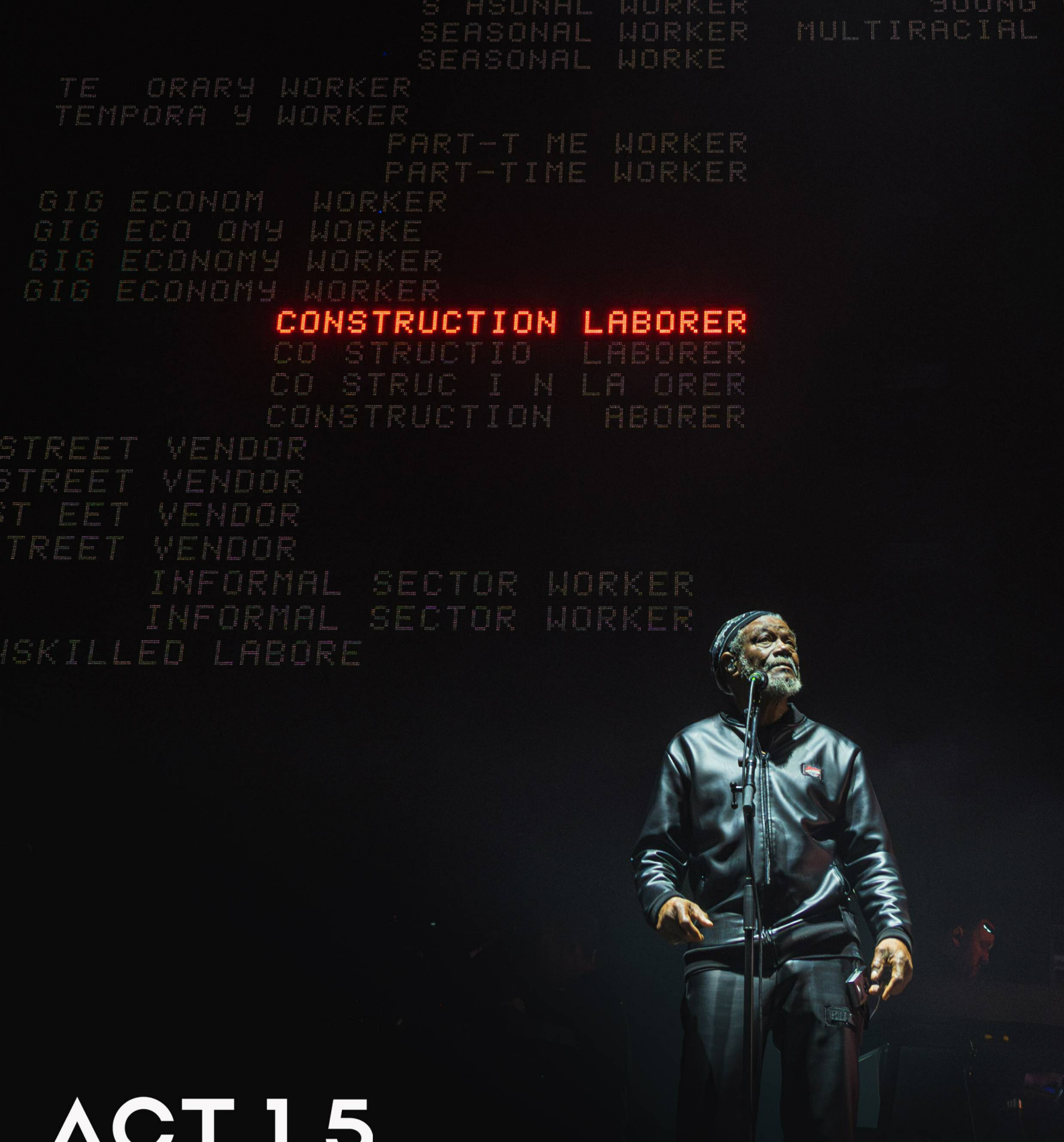

ACT 1.5

Assessing progress against the Super-Low Carbon Live Music Roadmap

By Professor Carly McLachlan & Dr Chris Jones

NB: All views contained in this report are attributable solely to the named authors and do not necessarily reflect those researchers within the wider Tyndall Centre

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Executive Summary

This report provides a review of performance of the Act 1.5 show in Bristol in 2024 against the Tyndall Centre for Climate Change Research Super-Low Carbon Live Music Roadmap. The key areas assessed are onsite energy, transport and food. The analysis is based on comparison of data from the show collected by A Greener Future (AGF) and a counterfactual hypothetical show where environmental measures are not prioritised.

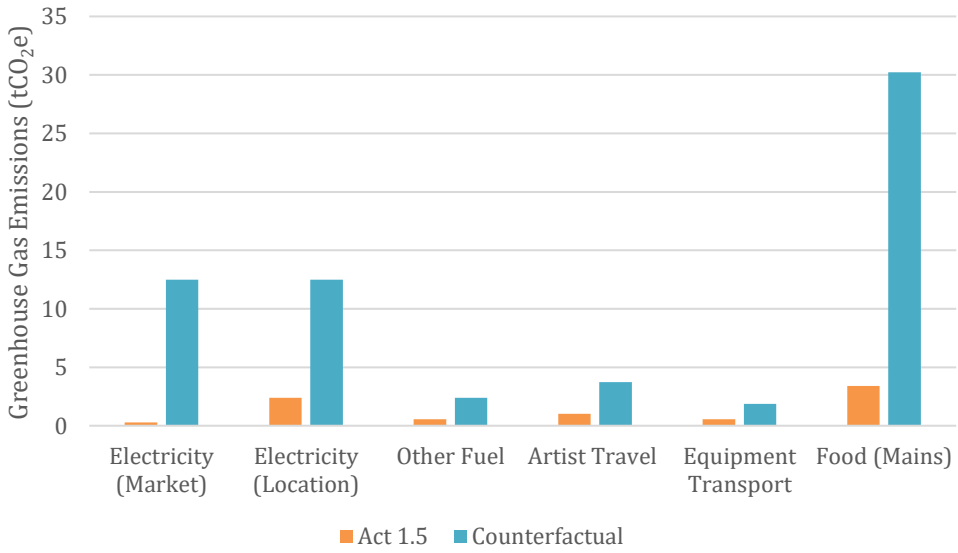

Figure 1: Comparing sources of onsite event emissions at Act 1.5 and a Counterfactual scenario

In addition to the greenhouse gas (GHG) emissions data, 10 key actors from the team delivering the show were interviewed about the sustainability aspects of the event. Most were interviewed before and after the show to allow comparison of the planning and design stages and reflections after delivery.

Key lessons identified include that Act 1.5 demonstrated that it is possible to run a 32,000-person outdoor event entirely from batteries without any diesel generator backup. Emissions associated with onsite electricity were at least 81% lower than the counterfactual show running on diesel generators (on a 'location' accounting basis increasing to a 98% reduction with 'market based' carbon accounting[1]).

The event also demonstrated the power of proactive engagement with local rail providers particularly when combined with flexibility about show end times. It highlighted that communication with audience and crew can present challenges

[1] 'Location based' emissions accounting is based on electricity used and the average grid emissions factor for the national grid. 'Market based' emissions accounting is based on the units of electricity bought and the accredited procurement of electricity by the retail supplier.

when new approaches are adopted and the associated need for consistent and repeated messaging on this basis (e.g. public transport offers).

