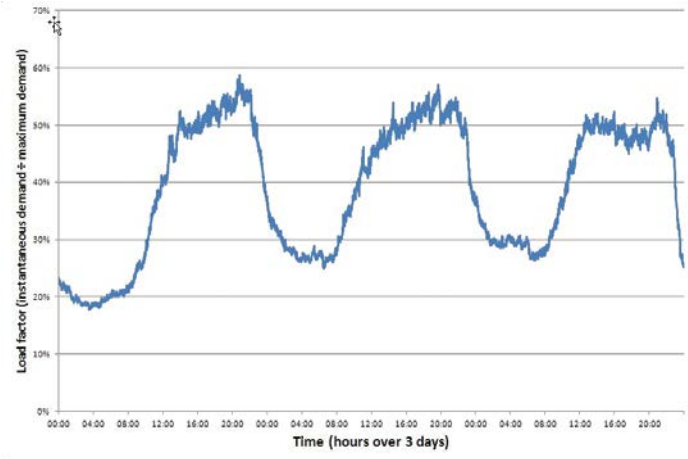
» The common practice of cross-hiring equipment. Many power suppliers don't own their equipment, and consequently use generators which are larger (rather than smaller) due to stock availability from their generator suppliers. Whilst there may be no intention to do this, it happens and the result is potentially higher fuel bills for the festival depending on how the generator is loaded.

» Specific needs of certain equipment. Some equipment, such as electric starter motors for showers and pumps, require a huge amount of power to get started and then run on very little, causing lower efficiencies for most of the running time.

3. Changes to the way festival power systems are set up could deliver significant fuel savings[3]

It is estimated that over half the generators monitored this year could achieve fuel savings of at least 39%. One festival could have reduced its fuel bill by an estimated £5,000 from two stages and the production area alone. Shambala festival piloted the ideas in this guide and saved 20% of its total fuel bill, despite increasing capacity.

4. Overnight power demand is generally much lower than daytime.



This isn't news to anyone but in many systems at outdoor events the same generator supplies daytime and overnight load and often the build and break periods too. These periods of very low load are often referred to as 'base load'.

Fig 2: Average generator load profile for 3 day events [4]

[3] Source: Ben Marchini, De Montfort University. Methodology: Fuel saving presented as a %age based on analysis at quarter, half and three quarter loads from a sample of 8 generators monitored at 8 events in summer 2012. Fuel consumption derived from manufacturers and suppliers. Cost savings based on %ages of fuel savings with diesel at £1/litre. More detailed information about the analysis available on request.

[4] Source: Ben Marchini, DeMontford University, 2012. Data derived from 73 power systems measured between 2009 and 2012 at a variety of outdoor event types.

2. A crash course in temporary power types

This section gives an overview of each type of temporary power, some case studies and tips.

- Grid connection (mains electricity) and permanent renewable systems
- Diesel fuelled generators
- Biodiesel fuelled generators (and 'good' vs. 'bad' biofuel)
- Solar power
- Wind power
- Pedal power
- Hybrid systems
- Emerging technologies

Table: Carbon emission by power type

Power type	Carbon
Diesel	**2.63 Kg per litre**
WVO biodiesel	**Zero rated**
Mains electricity	**0.54 Kg per kWh**
Wind and solar	**Zero rated**

Source: Department for the Environment, Food and Rural Affairs (Defra), 2012

Fact: Oya Festival in Norway is one of the largest festivals in the world to be powered by renewable energy from a grid connection. The power comes directly from a large hydro-electric plant through underground cables.

Grid Connection (mains electricity) and permanent renewable systems

Running your event from a national grid connection can be the cheapest option for some events. Using a grid connection can reduce transportation involved in delivery and collection of equipment. Using a 'green tariff' - an electricity contract which delivers energy from renewable sources - can also be the greenest option.

However, using a grid connection is often not a practical option unless the site or showground already has a supply – often the case only for city event sites. Otherwise, installing the substations or extensions to the underground cabling required can be prohibitively costly for temporary events Additionally, a grid connection may not be a suitable solution for the temporary power needed on a complex multi-venue site, where power sources are required at specific points over a large area.

Some events such as Glastonbury Festival (UK) and Melt! Festival (Germany) have installed permanent renewable systems on their sites. In both cases large solar arrays generate power which is fed back into the national grid all year round on FITS (Feed in Tariffs), as well as supplying some power during the event. This type of setup can provide a year round income, becoming profitable once the installation costs are returned. It can is also a way to displace, or offset, the diesel consumed during events (see glossary for a full explanation of offsetting).

> *"I am really encouraged that groups like the The Green Festival Alliance aren't scared of tackling huge subjects like power, and are leading the debate.*
> *Rob Da Bank, Bestival and Camp Bestival.*

Case study:

In 2010 Michael Eavis installed an array of 1,116 solar panels on the roof of a cowshed at Worthy Farm, the site of Glastonbury Festival. It is the largest private solar power installation in the UK, providing enough power for 40 homes. During the festival it will only replace about 6 diesel generators, but during the year it will offset a great deal of the energy provided by the remaining fleet of 200 diesel generators.

Diesel fuelled Generators

A diesel generator combines a diesel engine with an electrical generator (often an alternator) to generate electrical energy. Generators for outdoor events are generally reliable and increasingly quiet.

Diesel fuel is generally any liquid fuel used in diesel engines. The most common is a specific fractional distillate of petroleum fuel oil but alternatives that are not derived from petroleum such as biodiesel, biomass to liquid (BTL) or gas to liquid (GTL) diesel are increasingly being developed and adopted. To distinguish between these types, petroleum-derived diesel is increasingly called petro-diesel. Ultra-low sulphur diesel (ULSD) is a standard for defining diesel fuel with substantially lowered sulphur contents.

Diesel engines should be run at at least 60 - 75% of their maximum rated load to avoid damage. The Powerful Thinking research (2012) suggests they are commonly used inefficiently, shortening the life time of the equipment due to internal glazing and carbon build up. This practice is commonly attributed to the way the industry is structured: many power companies hire their generators rather than owning them, removing the incentive to look after their equipment in the long-term.

Pros	Cons
» Plenty of companies to choose from, and high compatibility of products between companies » An easy solution– it's the way it's done.	» Emissions are damaging to the environment » Energy market increasingly volatile causing fuel cost rises » Inefficient with varying loads

Embodied energy and life cycle analysis

For the purpose of this guide we have not fully considered 'embodied energy'; the energy and materials required to manufacture equipment (please see glossary for full explanation). A detailed life cycle analysis (also see glossary) would take into account the amount of energy used to manufacture a generator, and divide it by its number of uses to provide a carbon emissions figure to be attributed to each use. Suffice to say that the longer a generator lasts the better in environmental and business terms.

A newer type of generator not yet commonly available for hire in the UK is the 'variable load generator'. These systems can yield a higher efficiency for partial load conditions by reducing the rotary speed of the driving shaft. The equipment is more expensive and case studies of their application are not forthcoming for events at this stage. However, as the technology matures it may be a useful tool in the power strategy kit.

Biodiesel fuelled generators

The most important thing to keep in mind is that waste vegetable oil (WVO) biodiesel is a sound environmental choice, but virgin biodiesel has many damaging impacts.

Biofuel

Biofuels are created using plants such as corn, sugar cane and sugar beet and plant by-products such as from pulp and paper or oils from inedible plants.

Biodiesel is a type of biofuel produced by processing vegetable oil such as soybean oil, palm oil and waste cooking oil. Making biodiesel is a fairly simple process. The vegetable oil or animal fat is reacted with methanol and a catalyst, such as sodium hydroxide, to produce a methyl ester - the biodiesel. The methanol and the catalyst used in the process are recovered and can be reused. The by-product of biodiesel production is glycerine which can be used for other purposes such as the making of soap.

