HERE ALL TOGETHER NOW

environmental sustainable strategies
for temporary music events

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Abstract

IT

L'architettura effimera è alla base degli eventi musicali temporanei che, realizzati nella completa provvisorietà del loro allestimento, nascono con l'obiettivo intrinseco di preservare il luogo per come 'è stato trovato'.

Il presente studio di ricerca si sviluppa partendo dal presupposto che la temporaneità architettonica dell'evento non coincide con la scomparsa delle emissioni inquinanti, derivanti dalle sue attività. Per questo motivo, strumenti di quantificazione e organizzazioni, come 'Julie's Bicycle', 'Lifegate project', e 'A Greener Festival', assistono l'industria degli eventi con il fine di minimizzarne gli impatti ambientali. Questi strumenti, sebbene rappresentino un approccio concreto, restano strategicamente poco inclini all' innovazione, richiedendo, talvolta, un supporto tecnico per il completamento.

Pertanto, l'obiettivo principale del lavoro è strutturare un approccio innovativo, intuitivo e collaborativo che rappresenti una base per la progettazione sostenibile degli eventi, durante tutte le fasi di realizzazione.

La prima parte della tesi si struttura analizzando, in successione, il quadro storico in cui gli eventi e la sostenibilità hanno trovato delle complementarità e il quadro normativo internazionale di regolamentazione. Successivamente vengono divise le attuali strategie di sostenibilità ambientale per poi focalizzare l'attenzione su cinque macro-aree: design, energia, trasporti, rifiuti e acqua.

La seconda parte della tesi studia le interviste sottoposte a produttori di eventi e casi studio di grandi eventi contemporanei, ponendo le fondamenta per una nuova metodologia di pianificazione, riduzione, e monitoraggio delle emissioni inquinanti.

L'innovativa strategia proposta, mostra come la capacità di successo nella riduzione di emissioni di carbonio derivi da una cooperazione attiva tra organizzazioni, collaboratori, e spettatori di qualsiasi evento.

Questi strumenti sono pensati per essere racchiusi all'interno di un software aperto, auspicando in un continuo accrescimento e miglioramento di future implementazioni tecnologiche che renderanno sempre più efficienti approcci alla sostenibilità di futuri eventi musicali.

EN

Ephemeral architecture is the core of temporary musical events, which are realised in the complete temporariness of their setting and assuming the intention of preserving the place as it was 'found'.

However, the architectural temporariness of the event does not match a practical disappearance of its pollutant emissions. For this reason, in order to minimise pollutant emissions, quantification tools and organisations such as 'Julie's Bicycle', 'Lifegate project', and 'A Greener Festival' assist the event industry. Although these practices still represent a relevant approach, they remain strategically inflexible to innovation, as sometimes it also requires technical support for fulfilment.

Therefore, this work wants to present an innovative, intuitive and collaborative approach to events sustainable design during all their realisation phases.

In order to achieve these objectives, the dissertation firstly defines a historical framework in which events and sustainability have had complementaries and then outlining the current international regulatory framework.

Secondarily, the analysis divide current environmental sustainability strategies into five main aspects: design, energy, transport, waste and water.

Finally, based on interviews with sustainable event productions and case studies of relevant events, this work proposes a new toolkit for planning, reducing, and monitoring pollutant emissions.

The innovative strategy proposed here shows that practical feasibility in reducing carbon emissions derives from active cooperation between organisations, collaborators and attendees of any event.

These strategies are designed to be enclosed within open toolkit software, hoping for continuous growth and improvement of future technological implementations that will make more efficient approaches to the sustainability of future music events.

HERE,
ALL
TOGETHER
NOW

What does today's music event industry need in
order to be more sustainable?
This is the question that lead to our work.

Firstly, we have analysed the event music industry,
aiming to find key-points and key values in its strategies.

Then, an innovative methdology for increasing
environmental sustainability has been ideated.

HATN

sustainable events

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INTRODUCTION

In the science of biology, 'ephemeral' is a term used to define living beings that consume their entire life within a single day due to their natural impossibility to have a longer temporal experience. On the other hand, the 'provisional' terminology defines an extended period in which dynamics are dictated by unpredictability. These phenomena present the event as a new form of space-time that matches the middle of them: the ephemeral concept has a precise deadline while holding a longer duration, like the provisional.

The musical event is a reality intended in the middle of these two ideas: it both represent a definitive duration of time but simultaneously offers unplanned experiences in the attendant.

In addition, if we try to include the sustainable concept within the event music empyreal idea, its meaning assumes a broader significance.

Whenever the realisation of the event wants to involve the environmental assessment, its duration and activities need to be established in different spans: due to its complexity of emissions and activities, the music event produces the aspect of transient effects too, but this time on a broader scale and with a broader population involved. Also, due to the pollutant emissions, sometimes the adverse effects can involve a broader scale and a much longer time.

In addition, global warnings on climate change need urgent action on all industries to reduce their related environmental impacts and carbon emissions. On this basis, the event industry is also developing its methodologies and strategies for assessing the issue.

The new millennium era brought considerable methodologies in assistance of this sector. However, this science and its experimentation represent the beginning of a new concept of the temporary event, and its difficulties are evident in the emission reports still produced by their activities. Nevertheless, this complicated industry involves several constant and sudden applications of different services, materials and needs by all the parties that cooperate within the event. These difficulties lead to a multidisciplinary approach capable of interacting with all these services and introducing a new term of sustainability.

Therefore, this work wants to bring a fundamental part to the experimentation of this prior knowledge.

Furthermore, we are conscious that the realistic bloom of this subject also contrasts with the theoretical and technical knowledge of this period. Therefore, this work requires a more significant effort to introduce a new contribution to all the steps made by the event industry to cooperate, reduce, and invent new strategies.

However, thanks to the multiple inspirations that can derive from a broader developing area, the consciousness of this 'unknown knowledge' is an attractive perspective for the realisation of this work. Also, aiming to give the lecturer a work's completeness, a broader approach to all the substantial facts that can lead to the actual and future development of the event sustainability will be studied.

This approach is the method experimental that we have decided to use for this research. Attempts and failures are part of the experimentation, and the governmental administrative, and technical regulations put further stakes. However, we hope that these limitations can become the case with our experiment, the cornerstones of the construction process for a new era of sustainable events.

We want to encourage cultural, administrative, technical and innovative baggage both for the current generation and for future generations who will decide to make this sector even more efficient through this work.

The historical, planning, and economic concatenation now require a new element in offering new messages, hoping the reader will find new and future perspectives.

Therefore, the same process applied to the cooperation of the different services of an event will be applied as the methodology of this work: the concatenation, synergies of activities that will lead together to a more efficient and sustainable industry.

STRUCTURE OF THE WORK

The work structure carries an analysis that follows what global society and the current scientific community have recently outlined. Therefore, the first aim was to trace all pieces and traces of a proto-sustainability spanned until now.

Our first focus was to understand the major criticisms that the current event still brings to the area. So, the first question was: are there already traces of conjugation between sustainability and event creation?

To this question, chapter 1 has given a broad answer, also considering the recent immobilisation phenomena of of the events industry.

What emerges is that the development of the sustainable event brings its roots in the post-war period. Also, in the following preface, we define the historical context that led to the events' development.

The second question we asked ourselves is: how does today's social support and enable the development of an event?

For leading to a correct answer, we have analysed several case studies of mass events and music festivals. Furthermore, event organisations have been involved in a survey that explains the practical need of the current event industry.

We were thus able to show the new forms of regulation and supervision of a sustainable event.

This investigation into the panorama of contemporary festivals and music events has led to highlighting the main categories of pollution in the event. Then, it has become remarkable in its multidisciplinarity evidence: just as sustainability embraces different contexts, so the event shows its ability to renew itself in several aspects. For these reasons, we have proceeded through a step-by-step analysis of all criticalities. Then, After defining the major pollutants from the electricity supply, we wanted to identify new design criteria for the realisation of an event in the design of the stage.

Therefore, in the last part, a new methodology for planning, monitoring and offsetting the carbon-related emissions of events is thus ideated.

1. Analisys

of historical and regulatory frameworks that led to the sustainable development of music events

2. Interviews

and case studies for a better approachment with current needs

3. Development

of a new strategy for temporary music events

ROLE OF MUSIC EVENTS
IN ANTHROPOLOGICAL EVOLUTION

Entertainment has its roots in ancient times. The first real form of entertainment of which there is historical evidence dates back to the Olympic Games in ancient Greece, which, in conjunction with the worship of the Olympian gods, were the first event which, by entertainment, meant the grouping and mass participation of both spectators and leading actors. The setting up of a city with arches and columns becomes the prototype of an architecture dedicated to spectacle, representing the celebration of the event in the very features of the space that hosts it.

Moreover, periodic events, such as liturgical celebrations, become one of the main theatres of intra-engagement as well. Churches take their environment out into the squares and the streets become secular.

Also the Renaissance period, offers a new way of entertaining brought with the careful design of scenic architecture. Thanks to the contributions of Brunelleschi and Leonardo, popular festivals were introduced to shows, and the staging of plays. It was in this historical context that opera was added to theatre. It was in this historical context that opera was added to theatre.

Within the urban patternm the event becomes familiar with its ability to express itself through a simple temporary structure that, semantically, the years and experiences confirm more and more. Its historical research is ancient.

Thus, with the advent of the Baroque, the Rococo, the abundance of ornaments became the protagonist of the theatrical scene, until the industrial revolution in which yet another type of scenic design was introduced.

This construction is carried out with extremely meticulous cathegories, showing a completeness of elements where the designer is a figure of a festive artist, who takes on the role of a communicator. In this case, the stage is not present, because it is the city itself, stage and theatre of the spectators. The phrase 'Rome theatre of the world' is therefore intended to bring back to the reader a typical definition of how the squares, the streets, and the entire urban fabric actively participated in the creation and commutation of a temporary theatre. Decorations, ephemeral structures, and luminous devices adorn the city and make it the beginning of festive theatre. Thus, the city changes its face, or takes on a mask to transform itself into a concert of rhythms of forms and colours.

On a psychological level, it is acknowledged that festivity in the Renaissance era concerned spectators on a performative level. In the development of theatre in the 16th century, one of the main factors of its innovation was the so-called democratisation of festivity (Rabaglio, 2010). According to this idea, the spectator is individually involved, making the festival accessible to everyone equally. each spectator thus becomes the spectacle of the spectacle itself. There is no passive spectator, but everyone is the protagonist of the scene. However, the above expression, of rome as the theatre of the world, shows the relevance of society in hinting at a new discrepancy with this philosophy. In a tendency given to the society of social representation, the court becomes the protagonist of the events, while the people become mute spectators. Subsequently, the revolt of the bourgeoisie led to the reassignment of these forms, which slowly became detachable, bringing new subjects to the events of urban festivities. The bourgeois festivity, in fact, leads the individual to recognise an exaltation of humanism, in which the Protestant Reformation and the anti-festive form of the Enlightenment create the divergences that continue with the Catholic Church. In the nineteenth century, the freedom to choose one's religion became a matter of community importance, in which the individual was asked to participate in a new freedom. This led to the development of civic, or patriotic, festivals and popular demands. However, in the twentieth century, ephemeral architecture shows a new concept. the ephemeral artefact is no longer the host of the people but is itself the leader of the festival and the setting is no longer a banquet of diners-protagonists, but the setting up of a communication project which the people are left to admire. in other words, ephemeral architecture becomes the end and not the means. (Rebaglio, 2010).

And if in the social context of the time, the great festivities responded to the social meaning of the time, the same is true of events in a historical and propagandistic context such as that of the first half of the twentieth century. A social, as well as aggregation binder wants the events as an opportunity to establish new collective relationships, to unite minds, where conflicts create spectacle. the festival in pre-industrial society is the moment the community comes together. The festival is thus redefined as the mass festival, to reconstruct the previous fragmentation of socio-cultural events, in which, once again, people were placed at the centre of attention in the form of being able to participate in, and enjoy, the event.A new transsofrmation of the ephemeral takes place in the Italian postmodern era. in which the revolt of the population centres its character on wanting to eradicate from the individual his character of mere link in a chain of production. The phenomenon of temporary architecture is thus asked to question the new conceptions of community and conviviality for an air of optimism and liberation, to find the strength to overturn a trend, an answer to the sole demand for activity and production of the urban fabric. The city again becomes a place for the appropriation of space in its decorative form. the celebration of a party is therefore the cancellation of isolation. the time of the party is by conception the opposite of the time of work, to come together for something that gathers and entertains, and in the metropolitan theatre

Here, the architecture of stage design was presented to the spectator in a totally new key, that of the universal exhibition, in which the point of view of the event was a cultural, economic and social exchange in the panorama of entertainment. Thus, with the advent of this latest epochal innovation in theatre, entertainment is unshackled from its immovable foundations, to become the first approach to the travelling event.

The advent of the travelling entartainment

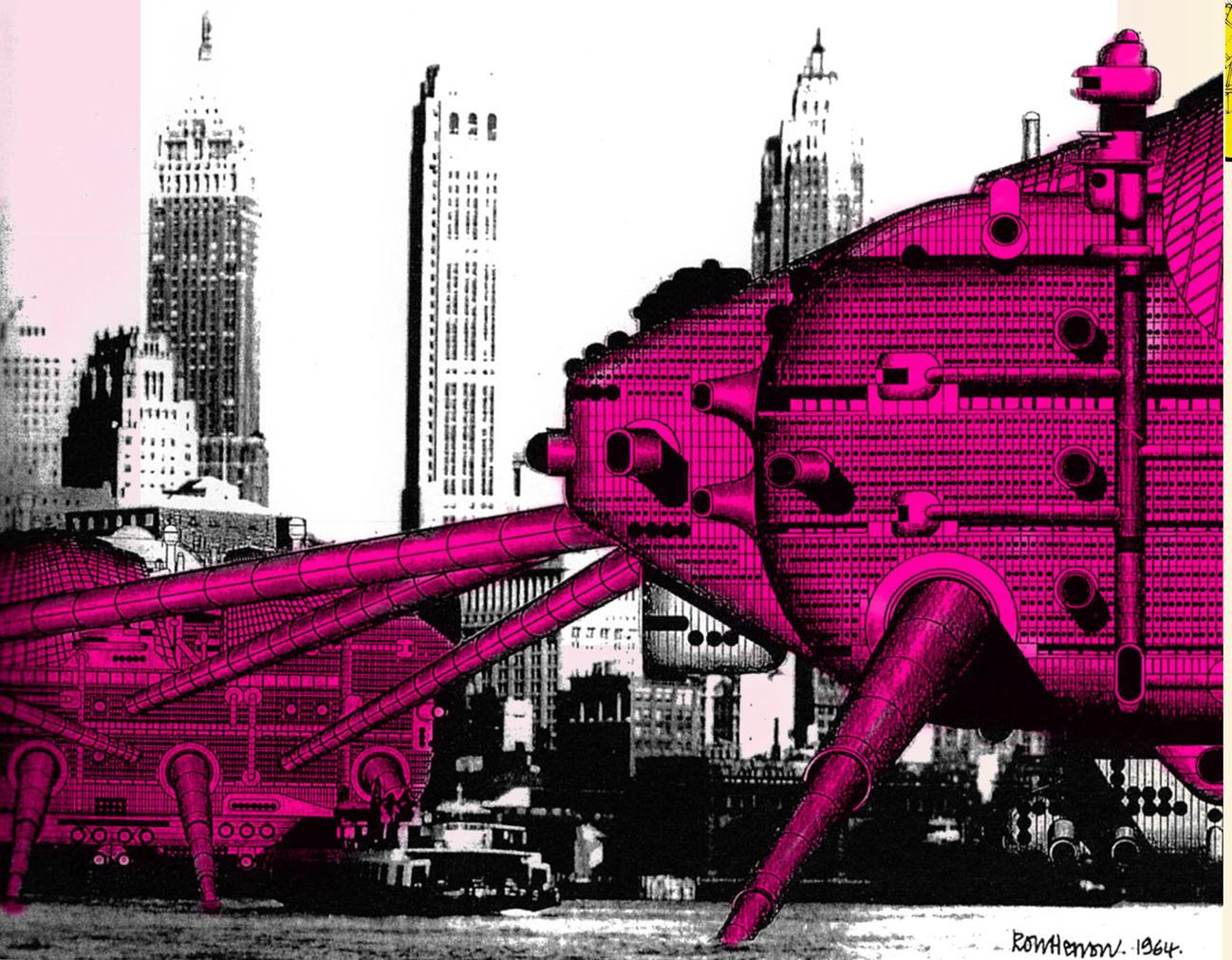
The design of an itinerant event means that the space of the event is itself completely detached from immobility. for this reason, one of the main paths to the mobility of the event is given by the creation of itinerant living: caravans thus become the very means by which the entertainment industry is allowed to undertake long journeys and thus be able to move its theatre to totally different places.

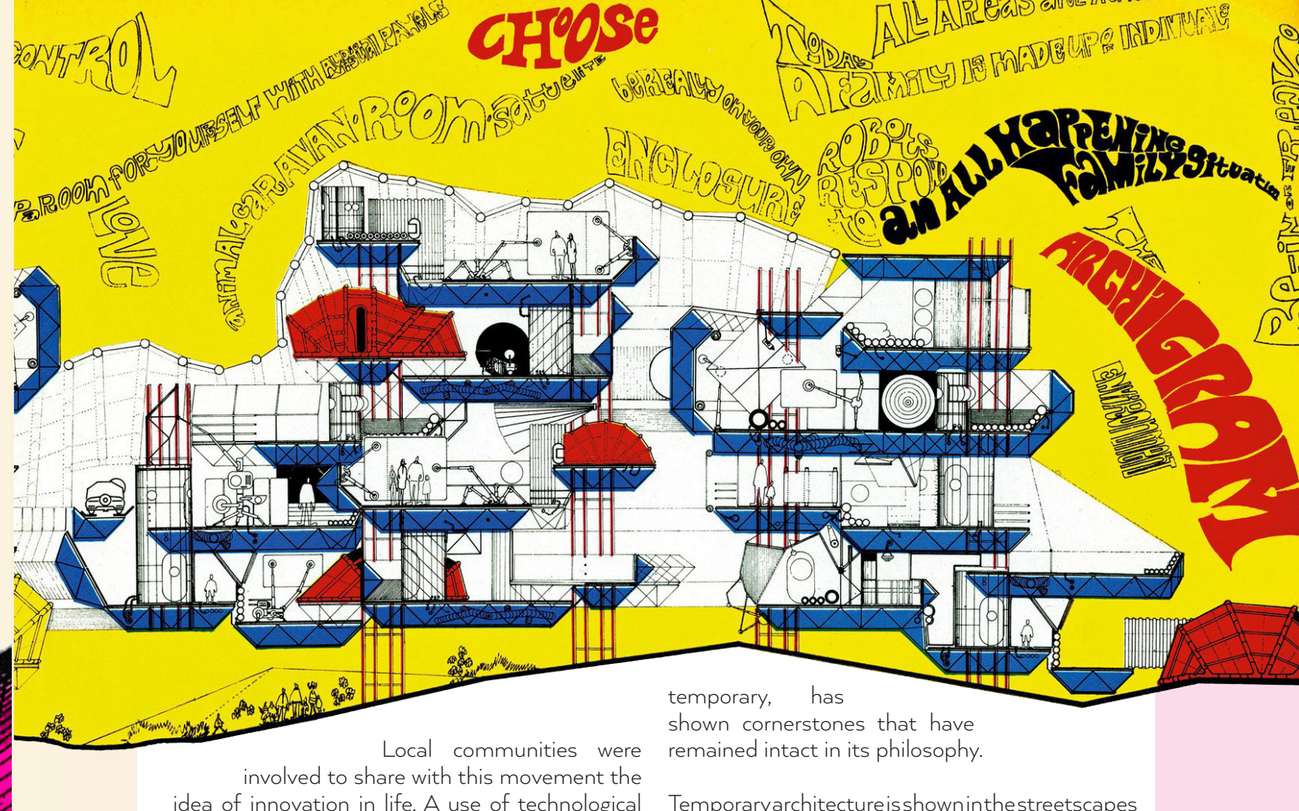
We could therefore identify the mobile home as the real engine of a revolution in entertainment. With the advent of the 20th century, the mobile home became a high fashion product in the British and American middle class. The home on the road was soon internationally appreciated, so much so that Arthur Sherman, in 1929, serially produced an inexpensive caravan that became one of the main means of the seasonal holidays chosen in the United States.

Also, the war events of the following years, and the great depressions they caused, showed the itinerant life a new need, to build instant cities around the factories for the development of the necessary materials.

The city became an itinerant industry thanks to the introduction of these mobile homes. Later, in the post-war period, the mobile home became an even more elaborate element, enlarging its spaces and developing new construction methods. Certainly, the level of comfort was increased but the practicality of transport was greatly reduced. However, due to the lack of manoeuvrability, these elements were no longer used for itinerant mobility, but rather, were defined for a removability where the concept itself,

was a life that, at the turn of the post-war emotion for the return to peace, showed the exlusion of life in the territory, and the eradication of architecture. Besides, Peter Cook's motto and manifesto, in the years of Swing London, 'it's all Happening!" showed the theme of mobility in its freshness.
An increasing number of affordable affordable, produced and huge demand for cars transmuted into a new mobility to conquer the unexplored space. Design and architecture openly embraced the 'transience' of the concept of mobility. The city becomes a movement, and the Archigrams of the time show the promotion of innovative toeries to satisfy new needs, drawing the guidelines of an architecture beyond the immovable traditional schemes.
they become the current concepts of a heritage that is hoped to carry on into the future of society. it is in this environment that the first idea of technical reproducibility was born. The production methods of industrial design, thought of structures as a composition of a combination of parts: assemblable, prefabricated houses that could be reused and recreated indefinitely.
This concept is then summarised in a definition is that of the instant city, where culture was disseminated through audiovisual systems, projections, exhibitions, shows and lights.





Local communities were involved to share with this movement the idea of innovation in life. A use of technological systems, making the way of life of this ideology their own, would slowly be transmuted into what in the field of entertainment would be the main core of its possibilities: temporary structures, vehicles for transporting the structures, dry mounted structures, and mobile audio video and lighting systems.
Although well outlined by a strong movement of conceptual innovation, the idea of itinerant structures was already present in the circus shows of the 19th and 20th centuries; horse-drawn carriages, dry-mounted structures, and trains to transport all the equipment, allowed the first temporary theatrical works. We could therefore define this moment as the relocation of the means and ideas of the itinerant for the proclamation of a city concept which, at its core, carries the foundations of entertainment.
Faced with a question and a concept that is quite simple to state, we wanted to re-identify its very concept of reason for existence and understand what its structure is based on, which, although temporary, has shown cornerstones that have remained intact in its philosophy.

Temporary architecture is shown in the streetscapes and cities as a socio-cultural value of the city itself. As we will see later in chapter 1, scenic devices are included in the urban industry to generate the transformation of the city itself. Besides, nowadasy, what one deduces is that entertainment is a pivot in its own right. even today, large tours operate with the same production mechanisms that a small country needs, encompassing all basic human needs.
This first introduction thus sought to bring to light, the historical background that assembled the desire to create touring events. From this period onwards, we could begin to outline the main traces of a history that began to approach a further post-industrial movement, in which ecology and environmental protection showed their necessities. Events, too, will not remain silent about this need, and slowly, sometimes seemingly unconsciously, will weave their historical fabric into an increasingly concrete realisation of the current realities of sustainable events.

fig. 1 (left)
Control and Choice Dwellings, Part Section, Warren Chalk, Peter Cook, Dennis Crompton, Ron Herron, Archigram, 1967

fig. 2 (top)
Archigram Issue 5, Autumn 1964, page 17
@ 1964, Ron Herron, archigram archives

A **research** among connections between the historical framework and the sustainable festival development.

1. HISTORICAL REVIEW OF SUSTAINABLE DEVELOPMENT AMONG FESTIVALS

The first analysis of this work aims to trace the historical delineation of the significant facts and circumstances that have weaved the history of the sustainable development in music events.

What appears is that the traces of big music events are practically non-existent in the years before the second World-War; in those years there was no development for the festival phenomenon neither for a sustainable development as well. Otherwise the post-war period, with its industrial and technological innovation, led to the first tangible traces of a development of events and, in parallel, of the concepts that led to their sustainability. From this research and literature review, we can thus assert that festivals and the sustainability "are children of the same era": both began to evolve and develop in the same period. Moreover, they seem working together and, many times, even before that an event could be defined as "sustainable," there were already appearing essential footprints given by objectives and aims that led to the development of sustainable issues. In this chapter, we will begin to answer the questions that led our research to find the historical lines that defined the sustainability development in events.

In particular, the key questions we asked ourselves were:

- *How did the phenomenon of sustainability in events start to develop?*
- *Which were the first events that started the development of sustainability at the festival?*
- *How did the festival phenomenon approach the development of sustainability?*
- *Basing on the actual cultural context and the past festivals and sustainable events, how can we predict the possible sustainabile development?*

Fig. 1.
The opening cerimony of the Woodstock Festival 1969
© Wikimedia Commons

Fig.. 2
A kid enjoying the WoodStock festival, 1969, © Wikimedia Commons

WHAT IS A SUSTAINABLE MUSIC EVENT?

Speaking in terms of Tourism, an 'event' is defined by Getz (2010) as a 'unique temporary phenomenon which is also an opportunity for leisure, social or cultural experience outside the normal range of choice or beyond every experience'.
Moreover, Laing and Frost[1] look into issues related to staging a "sustainable" event and define the following as "an event that has a sustainability policy or incorporates sustainable practices into its management and operations."
So, there is an evidence from the press that interprets festival sustainability as a matter of cleaning up after the event is over or doing less harm to the natural environment.[2] Furthermore, during a workshop in France organized by the European Festivals Research Project[3] , they approached festival sustainability as a matter of continuity of the event itself. Marschall[4] makes use of the term sustainability to refer to a festival's ability to secure its survival by continuously pooling resources. What appears is that the definition of a sustainable festival brings their roots into the respect of the environment, while giving to the attendees several messages for a more ecological life-style approach.
Now we want to research the main remarks in the event development. In the following paragraphs we want to find the sustainable issues that have led to the main concept of event sustainability, so that the result can bring us to the future planning and managing of a sustainable music festivals.

Fig. 3
The representative figure of the 2019 'Green Man festival', one of the events that promote sustainable practices; © 2019, getintothis.co.uk

1 Laing and Frost, 2010
2 Todd, 2010
3 EFA, 2006
4 Marschall, 2006

1960-1970: A STARTING POINT

The definition of sustainable events came across the same time as the development of the events as well[1]. In other words, as quickly as the society was moving forward its development, the events were moving their steps forward their developments too. We want to research the first traces that lead to the beginning of the event era.
It will be useful to use in our analysis the Sustainable Agenda, proposed by Fisk[2], for helping the reader to define the different developments that sustainability in events has made over time, and for understanding the historical events that have brought the history up to the present day. This analysis purposes different periods divided by decades. The starting point is the decade in which we were able to find the first fragments of the sustainable event development: the '60-'70, so called the *"Awakening"*.
In this period, the community firstly realized that their economic-activity impact on the biosphere is a pure consequence of our present way of living, they also started concerning at a 'sustainable' issue as well. Therefore, it was first realized that there will be a crisis somewhere in the future in which humanity will face serious and coinciding problems, making the whole structure abruptly collapse.[3]
Moreover, this is also the period that gives rise to a new cultural idea of events which, in the following decades, will have an increasingly cohesion in the main pillars of sustainability. But how did this interest in respecting natural resources start? Asserting the literature review, we can affirm that the first impression of a sustainable event development has started just in conjunction with one of the first impression about the world care: the publication of *Silent Spring*, written by Rachel Carson in 1962. In parallel with the great technological innovation, the author stated that there were already appearing negative aspects of innovation and no regulations: while flora and fauna were becoming irreversibly contaminating, climate pollution was becoming the new invasion of the planet.
This line of thought brings new ideas to the community's interest: (1) the importance of respecting the environment and (2) a development that wants to take care of what already exists, making it more efficient and less pollutant.
However, defining this period as a *'yet sustainable'* period would be erroneous; in this decade we still have to go in search of prototypes of events that could bring, sometimes consciously or unconsciously, the concepts that will have given rise to the concept of sustainability in itself.
It is interesting to point out that this period is approaching sustainability in a way that, although unconscious, is still one of the most sustainable in history in terms of results. How is this efficiency possible? The simplest answer stems from the fact that the innovation that was to take place in the years to come would have led to a good deal of preservation in parallel with much more polluting forms of production.
For example, taking a look at the most popular concerts of the 1960s, one of the leaders of the decade must be examined: The Beatles.
On a twenty square metre stage, going on in the middle of the afternoon, with poor lighting and no use of plastic, you could say that one of their events was already unconsciously about sustainability, as compared to many of the pollutions derived at festivals in subsequent years, one of their concerts had virtually zero values.
Speaking about environment, in this decade we discover another term that contained sustainability in a still primordial state: the idea of 'urban regeneration'.

"THE EVENT IS RECOGNIZED AS A PLANNING TOOL FOR BRINGING RADICAL IMPROVEMENTS TO THE URBAN CONFIGURATION."

1 Getz, 2008
2 Fisk, 2010
3 Zifkos, 2015

This concept connects sustainability to the world of events with the attention to the place in which they are stood. The urban regeneration aims to take advantage of the event impact on the hosting area for the local environment and local communities: in fact, the ability of the event to attract a great quantity of people in a short period of time makes it capable of regenerating more efficient spaces near territory. Therefore, the event is recognized as a planning tool to bring radical improvements to the urban conformation, concerned for a period of time that will go beyond the conclusion of the event itself. In 1960, the Rome Olympic games can be defined as one of the first and most important events that began to have primitives regenerative-sustainable traces. The goal of this event was to make the urban space the protagonist of regeneration, while including not only the area of the event itself but also the whole context; in this case the event defines the means of regeneration to favor the community, the environment, and economic development. The regeneration concept still remains a sustainable framework and it was either included in the present years of sustainable events management. Indeed, one of the most sustainable mass-events of all the times, the 2012 London Olympic and Paralympic games, give an example of sustainability and urban regeneration of the event areas.

Moreover, within a historical period in which the population found the approach to nature, the thought behind *Silent Spring* thus becomes an essential witness of a world consciousness that tries to move toward a 'return to nature'. The first mass events of this period are such an example of the expression of these ideals. These occasions are mainly recognized as tools for a big mass of people to claim their freedom and respect the human environment. Also, Sharpe and others4. note that festivals provide a way for groups to gain control over cultural space, challenge dominant ideologies, and move specific issues to the center. It is from these

4 Sharpe E. et al., 2008

Fig. 4
The Beatles at Shea Stadium in New York, This concert showed how large-scale outdoor performances could achieved.
© 1965, Corbis

concepts that hippie ideology may also has taken shape, finding fertile ground for its propaganda as a meeting place for music, a spasmodic love for nature and social fraternity. Therefore, we find the 1969 Woodstock Festival as one of the first attempts that could come close to the definition of the forecast concepts of sustainability.

Not only Woodstock. Monterey, the Isle of Wight and the Altamont Festival in the 1960s are also often cited as the start of the counter-cultural music festival.

Not only Woodstock. Monterey, the Isle of Wight and the Altamont Festival in the 1960s are also often cited as the start of the counter-cultural music festival. This era of rebellion, fuelled by rock rebellion, a sexual revolution, and antiwar politics, is the time when thoughts of revolution sprouted, also towards industry, for a return to a life that has as its forefather contact with nature and respect for the environment.[5]

Nevertheless, the traces of this rebellion are also transcribed in our days, when the present generations blame the previous ones for having left them a place on earth totally inhospitable, due to the high pollution of products during the industrial revolution.

The Glastonsbury festival itself, which, as we will see later, will become one of the forefathers of the sustainable revolution in temporary festivals, presents itself as an understone of political activism, social rebellion, and a festival of the "we."[6]

This music event led to an embryonic idea of what we can call the *'environmental social sustainability'*: an idea of respect of the environment and for each other. It is also interesting to notice that it was not only the hippy movement that set a first concept of sustainable development; while this ideology bases its ideas on a spasmodic love for Nature, in the same historical context, but in very different methodologies, new forms of 'primitive sustainability' arise their first development. It must be said that being the first example of this *proto sustainability*, it remains one of the most trivial examples; otherwise it is the progenitor of what with enormous efforts and not a few corrections, can be called, forty years later, the planning of the aspects of 'environmental sustainability in the long term'. Thanks to their regenerative and cohesive power, the mass events began to attract interest in public opinion. A multitude of "pseudo-events"7. was claiming more space, attracting the pleasure of political opinion - that was finding it useful for their propaganda- and the favor of the local community, which saw places of the future sociological and environmental development. Meanwhile, with the foundation "The Club of Rome" in 1968, arises the first international organization designed to analyze the main problems for global environmental awareness.

5 Jones A. and Bennet R., 2015
6 ibid.
7 Boorstin, 2008

Fig. 5
The first Pyramid stage at Glastonbury Festival, 1971. © 1971, Brian Walker

Fig. 6
During the 1986, the originally named the Big Top Festival used one of the first examples of off-grid renewable energy provision. In that historical context, these wind turbines aimed to show a full capable alternative to the nuclear energy & nuclear weapons
© 1986 Wind and Sun Corporation

In conclusion, large-scale festivals were born with the concepts of "freedom" and "humanitarianism". This intent, sometimes carried forward together with sustainability, will be what will make festivals grow through the 1970s and 1980[8].

1970-1980:
First sustainable concerns

While economy is growing and together with it the consumerism and international trade[9], in this decade a significant attention is drawn to the improvement of human equal rights, with even searching solutions to the overcoming pollution and waste.
Hence, in the previous decade, we found the unconscious sustainability that was present in the live performance scene interesting. This 'clean energy' was, however, determined by the low innovative advancement in the realisation of performance tools. Already in the next decade, however, thanks to the rapid growth in interest in temporary events, new performance tools were developed. One of the forefathers of these examples is the huge light park used by the Quuen, who showed huge shows surrounded by light effects that transported the audience into the atmosphere of their music.
Certainly, therefore, the effect that the use of these innovations has on energy demand is also becoming clearer. In this decade, therefore, unconsciousness shifts to the non-quantification of resources.
Nevertheless, this unawareness will also recur in the following decade, showing an interest only towards the end of the 20th century.
However, looking at sustainability in its much broader perspective, some progress is already being made. These same advances, in a lateral way, will also affect events in its multiple categories of entertainment
In 1972, the Club of Rome released the first report analyzing the current problems of environmental development: *"The Limits of Growth."* Their

8 Kitts T., 2009
9 Fisk,2010

message aimed to raise awareness among the world population for respecting world resources, as *"it probably cannot support present rates of economic and population growth much beyond the year 2100, if that long, even with advanced technology"*[10]. This warning has also affected the production of events and, therefore, we wanted to try to understand how event organizations began to commit themselves to a clear intent of protecting the environment. Nevertheless, in this period, there was no significant differentiation between mass-events.
Therefore, we wanted to take a step back for trying to understand if there was already any 'sustainability concept idea in the macro-category which encompasses either the events: the tourism.
By recomposing the history of sustainable tourism, we have been able to find in this period the birth of the movement that asked to the tourism for applying forms of sustainable development; this movement is the "ecotourism". Thanks to a research work done by Sirakaya et al. , we can reach a definition of eco-tourism that unites all the cardinal principles that led it to its development:

> *Ecotourism is a carefully planned tourist activity (whether natural, historical, botanical, ornithological, or archaeological tours) that it is compatible with sound ecological principles. Ecotourism results in no ecological damage from group impact on national parks and/or natural history resources. It is the philosophy of travel companies to support/use the destination's local resources, operators, lodging, guides, and other tourist facilities or services and of showing*

10 Limits of Growth, 1972

Fig. 7. During the 'Crazy tour', between November and December 1979, the Queen made a spectacle of modernity blended with music: strobe lights made the music scene enojoyment as never before. © vintag.es

evidence of continued support for the destination's conservation/preservation program and long-term planning.[11]

The first issue faced by the ecotourism movements and the planning of events were: a (1) severe underestimation of costs of the event, (2) a lack of attention to long-term forecasting, and (3) lack of attention to the demands of local communities. This is the case of the 1976 Montreal Olympics games: their apparent urban regeneration was decontextualized from the city center, making it difficult to communicate the area with the event itself. Otherwise, in this period, the event is seen as an engine of innovation; researchers started to increase studies of their economic, environmental, and social impacts[12,13]. Meanwhile the idea of mass events continues to becoming more significant. Local communities recognize that they can bring to the territory's livelihood in periods when the season is not profitable to standard forms of tourism[14]. An example of this concept is brought by Quebec Winter Carnival, giving a massive form of economic supply to the local community.

In the meantime, the first musical events appears replicating the success of Woodstock. This is the case for one of the most relevant sustainable festivals of our era. in 1970, placed in a farm in the Glastonbury's neighbourhood, the first edition of its homonym festival happens..

11 Sirakaya et al., 1999

Fig. 8
One of the main objectives of the 'We love Green Festival' is to raise awareness of its participants on sustainable issues such as the possible consequences caused by excessive pollution rates.
© 2020, We Love Green Org.

1980 – 1990:
Problematising the phenomenon

For the first time the analysis, researches an strategies for the environmental issues are named as '*sustainable development*'. The popularization of this definition has brought by the *World Commission on Environment and Development* (WCED), a body set up by the United Nations in 1983. Gro Harlem Brundtland chaired this organization, and it sought to find 'long-term environmental strategies for achieving sustainable development by the year 2000 and beyond"[15]. In their report, they defined sustainable development as:

'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' [16].

12 Coopers and Lybrand Consulting Group, 1989.
13 Gunn and Wicks, 1982, Gartner and Holecek, 1983, JRB Ritchies's, 1984,
14 J.R.B. Ritchie and Beliveau, 1974
15 (Bruntland, 1987, ix
16 WCED 1987, 43

The Commission's central concern was poverty reduction through increasing productive capacity in ways that ensured 'equitable opportunities for all'[17]. The key to the Brundtland report was ensuring that the activities and processes undertaken in the present would not hurt the potential future generations to carry out their activities. In the period the discussion of the sustainability of the events either takes its definition and, in 1985, during the Canada Chapter Conference, the commission will face for the first time the theme of a sustainable event development. Their concerns were about the Calgary Winter Olympics of 1988 and Vancouver World's Fair of 1986. Also, in this period, thanks to the global interest in sustainable development, various organizations began to plan sustainable development and, during the following decade, these researches will lead to the first regulations for environmental assessment; the same guidelines will be also affecting music events. In parallel with sustainable development, either idea of the mass-events develops its meanings and differentiates its typologies.

"The mid-to-late-1990s were the 'take-off' years for academic institutionalization of event management, and with it a more legitimized advancement of scholarship on event tourism and event studies."

1990 – 2000:
Raising a global intent

1990 is a landmark year in the event development literature: many authors introduce new guidebooks for reviewing the main differences of the events typologies. In these years Goldblatt's book *"Special Events" will be published, followed by "Festivals, Special Events and Tourism"* and *"Hallmark Tourist Events"* by C.M. Hall (1992). These works will be the beginning of a design that will bring new frameworks for a sustainable festival management. In the meantime, the concept of sustainability takes a major development in the society. Therefore, this decade is defined by Fisk[18] as "Contributing and transforming": while global development on innovation and increases the containment of the negative environmental impacts, 'recycling sustainable sourcing and disposal will be adopted as standards'[19]. In other words, since we have taken consciousness of what sustainability is, now we can start to minimize the impact.

in parallel with sustainable development, according to Jones and Bennett, 1990 also represents the epochal change in the festival scene for a new format. The popularity of alternative genres such as inidie (first proclaimed in the punk rock scene of the 1980s) shows new demands for musical entertainment. For this reason, rock music festivals such as Lollapalooza, Coachella, begin, accompanied by the globalisation that has affected these years, to organise an embedded in the music calenar, while movimng from one-offs to festivals that toured around countries and, some the world.

These territories therefore become the stage which, accompanying global intentions, will become the stage of sustainability which will accompany, in some cases, up to the present day.

The planning management of the World Student Games held in Sheffield, England, in 1991, is one of the first great examples of an event that incorporates sustainable framework. The event was intended as a catalyst for a broad economic and social regeneration of the city and the planning was made by integrating the three pillars of sustainability in the economic, social and environmental issues [20]. A year later, in 1992, the United Nations will give the global population one of the most enhancements for global sustainability: they will introduce the

17 ibid., 44
18 Fisk, 2010
19 Fisk, 2013
20 Bramwell, 1997

Agenda 21 during the Rio Earth Summit. With 170 states all over the world agreeing with the United Nations, the Sustainability development has officially begun. Indeed each nation enrolling the Summit decides to take part in a series of guidelines for protecting the environment. From these acts either the planning of the events will have a great sustainable improvement. An example is in the 1992 Barcelona Olympic Games; based on urban regeneration, the planning aimed to bring environmental, economic and social improvement for the whole area, either reducing the waste pollution. The regeneration included a new airport and clearance of a derelict waterfront area for construction of Olympic village.

These years were crucial for the planning and management of the events: there begins to outline the first guidelines and the most suitable methodologies for the development of events.[21] As Getz argues[22], The mid-to-late-1990s were the 'take-off' years for academic institutionalization of event management, and with it a more legitimized advancement of scholarship on event tourism and event studies. By the way, this process has been roughly 25-30-years behind the equivalent for tourism, hospitality and leisure. [23]

One of the interesting frameworks introduced in this period, is the Triple Bottom Line, attributed to John Elkington, who establishes how to manage the three main lines of the event sustainability: environmental, economic and social in short, mid and long period of time. In 1997, the American Council for the United Stations purposed a new treaty: Global Challenges for the Events Sector '15 Global Challenges' that have been defined and tracked since 1997 for The Millennium. In these treatments the main interest is to declare the need for improvements in sustainability in each type of future mass event must be planned "green and sustainable."[24]

Also, in this period, the concept of attending an event as part of a unique scene takes shape. This term indicates those who are fans of a scene, who go in search of a tangible fan experience at a festival. According to Jones and Bennett, participants in a scene are those who share the same appreciation for music, aesthetics, values and politics, which while often a way of life was no more evident than the fandom exhibited at music festivals aligned with their scene(s) or sub culture(s).

For these reasons, music festivals now provide a space to learn, engage with, and perform the cultural practices of a scene through a complex series of "semiotic activities: dancing, listening, talking, and, since the popularity of handheld smartphone technology, recording and uploading as well"

Moreover, at the gates of the new millennium, a new advance towards sustainability is given by the introduction of the first version of the ISO 14001, the first internationally accepted standard, providing to organizations a planned set of criteria requirements for an active *Environmental Management System* (EMS)[25]. This standard aimed 'to provide a clear environmental policy, divided into different phases, for implementing, setting up activities and defining the objectives of respect for the environment and its social and economic areas that derive from it'. Therefore, in the events context, this certificate acquires a significant importance: this organization recognizes the evolution of the industry, and aims to define the first intent of an international organization, already operating on the international territory, for providing sustainable guidelines for each type of activity, including events.

Either the tourism industry was improved with more sustainable methods. In 1997 was defined the Green Tourism Business Scheme, introducing the first label that aims to offer guidelines also for the organization of events. Furthermore, in

21 Chalkley et al, 1992, Stevens, 1992.
22 Getz, 2008
23 ibid.
24 Getz, 2008
25 Raj and Musgrave, 2009

1998, the European Parliament and the Council implemented a community policy program and a policy for sustainable and sustainable development, the European Management Audit Scheme (EMAS).Therefore the new millennium opens with a great wealth of analysis and development of sustainability; new event sustainable projects are beginning to present themselves, defining them expressly as 'sustainable': the Expo in Hanover is drawn up with Principles designs for sustainability, while the Sydney Summer Olympic Games are the first example of social sustainability in an event .[26]

2000- 2010:
NEW EVENT SUSTAIANBLE STANDARDS

The increasing interest from international organizations on the environmental issue proposes a critical starting point for concretizing sustainability within the events.

Many International results are taken in these years: the Stockholm 2001 conference definiens the air pollutants, the United Nations Sustainable Development Summit in Johannesburg

26 Smith, 2007

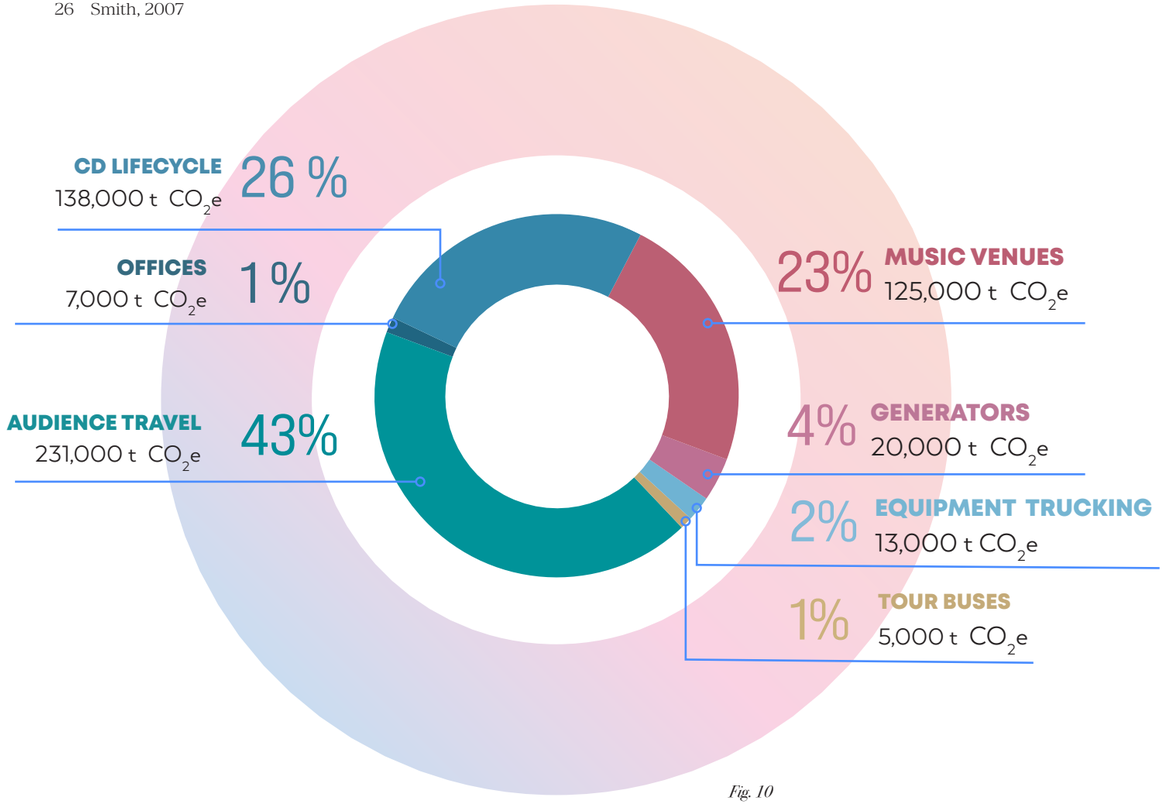


Fig. 10
GHG emissions per annum from the UK music market: recorded and live performance totals at least 540 000 t CO2 e.
Adapted by C, Bottrill et al,

implements a resource safeguard plan, and the report of the International Panel on Climate Change establishes the correlation between the CO2 content in the atmosphere and climate change. Either the use of sustainable energy resources becomes an essential factor for not overreaching the planet limits to Greenhouse gas emissions.[27]

From these intents arise the concrete commitments for the realization of more improved sustainable events. The Olympic Games of Turin in 2006 is one of the first examples of the new millennium sustainable events. In this case, sustainability is examined according to all three of its social, environmental, and economic declinations. There will be a management analysis of how the Olympic games would impact to the territory and, in addition, the regeneration for the Olympic park will be included in a development project that interested the entire urban territory from the early 1990s. In addition, the event proposes a method for offsetting the carbon emissions, restoring the greenhouse gas in the atmosphere. The festival industry also concretizes its effort for sustainable development. In 2005, is founded 'A Greener Festival' one of the first associations with the primary purpose of supporting sustainable festival management. Its main aims are: (1) to bring as a protocol for helping the event industry to share best practices, (2) to award and categorize events upon their sustainable practice throughout using a social communication and for mobilization the industry for helping the solution of the problem. Thanks to their guidelines the first sustainable festivals began to take life: in 2007, the Bonnaroo festival provides a site-wide recycling, a solar-powered stage and encourages the use of biodiesel while using only biodegradable catering products. Also, many other significant

27 Hacking & Gutrie, 2007, Sherwood, 2007.

events started using renewable solar power and hybrid engines with biofuels generators. Leading examples of these years are *"The Sunrise Celebration", "Latitude Festival" "Big" "Green Gathering" "The Glastonbury Festival" "Edinburgh Film Festival" "The Glade Big Session Festival".*

In 2005, the Kyoto protocol became effective and fundamental for the training of new sustainable management of the event organizations. This treaty is an international agreement created in response to the changment biosphere; it commits 180 participating states to mitigate climate change through the reduction of GHG emissions[28].