The plant-based food approach appears to have been much more positively received than had been expected by some and this could give encouragement for a greater proportion of plant-based items and entirely plant-based menus to be adopted at live events.

Unwavering commitment from senior personnel (including the artist) was identified as central to the success and ambition of the show as was a strong team and collaborative ethos.

Introduction

In 2021 researchers from the Tyndall Centre for Climate Change Research developed a decarbonisation roadmap for the live music sector (Super Low Carbon Live Music Roadmap). This roadmap set targets for different sources of greenhouse gas emissions (GHGs) associated with putting on live events that align with the scale and urgency of meeting the United Nations Paris Agreement on Climate Change. Many of the goals were set to deliver action within the 'critical decade' (the 2020s) identified by the Intergovernmental Panel on Climate Change (IPCC). Therefore, milestones in 2025 as well as longer term targets were set. In August 2024, Act 1.5 delivered their Bristol Downs one day festival implementing strategies for reaching these goals. Massive Attack headlined the festival with DJ Milo, Sam Morton, Lankum, Killer Mike on the bill for the day. This report is a critical evaluation of the progress demonstrated at this show and further learning for future events.

Table 1: Summary of performance of Act 1.5 against targets in the Super Low Carbon Live Music Roadmap

Type	**Road Map Goal**	**Act1.5**
Energy	Set target for zero CO-2 emissions from buildings by 2035 [50% lower than 2015 level by 2025]	Not Applicable
Energy	Set target to match UK electricity grid emissions intensity at all shows from 2025 onwards	Effective emissions intensity for electricity of 0.038 $kgCO_2e/kWh$ to 0.336 $kgCO_2e/kWh$ depending on accounting approach. This includes grid T&D, battery losses and energy to transport battery systems. Compared to UK grid factor for 2024 of 0.225 $kgCO_2e/kWh$ and diesel generator average of 1.25 $kgCO_2e/kWh$.
Travel	Set target for zero emissions from organisational surface travel by 2035 [20% lower than 2015 level by 2025]	Emissions for travel by artists and crew with equipment were 72% below the counterfactual.
Travel	Set target to limit total sector business aviation to a maximum of 80% of 2019. Reduce air freighting of equipment	No air freight of equipment. Artist travel avoided flying.
Travel	Adopt measures that promote significant uptake of low carbon travel options by 2025	Adopted measures - incentives for train travel and later running train services, electric shuttle buses.
Procure	Adopt procurement practices that evaluate whole life costs on financial, environmental and social grounds	HVO and CNG fuel for combustion vehicles and equipment, single use plastics prohibited, plant-based food served, local suppliers of beverages, composting toilets

Data on energy use, artist and crew travel, equipment transport, audience travel and food and goods consumed for the Act 1.5 show were collected by A Greener Future (AGF). This has been used to compare the Act 1.5 show with a hypothetical counterfactual reflecting typical practices when the Roadmap was developed as a point of comparison for progress against the Roadmap goals. Act 1.5 identified 10 key actors in the show who were interviewed as part of the analysis to get a more in depth understanding of actions taken.

In Section 1 we present the key decarbonisation elements of the show with insights from the interviewees across the areas of onsite energy, transport, food and waste. In Section 2, we bring together interviewee responses about how the decarbonisation elements performed and present analysis of the GHG emissions savings made. We review progress against the Super Low Carbon Live Music Roadmap.

Section 1: Decarbonisation Elements of the Show

In order to understand the development and performance of the show, we conducted interviews with 10 key show actors. These actors were identified by Act 1.5 and had the following roles: Executive Producer, Battery provider, Sponsor, Rail Operator, Local Council, Sustainability Consultant, Production Consultant, Tour and Production Sustainability Manager, Promoter, Artist. Most participants were interviewed before and after the show but two were not available before and so were only interviewed post show. The interviews covered topics such as career background, role in the show, how the show was being delivered, post-show reflections, potential impact of the show on the sector and the future of decarbonisation in the sector.

Pre-show approach and planning

Onsite Energy

The ambition was for the show to be run entirely on clean power. This was achieved through a combination of 1st and 2nd life batteries. Initially the team had hoped to be able to use feeder pillars to provide grid connected electricity to the site and charge batteries from this. The Act 1.5 team brought together the relevant actors to achieve this and the conversations were extremely positive. However, the timelines for understanding the long-term capacity needs of the site meant that this could not be delivered in time for the Act 1.5 show. This work is ongoing however, and should it come to fruition will be a significant legacy from the Act 1.5 show that will reduce the emissions of future events and activities on the Downs.

Batteries arrived at the site charged and were then 'topped up' as needed by batteries that were taken on 3 electric trucks working in a loop to charge up at a renewable charging station. This process started from 5 days before the show and continued through to the day of the show (with portable battery power used before this). The show's innovative nature meant that a number of sponsors were involved in supporting delivery. For example, all batteries were provided as part of sponsorship and sponsors also contributed to the provision of electric shuttle buses. For those sponsors, demonstrating the performance and reliability of their products in this context was really important, with this being part of their development of a commercial offer for similar events. Their intention is to use evidence from the case as part of their business model development - driving down costs to be competitive with more traditional approaches to power (diesel, and more recently, HVO).

Whereas festivals would usually have a single power firm managing all aspects of power design, build, management and fuel - here a constellation of actors came

together to make the power onsite work: two battery providers, the electricity provider, the power logistics provider, and four trucking companies. Forecasting demand and monitoring power use was an essential element of this. For months in the build up to the show these actors came together in planning meetings to understand requirements and performance. None of the teams were experienced in all of the elements of the set up - for example: powering an event entirely from batteries; topping up batteries during an event; transporting batteries on trucks were each a new challenge for some of the team. These challenges meant there was a significant need for cooperation, problem solving and learning between team members. One participant referred to this as a 'team of rivals' - companies that would often be competing with one another coming together to share their expertise and perspectives with a common goal.

The other shift in onsite energy was the move from fossil fuel diesel to HVO diesel for onsite vehicles and machinery. All plant equipment on the site was fuelled by HVO certified from former cooking oil. This is becoming an increasingly popular option across the live music sector. The availability of agricultural/food by-product feedstocks, and growing competition from several other sectors, may limit the scalability of sustainable HVO for onsite power generation, but it is a promising alternative for vehicles and machinery.

Image 1: Battery system for main stage

Transport

Several measures were put in place to reduce transport emissions for equipment, artists and the audience.

Massive Attack have actively reduced the amount of equipment they take on tour - reducing this to 2 trucks from a baseline of 4. All equipment trucks were compressed natural gas (CNG) or HVO fuelled. No other artists at the show transported equipment by truck. Artists on the bill were asked to travel by low carbon means and all travelled from their pre-show location without flights. This meant travel from Dublin, Paris, Glasgow and London to Bristol by ferry and coach.

Audience travel is a major contributor to a live show's overall climate impact, but this is an area that organisers have less direct influence over. However, several strategies were implemented.

Firstly, a local presale for Bristol postcodes was offered to minimise audience travel distances. If audience members showed a train ticket to Bristol on the day of the show at the gate, they were given access to a special bar area with toilets. Audience members were encouraged to buy their train tickets through a partner app to support investment in a new local forest. The partner app Train Hugger matched the ticket buyer tree provision so that the 3,898 native trees were planted in total. No carbon 'offsets' were claimed for this activity, rather the aim was to make a positive contribution to nature through this partnership.