Many biofuels compete with food production causing spikes in food prices and/or displacement of food cultivation on uncleared lands. In many parts of the world biofuel cultivation is linked to rainforest clearance, loss of biodiversity, displacement of local communities and the diversion of food crops to fuel. Because of these increasingly fraught ethical issues associated with other kinds of biodiesel it is very important to use Waste Vegetable Oil (WVO) biodiesel, which is derived from waste from industrial processes and food factories.

Biodiesel is considered zero carbon as the carbon emitted when burnt has been pre-absorbed by the growth of the plant.

Pros	Cons
» Zero carbon rated » Non toxic and non hazardous » No major implications for power reduction to enable use of this technology » Reliable » Cleaner emissions from the generator – minimal sulphur » No limit to the size of generator available (in theory)	» Biofuel can be more expensive than red diesel » Potential supply-chain problems with WVO biodiesel at large-scale events. » Inexperience in using biodiesel can lead to generator problems » Using virgin biodiesel can have many damaging impacts, depending on how it is produced

> *"The use of vegetable oils for engine fuel may seem insignificant today, but such oils may become, in the course of time as important as petroleum.*
> *Rudolf Diesel 1912 inventor of the Diesel Engine*

Fact: Waste vegetable oil (WVO) biodiesel is currently meeting 5% of festival power demand for the 94 festivals utilising the Julie's Bicycle Ig Tools

> *"Whilst organisers do not need to be experts, it helps if they know what to expect of the experts they contract and employ. As ever we urge the festival industry at large to utilise and pioneer more efficient ways of managing their power to reduce the unnecessary waste of resources."*
> *Claire O'Neill, Co-founder A Greener Festival and GM, Association of Independent Festivals.*

Case study: Introduction of biodiesel, Festival Republic

In 2011 Festival Republic approved targets to increase the contribution of biodiesel to the energy mix of 4 festivals compared to 2010, in order to reduce carbon emissions. Festival Republic worked with 2 contractors to deliver these targets at the following festivals during summer 2011:

Latitude	Biodiesel target = 19.60% – Contractor A
Big Chill	Biodiesel target = 18.88% – Contractor B
Reading	Biodiesel target = 20.85% – Contractor A
Leeds	Biodiesel target = 25.95% – Contractor B

This move was made in spite of biodiesel costing more than red diesel. Meetings were held with the 2 chosen contractors prior to the 2011 festival season and they were contractually bound to provide data on the actual fuel consumption breakdown up to 14 days after the event, otherwise payment would be withheld.

Both contractors had worked for several years on the festivals prior to these targets being set, though contractor A had more experience with providing biodiesel and had an established supply network.

The results delivered to Festival Republic were:

Festival	2010 % Biodiesel	2011 % Biodiesel
Latitiude	8.52%	8.83%
Big Chill	6.41%	17.96%
Reading	12.51%	8.53%
Leeds	18.52%	24.53%

The targets set were based on 2010 fuel consumption in litres (not percentages), but this consumption varied in 2011. For example, contractor B at Leeds hit the biodiesel target, but the total fuel consumption also increased overall, resulting in less of an overall decrease in carbon emissions than hoped. This emphasises the need to prioritise energy efficiency, as well as making the switch to more sustainable fuel sources. Festival Republic are aiming to present data showing that the actual energy draw from their festival stages was lower than the amount of power demanded in 2011, to encourage artists to demand less in 2012, alongside other internal efforts to reduce energy demand.

On the whole, the complexities experienced by Festival Republic when deciding to increase biodiesel use included:

- how prepared contractors are in terms of equipment and sourcing to deliver on specific targets
- how precise power demand is compared to actual use
- communication and feedback between festival and contractor
- a lack of biodiesel suppliers
- a limited supply of biodiesel
- price fluctuations.

Particularly noticeable in the results is the difference between Reading and Leeds, despite them being almost identical shows. There should hardly be any difference between their fuel usage but, in the absence of any formal feedback from the contractor, it was assumed by festival site managers that either: Reading's contractor's equipment was not suitable to run on biodiesel (with the same issue at Latitude), causing generator breakdowns and a reduction on biodiesel usage; OR that contractor A, newer to the biodiesel market than contractor B, had more difficulty in sourcing biodiesel suitable to be burned in their generators.

The key issue was a lack of communication on the part of contractor A, despite having committed to increasing biodiesel use and having purchased biodiesel with good intent to use it on site. This highlights a crucial need for better communication between festival and contractor, in order to capture the learning from pilots such as these.

Supplier focus: Midas-UK

Midas is the UK's largest supplier of biodiesel-only fueled generators. They have a fleet ranging from 20kVA to 200kVA and provide complete solutions for festivals. They offer a certificate, bespoke to each client, detailing the fuel burnt to supply the energy required and the subsequent savings in carbon emissions.
http://www.midas-uk.co.uk

> *"Integrating renewable energy sources into festival's site infrastructure can reduce diesel fuel dependence, cut noise and air pollution as well as greenhouse gas emissions."*
> *Andy Mead- CEO - Firefly Solar*

Tip: When comparing costs of diesel vs solar systems, remember to include the fuel savings for a genuine comparison

WVO biodiesel can be used in the same way as diesel in most generators with minor adaptions, although we recognise there is expertise required on the part of the contractor to manage it effectively. In the early days WVO biodiesel suffered from variable quality leading to generator problems, but these issues are reportedly rare in recent years and there are literally hundreds of mainstream events in the UK which have been 100% powered by WVO biodiesel. Some of the largest events in the UK are using a percentage of biodiesel in their fuel mix.

More Information can be found here: **http://www.juliesbicycle.com/resources/fact-sheets/biofuels**

Fact: Croissant Neuf Summer party 2012, with a capacity of 3000, managed to run the entire event using only 11kW of solar and wind power. The main stage LED lighting system used less power than an average hair dryer.

Supplier focus: Firefly Solar

Firefly Solar operates a fleet of biodiesel generators running 100% WVO fuel. Having delivered full site power for festivals around 5000 capacity using biodiesel generators to supply areas of high power demand and solar and hybrid systems in areas with lower power demand, Firefly Solar offer to design the appropriate energy mix for each event.
http://www.fireflysolar.net

Solar Power

Photovoltaic cells mounted on panels convert sunlight into electricity which is then generally stored in batteries. Electricity generation is higher when it's sunny, but they can still generate electricity in overcast conditions. An inverter is used to step up the voltage for use with standard equipment. When equipment is used, it draws energy from the storage which is simultaneously recharged by the solar panels during daylight. An array of panels will need some space which faces due south (in the Northern Hemisphere), in a location not overshadowed by trees or tents.

Solar generators generally produce lower levels of energy than diesel generators and there can be a finite amount of power if weather conditions are not favourable - the system's capacity to generate power is limited by the weather, which is somewhat trickier to fix than a diesel top-up for example. However, where there is good planning to match the power demand with the capacity of the system, a solar generator can deliver even in the worst weather conditions. With no moving parts to break down the systems are very reliable. Furthermore, planning in order to manage demand and drawing power from the system only when it is needed results in inbuilt efficiency - a diesel generator runs regardless of the power drawn from it, whereas a solar generator stores the energy for when it is required.

Solar generators have been used to power small to medium stages for many years. They tend to work best as 'integrated solutions' – i.e. power, sound and light provided by one company. Some providers can supply all the equipment to reduce the need for event producers to ensure the various suppliers are properly engaged. Though many can also supply a solar generator only service and work with existing infrastructure suppliers and contractors.

Solar generators have been employed to provide base loads overnight for stages and other areas. The batteries of a portable solar generator can be used to capture excess power from stage generators when they are running, improving the efficiency of fuel usage through a hybrid system. When power demand is very low at night, this energy storage can be drawn on, allowing the generator to be switched off.

For events or areas where quietness is required, for example campsites, poetry or theatre venues, VIP areas or cinema tents, solar generators offer silent power.