It becomes clear to be the evaluation and the reduction of the Carbon Emissions of the event. This goal was facilitated in 2006, with the birth of the non-profit organization of Julie's Bicycle. It aims to evaluate the environmental impact generated by events, proposing methods of energy support and training organizations in a correct ethical and sustainable use of energy. This organization also provided one of the first free a tools created to analyze the GHG emissions of the music industry. Thanks to the use of this tool, there have been numerous reports focusing on the emissions of the music industries[29].

In 2007, the interest for a sustainable design became the strategy of planning of the 2012 London Olympics. As previously said, the idea of this event was to link sustainable development to the concept of urban regeneration. For helping the process, the British Standard Institution also introduced a first policy document for the design of a sustainable event: the BSI 8901: 2007; thanks to this legislation, efforts were made to design and manage the festival through the environmental, economic and social issues. In addition this certificate brings organizational attention to coordination and the use of precise

28 UNFCCC, 2012

29 Bottrill et al., 2008; Tsiarta & Heathfield, 2011

Fig. 11

the 'bauli in piazza' demonstration is pouring into the squares of italy the outburst of most of the employees in the entertainment industry, who are currently going through a huge economic and social crisis. At the moment, the possible implications of the future are still to be planned.

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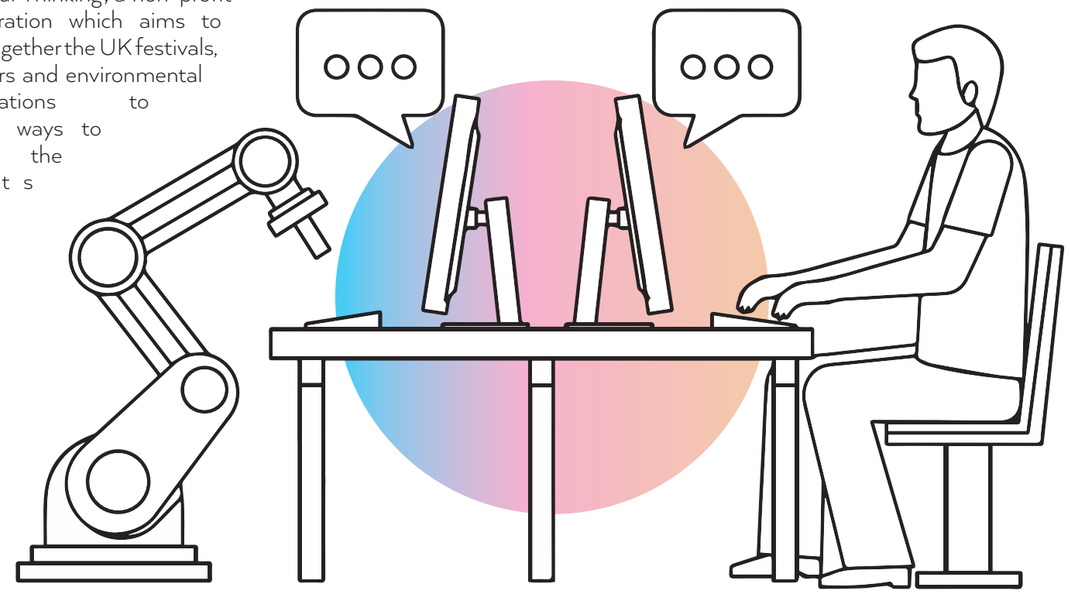
indicators and evaluation systems. Thanks to the guidelines set by the BSI, in 2013 the International Standard Organization (ISO), releases ISO 20121 in order to regulate the management and planning of sustainable events internationally, defining sustainability according to precise criteria. In the same year, the Department for Environment and Rural Affairs (DEFRA) introduces the Sustainable Events Guide. By the end of this decade, the events industry will have had important tools to be able to put great forms of sustainability into practice.
At the end of this decade, thanks to A greener Festival certificate, Julie's Bicycle, and the ISO 20121, the event industry will have several tools for managing the events in a significant sustainable way.

2010 – 2020: Climate changes and a further global intent

The decade that leads up to the present day is made up of sustainable practices that all aim to reduce the entire festival emissions. A multiplicity of events are coming forward, showing how it is now possible to implement efficiently and with a considerable savings on the costs of managing sustainable practices. Some festivals provide many examples; the Glastonbury Festival, the Peats Ridge Festival, the Burning Man Festival, and the All Points West Music and Arts Festival, are all committed to improving and developing their sustainability initiatives such as renewable energy supplies or sustainable meetings. Their development has also reached the goal of the 100% of renewable energy used for the whole event.
So may we declare that everything is getting done and emissions are totally reduced?
In 2015 a new global warning is exposed during the Paris Conference (COP21). Therefore 195 countries negotiated the 'Agreement on climate change': an historic international political consensus for global climate action pledging to keep warming to a maximum of 2 ° C, aiming for 1.5 ° C, above pre-industrial levels.
Indeed, as the research made from C. Bottrill et al. aimed to estimate the greenhouse gas emissions of the sale of music products and live music performances to UK consumers. The Results stated that approximately threequarters of the industry's GHG emissions are still attributable to the live music performance sector and approximately one quarter to the music recording and publishing sector. The primary GHG producing activities are audience travel (43%), live venue music events (23%), and music recording and publishing (26%), with smaller contributions from music festivals (5%excluding audience travel) and music organizations (1%)
In the same year is introduced 'A Powerful Thinking', a non-profit collaboration which aims to bring together the UK festivals, suppliers and environmental organizations to explore ways to reduce the costs



and carbon through increased efficiency and alternatives, and share findings to promote lower carbon industry, is founded.
These results bring a full and urgent rethink of how we produce and use energy in all aspects of life, events included: using less energy overall, using energy more efficiently, generating it from renewable sources and phasing out fossil fuels.[30]
This period brings the most accurate results analysis of the climate; facing the global population with the irreversible climate changes derived from the pollutants; thus the globalization allows to promote global action for reducing world-wide industrial and urban pollutants. Therefore, in 2015, United Nations introduced the Sustainable Development Goals (SDGs): 17 critical points adopted by the 170 members for running urgent actions in a global partnership for climate change. The SDGs provides an Agenda to be achieved in 2030.
Each territory begins to take part in this sustainable development directive. One of the most prominent examples is given by Italy; in 2016 it founded the Italian Alliance for Sustainable Development (AsviS) intending to raise the awareness in the Italian society, economic stakeholders and institutions, while promoting the importance of the Agenda. It has also introduced the institution of the Sustainable Development Festival, where the Italian alliance provides an annual meeting promotions of activities for achieving of the SDGs.
In this period also emerge the major categories of improvements within a sustainable festival thus:
- Waste management;
- The use of energy efficiency;
- The reduction of polluting materials and the use of renewable sources;
- The promotion of sustainable activities.

Therefore, while traditional architecture move towards to achieve maximum energy, self-sufficiency and minimum dispersion[31], the architecture of events moves towards the essential step of reducing GreenHouse Gases emissions.
Nowadays a sustainable festival is called a "Green Festival", and it brings the attention to the sustainable development through management practices, encouraging public transport, waste management and the minimization of the energy use.
As architects, we suppoe that the most significant contribution that we can give to a further design for a new sustainable future is intended by

30 Bottrill et al. 2008

31 The introduction of Nearly Zero Energy building requires by the European Commission that all new buildings to be nearly zero-energy by the end of 2020. All new public buildings must be nearly zero-energy by 2018.

Fig. 12
Offered by Deloitte, this provocative illustration brings attention to the new communication systems. The machine is now able to equate itself to humans in its tasks, it has thus assumed human contact. This can be defined the first step in artificial intelligence.
©2019, Deloitte

the designing of new forms of energy efficiency improvements. In these years are also coming up innovative forms of sensibilization and reduction of emissions. In 2019 the Shambala Festival reached out to their traders, encouraging them to create their own 'One Planet Plate'- a meal that is responsible for 0.5 kg CO2e compared to the average UK meal of 2 kg CO2e. The best dish, voted by the audience, was rewarded with a trader award, which includes a 10% reduction on pitch fee.
In the decade 2010-2020, therefore, it can be deduced that the significant commitments are no longer to follow the now fully asserted certifications, but rather to move sustainability towards the fulfilment of the Agenda of Sustainable Development Goals. However, due to a epidemic crisis, while the sustainable progress continues, the historical context of the 2020 has put the development of mass-events in 'standby'. Therefore it becomes interesting to establish, with a clear dividing line, what has happened so far and what it is possible to predict in the future.

2020-2030+:
Actual efforts, limits and future previsions

To understand the future that we can expect in the upcoming years, we have defined two different types of engagements that humanity is already carrying out: an economic-social recovery and a social-environmental recovery.
The current historical context has brought the entire globe a further crisis, caused by a world epidemic, COVID-19, which has blocked most of the global manufacturing sector settling the whole world in a critical standby-period. This is what we can define an economic and social recovery.
According to some 'green-organization', this state may bring new ideas of a revival. Indeed, the epidemic crisis has led to the oil crisis, therefore the World Wide Fund for Nature (WWF) and Greenpeace have urged to the world companies for advising new renewable sources as a solution to this juncture. Another improvements is given by the creation of further organizations in event management, including 'Positiveimpactevents.com', aiming to give new resources for empowering the future of the sustainable event industry. According to some research, those significant carbon emissions could also have led to the deterioration of world human health therefore the intent is now clear: it urges a recover from the standby period with a reset of the most pollutant activities.
This commitment can thus be defined as socio-environmental: it is not only required for the world but also for the single human and every single stakeholder. What the epidemic crisis changed in human thoughts is that being sustainable is no longer a moral responsibility; now, it is our survival responsibility.
In sentence, this global social and economic crisis has put us all in front of the need to reduce our polluting state concretely.
What we intend to do now is to understand what the intentions were up to now and which will presumably be carried forward, trying to think already of the near future when the pandemic crisis will end and how it will renew us.
A new approach to renewable resources has been given by the implementation of smart grids: in the field of electrical engineering, this type of electrical network, capable of distributing electricity by dividing the territory into smaller portions, all controlled by renewable electricity generation units in their own right. In this way, each unit on each territory can control the needs of the area, and allowing to stop the most polluting energies for the supply of renewable energy only when the request allows. This method is intended to achieve a successful result for the implementation of the Sustainable Development Goals within the urban territory.
SDGs also find a common act in several musical event organizations, including Powerful thinking organization. In 2020 their team released report for the event industry, assessing the impact of the actual event. Highlighting the critical issues that cause the current pollution of the festivals, they have launched a campaign called "Vision 2025", a series of actions to be taken efficiently and quickly against the climate change and the increasing pollution:

> *"The International Panel on Climate Change (IPCC) tells that in order not to exceed 1.5 degrees we need, "rapid, far-reaching and unprecedented changes in all aspects of society. This is a challenge to all of us to fundamentally change how we work."* [32.]

The campaign wants to achieve a 50% reduction in festival-related GHG emissions by 2025. The objectives that affect the events improvements are:

- reduction of waste sources by 50%,
- reducing reliance on fossil fuels by 50% (compared with 2014 emissions);
- Promoting with the partner stakeholders to reduce travel-related emissions;
- Working on the supply chain for improving accountability and the sustainability of food sourcing;
- Working together for sharing experiences about changes;
- Measuring and recording the critical impacts in progress;
- Sharing annual reports.

In this emergency context, however, the heritage of events is experiencing a strong sense of concern for its future: it has been realized that most of the types of current events cannot restart in health security. So, what to do? The emergency is expected to end, and activities can return to the full regime; it is now the perfect time for radical improvement.

32 Powerful Thinking Campaing, 2015

According to a global analysis carried out by Deloitte, only 37% of Millenials believe business leaders make a positive impact of the world.
This issue makes us understand two important aspects:

- *New technology has given us all the necessary needs;*
- *There is still a lot to do for the enhancement of industry;*

Even if numerous petitions have been filed by the event industry to ask for great support for the government to restart, it is legitimate to be able to introduce in this context an agreement for restarting the world care too. The music industry can be restarted by employing sustainable developments. Moreover, if sustainability is seen in its future values and innovations, it imagines a future of cultural and technological innovation. This shift aims not only to the mere use of one or more renewable forms, but to the conjugation of them in an interconnected technological project.
A suggestion comes to mind is: let's imagine the same as a "home sustainable-computerization", but within a festival industry.
The time has come to settle on the future of short-term sustainability with long-term success objectives, creating possible interventions that can concretely improve the ecosystem also in large temporary events.
If until now the most serious difficulty was the non-existence of renewable forms of energy, in 2020 we can create renewable energy supplies from a multitude of resources. By now, renewable sources have become the tool of which the main objective is to reduce emissions concretely.
Therefore, since the energy of the future has in itself numerous existing possibilities the current festival development system makes no longer a lack renewable energy supplies as primary reference. Now we assume that the music industry is asking to

ensure that the renewable energy supplies may bring efficiency, sustenance, and therefore a significant limitation of the carbon emissions. Indeed, taking inspiration by the smart grids introduction, we do not need to create a new form of renewable energy, but we need a tool capable to rearrange them more efficiently.

Now we have understood how path has led to the establishment of new forms of sustainability; we have understood the issue of the Greenhouse Gases that lead to damage to the global ecosystem; we have understood that the world needs to find new forms of supply that do not make the presence of plastic worse in the seas, pollution from particle matters, and the rise of CO2 in the air.

Also, we have already understood that it is possible to calculate and have tools to calculate our carbon emissions.

The sustainability practices of the previous decades have introduced methodologies and strategies that have sometimes proved successful results. Moreover, they have laid the foundations of the actual development. Nowadays, on this basis, we have the technical and practical knowledge to implement them.

Therefore, we may assume that in the decade 2020-2030 and the following ones, the achievement will be the systems that, in a cohesive functionality of multiple renewable sources, will bring critical reductions. Then the question that arises is: how to maximize the reduction of emissions of big-events?

While searching for the answer, we can observe the future of the global technological movement. Sustainability is tangling with the extreme Information Technology innovation that is about to be expanded all over the world. The time has come where the new technology will be defined as "***intelligently technological***". This is the period defined by Deloitte as Industry 4.0, and the effects will be radical in all kind of production forms. From now and on, between people and machines, there will be a new ***third individual***, "half-man, half-machine": the "artificial intelligent machine", capable of making much more complex calculations than those machines which, only twenty years ago, gave us the possibility of developing the actual forms of sustainable energy supplies.

Therefore, thanks to these 'old' technologies, the renewable energy that we have already known has been performed. Nevertheless, thanks to artificial intelligence, new ways of reducing the pollution will be possible to act from now on. So, here is our intent: we have created the "intelligently technological" systems, could we now create "intelligent sustainability" systems?

This literature review wanted to retrace the footprints of the past of sustainability to understand where the core of this movement is, and how it is expanding to the present day. Sustainability grows, but its values, and what generated it, will remain forever. What its intent has generated (e.g. solar power, wind power,) are fundamental tools.: by embracing the new artificial intelligence, sustainability can also push the path of generating new forms of 'sustainability 4.0'.

Therefore, the historical review showed interesting sustainable methods; now, our goal is to make them work together, in the best efficiency ever made.

2. STANDARDS AND GLOBAL AIMS

defining directives and regulations
in the sustainable event framework.

Environmental Standards

UNI EN ISO 14001:2015

Set of Criteria for an Environmental Management System.

This international Standard aims to provide organizations with a set of the criteria of an effective Environmental Management System (EMS). Even if being a voluntary certification, this standard addresses that the continuing of the concept of business, as usual, cannot continue, thus creating a business ideology of balance between maintaining profitability and reducing environmental impact. In substance, the Standard asks the organization to focus its attention on its current management to indicate its critical issues. From this analysis, it will be possible to identify the policies, objectives and processes to achieve this ISO aims to create a production process and services to cancel, or reduce or control the creation, emission or discharge of any pollutant or waste, in order to reduce negative environmental impacts.
The key points of the ISO 14001 Standard are:

a) emissions to air;
b) releases to water;
c) releases to land;
d) use of raw materials and natural resources;
e) use of energy;
f) energy emitted (e.g. heat, radiation, vibration (noise), light);
g) generation of waste and/or by-products;
h) use of space.

UNI EN ISO 14040:2021

One of the most used sustainable approaches for quantification of any element embodied energy and carbon requirements

These regulations are one of the most widespread within the panorama of sustainable development. Thanks to this framework, it is possible to calculate and evaluate the environmental impacts that any product or service may have on the environment. Its assessment includes its entire life cycle and, therefore, it is beneficial for determining the equivalent pollution produced by those mentioned above. The result of this analysis is expressed as carbon emissions, that is, the ability of that product or service to release a specific carbon dioxide into the environment. The standard proposes the criteria and characteristics to find the most realistic evaluation possible; however, no methodology is prescribed for the individual phases of the LCA.

Global Reporting Initiative (GRI) standards

A series of guidelines for a correct rporting of the pollutant emissions determined by the event.

The GRI is an independent organization whose purpose is to organize sustainability reports since 1997.
Thanks to his effort, organizations, companies, governments around the world understand how to communicate best the impacts on the issues that sustainability seeks to solve: climate change, human rights, governance and social well-being. GRI, therefore, makes the general guidelines of the report available free of charge, called the “Sustainability Reporting Standards” developed in collaboration with various stakeholders and continuously updating it.
The GRI reports are still the most used methodology in the world for drawing up financial statements or sustainability reports. This report is voluntary, but it is becoming increasingly popular among global companies: to date, about 93% of the 250 most essential corporations have referred to this standard for its report. Thanks to it, any company or organization can organize its environmental data so that it can communicate information on its sustainable actions, so as to strengthen the image of the company further to welcome new opportunities for respecting the environment.

Eco-Management Audit Scheme (EMAS)

A tool for determining the polluting emissions dtermined by a festival

EMAS is an eco-management system for companies, companies and organizations in order to evaluate their environmental efficiency. This tool has been developed by the European coMMISSION IN 1993. Thanks to this instrument, any organization interested can certify its compliance with the European Regulation of n.221 / 2009 which aims to favor more rational management of the environmental aspects of organizations on the basis of compliance with the legal minimums, but also on the continuous improvement of its own environmental performance and on being able to publicly communicate their efforts for a more significant development of sustainability. Unlike ISO 14001, EMAS can be requested by any company or company or activity that voluntarily decides to request it; however, the certification is valid only within the European territory.

A system that concerns Environmental, Social and Economic factors of a sustaianble event management.

Management Standards

ISO 20121:2012

Event Sustainability management System – Requirements for guidance use.

This standardis based on the policies introduced by the British Standard Institution (BS8901: 2007) for the management of the London 2012 Olympics.
The certification derives from the standardization work of 25 countries with ten countries as observers. It is offered to all the stakeholders involved in the management: organizers, managers, stand builders and traders of events. Hence, it specifies the environmental, social and economic factors of the event. It ensures the eco-compatibility of the venues and facilities, the transport, the disposal of raw materials, the supply of raw materials and the legacies, positive or negative, of medium and long term.
Among the main approaches offered by this standard, the Life Cycle Assessment is particularly advised; the LCA, indeed, is standardized by ISO 14040 and 14044.
Thanks to the analysis process given by this certification, it is possible to reduce costs, carbon emissions and waste produced, respect the biodiversity of places and creating diverse and inclusive jobs in the local communities through a 'holistic approach'. In addition, the standard carries also the material selection, in of an efficient use, during the buying phase but also in the full lifecycle as well. The certification model is principally dived into four significant steps: planning, development, control and action. This standard is voluntarily and issued by external organizations of the event that will evaluate if the guidelines are respected.

It was important to make this subdivision because the current regulations - from international to national level - deal with many aspects of environmental protection and sustainable design. Nevertheless, sustainability can be put before the design project, as well as integrated later. In order to be able to draw up and construct design criteria that embrace energy efficiency within a temporary event, we analysed these two types of standards. Their consideration led us to move the criteria to

two different aspects, ante-operam and post-operam.
In order to define the guidelines that allow organizations around the world to contribute to the development of Agenda 21, the United Nations Organization has agreed with more than 150 countries on the Sustainable Development Goals (SDGs). This chart of intent is also included in the Agenda 2030; this year is defined as the deadline to complete all the objectives of the SDG campaign.
The SDGs are composed of 17 main objectives which are divided into 169 targets, useful for exemplifying the lines of action to follow.
The SDGs are a prosequest of the Millenium Development Goals (MDGs) which were stated, at the beginning of the new millennium, to compose the guidelines from which both the SDG and the various sub-organizations that have been created carry out the actions.
All signatory countries, therefore, fulfil the duty to create a national policy to bring their means from the private sphere to public administration throughout the territory. These objectives, although separated by different capitulations, are in reality a unique, indivisible system, and are therefore to be considered universal and transversal. For this reason, within the seventeen points to be developed, you can also find the principles useful for the correct design of the sustainable festival and, in the case of our analysis, and energy control. Despite the SDGs, the MDGs did not explicitly mentioned the energy issues. However, according to the negotiation for the drafting of the SDGs, there was noticed how the energy topics underpins a social and economic development as well. The energy is then included as a global purpose as a possibility to eliminate the global poverty.
Therefore, the energy is then comprised of the main themes of the document. Thus, to encourage the development of the SDGs, in our research, we have identified the most concurrent goal of this thesis:

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

SDGs are composed of 17 main objectives for achieving a suistainable future in the entire world.

3. SUSTAINABLE ASPECTS THAT CONCERN A MUSIC EVENT

‘Events such as Boom have a transforming potential in many ways. Firstly, the gathering of thousands of people in a specific place for a limited amount of time is an opportunity for reflection on the communitarian nature of our species: How do we live together? How do we relate? How do we occupy space? What do we leave behind? What is our ecological function in the web of life? How can we satisfy our survival needs in equilibrium with the needs of all other species? These questions can be instigated in any event, even when music and art are the main focus.’

Dr André Soares, Ecocentro, Boom Festival

As far as we know, the main three pillars of the sustainable concept concern the enviornmental, social and economic aspects o sustainability.

Then, to act correctly, these three aspects have to be balanced together; however, this process is not often complicated and a plural process that needs to be undertaken at the same time. Due to the oversize of these topics, we can not afford a complete work that carries the main three pillars at the same time. Therefore, in this chapter, we want to explain their main aspects and characteristics while identifying the main actual issues of the three. Lastly, this preliminary analysis will bring us to the knowledge of the main requests of the sustainability sector within the festival asking for innovation. Thus, we will be able to justify the choice based on the global commitments currently undertaken, and consequently, we will be able to proceed with the work deepening the specific issue..

Environmental sustainability

During the music event, multiple environmental aspects have to be taken into consideration.
Also, the sustainable planning of an event brings the evaluation of the most relevant services that enrol the environmental impacts related to the event. Therefore, many events are yet introducing their sustainable environmental program. According to the experience made by the Sziget Festival in Hungary, the primary purpose of this mass event is to provide a conceptual framework emergent from existing principles and guidance that will be able to underpin the importance of sustainable event management.
Also, the event industry is quickly becoming one of the most critical sectors of the world economy, and this innovation is carrying both positive and negative effects on the environment. Events have direct and indirect connections within the environment, and the organisation's decisions about travelling, venue services and equipment have different kinds of impacts on the natural resources. Therefore, the evaluation of the event assessment has then become a crucial phase for the suitable development of a sustainable program.

Environmental aspects

According to Raj. R[1]. et al, natural resources that enrolls an event can be divided into two different types:

- *The natural environment, containing the traces of the environment, such as flora, fauna, and the surrounding landscape;*
- *The man-made environment, containing everything introduced or built by humans.*

Moreover, for the evaluation of the impact relation of the human interations with the environment, there are several physical factors that need to be taken into account. On this basis, thanks to work of different authors [2.3.4.5.] the environmental impacts can be grouped as follows:

- *Impacts on the natural environment: water quality, geological factors, air quality depletion of natural resources, flora and fauna.*
- *Impacts on the man-made environment: buildings and visual impacts, changes in land use, infrastructure*
- *Impacts on the whole ecosystem.*

n addition, for evaluating the physical impacts there is always a need of managing different scales of impact; the human actions may have global and local impacts, direct and indirect, reversible or irreversible, favorable and unfavorable. In the following sections we will review the main categories in which these impacts are placed. Also, these are the most relevant aspects that need to be taken in consideration in a well-made environmental assessment planning.

Air quality

Any mass-event carries a large number of air-polluting exhaust gas-and steam- emitting activities. These activities are also services not only focalized within the venue but also from services occurred for the well-functioning of the whole event. In this case, also transport and mobility are critical factors that are involved in the event assessment. Also, catering and accommodation establishments are included in the emissions. Consequently, CO2, CO and NO2 are emitted, causing an increment of a GHG effect. Moreover, also noise pollution resultant by transportation, entertainment facilities, hospitalities, belongs to the air quality emissions.
As Raj..[6.] mentions: 'the greater the increase in facilities, participants and business in a given area, the more intense the air-polluting impacts become.'

1 Raj.. and Musgrave., 2009

Fig. 1 (left)
We Love Green Festival is a sustaianble flagship event. Its slogan, also reflected in the name Green by name, green by nature
© Maxime Chermat, We Love Green

2 ibid.
3 Mathieson and Wall, 1982
4 Jenner and Smith, 1991;
5 Puczk. and R.tz, 2002,
6 Raj. and Musgrave, 2009

Geological conditions

One of the most important factors that occur in the geological conditions is littering. In this case, unremoved waste is not only an unpleasant sight, but it also seeks to spoil the territory. Also, the litter decomposition can release toxic materials into the soil. In this context, the heave metals released into the air by the ever-growing traffic precipitate on the surrounding vegetation. However, the untreated waste can damage not only the soil surface, but also the subsurface and underground waters as well.
Also, outdoor, indoor, urban and rural events may cause soil erosion. As a consequence, the decrease in vegetation cover is expected; this consequence can even disturb or plunder the present flora and fauna. Lastly, when a large footfall of participants into a greenfield is expected, there can be caused by soil compression; this process is the contrary of erosion and prevents the soil from maintaining its average water balance.

Water pollution

The presence of water surfaces located near or inside the event venue is often exposed to critical environmental threats and pollution. One of the consequences of water pollution may be caused by the suntan lotion that forms a subtle film when it gets into the water. This film over the surface decreases the oxygen uptake and deteriorates the essential condition of the water in local rivers, streams and coastal region.
Also, a negative impact of the event is caused by the connection with the level of sewage treatment.

Fig. 2
Rubbish in front of the Pyramid Stage after Glastonbury Festival 2016, at Worthy Farm in Somerset
© 2016, Birchall B. , P.A.

This treatment is a feature that allows essential well-being for both residents and the environment around. The sewage treatment originating by the event should be treated with a multiple phase technology that allows a complete treatment; without this technology, the cleanness of the waters is not maintained. Then, all these pollutant forms would be accumulated with organic materials. This form of pollution is thus called eutrophication. A severe presence of eutrophication should then be declared unsuitable for bathing because its presence negatively affects health.

Depletion of natural resources

The depletion of natural resources is accelerated by the use of fossil fuels in transportation, heating carried by the accommodations and the catering facilities operations. For avoiding this exhaustion, the usage of hydro, solar or wind energy is mostly recommended. Also, wasteful and careless use of the drinking water supply critically damages the effectiveness of water management, while decreasing the availability of freshwater as well. Therefore, this depletion may be avoided by the use of modern technology and the adoption of environmentally friendly services.

Flora and Fauna

Many events also have the intent of preserving and promoting natural resources, thanks to their focus protecting the environment and improving it as well. On this basis, there should me expected a same treatment made by all the attendant. On the contrary, many of the participant use to pose a less severe threat to flora and fauna directly. Sometimes, this bad attitude carries an interference with the order of the natural habitat that may influence negatively animals' breeding and feeding patterns.
Moreover, since the innovation is ever-bringing more mass-events in many territories, agricultural activities and areas such as meadows, woods are on the decrease. In this way, flora and fauna natural habitats are now interposed, causing an ecological disturbance and forcing local animals to migrate elsewhere.
Therefore, we may summarize that events may have negative effects on the natural environment and the may also directly change the natural landscape, conservation and protection of local flora and fauna. For these reasons, the evaluation and analysis of a most suitable venue area becomes a crucial point for a more positive assessment.

Impacts of music events on the environment

As happens for the social and economic sustainable development inside the event, also environmental sustainability is assessed with a strong relationship between the venue area and the inhabitant area. On this basis, environmental impacts that emerge thought the planning festival and the in-time activities result only after the end-of-life stage.
The in-time activities are accommodation, travelling, tourism facilities, and participation at the festival itself. The more remarkable is the amount of time, the greater will be the assessment to be taken into account, with the following effects on the environment. Then, negative impacts from mass events occur when the level of visitor use is greater than the territory's ability to limit the changes, according to Raj. R. et al. when uncontrolled events are placed around the world, there may put critical pressure on the territory, causing land degradation, increased pollute, discharges into the soil, natural habitat loss, increased pressure on endangered species and heightened vulnerability to forest fires.
Therefore, events and festival may often create significant pressure on local resources, such as energy, food and other materials that may be already in short supply. Also, the extraction and transport of these raw resources exacerbate the physical impacts associated with their exploitation. Also, due to the seasonal occurring of several events, a unique high demand is placed in a single time of the year. From this peak of needs there comes different environmental impacts that we will summarize below.

MEANS OF TRANSPORT	ENERGY CONSUMPTION FOR 1 PASSENGER-KM [KJ]
Aircraft	6'000
Train	2'100
Coach	2'100
Automobile with 1-4 passenger	7'800 1'900
Cyclist	120
Pedestrian	250

Table 1 Energy requirement for 1 passengerkilometre. Adapted from Halmay et al., 2006.

Transport

The different forms of travel by participants, organizers, staff and performers cause different forms of material use and different emissions as well. Walking or cycling has undoubtedly the most negligible effect, but the need for carrying the equipment of other furniture often requires different motor vehicles for the transportations. On this basis, pollutant emissions are characterized by noise and air pollution and also the required space for the vehicle. All these aspects put a significant load on the impact assessment. (table)
However, many solutions are implemented. For example, passengers that drive public transport have much fewer impact effects than those travelling with individual vehicles. This difference is clearly explained in the following table that compares the different energy requirements for one passenger-kilometre.
Hence, air pollution from travellers' mobility has a significant impact on a global scale. The effect is mainly characterized by CO2 emissions related to transportation use. However, the emissions contribute to a significant context to the local pollution as well.

WASTE MATERIAL	DESCRIPTION	MATERIAL	WEIGHT (%)
Plastic bottles	0.2 - 2.5 litre soft drink mineral water and beer bottles	PET	20-25
Plastic glasses	0.2 -0.5 litre disposable plastic glasses	PP or PS	15-20
Tin cans	0.33 or 0.5 litre cans	Metal alloy, alluminium of tin	5-10
Glass bottles	All sorts of glass, bottles	Clear and coloured glass	0-5
Paper	Paper wrapping, filiers, newspaper, periodicals, journals	White, coloured, cardboard cartons	10-15
Leftover food	All sorts of organic waste	All sorts of organic waste	15-20
Others	Plastic foils, contamined waste	Absolutely mixed	5-35

Table 2. The main elements of festival wastes. (PET = polyethylene terephthalate; PP = polypropylene; PS = polystyrene.) Adapted by Raj. R. et al. 2012

On this case, we may place the example of a particularly hot or cold country, where motor buses often leave the motor running for an extended period, in order to find a comfortable bus while coming back to the vehicle.
Also, noise pollution from cars and coaches, as well as the event themselves is an ever-growing problem in modern life (Raj. R. et al.)[7]. This pollution, causes annoyance, stress and even hearing loss for those in particular proximity.

Accommodation

This type of service does not significantly contribute to the whole pollution. However, their presence on a specific territory or the interference with natural habitats may occur in the assessment. Then, heating, cooling and lighting of accommodations require sufficient energy to run. On this basis, the usage of energy savings equipment is crucial for reducing emissions. In this way, the European regulations are an example of normative for environmental protection. These policies require environmentally friendly materials and ensure adequate insulation for avoiding overheating and unnecessary air condition services. In the accommodation issues, also the water consumption must be a subject of the assessment.

Meals

The meal consumption has an influence not only for their disposal phase but also for the production phase as well. Food production requires a large area that may cause soil pollution. Moreover, long-distance transportations cause a high fuel-emissions of air pollutants. In this way, many events are focusing their catering on km 0 productions and supplies. Also, disposable packaging materials are the preferred choice. Therefore, we can summarize that a more environmentally friendly choice is driven by locally made, natural and healthy meals.

7 Raj. and Musgrave, 2009

Energy

This aspect is one of the central roles in the festival production because mostly all the services require energy to the run-up. The energy consumption in festival largely derives from the consumption of electricity and heating demand for accommodation facilities, cooking. Moreover, there is a high demand for fuel consumption for transportation, and more often, for the operation of entertainment devices. Two aspects mainly characterize the results of extreme energy emissions: (1) a higher expenditure and (2) a raising in CO2 and other GHGs emissions.

Waste

The waste resulting from beverage consumption is the most noticeable during festival events. It is stated that half of the whole refuse comes from the beverage packagings. Moreover, recycling services are not widely used within events, and most of the drinks are packed in glass bottles. Also, the second most crucial part of wastes derives from leftover food and the cutlery used for consuming it.
In conclusion, we can summarize that festival impacts are categorized in two aspects:
The contribution in depleting of natural resources such as air, water, and soil pollution
The ruining of natural habitat for the local flora and fauna inhabitants.
Therefore, it is undoubtedly necessary the development of sustainable assessment. By following the environmental principles of a sustainable development, the following guidelines should be taken into account: controlling the use of resources. The adoption of a controlled management of natural, social and cultural resources;

- *Restricting the over-consumption while reducing the waste amount;* in this way, the over lasting period is allowed, and the over damaging of the environment is avoided;
- *Conservation of the biodiversity; in a controllable event, the assumption of the local flora and fauna must be taken into account for safeguarding the species while implementing a festival with respect for the environment;*

Involving events in long-term developmental concepts. As we have seen in chapter 1, events are workhorse for a sustainable regeneration.
On this basis, festivals can apply different levels of environmental sustainability for assessing a long-term positive impact on a local, regional and global scale.

Fig.3(a,b)
One of the main aspects that refers to the Burning Man Festival is its great attention to the social characters of the visitors. A
© (a) 2017, Mark Mennie, (b) 2019 Juan P. Zapata

Social sustainability

The social impacts of significant events are widely recognized[8]. Hence nowadays, measuring these impacts is quickly becoming a crucial need that involves non-economic and environmental terms. In this way, social impacts are defined by 'changes in the structure and functioning of patterned social ordering that occur in conjunction with an environmental, technological or social innovation or alteration'.[9]

> "A FESTIVAL IS ONE OF THE MOST RELEVANT SURROUNDING AREAS FOR DEFINING THE SOCIOLOGICAL BASES OF SOCIAL PHENOMENON"

Therefore, events have to be considered not only for their affection on economic and environmental impacts but also in a social system as well. In this way, events provide an improvement to the social relationships and surrounding, attaining more connection between people, while their abilities of comprehension of human aspects and behaviour are always improved.
Consequently, a festival is one of the most relevant surrounding areas for defining the sociological bases of social phenomenon[10], this social development can be described in the following aspects:

- *The aim of creating new 'social attractions' and escaping from the routine life;*
- *The improvement in communication and information technologies that are promoting interest in various events;*
- *Easier accessibility to travel and mobility for getting to the events;*
- *The increment of vacation periods, at the same time with rising real incomes, giving more accessibility to the event participation;*
- *The increment of world trade businesses leading to various events such as events and conventions;*

Also, the event is based on simultaneous processes of production and consumption: in essence, the attendee is 'attending' the event while is consuming the event production. Moreover, the event is seen as a 'personal' service that can satisfy the individual attendee. For this reason, the creation of temporary events enrols the local community also for the social impacts: these communities will be 'enforced' to come in contact with a foreign population that will be hosted during the event activity. Therefore, changes in economic growth and product development may be unequivocal, relating these variations also in the sociocultural characteristics of a particular area of the region.

8 Wood, 2006
9 Olsen and Merwin, 1977 p.41
10 According to Cooper et al. 2005

3. SUSTAINABLE ASPECTS THAT CONCERN A MUSIC EVENT

> "Social impacts of events are then measured on the host communities."

In this context of the interconnection between the local communities and the event attendees, there are foreseen two different scenarios: a beneficial or detrimental impact on the local community. However, if we have to analyze the aspects in a more 'realistic analysis', the social impacts are often produced by a mixture of these two main strands. In fact,. 'tourism destination managers are increasingly looking at events as an important mechanism for enhancing tourism development'[11].
Besides, the community role strictly involves the attendant expectations during his participation at the event. The participant is involved in the form of attractive places to participate, by relying upon his experience to do/have something to take in his travel experience.
The social community is then regarded to have a substantial impact on tourism development also for the event realization. In this way, there are several tourism aspects that are involved in the event aspects and are described as follows[12]:

- **The interconnection of different cultures,** *ethnic groups, lifestyles, languages and levels of prosperity;*
- **Behavior of people** *freed from many of the social and economic constraints of everyday life;*
- **The behavior of the host population** *which has to reconcile econimc gain and benefits with the costs of living with strangers;*

Moreover, there are further factors that influence the attendant participation to an event: age, education, income levels and socio-economic background[13].
In essence, events interconnect groups of two different people: the event attendee and the local community and both of them will be influenced by their social interaction, eventually involving them in a social-change. Also, events are strictly regarded as one of the powerful agents of cultural change. In this way, the raising introduction of global-scale events make the social tourism development as a prominent act in the staging phase: the big-scale events affect the direct visitation, flow-on visitation, catalyze urban development, brands a destination legacy a destination and also many community enhancements.
[14]Therefore, the social impacts of events are then measured on the host communities. The methodologies used for this assessment may vary considerably. For example, the stage development, seasonability patterns of activity and cultural differences between residents and tourists may affect the social evaluation of the whole event considerably.
According to the resident point-of-view, the development stage may dramatically affect the social influence of the event, because the tourist's perception will critically influence the local communities affection to the event. Moreover, there need to be considered a social reaction from the community. Consequently, there are produced many stage-based models that involve the characteristics of the destination type of tourism activity for evaluating the reaction that the event may produce on the host community. From the previous analysis, there are produced the significant positive and social impacts that the events may produce.
The main negative social impacts of events can be described as follows[15]:

- **Sexual disease,** *some of the attendees tend to travel abroad for enjoying casual sexual encounters and, in this way, several tourism markets have enrolled sexual content in their tourism production. However, at the same time with this market increasing, also the grave danger*

11 Fredline et al., 2006
12 Saayman, 2001
13 Cooper et al. 2005
14 Getz, 1997
15 Raj. R. et al. 2012

Fig. 4 (right)
Meditation workshop duing the 32nd edition fo Burning Man Festival.
©2018, Hu J.

of sexual diseases has dramatically increased

- **Health,** *the global outbreaks of major forms of influenza are now spread with at global scale community. Moreover, a rapid spreading of the COVID-19 emergency may give us the example of how the abroad travels have obtained an ordinary dimension; in this context, also the events seen as a interaction process of thousands of foreign populations, play a dominant role in the global disease traffic*
- **Commodification, staged authenticity and standardization***; in this way, the cultural performances and authenticity of a territory may be involved in a strong modification of their aspects for satisfying the visitor needs.*
- **Disruption of lifestyle of residents,** *with the increasing traffic and noise produced during the event, influence the host destination community*
- **Crime and vandalism**, [16] *the carrying of large amount of money inside the event has led to the proliferation of several illegal actives such as drug trafficking, robbery, vandalism, and violence.*

Unless a properly monitored and controlled organization, these impacts can also break up the social behavior that would tend to enhance the social cohesion aimed to be realized by the event.
However, the event also acts as a productor of many positive social impacts, and there have identified them as follows[17].

- *The fostering of community/civic pride, this process is able to inspire a local community for providing a cultural social experience to the event attendee*
- *Developing sociocultural awareness and peace, they can create a new behavior knowledge of other cultures and environments. This 'educational process'*
- *Leads to a greater awareness, sympathy and admiration for other societies skills.*
- *Shared infrastructure, during the planning phases also the local infrastructures may be involved in the construction by enhancing and meeting the needs of the developments. In this way, the well-being of the host community may be enhanced by ensuring a new and improved structures*
- *Direct Sociocultural support, by the creation of funs to assist and restore the heritage sites, conserve natural and cultural sites, or assist local charities.*

16 Mathieson and Wall, 1982
17 Cooper et al. 2005

SOCIAL IMPACT ON PEOPLE	DESCRIPTION
Their way of life	How they live, work, play and interact with one another on a day-to-day basis
Their culture	Their shared beliefs, customs, values and language or dialect
Their community	Its cohesion, stability, character, services and facilities
Their political system	The extent to which people are able to participate in decisions that affect their lives, the level of democratization that is taking place, and the resources provided for this purpose
Their environment	The quality of the air and water people use, the availability and quality of the food they eat, the level of hazard or risk, dust and noise they are exposed to, the adequacy of sanitation, their physical safety, and their access to and control over resources
Their health and well-being	Health is a state of complete physical, mental, social and spiritual well-being and not merely the absence of disease or infirmity
Their personal and property rights	Particularly whether people are economically affected, or experience personal disadvantage that may include a violation of their civil liberties
Their fears and aspirations	Their perceptions about their safety, their fears about the future of their community, and their aspirations for the future and the future of their children

Table 3. Conceptualizing social impacts associated with events. Adapted from IAIA, 2003a, p. 4

Fig. 5
One of the main aspects that refers to the Burning Man Festival is its great attention to the social characters of the visitors. All participants are expressly asked to maintain a climate of peaceful coexistence within the event and to increase their relationships with others.
©2019, Juan P. Zapata

Main dimension of the social impacts assessment (SIA)

From these two types of impacts, we can try to define the generic social impact definition. In this way, the social impact can be understood as the consequences to the human populations that are subjected to meet other people live, work, and play in their territory, influencing values and beliefs that guide and rationalize their cognition of themselves and their society.

The main dimension of the social are defined in the following categories:

- *Culture*
- *Community*
- *Political system*
- *Environment*
- *Health and well being*
- *Personal and property rights*
- *Fears and aspirations*

Under these aspects, the social impact assessment may start the analysis. The assessment is viewed as anticipatory research, that is able to gather data on the similar impacts of alternative options and then using the results for evaluating the best alternative that have to be implemented.
In this way, the SIA is used as a framework that is able to incorporate all the impacts created on humans according to the interaction of people

with the sociocultural, economic and biophysical surroundings. The SIA is then used for a design process of research, planning and management of change arising from policies and projects. In this way, the SIA aspects need to be included in the project design, planning and implementation, for determining an acceptable, equitable and sustainable development.
The SIA is followed by guiding principles[18]:

- *The equity consideration plays a fundamental role in the analyses;*
- *The capacity of predicting many of the social impacts;*
- *Planned events can be modified;*
- *SIA is an integral part of the event development process in al the phasing stages;*
- *The SIA needs a strong implementation with the sustainable development;*
- *The event should be planned in order to build the social and human capital of the host community*
- *Determine ways to benefit the host communities;*
- *SIA should determine alternatives of any planned event*
- *A major consideration has to be given to mitigation measures of social and environmental impacts*
- *The organization should incorporate local knowledge and experience*
- *The organization should ensure the avoiding of violence*
- *The organization should ensure the avoiding of any violation of the human rights*

All these principles lead to the aim of build and develop as significant social capital, a net-based system of network and trust between the event and the local territory. For achieving this objective, the organizer would therefore need to ensure that the development of the event can maximize the benefits and minimize the costs. The event manager also has to identify the impacts in advance, basing on the aim of pursuing better decision for the event realization and applying mitigation measures that can be implemented for maximizing the benefits.
Furthermore, for assisting the assessment, the IAIA has indicated the main impacts regarding the social impact evaluation.
When applied to large-scale events, the SIA has effectiveness strictly correlated to the quality of data, assessment methods and analysis it uses. This concept requires considerations of the context's cultural, political and socio-economic characteristics, and also include the legal and institutional regulations.