Secondly, a fleet of electric buses took those arriving by train at Bristol Temple Meads (BTM) to the show site (approximately 2.7 miles with an incline up to the Downs). At the end of the show electric buses provided a free shuttle back to BTM and Bristol Parkway.

Thirdly, in order to make train travel possible for as many audience members as possible, Act 1.5 worked with the local rail provider from the inception of the show. They shared anonymised postcode data for ticket sales to allow the rail provider to forecast the level of demand to different locations. Act 1.5 also brought forward the show end time to 10:15pm to make sure there was plenty of time to transport people to the station. The local rail provider chartered five extra trains, and the early show end time meant that two regular timetabled trains were available for audience members. This level of engagement from event organisers was highlighted as unusual and very much welcomed by the local rail provider. As one very experienced producer noted, with regard to bringing the show end time forward to make public transport options work for the audience: "It's very unusual, I mean, unheard of in my world". The train provider explained that for many events they do not have any direct contact at all with the event organisers and instead scan media to see where shows are happening and whether they might need extra

trains or capacity on existing services to support audience travel. Similarly, event organisers may not have contacts within train companies.

Food and Waste

Initially the festival had been planned as having meat-free catering. This mirrored the approach of the host promoter who was running their festival on the same site the following weekend. However, as the plans for the show developed, and particularly when requested from one of the sponsor partners, this was shifted to completely plant based. Act 1.5 felt that this was an appropriate approach for the event given its experimental and innovative nature and goal of taking environmental performance as far as possible. In the planning stages, there were some concerns raised about this shift including: the availability of suitable traders, audience reaction/satisfaction and levels of demand and the subsequent impact on commercial performance of the festival. However, these concerns were discussed and addressed by all parties and all interviewees were very supportive of this approach going into the show. There were no issues in securing enough traders and these were a mix of those who always had an only plant-based offering and others who offered only the plant-based items from their standard menus.

On waste, it was a key priority to allow for all food and serveware to be collected together and sent as a single combined stream for composting. No single use plastics were allowed on site (from traders or audience members) and any packaging traders served had to be the specified compostable serveware, paper or metal (drinks only) to ensure that the streams collected could be as pure as possible and recycled. This involved a lot of engagement with traders as well as people acting as ‘bin fairies’ helping audience members to use the correct bins. All toilets were compostable reducing the level of chemicals used and transport emissions as these arrived flat.

Section 2: Performance of the Show

The impact of the decarbonisation elements on the GHG emissions of the show were assessed by comparing the emissions calculated for the show with a counterfactual based on typical practices when the Roadmap was developed to establish progress over the period of the roadmap so far. This assessment focuses on the key areas of change set out in the Super-Low Carbon Live Music Roadmap – onsite energy use, artist travel, equipment transport, audience surface travel and audience flights. As food was another significant area of focus in the Act 1.5 festival, this has also been included.

Each area of intervention is discussed in the following subsections, including findings from interviews with key stakeholders. The figures below give an overview of the estimated emissions savings – showing significant success in meeting the Roadmap targets. There was detailed data collection on energy, food and material use directly influenced by the Act 1.5 production by AGF (onsite energy, artist and equipment transport, catering) which allowed for good comparison with typical practices for outdoor events when the Roadmap was created. The data for audience travel has more uncertainties, as a sample of audience members is used rather than data on each audience member's travel. Reference cases for audience travel are similarly less detailed as those that exist are also based on sample surveys. As a consequence onsite emissions are presented together, and audience travel emissions, where data quality is different, is discussed and presented separately. A breakdown of the key assumptions for the Act 1.5 and Counterfactual reference are given in Appendix 1.

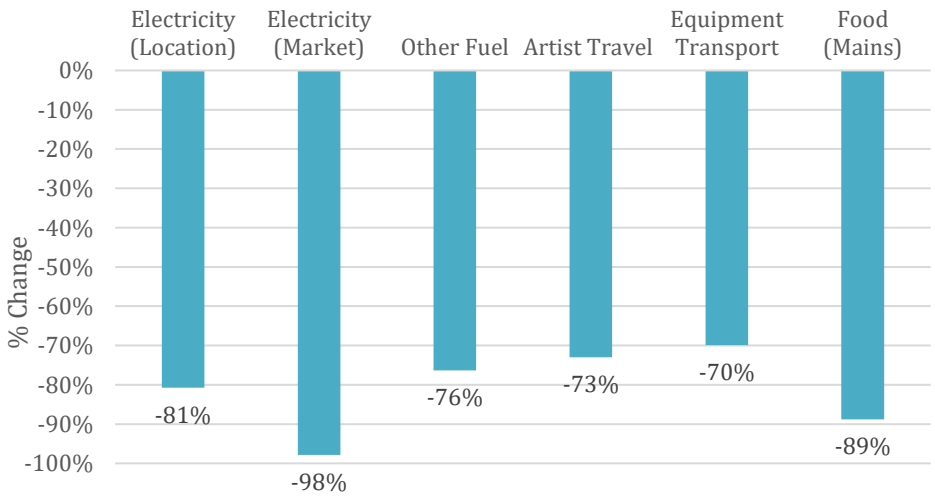

Figure 2: Proportional change in GHG between Act 1.5 and Counterfactual

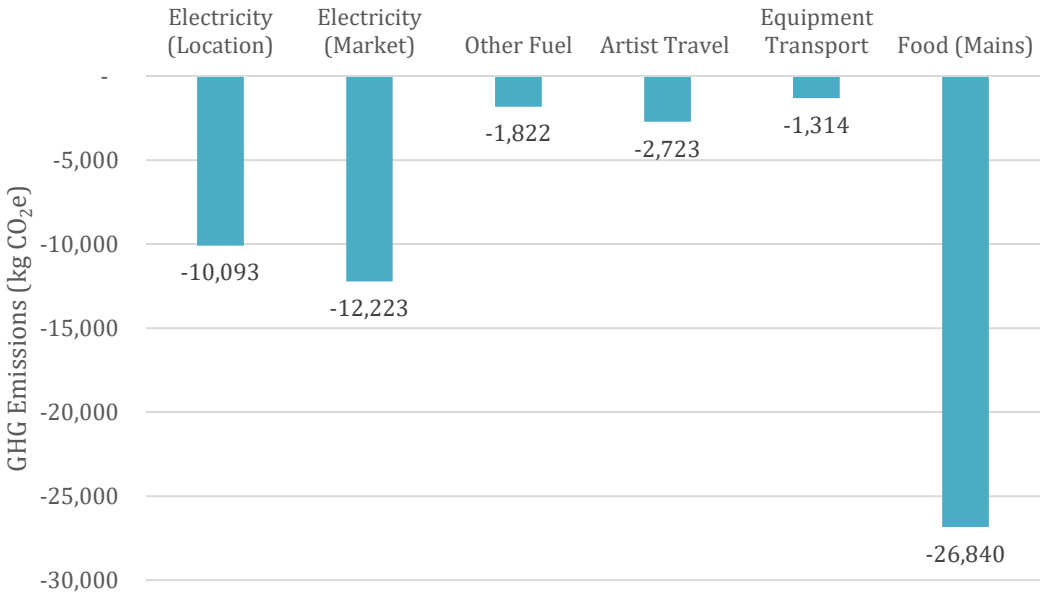

Figure 3: Change in Emissions between Act 1.5 and Counterfactual.