Pros	Cons
» Zero carbon – helps you lower your event's emissions » Very efficient » Silent » No exhaust emissions » Visible demonstration of a festival's commitment to low carbon energy » No fuel bill at the end of the event » Reliable systems » Potential to save costs and fuel if used in conjunction with existing technology	» Requires an area of south facing land (Northern Hemisphere) to locate the solar panel array » Lower power output » As a stand-alone solution on a small scale can cost more than diesel alternative if demand for power is high » Finite amount of power » Requires more detailed pre-production

Case study: The transition to low carbon power at Shambala Festival

In 2007 Shambala Festival (capacity of 10,000 people) was 98% powered by red diesel. By 2010 the event was powered by 98% WVO biodiesel, wind and solar power, with the majority of power being provided by biodiesel fuelled generators. The transition to biodiesel was relatively smooth, but implementing solar and wind systems was more challenging.

The transition to smaller scale renewable elements has required a shift in culture within the organisation. A lack of understanding about the basics of power was quickly discovered amongst both staff and end users. The organisation's ability to get staff informed and involved was underestimated in year one, with a variety of problems at the event, mainly resulting in a mis-match between supply and demand. This highlighted the need for staff to be fully engaged in the process, and for communication between the renewable power supplier and the end users to take place well in advance. The most successful examples have been when the power, lighting, sound engineering have been provided as a whole solution for stages.

The reduction in red diesel use has had a significant impact on Shambala's emissions and helped the festival reduce its carbon footprint by over 50% per person per day in 4 years. They have also cut fuel consumption costs significantly due to the use of other technologies and gains in efficiency.

Supplier focus: Firefly Solar

Firefly Solar offer a full range of portable solar generators with outputs ranging from 0.34kVa to 45kVa. They have the largest commercially available hire stock of portable solar generators in Europe. They offer design and installation of large solar systems at festivals or provide the dry hire of single portable solar generators. Firefly has the capacity to provide a range of renewable power solutions including: primary power supply for a large stage, supplementary power for site infrastructure, solar battery inverter systems to create diesel/solar hybrids – right down to small solar mobile phone charge points. Firefly also include a free consultancy service to all clients that will detail impartial information on whether a switch to solar is feasible and if the switch will realise financial and environmental savings. http://www.fireflysolar.net

Case study: Melt! Festival Sunplugged Stage

The Sunplugged stage, which will be 100% powered by a combination of renewable energy sources including on-site generated solar power, wind turbines and pedal power will be launched at the 2013 Melt! Festival in Germany. 3,000 square meters of solar panels have been installed. The stage will use state of the art LED lighting and power efficient sound equipment. This is part of a German commitment to the concept of 'Energiewende' – translated as 'energy turnaround'; a transition to low carbon power at the national level. Whilst the £160,000 project cost makes this unrealistic as a commercially viable stand-alone project for most events, it promises to be an exciting example of a large-scale stage powered by renewable power.

Wind Power

Temporary wind power works in a very similar way to solar. Kinetic energy is converted into electrical energy and then generally stored in batteries. There are currently very few temporary systems available on the market for events, despite their widespread small-scale use in other sectors, such as road signs, boats and off-grid living. This could be explained by the vulnerability to weather (i.e. no wind) which, in very short term applications that need consistent power, can be a problem. However there are a handful of successful small scale suppliers on the festival circuit who combine solar and wind.

Pros	Cons
» Zero carbon » Strong visual commitment to low carbon energy	» Vulnerable to weather conditions » Requires space to set up and rig supporting guy ropes » Not commonly available

Supplier focus: Zia Solar Systems

Zia Solar Systems provide mobile wind and solar power electrical generation systems. Shown is a Zia Solar combined wind and solar system powering a stage in the Green Futures Field at Glastonbury Festival, 2011. The system consists of a solar array, inverter, main battery and auxiliary battery, plus a wind turbine and ground panels.

Fact: 87% of the 47 festivals taking part in the A Greener Festival Award in 2011 used at least some renewable power, the most common being biodiesel and solar.

Pedal Power

Like wind power, pedal power translates kinetic energy through dynamos into electricity. Systems usually use batteries to store the power to provide a consistent supply. Common applications at festivals are phone charging, cinemas, sound and lighting, and interactive art installations. Each adult bicycle typically generates an average of 60watts of power and child bicycles generate an average of 30watts of power each. The power from all the bicycles is aggregated. The power generated is low voltage DC power, which is converted to 230volts AC. Power is usually stored in batteries, and used as required. If there are no batteries in the system, total power is based on the amount of people cycling at any one time. Typically 10-20 bikes can power a small stage or cinema using energy efficient equipment.

Bike Power UK have powered dance venues with a 2,000 capacity using only 20 bikes. Firefly have supplied to venues with 30 bikes powering everything from the sound system to an electric shower! It's an exciting way to get audiences involved with power and there are now several companies in the UK offering professional pedal power services.

Bikes are also often used purely in their mechanical capacity to turn the blades for smoothie making or spin painting, thus avoiding the need for electricity.

Pros	Cons
» Zero carbon » Often inexpensive » Very interactive	» Relatively low capacity » Requires some audience space in venue for equipment (the bikes).

Supplier focus: Magnificent Revolution

Magnificent Revolution is a not-for-profit project with the aim of engaging people with energy. They offer the Pedal Sessions Stage, Cycle Cinema, cycle powered sound systems, and educational workshops. Their Pedal Sessions project for festivals combines a bicycle powered PA sound system and cinema setup and uses 20 bicycles/40 legs to produce up to 1kW of power for films, bands, DJs and spoken word artists. http://www.magnificentrevolution.org/

Case study: An example of how pedal power practically works provided by Electric Pedals, and based on the charity DJ Derby, 2012

Event details
The event ran for 6 hours / Event footfall of around 5000 people / Power provided for the performances of 205 artists

Number of Bicycles and people
25 Adult Bicycles / 9 Child Bicycles / 2x Hand cycles for less able/elderly/ wheelchair users

What was physically powered?
All sound amplification / 5kW front of house PA / 1kW monitors / Bass amps, DIs, keyboards

How much power they generated
POWER = (20 adult bikes * 60) + (10 child bikes * 30) + (2 hand bikes * 10) = 1520 Watts
ENERGY = 1520W continuous * 6 hours = 9120 Watt-Hours or 10kWhrs (kilo-Watt hours)

www.electricpedals.com

Hybrid Systems

'Hybrid' refers to the use of a combination of technologies, for example the use of diesel generators with storage batteries and solar panels or wind turbines. One of the advantages of batteries is that they only deliver the amount of power required at any moment in time, as opposed to a diesel generator, which varies greatly in efficiency depending on load. An example of this kind of system is combining solar or wind energy feeding into batteries, and using the generator when either a higher load is required than the battery can deliver, or the battery is low on charge and not replenishable by wind or solar at the rate of power demand. See the graph opposite for an illustration.

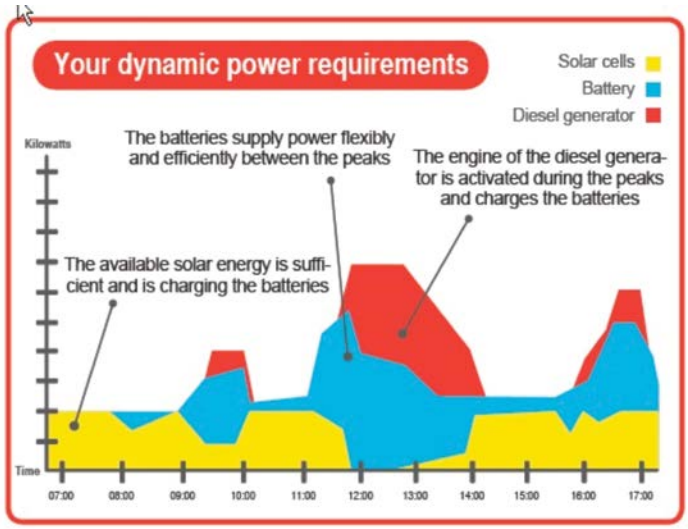


Fig.3: Dynamic power supply from a hybrid diesel solar generator

Pros	Cons
» Perhaps the most efficient approach to producing larger amounts of power at festivals » Reduces fuel consumption by an estimated 40% based on field trials. » Lower emissions.	» Not currently widely available for the hire market » Standalone/combined units have only been developed up to 15kVA in 2012 » May require higher upfront costs for equipment hire

Case Study: Provision of a hybrid system by Firefly Solar

Firefly Solar were commissioned by Grammy Award winning artist Imogen Heap to provide a hybrid power generator to facilitate the shoot and live internet broadcast of her single 'Me, the Machine'.