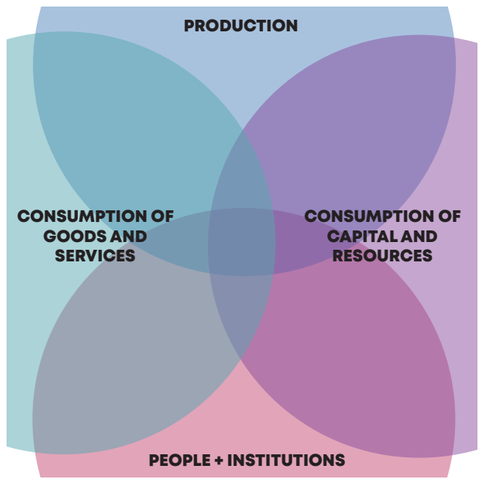


Fig. 6 The concept of economic sustainability, adapted from Raj. R. et al., 2012

Economic sustainability

The benefits of industrial innovation technologies engage the responsibility for sustainable aspects. In this way, these aspects enrol the enterprises in the knowledge and skills for influencing all the industrial processes for adopting more sustainable processes and practices. Thus there comes the need of adopting sustainable economic management of the production, for avoiding the over number expense of natural resources and their useless consumption. Also, the rising concern of developing countries over the last two decades 2000-2010 and 2010-2020, have raised concerns about social and environmental impacts of the economic decisions undertaken by the business organisations. Therefore, the sustainable approach that enrols economic sustainability becomes a substantial aspect of the decision making of sustainable development practices.
From this analysis, there comes the need for principles of economic sustainability and new approaches for helping the government and the industry when implementing efficient and effective economically responsible decisions. The process aims to benefit the communities without comprising the natural resources on the long-term scenarios.
Moreover, within the boundaries of the event industry, as we have mentioned in the previous chapter, sustainability is a relatively new concept of development.
Also, during the sustainable event analysis, the economic impact studies are often undertaken for a variety of purposes. These investigations usually concern elements of cost-benefit analysis, concerning the cost of hosting the event in comparisons to income generation and visitor expenditure. [19]These concepts also provide long-term benefits to the hosting communities such as increasing community profile, increasing employment, adding more trades and urban regeneration.
Moreover, the implementation of an event in a specific territory adds a catalytic effect whereby an increase in investment, coupled with additional monies and also creates tangible effects for the local way of living, such as improved tax revenues, increased property prices and a sense of personal

18 According to the methodology produced by IAIA, 2003,

19 R. Raj et al., 2012.

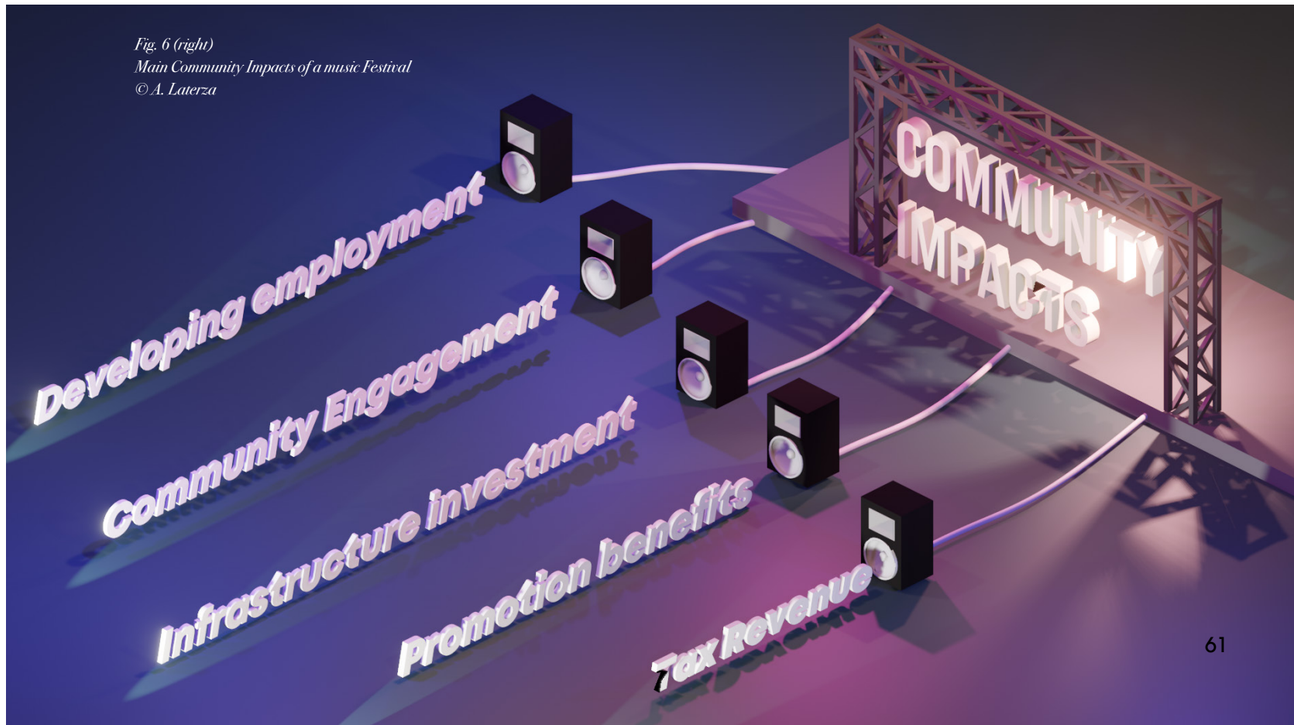


Fig. 6 (right)
Main Community Impacts of a music Festival
© A. Laterza

wealth.
Nowadays, with the presence of global economic systems that overexploit the natural resources, the population is consuming more significant quantities of these resources at an ever-increasing pace, the compelling evidence of the growing gap between rich and poor people is fast becoming a chasm were economic leaves behind the neglected society where health, famine and poverty and social injustices multiply (R. Raj et al., 2012)[20].
The economic concept of sustainability is therefore originated and developed for the need of analyzing and forecasting the future activities of cities and countries. Moreover, the British Government Panel on Sustainable Development (1994) states that economic sustainability means:
Most societies want to achieve economic development to secure higher standards of living, now and for future generations. They also seek to protect and enhance their environment, now and for their children.
Economic sustainability becomes relevant in all national and international aspects because local economies depend on economic sustainability to make choices in a socially responsible environment. Each territory is strongly bent to their 'direct' and indirect sustainability practices.
For representing the sustainable economic aspects in a graphical form, we may introduce a model that enrols the key-fields of economic sustainability.
This model represents the main aspects that bond the economic sustainability: production, consumption of good and services, the consumption of capital and resources and, lastly, people and institutions.
Hence, the interactions represented in the figure influence the main success factors of the decision making sustainability. Also, these four aspects intended to cover all areas of business, generating an input and output analysis of decision making.
Also, the theory of economic sustainability is linked with maintaining an efficient system profit and utilizing varied capital items and resources within the business environment.
Therefore the businesses are not considered as separated entities: the successful approach for sustainable economic evaluation is a holistic approach that bends all the component element process.
The economic sustainability that precisely concern event management enrols the creation of positive impacts for the long-term place marketing benefits and media exposure for the territory. The primary economic intents also regard the active participation of the local communities, utilize social capital and limit dependency on external businesses. A grassroots approach to rural tourism development, therefore ensures that tourism becomes a community

20 R. Raj et al., 2012

COSTS	BENEFITS
Noise reduction strategies	Financial gain for local businesses
Cleaning up the area	International exposure through media and marketing
Pollution	Developing community cohesion and pride
Criminal damage	Creating jobs
Empolyment cost for workers and police	Cultural impact through increased tourism and visitors
Organization and development costs	New facilities for local area

Table 4 ,
a theoretical CBA approach in the preliminary phase;
adapted by Raj. R. et al., 2012.

production. Furthremore, an event is often able to attract the tourists' attention in the territory[21].
Therefore, thanks to this sustainable development, the event can generate positive economic impacts, in addition to long-term marketing benefits and media exposure for the destinations. Also, the local community can become an actual supporter of economic innovation, becoming increasingly popular and encompassing a diverse range of economic themes. For example, events having a broad inbound audience are recognized as having a positive economic impact on town and cities as visitors may spend money on accommodations, retails, foods and drinks and further services.
Moreover, according to the organizer point of view, festivals and events that lead their bases on the long-term are seen in a very positive manner for the local community: they can generate economic sustainability in the whole community through the event tourism. Although events may have a positive and negative impact on the local communities, the event organization is often focused on political initiatives to be applied.
Lastly, in order to receive a more significant economic sustainability, the local communities can create host destination, by developing employment, additional trade and business development, investment in infrastructures and other long-term promotional benefits. It is, therefore, of massive importance, creating significant development not only for reviewing the actual situation but also to identify and manga the impact to assist in maximizing possible future benefits.

Cost-Benefit Analysis of Sustainable Events (CBA)

The analysis is a formal discipline assessed by the event organization, to evaluate a project or business activity and make objective economic decisions. This technique can enhance the quality and efficiency of any new business activity, investigating causes and effects on the different stakeholders.
The process involves the feasibility study as well and, by the integration with economic sustainability, the analysis has to include the main objective of bringing benefits of the large-scale event to the local community.
Therefore, the CBA measures the net benefits that will be generated from the event, including the estimated number of attendees coming to the area during the whole duration of the event.
Moreover, the CBA approach has the following benefits:[22].

- *Assessing the monetary event value;*
- *Assising the external effects of the event;*
- *Proposing expenditure decisions;*
- *Adding valuate to the promotion of cultural pride;*
- *Looking at positive and negative social effects of the event;*

Also, it may include some limitations, such as:

- *Ignoring the flow-on effects of the event;*
- *Ignoring the overall impact of the event on the economy;*
- *Tenderness for a monetary evaluation of the event.*

Moreover, events and festivals are a massive economic sustainability concept for local authorities, Therefore a decision-making process that can create a long-term strategic vision for the event management is explained by Raj. R. and we may summarize it in the further objectives:

- *Develop holistic thinking;*
- *Link divers' communities through festival;*
- *Involve local community leadership;*
- *Learn from local community groups;*
- *Create partnership with local community;*
- *Make difficult decision to enhance economic sustainability.*

Lasty, events and festivals give the opportunity to share with local community's different cultural heritage, bringing together community people from several different background. Thanks to the provisions of different cultures, individual and social values, the sustainability can benefit in the long term of a new exchange of information.

21 Brwon et al., 2004,

22 Raj. R. et al., 2012,

4.

APPROACHING THE ENVIRONMENTAL ISSUE

Why have we decided to focus our work on the environmental issue?
In this chapter we will describe the main topics of the environemtnal aspects that a temporary music event is undertaking in our days, and then we will consequently define our main objectives and decisions about the development of a sustaianable innovation for the event sector.

As we have seen in the previous chapter, the aspects that concern the sustainable development of an event are many and all equally relevant. Nevertheless, this research aims to give new factors and new concepts for efficient, sustainable development of events. Hence, due to the wide presence of many aspects in the event sustainable scenario, this research wants to put its valuable contribution on a series of methodologies that aims to cooperate with a broader spectrum of well-formed intentions of a new context of sustainable development. For these reasons, our research wanted to take shape on a non-summary. However, the well-defined development of areas of analysis thus represents itself as a single frame of a panorama that can be constructed, assimilated, and innovated in conjunction with the other contemporary innovations.

Nevertheless, creating a temporary event means creating something very similar to a small city. The idea of producing a host that accommodates power, toilets, water, transport and waste means that a temporary event embraces many different services that consume a great deal of energy. The idea of a temporary event consuming countless helpful resources and producing an enormous amount of waste is the furthest thing from sustainability. Moreover, the basic principle that has driven the entire culture of events remains, namely, the aim for which these events exist: human aggregation. The human being is defined in the sociological sciences as a social animal. As a social animal, public parties always have and always will be a part of human history. From this point of view, sustainable development within the event regenerates the same basic concept, developing an identity that leaves the animalistic part of the individual intact but at the same time leads him towards the scenario of active sustainability in his identity as an inhabitant of the earth. However, this scenario would be broken up or exposed to huge gaps if even one of them were missing. Thus, to quote R. Jones: "if all event organisers, from the largest commercial shows to small community fairs, kept sustainability at the core of their planning, the cumulative outcome would be impressive.""[1] .

Therefore, we have to use our concept of individuality in the human grouping that can bring together all the profiles of everyone. Just as it happens within an event, the union of individuality creates its power, giving life to a cohesive system where the human being becomes both the fulcrum and the missing piece of a core that encompasses him. With the same concept, this work's contribution will also be a fulcrum and a piece to be included in the sustainable development scenario, bringing a functional improvement.
According to Laing and Frost, the tourism sector's attention to the growing impact of its many activities is increasing rapidly. At the same time, therefore,

1 R, Jones, 2008

the importance of sustainability is moving towards great interest. The events sector is also moving towards these indications, and its crucial point of interest concerns sustainability strategies, defined in jargon as 'green strategies' that give the community the promise of a 'green renewal' of the area: in other words, the event concept wants to show itself as a way to leave the place better than it found it. This concept mainly occurred when an intense campaign of negative mass-event promotion brought public attention to the consequences of the strong pollution generated onsite. Numerous strategies have thus begun to emerge, including the triple bottom line, a method of analysing the event in which reference is made to its main cornerstones of the activities, which it meets in sustainable terms. Also, environmental concerns have led to co-operation between different organisations in order to make a more conscientious choice of 'green' strategies to be implemented in the services offered by the event. Some of the mass events that have taken part in these initiatives are the 1998 Kuala Lumpur Games, the 2006 Winter Olympic Games, and the 2009 Formula 1 Grand Prix. However, these highlights in the development of the event occurred during a period in history when they could be considered more exceptions than modus operandi that were beginning to be widely used.
However, this historical period, climate change and the current situation of technological innovation are leading organisational consciousness more and more towards the active integration of these elements. As Getzaffirms, the acknowledgement that attention to environmental outcomes of events is a priority area for research. This attention to developing better environmental sustainability can only be defined by the event's incorporation of sustainable practices or incorporating sustainable practices into their operations. Sustainability, therefore, requires an area of development that is well defined by strategic goals that come into play for a successful implementation.

Operational issues undertaken

TIn order to realise an environmentally sustainable event, it is necessary to look at the operational activities within the planning and activities. Events Activities can be related to onsite activities and the operations before and after the shows. Also, these activity aspects relate both to the event and the input and output parameters that affect the event. According to research that has been produced by Bottrill et al. 2008., the most significant pollutant emissions from an event are, in order, mainly three: (1) emissions from transport, (2) energy supply, (3) waste and litter. In addition, event organisers are still looking for new methodologies to highlight their sustainable practices.
The choice of a venue can be made irrespective of the venue's ability to incur the possibility of optimised transport, waste management and green power. Not only that, but the possibility of carbon offsetting is also a crucial and

relevant decision. Hence, the choice of materials, logistics and marketing can favourably change the audits of green events. However, it remains crucial that all these activities are coordinated internally.
The accessibility of public transport is a fundamental element, as it is the source of some of the highest GHG emissions and negative impacts on local nature. The use of cars could thus hinder the green development of the event, and some places could be inaccessible except by car. A possible solution is identified in carpooling or, even better, the use of shuttle services. Moreover, Waste Management is another critical issue on the agenda of the events, especially in the chaos of fragile environments. Thus the use of composting toilets becomes interesting and the promotion of recycling and minimisation of food waste. Nevertheless, energy represents the third most crucial impact within an event, which, as we shall see, is implemented in more sustainable forms of sustaining the event.
Therefore, the main activities that are configured within the event are: Design, Travel, Energy, Waste and Water, and their sustainable developments are synthesised in the fulfilment of some of the primary environmental practices considered as 'greening' intentions. These actions are defined by changes in products, processes and policies: reducing energy or water and waste, green and sustainable resources. However, the implementation of an Environmental Management System is a methodology that is often used.

Therefore, cooperation between these elements is crucial. The cooperation of the parties in these activities is thus a point of difference and possible competitive advantage. Hence, the possibility of promoting these practices using certification has given greater cooperation between the parties, promoting these activities according to a predefined order and commissioning them. These activities are presented below to show how the sustainable development of the event is progressing.

Parties involved

When the International Coast Blues and Roots Festival (Bluesfest) in Australia proposed six strategic goals for sustainable implementation, it was evident that aspects such as reducing onsite pollution, carbon-neutral initiatives, had a multidisciplinary focus that embraced the festival as one would any city community. The festival, in particular, functions as a natural ecosystem, in which, although the

fig.1
The Sustainable Mission 'leave no trace' is completely undertaken by all parties involved in the Burning Man Festival; in this picture, some participants have been inspired by the Sustainable event's mission 'leave no trace' when creating their own event vehicle
© 2016, Bill Klemens

organisation touts the goal, it is not the last one to be interested in the problem. For Bluesfest, the main issue was understanding how visitors and other partner stakeholders were concerned and how the events are received and or/in repeat involvement. Nevertheless, there was a great deal of apprehension on the part of the organisation in staging green events. From the very first moment, the main message to all cooperating companies was to respect and engage the local community. Hence, visitors, sponsors, venues, agencies, and governments were all interested in the sustainable issue through practices, supporters, and contributors to the event. However, as we mentioned earlier, a 'green' event is not always widely welcomed by enterprises, and not all stakeholders can be necessarily supportive. Events are often organised by stakeholders with divergent and sometimes conflicts of interests, thus requiring collaborative support and partnerships to be developed by both parties. Stakeholders involved in this process are[2]:
- sponsors
- community groups
- relevant government agencies
- department venues or land managers

It is not always so easy to achieve complete co-operation between all these events. It is necessary that all parties have approved the mission and that their intentions are extended in the long term, as many of the activities that include the sustainable participation of an event are developed in the time frame of the activities and the preceding and following phases.
This harmony between the parties is not only an indication of a good event but also, as Macbeth says, an indication of a 'social capital' that allows good co-operation in that community territory. Co-operation thus enables the presence of 'active interactions, connections, sharing of norms, trust and reciprocity that in turn foster co-operation to achieve joint ends. This involvement is thus fostered between organisations and stakeholders through round tables, which can help communication between all parties, build consensus and minimise conflicts that may be generated.'[3].
The importance of cooperation can also be seen in the success of the Burning Man festival, where the main feature of the event is to set fire to the main feature of the event, a wooden statue, which releases a large amount of carbon footprint. In order to make a carbon-neutral event where the presence of a large number of carbon emissions is ensured, a huge participation of all stakeholders was required. The thousands of participants who flock to the event each year were only able to attend the event by using renewable energy for their activities,

2 Laing and Forst, 2010
3 Jones, 2005

and at the same time, showing an active interest in learning sustainable practices.

The same interest was also shown during a survey carried out by the organisation of A Greener Festival, where it was shown that participants were aware of the strong nurturing imprint generated by the event (56%) and that around 48% of those who took part in the questionnaire would willingly pay an extra ticket price as long as there was greater integration of sustainable practices.

This sense of re-appropriation of sustainable practices thus becomes the very theatre in which to enact active participation to be brought back into the everyday life of one's community. Indeed, sustainable events endure in the consciousness of the participants through the promotion of cultural, economic and environmental intentions. Events thus become, in sustainable development, a heritage to be kept active in the nation to develop the community conscience of each participant.

The band Radiohead has begun to carry out a carbon audit of its performances, seeking real solutions to environmental pollution problems.

Therefore, the sustainable topic, particularly the environmental aspects, does not affect only a part of the users of the event, and therefore it is not possible to implement a real improvement if only one category of users takes charge of the problem. Environmental sustainability is therefore based on active co-operation between the organisation, stakeholders and attendees.

Environmental Management Organisations

Life Gate project

This tool is freely offered by the Life Gate 2.0 organization and offers a specific calculation methods of the CO2 emissions generated by different events, products and businesses. The methdology is based upone the Life Cyalce Assessment (LCA) scientific calculation. In addition, Many universities and other public auothorities have yet enrolled in the project; therefore, the second step of the project is fastly moving on. Infact, their main aim is to produce a carbon offset carried by a reforestation - planting new trees- and an afforestation - planting trees where there was never been forested before.

Also, the organization produces the Carbon credits, that the same organization descrives as '*a stock exchange*' between different companies. Such credits are generated by the tree planting trees.

Their purpose is to make this calculation tool as simple as possibile. Therefore. their methodology is copmletely offered in a web based version on their websits.

At the moment, many National and international acts have yet taken places.

At the moment, the organization is taking place in several forests of the world: they have already acted in Italy (6), Madagascar(6), Costa Rica(3), Panama (1), New Zeland (1) Bolivia (1) and Cambodia (1)

A private corporation for promoting sustaianable lifestyles and asssessing the carbon emissions generated by events.

Julie's Bicycle

This is a London based charity organization that supports the creative community to act on climate change and environmental sustainability. They provide a program of events, free resources and public speaking engagements for contributing to the policy development.

Supporting the Paris Agreement goal to limit global warming to 1.5 degrees Celsius by focusing on energy, they have created many tools for the sustainable energy framework. The suite of Carbon Calculators, a certification scheme, Creative Scheme, is the recognized benchmark for sustainability achievement between the creative industries. This organization is mainly focused on the arts and cultural sectors. Their main key objectives are (1) advocate and for a publicly inspire on climate change and sustainability while (2) supporting the Paris Agreement Goal to limit global warming to below 2 degrees by focusing on energy.

A volountary management tool for any organisation that aims to assess and manage its environmental perrofrmances.

A Greener Festival organization

This is a non-profit organization that has the task of helping organizers of events, festivals and venues around the world to find new ways to reduce environmental impacts. They were among the pioneers of this research already in 2005; to date, they promote certification, training, expertise and facilitate the exchange of best practice. They also instituted the A greener Festival Award, in which nearly 500 events across five continents participate providing the first event certification which includes on-site assessment and independent verification such as an event analysis across 11 categories of sustainable strategies.

a Greener Festival Award

A certification for event sustainable practices

This description led us to recognise the stakeholders involved in the innovation of environmental sustainability within the events. From this analysis, we now want to proceed to the definition of the main categories involved: Design, Energy, Travel, Waste and Water. Following the elicitation of these elements from the knowledge of the parties involved, we then want to proceed to the realisation of an experimental study for the improvement of the current situation of sustainable event organisation. When the decision is made to plan a music festival, many variants play a predominant organisational function that plays a fundamental role both in the development of sustainability and in the demands that the event itself entails. For this reason, the work now aims to present the fundamental prerequisites that a festival or a music event needs

for its realisation, and furthermore, we want to decline these aspects in the current scenario of sustainability.

Principles for a planning a music event

Typology

First of all, one of the fundamental aspects influencing the realisation, planning and organisation of an event concerns its typological form. By typology, we mainly mean the possibility of holding an event in different scenarios: urban, suburban or greenfield. here multiple hundreds of festivals in the world all-over a years, and typically they can be divided into three different typologies:
- Urban festival: within 15 minutes of the walk of a train station
- Peri-urban: within 15-30 minutes of walk from a train station
- Greenfield festival: greater than 30 minutes of walk from a train station

From these typologies, different issues can come with their location, together with the advantages that the place itself can have.
Typically, greenfield festivals are placed in a context that has rarely hosted events that gather large numbers of people, is typically used as farms or large parks. The large green areas will, therefore, be designed to have a low human interaction and, the occasionality of the festival could lead to a substantial impact on the ecosystem of the area. For this reason, the organizers of the festival may also be interested in preparing the area earlier than the festival itself.
In this case, it will, therefore, be useful to give the right emphasis on keeping clean and respecting the ecosystem; with a sustainable approach, we can choose to increase this degree of communication up to, for example, the communication of SDGs.
A substantially different situation is that presented by festivals present in an urban environment, since being already accustomed to hosting a significant amount of human traffic outside the festival area. Urban festivals are also able to boast several advantages with regards to the sustainability in comparison with greenfield festivals: one of the most important is undoubtedly an existing transport network allowing the organization to dramatically reduce a carbon

footprint created by ad hoc transport infrastructures.
Therefore, these three main scenarios drastically affect the possibilities offered by the venue and the possibility of implementing means of transport already present in the area. Selecting venues, depending on whether there is a capital city nearby or not, makes it easier to reach and provide services for all the logistics of the event. However, within the category of the type, the period of the event, its duration and the possibility of campsites in the area are also included. However, it is also necessary to establish, for a reason which also affects these aspects laterally, the type of activity present within the festival, if for example there are proposals for activities aimed at a single scenario of spectators, or different categories of interest are proposed.

Targeting

Successivamente alla definizione della tipologia, ènecessario procedere con la definizione del pubblico e come esso potrebbe essere presente, sia in quali quantità, sia nella quantità attesa, sia nella sua età e genere. questa principale definizione comincia anche a definire la grandezza della dimensione del festival. Come si può facilmente capire, più grande è la dimensione, e più significative saranno le presenze previste. Inoltre, la dimensione, e i partecipanti, influenzano anche la posizione della sede, che può essere definita principalmente come Urban - contenuta in una specifica area architettonica della città - o Greenfield - senza alcuna architettura urbana di rilievo all'interno della sede. Queste quattro dimensioni sono realizzate grazie all'analisi completa delle mostre quadriennali. From this idea, there may define four main festival sizes:

- *Small: less than 5000 attendees;*
- *Medium: between 5'000 and 20'000 attendees;*
- *Large: between 20'000 and 60'000;*
- *Major: greater than 60'000.*

However, although it is useful to target any age present at the festival, it is worth noting that, according to various research studies, the size of an event never varies with an attendance of more than 35 years. Not only that, targeting is also useful in defining the possibility of paid or unpaid attendance at the event.

Site areas

The definition of these spaces makes it possible to understand the sizing of the accommodation structures suitable for the demand of spectators who may come to the event. The aim of the festival is in fact also to allow the usability of all the spaces in an effective way for all the participants, and this dimensioning must necessarily be commensurate with the demand of the participants, as well as the total security of the place. Therefore, below we present the three main categories of the festival: stage area, trade area, and other infrastructures.

Performance a 1 nd stage areas

Quest'area è indicata come i palchi utilizzati dagli artisti in loco. A seconda delle dimensioni del festival, questa zona può variare le sue dimensioni, ma i principali stadi di musica sono sempre i sistemi regolari più intensivi che hanno bisogno di sistemi di energia direttamente sul sito.Stages principalmente utilizzare l'energia per l'audio, video e illuminazione attrezzature; anche se ci possono essere molti differenziazione scala di ogni evento, questi saranno sempre i requisiti massicci.Un layout di potenza tipica avrà una fonte separata per ogni palco, e questa fonte di alimentazione sarà utilizzato esclusivamente dal palco e qualsiasi vicino sistemi associati, come l'artista hospitalities.

Trade area

These parts of the venues are dedicated to on-sites stalls which engage the public commerce that is not controlled by the festival. The leading traders usually are operating for selling goods or services to the public, such as clothing stalls or food stands. At small festivals, there may be several contractors collaborating to provide bars; however, at medium-sized festival upwards, and a sole contractor typically provides the whole bars.
In addition, the site layout will be favourable to arranging the traders grouped into islands, in order to provide an area nearly them for storage, parking, preparation, and camping. Each trader is then provided with an independent power source, thereby reducing the quantity of cabling and complication involved in power provision. According to the size of the event, the power supply may be the same as for nearby traders or stages, or independent sources may provide them. The number of trader islands varies upon the size and layout of festivals. In order to operate with energy safely and correctly, there are usually placed some independent energy site infrastructures. These energy systems are used for lighting, production spaces, waste facilities, catering, and tour bus power provision.

Site infrastructures

These lands refer to all the other remaining systems needed for the correct service functioning and are not open to the public attendees: production spaces, waste facilities, staff catering, tour bus power provision, car park, security, and campsite lighting. The electricity mainly needed in these lands is dedicated to lighting and maintenance devices

Transports

As described in chapter 4, the co-operation with local authorities, provides fundamental support for the logistics and sustainability of the event. Being able to plan the event's transport allows for the creation of ways of using the event that not only significantly lower the total carbon footprint, but also allow for numerous improvements in space planning. However, the means of transport still remains the private car. Sometimes, this choice is mainly dictated by an easier communication of the infrastructures, and for this, the festival is in charge together with the organisation of making it as efficient as possible. However, many times the private car is only seen as the preferred means of transport for users. Transport planning can offer spectators many optimal choices that can improve both their personal experience and carbon footprint. In this case, the main forms of transport are listed below:
- private car
- taxis and vehicles with driver
- public buses
- bicycle
- Ferry,
-coach
- plain
Obviously, in the case of a transport analysis for the

Fig. 2
An aereal footage
of the Glastonsbury festival 2019
© 2019, manchestereveningnews.com.uk
manchemanchestereveningnews.co.uk

event, it is necessary to set limits to the possible forms of transport.
However, if the owner-operated car remains an essential component of transport, the question arises as to the main reasons for this preference. Firstly, it has to be understood that many places, requiring large unspoilt spaces, are often kept difficult to access by non-owned vehicles. For this reason, the implementation of alternative means becomes an excellent improvement strategy. In this case, the possibilities can be: the implementation of car-sharing, scooter sharing, and car-pooling services. Finally, one of the possible results could be the use of bicycles, so think about methods of renting bicycles, if needed, or to shorten distances and save on the ecological footprint.

Stage and other structures planning

The planning of this environment is mainly based on the energy demand of the event. This amount, however, is not easily quantifiable by the event production organisation, but is sent directly by the manager of the artist who will be performing. Therefore, lighting, video and audio equipment is mainly planned in conjunction with the expressed requirements of the artist partnership. Neverthless, it is necessary to plan, on the basis of the previously mentioned categories, if it is necessary to be able to insert more than one stage in the air for simultaneous performances. In this case, the performances that would require more than one stage can also be subdivided according to

Fig.3
The Terraforma Stage area is particularly charcterized by a relevant attention to a sustaianble design of the stage itself
© 2018, nastymagazine.com

the degree of forecast demand from the audience and energy demand. The demand of the activities present in the event, allows to quantify also the amount of energy needed, with possibly renewable sources.

Design of spaces and optimisations of preexistences

after the design of the general requirements, the design of the space is proceeded with, through the design approach of the area and the required surfaces. the main focus of this solution is to favour both the use of a catalogue of materials and elements already present, and to try at this stage to include space optimisation factors. in this case, the sustainable approach actively becomes part of the development of the venue. The optimisation of materials, water and energy recovery makes it possible to have a strong positive impact on the success of the event in a more sustainable way. Therefore, from this key design information, it is also possible to calculate the ability of the carbon footprint to be decreased.

Fig. 4
One of the trade areas inside the Melt! Music Festival venue
© 2019, Stephan Flad

Food, drinks and their disposal

The planning of an event must also take into account the possible waste disposal requirements resulting from the production of food and drink at the site. Optimisation, in this case, takes part in the whole production chain, starting with the realisation of the food and ending with its disposal. Nevertheless, the use of plastic material can considerably increase the carbon footprint of an event. for this reason, at this stage, planning activities such as refilling the same glass, or avoiding single use plasitc, becomes an interesting methodology which we will explain in detail later on. The management of the impact of food consumption does not only stop at production or consumption, but also at disposal, and in this case, disposal becomes necessary for a real improvement in efficiency. One could, at this stage, also plan methodologies to promote a conscious recycling of materials that are consumed during the event. In this case, the main categories of waste are:
- plastic
- paper
- cigarette ends
- wet waste
- dry waste
- allumininium
- glass
- other spcial waste

5. DESIGN

Role of the stage in events

As we have seen with the previous historical analysis, we are now at the beginning of the post-war period. This is the right time for a new concept of live music, in which the stage is fundamental. Exultation and enthusiasm are among the main factors of this decade, and in this case, new groups and musical inventions allow for the creation of new styles, genres and creations. The first concert held in a stadium took place at Shea Stadium in 1965, with the Beatles as the main attraction.
Although the minimal size of a stage at that time, the first performance of a stage on a large audience remains a critical factor because it is from there that the first significant design requirement to define the demands of a show of forty thousand spectators all gathered at the same time was born. Thus, the figure of a scenographer began to emerge when a spatial dimension of the audience had to be taken into account: he had to combine the personal spectator experience with sound, distance, and light dynamics.
This event thus became a milestone in music, and a few years later, the history of music would be enriched by a mass event: the Woodstock Festival, where rebellious young people, known as hippies or flower children, flocked for 15 consecutive days to dance to live music.
The concert was iconic for all the spirit that moved the activities of that period. The stage as a place of aggregation became a way of gathering and letting people disperse around a fixed point, an ever-present landmark. The real landmark of the event is represented by a structure that seems to collect the artists and dress them in a new bionic body made of lights and sounds. People were all united during this experience, and the music, right from the first moments of the event, did not desist from being carried on, even though adverse weather events threatened to interrupt and put the entire event at risk.
A similarly interesting event took place the following year on the island of Southampton: six hundred thousand people flocked to a hippie music festival. The stage became a landmark, but it was not yet given any particular characterisation. Then, a few years later, the Rolling Stones introduced this new design feature, which made a series of requests during their 1976 tour, including creating a much more interesting stage for the public than the previous ones. The implementation of projection screens and scenic elements was requested to enrich the entire stage design.
The musical performance was thus evolving into creating a set that had the order to define itself as spectacular, adding to the traditional architecture new materials and technologies that drew on the field of production. However, this artistic expression was about creating a stage but reflected the cultural movement that sought new acts of freedom, creating even violent clashes of public order. An example that is interesting to mention concerns Stonehenge in the 1985 festival, when the event represented solid intolerance towards the nomadic community. An attempt to respond to this involution could thus be outlined, with the new creation of movements that tended to be more camouflaged in appearance and the creation of sound systems. The significant stages thus became a phenomenon related to the creation of mobile sound systems, typical of the 80s, in which the independence of spaces showed a new way of dance culture, liberal and independent. Perhaps, on this quest for independence of music, the stage became a lateral phenomenon concerning the function of sound emission, as it now became more of a theatre capable of hosting art in different aspects, not only musical. An example of this is the Glastonbury festival, where the activities are not only musical performances, but also the promotion

fig 1
Es Devlin's set design shows the semanticity of the stage as a structure that is still compulsory today in the realisation of a concert
© Ed Devlin Studio

of other theatrical activities, which can also include ecology, medicine and politics. Music, therefore, takes on accompanying the other arts on the event's stage, identifying new forms of performance gathering in new protagonists of this metamorphosis of man into a great icon of the event.
It is the same concept that is being pursued in many of the most important festivals, such as the 'reading' festival and the 'Roskilde festival', where the stages are now no longer just one but spread across the entire event territory to accommodate new activities taking place in the same place.
However, the cornerstone of performance remains the very need that gives rise to the use of a stage: the interaction between the audience and the artists. In many ways, structures can be considered essential, even conventional, architecture, i.e. containers to extend the artist's arms to as large an audience as possible. For example, compared to the stage that is used for a theatrical audience, the inclusion of the spectator into the performance area includes new mechanisms that only a temporary stage can give. In the case of music festivals and green areas, the 'stage task' is of bringing together the dynamics that can occur in the space of artistic representation and the message itself that the artist brings to the stage. In other words, this concept of tribality is based on the symbiosis that the artist creates with the stage, which will then turn it towards to the audience. The architectural space is the communicative nexus through which the visual messages can be expressed through symbolic and emotional codes. We can therefore deduce that it is for these reasons that the architectural space occupies a well-defined territory, in which the image is represented using strategies that produce in the spectator the effects of natural theatrical scenography.
These structures become the moment in which the artist and the public unite in a single language for a minimal time, the only tangible imprint of which will remain in the spectator's memory. For this reason, perhaps, an even more profound and sudden bond is created between the artist and the general public since both are aware of the ephemeral nature of the moment they are experiencing. Therefore, thanks to the stage, the spectators are the artist's observers, but the artist also becomes the public attendant. It is not a question of the artist's mere elevation but instead of the public itself having the possibility of being seen, thanks to the artist standing on a higher stage.
The fleeting structures appear during the night, which is understood to be the end of the event, and the work that goes into the design of these structures is meticulous in order to maintain the very concept of the idea, which is still important today, of the temporary nature of stage architecture. It is on this basis, therefore, that we can point to the

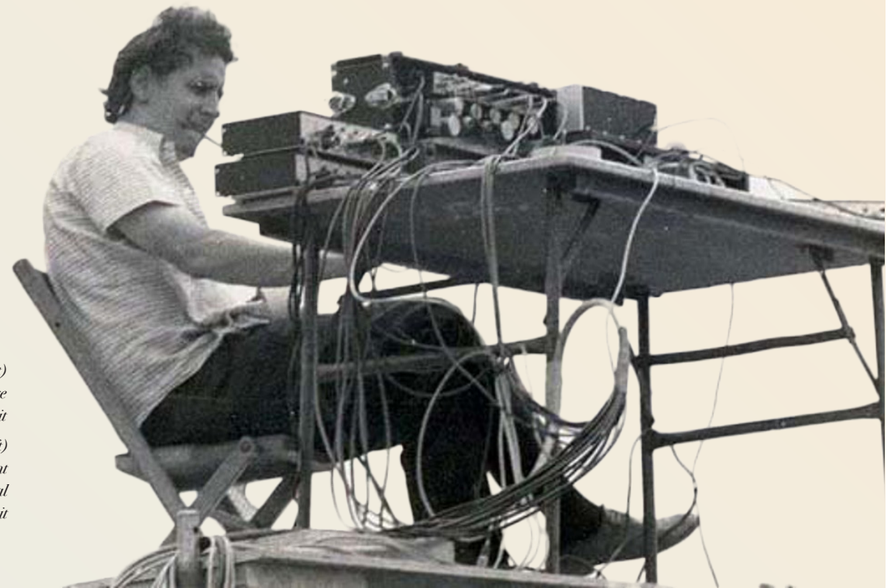


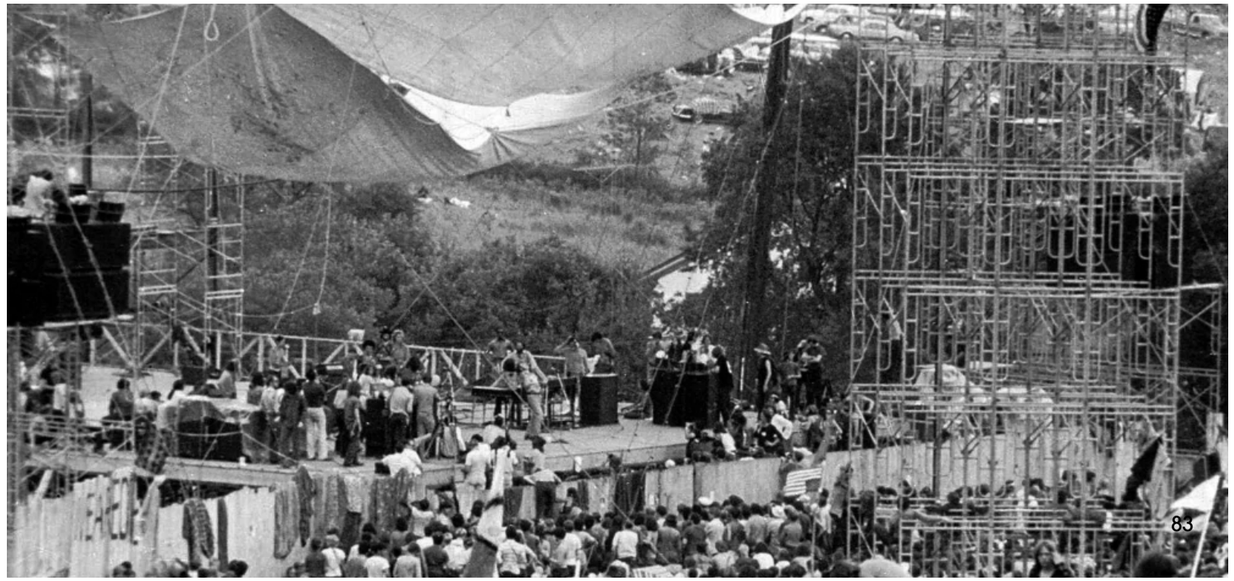
fig. 2 (right)
The '69 Woodstock festival main stage
© 1969, italiantechweek.it

fig. 3 (left)
Bill Hanley managing audio equipment during the '69 Woodstock festival
© 1969, italiantechweek.it

new movements that we visualise for the visual art of the spectacle: if at present, the spectacle takes place between the artist and the public, where the temporariness of the event must be processed during previous stages of scenic design, we imagine that it is the architecture of the stage itself, at a later stage, that enjoys this ephemeral nature of the act, allowing the artist, as well as the public, to enjoy the moment through scenic representation. An example is what happens with Coldplay, where with a simple luminous bracelet, the concept of the relationship between the audience and the band becomes even more intimate. Also, if it was possible to make this relationship enjoy the unpredictability of the moment, what would happen? This is the hypothesis on which we imagine that the future stage will move its conceptions.

Brief stage design history

The Stage Design is part of crowd management technology. Its structure has accompanied us on the growth path of festivals.
The history of the stage, just as in the history of sustainability, has a starting point delineated in the very decade we analysed in chapter 1. In 1969, with the great Woodstock festival, this discipline was delineated, historically speaking, as a vast improvement. Four entrepreneurs from New York managed to bring together the biggest bands globally; promotion in the small press gave rise to one of the biggest and most concerted festivals in history, with over 500 million people.
This breakout in music represents a decisive turning point in the realisation of the festival. In order to build a stage of that size, all concert equipment had to be related to these requirements for the first time. Previous concert events were catered for with small sound systems, sometimes already provided by the building hosting the event. However, in that decade, the entertainment industry was driving the innovation, and it was a need that pushed the demand for the rational to carry the artist's empathy beyond the previous 'wall of screams' that stood between the two. It is very characteristic of recalling the Beatles' experience at Shea Stadium in 1965, where the ephemeral stage of about twenty square metres and the equally derisory amplification could not overpower the screams of the band's beloved audience.
In 1969, organising a temporary, open-air public concert with more than two hundred thousand people meant embarking on a visionary project. To



fulfil this ambition, an engineer from Boston was the progenitor of this innovation that combined the physicality of music with its sound output. Bill Hanley, the engineer's name who did the audio management of many international Jazz Festivals and the Woodstock festival itself. He built the most significant ever audio thunderstorm with a 16 loudspeaker array, with a square platform on 20-metre towers, surrounded by columns of loudspeakers on the hillsides.
The technology of stage construction was in its infancy, but it was already a good discipline that would develop further and further up to the present day.
In the following decade, the advent of music and the physicality of structures were combined with a new integrator: lighting effects. Psychedelic light shows, or liquid light shows, appeared: rhythmic and repetitive movements of light beams involving the spectators and making them feel part of the show. This discipline is still favourably applied in almost any kind of festival. The pioneers of the advent of lighting were Led Zeppelin, who introduced laser technology in 1975. These small beams of light started from the back of the stage and moved around the space, involving the entire length of the audience. This technology proved fascinating to both the participants and the band's competitors. So, baing on the next tour, The Who implemented the same technology into their tour, which, as is often the case, also provided enhancements to the stage effects of its predecessors.
Moreover, futurism does not stop at individual lights but moves the stage like a temporary theatre capable of offering musical performances even more free expression and experimentation opportunities. In the 80s, the flying pig of pink Floyd. Not only that, even Michael Jackson used special effects, staging the magic of controlled explosions or light effects for Star Wars-style fights. However, this science never seems to stop its pinnacle of innovation, and so the next decade brings the significant expansion of the art of concerts. The advent of TVs and computers actively integrated into the whole concert set design. These new box elements were stacked on top of each other as if to symbolise large video walls. U2 and Madonna implemented these technologies in their first possible outlet.
Subsequently, the year 2000 offered territory for robotics and the computerisation of more complicated processes. Computer-generated graphics, renderings of three-dimensional models, and moving productions taken out of context became a new way of integrating technology into music. Mark Fisher managed to 'fly' Tina Turner across the stage with a robotic arm, while Daft Punk built laser-like realisations with parametric technology.
Nevertheless, as we have said, live event production technology is in a constant state of flux, and in the last decades, it is still moving towards new horizons, including the fusion of all these techniques into holographic representation. One example is Es Devlin himself, who includes significant special effects in his concerts to welcome the audience into the show, which takes place above their heads. A considerable whale floating in the air or signs flying above their heads are already the presence of a scene in great flux.
Nevertheless, the fusion of computerisation with special effects also takes place in the first person with the help of one's smartphone. Examples of this are virtual reality and augmented reality, where the user uses a smartphone or smart glasses. It is possible to enter the virtual world of music, visualise the music's lyrics playing in real-time, or change the face of elements of the scene by visualising them through the screen.
As previously mentioned, the reality is mixed with fantasy in holographic representation, which has become more prevalent in recent decades and has a glorious past behind it. In 1947, the Anglo-Hungarian scientist Dennis Gabor, who, in an attempt to improve the standard electron microscope, found himself inventing the holographic theory: a three-dimensional image that can be stored on a photographic film. In simple terms, a hologram is, therefore, a series of photographic recordings that produce three-dimensional images when illuminated with a beam of laser light. The mixture of reality and perception becomes even less tangible, and concerts and festivals become the theatre for this artistic liberation. An example is given in 2012, when, during the Coachella Summer Festival, the rapper Tupac appeared in front of everyone's eyes with almost natural features; but it was a mere holographic projection of the artist who died in 1996. In particular, virtual reality again breaks down the fiscality of the concert since, in it, the subject is no longer what the spectator sees but what the spectator is.
Virtual characters, spectres of imagination are part of the concentrate of holographic technology. The idea is to entertain the public in an increasingly profound way, thanks to involvement in three dimensions, and therefore in the first person. The spectator becomes the fulcrum of the point of view, unique and inimitable in the space around him.
This is how the forthcoming project aims to 'peel back from the two-dimensional film' great concerts in the past and that many performers were unable to attend. The holo-concerts promise to show and replay great performances by on-stage personalities such as Ronnie James Dio and Roy Orbison and Elvis Presley, Frank Zappa, Michael Jackson, Maria Callas, Amy Winehouse and Whitney Houston. Nevertheless, technology has already been taken to new limits by Eric Prydz (Swedish DJ, producer and musician), who, with his sixth EPIC 6.0: Holosphere show, created a music show that projected some of the most impressive holographic effects ever seen on digital screens and laser belts. Michael, an app capable of listening to him coming directly from the artist's speakers, involves the spectator by bringing his view of things from the point of view that does not stop at his presence in a given place of the event but manages to 'teleport' him directly onto the stage, together with the artist. Coldplay also used special effects technology to showcase the Xylobands, luminous LED bracelets that allow fans to interact with the live show. These bracelets interact with the viewer, showing the song's rhythm, changing lights and flashing according to what the artist is communicating from the stage, like having minor special effects on r wrist. The stage technology, however, remains the testing ground for significant innovations. The artist's involvement in the flesh in front of the spectator is still the core philosophy of the live concert concept, and the Muse concert is an example of this. In this case, the stage was designed at 360°, set up in the centre of the arena and rotating on itself. The recreated spaces when it changed were multiple, involving the spectators in a changing and never stationary theatre.

Current normative scenario

The construction of a stage is subject to specific regulations that guarantee stability and ensure a high safety level before sustainability. For this reason, its construction is regulated by the laws in force on the territory. In our particular case, the activity of supplying a stadium, it is necessary to frame it under its construction and regulatory point of view to understand how the current supply of the material interfaces and to be able to hypothesise subsequent evolutions of the technological sustainability of temporary installations. On the Italian territory, the body that regulates the construction of dismantling and assembly for the staging of concerts is presided over by INAIL il (Istituto Nazionale Assicurazione Infortuni sul Lavoro). The correct assembly of stages is supported by presenting the guidelines for the assembly, dismantling and erection of stages for events and concerts published directly by the body itself.This publication pays particular attention to the development of stages for the performing arts audience, examining the technical tools available for the construction of stages for temporary works and the equipment needed in the production and realisation of shows and similar events: the

assembly and disassembly activities, the works and the safety of the whole set-up.
The spectrum of analysis shows information from the Italian and the international context, paying particular attention to regulations in Italy, England, and the USA.
The guidelines take into account all the activities involved in constructing the temporary set-up, making sure that safety is never put on the back burner. Therefore, the mounting and dismounting phases must always be accompanied by installation diagrams and executive drawings of the project. Also, it must propose the documentation and methodologies with which the verification of the elements of the stage in question is carried out, and how the tightening of the connections between the elements of the stage is maintained inefficiency, according to what is foreseen by the manufacturer. It is always required, in this case, the efficiency of anchors ballasts and that the uprights are vertical and that the plan and facade bracing are maintained in efficiency through the appropriate visual checks.
Subsequently, the 'declaration of correct assembly' will be requested. It must declare that the structures have been assembled in a professional manner and positioned following the executive drawings and certify the static suitability of the overall system of suspended loads actually in place..

Safety as the primaryl technique

The need to define the construction of a temporary stage has been particularly pressing in the last decade. On 12 December in Trieste and on five march 2012 in Reggio Calabria, during the construction of the respective concerts of Jovanotti and Laura Pausini, two people lost their lives. The tragic events have made it clear that the assembly, disassembly and installation of temporary works of art used for these shows and events of lesser importance are very risky. Therefore, the requirement is to define, along with the correct construction of a stage, the safety for the stage itself, the entertainers, and the whole environment that is thus generated.
In addition, following the severe events, the Italian Ministry of Labour set up a working group to provide, in a document, practical tools applicable to all activities involving the assembly and dismantling of temporary structures. The work of drafting the 'Guidelines' continued until the publication of the decree-law of 21 June 2013. 69 (the so-called 'Decreto del fare'), coordinated with the conversion law of 8 August 2013, no. 98, containing 'Urgent provisions for relaunching the economy. With those above, 'musical, cinematographic and theatrical performances and trade fairs' were included in applying Title IV 'Temporary or mobile construction sites' of Legislative Decree 81/08, identifying the application of the regulations also under the Ministry of Health. In order to guarantee health and safety at work throughout the entire duration of the work. This decree has thus been in force since 2013. Subsequently, the work above had to be interrupted to cope with a new ministerial decree. In 2014, the ministerial decree of 22 July 2014, commonly known in Italy as the 'stages and fairs decree', took into account 'musical, cinema and theatre performances' and 'fairs and exhibitions. To add further clarification to the latter decree, in Circular no. 35 of 24 December 2014 containing the 'Technical and organisational operating instructions for the setting up and management of temporary works and equipment to be used in the production and realisation of musical, cinematographic and theatrical shows and trade fair events in the light of the Interministerial Decree of 22 July 2014'. Therefore based on these latest releases from the Italian institution, the working group resumes the initial drafting of the guidelines for the correct construction,
In short, therefore, the drafting of the stages decree, accompanied by the subsequent circular, had the precise task of filling in gaps and uncertainties on all the activities of assembly, disassembly and setting up of the same in safety, taking into account the particular requirements of the operational context.