Onsite energy

Electricity supply was picked out by many interviewees as the key success story of the show, both in terms of how well the onsite batteries functioned, and the electric trucks working on a loop to recharge batteries onsite. Many interviewees expressed that the key achievement was demonstrating that it is possible to run a show of this size completely from batteries. Whilst there had been a significant amount of pre-planning amongst the various actors involved in the power for the show, there was also a sense from the Tour and Production Sustainability Manager that this would all really only come together once on site - that was when any problems would come to the fore, the system would be tested and any adjustments made.

Although there was a strong commitment from this multi-organisation planning team to making the all-battery approach work, once onsite, there were some members of the crew who were initially sceptical that it could be done. However, the level of monitoring and real time data on levels of charge on the various batteries around the site gave the team confidence that the batteries were performing as expected early in the build phase.

There was also significant resilience built into the system - through the availability of the 'top up batteries' that could be taken to any battery on site, the monitoring of all batteries in a central hub, the main stage battery being made of two battery systems with the second as a spare to kick-in should there be a problem with the

first, and two other batteries being positioned stage side in case of any problem with the stage battery. Despite all of these levels of back-up, when diesel generators to be used for the festival on the site the following weekend arrived, there was a last-minute suggestion by some crew members to use them as a further level of back up. This suggestion came very late in the day - within 48 hours of the show. This nervousness was seen by interviewees as understandable given the central importance of making sure that power never fails at a live show and how strongly embedded this is in the culture of the sector. The unexpected arrival of the diesel generators on site brought the nervousness of some crew into sharp focus as they could now see a way to have an additional and more traditional 'back-up' to the batteries. It would be hugely unlikely that they would be used, but as they were available the question was raised - why not have them available? However, senior members of the team came together and agreed that this was not needed and would undermine the ethos and purpose of the event. It is worth noting that this was described by a number of the team as making that final commitment to 'flying without a safety net' - despite there already being various battery based 'safety nets' in place should any battery fail or unexpectedly run out of charge. In the end the batteries had 2 MWh of charge left - around 20% of total charge into the onsite batteries. The stage battery in particular had over 50% of its charge remaining.

One minor issue was that some batteries were set to communicate with the central management hub on the 4G network as their primary option rather than a hardwire connection. Given the location and the number of people on site, the mobile networks were not reliable throughout the festival and had to be swapped to using a hardwire connection and/or charge levels read manually from the batteries. This was taken as a useful learning point for one of the battery providers but seen as immaterial by the Tour and Production Sustainability Manager as charge levels could easily be read by one of the crew reading the display panel for each battery.

It was also noted that the crew had enjoyed the reduced noise and smell of power provision and that the responsiveness of the power and the lack of a background hum from the generators were positives for the sound technicians. Avoiding post combustion products (e.g. PM2.5) by not having diesel or HVO generators is likely to have improved onsite air quality.

In the initial power planning for the show, it was hoped that beverages would arrive on the site already cooled so as to minimise energy demand from the battery to get them to the correct temperature. However, this was not possible and so the chiller units had to be brought down to temperature on site. One of the battery providers brought in two additional batteries to address this, but to minimise energy demand it was agreed that units would only be switched on 24 hours before the start of the show (whereas usual practice would be to start this process immediately or certainly much earlier). They also agreed to keep the chillers 2ºC

degrees higher than standard practice and turn the chillers off before the end of the show to reduce the energy demand knowing that the beverages would remain cool enough during this time.

The roadmap set a target for phasing out the use of diesel generators for outdoor shows by 2025 and to match UK grid emissions intensity. Diesel generators produce GHG emissions of around 1 $kgCO_2e$ /kWh (five times the national electricity grid average of 0.2 $kgCO_2e$ /kWh) and have local air pollution impacts. The roadmap recommended switching to responsibly sourced biofuels or battery systems to deal with this.

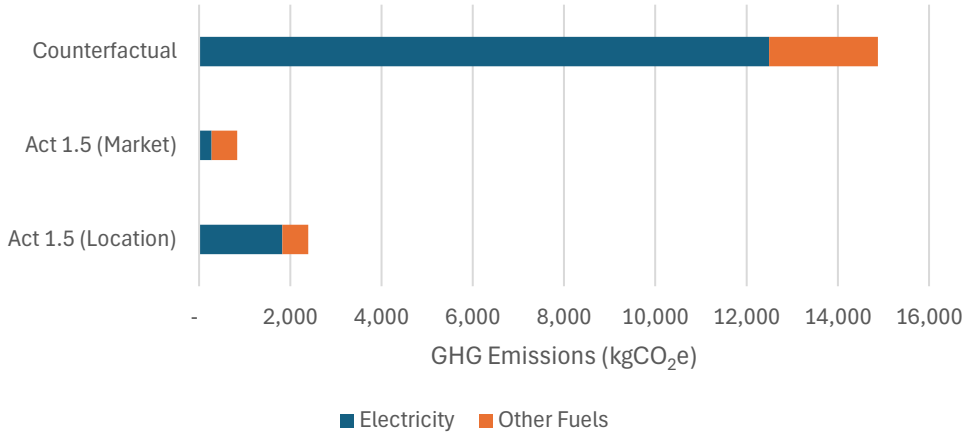

Figure 4: Onsite energy GHG emissions for Act 1.5 (with location based and market-based emissions accounting) and the Counterfactual reference using diesel fuels.

Using a battery-based system for onsite power makes a significant difference to emissions associated with power production for the Act 1.5 show. The Counterfactual show uses diesel generators. Based on fuel consumption at similar sized audience outdoor shows provided by AGF, 4,000 litres of fuel is assumed.

For the Act 1.5 assessment, GHG emissions from electricity were accounted for in both 'location based' – i.e. the average emissions intensity of electricity used from the national grid – and 'market based' – the electricity purchased based on the retail contract with a supplier. The stage battery was charged at the electricity provider's own site. This site was also used for the recharging of batteries. This provider only invests in renewable energy. Other sponsors who charged batteries before they arrived on site had renewable power purchase agreements in place. All batteries were charged through chargers connected to the national grid with no private wire arrangements. As is standard for GHG emission reporting, electricity emissions by both location-based and market-based methods are presented. The grid average (0.225 $kgCO_2e$) is used for the location-based accounting of this electricity, and 0 $kgCO_2e$ for the market-based accounting, plus transmission and

distribution associated emissions (UK 2024 average 0.0183 kgCO_2e/kWh) in both cases.[2]

GHG emissions for onsite electricity compared to the diesel generator counterfactual are cut by 81% and 98% for location and market-based methods respectively. There are important considerations to note with these findings. Locally charging the batteries and not transporting them for 64 miles to Stroud for recharge would have seen the reduction in emissions against diesel generators on a location accounting basis improve from 81% to 85%. Recharging batteries onsite, and sizing battery capacity and recharge based on the learning form this event, would also likely reduce losses. The complexity of charging between batteries, plus typical battery performance characteristics, meant combined electricity losses were at 19% for the show – which can be improved on in the future and would reduce emissions for power provided. It is also worth noting that if standard diesel trucks – instead of electric trucks - for 20 round trips to the battery facility (2,058 km in total) were used, Act 1.5 electricity location-based emissions value would be 55% higher – though this would still represent a 70% cut in emissions compared to diesel generator use. As with diesel generators, batteries also have upstream environmental impacts. While on a whole life cycle basis batteries significantly reduce GHG emissions compared to diesel generators [1], particularly when used with UK grid or renewables, they need to be used responsibly to maximise their value. The inclusion of second-life batteries for the Act 1.5 show highlights the potential to extend battery utility and take a resource conscious approach. Ultimately when all these permutations are considered, replacing fossil fuel diesel generators is unambiguously positive for addressing climate change.