Over the course of the five day shoot in April 2012 uninterrupted power was provided by a 60kva hybrid generator comprising of: a solar PV array, energy storage system and a combustion engine running on 100% WVO.

Throughout the duration of the shoot the hybrid generator was used to power all AV outboard and monitors, key generic lighting, catering equipment and outside broadcast equipment.

90% of the power required for the shoot was provided through solar PV arrays and the battery inverter storage system. The additional 10% was supplied by the biodiesel combustion engine which kicked in when peak demand was high or the energy storage system was low.

The use of Firefly's hybrid power generator negated the need for a 60kva diesel generator saving 660 litres of fuel being burned; creating a carbon saving of 1.54 tonnes.

By using the hybrid power generator the production team were able to dramatically cut on-site emissions and provided a silent working area for artists and crew which was a key factor on this project.

Supplier focus: Bredenoord - ESaver hybrid generator

Energy company Bredenoord are at field trial stage with a new hybrid generator combining a diesel engine, solar panel and battery technology. Initial tests suggest a reduction of 40% in fuel consumption. Switching between the sources and using the engine only in its optimum operating range enables the ESaver to supply current with significantly reduced emissions. The company believes this could soon become a cost-effective option to replace traditional diesel-only generators for smaller applications up to 30kva.
http://www.bredenoord.com

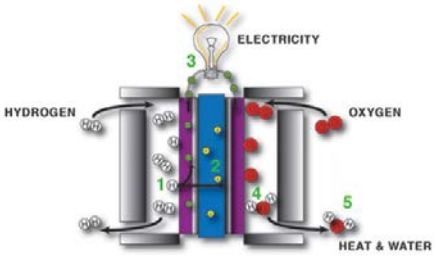
Supplier focus: Towerlight UK - Hybrid Tower Light

Towerlight's VB9-ECO LED Battery Hybrid features a hybrid battery/diesel system. The set runs on 90% battery power and 10% fuel. The battery is automatically recharged via a low battery monitor system. 72% fuel savings are achieved, as well as an over 4 fold increase in running time on one tank of diesel, meaning less refueling-related transport costs on longer-term hires. A 150 watt LED yields an equivalent illumination level to a 400 metal halide lamp, and has a 70,000 hour life-span compared to the latter's 6000 hours. The unit also has light detection sensor that automatically switches it on when light fades, and switches off when it becomes light again.
http://www.towerlight.co.uk/

Supplier focus: Firefly Solar - Pictor Solar Light

The Pictor Solar light provides an effective renewable energy solution for smaller-scale applications when low power is required and where space is at a premium. This solar generator doubles as both a tower-light with automatic twilight switching to provide night-time, exterior floodlighting as well as mains power to appliances night or day. It is silent running with zero emissions and can be charged using a solar array.
http://www.fireflysolar.net

Emerging technologies



Hydrogen Fuel Cell

A fuel cell is a device that converts the chemical energy from a fuel into electricity through a chemical reaction with oxygen or another oxidizing agent. Hydrogen is the most common fuel, but hydrocarbons such as natural gas and alcohols like methanol are sometimes used. Fuel cells are different from batteries in that they require a constant source of fuel and oxygen to run, but they can produce electricity continually for as long as these inputs are supplied. The fuel cell is embryonic as a solution to temporary power.

Supplier focus: Arcola Energy – Hydrogen Fuel Cell

Arcola Energy have showcased a 5 kW hydrogen fuel cell at Latitude Festival for 3 years powering a substantial LED lighting rig in the theatre tent. However, this technology for temporary use is not yet widely available or competitively priced for most applications.

http://www.arcolaenergy.com

Dance Power

The Sustainable Dance Floor uses dancing and moving people as a source of energy. The energy produced by movement is converted into electricity that is used to make the dance floor react to the public in an interactive way. The electricity can be used to power local systems such as LED-lights. The floor compresses 10mm when being stepped on. This small compression is enough to activate the internal generator of that module producing up to 35 Watts of sustained output per module. Whilst this is not a serious contender for festival power in general, it can be a fun and unobtrusive way to engage audiences.

Sustainable Danceclub **http://www.sustainabledanceclub.com**

Walking Power

Pavegen's power unit is installed into pavements. Every step generates 7 Watts of energy. Imagine if pedestrian trackway generated energy to power the festoon! It's early days for this technology - watch this space.

Pavegen **http://www.pavegen.com**

Power from Urine

At the time of writing, an article about 'piss power' from Nigeria is circulating the internet. Whilst we have no idea of the provenance of this report, we couldn't resist including it. Imagine - all that festival urine creating power! The claim is that the system works like this:

- Urine is put into an electrolytic cell which separates out the hydrogen.
- The hydrogen goes into a water filter for purification, which then gets pushed into a gas cylinder.
- The gas cylinder pushes hydrogen into a cylinder of liquid borax, which is used to remove the moisture from the hydrogen gas.
- This purified hydrogen gas is pushed into the generators.

We'll be including some feedback about this idea in edition 2 of the guide!

There are more power suppliers than we have mentioned here. You can check the Julies Bicycle Green Suppliers Database to search for sustainable suppliers in your area. Check back regularly as new suppliers are added on a rolling basis.

3. The Guide

How can you reduce fuel consumption?

This section will help you to:

- Reduce power demand
- Ensure your generators are correctly sized
- Increase the use of renewables and/or hybrid systems
- Structure contracts to encourage efficiency
- Decide what the first steps are

But first, decide what you want to achieve.
An average of 0.5 litres of diesel per person per day (pppd) for large events[5] and 0.273 litres diesel pppd for small-medium festivals[6] is the best available benchmark in the UK for what is 'normal' or average fuel consumption at festivals. You could aim to match this if you do not already, or if you have information from the previous year, aim to reduce fuel use by 10%.

To provide a starting point for measuring fuel consumption you need the number of people attending the event (tickets sold)[7] multiplied by how many days = total audience days. Divide this by the total litres of diesel on last years power invoice and you have it. The measurement of fuel per person per day provides the ability to compare consumption whether or not event capacity changes between years.

For reference the Powerful Thinking Campaign research suggests that over 70% of systems monitored could realise a minimum 10% fuel saving. It's worth noting that this assumption is based on individual systems. **More significant gains are likely to be made by organising the entire power infrastructure with a more efficient layout, enabling more combining of loads**.

You can also use the free online IG Tool, a carbon calculator designed specifically for festivals and provided by Julies Bicycle to measure the carbon emissions of your whole event. **http://www.juliesbicycle.com/resources/ig-tools**

> *"Somebody said: Somebody should do something about that. Then I realised I am somebody.*
> *Lily Tomlin, comedian*

[5] Industry Green (Julie's Bicycle) 2012. Based on aggregate data from 12 large festivals in the UK
[6] MSc Climate Change and Policy: What are the barriers to operationalising and expanding temporary renewable energy capacity at UK music festivals? Joel Baker, Sussex University, 2011
[7] Feedback from festivals about this method of measurement has highlighted that a festival site is designed for maximum capacity. Thus, if fewer tickets are sold than capacity, the fuel per person per day (pppd) figure will be higher. Whilst this is true, as unit of comparison there is no better approach than pppd, as it allows comparison between years and across the industry. You can choose whether to measure it based on capacity or actual audience size – or do both and compare what the unused capacity is costing you in terms of fuel efficiency.