Henceforth referred to as TS, temporary structures are therefore events classified as high risk for the safety of human beings. The presence of numerous contractors on the same site, the high number of participants in the work activities from different nationalities, and the concise and tight timeframe for completing and securing the entire TS.
As we will see later, the TS is mainly set up using prefabricated scaffoldings, sown from time to time in different locations, with unique geographical characteristics such as soil bearing capacity and weather conditions. The structural design is thus rather peculiar, asking to commit its technological characteristics of materials to an enormous spectrum of very different site characteristics.
For this reason, our following description wants to focus first on the definition of the main characteristics of these elements, examining and electing them in detail, and then to go on to compose as a whole the current state of its embodied energy..

Italian legislation and comparison with UK and USA

The Italian legal framework emphasises the importance of clearly defining the application of the regulation specifically to temporary works, indicated by the acronym OT, used for the specific realisation of 'musical, cinematographic and theatrical performances. The following definition describes the works as a work designed to be assembled and disassembled several times, as well as having the express characteristic of temporariness. This temporariness is highlighted by the fact that the work mentioned above must be removed after achieving the purposes for which it has been designed and conceived within the periods foreseen by the designer, and then it can be used again, after appropriate controls as well.

Therefore, the Temporary structure is defined as a stage consisting of: - a platform - vertical elevation structures - a roof structures. The English system has had some unpleasant accidents similar to those that occurred on the stages of Jovanotti and Pausini twenty years earlier. Eighteen people were injured in 1993 when the seats collapsed and, even more seriously, in 1994, about 1100 spectators were involved in the collapse of a removable structure at a Pink Floyd concert. The seats in the stands collapsed unexpectedly, causing the seats to fall more than three metres from the ground. Ninety-six people were injured, and thirty-six needed hospitalisation; fortunately, no one was killed due to the accident.
Following the unfortunate events, the UK Department of the Environment funded a guide called 'Temporary demountable structures - Guidance on procurement, design and use' presented in 1995 by the Institution of Structural Engineers, in conjunction with the Steel Construction Institute of the issues. The guidance achieved its aim. A second edition was released in 1999, which was supported by major companies in the sector, including Monitoring Group. However, in the following years, many structural failures required a further update of the guide. In 2007 it guided clients and local authorities, contractors, suppliers, and designers involved in the responsible design of demountable temporary structures.
TSs in the UK falls under the 'Construction Design and Management Regulation 2007', which defines the roles and responsibilities of those involved in construction. However, the regulation does not define the differences between conventional and temporary structures used in music events of all kinds. However, some guidelines and publications take into account all aspects of the event:
- management and planning;
- emergency and emergency management

Table 1: summary of the regulatory framework UNI, UNI EN, and CNR, for the regulation of TS in italy. It can be seen, during the elicitation, that there are no standards issued by UNI concerning the temporary work as a whole, but as disjointed parts between them

ITALIAN LEVEL	
UNI EN 13782:2006	Definition of Temporary structures , Tents and their Security
UNI 11580:2015	Public performance systems - Specifications for the design, manufacture and inspection of aluminium and/or steel structural elements.
UNI EN 1090-1	Execution of steel and aluminium structures - Part 1: Requirements for conformity assessment of structural components;
UNI EN 1090-2	Execution of steel and aluminium structures - Part 2: Technical requirements for steel structures;
UNI EN 1090-3	Execution of steel and aluminium structures - Part 3: Technical requirements for aluminium structures;
UNI EN 1991-1-1 Eurocode 1	Actions on structures - Part 1-1: Actions in general - Weights per unit volume, self-weights and overloads for buildings;
UNI EN 1993-1-1 Eurocode 3	Design of steel structures - Part 1-1: General rules and rules for buildings;
UNI EN 1999-1-1 Eurocode 9	Design of aluminium structures - Part 1-1: General structural rules.
CNR 10027:85	Issued by the Italian National Research Council, it legislates Steel structures for temporary works. Instructions for calculation, execution, testing and maintenance.
EUROPEAN LEVEL	
UNI EN 13200-1:2012 Spectator installations - Part 1	General characteristics of observation spaces for spectators I.E. design and management requirements for spectator installations in permanent or temporary entertainment venues,
UNI EN 13200-3:2006 Spectator installations -Part 3	Separating elements; design requirements for layout and product characteristics for separating elements
UNI EN 13200-4:2007 Spectator installations -Part 4	Seating - Product Characteristics. It specifies the mechanical, physical and chemical product characteristics of fixed seating used in entertainment venues.
UNI EN 13200-5:2007 Spectator installations -Part 5	Telescopic grandstands. It specifies product characteristics for telescopic grandstands in permanent or temporary entertainment venues,
UNI EN 13200-6:2013 Spectator installations -Part 6	Demountable (temporary) grandstands. It specifies product characteristics for demountable (temporary) grandstands in permanent or temporary entertainment venues,
UNI EN 13200-7:2014 Spectator installations -Part 7	Entry and exit elements and routes. safety and design features of the entry and exit passage elements

- communication
- crowd management
- structures and barriers
- electrical installation of lights
- food and beverage management and merchandising
- promotional attractions and first aid
- the presence of TV and other media

In the USA, the design of events is based on the guidelines proposed by the Event Safety Alliance (ESA), which has drawn up 'The Event Safety Guide' covering health, safety, and welfare at live music and similar events.
The ESA is a non-profit organisation in the USA that is made up of industry associations, live music organisations, whose aim is to eliminate unsafe behaviour and conditions:

- management
- planning
- the design of the site
- fire safety
- structures
- electrical installations
- crowding
- responsibility for safety and security

There is also an international organisation, PLASA, which brings together organisations and suppliers of technology and services for the events and entertainment industry. This association is also active in Europe and North America, with more than 1200 members. PLASA is an active organisation involved in developing ANSI-accredited technical standards, which facilitate the use of new and existing equipment and promote safe working conditions.
Within Europe, PLASA works closely with CENELEC, the BSI (in the UK), to support ISO standards. In addition, the ANSI BOARD in 2013, called ANSI E1.21-2013 Entertainment Technology - Temporary Structures Used for Technical Production of Outdoor Entertainment Events, is part of the PLASA programme.
The characteristics of a temporary structure in the ANSI E1.21-201 standard, or an equivalent standard, identified by the qualified person. In this context, the Event producer must submit the required documentation, including the specific plan of the appendices to the artist's theme, no later than seven days before the assembly of the work; any changes that will be required must be completed within three days before the assembly of the TS. The conformity of the structure with the regulations will be demonstrated by a letter of conformity sent before the beginning of the event, which will include:
-drawings, calculations, compliance with loads about the specific event,

- operational management plan,
- responsibility suspension and cancellation of the event.

In this context, we can see that these scenarios represent the main focus of each governing body in the realisation of the event. A significant push forward has been fruitfully given after regrettable events, especially those concerning the Italian territory. Two workers in the entertainment industry lost their lives due to an assembly that followed the experts' reports standards - before those presented after the accidents.
To summarise, the analysis brought to light that the ministerial decree of 22 July 2014 and circular letter no. 35 of 24 December 2014, led to filling some gaps in the stage setter, based on the particular operational needs: assembly disassembly, safe stage set-up.
In the UK, 'Temporary Demountable Structures' deals with the structural safety of temporarily used demountable structures and the overall management of events.
The Event Safety Guide focuses on health, safety, and welfare in live music and related performances in the USA.
The document submitted by the UK represents a more comprehensive and detailed standard on all topics. Hence, the guide active in the US ANSI E1.21-2013 ('Temporary Structures Used for Technical Production of Outdoor Entertainment

Events') represents a minimum level of design and performance parameters, in line with the contents of the UK guide.
As far as the Italian sector is concerned, it would be interesting to add further criteria on the formation and realisation of the spectacle as a whole and not only on the technical rules for implementing stage assembly.
For this reason, the presence of regulation at an international level might be necessary to make the different knowledge carried out by the different bodies compatible. In this case, it is interesting to analyse that the Italian regulation scenario allows particular attention to the territorial analysis of the site and then regulates the primary construction methods of the stage.
Undoubtedly, the construction and design in the Stautnitz scenario are proposed in a more generalist way than both the Italian and British scenarios. One can point to the forefather for the provision of specific characteristics and information for more detailed elements.
British legislation deals with the event in a much broader sense, including the structures attached to the stage and all the services offered to the performers to safeguard the social and environmental safety of the event.
However, none of these analyses has led to the provision of a standard and the inclusion of sustainability within events. This key point is of particular interest in this work, as we want to take a different approach to develop standards. This key point is of particular interest in our work, as we want to push regulations towards a different approach. Although all the regulations show particular interest in the event's design in a more specific or more generalised way, none in its environmental protection character. The fact that sustainability is a relatively more minor propagandised and supported discipline (in 1995, when the first guideline for the design of a stage in the United Kingdom was drawn up, we were still on the verge of the Rio Summit) has particularly affected the primordiality of these concepts in the context of temporary events. For this reason, we want to enter into the detail of the current main constructive scenario, presenting the significant characteristics of every single element that constitutes the stage, to highlight its weight in terms of energy, and to carry out a first approach of the stage, punctual and detailed, for the realisation of a stage that is concerned, in addition to the criteria of social impact and safety, also of environmental impact.
We can therefore summarise this discourse by saying that, following the normative that we have been able to present in these paragraphs, we can look at current construction techniques to learn about the construction methods used and detect their energy content..

Italian technical regulations

The Italian regulatory framework on temporary works does not include any UNI standards concerning the correct construction of the technological elements of which a stage is composed; for example, the constitution of a pavilion, the vertical structures or superstructures for supporting the equipment and its movement, as well as the closing walls, the roofing structures and specific design applications. However, the European technical standard concerning constructing tents installed in an itinerant and temporary manner has been included in UNI EN 13782:2006 - Temporary structures - Tents - Safety.
This standard specifies the safety requirements to be observed during the design, construction, installation, maintenance, operation and testing of tents installed in a temporary and itinerant manner with a covered area of more than 50 square metres. Hence, for tent structures with a surface area of less than 50 square metres, the manufacturer himself must provide documentation on the fire behaviour of the fabric and the stability of the entire tent

YEAR	LEGISLATION	DESCRIPTION
2008	Legislative Decree 81/08, supplemented by Legislative Decree no. 106 of 3 August 2009	This decree was subsequently supplemented by Legislative Decree no. 106, concerning 'Supplementary and corrective provisions to Legislative Decree no. 81 /08' The purpose of Legislative Decree 81/08 is to prescribe measures for the protection of the health and safety of workers at work, in all sectors of private or public activity.
2013	Law No 69 of 21 June 2013 supplemented by Conversion Act No 98 of 8 August 2013	named as 'Decreto del fare' and correlated with the 'Disposizioni urgenti per il rilancio dell'economia'. They jointly decree that musical, cinematographic and theatrical performances and trade fairs are included within the scope of application of Title IV 'Temporary or mobile construction sites' of Legislative Decree 81/08
2014	Interministerial Decree of 22 July 2014,	The so-called 'decree on stages and fairs' contains the provisions that apply to musical, cinematographic and theatrical shows and fairs. It was already provided for in the previous 'decree of doing', and is defined as interministerial because it safeguards the health and safety of workers. The decree provides for the application to all activities of assembly and disassembly of temporary works, including their preparation and disassembly with audio, lighting and stage equipment.
2014	Circular No. 35 of 24 December 2014	La circolare è stata resa pubblica dal ministero del lavoro, per descrivere le istruzioni tecnico-organizzative per l'allestimento e la gestione delle opere temporanee e delle attrezzature da impiegare nella produzione e realizzazione delle suddette TSs proposte dal precedente decreto ministeriale del 22 luglio 2014

Table 2
description of the Italian regulatory framework for the correct design, organisation and securing of any temporary works for temporary events

structure.
There is also a single UNI standard for TS elements for public entertainment: UNI 11580:2015, which defines systems for public entertainment, providing specifications for the design, manufacture and inspection of structural elements in aluminium and steel.
This standard specifies the design, calculation, fabrication and inspection of trusses, towers and any associated and related elements. The primary definition of trusses and towers is used for static and dynamic loads or purely decorative purposes and can be suspended, supported from the ground, on walls, permanently installed, or as a mobile structure. Below, we propose the regulations mentioned earlier framed in the provisions related to other regulations, and more in line with the European scenario.

Stage construction typologies

When designing the installation of any event, one has to deal with a series of elements, primarily technical, that make it possible to maintain a set design composed of special effects of various kinds. In order to facilitate the best possible implementation of these technologies, a series of technical elements, technological solutions and materials from the architectural tradition are combined with the composition of a technical study of the scenography, promoting new possibilities dictated by the very demands of the type of entertainment.
Firstly, the definition of the temporary and spatial factors creates the foundations of an analysis that can proceed in detail to the realisation of the event. Then, based on these concepts, cooperation is necessary for the complete realisation of the intervention's event area. These two variables, time and space, are closely interconnected with the design solutions in the structural systems that are decided to be used. Nonetheless, to guarantee the greatest possible adaptability to all possibilities, with assembly and disassembly methods adapted to each possibility, the definition of the space and time required is fundamental to the event's timing.
As mentioned above, the structures of the stage can be listed as follows:
-Towers and trusses
- scaffolding elements forming the platform
- connections and joining elements
- handling elements (electric chain hoists, motorised structures for lifting roofs)

The structures of roofs, towers, and horizontal supports are, however, only a few of the possible logics that arise within the distribution system and production logics that are all carried out through prefabrication.
On the contrary, the production logic of the scenographic and particular effects system is based instead on the Production of craftsmanship in order to create new technologies of decoration; however, this practice does not want to draw on a lack of innovation, but rather on the thorough search for new sets, has the task of wanting to open up new avenues of experimentation in special effects. For example, PVC plastics and materials to create new light effects or large printable surfaces and polycarbonate to create rigid transposable surfaces for light design are all elements that require arousing a strong emotion in the spectator creator. For this reason, the technical world of set design is still contaminated by craftsmanship, just as the parametric production process of structures is accompanied by the graphic art that creates it.
However, one of the essential achievements in the realisation of temporary shows is implementing an event's structural and scenic apparatus, which defines a series of implementing regulations that allow for an enormous improvement in the ease of transport. As we saw in the introduction, the travelling show has its roots heavily in constructing the whole travelling city. This system was made possible thanks to the construction of the 'Mobil-homes' for an open-air tourism, in the period between the 20th and 19th centuries.
From this idea, the simplest of portability relations is creating structures that are easily reconstructed in a site far away from the production site. Thanks to this definition, the term portability takes on its meaning: prefabricated devices, be they houses, platforms or stages, that are generically designed to facilitate their transport and usability. Three main possibilities facilitate this portability:
- The realisation of a single element designed to be carried over long distances and made usable immediately, with assembly and disassembly times that can be defined as instant due to their concise duration.
- The composition of separate technical elements which, when transported together, are assembled on site
- Modular parts pre-assembled during Production and then aggregated using dry assembly methods on site. Therefore, these three possibilities can be defined for multiple construction systems, allowing for variability in the final product.
The stage is always the first to be set up at the event site and the last to be dismantled. For this reason, a travelling event may sometimes need several rigging systems working in parallel to occupy different areas more quickly.
On the other hand, if it is a one-off event, the repeatability of the event is lost, but the ability to be assembled and disassembled is a feature that is nevertheless incorporated into the Production of the event. Therefore, the methodologies and technologies remain the same, as the scenic elements of Production are always based on the installation of these elements on the prefabricated structures.

HOST VENUE AND THE SOIL

The presence of prefabricated elements means that the stage is a TS designed to operate in the most diverse weather conditions and unique soil characteristics. For this reason, before any installation it is necessary to know the unique and specific characteristics of the site such as
- load-bearing capacity of the soil
-environmental conditions
- lpresence of external interferences such as power lines
This analysis is designed to understand not only the characteristics but also the risks of the site under analysis. For this reason, it is also necessary to know the position of other underground services in the area, which may determine the dangers during the construction and dismantling phases. In this case, the risk of soil subsidence, in addition to the presence of underground services, may result in low soil consistency such as the presence of pre-operational excavations. Although these soil situations are not present on the surface, they must be known through the retrieval of all relevant information and through structural soil investigations.
A Soil characteristics knowledge is therefore crucial in the following categories:
- soil conditions in the event of heavy rainfall
- possible ice surfaces
- Substantial support surface such as asphalt, concrete and thickness, properly analysed for the loads to be borne.
Further information concerns:
- the size of the installation site in relation to the presence of transport and loading and unloading services for the necessary equipment
- the existing structures that can be used to anchor the twisted structures or otherwise the anchoring points, appropriately indicated in a documentation of the characteristics of the permissible suspended loads
- safety features of on-site installations.

Main components of a stage

As we have already said, the stages are mainly made up of prefabricated elements linked together. Each element performs a unique function which, when coordinated as a whole, defines the entire function of the event itself: reception to the artistic performance, film projection, theatrical performance, lifting structures, video screens, cameras, sound systems, special effects. The presence of prefabricated elements means that the stage is a TS designed to operate in the most diverse weather conditions and unique soil characteristics. For this reason, before any installation, it is necessary to know the unique and specific characteristics of the site, such as
- load-bearing capacity of the soil
-environmental conditions
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- safety features of on-site installations.

However, the stage is defined as an organ uniquely defined by a TS that acts as the exhibition, representation, or entertainment. Therefore this TS is mainly realised by a metal structure.
The triad of elements defined above (platform, elevated structures, and roofs) performs coordinated action, but not all three are present.

Platform and scaffolding

The platform is one of the elements that characterise the stage and is always present. Unlike elevated structures and roofs, which are respectively less present, the platform characterises the footprint of the stage itself, which is technical and functional. For these reasons, a platform is an element that characterises and contextualises almost the entire panorama of temporary events.
Due to its characteristic profiled assembly, and given the demand for weights similar to those found in construction sites, a scaffold construction system is used to build the platform, which is the same as that used in more traditional construction.
The latter is equipped with wheels to allow several coordinated assembly phases to be carried out simultaneously. Hence, the semi-mobile system makes it possible to separate the area where the structures are hung from the area where the platform and instruments are set up.
The function of a scaffold, and therefore of the platform that is mounted on it, is to raise the floor level with respect to the stalls, to allow greater visibility to each scenic component present on it.
This height is usually raised from ground level by two to three metres. It is also defined according to the area and usability of the event for:
- allow for mobility below the stage area to provide a passageway and plant activities for the event
- compose additional platforms and scaffolding to encourage darker areas, depending on the activities that need to be highlighted.
In order to level the walking surface of the levelling platform, the platform can also be equipped with hydraulic levelling systems.
Due to realization as an above-ground structure, the stage does not have any elements in the foundation holding it to the ground. For this reason, the stage is usually anchored to the ground from the level above it, using ballasts or suitable structures.
As we will see in the next paragraph, an attached structure of roofing and vertical elevation can be presented above the surface of the platform.
Hence, a number of innovations in the shipbuilding sector improve two different categories: the construction sector and the building construction sector.

Trusses

Most of TSs are also suitable for accommodating the scenic aid and support elements for light projectors, audio speakers, video screens, video cameras, direction, etc. When these installations have a scenic need to be placed higher than the platform, trusses can be used.
Unlike scaffolding, these structures are specifically designed for use in temporary structures for exhibitions and shows. These systems are mainly used to support audio, video and lighting systems.
In recent years, trailers have been composing a particularly active part of the entire stage, reducing the use of scaffolding structures to reduce the assembly time of semi-assembled structures. Scaffolding is a slower technological system because most of the components have to be assembled on site.
Trusses are made from steel or aluminium profiles. In structures requiring more significant stress, they are made with a larger cross-section than the less connected elements.
These elements are manufactured by cutting and welding tubular structures. Thanks to the welding quality, it is possible to define the load-bearing capacity of the internal system: it is this joint that is the critical point in the risk of breakage.
trusses are divided into different categories, which are listed and explained below:
- Trusses, mainly used for equipment supporting
- Lifting towers
- Grid and coverage matrices
In addition, these prefabricated systems are made up of modular aluminium elements, which, once assembled, can form the horizontal and vertical technical elements that structurally support the system. Aluminium is chosen because it can be extruded during manufacture thanks to its particular lightness and workability. This element can be cut and welded, thus creating standard prefabricated elements and new forms at the client's specific request.
These trusses consist mainly of two or more longitudinal beams, which are called beams; depending on the cross-section of the pipe and the number of diagonal elements interconnecting two or more beams, the load-bearing capacity of the structure is defined. Therefore, we can define the main types of horizontal truss systems:
- Complex systems of pylons hung using motors on pre-existing structures in the area or elevated structures (towers), which we will see later.
- straight trusses, lean-tos, on end on vertical lattice masts as well.
In addition, trusses are also distinguished by their cross-section, which can be:
- flat, but less used due to its low load capacity
- triangular, where an upper current carries the stresses produced in compression, and the two lower currents carry the tensile stresses. The lower current stabilises the equipment, and the two upper currents have the function of statically stabilising the entire structural system.
Every motorised system used and therefore suspended from such structural systems requires

a basic safety harness. In this case, the presence of an upper current also becomes essential for the safety system. A safety strap is first passed under the lower beams, crossed with the upper beam and finally connected to the lifting motor. Nevertheless, a second loop around one of the beams is recommended to prevent the beam from bearing unnecessary loads. In this safety system, an adequate length of the strap also prevents the beam from bearing vertical loads:
- square section which is laid indifferently according to the four beams. In this case, the safety harness is made by first passing under the lower beams and then passing inside the upper ones.
- rectangular cross-section, which is used for a higher load-bearing capacity than the square one
- Foldable: Can be found with either a triangular or rectangular cross-section and therefore consists of three or four beams forming the triangle or square.
A truss system with folding arms allows the beam to be opened for use and closed for disassembly to save volume during transport. Depending on the manufacturer, the construction section may vary. However, some main section definitions subdivide the system according to the permissible load capacity:
- Low load-bearing beams: can be used for decorative purposes and to support light-weight equipment
- Medium span beams: used to support lighting systems
- High-flow beams, used for lighting, but also acoustic systems
As the latter cover vast spans, when fitted with wheels, they are also used as element conveyors or protection cages for elements placed between the diagonals of the beams. The scenic elements are mounted directly on the beams using clamp hooks.

Low-capacity beams	Decorative and light plant use Theatres, showrooms, exhibition stands,	lenght 200-250 mm Beam section of 30 mm Beam thickness 1,5 mm diagonal beam section 10 mm diagonal beam thickness 1 mm
Medium capacity beams	Support for lighting systems	lenght: 300-400 mm Beam section 50 mm Beam thickness 3 mm diagonal beam section 15-20 mm diagonal beam thickness 2 mm
High capacity beams	For acoustic and lighting systems, used to cover particularly wide spans, around 20 m	lenght 500-800 mm Beam section 50 mm Beam thickness 4 mm Diagonal beam section 25-30 mm Diagonal beam thickness 3 mm

TOWERS AND AUXILIARY STRUCTURES

If the stage equipment placed at height does not have a strong enough support to support the trusses described above, the TS also equips itself with

elevation towers to support the stage equipment. Generally speaking, due to the emptiness of the stage support, elevation towers are generally used in open-air performances. There are two types of structures: support towers and elevation towers. Support towers are based on the construction of scaffolding which is mainly raised in a vertical tower to allow the support of trusses. On the other hand, elevation towers are pre-assembled arms that allow the stage set to be erected much more quickly due to the absence of a longer assembly phase on site. The latter consists of a vertical truss structure with a square cross-section attached directly to the ground. The horizontal trusses are attached to these elevating structures using a sliding carriage that brings them to the desired height. The trussing can be either electrically motorised or with the aid of a winch that allows manual movement.
This type of connection is generally equipped with sixteen wheels that rest on the four beams of the vertical elevation. Per garantire la stabtilià, la torre ad elevazione vene messa in sicurezza tramite:
- the use of a support cross, with four adjustable feet that can be levelled to the shape of the ground
- Through the application of other steel girders and lattice modules to create a connecting cross at the base. Hence, to ensure further stability, it is helpful to ballast the tower, either by connecting it to heavy concrete blocks or too large tanks filled with water-filled on-site and emptied to facilitate transport. However, another method of stabilising the system is to create a bracing system using steel rods. However, as this system requires more free air around it, it is impossible to install on it.
In addition, these tower structures can be completely detached from the stage platform to accommodate other technical elements such as:
- tower structures to support light projectors, sound diffusers and director's station or video filming
- for supporting video screens (with additional bracing)
- ring or linear trussing to support the lighting, acoustic or mainly scenic equipment.
All towers are assembled using a step-by-step method, whereby the mainframe is made horizontally, and the modules required for the required height are placed one on top of the other. The horizontal mast is then raised into position using a crane. A more complex but more effective method of assembly and elevation is proposed with modules fitted with a hinge. These hinges serve as connection pins between the modules. The modules are mounted in a horizontal position and then rotated into a vertical position by an electric motor that pulls the module into the vertical position. In this case, it is not necessary to use a crane to position the module, but the scaffold is self-built by using it as a ladder to climb up onto the roof.

COVERAGE (GRID)

This system is also known as 'Grid'. This structure is defined as a modular, truss-like structure made up of square or triangular trusses that form a grid to support a roof when connected. Thanks to its constitution, mainly aluminium systems to be screwed into particular nodes, this system is usually quick to assemble and easy to transport. The roof, if present, is generally assembled at ground level and then brought to height using manual or motorised lifting systems.
In addition to covering the area above the platform, it can also act as a support for audio, lighting, video and stage equipment.
There are two different types of roofing grids: for indoor and outdoor events. This definition is essential to understand the higher specifications required by the system. In the case of a grid for outdoor events, it is necessary to provide cover systems to protect against atmospheric events. Although designed to withstand large temperature and humidity fluctuations, the electrical system is still susceptible to loss of strength in the event of severe adverse weather phenomena. However,

due to severe logistical and managerial problems in postponing the event, it is better to prepare the entire technical system to withstand a certain amount of water and adverse weather events. Therefore, a waterproof tarpaulin or inflatable cover is applied to the surface of the roof grid using a lacing system.
However, with an elevating tower system, assembly is much quicker than with support towers, where the scenic systems are set up directly in the elevation. In elevation towers, the grid is set up at ground level (or on the platform below, if present). The grid is then hoisted up and positioned at the desired level. Finally, depending on the width over which the roof is suspended, intermediate towers may be used. Another system uses scaffolding structures, thus creating two side walls to the grid, formed by the modular systems. In this case, too, the roof is hoisted up using hoisting motors. As a matter of good safety practice, after the enclosure has been placed in position at the desired height, it is supported using support points. In this case, even if there is a break in the motor or the connecting chain, the enclosure will still be supported by the tower.
On the other hand, in indoor events, the problem of adverse events does not directly concern the logistics of the event (rather, it concerns the organisational aspect of reaching and transporting the venue). The use of the grid, in this case, is only studied for a good measurement of the necessary weights, which is not tied to the existing coverage.

CONNECTIONS

Each truss manufacturer has its technique for connecting trusses. However, the basic technique used for these connections is very similar in the different manufacturers. Usually, the pushes used are made of extruded aluminium with a double cone, which allows the connection between two matching trusses using holes. This system is secured using steel cones that are aligned between the two adjacent components. The two cones are then secured with safety pins to prevent them from accidentally slipping out of their engagement.
Furthermore, depending on the section of the truss, cylinders of various sizes are used. However, there are also more special connectors. The articulated connectors are used for lifting towers, while connectors with plates connect vertical trusses to the ground.
A widely used, but now discontinued, method of connection involves inserting a tongue-and-groove of the ends of the trusses, then adding the previously mentioned re-connection cylinder.
The truss modules, which are available at any required angle, also allow the trusses to be fixed in various orientations, depending on the stage requirements. The most commonly used angles are 45°, 60°, 90°. 120°e 135°. Between one and six trusses can be connected simultaneously; however, all trusses connected must have an equal cross-section. Therefore, the connection modules also differ in

- triangular
- rectangular
-flat

Rigger

The rigger is a name that has etymology in the very diction of 'to rig' an element. This is the name given to the professional rigs used to suspend and assemble rigging. Usually, due to the impossibility of having a standardised assembly practice, field experience defines the best assembly methods. The rigger is a figure who has the task of choosing the type of truss to adopt for the stage to guarantee the safety of the whole installation. This task contains fundamental challenges that are mainly summarised in two categories:
- wide choice of trusses available for use;
- the modularity of the product, which does not provide modular products on which to place and or suspend the beam.
For this reason, the rigger's task is largely matured during the knowledge and experience provided by years of work.
However, there are parameters to refer to during the design process. These criteria require the implementation to meet quality and safety criteria for the entire installation:
- know with good precision the load of the beam
- know with certainty that the beam chosen can bear the load along its entire length
- check the technical data provided by the manufacturers, knowing that the load of the equipment also includes the technical load of the stage equipment
- check the load capacity of the suspension hook chains
- calculate the loads at static level, if distributed at different points along the length
Hence, if the lifting and suspension of trusses is assigned to lifting motors, it is necessary to check that the lifting speed is equivalent for all motors used.
Nevertheless, it is necessary to check the distribution of the loads - more incidental to the central point - and consider all lifting modes; sometimes, manual lifting is advisable when there are more than two lifting points. Finally, the loads must be equally distributed over the whole beam.
Ultimately, it is the rigger's job:
- check the presence of temporary loads so that they do not affect the torsion or bending effects of the system
- check that all connections are fitted with safety pins before being placed in position
- check the resistance to overheating of more than 100°C for each material in the system used on the truss
- check that the materials do not damage the truss concerned
-when disassembling, check for damage or replace.

Lifting engines

These motors relate to the use we have previously presented: raising beams, supporting technical, acoustic and scenic lighting equipment. These systems are mainly made up of:
- an engine
- a chain that wraps around the inside of the engine
- a possible safety pocket for holding the chain
The end of the chain is hooked underneath the support cover, and the motor is hooked above the masts. In this way, the lifting system is easily accessible for maintenance and adjustments.
In addition, the motors can also play an active part in the set and not only in the assembly phases: they can also make the beams move to show different parts of the set at different times.
The models currently available on the market have a capacity that varies from 4 to 8 m/mm and is related to a motor power that can vary from 0.5 to 2 kW. The load capacity of these motors is generally up to 2000 kg.
Different types can lift the truss systems we have previously illustrated:
- lifting towers (with lifting system implemented inside)
- engine hooked to the beam to be lifted, and the end of the chain hooked to the end of the tower; the weight, in this case, is supported by the chain hooked to the tower
- motor fixed on the beam, and the chain runs along with the tower to the end and then returns to fix itself on the beam. In this way, the load is distributed to two different points
- The motor is attached to the base of a tower and the chain hooked to a system of pulleys which are in turn connected to the roofing system via a pulley at the end of the tower.
In this case, when the motor is running, it can retract the chain. The system then pulls the cable through the pulleys, and the cover is raised automatically..

Clamps

Clamps are those aluminium connection systems. They make it possible to attach equipment to the beam and to join the various trusses together. There are several categories on the market: simple, jointed, with armour with support. However, there is usually always a clamp closure or a snap closure that prevents it from opening. The cross-section is usually circular to be better adapted to the tube or rectangular C-shaped for the lighter ones. In order to ensure the safety of the suspended element, a steel strap have to be connected to a safety rope. This method ensures the structure in case of failure of the clamp.

Assembling and disassembling phases

Assembly, disassembly and set-up phases are conditioned by their complexity and interference with other work activities. For correct assembly, it is necessary to be present:

- installation diagrams supplied by the fabricator or stage designer; as well as executive drawings of the project drawn up by a registered professional
-stage assembly instructions are available, including an illustration of how the stage is to be assembled, if necessary transformed and dismantled, showing the necessary sequences indicated 'step by step', as well as a description of the safety measures to be taken, and the personal protective equipment to be worn by personnel
- documentation of checks on all elements of the stage in the operation
- tightening of the connections, maintained in the manner proposed by the manufacturer
- anchors and ballasts are maintained in good working order
- vertical uprights
- the plan and façade bracings are kept in good working order using a particular visual check of the diagonal struts and diagonals in the plan; consequently with a visual check of the state of preservation of the connections

Also, the assembly personnel will be required to keep to the assembly stages of the various elements and check the previous stage's completeness before proceeding with the next one.
At the end of the stage set-up, it will therefore be necessary to provide a document certifying that the entire structure has been checked. The structure corresponds to the various configurations indicated in the assembly sequence provided by the manufacturer and designer.
This information must all be contained in the declaration of correct assembly, which certifies that all the structures have been assembled in a workmanlike manner and that the static suitability of the system has been certified by a qualified professional.

Technical and sustainable innovations

Technical solutions

Deciphering the innovative technologies in this field was not an easy task, not because there is no active innovation in this field, but because the very prefabrication and fast assembly of the TS represents a considerable challenge in the combination of innovation and freedom in artistic choices between stage-design and set-design. However, to look for innovations, we wanted to mention the current global panorama, where necessary avant-garde components already present themselves. Although some may seem technically more straightforward and others much more technologically advanced, the idea of ingenious design engineering remains at the heart of all the examples we offer below. Among the design firms that we have found to be remarkably modern is the overseas stage construction company Stageline, followed by AllaAccess, and Stageco. On the Italian scene, Vectorgroup mainly summarises the

significant improvements that the events industry is making. As is often the case, unfortunately, the engineering quality of material often remains hidden literally behind the scenes of a show. This concept was the most challenging task: finding evidence of innovation. However, some traces were already present. Moreover, that is why, now, we want to describe some interesting innovations to which we want to make an experimental contribution later on.
While keeping the main assembly element, the scaffold, unchanged, it is interesting to note how solutions can be applied in different methodologies to achieve results far beyond the average yield. The Italian company VectorGroup, in this case, gave an example of a drastic improvement in scaffolding assembly. During an event held at Marcello D'olivo square in Lignano Pineta, the company faced a significant problem from marine weather conditions that were causing dangerous air turbulence and intense storms. The stage was indeed subjected to severe weather conditions during the summer seasoning, with winds of up to 120 km/h. However, the primary scaffolding structure was designed to create a single fixed structure that subsumes the covering and allows for a single frame to achieve very high stiffness. The dimensions of the stage were 12x10 m, 12 m in height and six triangle base pillars covered with PVC cloth.
Therefore, the creation of resistant structures is a task that is also solved thanks to simple technical systems that, in their pre-assembly, can guarantee a substantial improvement. Another aspect, however, that takes innovation into account is to push the capabilities of making such a temporary system prefabricated and assembled even further. Also, when listing the individual technological systems that lead to creating a stage, we have not had the opportunity to see if there was a possibility of interrelating all these elements in a pre-assembly. In this case, a fascinating methodology comes from overseas, from a leading company in this sector. The Stageline has succeeded in scaling down building a stage while maintaining its enormous potential. In other words, a travelling system such as a stage has its entire construction in its transport

Fig.5
a photograph of the stage built to withstand violent turbines
©2021, vectorgroup

Fig. 6
The stage set up for the 2016 Pickathon Festival
© 2016, Tim LaBarge

system. a combination of stage and trailer is thus considered remarkably modern and capable of building stages of even the most significant dimensions. This combination of systems allows two significant savings to be made: the time required for construction and the labour involved. A 21 by 17-metre stage, which in the past required at least a day and a half's work, can now be built in just sixteen hours. The entire system is equipped with five trailers that transport the material simultaneously to the site. Most of the assembly takes place at ground level, starting with the floor panel. Next, the roof panel, housed in a second trailer, is installed on the surface of the floor panel. At this point, a connection between the floor panel and the roof panel is required using Telescopic hydraulic columns, making a laborious and not entirely simple procedure much more effective. The transport system thus becomes an integral part of the event itself in its realisation.
Moreover, while this type is still difficult to fit into its step by step consecution, in the case of smaller surfaces, the entire system is installed within a single rack, allowing for almost fully automatic assembly. Thanks to this type of retractable stage, assembly time are reduced by up to 30 minutes, for smaller surfaces (7 x 6 m) up to 16 hours for a stage that would typically take at least twice as long..

Sustainable ideas

If from a technological point of view, innovation goes hand in hand with the conception of new materials and engineering techniques, innovation on a sustainable level can enjoy a considerably more creative landscape for event organisers. As is now widely known, there is a single mission to protect the environment in the environment of sustainability. Therefore, it is easy to understand how materials that are reused or have a lower impact than typical materials are favoured in use. In this case, the Pickathon Music Festival could be one of the festivals favouring sustainability even in stage design practices. The building stages are in fact made of materials derived from recycled materials. Thanks to a partnership with The Diversion Design/Build Studio at Portland State University's School of Architecture, the event could engage with innovative stage-design practices. Their concept was defined as an architectural experiment

denoted as 'Diversion Architecture'. The aim of this study was to show how numerous contaminations can cross the semantic form of a stage in the field of sustainable design and reused materials. This result is put to good use in the realisation of the Pickathon Tree-Line stage, where the combination of non-typical, reused materials and the diversion of non-typical experiences like those embodied in festival gatherings.
Moreover, the 2016 edition of this festival follows up to several enterprising sustainable ideas for a stage. Previous successful partnerships had already attracted Portland University students with the event. In 2014, the workshop created a stage using only pallets for the platform structure. A total of 520 shipping pallets and 6,000 screws were used, resulting in a tmepoerary structure reaching a height of 5.5 metres, a length of 12 metres and a width of 18 metres. Therefore, this structure is comparable with the dimensions of the previous innovative technological solutions we have analysed in the previous paragraph. Thanks to the particularity of the scenography it created in the spectator, presenting new material for the entire structural body of an event allowed the festival to be presented with its own very personal identity, given by the absence of the typical steel that we have seen in the previous ideas of prefabrication and pre-assembly of the elements.
Each year the festival has produced innovative recycling ideas by combining different materials, coordinated with the sole mission of using recycled materials. In 2019, double scenic towers were built to house the lighting system and sometimes seating for the audience. Using 15 to 30 apple bins, they were combined in pentagonal clusters of five binsThe latest interesting example proposed in the editions of this festival concerns another fascinating combination of scenic architecture and sustainability with dimensional wooden trusses and dimensional lumber. The idea of a partnership with a design studio to develop a stage with low environmental impact also brought significant results to the Terraforma Festival. Thanks to the partnership with Fosbury Architecture, Studio Zarcola and Studio Petrucci, the organisation built most of the facilities in the park from wood, including the main stage. Sofia Coutsoucos and Matteo Petrucci design the architectural model to minimise the impact of the stage structure. In addition, the structures are designed to be demountable and then reassembled in future editions. In addition, thanks to the partnership with the AOUMM studio and the students of the Milan Polytechnic, wood from previous editions of the stage has been used to create a structure that will last over the years to develop the furnishings in the park.
Within the temporary stages, the use of wood is thus a constant in the use of materials, substitutes for steel with a low environmental impact. Even in the Extrema Outdoor Music Festival case, the basic concept was to use recyclable wood from pallets. The structure consists of 600 pallets to create a stage that delineates the territory of the event within the surrounding environment with a semicircle. This structure is modular, with a diameter of 20 metres and a height of 4.5 metres. Within the semicircle, three different levels define the functionality of the structure: the first, to level the ground, the second, to create triangular squares that allow a view of the lake, and the last, which acts as a support for the stage sound and lighting system.

Fig. 7
The stage set up for the 2019 edition of the Terraforma Festival
© 2019, Terraforma Org.

The project followed a step by step assembly that lasted six days for the setting up and two days for the disassembly. It is clear that, despite the decidedly lower reception capacity, this project, compared to the previous ones offered, shows much longer assembly times. However, using these materials and the functionality of the service offered in their realisation proposes to our research a wider spectrum of investigations. Therefore, we would like to ask ourselves if, within the temporary structures, there is the possibility of some innovation which, even if not produced for the mere use of the musical event, can in some way approach its possible fruition. .

Innovation from the Temporary Pavilions

Whether it is an event, such as natural disasters, warfare or pandemics, temporary architecture has its strengths in the immediacy of its realisation. On this basis, the realisation of temporary pavilions allows having only one priority: solving the problem around housing in the shortest possible time. For this reason, scaffolding still becomes a short-lived and enormously influential method of realisation. Therefore, the construction allows for both a short and tight budget to create new meeting places. the system can create numerous shapes in triangular, diagonal, horizontal alignments, combining the primary materials of wood, textiles, polycarbonate and metal. The Horts Festival presents itself as an interesting combination of these primary materials in a temporary building that hosts the event no longer outside but inside. The venue's site is a 14th-century castle that remains inaccessible due to renovation works. For this reason, on the roots of inspiration born from the presence of this building, the pavilion is purposed with the name 'Newcastle'. The scaffolding system is built under a budget of 10,000 euros. This advantage makes it possible to reproduce, on the same scale as the castle in the immediate vicinity, the temporary construction of a castle. The structure rises with continuous balconies where actors and performers blend into the same scene, as in the Elizabethan theatre; this festival uses a temporary pavilion to innovate the scenicity of the festival moment to create a new interaction with the audience.
Therefore, the scaffolding is a part of the shipbuilding environment, but its parallel world of entertainment makes the temporary

Fig. 8,
(left) Exterior view of the scaffolding for the Newcastle stage in 2016
(right) overview of the Newcastle Festival
© Jeroen Verrecth, 2016 (both)

architecture the sole and fundamental protagonist of the leading building site. This concept is also behind the scaffolding created to regenerate an abandoned fountain project into an Urban SPA, i.e., a postponement to reactivate water sources. This second project proposes scaffolding as support for sunshade bars and textile shades and hammocks, and resting platforms. According to PKMN Studio - the creators-, thanks to its simplicity of design, the project aims to emulate this example in all possible combinations of the globe, give space back to the citizens, and give the city the regenerative appropriation inhabitants deserve.

Therefore, it seems that scaffolding remains the forefather of a semantic realisation of temporary precisely because of its great intrinsic functionality. Indeed, it represents the fastest method, even in the Thematic Pavilion X BIAU, to show a character of modularity and complementarity with numerous services. Based on this idea, the flexible character of the space created shows how the shelf structure becomes the creation of a container of numerous, different possibilities between them. Therefore, in its metallic structure, the scaffolding shows the capacity of a modular, dry and utterly recyclable structure.

Continuing the experimentation with steel and combining it with other primary elements, including wood, we can think that the temporary structures could inspire the musical event with Prototype Square in Latvia. In this case, the pandemic crisis has led to an enlargement of the space needed and the identification of isolated meeting spots to develop a sense of appropriateness of temporary spaces. Once again, scaffolding is used, in modernity, as an example of the speed and limited option in planning a temporary structure. Shelf-holding allows for a total redesign of a space

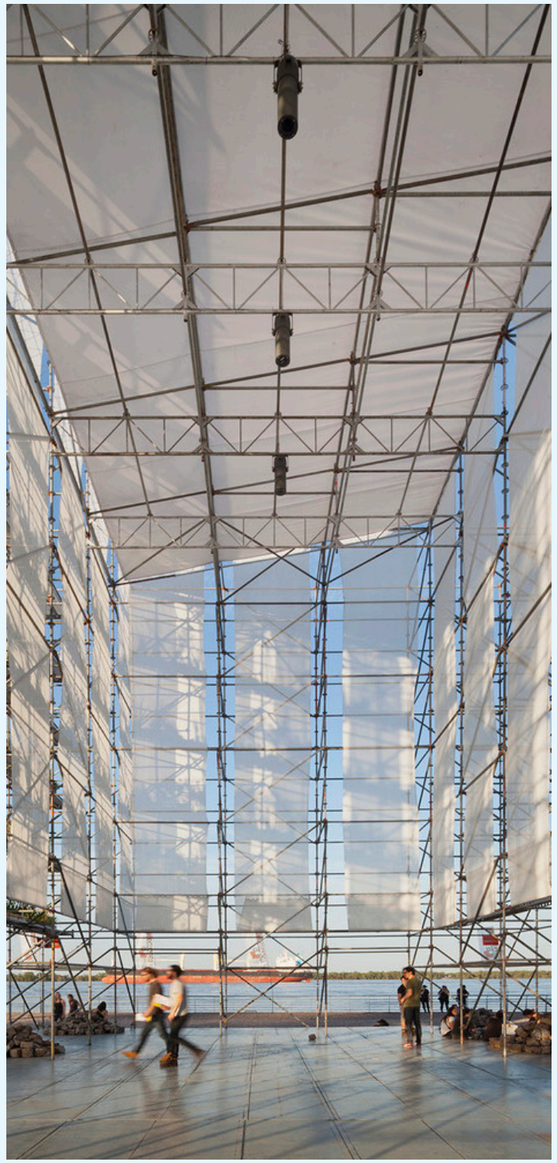


fig. 9
Interior view of Pavilion IX Biau
© 2014, Federico Cairoli

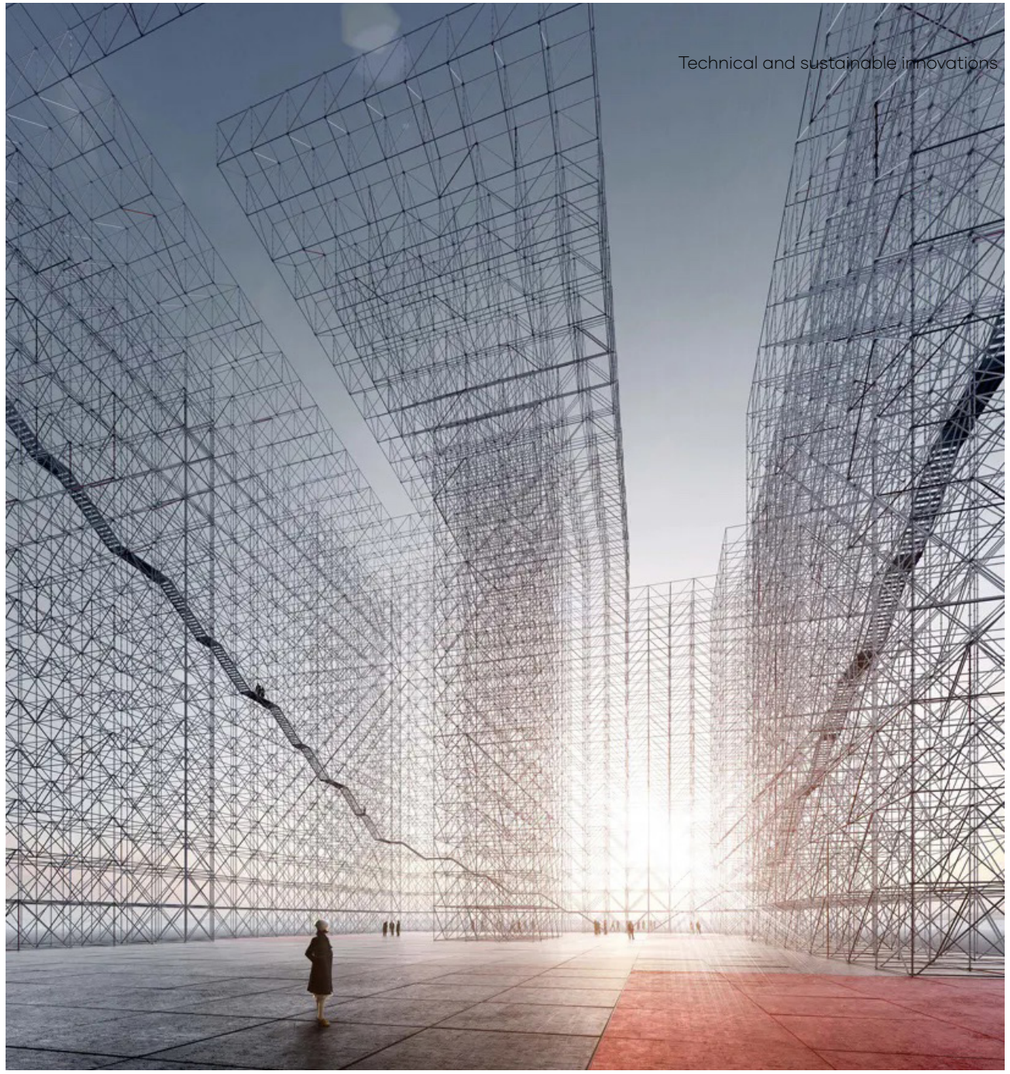
according to the needs of the individual request. However, steel is not the only material that can be used to make a shelving unit. Wood can also lead to interesting realisations. In this case, the Dulwich Pavilion, a transformative project for the Dulwich Picture Gallery and Almacantar, is an example of naturalness that comprises a timber truss roof suspended over a level in its lightweight and minimal style timber deck supported on three fixed slender mirrored panels. The flexibility of this construction is also extended with the possibility of numerous different configurations, thanks to the possibility of moving or removing the remaining wall panels. Based on what we have analysed in these paragraphs, we could say that the pavilion as a project of its time is the non-musical but aggregative variant of an event, in which a different kind of space is required to host, instead of the excellent spectacle, perhaps only visual, scenic, or introspective. As in the case of Newcastle, it often happens that the very concept of entering the pavilion allows the spectator to enjoy it thoroughly. Unlike a stage, its statuesque movement affirms the spectator's fascination with contemplation rather than becoming part of it. However, temporary architecture can respond to environmental demands because due to its very characteristic of temporariness, intensive design practices are avoided, and large amounts of energy are avoided precisely because of the short lifespan.