All electricity inputs to battery systems are included in the GHG emission calculation - this covers power used onsite and losses due to battery round trip efficiency and transfers between batteries. Electricity, CNG and HVO inputs to transport batteries to and from the show, and round trips for recharging at Stroud were also included. The effective emissions intensity for the show was 0.336 kgCO2e/kWh and 0.038 kgCO_2e/kWh for the location and market-based approaches respectively. Changes to charge onsite (as originally planned) or more locally would have meant an effective emissions intensity of 0.256 kgCO_2e/kWh (location-based accounting), and lowering battery losses to ~10% would improve this value further. Future shows at Bristol Downs using the electricity feeder pillars planned for this show and learning on battery loss reduction should be able to get very close to the UK grid average. As the grid decarbonises further the improvement against diesel generators will be enhanced further.

[2] See UK Government Greenhouse Gas Emission Conversion Factors - https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024

Transport

The transport of artists and their equipment and audience to and from the show was an area of success. Interviews with key stakeholders indicated that whilst implementation of public transport interventions was successful, there is potential learning from the practical challenges faced to take forward for future events. Emissions from audience travel, particularly by air, are significant.

No problems with equipment and artist transport were reported. However, train travel for attendees on the day of the event faced a number of challenges as the show date approached. Communication with the rail provider had been proactive and ongoing. The date was always challenging as it was the Sunday of a UK Bank Holiday weekend. Train drivers do not have to work on a Sunday as part of their normal shifts so there is always more uncertainty in ensuring there are drivers available. A Bank Holiday weekend potentially makes this even more challenging but the in the pre-show interview, the rail provider explained that they have a good relationship with drivers and so were confident that they would be able to staff the five extra chartered trains and the two scheduled services post-show. However, shortly before the show date, a long running national pay dispute for drivers was resolved. Our interviewee noted that drivers then knew they would shortly be getting a substantial amount of backpay and so the motivation to take on extra shifts was likely reduced. This led to a reduced number of available drivers and a number of cancellations on the Sunday across the network. In the days before the show there was some discussion of a replacing the show trains with buses. This is a fairly common occurrence on Sundays in the UK rail network. However, it would have been a major disappointment for the show organisers and indeed for those managing the show trains for the rail provider. In the end all the show trains did run and there were no replacement buses for these services. Retaining the show trains created some friction with different departments within the rail provider with some colleagues only learning about the extra show trains when conversations about which services should be replaced with buses due to the availability of train crew occurred. However, this indicates the potential contextual challenges outside the control of the organisers when trying to support audience members to reduce travel emissions.

The rail provider identified that whilst the postcode data had been really helpful, a significant proportion of tickets were sold after decisions had to be made about extra trains and so in the end they felt they could have provided additional carriages on one route and fewer on another. This was exacerbated by people not booking travel in advance when travelling locally on trains. The rail provider explained that travellers are used to being able to just arrive at the station and buy a ticket on local networks and so there were significant numbers of rail users on the show trains in addition to those who had booked a place.

Transporting audience members from the site to the train station was very successful with over 2,000 people transported from the site to the stations within 45 minutes. Shuttle buses for arrivals to the show were also largely successful but there was a sense from some of the interviewees that communication about the travel offer could have been improved and repeated more. This was quite a different experience for the audience compared to a standard show and so although there was a lot of communication on transport, even more communications with audience and door staff may have made things smoother for some attendees.

Audience travel is typically the greatest contributor to the overall emissions impact of a show. The impact of the Act1.5 initiatives - additional late trains, ticket perks for train use and finishing the show earlier - is difficult to calculate as we do not have data on how every audience member travelled to the show. However, an audience survey (7% sample of audience) conducted by AGF provides sufficient data to make an estimate of these emissions.

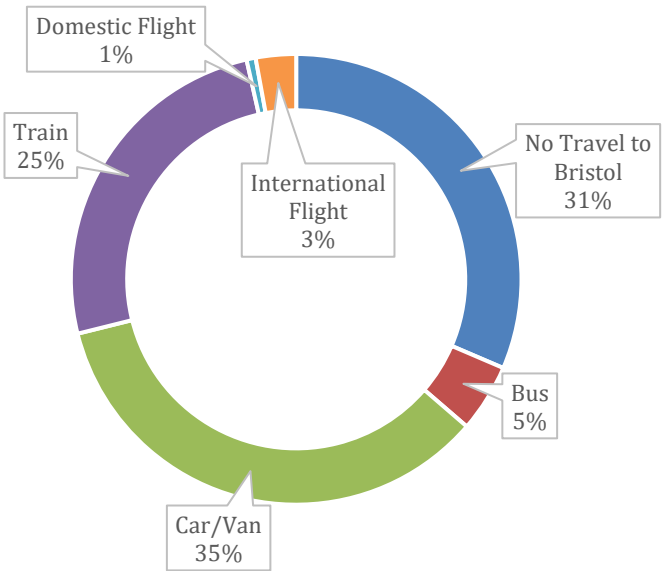

Figure 5: Audience travel mode to Bristol for the Act 1.5 show based on audience survey

Figure 5 shows the breakdown of travel modes in the audience survey for travel to Bristol for the show, with similar values for onward travel after the show. Note, some Bristol residents travelled to the city for the show. The survey reports travel to and from Bristol, and within Bristol and from the show as well as distance travelled. Travel to and from Bristol is 92% of audience travel emissions on this basis. The audience survey is a snapshot and may under or over represent modes of travel, but it is used here to evaluate audience modes and distance travelled. Similarly, the only data about other music events is also from sample surveys and a fully equivalent event with survey data wasn't identified. The following values are

therefore based on extrapolating the modes and distance of travel from the survey to the audience as a whole.

Determining the precise impact of the local presale and enhanced train capacity and availability is not possible with the data available. As the first Massive Attack show in the UK for five years, and with (at the time) few other shows going ahead, the show had large interest outside of the South West of England.

Broader analysis of audience travel for the Act 1.5 show highlights the emissions impact of local audiences compared to those travelling further - particularly where car travel and air travel is involved. The figure below shows that Bristol residents are estimated to be 39% of the Act 1.5 audience and just 1% of audience travel emissions, while travellers from outside of Europe are 1% of attendees but 29% of audience travel emissions.