How can you do it?

1. **Reduce power demand**
   - » Plan in detail what your actual requirements will be by asking every user (traders, lighting, PA, bars, offices etc.) what they really need Work with your contractor to provide a form which asks the right questions to establish their power needs. Don't simply ask them if they need a 16 or 32 Amp feed. Work with your power supplier to establish exactly what information they require in order to better assess your power requirements.
   - » Put in place a simple power reduction policy for your whole event and share with staff, contractors, artists and traders to make clear to everyone that you expect people to consider what they need, and whether they can make reductions in power demand where possible. This should include behavioural aspects like encouraging people to switch things off when not in use.
   - » Encourage existing contractors to find new suppliers who use energy efficient equipment, e.g. LED stage lighting and festoon runs.
   - » Many festivals already create a financial disincentive to traders using more power by charging higher rates for larger supply. Consider how the price structure can affect demand, and offer incentives to those who are self sufficient with renewable power.

> *"This guide responds to repeated requests from festivals for more information about how to manage power more efficiently and aims to spark an industry-wide conversation. There's no magic bullet; power can be quite complex, but there are certainly gains to be made if we move forward together and share experiences.*
>
> *Chris Johnson, Chair, Green Festival Alliance.*

What should I include in a Power Reduction Policy?

- » Ask contractors to reduce their requirements by using more energy efficient equipment, for example LED lighting, LED festoon.
- » Consider charging traders proportionally more for larger power supplies and offer incentives to those who use much less power.
- » Remove fuses from the heaters in offices, and ask staff to wear jumpers
- » Discourage the use of electric kettles and electric urns – they use an amazing amount of power!
- » Limit power during build and break periods to set times.
- » Effectively communicate reduction aims to all production managers and venue managers – every bit helps.

Tip: Work with your existing supplier to aim to reduce fuel by 10% and split the difference in the budget savings, giving both parties an incentive.

Fact: 500m of LED festoon with 5 Watt bulbs can draw less power than a single kettle.

2. **Reduce the size of generators where possible**
   - » With increased confidence in your requirements due to better planning, work with your power contractor to reduce the size of generators where possible.
   - » Either monitor loads internally or ask the power company to monitor to see if smaller generator sets can be used the following year.
   - » Consider the extra cost to install smaller secondary generators in areas where there are significant periods of lower power demand, e.g. production offices during build and break periods, stages overnight. In many cases you will save budget overall through fuel reductions, despite potentially hiring extra equipment.

Tip: When comparing costs of diesel vs solar systems, remember to include the fuel savings for a genuine comparison

3. **Increase the use of biofuel, renewable systems and/or hybrid systems**
   - » Consider asking your supplier to use biofuel
   - » Consider wind and solar options for small-medium sized venues and stages, remote areas, site lighting, offices, build and break periods, phone charging, healing and craft areas.

» Consider hybrid solutions for base loads overnight on stages, and areas where there are significant periods of lower demand

4. Structure contracts to encourage efficiency

Your contract is perhaps the most effective tool you have to make real changes.

Here are some suggestions about what to consider in a contract:

» **More detailed planning to reduce generator sizes and improving distribution as a whole:** To plan and manage generator size you need accurate information from those who require power. Many of those we work with have found taking this role in-house to be beneficial. Whilst it may seem like extra work, experience tells us that adding extra criteria on energy to existing requirement lists is straightforward. It's important to ask your power company what information they actually need, and to get it right. Ask all power users specifically what equipment they use, rather than if they require a 16 or 32Amp feed. Our research shows that few people actually know what they need.
» **Efficiency targets:** Make clear your expectation of fuel reduction targets with the power company. Create incentives through shared gains for efficiency in the contract or simply make it a non-negotiable clause.
» **Monitoring:** Ask your company to monitor loads throughout the event and include the results in a report. They may say this takes extra man-hours. As a minimum be prepared to pay a little extra to accommodate several hours of labour to spot check all the generators day and night in each 24 hour period. Alternatively you could task a member of staff or bring in a specialist to independently monitor and identify future savings.
» **Post event report:** Request a post event report which includes the size and numbers of generators, efficiency monitoring data for each generator, total fuel usage, carbon equivalent and recommendations for future efficiency gains.

Tip: Don't try everything at once. Work with your existing supplier(s) to look at how contracts could be changed to promote efficiency and what new ideas can be introduced. A longer term commitment with your supplier can help to create the confidence to shift things toward better efficiency.

What should I ask my supplier?

Not everyone is an energy expert. Below are some questions to guide initial conversations with your supplier and make sure you're heading in the right direction.

» Based on the previous year (if applicable), do they think loads could be combined with changes to generator locations to achieve fewer generators?
» Again, based on previous experience, what equipment do they consider it will be useful to advise against to achieve reductions in demand
» What information is actually useful to them which you can include in traders documentation to more accurately assess demand
» Where hybrid or smaller generators can be employed to reduce fuel consumption overnight
» Can they use LED festoon?
» Can they use at least a percentage of biodiesel?
» Ask your supplier if they are using fuels certified EN 14214, which guarantees compliance with hardware warranties
» When using biodiesel make sure it is locally or regionally sourced WVO biodiesel.

Case study: Lessons learned from managing energy at the Olympic Games 2012

Hosting a low carbon Games and achieving a 20 per cent reduction in energy consumption across the event was an ambitious target. This case study provides an overview of lessons learned from managing energy consumption during the Games.

The final result was a significant reduction in demand achieved by reducing overlay and unnecessary equipment in the design stage, specifying low energy equipment and implementing operational management procedures throughout the event and afterwards during the deconstruction of venues.

During the Olympic Games on average the maximum recorded demand for grid electricity was 55 per cent less than the predicted, designed capacity and that of temporary generation was 69 per cent less than the predicted, designed capacity. The total kWh consumed during 2012 in the build up to and staging of the Olympic and Paralympic Games was 25 per cent less than the early 2012 forecast. While forecasts and design capacity allow for safety margins and an element of uncertainty the final energy consumption levels exceeded the targeted 20 per cent reduction. It is estimated the total savings could have exceeded this with earlier implementation and a strong focus on operational controls.

Measuring success

- A number of key successes can be highlighted:
- Total grid electricity was 25 per cent less than early 2012 forecasts leading to a £2.6 million saving and generator fuel was 40 per cent less than forecast leading to a £1.2 million saving – a significant part of savings can be attributed to energy conservation measures.
- Actual demand for grid electricity was 55 per cent less than the predicted demand and for temporary generation was 69 per cent less than the predicted demand.
- A low carbon energy mix was used for more than 50 per cent of the grid electricity during the Games.
- A conservation action plan was implemented at all venues and compliance with this regularly audited.
- Some real-time monitoring was implemented and Day+1 was implemented which fed into the operational management.
- Data has been collected and is available for future design and operation of the Games (LOCOG Energy Transfer of Knowledge Report to the IOC).

Lessons learned

- A number of lessons learned can be highlighted:
- Establish an agreed Energy Conservation Policy with high-level support at the earliest opportunity.
- Design of energy provision at venues should aim to maximise energy conservation alongside effective provision rather than be purely demand led.
- Challenge the stated energy requirements of concessions, broadcasters and so on to avoid the inefficient operation of temporary power systems.
- Design venues to enable easy and effective operational management of energy.
- Identify team members who are both accountable and responsible for energy conservation.
- Ensure venue users are trained in the efficient use of energy systems.
- Explore the potential to incentivise effective energy conservation.
- Implement an effective monitoring system to be able to react quickly to energy use – that is, maximise real-time monitoring.