For this reason, in order to minimise the environmental impacts, architects must also concern decisive modes of less-energy production. This concept thus represents not only an environmentally conscious approach to pavilion building and alternative processes for realising the idea. Sustainable architecture must not renounce or compromise the beauty or sophistication of a project. Therefore, a sustainable pavilion also aims to reduce the number of materials used in construction. In the Heads in the Clouds Pavilion, sustainability is combined with the number

fig. 10
1RAUM Pavillion interior view: tAll the material inside is disassemblable, in line with the circular economy concept,@ 2019, Deezen.com

of materials used in construction and to bring sustainability into the expression of architecture. The project is made up of the same number of bottles thrown away in New York state for one hour. Other examples of sustainable architecture that demonstrate the concept of sustainability both in the method of construction and in the form of the exhibition itself are the Governs' Cup Pavilion, built from thousands of recycled plastic cups to create a plastic-shaped tree; however, the Upcycling Pavilion also brings attention to the attendee's excessive demand for materials that have become part of the main architectural conventions, building curvilinear walls out of borrowed soda crates.

This type of architecture materialises the circular economy concept and interprets it based on the requirements that a particular building needs for its use. On this basis, even the most challenging demands, such as those of a restaurant, can be fulfilled in this type of temporary architecture. For example, the RAUM pavilion was designed to fit in with the circular economy concept, where the



pavilion houses workshops, meeting areas, and a restaurant but will only be maintained intact for three years. The building and the pavilion are designed to be disassembled and rebuilt in a new location, or, if necessary, it can also be composted and recycled at the end of its lifespan. Continuing this complementary relationship between the complexity and sustainability of construction, the Collective Penda design offers us an example of a

Fig.11, 12, 13
(Upper) the wolkenbrugel project proposed by El Lissitzky ,
© 2019, El Lissitzky
(left) two renderings of the Penda Tmporary Structure 'One With the Birds', with an exmepiod of the Modular Temporary Hotel
© 2014, Penda Studio

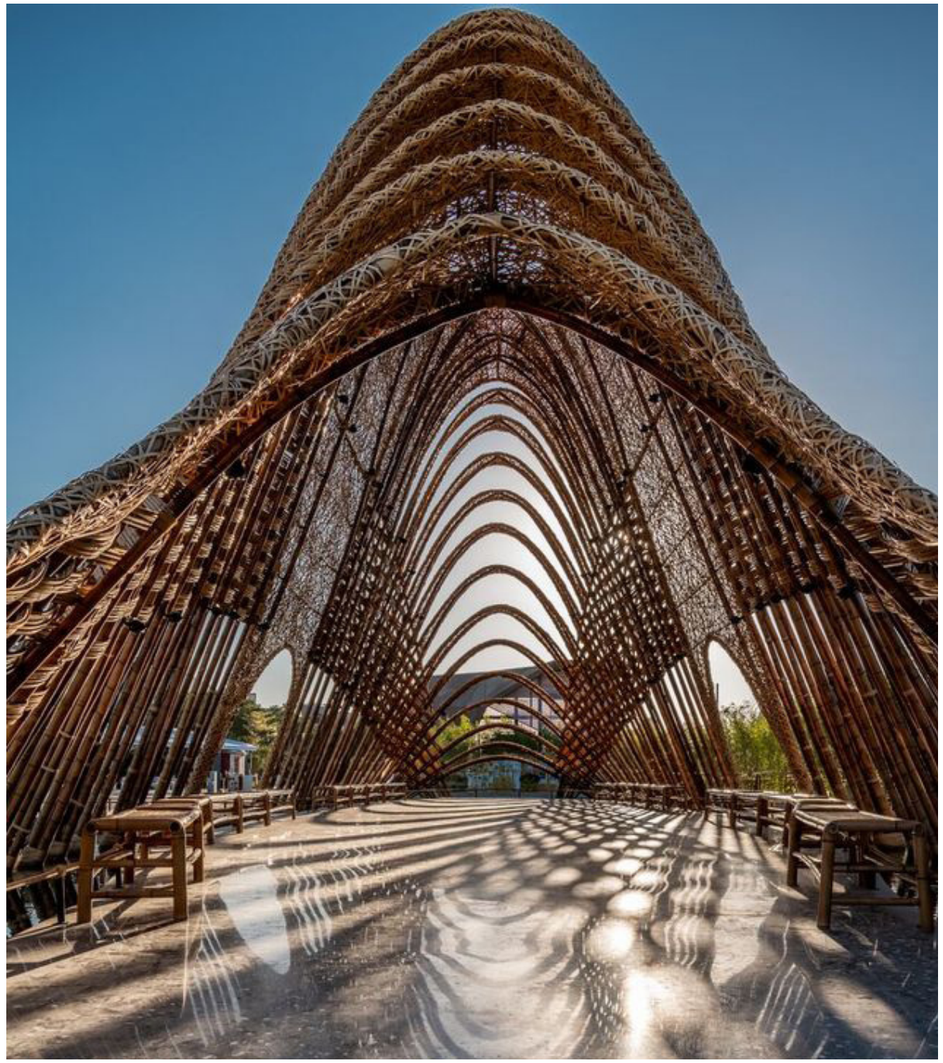


Fig.14, left and right
Two views del Bamboo Pavillion
© 2014, Shih-Hong, Yang

shape is designed for greater stability without the need for a foundation. The structure is also built following the idea of sustainable materials as well as the use of bamboo as a structural material.

Faced with the creation of a dull metal, steel structure, there is a sense of inappropriateness in its repeatability, flexibility and modularity, which each designer has tried to fill with diversity. In this reappropriation of identity, an example of a temporary structure made solely of metal, an Italian artist, Edoardo Tresoldi, proposed a new approach to temporary architecture, through a monumental sculpture that is both place and contemplation. At the Coachella Valley Festival, an ephemeral work is thus proposed, showing the story of a single-material architecture that enjoys a unique moment of temporariness.
However, this absence is still transformed within a work proposed by El Lissitzky, in which his objective becomes that of rendering precisely through the use of these temporal structures, the perception of a space and depth, through the lines created by a three-dimensionality that is followed. The detection of this temporary structure is to define itself in the un-built. The project is called wolkenbrugel and consists of a grid which, by sometimes subtracting certain components, or by joining them together, the visitor's imagination is able to transport the absence, the lack of the primary building component, into the viewer's sensation. In human habit, surfaces are contrasted with lines. In the absence of surfaces, these projects show the capacity of an element as simple as the shelfholding to interpret a sensibility that is so masked by many of the works, coated, or covered for various needs, that the possibility of making the absence itself visible is not taken into consideration, as in these cases.A final interesting idea comes from two interesting possibilities which both share the same material: wood. Although we have already encountered it in the previous paragraph, the use of wood in this case presents itself in a very

different way. In this case, bamboo is used as a scaffolding structure. One of the most interesting examples of this is the Bamboo Pavilion, built in Taiwan by ZUO studio. In this case, wood becomes a material capable of challenging the flexibility of a steel scaffolding, with clearly more curvilinear forms. The pavilion is intended to be a space where, as we have seen above, it must be able to be both a monument and architecture. Unlike that presented in the steel structures, the atmosphere, in this chaos, wants to welcome the spectator for a more excellent balance between the architecture and the nature of the place. According to the designers, the bamboo pavement is a metaphor for 'architecture's footprint, like a seed has been spread and grown, symbolizing our hope and dream of future- offering a more habitable environment to our next generation.'

Virtual stages

Among the many innovative drives that the pandemic crisis has brought about, there has also been a strong demand for innovation throughout the events sector since its inception. As we have seen in the chapter concerning the story analysis of the sustainable development of events, at present, the events industry is still in a phase of forced stalemate, in which, although the means of sustainability are not the engine that can undo the current pandemic problem, they could still be of some benefit in the future rehabilitation of the events machine.
However, it has to be said that a new era is taking place, sometimes forcing the habits of the human being more than necessary, to give sociality new ways of expressing itself, and at the same time guaranteeing the possibility of being able to do so.
From these roots and other needs that we are about to explain comes a new way of staging an event, different from all those we have seen so far. The stage is transformed and represented virtually in a different guise since, now, it is possible. The immersive reality that the event used to give to the individual spectator in his or her single seat in the stands now breaks down and reassembles itself in his or her office chair in order to follow the event in a different way, but trying to produce the same excitement as a live presence. Can this, or other means of augmented reality, really replace the event? However, this question has an entirely subjective factor, which, in this precise historical period, is being answered in a more generalised manner. Indeed, in this crisis, this reproduction of the real seeks to obviate the problem of the pandemic crisis in order to give spectators back the satisfaction of an event.
Moreover, substantial differences involve several parameters. It should be borne in mind that a physical event, compared to a virtual event, requires a much larger investment capital since, in addition to the equipment needed for its realisation, the costs of accommodation and meals for the crew must also be covered. Not only that but the range of action of the event, in this case, can be expanded with remarkable ease, since, especially at this time, border restrictions and different time zones may deny the possibility of extending the frontiers of a physical event as far as possible. Similarly, online events can create a group of spectators at any time of day and for any day of the year, accessible by virtually all of today's electronic communication tools. Therefore, it should be pointed out that this period has led to the emergence of optimal solutions that match the psycho-mobility of a virtual event. In-person conferences, trade shows, company gatherings that have been postponed or cancelled have found the only possible solution in the realisation of a virtual event in total pandemic security. Thus, the cancellation of the physical venue has found a possible replacement in this new world for events, where, indeed, virtual events may have some advantages (Sanders S., 2020). In this respect, according to Sanders S. himself, one can sum up ten possible innovations in which events can gain a better advantage over physical versions:
- The possibility of accommodating many more people at an event: reaching the event is no longer dictated by the economic possibility of showing up at the venue;
- As a corollary to the previous point, travel and accommodation costs are also saved, as the event can be followed directly from home;
-Virtual events give a better optimisation of the event: the possibility of recreating the environment of the event directly from one's own home also allows the spectator to have more flexible schedules and gain some free time that he/she could use for other necessary activities in his/her day;
An estimate of lower service costs converts into lower ticket costs; if the Venue Hire tax is not incurred, and the travel and hotel costs for the crew are not necessary, many of the logistic costs are avoided. According to their estimation, the avoided service costs can translate into lowering the ticket price enormously, or in some cases, allowing free content that was previously presented for a fee.
- More flexible schedules according to the viewer's needs: it is possible to run a double session simultaneously, inviting many more viewers to participate and enjoying different topics simultaneously.
- Virtual events are managed from a more comfortable environment, thanks to the possibility of finding a space already set up in one's place where everything needed to follow the event in the subjective optimal situation is already prepared;
- Improved possibilities to achieve telematic contact with some participants by offering a side-channels parallel to the main sessions where users can be contacted.
- Quicker Paths to new revenues; thanks to the logistical capacity to organise the event, many of the operations of entry, check-in, bade verification are eliminated, thus allowing more efficient contact with participants;
- Virtual events put all participants on the same viewing level; in this way, all viewers can be called upon equally to take part in the conversation and to experience the entertainment or disruption of the event at first hand
The possibilities of realising such an event six greatly expand, giving both the organiser and the participant new methods of dissemination and participation. However, this innovation is still at a relatively embryonic stage, where many of the technologies in a single home can still support personal participation in an event. However, the emotional transport that a physical event can determine in the spectator himself is still tricky. The physical event is also characterised by the involvement of the five senses that the spectator has hardly ever tried to give up, and, especially after a pandemic crisis, the desire to relive an event physically is even higher than in the ordinary activity before these unpleasant periods of social distancing. However, virtual events represent a new era of innovation that it is impossible to give up and indeed, it is right to take part in some possible contexts. The physical event has a world that can bring people together on a virtual level, where electronic objects can still act as a conduit in both cases. The physical event has a world that can bring people together on a virtual level, in which electronic objects can still act as a conduit in both cases. Indeed, if the event can be transported entirely on an electronic device, it is the same electronic device that can give us access to a physical event. the sharing of the two possibilities thus becomes an interesting outlet for a future of innivation that is already expanding in this area.

Embodied Energy and Carbon Quantifications

In order to quantify the embodied energy, a company was selected to produce the construction elements for the stages and the modular platforms. The choice fell on the company that provided enough data to determine the embodied energy of the individual elements. The choice fell on the Italian manufacturer Proel, which offers its characteristics for each truss of interest for the analysis in its

catalogue.

We have also chosen to analyse products made of aluminium, as they already offer improvements in their characteristics: - Specific weight one-third of that of steel - Maintenance-free due to high resistance to corrosion and atmospheric agents - fully recyclable at the end of their lifetime.

We therefore first identified the corresponding truss models and then continued the analysis by searching for a platform that would conform to those used in the modular stages, and finally, the additional materials, the quantification of which becomes more approximate in units due to the multiplicity of different materials involved in the analysis.

Truss Quantifications

The following shows the analysis of a possible embodied energy derived from models QUADRO, TRIO, DUO series manufactured by the Proel stage equipment factory. All trusses analysed have a cross-section of 50 mm. Also, since many of the sections or dimensions tend to be the same for modularity, the truss models chosen are in themselves generically attributable to similar models of other manufacturers already on the market. Furthermore, according to a linear interpolation carried out on the energy quantification, even in cases in which the truss width increases (while maintaining intact the circular sections of the beams), the quantification of embodied energy and carbon also follows linearity. The datasets for embodied carbon and embodied energy were taken from the Inventory of Carbon and Energy (ICE) databases. Hence, to accomplish the actual dataset offered by these databases, the embodied energy was quantified in boundaries A1-A3, from cradle to gate.

ALUMINIUM EXTRUDED PROFILE		
EMBODIED CARBON	8,78	$kgCO_2e$ / kg
EMBODIED ENERGY	157,1	MJ/KG

PVC TEXTILE		
EMBODIED CARBON	70,61	$kgCO_2e$ / kg
EMBODIED ENERGY	2,55	MJ/KG

Table 3, 4,
Summary of the Embodied Energy and Carbon ptaken into account for the quantification of aluminium elements
Data are sourced from the ICE V3.0 ed ICE 2.0

Technical characteristics and embodied energy of a Proel DUO truss

PRODUCT	LENGHT (mm)	WIDTH (mm)	WEIGHT (kg)	EE (MJ)	EC (kg CO_2e)
DUO 25	1000	250	3,389	532,41	28,76
DUO 29	1000	290	3,485	547,49	30,60
DUO 40	1000	400	4,42	694,38	38,81

Technical characteristics and embodied energy of a Proel TRIO truss

PRODUCT	LENGHT (mm)	WIDTH (mm)	WEIGHT (kg)	EE (MJ)	EC (kg CO_2e)
TRIO 25	1000	250	5,519	867,03	48,46
TRIO 29	1000	290	6,203	974,49	54,46
TRIO 40	1000	400	8,11	1274	71,21

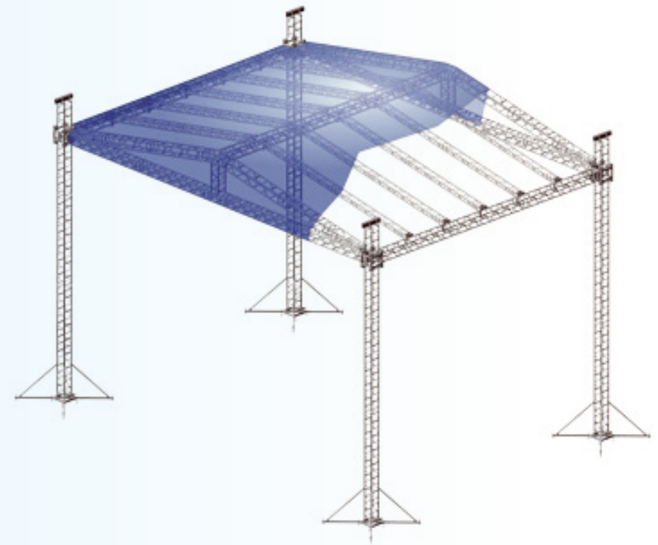
Technical characteristics and embodied energy of a Proel QUADRO truss

PRODUCT	LENGHT (mm)	WIDTH (mm)	WEIGHT (kg)	EE (MJ)	EC (kg CO_2e)
QUADRO 20	1000	200	3	471,30	26,34
QUADRO 25	1000	250	7,087	1113,37	62,22
QUADRO 29	1000	290	7,907	1242,19	69,42
QUADRO 40	1000	400	10,802	1697	94,84

Towers + Coverings

After quantifying the truss, we can quantify all the elements that use this modular piece to build the rest of the stage. As we have explained in the paragraph on construction techniques, the stages are modular structures that are always made of the same element for speed and ease of assembly. In particular, the manufacturer Proel itself offers truss assembly solutions to create towers for the assembly and support of light equipment and roofing.
This grid covering has a modular dimension. Therefore, we will analyse the two solutions proposed by the company of 10x12 metres and 10x8 metres, both with a maximum height of 7 metres. The main technical element is based on the Truss Quadro 40 and 29, which was presented earlier in the analysis, and which we can use to continue the analysis.
Therefore, in addition to the previously collected data, an estimate of the roofing and the towers' support bars, also made of aluminium, has been added. In both cases, the quantification used the previously mentioned databases of the Inventory of Carbon and Energy (ICE). The manufacturer does not provide the length of the booms; however, based on technical knowledge, a length of 1.5 metres has been assumed for the bracing and one metre for the base feet. The density of the applied material is 4 g/cm3; lastly, the six zones used is the same as that used for QUADRO trusses, i.e. 50 mm.
From these assumptions, the base diagonals have an estimated weight of 8 kg, and the base bars 5.30 kg each.

PRODUCT	PLRFST1008	PLRFST1210
LENGHT	10	12
WIDTH	8	10
HEIGHT	7	7



PARTS	PRODUCT	QUANTITY	LENGHT (m)	EMBODIED ENERGY (MJ)		EMBODIED CARBON (kg CO2e)	
				SINGLE	TOTAL	SINGLE	TOTAL
TOWERS	QUADRO 40	4	7	11,878.96	47,515.84	663.89	2,655.56
HORIZONTAL BEAMS	QUADRO 40	2	10	16,969.94	33,939.88	948.42	1,896.4
VERTICAL BEAMS	QUADRO 40	3	8	13,575.95	40,727.85	758.73	2,276.19
DIAGONAL PRIMARY BEAMS	QUADRO 40	5(+0,1)	5,1	8,654.67	4,4138.81	483.69	2,466.819
DIAGONAL SECONDARY BEAMS	QUADRO 29	5(+0,1)	5,1	6,335.17	3,2309.367	354,06	1,805.706
PVC COVERING	GENERAL TEXTILE	2	10x5,1	127.5	255	3,601.11	7,202.22
BASEMENT SCAFFHOLDING	GENERAL BEAM	4	1	832.63	3,330.56	30.634	122,536
DIAGONAL SCAFFHOLDING	GENERAL BEAM	4	1,5	1256.8	5,027.2	70.24	280,96
			TOTAL:		130,796.33		140,838.895

6.ENERGY

Sourcing the energy supplies determines one of the essential provisions for a successful sustainable music event. Neverthless, electricity has a predominant role during all the steps of the planning before and during the event itself, becuase each type of activity onsitee would need a precise amount of energy.

Therefore, aiming to find innovative solutions to energy efficiency, we want to analyze the single source of energy requirements during the whole event. The literature has brought us to reviewing the MartVVini et al. 200... work, four-year research that analyzes the energy consumption results.
The research also brought the results of the potential energy related to GHG emissions reduction at UK off-grid events. Energy consumption is related to over 70 power systems at 18 events, between 2009 and 2012, and included stages, traders, bars, performers' tour buses and campsite lighting.
The collection of time-accurate data led to the analysis of main energy trends so that they can be exploited to improve energy efficiency and reduce GHG emissions and operating costs.
From these results, we want to obtain the primary energy requirements, defining the indicators that are useful for our service design and, lastly, we aim to find a pro consumption dimension of an exact

quantity of energy requirement at-person.
The energy consumption data have been acquired minute-by-minute by analyzing the mainly current transformer: each generator will include three phases with split-core cabling.
Due to the massive usage of audio, video and lighting, stages are the most energy-intensive systems, even if the size and scale of these areas vary significantly from event to event, particularly at more significant events. For this reason, the specific provision consists of separate electrical power source for each stage, which will be used by the stage and any associated adjacent systems, such as artist hospitality.
The primary sustainable sources of energy are diesel-powered generators, some photovoltaic systems and

some wind power.
An energy security planning becomes indispensable in areas not powered by off-grid supplies, where there is no attack on a grid connection. Therefore, the traditional approach is to oversize generators in order to provide the excess capacity to cope with any sudden peaks. More significant events may also use a backup generator in case of power failure in the primary generator. Moreover, a hybrid system also guarantees the power from renewable technologies, including battery storage and assuring energy security, achieving the actively managing of the electricity demand. As the event becomes smaller, the energy demand would be smaller too. In these cases, events use relatively low power system and demand is managed by limiting the electrical equipment that can use, until when, if the battery storage is low, there will be manually switching off some of the renewable energy equipment.

Energy is a primary object for planning an event because it allows performances to remain unhired and maximized with no power failure. In a festival, the audience experience is paramount, and bringing inadequate electrical systems to a festival would mean compromising the overall success of the entire event.
The majority of festivals will not be able to gain power through the national grid, and therefore make us of off-grid rental power.
This type of energy is provided for a short term or emergency bases, such as festival, construction or disaster relief. Their primary aim is to provide continuous electricity regardless of the situation, maximizing energy security. One problem that has become relevant in recent years is that most diesel generators are often underutilized and oversized, with up to 50% of the fuel "going up in smoke" [1].
Aiming to improve safety while supplying the electricity, the electrical systems are designed to operate autonomously, dividing the generators by separate areas, so that, in the event of a failure of one system, it will not compromise another. Some systems are also able to supply a backup generator, or it is possible to supply smaller generators for separate power circuits. Therefore it is useful to look at renewable sources also with the approach referred to the safety of the success of the event, as reported by some research[2, 3, 4] if a technology cannot guarantee that it can provide enough power for an event, then it can appear to be too risky for implementation. An example was the edition of the Glastonbury Festival, [5]where the installation of photovoltaic panels was able to generate enough energy for some parts of the festival, they cannot, however, be guaranteed to be sufficient for the entire performance time, and as a result are due to be used to power the farm and the national grid rather than the festival[6].
A good alternative may be the use of biodiesel instead of red diesel to power the generators[7]; GHG emissions are calculated on the basis of the quantity of fuel used, and the emission factor of fuel, therefore using biofuels with a low emission factor could help the reduction of emissions. However, there are also suggestions that biodiesel can prove problematic when used in specific engines[8].
Another issue for reducing electricity emissions is not related to the quality but on the quantity of the demand; to reduce the amount of energy required, however, it is necessary to analyze the operating hours or reduce the demand for the equipment being used.
So, for reducing operating hours, firstly there is the need to establish them, while, reducing equipment demand depends on the system that is being used.
The primary system that will be controlled from a festival organizer and therefore the systems which are easier to control to reduce energy demand through equipment specification are those relating

Fig. 1
'OFF the Grid Festival' is Australia's First Solar-powered Music Festival located in Melbourne. The event was completely powered by photovoltaic panels, demonstrating that careful planning can lead to innovative and sustainable ideas.
© Organizators

1 Jones, 2010
2 Reuters, 2009
3 Gloyston, 2011
4 Renewable Energy World Network Editors, 201
5 Morris, 2010
6 Morris, 2010; Bakewell, 2011
7 (Aggreko, 2009
8 Atadashi et al., 2010

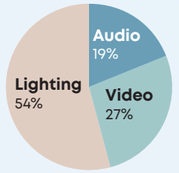


Fig. 2 (left)
Average power breakdown demand adapted by Marhcni, 2013

SYSTEM TYPE	TOTAL CONSUMPTION [KWH]	MAXIMUM DEMAND [KVA]
STAGES		
Main stage lighting	6990	1185
Main stage video	1999	344
Main stage audio	1657	229
Main stage front of house lighting	1078	163
Main stage guest lighting	908	589
TRADERS		
Trader island (20 traders)	4614	480
Bar	3313	367
INFRASTRUCTURES		
Crew catering	1933	382
Campsite lighting	1916	222
Tour buses	1498	485
Production offices	511	69

Table 1
Example total consumption and maximum demand. Adapted by Marchini et Al., 2014

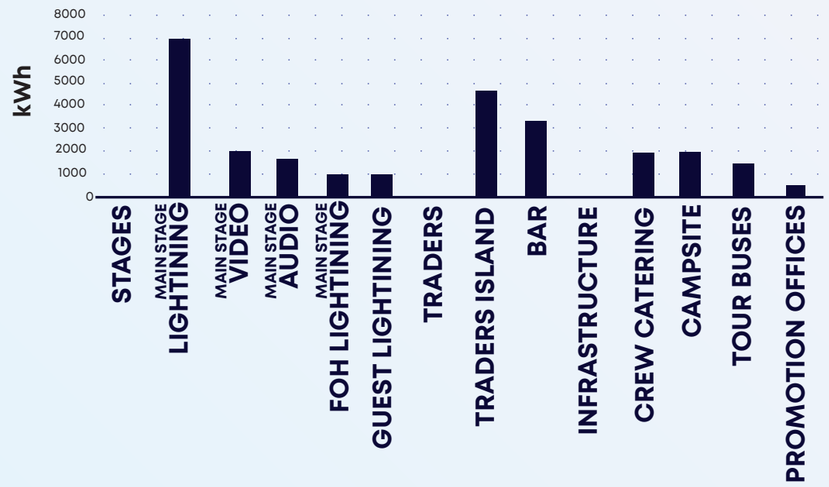


Fig. 3 (top)
Typical electricity consumption by activity. Adapted by Marchini et al., 2014

to the stages and assorted infrastructure: elements of the festival such as:

- *waste removal;*
- *production offices;*
- *tour buses;*
- *campsite lighting;*
- *water supply;*
- *stage supply;*
- *trade suppliers.*

Each of this system is adapted for its requirements and though cannot be reduced through the technique of using a low energy equivalent. For instance, using a substitution of campsite lightings from Fluorescent lamps (CFL) to light-emitting diodes (LED) can occur to some issues: there could be existing stocks of these bulbs and existing system designed to accommodate them; in addition, their perceived durability and lower capital cost make them easily replaceable.

The same happens for stages. In this case, most of the light and video equipment are yet using a typical flat LED system, so they are still using their minimum as possible technology in their field and as a result, are not an area where savings could be expected through equipment substitution.

The audio equipment is provided through the number of amplifiers that can be differentiated thought different classes of efficiency: A, B, AB, or D. Classes A, B, and AB are defined as analogue amplifiers, and these classes are inefficient when used to the full capacity; also, they might be suffering heat losses as a result that may also ask for mechanical ventilation and, as a result, a further power demand. The D class instead means for amplifiers that operate digitally and are able to achieve much greater power efficiencies and reduced losses when used to full capacity [9]but they may use more power at low signal levels than the analogue amplifiers. So, an audio efficiency improvement may be very variable depending upon the purpose of the amplifiers, being affected by output volume and waveform and both digital and analogue amplifiers have shortcomings regarding their efficiencies at varying loads.

Physical quantities for energy amount evaluation

Energy use [kWh]

For the evaluation of the environmental impacts, made by the energy usage, we will focus our analisys on the energy use of the festival ***in process.*** So we have to use a second parameter that control how much energy we've used for the show. In this case the energy is calculated as kilo Watt per hour of usage [kW].

9 Self, 2010

The energy efficiency is the process of doing more with less[10]. In a practical way, energy efficiency is a very sustainable approach, indicating the methods for designing a powerful energy system without having any losses or underestimation of the energy.

Voltage

The voltage is the force made by electricity to flow through a wire. Its unit of measurement is Volt (V). For festival events most items are designed to run on 230V in AC. Occasionally there are items designed for 110V AC (using a yellow plug) and 400V AC (using a red plug). A higher voltage is not necessarily better.

Current - Ampere

The amount of energy that flows through a wire over a given time. The thickness of the wire restricts its flow. Plugs and sockets are rated up to a certain current carrying capacity – 13 A domestic, 16 A & 32 A etc. The symbol for current is (I) and the unit o measurement is the Amp (A).
Ampere (A, I)
The Ampere is unit of electric current enrolled by the International Standard System of Units. One Ampere represent the one Coloumb of electrical charge moving past a specific point in one second. The relation between the ampere is defined as follows:

A = Coloumb ⁄ Second

Watt (W)

Power is measured in Watts (W) and it is defined as the rate at which energy is consumed by a system. We can consider it in two ways:
- the amount of power a machine can produce
- the amount of power that a system consumes

The relationship between Voltage, current and Power is defined in the formula:

P (W) =Ampere × Volt

10 Powerful thinking, 2017

Volt (V)

Volt is used for defining the electrical unit of voltage of potential difference. One Volt is defined by the consumption of one joule per electric charge of one Coloumb. This relation is therefore described as follows:

Volt= Joule ⁄ Coloumb

Joule (J)

Joule is the unit that defines the work or energy in the International Standard of Units. It is equal to the work bone by one Newton acting through one meter. Otherwise, in electrical form, the Joule is equal to Watt-second; this is the energy released by a current of one ampere passing through a resistance of one ohm.

Coloumb (C)

This unit represent the measurement of electric charge; moreover, it defines the charge carried by one ampere in one second. It is therefore defined as follows:

Coloumb= Ampere ⁄ Second

Ohm (Ω, R)

This is the standard unit that represent the electric resistance in the International Standard of Units. It is formally defined as the electrical resistance between two points when a constant potential difference is applied into such a conductor that produces a current of one ampere. It therefore defined as follows:

R =Volt / Ampere

Typologies of festival electrical equipment

Grid connections

Running an event through a grid connection means connecting the equipment to the national grid connections that are already in production. The main advantages are that it can reduce transportation costs involved in the delivery and collection of equipment (e.g. lending of generators and cost of fuels). The use of this electricity can also be made by involving a sustainable industry that produces energy through renewable resources.
In some cases, this energy can be not the best options. This issue mainly happens when the site has not already placed a supply: installing a substation or extensions to the underground cabling can produce a higher cost than there can be requested by other temporary energy generators. Additionally, working in a large venue, using a single substation energy source, may be insecure and a more difficult organization for connecting multiple sources on a large area.

ADVANTAGES	DISADVANTAGES
Where existing supplies and connections are available, this can represent the cheapest solution	Installing new grid connections can be expensive and time consuming.
A 'green tariff' can be procured.	Locations of specific electrical consumers
Greater reliability (reduces risk of mechanical failure or human error).	onsite may prohibit a grid connection.
Can reduce emissions and costs associated with the transportation of plant to site.	No redundancy planned for in the event of a grid power failure.
Silent running.	
Cheaper than most temporary power solutions (£/kWh).	
No fuel burnt, thus less air pollution.	

Table 3
A comparison between main adavantages and disadvantages of a National grid connection
Adapted by Green Festival Alliance (GFA), 2013

Fig. 4
An example of diesel fueled generator,produced by Generac Mobile
© 2020, Generac Mobile

Diesel fueled Generators

This machine combines a diesel engine with an electrical generator (often an alternator) to generate electrical energy. This type of engines is generally reliable and increasingly quiet. This type of electricity is provided for events and emergency systems whenever there is asked for a high demand for energy for a short period. Any diesel liquid fuel powers the engine, the most common is a specific fractional distillate of petroleum fuel oil. However, there can also be used many alternatives that are not derived from petroleum: biodiesel, biomass to liquid (BTL) or gas to liquid (GTL) are more sustainable resources and are increasingly adopted. The diesel engine has an energy efficiency based on its running modes. For this reason, they should be run at least at 60 - 75% of their maximum rated load to avoid damage of the machine. As mentioned before, during the literature review, it has been many times found an overestimation of the machines that cause higher electricity costs and shortening the lifetime of the equipment. The leading solution to overcome this problem is to own a selected generator by not relying on stakeholders who may not provide a suitable machine. A possible solution could be a technology currently under development, defined as a "variable load generator". These systems can yield a higher efficiency for partial load condition by reducing the rotary speed of the driving shaft. However, at the moment, this energy has not yet been implemented in the organization of festivals.

ADVANTAGES	DIAVANTAGES
A cheaper cost	the system produces the most relevent percentages exhausted of pollutant emissions
Available in a great amount	
Not depending from weather or venue conditions	

Table 4
A comparison between main adavantages and disadvantages of a Diesel Fueled generator
Adapted by Green Festival Alliance (GFA), 2013

Other renewable energy systems

Fig.5
An example of biodiesel fueled generator,produced by Js Power
© 2020, Js Power

Although the current situation of our global electricity infrastructure is based on the use of fossil-fuels, the change is becoming more rapid, and the reduction of pollutant emissions is increasingly required. In addition, the territory and the economy are increasingly adapting to making renewable energy the best preference for all types of energy requests. 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.
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 industries. For these reasons, many events have already adapted to new forms of renewable energy which we list below.

Biodiesel fueled generators

These generators are powered by a waste vegetable oil (WVO) fuel, created using oil contained in some edible or not edible plants; it is divided into Bioethanol and Biodiesel. Biodiesel is made by a simple process: the vegetable oil is reacted with methanol and a catalyst, such as sodium hydroxide, for producing a methyl ester, that is, the biodiesel. Both the methanol and the catalyst used in the process can also be reused and, the by-product of the biodiesel production is glycerine that can be used for other purposes in the industrial production, such as the making od soap. The Bioethanol, also defined as green diesel, is a type of renewable diesel fuel produced by hydrotreating vegetable oils. Unlike sugar biodiesel, hydrogen is used as the catalyst in the creation process instead of methanol.
Due to deriving by food production, biodiesel can cause spikes in food price, causing displacement of food cultivation by the previous deforestation of the area. Biofuels cultivation has stated to be related to rainforest clearance, loss of biodiversity and displacement of local communities. Because of this unethical issues, it is recommended to use WVO biodiesel which is only derived from waste from industrial processes and food factories.
The Biodiesel fuel is considered as a Zero-Carbon Footprint because the carbon emitted when burnt has been pre absorbed by the growth of the plant,

but the process used for creating the fuel requires much energy for processing the amount.
For explaining this concept, we need to classify the fuel in three categories:
- Type 1: Sugary, starchy and oily plants that are also edible food sources;
- Type 2: Wastes or woody and oily planted that are not edible food sources
- Type 3: Algae

For each category corresponds to a different advantage or disadvantage. The choice of type 1 WVO means the easiest to possibility find; but it would increase competition with food production, causing spikes in food prices. Many times, to increase production, deforestations are also created to increase crops, causing a loss of biodiversity and a significant amount of the carbon emissions that will derive from clearing forests, soil erosion, fertilizers use and transport of feedstocks. In case of type two, even if there comes up by not edible food sources, the energy required for converting the plant to Bioethanol is complicated and expensive; also collecting the used oil from single private and public sectors can be an expensive and challenging mansion. Lastly, in case of the production of WVO by the Algae, it is required a large amount of water and the fertilizers needed emits more GHG than that one that would be saved by not using fossil fuels. This analysis shows that, although in some cases biofuel can be considered a more sustainable alternative, analyzing the production process, it could occur the WVO itself may have issued more indirect Greenhouse Gas emissions than typical fossil fuel.
It may also be noted that long-range transport of biofuels adds a feedstock result in additional to GHG emissions. It is estimated that transport of over 10,000 km of biofuels can contribute to 7-38% of total carbon footprint.
To understand, therefore if biofuel is really more sustainable than fossil fuel, we refer to the entire production chain and life span analysis in an LCA form.
From the chart, we can understand that not all the biofuels have fewer impacts than fossil fuel and that biofuels cannot solve the problem if it is a limited

ADVANTAGES	DISADVANTAGES
Are considered as 'zero carbon' (the carbon emitted when it is burned as a fuel had been already absorbed by the growth of the plant	More expensive than red diesel
Reduced CO_2 and NO_X emissions compared with red diesel	Even if widely available, a large amount of supplies in a short term may be noticed as a issue
Non-toxic and non contaminative	Can cause *generator issues* due to high viscosity
	Can shorten lifetime of generator

Table 5
A comparison between main adavantages and disadvantages of a biodiesel Fueled generator
Adapted by Green Festival Alliance (GFA), 2013

supply over the total amount of fossil fuel.
For this reason, the search to minimize the total consumption of electricity remains a logical choice.
Lastly, In January 2018, the EU parliament voted to approve a proposal that bans the use of palm oil in fuels from 2021, and also bans any food-based biofuels from 2030, due to the high demand that is driving deforestation in Malaysia and Indonesia.
The European Commission, aiming to ensure that biofuel is sustainability produced, have also verified several schemes that recognize as valid certification of sustainability criteria.

Photovoltaic PV system

Whereby by 2020, it is the second most expanded power supply, with a global operational installed capacity that is reached to 627 GW. (Sawin, JL, Renewables 2012 Global Status Report, 2012) creating an average growth of 785% during the period between 2011 and 2019.
The overall performance of this system depends on:
i) The geo-location and resource information, such as solar intensity, cloud cover and temperature
ii) System efficiency of the PV devices and DC-DC converters.
Photovoltaic panels are mainly formed by photovoltaic cells that convert sunlight int to DC electrical supply. Energy is stored inside batteries. Thanks to an inverter, the voltage is converted to be used for standard equipment. Weather conditions strongly influence the generation of electricity. 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. Usually, the solar generator produces lower levels than diesel generator; also, the amount of power if dramatically influenced by weather conditions. However, where there is proper planning to match the power demand with the capacity of the system, a solar generator can deliver even in the worst weather conditions. The system is very reliable due to no moving parts to break down. Furthermore, a solar generator runs its power for storing the unused energy.

ADVANRTAGES	DISADVANTAGES
100 % renewable	Additional hire & logistics costs
Zero carbon emissions	Requires south facing aspexts and additional space
Silent running	Performance affect by cloud cover
Prevent reliability	Limited power output
Can interface with hybrid technologies to reduce other generator runtimes and fuel consumption	Application limited due to storage batteries
Visible demonstration of a festival's commitment to low carbon energy	

Table 6
A comparison between main advantages and disadvantages of a phorovoltaic system
Adapted by Green Festival Alliance (GFA), 2013

Fig. 6
The Solar panels installed by Firefly Clean Energy power supplier
© 2014, Firefly Clean Energy organization

In recent years, solar generators have been used to power small to medium stages, but tend to work in the best way for "integrated solution" given by the same audio and light supplier.
Solar generators have been employed to provide base loads overnight for stage and areas.

Wind power

This term refers to a system combination of technologies previously mentioned with storage batteries for collecting the whole unused energy.
Wind energy is created thanks to Wind Energy Conversion System (WECS), thus converting wind energy to electrical energy. These systems have been popular since a previous time, in comparison with the PV system. Nowadays the usage of WECS is continually increasing, reaching 651 GW in 2019 of overall energy production.
Its main structure is mainly composed of two parts: the mechanical part and the electrical. Firstly, the mechanical part extracts the wind energy thanks to rotational kinetic energy; then the energy is sent to the electrical part for transforming it in electrical current.
Its central structural part is composed by the 'tower', the 'rotor' and the 'nacelle'. In the nacelle, there are placed the mechanical and electrical parts. Besides, the rotor may contain two or more blades. The wind turbines capture the energy thanks to the blades and transfer it to the generator. The generator is then driven by the wind turbine that generates electrical power. In the figure The main advantage of using the batterers is to deliver only the amount of electricity needed and to store the rest for any moment, making the energy efficiency of the system always constant. 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.

ADVANTAGES	DISADVANTAGES
Zero CO2, NOx and PM emissions.	Limited supply chain for rental spec units.
The only by product from its operation is water.	Very limited power output (175 W), so only suits low energy applications.
Silent running.	
No possibility of fuel orearth contamination.	
Low maintenance and servicing.	
Better fuel to kWh energy conversion than red diesel	

Table 7
A comparison between main advantages and disadvantages of awind turbine system
Adapted by Green Festival Alliance (GFA), 2013

Fig. 7,
Skyrota Wind Turbine installed in the 2009 edition of the Glastonsbury Festival
© 2009, responsesource.com

Hybrid systems (HPG)

Hybrid generators are innovative generators that combine traditional fuel-generator with another controllable renewable energy source. This combination is creating a fuel-efficient noise reduced and environmentally friendly source of energy. The hybrid system may be mostly composed by a fuel cell or another device which generates the electricity from an electrical source, such as the hydro-electric generator as well. Moreover, there is often applied solar-powered generator or wind turbine generator.

The HPGs systems are used at events as in different ways:

- **Baseload management:** *when the HPG is connected to biodiesel or a diesel generator for items with a variable power required to ensure the diesel or biodiesel generator only runs when demand is high. Suitable uses include stages, concessions or production compounds. The HPG automatically detects when a load is low and turns off the diesel generator, by transferring the same load to its internal storage bank. On the contrary, when a higher load is detected, the diesel generator is automatically started.*
- **Renewable primary supply**: *Connect an HPG to solar panels and wind turbine to provide a stand-alone power system and optionally connect a diesel generator for back-up. Solar panels or a wind turbine provide intermittent power to the load. The internal storage system ensures that demand is met when the massive cloud is present or wind speeds are low. If connected to a diesel generator, the HPG will automatically start it and transfer load if the HPG's storage runs low. Suitable uses include remote site lighting and camping fields (LED festoon), pumps for on-site water management and distribution, small stages, and individual cabins such as box office or security posts.*

- **Uninterrupted Power Supply:** Connect to HPG to the grid, diesel or biodiesel generator to provide a seamless power transfer and continuous power output in the event of a primary power supply failure. Suitable applications include critical event areas such as police compounds, medical tents and communication systems. communications systems.

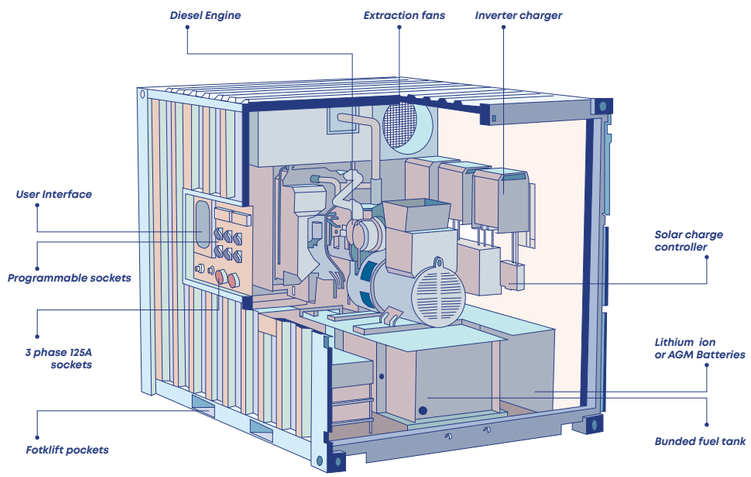


Fig. 8 Example of hybrid system adapted by Firefly hybrid power.

Innovative systems

Pedal power

Just as wind power, also pedal power translates kinetic energy through dynamos into electricity. Systems usually store the energy into batteries. Typical applications at festivals are phone charging, cinemas, sound and lighting and interactive installations. Each adult bicycle typically generates an average of 60 watts of power, and child bicycles generate an average of 30 watts of power each. Then the power from all bicycles is aggregated. The power generated Is low voltage DC power, which is converted to 230volts AC. Typically, 10-20 bikes can power a small stage or cinema using energy-efficient equipment. Typically, 20 bicycles con produce up to 1 kW of power for films, bands, DJs and spoken word artists.

ADVANTAGES	DISADVAGAGES
An interactive and educative way for introducing people of the concept of self-sufficient energy production	A limited power output: 5-250 W.
100% renewable	Limited number of suppliers.
Zero carbon emissions	

Table 8
A comparison between main advantages and disadvantages of pedal powered system
Adapted by Green Festival Alliance (GFA), 2013

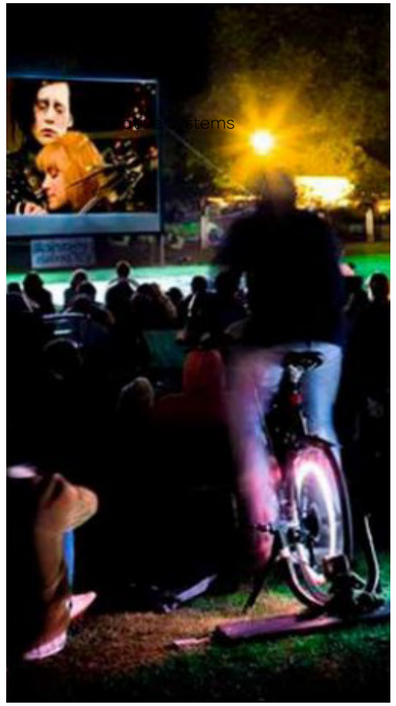


Fig. 9 a bike powered cinema
© 2020, Electric pedals

Dance power

The sustainable dance floor is a project that uses dancing and moving people as a source of energy. The energy produced by the movement is converted into electricity that is used to make the dance floor react to the public, and the generator can be used to power up the LED lights. The mechanism is based on a floor compression: when stepping on, the height reduces of 10 mm, activating an internal generator that is able to produce up to 35 Watts of sustained output per module. Actually is not considered as totally substitute for festival generators, but this technology can develop better chances to have more power supplies.

Fig. 10 an energy-creating flooe
© 2020, Energy Floors

Fig.11,
an example of urine powered toilets
installed at theGlastonsbury Festival
© 2009, responsesource.com

Walking Power

These units are installed into pavements, and every step generates 7 watts of energy. It may be thought of a pedestrian energy to power the festival.

Urine-power

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 remit the moisture from the hydrogen gas. This purified hydrogen gas is pushed into the generators for creating electricity.

Hydrogen fuel cell

This machine can convert the chemical energy from a fuel into electricity through a chemical reaction with oxygen or another oxidizing agent. The most common fuel used is hydrogen, but there have also been used many hydrocarbons like natural gas and alcohols like methanol. The fuel cells act differently from the battery due to the requirement of a constant source of fuel and oxygen to run. However, they are able to produce electricity continually for as long as these inputs are supplied. This technology, due to higher costs, is commonly considered as not yet widely available.