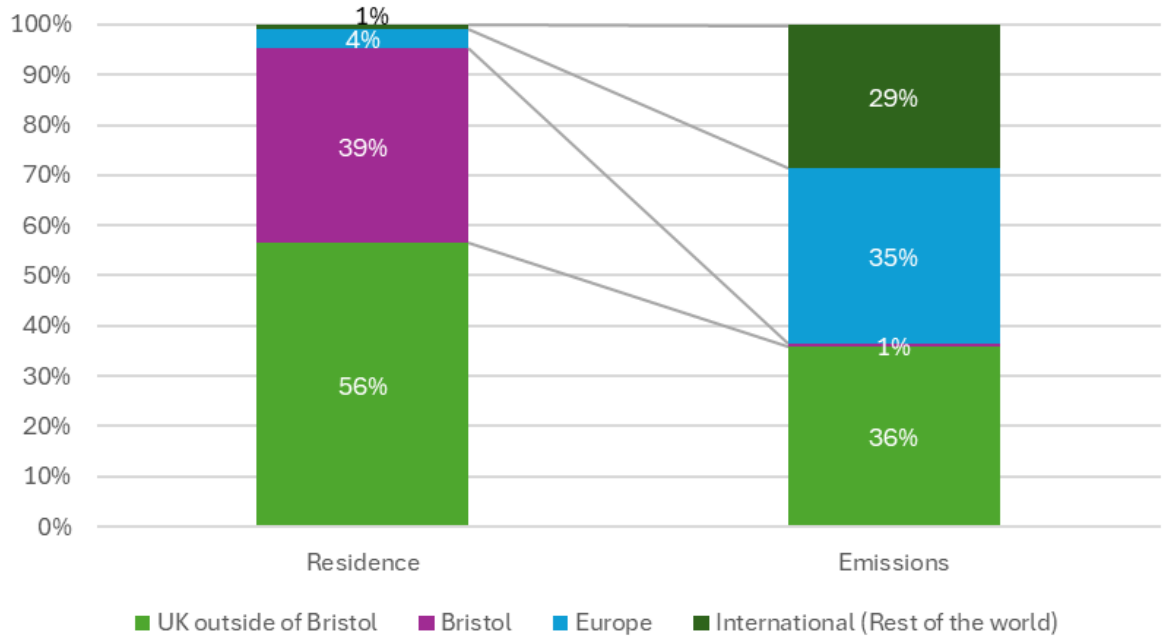

Figure 6: Comparing the proportion of audience from place of residence with the proportion of audience travel emissions for the Act 1.5 show, based on audience survey data

The Act 1.5 approach primarily targeted surface transport. As is common, air travel is the highest single contributor to the overall emissions impact of the show (inferred from the travel survey). This report focuses on surface travel to evaluate the Act 1.5 approach. For the purpose of evaluation, we have created two hypothetical counterfactual cases to consider the potential impact of local ticket sales and promoting train travel. The first hypothetical case is to assume that the Act 1.5 strategy (e.g. making late running trains available and perks) boosted train travel by 50% - so half of those travelling by train are switched to car for the counterfactual. In the second hypothetical case, 50% lower train use is again assumed, and the proportion of local ticket buyers drops from 31% to 15% to represent the potential impact of the restricted ticket presale. Figure 7 shows how these changes to audience travel would impact emissions for the show.

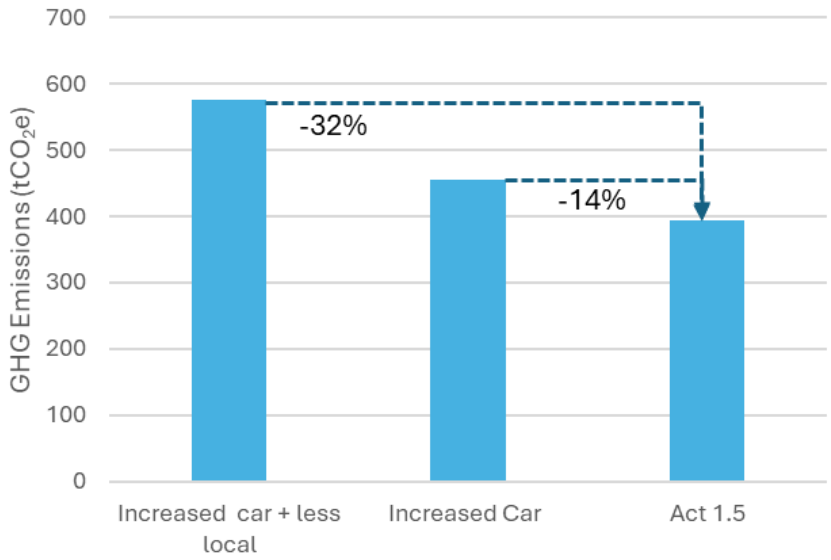

Figure 7: Estimated audience surface travel emissions, comparing Act 1.5 and alternative counterfactual cases

Air travel by audience members has a significant impact on total audience travel emissions. The high emissions per traveller by aviation means that even a slight difference between the extrapolated values from the audience survey and actual audience travel would affect overall emissions significantly. For the Act 1.5 show there are no specific measures to limit audience air travel - it is not clear the extent to which local presale would affect out-of-Bristol UK travel more or less than overseas visitors - therefore air travel is assumed to be the same for Act 1.5 and the 2019 Counterfactual. If the estimate of audience air travel is included in overall event GHG emissions it is the largest contributor - 64% of Act 1.5 and 59% of the Counterfactual - despite just 5% of the audience flying in both cases. There are attribution issues for all audience travel in the sense that travel could be for more activities than just to see the show - i.e. spending a week long holiday in the destination. However, it is also possible that travel is exclusively or primarily to see a show. The audience survey identified 1% of travellers as flying from outside of Europe (the greatest proportional contributor to emissions). International air travel for live music events is clearly a very significant issue to consider.

The key recommendation for artist travel from the Roadmap was to move from aviation to low carbon alternatives where possible. For Act 1.5, having artists travel from Paris, Dublin and Glasgow to Bristol by coach and ferry rather than by aeroplane contributed to saving 2.7 tCO_2e for the show. Emissions for artist travel were 73% lower for Act 1.5 than in the Counterfactual case where journeys between these cities is assumed to be by air.

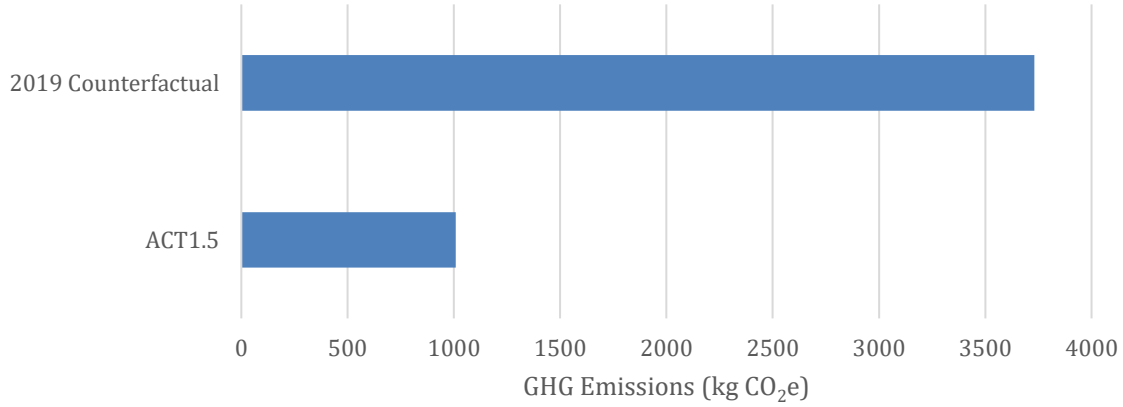

Figure 8: Artist travel comparing Act 1.5 with counterfactual case where artists travel from Dublin, Paris and Glasgow by commercial aviation

Two key factors influential in the emissions associated with transporting touring equipment for shows were addressed compared with the counterfactual case. Fuel switching from diesel to HVO for vehicles and cutting the amount of equipment transported (from 4 to 2 trucks) reduced emissions by 70%.