The Full case study, Managing Energy Consumption during the Games, can be found on the Olympic Legacy website: **http://learninglegacy.independent.gov.uk/themes/procurement/case-studies.php**

What can you personally do - roles at a glance

Management structures at many festivals are unique and organic, and role descriptions and titles reflect this. Here are some suggestions about what the senior managers in your organisation can contribute to reducing fuel consumption and changing the energy culture in your organisation.

Festival Organiser

Lead by doing - make a commitment to energy reduction:

» challenge the culture of 'you get what you ask for.' Keep nudging your team to ask 'Do you really need that much power?'
» Make an action plan or policy with your team/production company to set goals for efficiency. Be ambitious and positive.
» Assign someone to focus on energy.
» Share your aims and motivations with all staff and be supportive of their efforts.
» Introduce some renewable energy into your power mix.

Procurement Manager(s)

Recognise your control over the supply chain - Consider efficiency in contracts:

» work with your power contractor to identify where reductions could be made. Reflect this in the contractual arrangements.
» Ask all contractors to consider their actual requirements. Discuss how they can be reduced or better defined
» Consider new ideas like LED festoon, solar lit toilets for remote areas.
» Share your aims with contractors – show them how energy efficiency benefits both of you.

Booker

Be part of the fabric of a green event:

» communicate your commitments to artists and agents.
» Work with artists and agents to reduce tour bus power requirements
» Encourage or be aware of Green Riders, the industry campaign working with artists to 'green' their riders.

Site Manager

Power makes the magic happen – put it at the heart of your site design:

» set up a meeting with creative producers, procurement manager and the power supplier to discuss how better site design could assist in fuel reductions.
» Ensure that monitoring takes place at the event, and areas for future savings are identified.

Festival Managers /Staff managers

Live your values - festival staff help reduce demand and change the culture:

» your staff/crew can reduce demand, change cultures, and communicate your efforts to your audiences.
» Make sure each member of staff or volunteer knows your events commitment to sustainability and a few key examples of what you are doing.
» Show them the easiest ways they can help - switching off lights, wearing a jumper instead of turning on the heater, and using less water.

Other Contractors (e.g. lighting, sound, showers)

Help us do the hard work for you – recognise your role in helping an event to green its operations:

» identify periods of low demand to allow for alternative solutions – be open to suggestions.
» Ask energy managers for advice on reducing the amount of power required for your equipment or service.
» Include energy in your long-term stock investment plans.

Markets Manager

Use your convening power - work with concessions to accurately assess and reduce requirements:

» create a form for traders to list their equipment and supply to the power supplier
» Consider developing a pricing structure for power supply, charging slightly more for inefficiency. Increase the price gap year on year.
» Ban electric urns in favour of gas. Issue ban a year in advance and give traders information on why and where to upgrade
» Reward traders who are more efficient or use renewable power through cost savings and a green stall award

Artistic producer

Clearly communicate a commitment to energy reduction:

» ask for requirements from art projects and venues in advance – ask for what equipment they are using rather than whether they need a 32A or 63A etc.
» Communicate a commitment to energy reduction in tenders and feedback on proposals
» Use creativity to make your audience aware of what you are doing and renewable technology.

Sign up to the Powerful Thinking Campaign:

- Aim to reduce fuel by 10% in 2013
- Receive additional information and resources as they become available
- Receive free or low cost consultancy, monitoring or energy auditing. There may be free or low cost energy advice and auditing available for your event through a European funded initiative with Julies Bicycle – details of eligibility to be finalised in early 2013.

We will also contact you toward the end of 2013 to see how much fuel you have saved, so we can report on what has been achieved across the industry.

Sign up HERE **www.greenfestivalalliance.org.uk/powerful_thinking/2013**

Get Involved - be part of the journey:

In this guide we have addressed what we believe to be the main issues for power at outdoor events. However it is not exhaustive, in particular in the areas of communicating energy with audiences. This guide aims to begin an informed industry-wide conversation, and we welcome feedback for future revisions of the guide, both in terms of practical applications of the ideas and technical information. This is the beginning of a journey.

Please contact **info@greenfestivalalliance.org.uk** with questions, additions or feedback.

4. The future of temporary power at events

What does the future of temporary power to outdoor events look like?

Despite the entrenched nature of our current global energy infrastructure, change is inevitable as fossil fuels become more expensive and less accessible. It is widely accepted in science and politics that unchecked emissions pose a significant threat to the climate system, and we are already seeing the current economic and energy infrastructure being remodelled to account for this. The consequent profound changes will be nigh on impossible to achieve in a way that does not impact on all aspects of the festival sector: energy costs are volatile, carbon pricing is already happening and it is these business realities that are stimulating change much more effectively than climate science. Protecting energy and resource supply, understanding demand, and capital interventions that will buffer the sector from price and supply volatility are of critical importance. New technologies and business relationships in energy and resource supply, distribution and consumption have already begun to transform the creative industries. Investing now will ensure that the UK can meet its legally binding 80% reduction target by 2050 and will, in large part, determine the future shape of how we power the festival industry.

If festivals are to play their role in the wider context and mitigate for potentially significant cost increases, organisers and suppliers will include the following as standard practice:

- Dedicated energy managers
- Policies and action plans to manage power demand and consumption
- Real-time/live energy monitoring during events
- Standard industry-wide reporting frameworks for suppliers to report to clients about efficiency
- Thorough debriefs referencing end users that need to improve their performance
- £/kWhr and Litres/kWhr measures of efficiency for generators and events as a whole
- A culture of efficiency reflected in contractual arrangements
- Key contractors such as stage lighting providers supplying load schedules in advance
- Reduction of fossil fuel reliance as other technologies become more available and competitive.
- Demonstration of new and low emission technologies to audiences, capitalizing on the unique relationships festivals have with their attendees.
- Introduction of variable load generators
- All generators being supplied with diesel particulate filters (DPFs)

The future is now...

As we go to press with this revision of the guide (version 1.1) in early January 2013, an exciting development is taking place in the industry: Midas, a temporary power company dedicated to WVO biofuels and energy efficiency has been working with the Green Festival Alliance and Julies Bicycle to explore how an industry-wide standard for monitoring and reporting on power can be established and taken to scale. A case study of their new monitoring technology and energy label can be found in the case study on the next page. In 2013 the GFA will be working with Midas and events across the UK to implement monitoring and develop comprehensive datasets to explore where efficiency gains are being made, and share learning between events.

Case Study: Midas Remote Power Monitor

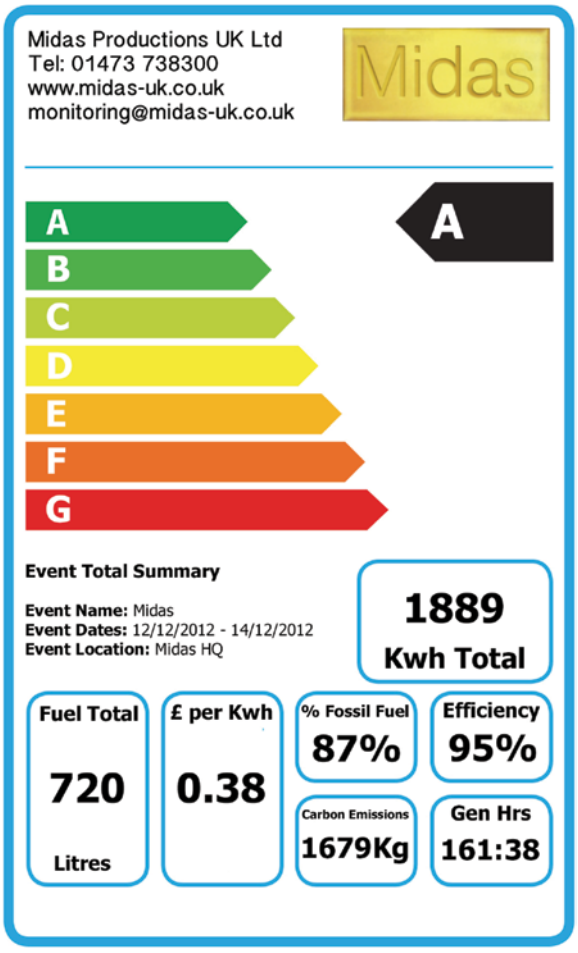
Fuel prices and power demands are only ever going to get higher. We are being educated to become accountable for the energy we use, and in domestic environments energy suppliers are providing basic home energy monitors for the home user to track their usage and identify savings.