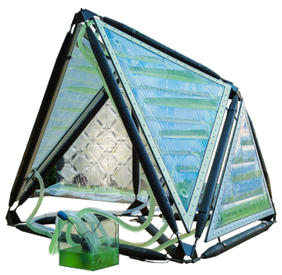


Fig.12,
a functioning example of algae energy based
system, presented a the Milan Design Week 2019
© 2019, Carlo Ratti Associates

Algaetecture

This type of architecture combines the ability to generate energy while producing a living space for its users. It is called 'Alagetecture' and was first presented by Carlo Ratti Associati during Milan Design Week 2014. The structure houses a micro-algae that can create its photosynthesis much more efficiently than a tree or a typical plant. Thanks to this critical process, the algae develops primarily by reducing the carbon dioxide in the surrounding environment, thus producing oxygen, cosmetics and, nonetheless, also energy as bio-fuel. In this proposed case, the algae have been applied to a facade system designed by architect Cesare Griffa and are intended to be implemented as an 'architectural skin' on buildings' facade.

Solar - Wind tower: The GEM tower

In order to overcome the polluting nature of festivals, a professor of Innovative Structural Design, Faas Moonen, has come up with an innovative method of combining different renewable energies into a technology that can greatly improve the energy supply within festivals. His project was introduced as the Green Energy Mill (GEM) Tower.
Thanks to a 2.3 million euro grant from Interreg Europe organisation, it has been able to develop a sustainable alternative; postdoctoral support and three PDEng researchers have also made it possible to specify the feasibility of its work.
This is how the idea of a sustainable hybrid supply between wind and sun was born, which nine companies - including festival organisers of Pukkelpop and Eurosonic Noorderslag - are already working to implement in their events.

The GEM towe combines on a vertical axis wind turbine, PV panels, and a battery. In addition a bio-fuel generator is provided as a backup energy provision.
The possibility offered by this technology is to produce totally renewable energy within the festival. An interesting point in this respect is that the element not only acts as an energy generator, but also negates the problem that repeatedly occurs with inconspicuous structures. In this respect, the idea was also to find a balance between a pleasing aesthetic form and efficiency.

The tower is also made of sustainable materials, and may be able to generate power for 261 consecutive days, according to test results. Nevertheless, there are three battery packs on the base of the tower, capable of storing up to 90 kwh of electricity.

The main power generation is through the vertical wine turbine. This element has a weight of 700 kilograms, and rises 18 metres. This height has been defined as the maximum limit for temporary turbines, due to the strong wind speeds at higher heights.
Una forte componente di innovazione è composta dall'inserimento, all'interno della torre, di 72 celle solari grandi e flessibili che gli organizzatori del festival possono inserire possono mettere sui tetti dei loro stand di cibo, unità di servizi igienici o tende e collegarsi al pacco batterie della torre.
These solar collectors come in different colours and are made from a so-called material (Luminescent Solar Concentrator). This material was developed in the research group of Prof. Michael Debije in the Department of Chemical Engineering and Chemistry. The panels are able to capture the iconming rays of light on their plates, and transfer it to the sides. In this way, photovoltaic cells capable of capturing light, which convert the light beams into electricity, are inserted into the frame of each panel. Nevertheless, these panels do not

require direct irradiation and are therefore more easily applicable than simple solar cells In both the shade and in the sun, they provide energy. Even on a completely cloudy day, they continue to produce electricity".

Another important aspect of this structure is its ease of transport and assembly. In order to promote more sustainable transport, the tower mechanism allows it to be foldable. As a result, assembly time is reduced to less than a day. The entire structure has a weight of 3500 kilograms, and is mainly composed of steel. The tower is folded up to be about one-meter thick and can be folded out to a height of 14 meters. At present, the tower's elevation mechanism requires the use of a crane, but subsequent innovations have already proposed the creation of a self-elevating mechanism.

The conception took about two years, starting in 2017 until the first tests in 2019. 2020. According to their creators, the GEM Tower, aims to reduce festivals' carbon footprint by 20% by making diesel generators superfluous.

Performance indicators

As mentioned above, the research aimed to analyze the load profile of the different supplies. Therefore, the utilization of indicators has been fundamental for describing the relationship between power consumption and consumption patterns over time.
These indicators are dimensionless descriptors that allow rapid comparisons between any system values; the analysis has based on the principle of measurement of building on the work of Chicco et al., Nazarko and Styczinski, and Ferreira. The advantage given by this indicator is to find a rapid comparison between any system and providing empirical visual analysis of the different values.
The indicators have been used for each of the different electricity areas. However, a primary selection has been made due to the site layout system for each event. The current transformers could only be attached to split core cabling – which was, typically, the cabling from the generator

themselves[11] – or on distribution boxes for the more extensive system. Therefore, only those that could be isolated by an exclusive section of the split core cable could be monitored. As a result, traders areas encompass the variety of different traders (i.e. 'food' and 'non-food' traders).

The indicators are expressed as follows:
- *Load factor*
- *Modulation factor*
- *Peak demand uniformity coefficient*
- *Impact factor*
- *Baseload uniformity coefficients need for security equipment.*

In the following table there are expressed the main purposes of the usage of the chosen indicators and their mathematical explanation.
Morover, we can assume that Peak demand uniformity coefficient (PDUC), baseload uniformity coefficient (BUC) and impact factor (IF), describe the relationship between different time period of the events. Indeed, Load Factor (LF) and modulation factor (MF) are used to describe each time period's relationship between the average, maximum, and minimum demands. The analysis of the indicators led to the identification of potential electricity savings, that will be described in the next paragraph.
After the all the data on the energy requests have been collected, it has been possible to proceed to the realization of the following indicators, so as to realize some synthesis diagrams, from which all the main problems of the equipment have been identified.

Actual problems

A problem occurring the electricity made by generators is purposed by the research conducted by powerful Thinking in 2012. They stated that on eight events monitored, every single system had periods working below 25% load, and some of them operated entirely below 25% while in 60% of cases, the generator was more than double the capacity required. This issue lack in the energy efficiency of the generators, creating a high cost while it could be affordable at a nominal cost.This problem comes if, while the planning and management phases of the event, it has been thought of a generator much

11 Marchini,2013

Fig.13
The GEM Tower during its final tests
© Klein

more than the actual needs, so there has been an overestimation of costs. In addition, generators run less efficiently at very low loads; this means that for every of fuel burned the generator is giving less power, or much more power is created for obtaining the same result of a smaller machine. Lastly, running at a very low load can cause damage and reduce its life.
this problem can also be caused by a lack of accurate information about the energy requirements. This case can happen when the artist's management or the organization have made an oversized estimation of the energy request. The artists, contractors or festival organizers demands for a single source of energy while, differentiating in multiple energy sources can make the energy more reliable. A practice of cross hiring equipment; due to the fact that many organizers don't own their energy equipment, are using generator basing on the other stakeholder's availability; when this happens, there may be used larger generators than what it is actually needed

Solution for reducing the emissions

1. Reducing power demand:
   - *Planning in detail what the actual requirements will be. Asking to every partner company (traders, lighting, PA, bars, offices) what a detailed list of their energy needs;*
   - *Put in place a power reduction policy for the whole event staff, contractors, artist and traders, for making a collaborative step together;*
   - *Find Light suppliers that offer more efficient equipment.*

2. Reducing the size of the generator while calculating the exact energy demand
3. Increase the usage of biofuel, renewable sources and / or hybrid systems for creating a more efficient device
4. Use the smaller generator for the overnight energy demands.

Due to using the same generator during daytime and overnight, there can be differences of overload as of minimum load, causing a worse energy efficiency. The figure () shows the average generator load profile for three-day events; it is clear that the overnight power demand is much lower, so, for minimizing costs and carbon emissions while maximizing the energy, different supplies can be useful.

5. Swtich mode amplifiers and LED lighting with more efficient refrigeration and more energy-efficient beer dispensing equipment.

Other aspects to take in consideration for mitigating and reducing carbon emissions:
Dedicate energy managers to the planning of the event
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

Fig. 14
An example of non-road generator used for the energy provision at the Cropedy festival - © PowerHire 2016

GENERATOR	FUNCTION	GENERATOR (KVA)		POTENTIAL SAVINGS		
		USED	POTENTIAL REPLACEMENT DIESEL (LITRES)	CO_2-E (KG)	[%]	
A	Bar	200	100	200	650	19
B	Bar	200	125	150	480	10
C	Main stage lighting	325	250	540	1700	8
D	Main stage audio/ video	325	125	1600	5200	53
E	Stage and traders	200	169	40	120	2
F	Main stage total	500	75	3900	12,000	80
G	Second stage total	250	125	1000	3200	39
H	Production area	150	25	430	1400	62

Table 11
Potential GHG savings from downsizing generator
Adapted by Marchini et al, 2014

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)
- Hazardous air pollutants (toxics) (benzene, Acetaldehyde, and 1,3-butadiene) linked to congenital disabilities, cancer, and other serious illnesses.
- CO2 and Greenhouse Gases: contributing to, as precedently said, global warming and climate disruption.

PROPOSALS FOR AN ENERGY SUSTAINABLE DEVELOPMENT

The analysis brings to different scenarios of potential GHG emission reduction that we will analyze more in detail the results in the following paragraphs:

1. Specifying more energy-efficient equipment; using the ***load profile*** indicators to determine the actual electricity consumption for lighting, audio and video power use;
2. Sizing generators more efficiently; using the load profile analysis to detect oversized generators;
3. Renewable energies and fuel substituting; using load profiles and indicators to identify opportunities for renewable energy or where battery storage could be used to meet low overnight demand.
4. Switching existing equipment off when not in use; using the indicators to rapidly identify when the equipment was using more power than expected through comparison with similar systems;

1. SPECIFYING MORE ENERGY-EFFICIENT EQUIPMENT FOR REDUCING GHG EMISSION AND ENERGY DEMANDS;

First of all, the results acquired aimed to research for aiming potential electricity savings. As a result, a reduction in GHG emission and on energy demands may be both achieved.
For each venue area, there have been identified several improvements; therefore, for a better description, in the following paragraphs, we will analyze this issue as it can be improved in the single areas.

Stage area

More than half (54%) of the energy required in the stage is used by lighting. It is also interesting the analysis made in occasion of their usage of LED lamps: comparing the incandescent types, the maximum lighting energy demand during the performance was at least 25% less than other performers during the same festival.
The of the previous incandescent models with LED lamps, allowed the reduction up to 90% of energy demand. The efficiency of audio equipment has also been achieved by

GHG REDUCTION DUE TO REDUCED OVERNIGHT LOAD	[%]	SAVINGS (KWH)	SAVINGS (KG CO_2-E)
Lighting	3-11	199	200
Video	10-15	245	246
Audio	1-9	121	122
Bars	4-9	140	141

Table 12
Potential GHG reductions due to reduced overnight load.
Adapted by Marchini et al, 2014

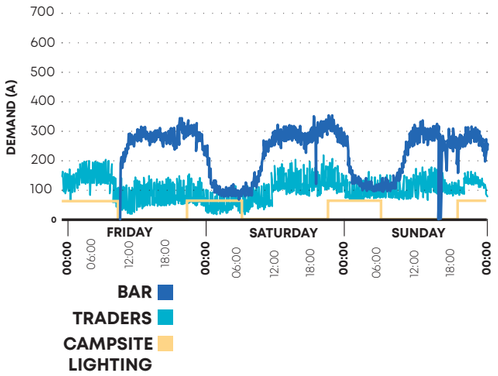


Table 13
Typical consumption profile for electricity use for nonstage systems.
Adapted by Marchini et al, 2014

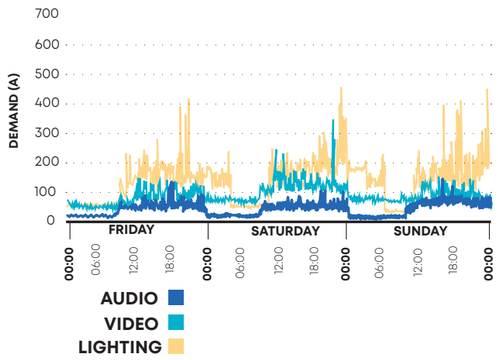


Table 13
Typical consumption profile for electricity use on stages.
Adapted by Marchini et al, 2014

using class-D switch mode amplifiers, reducing up to 44% of the analogue amplifiers. Furthermore, stage video systems are typical with LED-based and therefore, with relatively low energy technology. Overall, the use of more efficient equipment resulted in a 44 to 90% reduction in energy demand. In the following table are shown the primary electrical demand for stages, traders and infrastructures.

Trade areas

Either in the case of trader areas, the most significant energy demand is determined by lighting; in this case, the use of LED lamp was the most useful solution to decrease demand. Either in the case of other infrastructures, the use of LED lamps was beneficial. Moreover, similarly to the trade areas, these sites requires mainly lighting energy. There are several examples of individual traders already using renewable energy supplies; basically, they are traders with low energy requirements, because their energy need (of nonfood traders) was only of lighting and cash machines. Therefore, thanks to a battery storage system, the demand could be wholly achieved. Some non-food traders also operated with PV panels. However, traders typically use to pay a fixed cost to the festival organization for their electricity needs, so they have no incentive to reduce power use. On the contrary, they have a 'perverse' incentive for maximizing the demand in order to get full value from their tax payment.
Therefore, being the demand much more limited than that generated by the internship in these areas, only 10% of energy-savings was obtained.

Infrastructures systems

All systems are assumed to have 10% thorough general innovative technologies but using more efficient lightings and audio equipment there can be savings up to 44%.

2- Sizing generators more efficiently.

The main reason why the oversize happen is due to a small number of size types available, and for the estimated electricity energy demand, pretending to be higher than the actual demand.

More accurate sizing generators can significantly reduce fuel consumption and reduce the costs of supplying the generators; moreover, there could have been a reduction 35% (-25 tonnes CO2-e) of GHG emissions through using smaller generators..

3- Renewable energies and fuel substituting.

The issue shows that, on average, savings can intercurrent up to 50% of total GHG emission reductions, amounting to around 10,000 of the 20,000 tonnes CO2-e attributed to festival diesel generators.
Another impressive concept comes with the substitution of the generator fuel. This idea can be applied to all the diesel generator system on-site, across stages, traders and infrastructure. Using biodiesel is one of the most straightforward substitutions to reduce GHG emissions.
The report also shows that the high electrical demands of the stage would have required a vast PV array and massive battery storage to meet the demand. Therefore, the usage of biofuels has appeared the most logical solution to reducing emissions.
One idea that comes to from the research is an individual energy supply made for each trader due to their not high energy requirements of 480 kVa (in comparison with more than the quadruple for the stage requirements). Some non-food traders operated entirely from batteries powered by PV panels or batteries that had been charged before the event, therefore not requiring a power supply from the festival; however, since traders typically pay a fixed cost for a power supply and with the cost depending upon the size of the supply, there is no incentive to reduce power use.
Lastly, due to a multitude variety of systems that operate under this title, no one solution could be applied. Nevertheless, the utilization of appropriate PV system can fully achieve multiple system demands, such as campsite lighting and parking lightings.

4. Switching existing equipment off when not in use;

For an easy understanding, the running period during the analysis is synthesized over a 'weekend', differentiating the operating hours by 'daytime' and 'night-time' as non-operating hours. For this result, the indicators present the energy consumption of the different types of electricity use during different time periods throughout the event.

Ideally, any equipment may be switched off whenever not in use, but standard and safely practices of outdoor events that results 'in process' during the whole-time event.

Therefore, they may only operate with a 'best practice' method. For this methodology, there has been defined the datasets with the lowest impact factor.

Due to many differentiations in the traders' needs (i.e. cooling, hot water,

cooking equipment and so on), this analysis has been achieved only for the stage areas. The results are presented in the following table:
Each system type was deduced to be at least lower 33% than the mean impact factor. By switching off the equipment when possible, there can be GHG reductions up to 9-15%.
The following two graphs we can analyze the typical minute-by-minute consumption over a weekend of the outdoor event. In the first figure, it is analyzed the only trader and infrastructure areas, while in the second graph, it is only analyzed the stage

consumption.
There have been achieved mainly two types of sustainable methodologies: demand-related savings, supply-relates savings. However, this research explains that it has not been possible to add up all the individual savings to obtain an overall value[12].
Each of these savings affects each other; for example, if energy equipment is specified before the festival taking place, then the saving from switching that equipment off will be reduced since it is now more efficient. Similarly, if the generator is correctly sized, then the savings from installing variable speed drive generators or battery storage will be reduced since the generator is now working more efficiently because it is more accurately sized.
For each scenario, there has been a prediction of the potential savings comparing each system, from the more efficient to the inefficient.[13].
Indeed, nowadays LED lighting and switch-mode amplifiers are always becoming more popular and are yet representing a more significant proportion of equipment used by festival organizers. This already results in lower lighting and audio loads; unfortunately, the high video loads still remains a technological issue that needs to be improved.
Lastly, data shows 30% savings in demand-based emissions and 40% in supply-based emissions that can be achieved; leading to savings of up to 50% in total, amounting to 10,000 of the 20,000 tonnes CO2-e attributed to festival generators[14].
As the authors say, the monitoring of energy within festivals will be expected to be increasingly accurate as long as the researches continue; then it will able to specify more energy-efficient equipment, more renewable energy systems and electrical storage will be introduced.
Based on the analysis of the data, the electrical equipment will be automatically controlled, to allow previously identified unessential loads to be temporarily switched off when demand for essential loads is high. The author's predictions are intended to a 5-10 years future; he hypnotizes several ideas.
Widespread monitoring of electricity consumptions up to 5-10 years by the introduction of his research; also, the introduction of highly efficient equipment would bring more savings. In addition, the idea of "smart microgrids", as an interconnection, having battery storage and operated at maximum efficiency with the addition of the renewable sources, would have the ability to minimize the GHG emissions.

Non-road diesel engine environmental optmisations

A non-roard generator is an engine conntect to an alternator for producing electricity.
These disel engines muovono ancora oggi molte attività del world good's production, as they provide power to much of the world's equipment as well. Uno dei loro vantaggi è sicuramente di poter provide energy economically and in an efficient status.

According to the interviews conducted, the main form of energy supply is the power generator. although some attempts have been made with different means of energy supply with renewable forms, the use of the diesel generator as the only form of electricity generation remains the most useful choice for the organisations, in order to have a greater guarantee of

12 Marchini, 2013
13 ibid.
14 ibid

the ability to supply energy even in adverse weather conditions. this would maintain greater energy independence even compared to the connection via the national grid. This would also maintain greater energy independence compared to connection via the national grid.

However, thanks to the numerous benefits of reduced space and high efficiency, the use of these products is not only reserved for the world of entertainment.

Undoubtedly, this type of power generation is among those that guarantee the best ability to produce energy even in the most adverse conditions.
For this reason, in addition to their use in temporary events, they are also used as bakcup generators in large cities, or distibuted emergency generators within the microgrid. They can also operate quietly during peak electricity demands, improving support over the entire grid electricity line. In this regard, it is estimated that nearly 1,000 MW of bakcup generators are implemented inside the New York City grid line.1.
Therefore, the use of diesel engines in construction, mining, agriculture, general industry, forestry, airport service equipment, marine and lawn/garden, and so on, is expanding dramatically every year. Indeed, although the generator is consciously one of the most polluting tools, it remains one of the most relevant methods of energy supply.Interestingly, only twenty years ago, diesel engines commonly recognised as 'the most efficient prime mover available today'2.. However, it is clear that for some sectors, such as areas not covered by the national grid, or emergency situations, the generator still reflects this definition. Moreover, acording to several reserarches3., generators release an environmental impact that cannot remain indifferent during their use. Hence, non-road diesel vehicles contribute to approximately a 44% of the total Diesel Particulate Matter emissions, and of 12% of nitrogen oxide (NOx) emissions.
In this way, the diesel exhaust consists of hundred of gas-phase, semi-volatile and particle-phase organic compounds that are produced throught the combustion of the fossil fuel.
Thereofore, despite the main advantages previously introduced, the diesel engine fuel is *inherently dirty*4..
These emissions leads to atmospheric deposition that adds to groudn and surface water contamination.
In addition, the running of engines propduces pollutant as well.
Moreover, the DPM sources dervied from nonroad sources are significantly higher thant onroad sources.

The main problem with the diesel generator remains the use of diesel which is highly polluting, causing an increase in global emissions every year. It has been found to cause cancer, and other cardiovascular hence respitary deseases as well. That generators produce pollution is therefore a clear fact. As on the human being, the effects are also evident in nature and, moreover, correlated at a later date to the very health of the human being and of all animal and plant species. The pollution generated has effects on air, water and soil. In other words, there is an obvious global change. However, diesel engines are already part of an innovative progress that began with the gasoline. over time, this fuel has become associated with its predecessor, bringing both advantages and disadvantages. To achieve the endure of the diesel cycle's pressure, that is 1.5 times higher than the gasoline, heavier costs are required. Moreover, diesel's lean combustion are meant to produce less power than the gasoline's displacement power. Also, the gasoline's diffusion flame by the combustion process si also faster than the diesel's; this differenciation also leads to a difference in maximum operating speeds.
In regard of the main beneftis that leads to the usage of diesel engines, it is relevant to mention the quantity of fuel used; compared to the gasoline

1 NESCAUM, (2003)
2 Alan C. Lloyd and Thomas A. Cackette, 2001
3 Zheming et al., 2015, Greene and Hammerschlag, 2000, Heath et al., 2006; Carreras-Sospedra et al., 2010
4 Alan C. Lloyd and Thomas A. Cackette, 2001

it results approximately as the 70% and, under partioal load conditions, the usage of fuel is even more efficient.[5.]

Therefore, the analysis considers it important to bring into focus the calculation of the impact of generators, defining their specific characteristics and determining the polluting aspects that determine their use in large outdoor events, and the current regulations in place.

As this research is in progress, we are still looking for new forms of innovation (to which we hope to contribute with this follow-up work). some technologies are characterised by the use of fuel-cells and hybrids technologies. Some technologies are characterised by the use of fuel-cells and hybrids technologies. as we have already mentioned while illustrating the various forms of energy supply, HPGs represent a turning point for maintaining generator efficiency without affecting a peak demand level of electricity, while maintaining a service that reduces emissions. for many international administrations, diesel is thus becoming a fuel to be dismantled as soon as possible. according to Lloyd A. et al, as early as 2001 the next decade was already being prefigured as 'the decade of clean diesel'. at present, it is still impossible to eliminate diesel, so we must commit to new forms of sustainability in order to solve in the most rational way the problem we are forced to live with, at least in the short term.

Fuel Substitutions an other pre-treatment solutions

it is therefore necessary to determine how one can reduce one's own pollution. one of the solutions immediately put into practice was the modification of the fuel. Action was taken to reduce sulphur and aromatics contents, which immediately resulted in an improvement in the creation of future diesel. Reducing the sulphur content will reduce particulate matter formation. Research is currently moving towards the use of vegetal substances, derived from plants, to produce vegetal fuels named as biofuelHowever, this type of vegetal diesel causes problems due to its low volatility, high viscosity, molecular weight density and high sulphur content. [6.]

Therefore, side effects are highlighted in parallel with the use of diesel. For example, it has been found that palm biofuel has a higher flash point than diesel, and it is also safer as well[7.]. However, la sua 'kinemtic viscoity and density' is also resulted to be higher thant the diesel fuel, and thus can cause spray characteristcs [8.]

Also, the biodiesel provides a decrease of the Carbon dioxide CO_2, and hydrocarbon emissions, with a small increas in nitrogen NOx [9.]According to the research made by K.A.Abeed et al., 2012, the results show that the usage of palm biodiesel fuel has a great performance of the "73% less unburned HC emissions and 46% in carbon monoxide emission".

Numerose ricerche si sono anche spinte verso la realizzazione di biofuel a base di microalgae. La loro naturale caratteristica di high growth rate, yield, and oil contento, li harei dei candidati ideali alla ricerca.[10.]

In this case, the mixture is onsidered to replace the 20% of the common diesel fuel. Moreover, microalgae fuels are highly biodegradable and free of sulfphur[11.]

Fuel changement was not the only improvement applied in the short term; several additional emission treatment devices were also introduced. As well as modifying the engine to make it less efficient and less polluting, work has also been done on exhaust gas recirculation and catalytic aftertreatment.

Based on what we have discussed so far, we can see that although the generator is one of the most important forms of energy supply, it is still one of the most widely used. Especially for are where the electrical instability of isolated networks - due to the fluctuation trend of the renewable energy proviisuon and their high variability in load profilethe diesel generator still remains a predominant and sometimes fundamental tool.

For this reason, research has continued to follow the development of efficiency, in parallel with the future prospect of total replacement.

Moreover, as we have precedently discussed, recent regulatory frameworkd have led to more strict rules and emmission standards.

According to Issa M. et al, the actual diesel generators should be improved within the following aspects:

- **Energy terms**: *due to a massive overstimation of sizes, while operating a lower load factors makes more pollutant and less efficient energy provisions.* **the main aim is to maintain the generator utilization factor greater than 30%**
- **Economic terms:** *while they are relatively chip products, diesel generators still require expensive operation and maintenace. especially in isolated networks and remote areas whereas fuel prices are dramatically higher than the normal costs*
- **Environmental terms** *because, as we have previously discussed, the use of this energy provision causes several environmental impacts on local air and soil, while contributing to the GHG emissions.*

Therefore, we now want to introduce new tools to be implemented in diesel generator technology in order to improve its energy efficiency. The tools presented include methods to decrease their fuel consumption and greenhouse gas (GHG) emissions. The generator, in fact, during prolonged operations tends to deposit on the engine walls the condensation of combustion residues which, after a certain time, tend to increase friction, reducing overall efficiency and thus increasing fuel consumption[12.]

According to Forcione et al., et al, one simple way to eliminate desposits ands thus improving long-term efficiency, is to operate the diesel generator at higher speed until the operating temperature is attained. [13.]

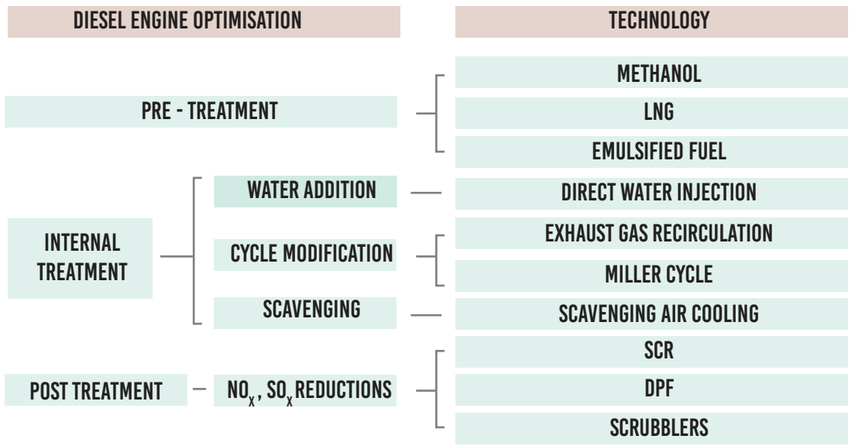
Moreover, there are presented below main available technologies for diesel engines optimization, as well as the actual mechanical and electrical technologies

Thus, these methods are based on the application of pre-treatment, internal treatment and post-treatment technologies for diesel engines and the application of mechanical and electrical technologies for diesel power generators (DPGs)[14.].

Although many of these methodologies not have a singficant impact on fuel consumption and reduction, they effectively provide SOx, NOx PM reductions over the year of over the 80%.

Neverthless, the further mechanical and electrical technologies applied to Diesel Generators have a significant impact on fuel consumption and reductio as well.

5 Lloyd A. and Cackette A., 2001
6 C.L. Peterson, et al., 1999
7 K.A. Abed et al., 2019
8 R. Samsukumar, et al., 2015
9 A. Khalid, et al. 2012
10 S.H. Al-lwayzy, et al,, 2015
11 A. Demirbas, et al., 2011
12 Issa M. et al, 2019
13 Forcione, A. and Saulnier, B. (2004)
14 ibid.



Optimization of the DE using pre-treatment, internal-treatment and post-treatment solutions.. Adapted by Issa M. et al., 2019

This methodology is based on fuel subsistitions. On this basis, methanol and liquified natural gas (LNG) can be used for this process. These comopnents are charcterized by a lower sulphur content, thus reducing SOx, NOx and PM emissions.

Methanol was the subject of a major rsesearch conducted during the 80s ands 90s[15.] for mobility applications. Indeed, due to its major availability, production and application, it was also implemented into fuel cell cars [16.] Despite its easy application in vehicles, methanol still represents a challenge for its application in non-road diesel engines. Its low methanol cetan number makes its auto ignition difficult.[17.]Hence, emissions derive from the use of methanol showed a great reduction in NOx and PM particles but an increase monoxide (CO) and Hydrocarbon (HC) emissions.

Therefore it has been developed diesel/methanol compund combustion named as DMCC. By using this method, the diesel engine will operate on diesel alon on the engine start, thus providing a cold start capacity while reducing the aldehydes production when it will operate at medium and high loads. Therefore, the mixture will provide a uniform reductino of NOx and PM emissions

According to the research made by Wang et al., when operating with MDCC there is a 8% reduction in NOx and 2.8% of fuel consumption.

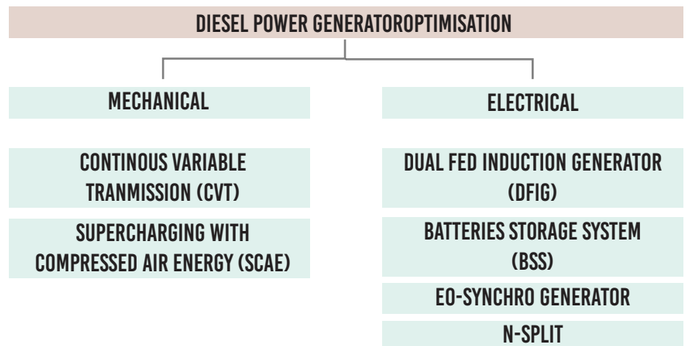
Neverthless, this fuel consumption can also bring different adverse effects. Methanol increases corrision risk; there must sufficiently upgraded to fuel tanks.

Despite these effects, Methanol seems to be a promising and more sustainable option for the air pollution issue In comparison with the use of oil fuel, It thus reduce the emissions of[18.]:

- *CO_2 of 11 %;*
- *PM of 96 %.*

Indeed, costs terms have an important benefit of 31% per year[19.]
Hence, the option of a emulsified is taking place as well. This mixture consists of two entirely

15 Heinrich W. et al., 1986
16 Allard M. et al., 2000
17 Wang, W.G. et al., 1997
18 Elgohary M.M., et al. 2015
19 ibid.



Optimization of the DPG mechanical and electrical technologies.Adapted by Issa M. et al., 2019

immiscible liquids, and thus it offers the advantage of a better automization, while distributing the fuel in a complete combution.[20.] This type of fuel is capable of reducing NOx and PM emissions rispectively of 30 % and 80%.[21.] Neverthless it promotes corrosion of engine components and the short phenomenon of *oil-water separation* [22.]

Internal-treatment optimization

Internal-treatment consists of a direct modification in the diesel engine. This optimization is done using mechanical modifications in the injector design. These modification involve

- *direct water modification (DWI)*
- *engine cycles, such as the adoption of Miller Cycle,*
- *exhaust gas recirculation (EGR) and/or combustion chamber, such as the use of scavenge air temperature.*

All of these modifications bring a positive impact in the NOx nd PM reductions .

Hence, DWI technology is composed of two parts: the first one acts to spray water, and the other for the fuel injection. In this second phase, there is injected a water-fuel density of 0.4 -0.7 into the combustion chamber, thus allowing a combustion reduction temperature, and so NOx reductions as well. According to the report made by Wärtsilä Corporation, the NOx emissions are reduced by up of 60%[23.] Morover, this modification does not require any extra space and additional costs as well, but it can bring to a lightly higher fuel consumption of approximately 2%.

The Miller Cycle instead is not a contemporary innovation. It was initally proposed by R.H. Miller in 1947. This method involved the reduction of compression cycle work; so, it consisted in the use of the Early Intake Valve Closing (EIVC) for achieving an internal cooling before compression.
This cycle is therefore defined as a 'cold cycle' and thus allows lower NOx emissions up to 40-60%, while also increasing the engine efficiency as well.[24.] Hence, for each 3° C reduction, nitrogen oxide emissions decreases approximatively by 1 %.[25.]

20 Patel N.S., et al., 2017
21 Kim M. et al., 2018
22 Zhou S. et al., 2014
23 Wärtsilä Corporation,.2006
24 Kovács, D. and Eilts, P., 2015
25 Geist, M., 1998

Furthermore, there is also the Exhaust Gas Recirculation (EGR). This modification allows a temperature combustion reduction, aiming to reduce NOx emissions. In this case, the temperature reduction is achieved by using a combination of exhaust gas with the fresh air, while bringin a low calorific value, thus creating a temperature reduction of the combustion chamber temperatures that allows less NOx formation up more than 40%.[26.]

Neverthless, further options can be implemented. For example, Humid Air Moisturizer (HAM) can make reduction in the nitrogen oxides formation by up to 65%.[27.]

Post-treatment optimizations

This option allows a modification applicable to the use of even older machines. This creates an adaptation for all possible forms of diesel engine. The main reduction in after-treatments relates to the NOx emission limit. However, NOx emission reductions are based on this particular option or on internal treatments - such as EGR and the Miller cycle - no real reduction in Sox emissions could be found.[28.]
This solution involves the adoption of:

- *Selective catalyctic Reduction (SCR) or*
- *Diesel Particulate Filter (DPF)*
- *scrubbers*
- *low sulphur content fuel, such as LNG, methanol and light marin fuel oli (LMFO).*

Neverthless, SCR does not require a architecture modification within the engine, but it can be subject restrictions. Hence, offers the largest reduction of nitrogen oxide up to 90% on the diesel engine.

The SCR functioning principle is based on the combination of the wate exhaust gas with ammonia (NH_3), or urea, before that the combination will pass over a special catalyst layer at a high temperature between 300 °C - 400 °C. This interpolation allows to reduce NOx to N^2 and water (H2O).

Moreover, for an optimal operation, the engine load is recommend to be higher tha 40%, while having an exhaust gas temperature between 270° and 400°. Neverthless, if the temperature is below 270°, it can form ammonium sulphates and destroy the catalyst effect. However, if the temperature exceedes 400° C, ammonia burns rather than reacting with nitrogen oxides[29.] Therefore the SCR offers up to 90% of NOx reduction.

Despite this main reduction of in NOx made by the SCR, a Diesel Particulate Filter (DPF) is used to reduce the PM by an amount of aproximately 80%; neverthless, due to an increased backpressure on the engine, the fuel consumption will increase. For avoiding this problem, it is reccomend to remove the catpured particles using a 'regeneration technique'.

Hence, the wet or dry scrubbers are able to reduce SOx, NOx, and PM emissions, removing up to 99% and 60% of rispectively SOx and NOx[30.] However, they still present an expensive technology. This option relies on the use of Ultra Low Frequency (ULF), that, with a wave treatment water can remove gases. Despite conventional system, this option does not require purely fresh water or either a cooler for supporting the chemical process. Hoever, scrubbers require frequent maintenance and thus suffering from very sever corrosion as well. [31.]

Mechanical and Electrical optimizations

As we have discussed extensively previously, a generator activated as low speed produces more pollution, consumes more fuel and leads to wet stacking phenomena as well.
An innovative method of solving this problem is based on variable speed diesel engine (VSDE) technology. This offers the possibility of adapting the speed of rotation of the shaft to the load applied, allowing a reduction in fuel consumption while improving combustion temperature. This option can be achieved through two different approaches[32.]
- a mechanical method, incorporating a continuous variable transmission (CVT)
- an electrical solution involving the replacement of the synchronous alternator with an "Eo-synchro alternator" or a "dual-fuel induction generator".
Hence, the mechanical method actively reduces fuel consumption and GHGs by adjusting the working speed regardless of engine speed, producing a 25% GHGs fuel economy optimisation. However, according to The Quebec Company CVT Corp who carried out the tests, the maximum power of the generator must not exceed 150 kW
Moreover, due to expensive components and hard maintenance, when CVT fails, it is normally forced to be fully substituted.

Renewable energies can also be involved in this process. For example, the optimization can be achived with a supercharge of the diesl engine[33.] This method consist of a compressed air and energy storage (CAES) that enables a signfiicant fuel reduction and GHG emissions by 25%.

Hence, another method can be the air power assist engine (APAE). This technology consists of a connection with an air storage tank to the exhaust collector; then, there is used a 3-way valve to change the flow between the turbine and the air storage tank. With this method, a fuel reduction of 15% is achieved. Hence, it is also generated a positive power by using the compressed air energy. Moreover, the pneumatic overfeeding showed an increase in engine efficiency, achieving a 34% of reduction in fuel consumption.

On the other hand, electrical technologies make relevant savings as well. The Genset-Synchro alternator is one of the main examples, and allows a consistant fuel saving. This technology is a power unit control system that modifies the structure holding the stator windings. in this case, the engine structure rotates dreely in reference to the rotor and frame[34.] Then there is placed an auxiliary motor, driven by a dedicated automatic controller that can dictate the desired position, speed or acceleration of the stator structure. This technology is able to save up to 12% at low loads and up to 5% at high loads.Although, the presence of rotor brushes require more maintenance. Moreover, due to the compnesatore motor and the electronic dirve power, the maximum power delivered by the generator is limited to 85%.

Also, electrical optimisation can be achieved by improving losses to the greatest extent possible.

This process can be achieved by two different approaches:

- *the use of n-split DPG's*
- *the use of DPG's with storage batteries*

In the first case, the use of n-spli involves several smaller units of motors, while the combined power is equal to the single main motor. This technique avoids partial operation with minimum loads on a single generator. Thus, this method has improved life cycle cost performance, net waste energy, CO2 emissions and fuel consumption. a reduction of 26% in LCC and 26.5 % in fuel consumption is presented. However, CO2 emissions and net dump energy analysed over a 9-year period were respectively 27% and 85% lower than when using a single large generator.

Finally, the last optimisation method involves the use of diesel engines with a Battery Storage System (BSS). This concept was particularly interesting for its integration into microgrids operating in stand-alone mode. This technology includes local and general battery storage. The first is the one that

26 Issa M. et al, 2019
27 Park, H.K. et al., 2006
28 Man Diesel Turbo, 2018
29 Nett Technologies Inc.. 2016
30 Ibrahim, S., 2016
31 Wolfson, R.,2012
32 Issa M. et al. 2019
33 Ibrahim, S., 2016
34 Issa, M., 2016

applies to the microgrid in case of long periods of emergency situations, while the local batteries provide energy for shorter period of time. Obviously, the period of activity of this technology depends on the amount of fuel and battery discharge capacity. According to tests, this application allows a reduction of 2-5%.

In this context, the integration of electric vehicles as energy accumulators could be a future prospect in the case of large diesel engine applications with BSS.

in conclusion, each of the above solutions has its own set of disadvantages and advantages.
For this reason, it is useful to summarise the main benefits in a comparative table.
Moreover, Issa M. et al. propose a number of useful criteria for comparing possible methodologies. These criteria are based on the ease of adaptation of the diesel engine to modifications for the reduction of environmental impact. The list contains:
- Adaptability to the diesel engine; the environmental impact reduction system must be able to adapt to the fuel currently in use at major off-grid sites, without requiring changes to the internal architecture of the engines.
- Efficiency of the technology, to maintain good performance and reduction of greenhouse gas emissions.
- Low cost, as low as possible
- Simplicity of design, useful to maintain a correct maintenance guide and service in many different situations. In conclusion, thanks to the work done by Issa M. et al., in the following table we summarise all the technologies previously listed, in their main benefits and limitations.

TECHNOLOGY	BENEFITS	LIMITATIONS
PRE-TREATMENT SOLUTIONS		
EMULSIFIED FUEL	- Allows Significant reduction by an amount of 80% - Renewable Source - Biodegradable	- Increase the Fuel Consumption by 3% to achieve the same output - Corrosive
METHANOL	- Allows NOx reduction by an amount of 60% and fuel consumption by 2% - 3%	- Toxic - Burns with non-luminous flame - Higher Cost
LNG	- Has environmental benefits through an average reduction of SO_x, NO_x, CO_2 and PM	- Highly flammable - Requires huge investments for storage and installation
INTERNAL-TREATMENT AND POST- TREATMENT SOLUTIONS		
DIRECT WATER INJECTION (DWI)	- Potential reduction of NOx by an amount of 60% - Can be applied for medium speed marine diesel engine	Increase the fuel consumption by 2% to achieve the same output
EXHAUST GAS RECIRCULATION (EGR)	- Low operating cost - Allows significant NOx reduction by an amount of 30%	- Cannot be employed at high loads because it will reduce the peak power output - Increase the creation of PM -Drop in engine efficiency
MILLER CYCLE	- Increase the efficiency of the DE - Allows potential reduction of NOx by an amount of 40% - 60% - Reducethenumberandsizeof exhaust ports	- High cost engine - Requires more maintenance
SCAVENGE AIR TEMPERATURE	- Reduce the number and size of exhaust ports - Allows a potential reduction of NOx by an amount of 60%	- Cylinder head complex - Requires periodical maintenance
SELECTIVE CATALYTIC REDUCTION (SCR)	Potential reduction of NOx by an amount of 95% - Relatively simple installation	- Maysufferfromerosion - High efficiency turbocharger is required to overcome the pressure drop Require space for urea storage and a good surface for installation
DIESEL PARTICULATE FILTER (DPF)	- Simple installation - Reduces PM pollutant by 95% and Black Carbon (BC) emissions by an amount of 991%	- Allows a back pressure in the engine involving additional fuel consumption by an amount of 4% - Requires regeneration techniques to remove the captured particles
OPEN-LOOP WET SCRUBBER	- PotentialreductionofSOXby an amount of 98% - Potential reduction of PM by 60% - Allows the possibility to continue to use the cheaper bunker fuel instead of low sulphur fuel	- Subject to corrosion (seawater) - Requires regular maintenance - Requires additional electric power source - Increase fuel consumption - High cost
CLOSED-LOOP WET SCRUBBER	- Potential reduction of SOX by an amount of 98% and PM by 60% - Allows the possibility to continue to use the cheaper bunker fuel instead of low sulphur fuel	- Requires storage space to hold wastewater and hazardous chemical solutions - High consumption of fresh water - High cost

7. TRAVEL

Coachella 2014 promotional banner
© Coachella Organisation

Although the music industry is not defined as one of the most carbon-intensive industries, the transportation issue is one of the majorities interest in sustainability at festivals because one of the significant carbon footprint percentages dramatically increases based on the type of transportation network involved in reaching the venue. Besides the tremendous promotional ability that the event has on its participants, it creates an ideal ground for realising possible good intentions towards all participants sustainable mobilities.
Bottrill et al. 2008, stated that the average transport emissions to a festival are between 67% and 82% of the total festival emissions, excluding waste.
It should be noted that the choices that a traveller makes to reach the festival are not under the direct control of the festival organisers.
According to A greener Festival reports (2011), 61% of festival-goers travel by car, reflecting the overall presence of a car instead of public transport. To deduce the reasons for the choice, Anable & Gatersleben (2005) suggests that more significant advantages come from the flexibility of the trip. Festivals that also include camping areas and, therefore, the presence of more than one day at the events, it is necessary to bring baggage that, with an own vehicle, is more comfortable to transport to the place.
As mentioned above, another source of enormous energy consumption is given by the energy produced by waste management, causing a massive amount of Greenhouse Gas emissions. For many years this problem has been the subject of debate and the phrase "leave no trace" was quickly rebounded to declare the desire to reduce the energy consumptions given by the "on-site waste"[1]. Encouraging the audience to reduce the amount of waste or avoiding non-biodegradable materials has helped organizations decrease the time spent on site for the post-festival cleanup, decreasing the energy for disposal waste management and decreasing the damage to the local ecosystem.
It is essential to say that a significant part of the GHG emission does not occur on site. Instead, these leading pollutant emissions result from waste being processed once it has been transported from the site to be reused or committed to a landfill. Therefore, even these emissions are not strictly under the control of the organizers: the stakeholder cannot control how much waste is deposited on-site, and they may not be able to control the post-event waste disposal process.
The awareness of greenhouse gas emissions during transport is already detected in an analysis proposed by Bottrill et al.,[2] where one report states that annual audience travel accounts for 43 per cent (231,000 tCO2e) of all the UK music industry's reported emissions; according to a report by Powerful Thinking, however, the percentage of CO2e from travelling accounts for around 80 per cent of the entire event.
In order to calculate GHG emissions resulting from the mobility of an event, we look at the equation proposed by the Department for Environment, Food and Rural Affairs:

$$GHG\ [kg\ CO_2e] = \Sigma\ distance\ data \times emission\ factor\ [kg\ CO_2e/km]$$

These emissions are defined as indirect emissions, thus not caused by the festival; hence they are decomposable into ways of improvement with targeted approaches without comprising the event onsite activities. However, we are aware that the problem derives from the single individual and a specific and strategic approach between different parties, governmental and non-governmental, cooperating to realise a priority aim such as sustainable environmental protection. Committed partnerships on transport mobility, audience promotions, and commercial and local concerns can play an influential role in realising this future goal. Music festivals attract an audience that extends beyond the borders of a country. These long distances make it more challenging to organise mobility by a single strategy, as it is almost indispensable for many travellers to have their means of transport. Therefore, we intend to propose a comparison of the different possibilities that an attendant to an event brings as carbon emissions with him/herself to define the best solution.
We could therefore say that it is not only the festival promoter which can be blamed for the consequences of these travel emissions: a lack of redundant facilities, demands and also audacious travel promotions, local restrictions, and temporary structures are all factors which can actively contribute to the critical increase of these emissions.

1 The Powerful Thinking Guide, 2017

2 Bottrill et al., 2008

Travel issue

Therefore, it is interesting to know how the individual participating in the festival is involved in managing his transport. In other words, is it possible to find critical points in his energy management and his travel activities? Moreover, can these critical points be improved in any way? Thanks to the study produced on fourteen festivals across the United Kingdom, it was found that there are several points in common for each event in festivals of major and large sizes (from 20,000 to more than 60,000 people). This was analysed:
-the percentage of related car occupancy for about 1,700 cars in the eight events
- distance covered for four festivals
- the ability of festival-goers to learn the principles of sustainability for more than 1,200 people
- attitudinal survey of coach travellers for more than 1,000 people
- promoter survey completed by 13 festival organisers

Audience surveys are, therefore, the organisation's way of accurately determining the participants' travel emissions. The origin, mode of travel, type of vehicle and occupancy of seats in the vehicle are the method of accurately determining the emission of an individual performer.