Image 2: Electric Shuttle Bus (audience)

Food

Act 1.5 had secured one more than the number of traders recommended by the local promoter who has been running the site for a number of years. However, demand much outstripped this and so queues, particularly immediately before the headline act, were very long. Two explanations were offered across the various interviewees. Firstly, that there had not been a good understanding of the demographic and purchasing habits of the particular audience that came to this event who would have comparatively more interest in the food than drink than a 'typical' festival audience. Secondly, that the recommended number of traders was based either consciously or unconsciously on a sense that the plant-based food would not be appealing to the audience and so demand would be lower than a 'typical' festival.

There was disappointment amongst the key actors in the show that this had not been as positive an experience for audience members as they had hoped - especially as they had actively tried to create a varied and exciting plant-based menu and invited audience members to come and try what might be new eating experiences. However, there was also a sense that this helped to demonstrate that demand for plant-based food could be relied upon and so any initial concerns about making the switch from meat free to plant-based were unfounded.

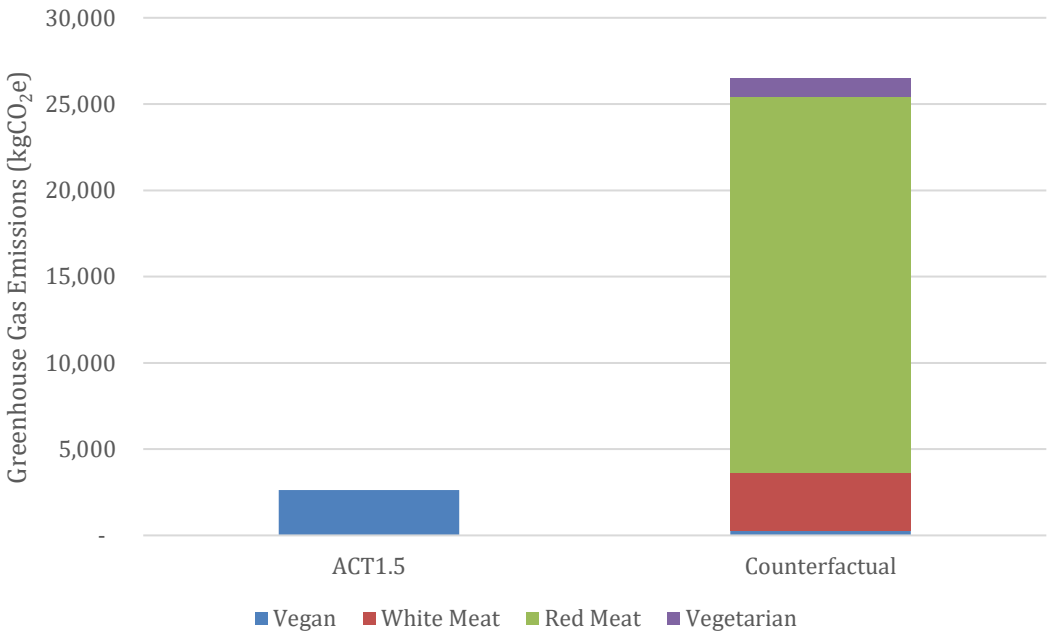

Figure 9: Comparison of GHG emissions from food served at Act 1.5 show and Counterfactual case

For Act 1.5 100% of food sold was plant-based. In the counterfactual case it is assumed that meals are 10% plant-based, 30% vegetarian, 30% white meat (e.g. chicken) and 30% red meat (e.g. beef) in terms of protein source. Life cycle emissions for meals were taken from a comprehensive assessment of the

environmental impacts of meals in Takacs et al (2022). Meals with beef, such as beef ramen, have GHG emissions that are 14 to 16 times greater than a plant-based equivalent [2], accounting for the majority of the 89% difference in emissions.

Section 3: Learning and Insights from the Show

As an event combining several emerging and novel initiatives the interviewees identified a number of areas of learning from the show.

The two most pervasive of these were a sense that it has now been demonstrated that powering a show of this size completely from batteries is possible and that the strength and depth of the commitment to the vision and ethos of the show was essential to making it happen in practice. In addition, there were insights on: thinking differently about power, plant-based food, audience transport and engagement, actions with impact beyond the show and collaboration.

Demonstrating it works

The key achievement of the show for most interviewees was that they had demonstrated that a show of this size could be powered entirely by batteries without diesel generator back-up. Some expressed a sense that if there had been any major issues with the power on the show day, this would have bolstered the arguments of anyone sceptical of the approach taken. A number of respondents referred to the need to deliver and the negative impact that could have been created had there been a significant issue. However, it should be noted that all interviewees involved in decisions about power were highly confident that everything would work as expected on the day given the level of planning the team had done and the expertise of those involved.

Unwavering commitment

The impact of the artist really making a clear statement and commitment was expressed by various interviewees. In addition, the importance of a number of key senior members of the team being completely committed and unwavering in their determination was seen as essential - with the Executive Producer, the Tour and Production Sustainability Manager and the Sustainability Consultant all being flagged as central to this. Also, the promoter being willing to take on a project with these extra requirements from the artist was seen as a key element of success. These multiple points and layers of senior commitment meant that when issues arose, the only possibility space considered for solutions was within the constraints of putting on a super-low carbon show. Many respondents talked of experiences of other shows and events where there would be one or two individuals very committed to sustainability but when issues or unexpected costs arose there was a rapid reversion to ‘business as usual’.

Thinking differently about power

There was a sense that many of the power team would now collaborate in an ongoing way and take forward to other shows that this is now possible. This was

combined with a greater awareness and experience of thinking differently about power when using batteries - getting used to the idea of the power being finite. An example that demonstrated this well was adjusting the system by bringing in extra batteries to chill beverages but then chilling those beverages in a way that was much more conscious of the total energy demand than would traditionally be the case with generators onsite. Of course, such energy saving measures should be applied when using other fuels but the imperative to do so on the ground is perhaps less pressing.

Demand for plant-based food

Whilst the queues for food were disappointing for the team, the fact that demand for the plant-based traders was high was seen as a very positive in terms of giving the industry confidence to move towards a greater proportion of menus being meat free or entirely plant-based.

Audience transport and engagement

Asking the audience to engage not just with buying their ticket for the show but also their transport to and from the show was seen as an area where there could be further improvement. It was also thought this may get easier as this becomes something that audience members are more exposed to and it becomes part of the expected process of buying a gig ticket. In particular, the fact that rail tickets cannot be bought more than 3 months in advance in the UK made these transactions and communications much more complicated - with multiple points of engagement and purchase needed.

The analysis of audience travel emissions shows the potential value of promoting local presale or other measures to reduce the proportion of audience travelling long distances by car or aviation. The Act 1.5 audience survey shows that audience members travelling from further afield are more likely to fly - including UK domestic flights and flights within Europe. There is some evidence[3] to suggest that greater travel for live shows is increasing while artists visit fewer locations. This is a challenging area for artists with international fanbases to manage - but an increasing trend towards international travel by air and longer distance in-country by, typically fossil fuel, cars for live music is not compatible with aligning the sector to the Paris Agreement. Carbon offsetting for flights is not sufficiently credible as a mitigation approach and the aviation sector is at least a decade away from offering commercial low carbon flights [3, 4]. This trend may have some financial and cultural benefits but would need to be reversed in order for the sector to reduce its climate impact.