Events, up until now have been unregulated and power to a lot of organizers is something that is hired and used; with little or no control as to what is actually being used and how.

The only indicator of efficiency, or lack of, has been the fuel bill which is presented post event.

Midas have developed the Remote Power Monitor which allows the Event Organiser to see:

- Where power is being used on a second by second basis,
- How power is being used (i.e. peak loads with times)
- How efficiently that power is being used (Balancing, quiet periods with low loads etc.)



What is Monitored:

- Voltages (L1-L2, L1-L3, L2-L3, L1-N, L2-N, L3-N, L1-E, L2-E, L3-E, N-E)
- Frequency
- Current (L1, L2, L3, N, E, Earth Leakage, Current Total (L1+L2+L3))
- Min and max data for voltage, frequency and current with time stamps per day and over whole event
- kW
- Total kWh per day and whole event

All the information is currently stored to memory and processed by Midas assessors post- event. A live version is due for release soon, which would allow both power companies and festival managers to see how their site is running in real time.

With clients' information on their total event fuel usage in litres and the price they paid accurate information about efficiency can be provided:

- Pence per kWh
- Efficiency by generator as an average over the event

A total energy performance label with accompanying assessor notes can be supplied once all the data has been processed.

5. Common questions and myths

Q. Are Biofuels bad for the environment
A. Biofuels, especially palm oil and jatropha, are often cultivated on deforested land, displacing agriculture and indigenous people. The emissions from cutting down the original forest can exceed the emissions saved by displacing the use of a fossil fuel. It's a complex issue and one of trade offs, but 100% waste vegetable oil (WVO) or 100% domestic biodiesel such as oilseed rape are widely considered to be 'green' fuels. WVO is used cooking oil which has been prepared for use in generators and it is generally sourced locally. Using it for power keeps it out of the waste stream (including sewers where it can cause blockages) and has far less associated emissions when compared to diesel. As a rule of thumb, biofuels are preferable to fossil fuels, especially when sourced locally.

Q: Isn't renewable power unreliable?
A: No. Most newer systems have battery back-ups storing energy, and continue to produce power in overcast conditions. Many providers come with a reserve in place. Some also say that as there are no moving parts it is actually more reliable. However, it should be noted that there is more of a need to work out power requirements, in detail, in advance to match supply and demand.

Q: Do renewable solutions cost more?
A: Sometimes they do, but sometimes they don't, just like any other power company decision. In many cases where a large amount of power is required (for example above 45 kVA), there may not be a viable solution or costs may be prohibitive. But for smaller requirements, you may be able to reduce the amount you need to power in the first place by working efficiently, and use cost-effective renewable solutions. Feedback from festivals suggests that it is often forgotten that there are no fuel bills post-event for solar and wind systems. There are many examples at small to medium scale events of renewable and hybrid approaches which can deliver cost savings. Savings will be dictated by circumstance, so it is very important to maximise planning and explore all available options.

Q: Isn't it the case that we always need a margin of error in the capacity of generators for the unexpected?
A: Yes, but the Powerful Thinking research this summer suggests that current margins are often excessive.

Q. Can you power entire events on renewable and low carbon solutions?
A. There are many examples of small to medium festivals (under a capacity of 20,000 people) being entirely powered by renewable and WVO solutions. Examples include Croissant Neuf, London Green Fair, Shambala and Sunrise Celebration. Renewable technologies are generally considered not yet capable of wholly powering larger events and stages for very large audiences but a hybrid approach is still both easy and widely in use.

Q. Does Festoon lighting need to remain on during the day to manage loads on generators?
A. Only if those generators are also supplying other requirements, or if a load needs to be maintained on the generator. If a generator is dedicated to festoon lighting it can be switched off. Some companies now have automatic sensors which switch off site lighting, festoon runs and tower lights when daylight emerges.

Q. Do amps and stage lights need to remain on overnight?
A. Some companies say this is necessary in order to keep equipment warm and avoid condensation, but others say their equipment does not require this. It can depend on the equipment. Either way, it's worth considering a secondary power source so a main generator can be switched off.

Appendix

1. Further Resources

Julie's Bicycle Green Supplier Database
Check back regularly as entries are added on a rolling basis.
http://www.juliesbicycle.com/resources/jb-green-database/suppliers

Julie's Bicycle Industry Green Tools
Use these to measure your event's carbon footprint.
http://www.juliesbicycle.com/resources/ig-tools

Carbon Trust Technology and Energy Management Publications
http://www.carbontrust.com/resources/guides/energy-efficiency/technology-and-energy-management-publications

Julie's Bicycle Environmental Policy and Action Plan Guidelines
Create a specific action plan for power or write power-reduction commitments into your festival's overall environmental policy.
http://www.juliesbicycle.com/resources/environmental-policy-guidelines

White Light Green Guide
Advice on low-carbon lighting design and technology.
http://www.whitelight.ltd.uk/greenguide

Energy Saving Trust Recommended Products
While these are mainly consumer products for domestic use, there may still be some suitable to e.g. production office use – or employ them in your year-round office.
http://www.energysavingtrust.org.uk/Take-action/Find-Energy-Saving-Trust-Recommended-products

Julie's Bicycle Quick Factsheets
Biofuels: http://www.juliesbicycle.com/resources/fact-sheets/biofuels
Offsets: http://www.juliesbicycle.com/resources/fact-sheets/offsets

Beyond Power

General Tips for 'Greening' your Festival
http://www.juliesbicycle.com/music/festivals

Julie's Bicycle 'Better Batteries' Campaign
http://www.juliesbicycle.com/about-jb/campaigns/better-batteries

WRAP Resource Management Plan (RMP) Tool
http://www.wrap.org.uk/content/sustainable-event-management

Sustain Good Food for Festivals Guide
http://www.sustainweb.org/publications/?id=243

ISO 20121 Sustainable Event Management (certification)
http://www.bsigroup.com/en-GB/iso-20121-sustainable-events-management/

A Greener Festival Awards
www.agreenerfestival.com

2.Glossary

Alternating Current (AC)
Alternating current means the direction of flow of electricity is constantly being reversed back and forth. The electricity in our mains grid is AC, mainly because AC is easier to transfer over longer distances and can provide more power. However, most electrical circuits require DC (direct current), so AC power must be converted prior to being suitable for certain devices (hence the use of adapters in power supplies to e.g. laptops). Also see 'Direct Current' and 'Power'.

Ampere (A)
Amperes, or amps, are the unit of measurement for electrical current – the amount of electric charge passing a point in an electric circuit per unit time. 16 A and 32 A are two of the current ratings used in standardized industrial plugs. The type of supply needed will depend on the amount of kit plugged in and how much current each piece of equipment will draw. Also see 'Power'.

Audience Day
Audience days are the number of days each festival goer spends on site. For example if a festival goer has a 2-day ticket, this means they spend 2 audience days at the festival. To calculate audience days multiply the Total of number of days with the Total tickets sold for each day.