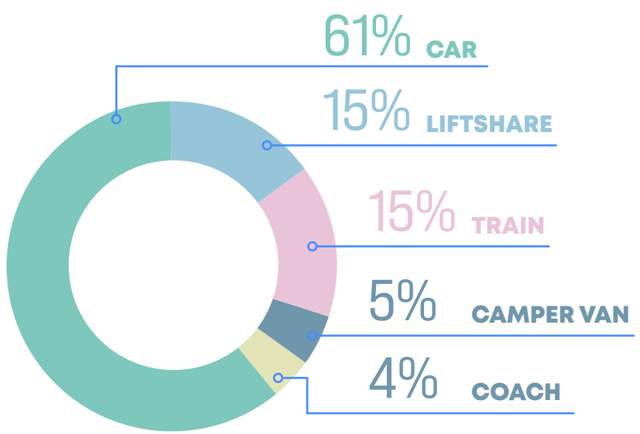


Fig. 1
UK festival Audience by travel type in 2019
Source: Powerful Thinknig 2020

However, in parallel to mobility by private vehicles, there is also public mobility determined by coaches or trains, making the realistic calculation of the total emissions per participant more difficult. Nevertheless, the quantities resulting from a taxi to get to the appropriate station must also be included. However, it has to be pointed out that in the case of short trips, the quantities are comparatively smaller than in a private car.
It was found that the lack of connections to the festival, due to an event being in the neighbourhood or greenfield to the city, substantially affected the presence of festival-goers arriving by car: their share was 72%. Not only that, the car occupancy rate states that close to two-thirds of cars travelling to the event had two or less than two people travelling in the exact vehicle. About half of the participants were not even aware that there was a possibility to travel by coach and train (55% and 47% respectively). However, as previously mentioned, one possible way of improving this figure would be to promote other practices.
Understanding that the audience behaviour and the preferences of the individual attendant is a considerable and necessary step in the realisation of sustainable travel; nevertheless, this analysis leads to a proposal to a specific new transportation method with reduced carbon emission. Moreover, one of the exciting results of this analysis is to recognise that the management of transport modes derives from several factors which are not all interrelated. The variation of pollutant emissions resulting from the travel of attendees at a single event is in fact primarily determined by two fundamental factors:

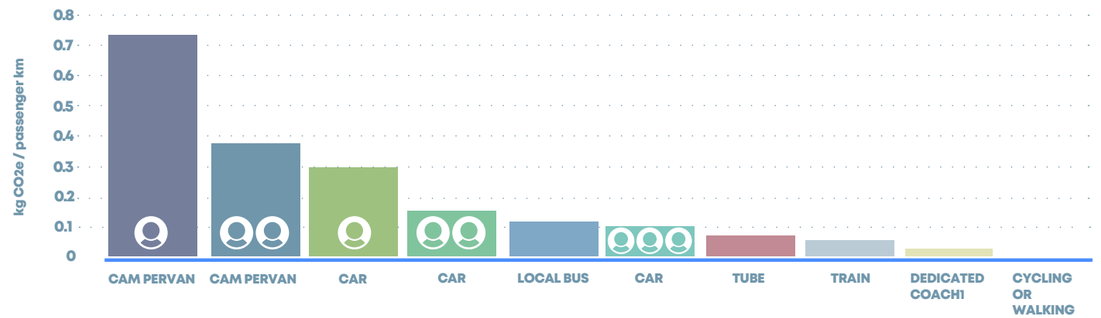


Fig. 2
Relartive impacts of Travel Types
(CO_2e/Passenger Km)
Source: Powerful Thinknig 2020

- Demographic and location: where younger audiences tend to be familiar with and use public modes of transport and, nevertheless, the distance to the event may be a determining factor in the realisation of more significant amounts of carbon emissions; otherwise, family festival audiences usually tend to rely on cars for more convenience, flexibility and carrying the amount of stuff

- The operational carbon footprint of the whole event, which also includes emissions from the audience, crew contractor travel that can be mitigated

Also, in the case of events already consolidated within a territory, public transport becomes a preferential choice, also thanks to the possibility of actively promoting the implementation of public services.[3] Besides, the secon report made by Susan Michie, et al., [4] showed the behaviour that also determines the transport choices are mainly derived from:
-individual physical and mental abilities, as well as skills and knowledge appropriate to the field of interest
- opportunities within the sector
- Motivation for decision making, actions, and awareness
While one of these three points varies considerably depending on the individual, the third and second points may allow the organisation to make a marked improvement in the awareness and capacity of the event to bring forward carbon reduction possibilities.
Therefore, if audience travel accounts for 80% of the festival's emissions, it becomes clear that this factor could be studied to achieve even substantial improvements. Nonetheless, in many cases, little account is taken of non-audience transport (such as crew staff, contractor service traffic), representing a blind spot in obtaining this data, which could sometimes be the subject of a significant improvement in the mitigation of pollutant emissions by an event.

3 Source: Powerful Thinking, 'The Show Must Go On', 2015
4 The Behaviour Change Wheel, Susan Michie, Lou Atkins & Robert West http://www.behaviourchangewheel.com/

A COMPARISON WITH THE URBAN MOBILITY

Mobility is also one of the critical aspects of sustainable development. The transition to a new way of life is also strongly included in the individual transport sector, where the individual user must find a way that has the least possible impact on global pollution. In large urban centres, this transition has taken place by implementing new, more efficient means of transport, but, as we will see later, many users still prefer private to public mobility. A report of ARPA Piemonte also provides an example. In the case of the metropolitan city of Turin, the presence of 1,000 inhabitants created the spread of 700 cars, which is significantly higher than the European average of 450 vehicles per 1,000 inhabitants. Nevertheless, most cars (52%) are fuelled by petrol and a considerable proportion (37%) by diesel.
In parallel with the development of the cities, the event also benefits from the same users who are gathered in the urban centres. Therefore, this table provided by ARPA allows us to understand a first approach to the problem, where, although the provision of alternative means of transport is already present in the urban territory, there is still a substantial deficit in their use. Therefore, below we would like to propose current solutions to developing more alternative and sustainable mobility.

APPROACHES FOR REDUCING THE IMPACT OF AUDIENCE TRAVEL

The ways to reduce travel emissions are already in place, and they also concern methodologies that were able to give considerable support to reducing the audience travel carbon emissions. First of all, there is the possibility of Car Sharing, already implemented by GoCarShare and LftShare organisation, proposing the possibility to give priority parking and free car parking for the first 100 cars arrived in car sharing. Thanks to these incentives, it was possible to save around 16 tonnes of CO2 at the Download Festival, one of the festivals organised by the Festival Republic Organisation. Also, the GoCarShare organisation is available to cooperate with many events worldwide. At present, the organisation is in partnership with more than 100 festivals, and thanks to this contribution, more than 70,000 attendees have decided to use the carsharing service.
However, another way to travel with a significant reduction in emissions came from implementing a public transport line for the event. The Shambala Festival reduced its carbon footprint by 10% by offering customised coach travel services that saved on car travel costs. Also, several other festivals could benefit from this improvement; the Boomtown festival, in 2019, achieved a 20% participation from the audience arriving by coach transportation. However,

by analysing predefined routes, offering flexible journeys, different drop-off locations, and testing different points of sale, the audience engagement capacity of this service can be better defined. However, one of the most cost-effective methods of carbon emissions is cycling. The Festival Republic organisation ran an 80km race that was rewarded with a free ticket to the event if completed.
Finally, analytical tools, such as Julies Bicycle, can measure the impact, showing detailed reports and calculations on reaching the target by 2025.

1 Gather all travel information with questionnaires and postcode data, asking for ways to improve services;
2. offer ticket incentives and other benefits to people who decide to travel by public transport and carsharing mode;
3. Limit the number of cars by making sure that there is a parking ticket or even discounts for those who show up with more than three passengers in the car;
4. Cooperate with local authorities to provide adequate shuttles and bus stops for the event;
Give incentives for people to walk or cycle to the event, including free services within the event and ensure lock-up options;
6. Supportare il messaging around greener transport audience;
7. Offering the possibility of balancing carbon emissions with a carbon offsetting mode.

Examples of alternative transport methods

Scooter-sharing

Many companies focus their renting possibilities on the same modality. The Mimoto Organisation is an example of electric sharing implemented on scooters. The service is present in Milan and Turin and enables the concept of free-floating to be promoted. This is an accessible parking mode, in which the user is free, by the highway code, to park the vehicle in the designated parking areas. The renting is done entirely through an application that can be controlled by a smartphone, and all the costs of maintenance and upkeep of the vehicle are taken care of by the company. The user is only charged a fee per minute, plus a possible charge in the event of infringements. Thanks to the practicality of the vehicle and its ease of use, the usage times are shorter than those for ordinary public transport, which is why this type of transport is still preferred in metropolitan areas.
Within the category of scooters, there are also electric mini-scooters that do not require a driving licence to be used. These vehicles can be placed in the middle category between a bicycle and a scooter. Practicality is undoubtedly one of the

main improvements offered by this means of transport. Of course, practicality is far superior, and thanks to technological innovation, many urban centres are offering scooter sharing services at low costs. Thanks to the possibility of taking the user to many areas that are easier to reach than by car.
However, as these scooters are a middle ground between the bicycle and the scooter, these vehicles are still waiting to be regulated as indicated by the highway code. Nevertheless, their practicality of transport also favours the broad implementation of offences such as parking in unauthorised places and travelling at high speeds (maximum 25km/h compared to the 6 km/h allowed by Italian law) in restricted areas walking, such as pedestrian streets and pavements. Although it, therefore, proposes the best service in reducing pollutant emissions and efficiency of use, the scooter is still such an innovative service that it is still wandering in search of an improvement that will not worsen the quiet life in urban travel areas.

Bike Sharing

The same concept proposed for scooter sharing is also proposed for bicycle rental. In this case, the method is mainly proposed in two modes: free-floating or with parking stations. In the first method, it is usually implemented by private companies that enter the city territory, while in the second case, a municipal agreement is used to propose the activity on the territory. Taking the city of Turin as an example, the primary services offered are Mobike, free-floating, and TObike for parking in particular areas. However, for a short period of about a year, the metropolitan cities offered several bike-sharing services of many private organisations, but the ease of free-floating also encouraged the theft of bikes for easy disassembly and resale. To date, Mobike still manages to compete on the territory because the body and the elements that make up the bicycles are of different manufacture than standard bicycle models, making adaptation impossible and therefore broadly discouraging ordinary theft. Nevertheless, the advent of the electric scooter has made it possible to implement numerous improvements to this service in practicality and ease of use..

Car-sharing

The most popular car-sharing service is based on the same free-floating concept as above. in this case, the vehicle is either diesel or electrically powered and can be parked in any parking area in the city. The leading companies operating in the area are Enjoy and Car2go. Both companies have a recent birth, and their mission is to make individual mobility a reality for users who need more transport space but do not arrive within the metropolitan area with their means of locomotion. For example, a worker, or a student from neighbouring countries, is the company's target. And yet, some companies also offer a renting service

to reach airports, where, in this case, the problem arises in reverse. The idea of having a privately owned vehicle only for the time needed to reach the intended destination is undoubtedly a method that has allowed the company to encourage a more sustainable approach; however, both Car2go and Enjoy currently offer a fleet of only heat-powered vehicles. In contrast, LeasysGo, an organisation that has been active in the Turin area for just under a year, offers to carshare in the same mobility as its competitors, but with electric vehicles only.

Event-Coach/Train

In these services, it is usually the event's promoter that provides the opportunity or allows third-party organisations to operate in partnership, offering packages that include both the event and the cost of the service for them. In this case, the management of the mobility is entrusted to these companies, and conventional routes are established where the highest demand is expected and are interspersed with stations along the route according to the users' needs. This system makes it possible to develop sustainability through different environmental aspects; it allows the emotionality caused by the event's activities to be triggered from the very moment the journey to the festival begins. As the festival and the musical event are a driving force for social aggregation, within these modes of transport, there is a high presence of social interaction favouring their use, sometimes even more than a more eco-sustainable choice for the individual. This synergy of achievements is nevertheless an interesting method that deserves to be improved and implemented in most events, as it is one of the best methods of transport with significantly lower carbon emissions than all other possibilities.
Moreover, allowing thousands of people to be aggregated in a single event is a particularity that the event organisers cannot avoid; it must therefore be protected and improved. This is the case of the journeys offered by the organisation itself, proposing packages that include the cost of the ticket to the event, including a surcharge for a coach or train transport service. Within the definition of the festival's sustainable practices, this method allows a drastic reduction in the emissions of a private vehicle. It enables the event holder to consider the emissions caused by the individual participant via public transport, which would otherwise be impossible to determine. The boundaries of event quantification can also include public transport, ensuring that the organisation can offset the carbon emissions of the event even more accurately.

Towards zero-carbon Travel emissions

As much as the festival sector is linked to this critical carbon emission, it is also worrying that transport demand is expected to continue to grow across the entire world in the coming decades. The car ownership rate will increase by 60%, and the demand for freight aviation will triple by 2070. So can technological innovations be introduced to ensure that emissions of particulate pollutants do not increase critically?
The use of hydrogen-powered cars and electric technologies have brought about significant improvements that are likely to lead to carbonisation in the coming decades. Motorbikes are expected to be phased out by 2040, railways by 2050, small trucks by 2060 and finally, cars and buses will be completely phased out by 2070. However, by 2040, the European Union, the United States, China and Japan are still expected to phase out conventional vehicles.
Electric vehicles are estimated to reduce greenhouse gas emissions by more than 50%[5] and although they are themselves the cause of considerable ethical and moral concerns about battery production, it seems that still, the production of EVs may be the only way to increase carbon emissions as much as possible. Also, according to the report, by 2025, around 10% of the festival audience car users will be coming by EV. Nevertheless, in ten years around also a third of the users will have switched. Mobility can be integrated into existing computerised booking services, thus showing how the same route can be travelled and connected more easily by different public or private transport members. This idea will encourage shared planning booking and pay for car-sharing travels. These objectives are still far away shortly. For this reason, we want to propose new approaches, such as negative offsetting through other parts of the energy system.

5 Cambridge Econometrics Fuelling Europe's Future February 2018: https://europeanclimate.org/wp-content/uploads/2018/02/FEF_transition.pdf

8. WASTE + WATER

Analysing the problem

Among the different forms of pollution that an event produces, waste at the event site is readily noticed even by the event users themselves during the event.
Extracting, refining, transporting and manufacturing them into brand new products are all processes that sometimes also require a significant energy component, causing carbon emissions that can lead to toxicity in the environment at different scales. Ideally, the concept of waste in sustainability is also understood as a sense of a premature end to a product's life. Therefore, in sustainability, getting waste also means that the material we use is of manufacture that does not allow reuse or recovery for a different life cycle. Nevertheless, these products are sometimes embedded in a system that does not allow the population to benefit from implementing reuse and recovery practices. The main issue that characterises the waste element within an event is to understand the material as a resource still available in its final phase of life, where, if it cannot be reused for a different purpose, it is still necessary to recycle or recover it.
Waste, therefore, remains a visible and significant challenge for the organisation of events. However, as we have seen for other previous categories, Events are involved in the idea of a new microcosm in which new strategies and innovative attitudes can also be tested. Therefore, new systems and services are sometimes implemented or tested. However, careful pre-event planning, aiming for as accurate a process as possible, and efficient on-site waste management can give the organisation significant control over all on-site waste streams. Furthermore, the idea of new waste management for participants is seen as a new behavioural proposition for rules that need to be adopted urgently on a global scale.
Waste management is the issue involved in the problem because any event cannot be exempt from producing waste, as any living microcosm can do. Therefore, management of the problem is the only truly effective method of implementing solutions to the problem. Unfortunately, as is the case with the different housing microcosms, even in the case of events, the needs for disposal recovery and reuse are so different according to the multi-face categories involved in the problem therefore different from being adopted in all events.

A waste Hierarchy

Some parameters can make predictions based on audience demographics, sites, contractors and available budgets. Also, the European Waste Hierarchy is a framework used for determining decision-making strategies that can be intercalated in the cooperation between the festival organisation and partner companies. This framework is included within waste management to propose

to organisations new ideas for methods of waste collection, recycling, limiting the use and creating incentives to change consumer behaviour. This Waste Framework has, therefore two key objectives:

- preventing and reducing negative impacts
- waste management to improve resource efficiency

This framework proposes a specific hierarchy to be applied by each European Member State for waste management. Thus, prevention and re-use are the preferred options; then, the hierarchy proposes a recycling and recovery option for challenging to recover items, such as electronic equipment, batteries, and construction elements..

MINIMISATION AND PREVENTION
- use less materials in design and manifacture
- keep products for longer and re-use.
- reuse or repurpose materials instead of rourcing new.
- use less hazardous materials / materiasl with lower environmemntal impacts.

PREPARING FOR REUSE
- check, clean- repair, refurbished whole items or spare parts.
- design for disassembly and re-use.

RECYCLING
- includes compositing
- not everything that is labelled as 'recyclable' can automatically be recycled at the majority of facilities or if its in waste streams that are too contaminated - for example if something consists of two or more materials glued together.

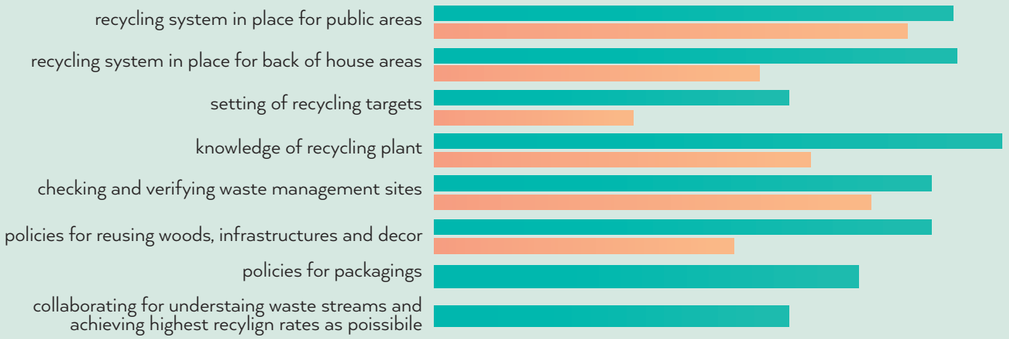
OTHER RECOVERY
- anaerobic digestion for organic materials, and incineration with energy recovery / 'Energy from Waste' i.e. where materials are burned and the energy is generated and captured

'DISPOSAL'
- landfill and inceneration without energy recovery.

Waste reduction strategies

Among the activities that are part of environmental sustainability applied to music events, waste disposal is one of those most easily promoted by festivalgoers. This element is categorised as a priority for the event. Despite its simplicity, placing more recycling bins within the areas proved to be one of the most relevant. However, according to the audience, the presence of multiple recycling bins in the area did not necessarily encourage a sense of recycling rates, but rather it was sometimes more confusing to place the right element about the correct recycling bin. For this reason, in addition to planning a wide availability of recycling bins, there is also a demand from the visitors to be properly informed on how to recycle products correctly. Clearer signposting and voluntary guidance, and ultimately an effective reduction of disposable items at the base, are the right strategies, according to Powerful Thinking, that can lead to a real improvement of the situation.
However, as we have said before, the event is a set of test-beds that, sometimes with minor changes, can bring significant improvements or sometimes collateral worsening. In this case, the public can conflict with the ideals of reducing single-use items, where the avoidance of single-use materials has not led to a real improvement in recycling management if they have not been properly informed about how to collect the waste. As with travel emissions, the amount of waste produced by the organisation is much easier to examine than the public. In addition, in waste disposal quantities, the use of forms of incineration for energy or reuse will reduce the amount of polluting emissions. Also, according to a report made by Powerful Thinking Campaigning, a sample of festivalgoers were interviewed for four consecutive years to see how changes in the interaction with waste management and more sustainable strategies have evolved. From the report, it can be seen that most of the leading waste disposal activities were already included in the management four years ago. A significant reduction involved several event policies and regulations to determine prohibited elements from being used to administer food and products for sale and be used within the venue. In addition, co-operation with sponsors to understand waste streams and ensure the best recycling treatment was a second element that enabled festivalgoers to become significantly more efficient.
Below, we list the main strategies considered by organisations to reduce waste creation effectively:
- Onsite recycling system for public areas
- onsite recycling system for staff areas
- setting recycling targets for the event
- Include waste stream and the recycling plant where the waste is conducted to
- Reuse policies for wood elements, infrastructure & decor
- Standards and policies for packaging traders
- Cooperation with sponsors for developing the best efficient waste stream and achieving the highest recycling rates as possible.

WASTE MANAGEMENT PRACTICES BY FESTIVAL ORGANISERS



Refill services

The FRANK Water charity is a company that fits into the UK's major event traders to provide a water refill service. The organisation has participated in 77 different festivals offering a 300,000-litre water refill service. The strategy is to provide an adequate number of volunteers at the event who can offer the same efficient service as buying a single-use plastic bottle.

Reusable Cups

In parallel to the refill service, one can also reuse items that should instead be destined for the trash after use. Firstly, reusable cups become a priority element in this strategy. The Hay Festival took this strategy forward in 2018, going from consuming 350 wheelie bins full of disposable cups down to just 25. Hance, the organisation, introduced

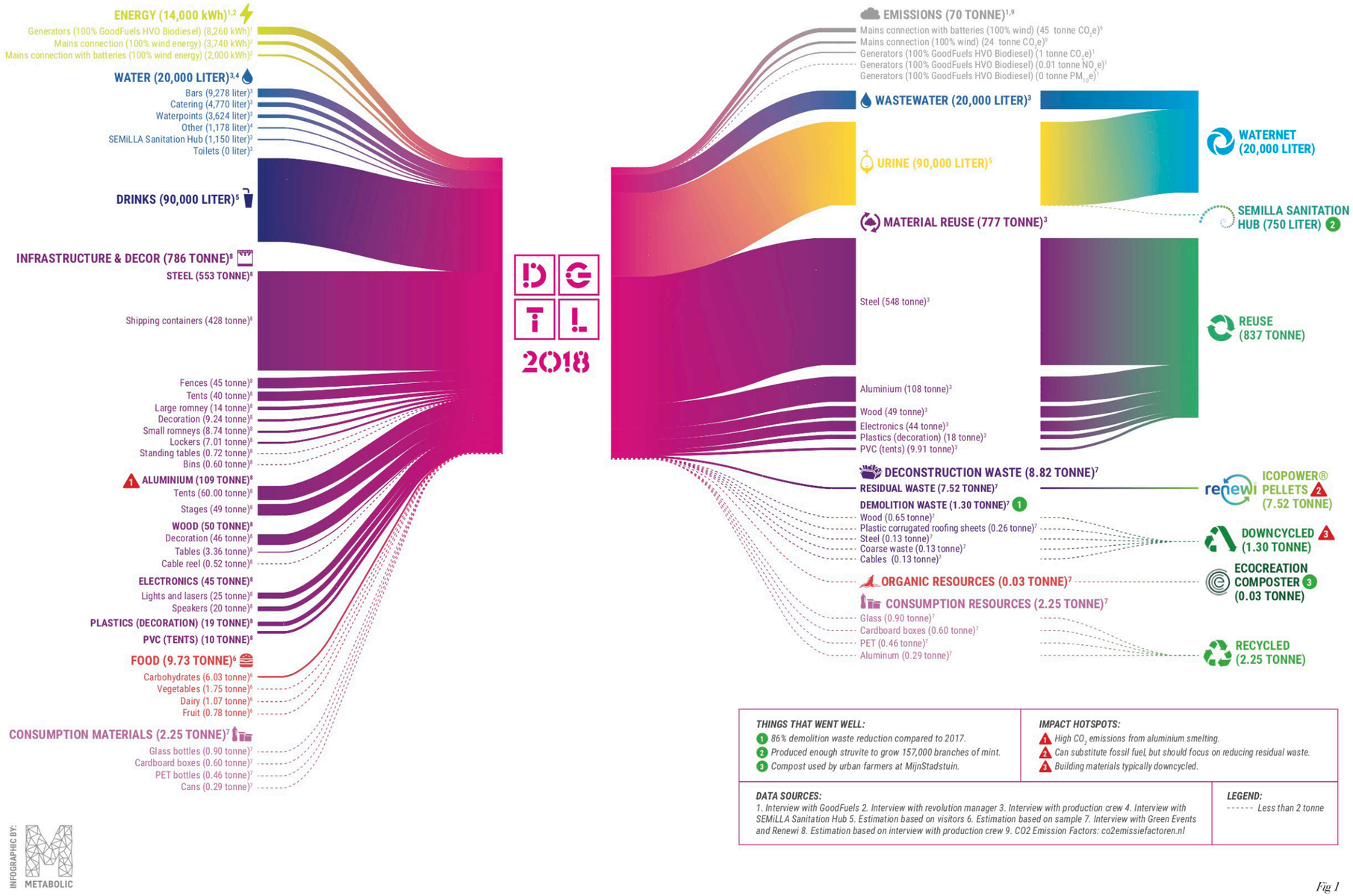
a deposit scheme to reduce unwanted waste during the event, achieving another reduction of 56% in cups waste. The reduction in plastic cans was also reduced by 48% compared to 2017. Also, crockery and cutlery can be supplied in a reusable form. The Fire in The Mountain festival hosted 2000 spectators in 2019, who were provided, in case they purchased food, with meals served in reusable plates that have been cleaned onsite. The response from traders and attendees was positive, and it also helped to reduce single-use waste drastically.

Besides where the material is reusable, reuse can also be stimulated by providing hire-and-washing services that can be made more efficient directly by the spectators in the vicinity of the food stalls.

Finally, in addition to disposable bottles, a solution can also be proposed to purchase metal bottles at the event, hoping that they can be reused in numerous spectator activities in the long term.

Recycling methods

Effective recycling practices within an event are determined by several factors that can lead to a rate ranging from 5% to more than 50%. Firstly, reducing the material to be processed as waste is undoubtedly an essential element for improving the waste stream. However, an appropriate method of recycling must include clear signposting for the users of the event. In this case, it is pointed out by Powerful Thinking that there is no uniformity in waste signposting among festivalgoers, which is why deciphering the proper disposal practices among different events can become a barrier to good recycling practice by attendees. Threfore it is proposed to provide equal signposting for all events wishing to offer a recycling service. The imbalance of unclear or non-universal signposting may lead to users counting recycling bins, causing an



THINGS THAT WENT WELL:

1. *86% demolition waste reduction compared to 2017.*
2. *Produced enough struvite to grow 157,000 branches of mint.*
3. *Compost used by urban farmers at MijnStadstuin.*

IMPACT HOTSPOTS:

1. *High CO_2 emissions from aluminium smelting.*
2. *Can substitute fossil fuel, but should focus on reducing residual waste.*
3. *Building materials typically downcycled.*

DATA SOURCES:

1. Interview with GoodFuels 2. Interview with revolution manager 3. Interview with production crew 4. Interview with SEMiLLA Sanitation Hub 5. Estimation based on visitors 6. Estimation based on sample 7. Interview with Green Events and Renewi 8. Estimation based on interview with production crew 9. CO2 Emission Factors: co2emissiefactoren.nl

LEGEND:

------ *Less than 2 tonne*

Fig 1
infographic about the waste stream implemented by the DGTL festival in 2018.
©, 2018 DGTL

increase in contamination. Therefore, clear messages can help the audience to solve the problem. The Electric Picnic event experimented, providing more volunteers to inform viewers of the 9% proper waste disposal practices.
In addition, festivals with a more significant presence of participants can also opt for onsite waste management services that allow waste streams and segregation to be controlled directly at the event site. Also, materials that are more difficult to include in the waste streams, such as polyethene-lined paper cups, are processed directly at the event site, thus allowing a more straightforward reduction of contamination and improvement in recycling activities.
In addition, assistance from onsite volunteer sorting is therefore defined as the most effective way to gather all data about waste disposal accurately.
In parallel to the individual use of plastics or other small elements, another problem is caused by materials with events producing individually managed stages or events producing their own sets. In this case, the process of disposal or reuse can be a predominant factor in accounting for the final result of waste production. This is the case of the we love Green Festival, where every year the organisation launches a competition to propose new design ideas for the reuse of materials from the set design of previous years. Similarly, other music event organisations, such as Dour Festival (Belgium), Boom Festival (Portugal), Pohoda Festival (Slovakia), A Greener Festival, and the Green Operations Group
Therefore, any product can be recycled or reused, but this process is inevitably affected by a cost-benefit ratio with which to examine whether there is balanced economic and environmental sustainability. However, organisations take charge of cleaning the whole event from single-use materials to recycle them entirely and make new products. An example of such companies is TerraCycle's Zero Waste Boxes and Stormboard, which collect material from larger mass events, including the Glastonbury festival, to make products for use in subsequent events.
Another way of recycling is called EfW, or Energy from Waste, wherein this case, the material that is to be taken to a pulp is incinerated to generate electricity. However, this methodology is as simple as it is inconvenient for a recycling index, as it has a more negative environmental impact than recycling material, but it remains a more practical example of implementation.
Other ways of divestment include the following:
- Packaging with decomposable certification;
- Using an Anaerobic digestion process, i.e. a technique that separates the polluting elements of material and then brings the compostable elements to the EfW;
- Sending the material to an In-Vessel composting system;
- Offering Closed-Loop compositing, i.e. a collaboration between the manufacturer, collector and composter for assuring a composite packaging during the whole production process;
- rapid compositing technology that can compost food and food packagings in 24 hours.

Management of wastes

When waste management involves several resources, organisers, contractors and public users to act together, one of the most important strategies is undoubtedly the cooperation of all these parties together. The organisation Grist Environmental offers the waste management process for waste collection and transport with collected waste streams, recycling and recovery strategies.

Avoiding single-use plastics

One of the elements that most characterises the demand for eliminating global waste is that determinant by plastic is a long-lasting element, challenging to dispose of and, above all, frequently used for disposable elements. The same problem is present at festivals, and it was essential to include successful targets in the prevention programmes.
Live Nation's organisation included plastic in its environmental charter in 2019, including a global target for all festivals run by the organisation, while the Glastonbury Festival introduced regulations in 2019 to ban single-use plastics in all areas of the event, including ordering food services to use recyclable or compostable materials, such as paper, card, wood, or leaves.
Based on the report defined by Powerful Thinking Campaigning, the single-use plastic elements to be avoided within an event are the following:
- Water and drink bottles
- Cups, plates, cutlery, food containers
- Straws and stirrers
- Badges and wristbands Fancy dress clothing and glitter
- Personal care and travel miniatures
- Signage, stickers and laminating
- Promotional items
- Tents, gazebos and cable ties
- Refuse bags

However, while the plastic ban must raise awareness of a new way of not plundering the earth's resources, it is also necessary not to repeat the same methodology on other materials. In this case, using single-use elements, such as aluminium, glass, and cartons, has an equal environmental impact that cannot be neglected, especially if used as substitutes for the same elements required with plastics. the risk, therefore, is to repeat the mistake of over-producing plastics with a different material. Moreover, for this reason, a festival community must be sensitised not to the non-use of a single element but the re-use and understanding of its value. In addition, the understanding of the environmental burdens associated with the usage and production also enables the finding of suitable materials. In this case, the parameters involved in the

choice are as follows:
- quantifying carbon emissions during production
- the ease of following its recycling disposal process
- which is the most suitable solution at the end of its use.

The initiative at the Shambala Festival also showed how cooperation with spectators is possible. Through a campaign called 'bring your own cup', 30,000 hot drinks cups were reduced during the event, as each participant was asked to use their own bottle brought to the event. In the remainder, more than 12,000 cups were collected for recycling. When waste management involves several resources, organisers, contractors and public users to act together, one of the most important strategies is undoubtedly the cooperation of all these parties together. The organisation Grist Environmental offers the waste management process for waste collection and transport with collected waste streams, recycling and recovery strategies. .

Alternative decoration objects

An event is also a place where the need to celebrate gives a tendency to adorn oneself or make oneself part of a festive feeling that leads the spectator to want to decorate themselves or keep themselves recognisable with temporary items to wear. In this case, glitter has been a redundant element at festivals, which, however, is mainly composed of plastic, can cause an increase in microplastic pollution. Therefore, the Bio glitter company has come up with a plastic-free alternative to a glitter that is entirely free of the environmental damage caused by competitors. There may also be alternatives for other items such as wristbands made from far more sustainable materials such as bamboo, hemp and cotton Eco. The company Nordic has created a range of products exploring materials other than plastic for use in events.

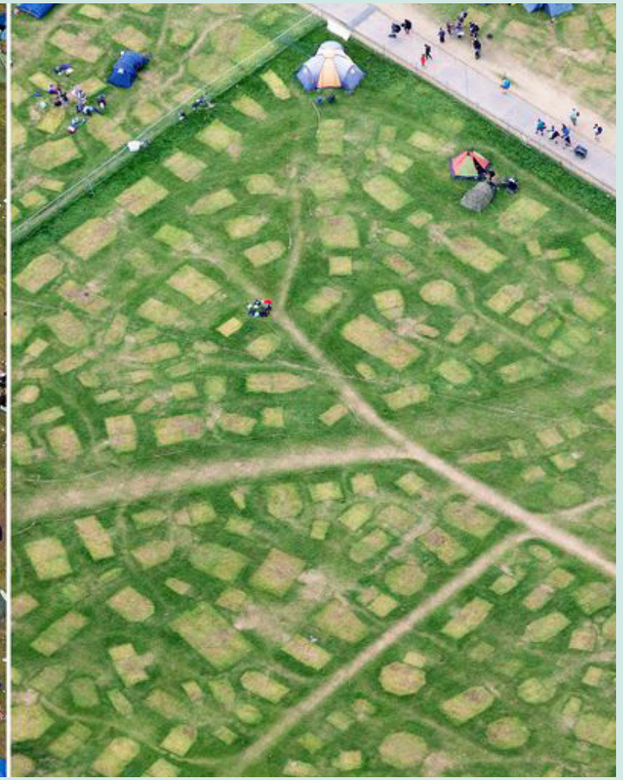


Fig. 2 The Day after the ending of the Glastonsbury Festival,: the waste left by the aiendant compared between the 2014 (a) and the 2019 (b) editions.
As, the festival organiser Emily Eavis confirmed, this achievment has ben possible thanks to a bottle ban enforced at the 2019 event for the environmental reasons.
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Campsites management

At every festival that hosts the possibility of staying overnight in campsites and tents, it is often the case that camping gear is left behind, significantly when it becomes irreparably damaged to be reused. In 2018, The Association of Independent Festivals reported that throughout the festival season, around 10% of festival-goers abandon their tent after using it at the event.
Of the organisations, including Comp-A-Tent, was thus able to collect abandoned gears at mass events. The organisation has ascertained that more than 77% are abandoned, with approximately 250,000 abandoned items per year contributing to 900T of waste each year.
Moreover, the abandoned tents are not donated to charities but are dismantled or forced to be destroyed. Due to time constraints, only 10% of them are actually donated. According to the organisation, viewers also believe (36% of respondents) that tents can be recycled but are not aware that the process requires a large amount of money due to the non-feasible recycling method and the large tonnage left every year.
According to Comp-A-Tent, up to one-third of tents can be supplied and sold to retailers as 'festival tents'. In addition, this type of equipment is not suitable for EfW due to a low colour value caused by the polyester fabric, which is also coated in flame retardant for human safety. In addition, inflatable mattresses are not suitable for EfW as well. Their PVC fabric, when burnt, creates hydrochloric acid (HCl), a contributor to acid rain. However, modern incinerators filter out the acid, a contributor to acid rain, and require a significant amount of resources for each element.
Numerous campaigns have also tried to discourage the phenomenon. In 2019, AIF 'Take your Tent Home', cooperated with more than 60 festivals to avoid single-use plastics and tent abandonment. The organisation also made a comparison, noting that one abandoned tent can be bought for 8,750 abandoned plastic straws.
Also, in the same year, the Festival's Republic campaign encouraged Staged artists and spectators by showing detailed sustainable campaign propaganda on the importance of recycling and not abandoning one's tent after the event. Thanks to this campaign, there has been a decrease in tent abandonment of about 50%r compared to 2017. Another strategy was proposed by BoomTown festival, in which more than 200 'eco-warriors' worked at the venue promoting the concept of recycling and reuse during all activities.
Thanks to good cooperation, abandoned tents can be collected and regenerated. It was this goal that the Camplight organisation managed to achieve, collecting more than 1,000 tents and making new camping equipment materials to be rented out to festival-goers.

Eco Bond Incentives

In order to solve the waste problem, the idea of eco-bond incentives has been launched, whereby festival attendees are rewarded with a cash prize (usually worth £10) for bringing a bag of recycling and general waste to a collection centre. This

strategy has been positively adopted at many of the events which also host campsite areas. This strategy improves both recycling rates and also helps for maintaining a cleaner are during the event; many organisations, such as the MyCause organisation, take over the management of this service by issuing an eco-bond system..

Further approaches

Co-operation between partner companies remains a crucial point where improving the link between them also improves the recycling result. Through co-operation, the number of elements in the waste stream can be increased, and the reuse of materials that would otherwise be destined for maceration can be added. The message can be promoted through communication campaigns, and the strategy improved from the first moment the ticket is purchased.
Another point in favour is to compose clear and universal signage to clarify the meaning of waste sorting, providing the right help to viewers who are not familiar with waste collection strategies. In addition, based on the cooperation provided with the partner companies, one can continue to build segregation of waste streams and materials used during their activities and, finally, propose the co-operation with the partner companies' crew to collaborate for the same purpose of resource conservation.

Other waste management ideas

The microcosm of the event extends its aims to raising awareness of recycling activities outside its venue. However, the process can also oppositely take place by proposing new ways of disposal and recycling to the event. For this reason, in this paragraph, we would like to report some interesting examples of waste management.
The first is reducing environmental and noise pollution, with a simple strategy implemented by a mayor of a municipality in Sicily, Italy, who replaced door-to-door waste collection in the historic centre with trucks, using donkey carts. The initiative was a popular folkloric success and had economic benefits, reducing the annual cost of waste collection by € 8,000 to € 2,000 for the same service. The activity also provided new jobs, allowing associations integrated into the territory to safeguard a growth out of the mafia racket to support young adults in their training.
Another method is to set up creative recycling centres, which can take all materials that are difficult to dispose of and create a reuse strategy by reinventing new forms of materials and products needed for other purposes.
An enormously synergistic system is also exhibited by waste management in Hammarby, Stockholm, where household waste is channelled to a collection point under the urban fabric that can treat the sewage, generating biogas

Fig. 3 Shambala Festival 2018. At the moment of purchase, the ticket price receives a £ 10 surcharge called 'Recycling deposit'. In order to receive the surcharge back, the attendant was required to sort its waste produced within the festival, by placing it in the appropriate containers located in the 'recycling exchange' area.
© 2018, Shambala Festival

that is immediately usable in the residences on the site. At the same time, solid waste is remixed for use as fertiliser for the apartments. In this way, the collection is on-site, and both the percentage of non-recycled material and the costs of transporting the elements decrease. Human waste is also treated innovatively to be returned directly to the ground, as is the case at an Organic Waste Treatment centre in Sweden, where the waste is directly treated to be purified and returned to a nearby stream.
In this case, the Junker app can make its users communicate based on requests to retrieve waste. The user can ask for advice on where and how to dispose of his waste and report dirty streets, bulky waste, and dirt roads in the app. In addition, through QR-code detection, it is possible to frame the barcode to understand the method of recycling and collection associated with that specific product, avoiding unpleasant consequences in the disposal of the product in the wrong collection. Since 2015, therefore, many organisations are entering the landscape of environmental sustainability by introducing recycling targets. Moreover, according to the estimation made by Julie's Bicycle in 2014, 2 kg of waste are produced by a single user within the festival. According to the organisation, this figure allows us to understand that there is a drastic reduction of waste produced by one person. Therefore, this level has been achieved thanks to the festival's recycling rate, which continues to be higher and higher. Nevertheless, in 2014, the recycling rate of a median festival was 37%, an increase of 5 points compared to the previous year. This figure is mainly determined by the difficulty of identifying the waste stream for every single element that comes into use within the event. In fact, there is an estimate of

the amount of material recycled in the case of on-site waste management companies, but no quantified data at the end or beginning of the process. However, a lack of knowledge and regulation in this field does not allow the event to fully consider a certain amount of items that have been recycled or become waste at the end of the event.
Therefore, we could say that the main problem remains the lack of communication between different parties about waste quantification. However, this difficulty can be ameliorated if it is possible to introduce it into the event management companies that can quantify the whole waste process inside the event and outside it until the end of the disposal processes.
Among the proper quantification, another relevant practice is prevention at the beginning of the material event. In this case, the adoption of reusable cups and other disposable items at festivals proved to have a high priority over the total waste generated. Below, we propose realised examples of events that led to a clear improvement in waste management.

Water conservation strategies

Water is still one of the primary goods to be safeguarded, as its limited resource is being plundered due to climate change and the dramatic increase in world population. This phenomenon, therefore, affects any global community and population, especially in situations where the primary good can be promoted for its substantial value and where it is itself a theatre of environmental protection. Event organisers are therefore well aware of the need to conserve water and the possible consequences of what might happen if they do not. Each year, according to a report made by MET Organisation, 184.5 million litres of water are consumed by festival activities; the same areas could be affected by water scarcity in 2050. In addition, drought situations within a festival can cause significant environmental and economic damage to the final output of the event. Moreover, event schedules during warmer seasons are also subject to higher water consumption, and more water will therefore be needed during event activities.
It would also seem counterproductive to standard natural theory. However, the high concentration of attendees within a single urination area can cause considerable environmental impact. This phenomenon occurs because of the large amount of ammonium reintroduced into the environment.
Therefore, by connecting the site to a personal water source, numerous benefits are associated with the water demand of the event, significantly improving the economic and environmental aspects of the event; thus, the choice of a venue with available water inside is a determining factor. According to Julie's bicycle, the benchmark of the consumption of water inside a festival is to 14.3 litres per person per day. This figure is higher vthan the same quantification

made in 2014. Therefore, it could be assumed that climate change has started to bring more droughts at certain times in a more pronounced manner, and nevertheless, the refill service may have influenced the practicality of requesting cheap and always available water.
Tuttavia, in questi casi, è comunque preferibile mantenere questo servizio piuttosto che rientrare l'acqua all'interno di singole bottiglie monouso. Inoltre, trattare l'acqua come una risorsa cruciale e importante deve essere sempre considerato al fine di ridurre il consumo eccessivo durante l'evento.
Moreover, water consumption is strictly correlated to water pollution. There has been inserted strong legislation that wants to protect water in rivers and streams. Also, chemical compounds added in cleaning and personal care water compounded require an extensive reprocessing process of the water leaving the event. Therefore, one of the main methods of improvement in implementing a strategy to reduce pollution caused by water use is the use of materials designed to have a steady reduction in chemicals used.
Also, a less visible and more difficult to be fully quantified is the water footprint derives from every activity inside the event. An improvement strategy for these activities could be understood as a cooperation between the event organiser and only those partnership activities that are recognised to have higher water efficiency. In addition, rainwater harvesting technologies also allow rainwater to be reutilised for soil purification activities after and during the festival.
In order to avoid polluting the river with high percentages of amino acids from the urine of the spectators, it is also necessary to block the passage and access to the river with appropriate fences and make sure that the area is controlled. Also, appropriate signs and communication can discourage spectators from performing acts that may impact their planet.
Therefore, temporary health services are the primary sources of GHG emissions they cause. The main impacts are derived from transport, the amount of waste generated, and the chemicals used for treatment. However, the organisation's interest in sustainability principles has led to the cessation of the use of chemicals containing formaldehyde in their facilities and their replacement with effective, biodegradable alternatives. Also, the adoption of compostable toilet services achieves a chemical-free service and, in cases where the waste can be stored and redistributed, can also be used to improve the state of the land even within a wider radius of the event. Energy can also be created by the use of appropriate toilets that can transform waste into energy. Lowatt's company created a temporary toilet structure within the Deer Festival that could store 52,000 litres of water and, by collecting 28.3 tonnes of water, was able to create an electricity point that could generate 1,078 kWh of energy.
A similar concept was also presented during the pee power in the chapter on energy provision aspects of a festival. In this case, urine can produce the energy needed either for the collation of a smartphone charging station or providing lighting, or it is also able to improve the introduction at an experimental level for refugee camps and no sanitation or electricity available areas.
Also, another water management system is provided by the MTD Water organisation, which has developed a system of temporary bottle refill stations for events. Also, the organisation is committed to quantifying the water resources needed throughout the event and ensuring only the amount needed to minimise adverse environmental impacts. Service management also includes water cooling and calculating the best route for the exact pipe routes and routes for optimising the transport utilisation.
Other solutions designed to safeguard water also include simpler but still highly efficient strategies. In this case, percussion taps or timer dispensers can be used to safeguard consumers, or proximity sensors can be used to reduce waste drastically.

OVEWRVIEW OF WATER USE IMPACT AND REDUCTION OPPORTUNITIES

TYPICAL % THAT WATER CONTRIBUTES TO THE ONSITE CARBON FOOTPRINT OF A UK FESTIVAL	> 1 % (excluding transport)
TOTAL AMOUNT CO_2 PRODUCED BY UK FESTIVALS ANNUALLY FROM WATER USE	60 tonnes
TOTAL ESTIMATED WATER USED BY UK FESTIVALS ANNUALLY	184.5 million litres
A KEY OPPORTUNITIES TO REDUCE WATER USE AND ASSOCIATED IMPACTS	Use of water conserving technology and minising leaks: working with supply chain to reduce water footprint of products and services

OVEWRVIEW OF WASTE USE IMPACT AND REDUCTION OPPORTUNITIES

TYPICAL % THAT WASTE CONTRIBUTES TO THE ONSITE CARBON FOOTPRINT OF A UK FESTIVAL	24%
TOTAL AMOUNT CO_2 PRODUCED BY UK FESTIVALS ANNUALLY DUE TO WASTE	5,500 tonnes
TOTAL AMOUNT OF WASTE GENERATED BY FESTIVAL ANNUALLY	25,800 tonnes
KEY OPPORTUNITIES TO REDUCE WASTE AND ASSOCIATED IMPACTS	• Reduce the amount of materials and resources consumed • Increase re-use rates for mterials • Introduce reusable cups • Engage audience recycling intiatives • Eliminate biodegradable

Source: The Show Must Go On, 2019

CASE STUDIES OF SUSTAINABLE MASS EVENTS AND FESTIVALS

9. XX OLYMPIC GAMES TURIN 2006

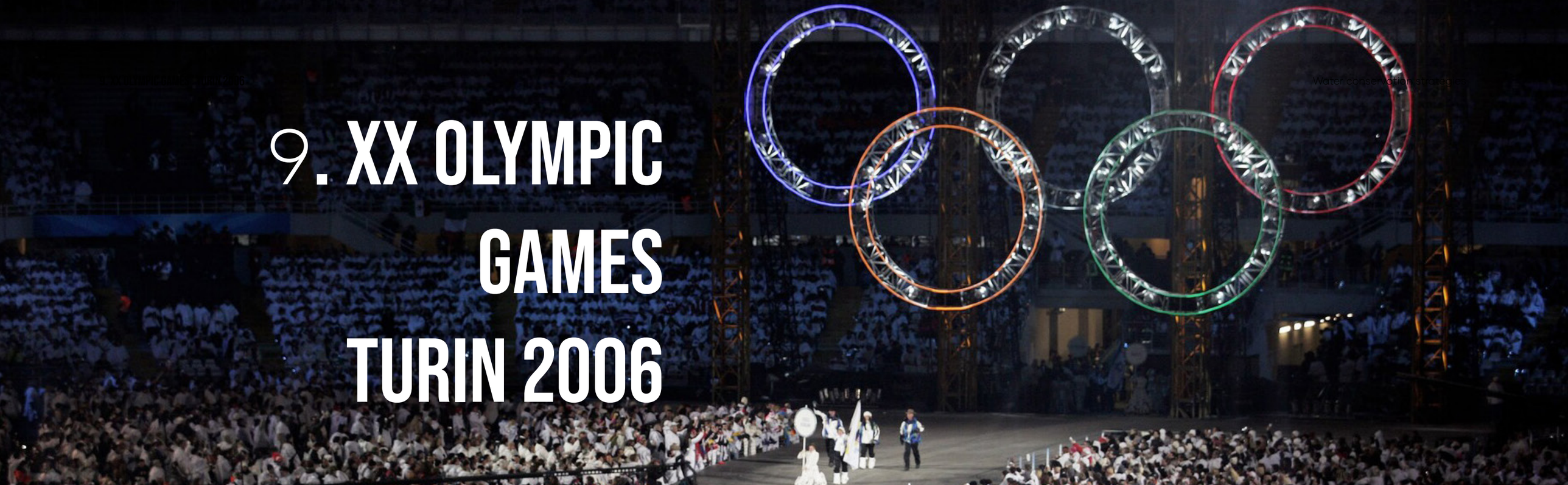


Fig. 1
The opening Cerimony of the XX Winter Olympic Games
© 2006 Olympic.org

The Winter Olympic Games in Turin are the 20th edition of the Olympic Games. Thanks to the policies of the International Olympic Committee, Olympic Games have made several improvements throughout their period of realization.