[3] See news reporting and surveys - Access All Areas (2024), UK Live Music Events Sparked 33% Rise in Music Tourists Last Year; AAA (2024), 3 in 5 Younger Travelers Go the Extra Mile for Live Events**;** Event Industry News (2024), Bands are Skipping More Towns and Cities on Tour

Actions with impact beyond the show

The willingness of the team to support the ambitious and longer-term project of grid connection at the site meant that the full impact of the show may well grow in the coming years. A commitment to using the moment and the focus of a particular show to drive longer term change means that conversations and commitments can go beyond what is possible in the near-term and move to how more fundamental change can be supported. Another way of considering this would be what infrastructure and facilities do you need the next time you play at this location and how can you build partnerships to support this?

Collaboration

The nature of the collaborations and partnerships made were central to why interviewees felt the Act 1.5 show had been a success. This ranged from all the teams, many of whom had not worked together before, in the design and implementation of the power set up to a strong common vision from senior personnel to sponsorship and partnership arrangements. An ethos of collaboration and openness to the new expertise that needed to be brought in to do things differently as well as a valuing of the traditional and extensive experience from those with a long history in the sector was seen as facilitating constructive and collegiate working practices.

Section 4: Conclusion

In the Super-low Carbon Roadmap, we identified 3 key approaches that we believed were central to delivering substantial emissions reductions in the live music sector. Firstly, the need for super-low carbon practices to be central from the inception of a tour/show and considering this in every decision e.g. routing, venues, transport modes, set, audio and visual design, staffing, promotion etc. Secondly, actors using their direct power as well as their wider influence to overcome barriers and champion new practices. Thirdly, progress being monitored and reviewed - sharing both successes and remaining challenges and how they could be addressed.

The Act 1.5 show clearly adopted the principle of making sustainability central from the beginning and this impacted all areas from design to delivery. Key decisions such as the use of 100% battery power were made early and therefore framed how the show was designed and delivered. The approach to fan travel was developed early with proactive engagement with the rail provider and willingness to design the show (i.e. the end time) to facilitate greater use of public transport. A deep consideration of emissions reduction was clear in the planning and design of the show across equipment, power, food and transport.

This consideration across all aspects of the show demonstrates Act 1.5 effectively using their direct control and working with a constellation of collaborators, partners and sponsors to stretch the scope of their influence on super-low carbon practices. Working with the rail provider to ensure an extra 5 trains after the show end time for fans is a clear example of collaboration to go beyond areas of direct control. In addition, the work undertaken to bring together the right partners to meaningfully explore a grid connection (even when it became clear that this would not be delivered in time for the show) demonstrates collaboration beyond the confines of a specific show's footprint to drive wider sector and place-based improvements.

In terms of monitoring and review, A Greener Future (AGF) were a central part of the Act 1.5 team and gathered data on all aspects of the show - including, power, transport, food, waste, water, merchandise etc. This report is an attempt to share relevant insights on successes and challenges particularly in relation to the Super-low Carbon Live Music Roadmap - the underpinning data from AGF will be made available too.

Act 1.5 has demonstrated that it is possible to run a significant outdoor event entirely from batteries without any diesel generator back up. Emissions associated with onsite electricity were at least 81% lower than the counterfactual event running on diesel generators (on a location accounting basis increasing to a 98 % reduction with market-based accounting). The event also demonstrated the

power of proactive engagement with local rail providers particularly when combined with flexibility about show end times. The plant-based food approach was perhaps much more positively received than had been expected by some and this could encourage a greater proportion of plant-based items and entirely plant-based menus to be adopted at live events.

Unwavering commitment and collaboration were central to the success of the show. Teams across organisations were formed to do things differently. In particular, the commitment to battery power required a team that brought together expertise and experience from traditional power systems providers and new battery technology firms. The collaborative and collegiate approach of this team was seen as central to the success of this innovative approach. Unwavering commitment from senior members of the team (including the artist) created an environment where the only possibility space for solutions in the face of challenges remained super-low carbon. Aviation emissions from fan travel emphasise the importance of addressing the trend of increased international travel for live music.

Overall, the Act 1.5 show demonstrated that existing technology can support an event of this size running only on batteries and the importance of planning, commitment, communication, culture shifts and collaboration to make this work in practice.

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Appendices

Emission Source	Act 1.5	Counterfactual
Electricity	Electricity used to charge batteries before and during the set-up, event and take down (inc. at Stroud charger) in kWh provided by operator. Value includes losses and electricity and CNG fuel used to transport batteries from/to origin and for recharging. Location based allocation (UK grid average for 2024) and a market allocation (reflecting the renewables energy tariff at the site) is reported, transmission and distribution (T&D) included.	Diesel generators using 4,000 litres over the set-up, event and take down based on AGF values for other 32k audience shows. This equates to 10MWh electricity on typical diesel generator efficiency. Transport of diesel generators assumed to be within the Bristol area. Dept. Energy and Net Zero (DESNZ) emission factor 2024 used.
Vehicle and Equipment Fuels	HVO fuel use provided by operator covering site vehicles and machinery. DESNZ emission factors 2024 including Well To Tank (WTT) used	Standard diesel fuel is assumed for site vehicles and machinery at same relative consumption as the reported HVO fuel. DESNZ emission factors 2024 including WTT used

Band Travel to/from site	Mode of travel and start/finish locations reported by artists. Google Maps used for distances and DESNZ 2024 emission factors for carbon calculation. Travel to the show and onward travel included. HVO fuel in tour bus.	Start/finish destinations reported by artists. Routes where a flight might be used (Dublin to Bristol, Paris to Bristol) are assumed to be business class flights. DESNZ 2024 emission factors used.
Transport of equipment / materials	Distance and number of vehicles reported by artist. Half the number of vehicles typically used due to Act1.5 approach. HVO fuelling for trucks, WTT included.	Standard number of HGVs (4 as opposed to 2 in Act1.5) and regular diesel fuel including WTT assumed.
Audience Travel	Values of audience mode and distance travelled extrapolated from survey of attendees by AGF (sample 7% of attendees). Car and van vehicle occupancy applied is 1.6 passengers/car following UK average. Values for mid-size petrol, hybrid or electric car used as appropriate to the vehicle type. Economy class for flights used. Number of users on electric event shuttles and electricity used to bring in and operate these buses reported by operator, other bus users assumed to UK average bus emission factor. All emission factors from DESNZ 2024.	Hypothetical reference cases varying the number of attendees coming by car and from outside of Bristol by +50% is assumed and -50% local resident attendance. All event shuttle buses assumed to be average UK bus emission factor from DESNZ 2024

Food	100% of meals sold onsite vegan. Life cycle emissions of food based on review study by Takacs et al (2022) - https://doi.org/10.1016/j.jclepro.2022.134782	Meals sold on site assumed to be 10% vegan, 30% vegetarian, 30% white meat and 30% red meat based dishes. Life cycle emissions of food based on review study by Takacs et al (2022) - https://doi.org/10.1016/j.jclepro.2022.134782

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