Biofuels
Fuels derived directly from living matter e.g. biodiesel, algal fuel, and bioethanol. There are three categories of biofuels, which refer to the type of plant material used to create the fuel. The first category of biofuels are derived from plant material that is also a food source i.e. ethanol from corn. The second category of biofuels are derived from plant material that is not also a food source i.e. biodiesel from inedible oil. The third category of biofuels refers to algae used to derive biodiesel. Currently only the biofuels in the first category are economically viable at scale. Please see the section on biodiesel-fuelled generators for more information on the environmental credentials of different types of biodiesel, or go to http://www.juliesbicycle.com/resources/fact-sheets/biofuels.

Carbon Dioxide
A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1.

Carbon Dioxide Equivalent (CO2e)
The universal unit of measurement used to indicate the global warming potential (GWP) of each of the 6 Kyoto greenhouse gases. It is used to evaluate the impacts of releasing (or avoiding the release of) different greenhouse gases, and impacts are usually represented as CO2e emissions.

Carbon Footprint
A measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide.

Direct Current (DC)
Direct current is the unidirectional flow of electric charge i.e. current flows only in one direction. It is produced by sources including batteries, solar cells, fuel cells, and some types of generator. Most electronic circuits require a steady DC. Also see 'Power'.

Direct Emissions
Emissions that are produced by organisation-owned equipment or emissions from organization-owned premises, such as carbon dioxide from electricity generators, gas boilers and vehicles, or methane from landfill sites.

Embodied Energy
Embodied Energy is the sum of all the energy required to produce goods or services, considered as if that energy was incorporated or 'embodied' in the product itself. The concept can be useful in determining the effectiveness of energy-producing or energy-saving devices (does the device produce or save more energy that it took to make it?), and, because energy-inputs usually entail greenhouse gas emissions, in deciding whether a product contributes to or mitigates global warming.

Embodied energy is an accounting method which aims to find the sum total of the energy necessary for an entire product life-cycle. Determining what constitutes this life-cycle includes assessing the relevance and extent of energy into raw material extraction, transport, manufacture, assembly, installation, dis-assembly, deconstruction and/or decomposition as well as human and secondary resources. Different methodologies produce different understandings of the scale and scope of application and the type of energy embodied.

Emissions
The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere.

Energy Efficient Equipment
Efficient energy use, sometimes simply called energy efficiency, is the goal of efforts to reduce the amount of energy required to provide a service. In the events sector, many of these efficiency gains can be made via the types of technology and equipment employed - for example by using more LED lighting or energy efficient sound equipment.

Environmental Impacts
The effects human activity has on the environment, usually measured in terms of carbon dioxide equivalent (CO2e). Examples of negative impacts on the environment include emissions released from travel, energy, waste, water consumption etc.

Environmental Sustainability
Environmental sustainability refers to the ability of natural ecosystems to remain diverse and productive, thus being able to support life over a period of time. All human activity is based on these ecological goods and services. Some human activities, such as the excessive production of GHG emissions (including carbon dioxide), have led to the decline in natural ecosystems and to changes in the balance of natural cycles, thus undermining and degrading the capacity of ecosystems to continue supporting life. Living sustainably, for example, by reducing carbon dioxide and other GHG emissions, will ensure the long-term viability and productivity of these ecosystems, providing both humans and other living systems with the capacity to endure. It is in this context that we create a direct link between GHG emission reductions and environmental impacts.

Generator Load
The power delivered by a generator at any given time, determined by the power demands of the circuit/equipment hooked up to the generator. Peak load is the maximum power requirement of a system. Base load is the more or less constant power requirement of a system underlying any peaks.

Green Champions
Individuals within organisations, or organisations that are willing to be sector leaders in environmental sustainability, piloting initiatives and campaigns.

Green Energy Tariffs
The exact specification of a 'green tariff' varies from company to company. Some, such as Good Energy, specialize in providing up to 100% of energy directly from renewable sources. Other suppliers of green energy tariffs make a contribution to environmental schemes such as renewable energy projects, however this does not necessarily mean that the energy you are supplied with comes from a renewable source. Green tariffs are sometimes more expensive than standard tariffs, however they have better environmental credentials and by switching you are contributing to increasing the market demand for greener energy.

Greenhouse Gases
The current Intergovernmental Panel on Climate Change (IPCC) inventory includes six major greenhouse gases. These are Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF6).

Ig Tools
The Ig Tool (Industry Green Tool) is a free online carbon calculator created by Julie's Bicycle which is designed specifically for the creative industries. It helps event organisers to measure and manage their carbon emissions. http://www.juliesbicycle.com/industry-green/ig-tools

Inverter
An electrical power converter used to switch direct current (DC) to alternating current (AC). They are commonly used to change the power from DC sources such as solar panels and batteries to AC.

Kilowatt Hour (kWh)
Energy as the product of power and time i.e. energy = the amount of power expended x the amount of time. This is the common unit used to bill electricity to consumers. For example, a 60-watt lightbulb that burns for one hour uses 0.06 kWh.

LED Lights
A light-emitting diode (LED) is a semiconductor light source – they are used as indicator lamps in many devices and are increasingly used for other lighting. LEDs present many advantages over incandescent lighting, in particular in terms of energy efficiency. LED technology is developing rapidly and is becoming a much more realistic option for outdoor and daytime use.

Life Cycle Analysis (LCA)
Also referred to as a life cycle assessment, or cradle to grave analysis. Investigation and valuation of the environmental impacts of a given product or service caused or necessitated by its existence. It is a variant of input-output analysis focusing on physical rather than monetary flows.

Offsetting
A carbon offset is a mechanism that allows a company, organisation or individual to reduce their greenhouse gas emissions in one area of activity (e.g. building energy use or air travel) by investing in projects that seek to reduce the greenhouse gas emissions in another (i.e. energy efficiency, new clean technology, forestation). The idea of carbon offsetting is to neutralise net emissions. The emissions saved from a carbon offset project should be certified as carbon reduction. These offset credits can then be sold and bought through the carbon market as tonnes of CO2 equivalent. For more information, see http://www.juliesbicycle.com/resources/fact-sheets/offsets.

Power
Power is the rate at which energy is transferred, used or transformed – in this context, mainly the rate at which a piece of equipment transforms the energy it receives into its particular output. For example, the rate at which a generator transforms fuel

into electricity, or the rate at which a light bulb transforms electricity into heat and light. Power is measured in watts (W).

One measure of power in a circuit (the rate at which electric energy is transferred by the circuit) is voltage multiplied by current, or volt-ampere. Power = volts x amps, or W = VA. This type of measurement is only accurate for direct current (DC) electricity. In most alternating current (AC) circuits, the VA figure will be larger than the actual delivered power in watts because of reactance – opposition to the passage of AC exhibited by some electronic components. For example, a supply rated at 800 VA will usually deliver 1/2 to 2/3 of this in terms of wattage. When it comes to ratings for devices, the VA rating is limited by the maximum permissible current, and the watt rating by the power-handling capacity of the device.

Generators are normally sized in kVA – kilo-volt-ampere, or thousands of VA.

Renewable energy sources
Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished).

VA or kVA
Volt-ampere or kilo-volt-ampere, generally used to size generators. Also see 'Power'.

Voltage
The electrical potential difference, or electric tension, between two points. measured in volts (V). Also see 'Power'.

Watt (W or kW)
The universally used unit for power, measured as joules per second (J/s) – i.e. the rate of energy transformation. The more wattage, the more power, or the more energy is used per unit of time. kW are kilo-watts – or thousands of watts. Also see 'Power'.

This guide has been researched and produced by the Green Festival Alliance UK (GFA). The alliance was founded in November 2011 by 8 partners; Shambala Festival, Julie's Bicycle, Festival Republic, Bestival, the Association of Independent Festivals (AIF), Firefly Solar, A Greener Festival and Kambe Events. The group is committed to working together to actively promote sustainable practices and innovations in the events sector. The members have a combined audience of over 1 million across over 50 events.