An essential step towards sustainable development was taken by the IOC in 1999, adopting Agenda 21 as a commitment to the subsequent Olympic events. Moreover, Turin 2006, together with Sydney 2000 and London 2012, represent some of the cornerstones that represent the evolution of sustainability applied to significant events, as a driver of innovation and environmental, social and economic requalification.
The Turin Olympic system is defined by the centre, located in Turin, with a Pinerolo annex. The area is characterized by the mountains of the Alps and also pivots around the Sestriere for snow sports. The primary connection has been provided by two motorways, two state highways and two railway lines; these communications were fundamental requirements to achieve the objectives of the IOC standards.
The "Lingotto" district of Turin has been identified as a "hub", while the ice hockey, figure skating and speed skating facilities on temporary rinks and the Olympic Family Hotel have all been located in the district; also, the Main Media Centre has been located a short distance from all Olympic services. As mentioned, the other two outbuildings respectively host a curling tournament in Pinerolo and, in the mountains, an alpine ski sport in the Sestriere area. Finally, the athletes were hosted in three Olympic villages, while the media hosted seven media villages located along the Turin area or in mountain hotels.
The commission dealing with sustainable development has been named by the acronym TOROC, with the direct support of its environmental department; in this way, the Turin Olympic organization focused its attention on sustainable development. Its mission was to combine sustainable strategies with those of policy and legal requirements.
Also, the TOROC Foundation is a non-profit organization that has been responsible for the management of all Olympic events, including the opening and closing ceremonies, hosting athletes, coaches and technicians, the Press Villages, the Press and International Broadcasting Centres, and providing television and radio services.
According to the ISO 140001:1996, the TOROC foundation has also designed

and implemented an Environmental Management System (EMS), and also the European Eco-management Audit Scheme (EMAS). This tool provides a precise sustainable development and promotes continuous improvements in organization of environmental management.
Two separate certifications were obtained in two separate stages of the work: firstly, in 2004, about the planning and promotion, then in 2005, the facilities and competitions sites analysis.
As the foundation also stated, due the tangible and intangible traces that the events will leave on the territory, their main objective will be to develop innovative solutions to "create an Olympic legacy of Valuable for the territory". [1].
Therefore, in order to achieve their purpose, the first main document published was a "Charter of Intent". This work summarizes all the progress made during its implementation, by giving concrete form to the ethical, social and environmental principles implemented, while adapting the functionality and accessibility of the host territories and developing sports and tourist facilities for the Games' Time also for their long-term use.

Charter of Intents and main purposes

The TOROC organization committee has been interested since the beginning for ensuring the sustainable development of the project throughout its implementation phases.
Since 2001, the TOROC foundation enrolled in their team several institutions and NGOs (voluntary services, labour and human rights) for participating. It was, therefore, essential to trace the traces of the Olympic Charter and the IOC Code of Ethics as essential documents for the proper development of the objectives set.
In this sense, it is the organization itself that underlines two fundamental points that have inspired their management:

> *The Olympics Games aim to place the sport at the harmonious service of man everywhere, with the peaceful coexistence and the safeguarding of the dignity among men and women. In this regard, the Olympic Movement undertakes, alone or in collaboration with other organizations and within the limits of its means, to promote initiatives aimed at promoting peace (Olympic Charter, art.3).*
>
> *The protection of the dignity of the individual is a fundamental requirement of the Olympic Movement.*
>
> *IOC Code of Ethics, "A. Dignità", par.1*

1 Organising Committee For the XX Olympic Winter Games – Torino 2006,, 'The environment at the Heart of the Olympic games'

Their intention was to create games that would stimulate and educate 'peace, tolerance, justice, freedom, solidarity and equality between peoples and individuals' (charter of intents, TOROC foundation, May 2002).
These objectives are described in a more comprehensive form in the charter of intents document. This document has been released by the TOROC in 2002, at the beginning of the project phases. Within this essay, the organization aimed to give 'an effective contribution of positive and exemplary actions', aiming to spread in the world the culture of global responsibility. For these reasons, the charter has been made an integral part of all the subjects involved in the implementation, such as institutions, public bodies, associations, sponsors, suppliers, third party companies, to request and guarantee their effort and adherence to the principles of their mission.

The charter is made up of 10 articles declined as follows:

- *1. Responsibility;*
- *2. Non-discrimination and freedom;*
- *3. Life, health and safety;*
- *4. Minors;*
- *5. Sustainability and environment;*
- *6. Integrity and transparency;*
- *7. Dissemination;*
- *8. Participation;*
- *9. Applicability;*
- *10. Application and control*

Fig. 2
The opening Cerimony of the XX Winter Olympic Games
© 2006 Olympic.org

In these ten principles underlying the event, there are also outlined all three major categories of environmental, economic and social sustainability - anticipating those that, a few years later, will take part in the Sustainable Goals of the united nations.
In particular, the most relevant in our work is Article 5, dedicated to environmental sustainability. Within this principle, the organization recognizes the environment and the territory as an integral part of its sporting commitments, since it guarantees the usability and survival of the sport itself.
In this way, the territory must be respected and protected during all phases of intervention, applying the principles previously presented in Agenda 21.
Therefore, the design will require an assessment of the low environmental impact on water, air, soil, the biodiversity of the place. Moreover, the use of renewable energy sources is represented as the keystone for the electricity and heating provisions. In this way, the event is configured as sustainable development for itself and, at the same time, for its place of belonging, improving the overall environmental balance of the Olympic Games territory.
Also, the final objective of Article 5 presents itself as the progenitor of a culture of education and awareness-raising of the activities, in synergy with local authorities, to promote sustainable development even after the end of the events, giving ample space to youth education since it is, in particular, their

responsibility to protect the territory in the future.
Thanks to the publication of the 2006 Turin Temporary Works Evaluation System manual, we can learn about the practices put in place to proceed with the sustainable development of the event concretely. It can be seen that architectural sustainability has been mainly focused on two fundamental aspects: construction methods and technologies that favor the reduction of environmental impact - in particular, insulating materials that have a high thermal resistance - and, at the same time, preferential methods to favor an energy supply with a low environmental impact. These two annals are accompanied by the development of a methodology that assesses their environmental friendliness to provide a guide manual for the categories of companies involved in the construction of the Olympic Games.

Strategic Environmental Assessment

The 2006 Turin Olympics are also the first case in Italy where an environmental impact assessment of significant events was carried out. To comply with this strategy, a verification process 'aimed at evaluating the sustainability of plans and programmes of the specific geographic area, before these come executive' was implemented. It was, therefore, necessary to start this process

in a long period before the event, and more precisely in 2001. The TOROC commission presented the results of the study to the Region Piedmont council for their approval following the laws currently in force. From the commission, several principles emerged concerning technical aspects, procedures and programmes aimed at 'further improving the environmental performance of the programme'. Therefore, in order to ensure compliance with the contract with the International Olympic Committee while relating with the govern al policies, there has been founded a new organization called Torino 2006. The scope of this new committee was to communicate with the local administration for the organization responsible, regarding contracts to design and construct the infrastructure facilities specified from the Law 285/00.
Furthermore, TOROC foundation was required to define a set of available planning tools to be used by the Agenzia Torino 2006 during the various stages of the construction works.
Under the Strategic Environmental Assessment, the main issues defined were:
- Insert waste from excavations and worksites;
- Sustainable mobility;
- Safety of workers and local inhabitants;
- Water management;
- Environment and landscape safeguard.

Finally, the Foundation also presented a manual of guidelines for the correct sustainable design of Olympic multimedia villages.
In order to ensure proper sustainable development, an active monitoring was necessary for all phases of the event. There have been defined indicators that would affect different chronological moments of the design:
- Before and during the planning stages
- During the building stages
- During the testing stages
- During the event
- After the event

Each phase was followed by the compilation of an environmental sheet and a progressive assessment of environmental targets achieved.
The plan also included 16 environmental indicators, quantified at regular intervals, using Geographic Information system, (GIS) for achieving the following objectives:
- Assess and monitor environmental impacts (positive and negative) of the organizational process
- Guarantee at the end of the games the overall environmental sustainability

Methodology

In order to guarantee the compatibility of the sustainability criteria mentioned above, the concept of environmental protection and protection is thus fundamental. In order to be able to decline it in scientific terms, it was, therefore, necessary to implement a methodology for the analysis of the design work. To this end, evaluation indicators have been used which can be categorised into three main types:
- Technical and economic aspects
- Energy-environmental aspects
- Response to the vision of Turin 2006.

In the case of indicators of technical and economic aspects, the possibility of each material to have a more innovative correspondent, at a lower cost, has been identified. In order to be able to age to the target, two databases were identified for materials that were commonly available on the market: (1) American Society of Materials (ASM International) and (2) Cambridge Engineering Selector v.4 (CES4). The latter, in particular, proved to be useful for defining the technical-physical aspects of each material, in order to identify what are called 'performance filters', i.e., the selection criteria that identify the material's significant aptitudes to satisfy or not satisfy the technological and physical actions required in the design. Therefore, it has been possible to obtain tools to support the activities of (1) research of materials based on the required conditions of use, and (2) examination of the characteristics of individual materials. Subsequently, continuing with the definition of performance filters, it was possible to identify their critical value - such as resistance to chemical agents, or resistance to atmospheric agents - able to evaluate a first selection that the material corresponded to the project requirements. After this first phase, it was possible to proceed with the identification of the functional performance congruent with the technical element, that is, all the factors that allow the material to be linked to market acceptance conditions.

There have been applied several criteria of choice about the environmental aspects of a material. Firstly, it is analyzed whether the material's environmental criteria are adequately met concerning the previously mentioned sustainable development. In order to obtain a satisfactory result, it was, also necessary to analyze the environmental criteria during all phases of the product's life cycle, which, concretely, was implemented with the creation of a Life Cycle Assessment. Thanks to the analysis, it was possible to compare the different choices of materials based on both energy performance aspects of the material and environmental performance. In this regard, a table of eco-compatibility criteria was therefore drawn up for the construction works taken into consideration for temporary works through the use of an LCA analysis, following the ISO 14040 standard.

Table: List of eco-compatibility criteria of building works taken into consideration for temporary works using the LCA methodology.

The scientific publications used for the data-acquisition are:
- Boustead model v4.4;
- Italian I-LCA database;
- Handbook of Sustainable Building (HSB);
- Green Building Challenge 2000 (GBC);
- Guidelines for sustainable building (GSB).

Also, The boundaries of the analysis are complied with the stability of ISO 14041; therefore, the analysis concerns the material in its life-cycle until the end of the production phase (from cradle to gate).

From the analysis of the LCA, it has been possible to identify, among the preferences of materials, their toxicity index and recyclability index.

Finally, the indicators that concern the analysis of correspondence to the vision of Turin 2006 required a study of the material no longer only functional or environmental but sought a correspondence in the formal idea of the Olympic game that could distinguish it as an aggregative sporting event for the territory.

PHASE	NEEDS	REQUIREMENTS
Production off-site	Health and climate protection	Reduction of air pollutant emissions in the off-site production phase
		Reduction of emissions of pollutants into the air from the transport of raw materials and the finished product.
	Rational use of raw materials	Minimisation of the use of non-renewable raw materials
	Rational use of energy resources	Reducing energy consumption in the off-site phase , extraction, production, distribution
		Minimisation of transport consumption
Functional	Air and climate protection	Reduced emissions of pollutants into the air
		Reductions in emissions of climate-altering pollutants (GHGs)

Table 1
List of eco-compatibility criteria of building works taken into account for temporary works by means of the LCA methodology
Adapted by Giordano R, Revellino P, 2006

Sustainability Report

The Sustainability Report programme has been placed as one of the most relevant verification and control tools converting the level of implementation of the Charter [2]; their main advantage is to report on environmental, economic and socio-cultural issues. The TOROC foundation has therefore planned three editions of the report, starting in 2003, then 2004/05, and finally in 2006. Each elaboration has been divided into four main phases:
- The definitions of TOROC's sustainability mission;
- Analysis of activities;
- Indicators and data collection;
- Drafting of the report.

The leading indicators identified for the calculation of social and economic performance are provided by the GRI guidelines and the global impact of the Olympic Games "TODAY" and therefore used as the main standards of the whole evaluation. In addition, environmental indicators are mainly designed by the SEA monitoring plan and the EMS programme.

Green Procurement of Needs

In addition, TOROC's Purchasing and Environment departments were able to develop a Green Procurement project. The objective of this work was to focus on the most relevant product categories registered at the Olympic Games, for the implementation of a Sponsor and Sustainability programme. The registered companies were invited to comply, on a voluntary basis, the indications relating to ethical and environmental policies while giving them tools and actions that they can implement. By agreeing to this programme, companies demonstrate compliance with environmental policies, despite being authorized to use the Torino 2006 environmental logo.. The three main sponsors that awarded the

logo were the following: IVECO, Kyocera and Mc Donald's.

HECTOR project for climate protection

Besides, the TOROC foundation has developed a project to assess the environmental climate of the area. The project was named HECTOR, which declared for 'Patrimonio Clima Torino. Their main objective was to raise public awareness of climate change issues and, in addition, to compensate for the number of greenhouse gases produced. In order to achieve these objectives, several financial investments were made mainly in energy efficiency or

renewable energy projects.
The work carried out is summarized in the following six phases:
1. Evaluation of total emissions to be managed;
2. A partnership project involving public institutions and private companies;
3. A funding of 3,000,000 euros from the Piedmont Region for the financing of renewable energy and sustainable projects;
4. Communication strategy to promote positive practices towards climate change;
5. Active monitoring of the HECTOR programme during all phases of the event;
6. A third-party certification to be implemented.

Assessment of energy provisionsystems

In the case of energy supply systems, the analysis could only be carried out preliminarily, basing on analytical calculations, possible scenarios among the main hypotheses.
The objective of the analysis is to compare the leading technical solutions for the electricity supply of the event, by relating environmental energy pre-expressions and the leading technology solutions.
In this case the methodology carried out takes into account the overall energy load of a production system, considering the sum of the energies required in each process considered in the analysis. Therefore, it was interesting to define the 'environmental load' of each solution, thanks to a set of indicators that would detect the criteria able to describe the environmental quality of the service. It was, therefore, possible to define three main 'energy loads':
- Direct energy, i.e. the energy used directly in the production process;
- Indirect energy, the energy needed for the production and transport of in-situ materials, which will then be used in manufacturing;
- Feedstock energy, the energy already contained within the raw materials and can be considered as a 'recoverable' share in the outputs of a material dismantling process.

The decomposition into these three types could therefore distinguish not only the energy used to satisfy a necessity of satisfying for electricity provision or the process energy requirements but could also consider the 'primary energy' coming for the most part from fossil fuels present in the earth's crust.
From this analysis, therefore, we arrive at the definition of an 'energy mix' carried by the comparison with the energy needs of the National production. Therefore, in order to achieve the result, it has been analyzed the combination of primary fuels that a nation uses for the production of electricity.
From the results obtained, it was possible to identify possible effects on

the environment, determining measurable effects in the immediate neighborhood, or whether these should be considered on a planetary scale. For this reason, three 'scales of action' have been defined:
- Global effects;
- Regional effects;
- Local effects.

As we mentioned earlier, this analysis also made use of the leading indicators for verifying the environmental quality deriving from the various possible solutions. In this regard, the two main objectives in the development of these are:
- The quantification of the depletion of natural resources
- The impacts that the substances released into the environment according to the different 'scales of action'.

Consequently, the analysis could lead to three different reference scenarios:
- Connection to the National Grid;
- In-situ production of electricity using diesel generators;
- In-situ production of electricity using natural gas generators.

FUNCTION	MATERIAL	QUANTITY (KG/ CONNECTION)
Conductor	Copper	58.800
Insulation	Polyethylene	4.200
Filling	Calcium carbonate	12.60010
Sheath	PVC	8.400
TOTAL		84.400

Table 2
Characteristics of connecting cables
Adapted by Giordano R, Revellino P, 2006

Definition of energy requirements

The preliminary design of the energy requirement has foreseen a request of 3 Megawatts for each site, assuming a period of activity of 2 effective months, with about 1440 hours of operation, corresponding to an average of about 4'300 MWh. From the results obtained, it was possible to deduce the availability of 1kWh of electricity.
Moreover, in comparison to the electricity demand, there is also the heating demand of the temporary works, corresponding to about 400,000 m^3 of buildings; besides, the heating energy estimated corresponded to about 15,060,000 MJ for the two months assumed.
For the above estimate hypotheses there have also been evaluated the following climate conditions:
- Outside temperature: -10 °C;
- Whole temperature: +10 °C;
- Air exchange: 1 complete per hour.

First scenario: national grid

Analyzing the different scenarios, in the case of electricity production, the vectoring of the energy using underground cable was also required, with consequent excavation works necessary for the burial. The assumed requirement was 1kWh supplied by the Italian energy mix.

Moreover, for the total excavation activity, 40,000 MJ of energy required are assumed. The environmental loads were then examined based on the two months of activity assumed, dividing the quantities by the total hypothetical total energy consumed, i.e., 4,300 MWh.

Second scenario: fuel generator.

In the case of the second scenario, with diesel generators, 800 kW supply units are hypothesised, with technical characteristics explained in the following table:
In this case, the supply is thought to come from 20t tankers, for a route of 70km fully loaded on the outward journey, and empty on the return journey. The expected fuel consumption is 9MJ/kWh.
Finally, the air emissions from diesel combustion have been calculated according to DIN 51606S. There have been assumed three types of exhaust gas treatment, using particulate traps and a three ways catalytic converter, assuming the following specifics:
- NO + CO -> ½ N2 + CO2 12;
- 80% efficiency of the catalytic converter filter;
- Performance of particulate traps: 60%.

In the calculation, the production of the steel necessary for the realization of the groups was also included, estimating 9 grams of steel per kWh produced.

Third scenario: Bio-fuel generator.

The last hypothesized scenario concerns natural gas generators. In this case, the technical characteristics are described as follows:. Assuming the same supply of the previous scenario, it is also assumed that fuel consumption is 11MJ/kWh; however, greenhouse gas emissions are much lower than in the previous scenario, also assuming no treatment for exhaust fumes. The production of SO2 is also considered to be zero.
A thermal recovery plant from the combustion of the generators has also been designed. In this case, the recovery index from cogeneration between electricity and thermal energy is 1.2-1.4; this means that the value is slightly higher than electricity.
On the basis of the preliminary study, partial heat recovery has been thought, only of the cooling water and not of the exhaust fumes. This choice proposes a recovery of 30% of the thermal energy. Also, according

MODEL	OUTPUT POWER [KW]	ELECTRICAL EFFICIENCY [%]	WEIGHT (KG)	CONSUMPTION [L/H]	NOISE LEVEL DBA [7M]
Spark manchester 8.p	800	40	9.400	221	60-65

Table 4
Pirincpali characteristics of the diesel generator considered in the second scenario
Adapted by Giordano R, Revellino P, 2006

to the TOROC commission, the temporary works foresee to require an electric power of 70 MW which, in case it would come from generated by the proposed generators, it would be allowed to think that it is satisfactory for the heating of the volumes.
Thanks to this choice, the possible energy efficiency derived from not using combustion boilers for heating was also analyzed may obtain an energy saving of about 4 MJ of total fuel.

Thanks to the use of LCA analysis, it was thus possible to identify the different energies required in the various scenarios listed above, indicating the different types of characteristics that can best meet the demand for sustainable intent of the project. The indicators used, which are internationally recognized (they refer to the 1999 MSR document published by the Swedish Environmental Council for the purposes of the Environmental Product Declaration), make it possible to convert an emission of any type into an equivalent emission of the substance used to measure its impact. The main substances present have therefore been converted in two ways:
- **CO2e**, those that can contribute to the greenhouse effect
- **SO2eq** those that contribute to acidification phenomena.

The results can thus be expressed in the following table:
Thanks to the comparisons shown, it is already possible to deduce that the installation of temporary generating sets allows a particular advantage in terms of polluting emissions, especially in those cases where it is intended to proceed with a heating recovery system for temporary structures.
On the basis of the scenarios analyzed, it is also possible to understand that fueled gas treatment systems make it possible to reduce particulate emissions, but at the expense of the global impact, since the reduction of nitrogen, at the same time as CO oxidation, leads to an increase in carbon dioxide emissions, causing a significant increase in the greenhouse effect. Therefore, the global effects are worsened, although favoring local effects.
However, analyzing the case of introduction of alternative fuels such as biodiesel and white diesel, it is estimated that emissions could be much lower.

MODEL	OUTPUT POWER (KW)	ELECTRICAL EFFICIENCY (%)	WEIGHT (KG)	CONSUMPTION [L/H]	NOISE LEVEL DBA (7M)
Spark Dover 8.n	768	40	12.000	239	60-65

Table 5
Pirincpali characteristics of the biodiesel generator considered in the thirdscenario
Adapted by Giordano R, Revellino P, 2006

Besides, it would be necessary to include the production of the gas itself in the LCA analysis.
The analysis was based on the use of vegetable diesel fuel which is not commonly used for the commissioning of this type of generator, instead favouring a mixture of fuel with diesel. Furthermore, it must also be taken into account that the production of vegetable oil also favors absorption of CO2 by the plant that produces the raw material.
Therefore, it is concluded that the LCA studies could finalize their intent on two main types:
- The production of a wood or biomass product is associated with a 'credit' of CO2 obtained from the amount absorbed by the atmosphere during the growth of the material,
- emissions from a biological source are not taken into account when calculating the contribution of the potential greenhouse effect
Although the results may be different, the conclusions that converge are the same in the analysis of "from cradle to grave" material. In the approach analyzed, the first approach has been taken into consideration, thus favoring a CO2 emission result, assuming that it releases a quantity equal to the quantity absorbed during the production phase of the raw material. Therefore, it follows that biofuel has a much lower value which, together with the use of heat recovery, becomes a 'negative' component, considering itself as the 'avoided greenhouse effect'.

SCENARIOS	TOTAL ENERGY DEMAND	GLOBAL SCALE EFFECTS	REGIONAL SCALE EFFECTS	LOCAL SCALE EFFECTS
	(MJ/KWH)	POTENTIAL GREENHOUSE EFFECT ($G\ CO_2$ EQ./ KWH)	POTENTIAL ACIDIFICATION ($G\ SO_2$ EQ./ KWH)	
Connection to the power grid	12,3	670	14	Excavation works No acoustic pollution
Diesel fuel generators	10,1	770	4	Sound emissions (60-65 dBA) Emissions on site of which particulate matter: 460g/kWh
Gas oil generators with heat recovery	5,9	500	0,6	Sound emissions (60-65 dBA) Emissions on site of which particulate matter: 460g/kWh
Gas oil generators with exhaust fumes treatment	10,1	1297	3	Sound emissions (60-65 dBA) Emissions on site of which particulate matter: 460g/kWh
Gasoil generators with heat recovery tfs	5,9	1020	Negligible	Sound emissions (60-65 dBA) Emissions on site of which particulate matter: 280g/kWh
Natural gas generators	11,6	660	0,8	Sound emissions (60-65 dBA) Emissions on site of which particulate matter: 280g/kWh
Natural gas generators with thermal recovery	11,6	660	0,8	Sound emissions (60-65 dBA) Emissions on site of which particulate matter: 280g/kWh

Table 6
Summary of results for the scenarios considered
Adapted by Giordano R, Revellino P, 2006

10. EXPO 2015 MILAN

Universal Expositions are the largest among global events. They have started beginning in the first half of the 19th century, and then they have always been growing representing a showcase of innovations and inspiration to the populations. These events represent a crucial platform for showing and sharing new ideas, besides a contribution to progress and development. Based on a set of criteria for the classification of events,[1] the Milan World Expo 2015 is a mega-event due to its number of visitors (22 million tickets sold), cost (6 billion Euros) and capital investment (14-18 billion Euros)[2].

The Expositions are managed by the winner candidate country that is accompanied by the participation of many other countries around the world.

Milan's bid for hosting the event set up in 2006. In that period, the Italian government officially put the City of Milan as the primary candidate for hosting the Universal Exposition. To corroborate the choice, the Italian government made a formal proposal to the Bureau International des Exposition (BIE), that is the body in charge for regulation and bidding the process, but also for selecting the winning committee. Then, in 2007, the proposal has been officialized in a Candidacy Dossier, with an annex describing the approach to the City to plan, organization and management of the possible event. Therefore, in March 2008, the Member Countries of the BIE met in Paris for declaring the final chose of Milan as the venue for the Universal Exposition of 2015.

The theme chosen of the event was: ***Feeding the Planet, Energy for Life***. According to, La Tegola Et al 2014, The pavilions of Expo 2015 in Milan, are a privileged observatory about the concept of sustainable construction in all languages of the world.

The main objective of the event was focusing the attention both on the importance of giving nutrition to human populations while understanding how of feeding the planet too; therefore, the idea was to highlight how these two concepts were deeply connected.
The challenge of this event was to define how the humankind can simultaneously feed itself and the planet too, by following a multidisciplinary approach that comprehends environmental, historical, socio-cultural, anthropological, scientific, economic levels.

The choice of a theme that is particularly connected with the protection of the planet has made the 2015 Expo a theatre of innovation for sustainability as well. This interest is also visible in the first documents that come to support the possibility of realization of the event. The first publication is a feasibility study, assessing potential impacts on the local territory and their implications in terms of sustainability.
This study can be divided into three levels of analysis:[3]

expressing the scope of the Exposition: the grass-roots idea was that the several different activities in the Exposition were addressed to the three distinct and interrelated categories:
- All the processes that involved environmental influence (such as air, water, soil, wastes) must be analyzed in their environmental impact;
- All the relations between the event, activities and processes must be monitored for a sustainable development
-That the context, the Expo related processes that may have an impact on the surrounding environment, must be analyzed, even if they are not necessarily directly attributable to the event organizers.

Analyzing the Life Cycle of the Event that enrolls the overall timeframe of the Exposition, starting from candidature, planning and design, management till closure and post-event. Thanks to the analysis, there have been represented the environmental, social and economic impacts for the entire timeline of the Exposition. The analysis also occurs both private and public actors with their specific implications; for these reasons, there have been developed 'tailormade' tools for integrating the principles of sustainability in all the phases.

Analyzing the interaction between the event and the environment; thanks to an OECD's Pressure-State-Response Model. The analysis occurs in the territorial urban context that will be affected by the event and the activities directly associated. The scope of the analysis is to present the influence that the event would have not only in its hosting territory but also into a much broader area, including the City of Milan, near towns and extending outward to the hosting region of Lombardy. The model encompasses the environmental characteristics of the territory, such as air soil and surface, water, physical agents, wastes and energy. The objective was to set a baseline for verifying the environmental compatibility of the event without comprising the hosting territory.

These preliminary analyses led to the identification of the 'sustainability management' approaches, accounted both on a mandatory and voluntary process, that must be applied during the managing and planning phases. These approaches are synthesized in two main categories:
- A Strategic Environmental Assessment (SEA)
- Sustainable Management Tools, including the activities for capabilities development on the site activities and of those for providing the services, such as the supply of materials and services, catering services, mobility, merchandising.
Also, the organization provided a Candidacy Dossier with the following instruments for a correct sustainable development; The Dossier included

Fig. 1
An axonometric view of the Expo 2015 Masterplan
© Stefano Boeri Studio, 2009

3 Iraldo et al., 2012

several sustainability aspects:

- **A charter of Values**, that reports the primary policy guidance tool for inspiring the entire life cycle of the event
- **An Environmental Management System,** for developing a 'systemic view' that will be able to achieve the best possible environmental performances. The first key point of this work was the maximum reduction of the carbon footprint, with several strategies that used as less CO2 emissions as possible while offsetting carbon emissions related to the organization; in particular, a great example of these scopes has been given by the usage of local projects of requalification, or through the purchase of credits on the international voluntary market. Moreover, for reducing waste production, there has been developed a cycle of production separate waste collection system able to recover and recycle the most significant amount of waste possible.
- **The adoption of tools** for supporting and guiding participants in the prevention, reduction and management of their remarkable environmental impacts; there has been developed two separate areas of the Dossier were identified in the Dossier, including:

- A procurement System; for the adoption of a detailed procurement system from contracting out the necessary works, as well-aimed to supply the significant quantity of good, material and services that are needed for the whole event.

- A Guide for self-Design, Construction and Management of the spaces, pavilions facilities.

- A sustainability report; for communicating to the stakeholders, the efforts and results brought for achieving the environmental, social and economic sustainable development.

After that the Dossier was completed in 2006, the second report in 2010 presented was set up, with the scope of organizing, creating and running the event, including all the sustainability measures and tools that were previously described. In the following paragraphs, we will analyze these sustainable developments has taken into accounts.

Methodology

The methodology policies chosen for the elaboration of the Sustainability Report is the Guidelines for Sustainability Reporting of the Global Reporting Initiative, the so-called GRI-G4, with also the integration of the GRI Event Organizer Sector Supplement, elaborated after the 2012 London Olympics.

When we focus on the GRI-G4 model, we can understand that a great importance has given to most significant aspects for each/activity process could be involved to be considered as sustainable during all the phases of the life-cycle. According to Iraldo et al, 2014, the Milan Exposition foundation has provided common has presented several key points:

- the brief evolving life that usually characterizes a mega-event organizing entity;
- the tendency to improperly attributing the responsibility of the complete amount of activities related to the wide-scale event affecting the hosting territory.

From the experiences made by the previous large-scale events, the organization considered only one paper not enough. Therefore, they divided the sustainable processes into different works, according to their analysis timeframe. The first sustainability report was released in January 2014: it included all the preliminary activities from a formal constitution of the project, started in the first half of 2013. The second edition was published in January 2015 and accounted for the report of the activities developed between June 2013 and June 2014.

Lastly, the third edition was published after the end of the event, for assessing all the result data of the event.
Each report provided the economic, social and environmental impacts of a specific exhibition semester and provided for the first time in the Expos' history 'a benchmark of performance indicators for future organizers, starting from the next Dubai's World Expo in 2020' (iraldo et al...). Each report was carried out by following the sequent key-points:
1. Preliminary identifications of the scopes or the reporting covered, including economic, social and environmental performances;
2. A series of interviews with the departments enrolled in the Expo 2015 organization, aimed to verify the availability of the necessary data, information and indicators;
3. Stakeholders' mapping, with the objective of identifying the specific needs and expectations of each company;
4. Collection and processing of data and information;
5. Results of the document.

According to the main focus of our thesis, in the next paragraphs, we will analyze the significant intents and results of the environmental and energy reports taken into account by the Expo Organization.

Environmental aspects of the event sustainability

The main focus of the systemic approach made by the Expo organization for managing the environmental aspects of the event has been applied with the adoption of two primary references:
- The International Standard ISO 20121:2012;
- Several requirements from the European Regulation n.1221/2009/EC (EMAS).

The main reasons that led the organization to the choice of these two references have made by the peculiarity of the event and, indeed, for guaranteeing an efficient Sustainable Management System; moreover, the inspiration made by several events, such as Turin 2006, made a critical role for the choice of the significant guidelines.
For verifying the accomplice of the guidelines brought by the ISO 20121, a third-party verifier organization was carried out for the process. In mid-2014, the organizational management succeeded the verification, by relating to the Expo the first Universal Exposition that obtained the ISO 20121 certification for planning and implementation phase of the Exposition; at the same time, the practical efficiency of the event would be regarded during the period of activity of the event. Moreover, many of the sustainable approaches of the event would have been carried out during the course of the event; therefore, it implies that the auditors will check if the participants are complying the guidance and indications foreseen.
In addition, the Expo organization realized a series of guidelines to communicate their efforts to the participants, including:
- Sustainable criteria for the realization of Self Built Pavillions, suggesting how to reuse the dismantled pavillions once that event is closed;
- A Green Procurement, aimed to support the participants to the usage of adequate and effective criteria with procurements of needs useful for their participation to the Expo 2015.

This work brings five different key-points for reducing the environmental footprint in the whole life cycle, including food and beverage and catering activities, furniture, merchandising and packaging. The same guidelines have been used by the internal Expo organization for organizing its own activities. Moreover, this document concretizes a step forward the sustainable development: it enrolls all the participants, including countries, companies and organizations, in the commitments of sustainability. However, the Expo organization did not force any of the companies to the implementation and, therefore, they are still presented as voluntary tools.

Fig. 2
Presure - State - Response analisys of the Expo 2015
© adpted by Iraldo et al, 2015

Environmental monitoring plan

It has also been fundamental the realization of the Environmental Monitoring Plan (EMP), achieving the scope of a 'life-cycle' analysis. The work aims to monitor the whole event by dividing it into four different phases:

- ***Ante-operam,*** from 2011 till 2012;
- ***Worksite phase***, covering the period from 2013 to April 2015;
- ***Event phase***, including the period from May-October 2015;
- ***Dismantling phase,*** for the periods from November 2015 till approximately October 2016.

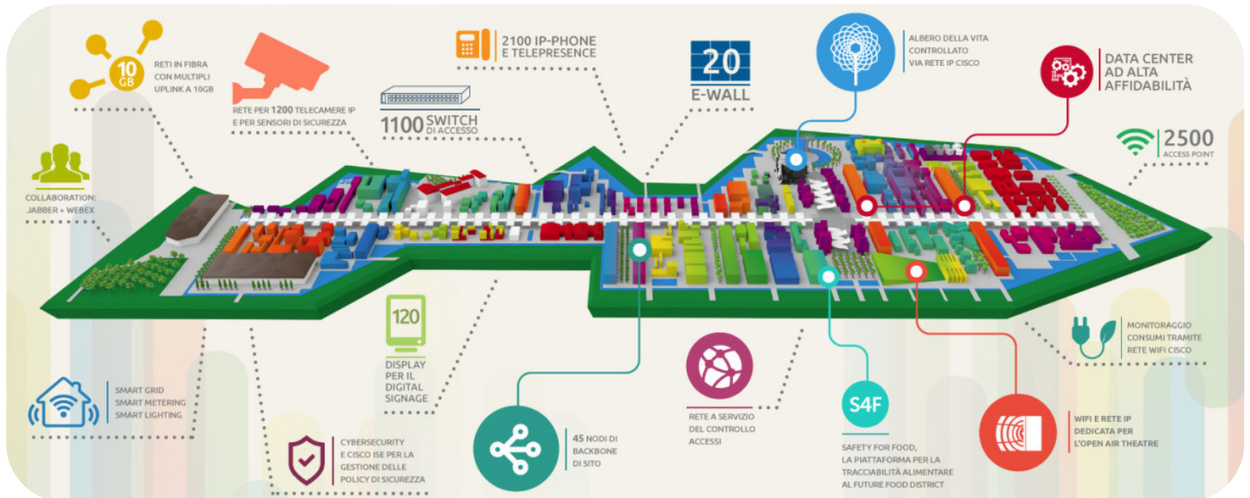
From a spatial point of view, this plan is referring both to the hosting site of the Expo and its surrounding areas; in these territories, the main environmental consequences are expected to take place, especially for the most sensitive receptors of the area.

In the first work, the ***ante-operam*** phase, is included in the first version of the sustainability report, while the second report included the results of the still going-on construction phases.

The primary intents of third-party organizations and other countries enrolled in sustainable development take place also in the Expo Sustainability report and, more in general, all the participants relating to solidarity, food security, research, and more. However, the primary intent set up by the companies has been defined as the scope of leaving a positive legacy on the Expo Milan 2015; this intent is defined the Sustainability Knowledge Programme, and it asked to the commitments to share ideas, dialogues and best practices for collaborating to the sustainable development.

Energy provisions of the event

The organization has actively promoted energy-efficient solutions, starting from the exhibition site in terms of both electricity and heat provision. The main avenue is composed of a roof specially designed to ensure natural ventilation, favorably decreasing the cost of electricity for cooling. Moreover, in the six months of opening, 47 GWh of electricity were consumed, with a decrease of -55% compared to the estimates during the environmental impact study. The supplies have been chosen entirely from renewable sources certified at the origin, also using innovative technologies that minimize energy efficiency. In this way, the outdoor lighting has been delivered by LED outdoor lighting fixtures with high energy efficiency. The development of a smart-city interconnected in every nerve point of energy provision has also been favored, promoting savings of up to 90 thousand MWh of fossil energy, 21 thousand tons of CO2, 36 tons of nitrogen oxides, 62 tons of sulfur dioxide, over 5,000 kg of particulate matter, including over 4000 kg of fine particulate matter.



EXPO Environmental Management System

Thanks to a partnership between Siemens and e-Distribution, it was possible to think of Expo 2015 as an experimental project of Smart-City realized entirely from scratch, with a new system of technologies that are the basis of the development of Smart-Grid.

The objectives set with this project are those of:

- Stability of supply and grid resilience
- Energy demand and grid capacity real-time balancing
- Monitor, control and optimized energy management inside Expo Area
- Energy consumption optimization and CO2 reduction
- Real test of new Smart City technology

Within the project, renewable energy generation facilities have been installed, and in order to maximize efficiency and minimize pollutant emissions, all systems have been brought back to a single power supply management system. Therefore, a cloud-based Environmental Management System has been realized, able to offer real-time monitoring and management services in software as service model. This system has been named Monet.

The software manages comfort, lighting, meters, loads, electrochemical generation and storage, offering site and object management services, asset management, energy monitoring and reporting, energy efficiency and demand response.

Fig. 5 (center) The smart-city map for EXPO 2015
© 2015, Expo Milan

Fig. 4 (right) screenshot of the Web Application of the Expo EMS
© 2015, Cisco

The system manages ten interconnected rings which allow a complete refeeding of failure:

Fig. scheme of interconnection of the smart-grid

In the EMS are present:

- SmartMeter and Meter Data Management systems;
- SCADA (Supervisory Control And Data Acquisition) for the supervision and control of the electrical distribution network;
- SCADA for the supervision and control of consumption and generation within Micro Grid.

Fig. (a) complete structure of the EMS devices. (b) main sequential functioning of the EMS

Therefore, cabins have been installed inside the venue that provides real-time control and measurement to generate energy demand data. This data is then communicated via protocols in the field and then sent to the cloud. The cloud database was created as a non-relational database

called "Mongo DB" that acts as a system bus connects a series of logical packages into which are divided all the functions of supply, control, monitoring, maintenance.

Thanks to the use of a cloud platform, every pavillions energy manager can access a Web Apps of "EMS Operations Center" and "EMS Mobile": the first one is dedicated to the overall supervision from the computer, android or ios devices, the second one can monitor and control the equipment related to their site. In addition to the energy managers of each pavilion, also Siemens, e-distribution and Expo staff can access the portal, each one, with different degrees of total energy visualization superiority.

Providing the power for the Pavillions throught the smart grid

The provision of energy at the national majority level is entrusted to the company Enel Distribuzione. Similarly, this Council lead partner was chosen to finish the installation. A large part of this project is focused on the realisation of a smart city prototype concept. The provision of efficient food will thus switch to efficient and sustainable energy to produce urban environments. Enel will thus supply energy from[4]:

- *75 megawatts of installed capacity*
- *1 million kilowatt-hours of daily power consumption*
- *100 medium-voltage substations to provide power to pavilions*
- *100 EV charging stations*
- *8,500 Archilede LED lights for the exhibition area (which will reduce energy use by about 36%)*

Hence, the network will be provided with an energy storage system to complete the smart grid. This system, therefore, provided a closed-loop medium voltage.

4 Smart Cities Council, 2015

Fig. 7
The EXPO comman centre
© 2015, il Corriere Della Sera

The system was also able to isolate faults and recognise optimal operation on the whole line, isolate individual elements in case of malfunctions. As mentioned above, each hall had its own EMS, remote control and protection system provided by Enel. All of this was controlled from the exhibition control centre and, on-site, represented inside the Enel pavilion.

City command control centre (EC3)

Thanks to an agreement between the Municipality of Milan and Expo 2015, it has been possible to devise a logistical and technical location for the control centre for the security, prevention and management of the entire Expo 2015 smart city. The chosen location is outside the Expo territory, situated 800 metres from the exhibition as the crow flies. From there, it is possible to identify the entire flow of people, vehicles and goods passing through the exhibition 24 hours a day. In addition to the logistics section of the network, the command centre also houses all the police forces' management services, public utilities, fire brigade, 118, transport companies, and direct connections with all the operations centres outside and inside the event. The control centre was made operational by 700 field staff for troubleshooting in progress. In addition to Enel Energia, the companies Siemens Accenture, Samsung, Ericson, Selexes for the smart grid logistics, Cisco for the network supervision, and Telecom Italia Mobile (TIM), to provide the telephone internet communication network, all cooperated to make the smart city usable. The TIM organisation provided the network connection via 300 km of fibre optics, 18 4G antennas and 450 servers.[5]

On the other hand, Cisco provided the wifi connections, Ericson for the mobile network, and Samsung the interactive screens for each pavilion. The conception of this smart city was a pivotal element in the efficiency of the event and the implementation of an experiment of the city of the future. Approximately 2,500 alerts per month were recorded, which were traced by 6,0006. elements connected to the smart grid, allowing immediate dispatching of the staff to correct the malfunction in a much shorter time than an analogue analysis of the problem.

The focus on sustainability was thus also entirely placed outside the event perimeter. Everything was powered by photovoltaic energy, thus providing

5 Confcommercio Milano, 2013
6 Pennisi, 2015

power for 27 monitors, 40 interconnected computers and 40 solar modules with a power output of 9 kWp.
The universal Exposition has been an event that was interested both by the stakeholder's context and by the international framework, for adopting specific instruments and measures with the objective of a long-term positive outcome for the host city and the territory.
In these paragraphs, we have seen the main tools that interested the sustainable development in terms of social and environmental sustainability, although its organization also provided several instruments for the economic aspects.
Moreover, the Expo Milan 2015 is the first Universal Exposition that assumes the main scope of researching and practicing innovative solutions for sustainable development into events. Also, as we have mentioned in the Turin 2006 analysis, the Charter of Intents, the Footprint calculation, the Sustainable Management system and the Green Procurement of needs represent a valid statement of the commitments that the event carried out for itself and for the third-party organization.
Furthermore, the release of many sustainability reports is one of the key points to measure and analyze the position to the society, and either to communicate the intents to the stakeholders. Therefore, also according to the analysis made by Iraldo et al, we would like to delineate the main aspects that a Mass-event must take place for its innovative and efficient sustainable development.

1. Long term strategy and policy vision.

From this point of view, a sustainable legacy must be intentionally planned by the organization. Moreover, its intents must be part of the missions and must be included in the main aims of the event. This process allows the management to take the legacy in strong consideration for the possible effects of the event. Thus, the work must be able to define the environmental impacts before that event takes place and continuing analyzing until the post-event life dismantling process. From these values, an example is the action of self-building the constructures with the same participant of the event. In this method, it is empathized the value of the materials and components as a secondary raw material for new buildings and constructions.

2. Full and effective integration

the event sustainable planning and organization into the "ordinary" governance instruments and local environmental policies.
Secondly, there must be the assurance that the government and the local administration in which the event takes place should be able to adopt the sustainability legacies. In this case, environmental policies have a dominant role. The influence of government policies may influence the good results of environmental sustainability. In this case, Expo Milan 2015 actively collaborated with the Municipality, and the Lombardy Region thus all the institutions involved. Only when there is this strong cooperation between the different governal and non-governal administrations, future planning can take place. Otherwise, when there is a lack of communication or collaboration, there can be a critical aspect that involves the whole succeeding of the project. In this case, many sustainability intents are taken in place by the Expo Organization – such as sustainable reporting, green procurement, environmental management system, etc. -, were primarily undertaken by the Milan Municipality and the other administration that were involved. For example, the Green Procurement was not diffused in all these institutions.

3. Stakeholder involvement and active participation.

In order to create a relevant, sustainable development, many different stakeholders are taken in action for the same missions. Sustainability is, therefore, a collective effort, and the cooperation between all the parties plays a successful role. The inclusion of the stakeholders in the decisional process is, therefore, a relevant aspect of sustainable development. However, there must be said that the stakeholder involvement must be significant: the organization is asking for a responsible governance framework and realizing the practical cooperation between the several interests of all of them. It is useful the parallelism between the same lesson learnt by the Expo Milan 2015 and the Turin 2006 Olympics Games where they both provided as a high priority the stakeholder engagement. Even if many attempts were made by the organizations, there has not been seen as a relevant engagement by the third-party stakeholders. The main consequences are related to the movements that do not desire the event to take in the place, whereas, in these lacks of commitments, they find great examples of carrying on the 'no-event' protests.

4. Create competence and awareness in key-people.

Also, it is fundamental to relate the planning with the people responsible for designing, planning, developing and implementing the measures foreseen by the organizer's mission. As Iraldo mentions, The legacy "walks" (i.e.: is transmitted) mostly "on the legs of human beings". Therefore, the involvement of the personnel is firmly committed by the communication the key-people that undertakes the situations. In this case, many past-events give us an example of this lack of communication as one of the weakest points for really adopting the measures foreseen to succeed the sustainable performances while transferring the key-message of the intents.

5. Monitoring the performances in the different phases of the event

Even this aspect may be considered as crucial, both for a 'fine-tuning' point of view and for long-lasting proofs of the sustainable processes undertaken.
Carrying out monitoring activities plays a relevant role for determining the future social, environmental and economic benefits firstly and then, during the event, for monitoring the results in the output. The adoption of a monitoring process must not be only related to the event organizers, but must be taken in place into all the different commitments of the event, with local institutions as well. In this case, the presentation of a Sustainability report is acting a 'surveillance' player for reporting the activities of the long-lasting, sustainable process.

6. Involving Participants in the sustainability actions and consider them as ambassadors.

Lastly, involving the participants means to enrol the audience in the sustainable process. Therefore, the realization of the intent is not only delegated to 'planning and organization', but enlarges its boundaries to all the attendees of the event, representing them as one of the dominant role of the final success. The promotion os sustainability into this event is an excellent opportunity for offering the people a new mindset for raising awareness and offering the benefits of more ecological products and actions while encouraging them into making responsible decisions with long-term effects.
This last condition is the primary intent of the Expo Milan 2015, and one of the most critical initiatives. The introduction of new behaviour in the procurement process, showcasing the most innovative technological sustainable developments have shown the attendees the best practices to take for future worldwide benefits.

11. CASE STUDIES OF MUSIC FESTIVALS

Glastonbury Festival of Contemporary Performing Arts

LOCATION:	Pilton, Somerset, England.
SIZE	major event.
VENUE SIZE	up to 3,70 km^2
ATTENDEES	more than 200'000.
TYPOLOGY	theatre and music festival.
ACTIVITY:	Five days in June.
NUMBER OF STAGES	6

Glastonbury festival is a festival that has been running since 1970. It is defined as one of the largest greenfield music and performing arts festival in the world. In addition to contemporary music, the festival hosts dance, comedy, theatre, circus, cabaret, and other arts. Most of the staff is made up of volunteers so that the necessary funds can be obtained to donate a large amount of money to charity organizations.

Sustainable ideas

A permanent renewable system on the sites: large solar arrays that are being used during the festival is running, and when it is concluded, the energy is fed back in the national grid all year round, providing a Feed-In Tariffs for the festival organization. In this case, profitable costs are returned. In the Green Fields coordinators camp they have used a 1.5 kW solar unit with 22 kWh of battery storage to run the area without problems.

They were not able to take off the total use of generators. However, during each edition starting from 2014, the energy output is checked for analyzing the efficiency of each generator through (126 in total), using the Aggreko Remote Monitoring system (ARM), and then quantifying the correct sized generator for the next festivals and saving purposes. Thanks to this research, the organization was able to understand that the chosen generators were definitively oversized.

The festival also uses a peak loads control method defined as power stations, that is useful for creating power zones in some areas of the site; these stations are a grouped set of generators that are turned on as power demand goes up and then are turned off at times of low demand.

The festival also uses hybrid systems that switch automatically off the main generator when demand drops. The most important use of this equipment was used in areas with a suitable load profile: places where a specific activity was well defined for a certain period of time such as parking areas, build break operation and vehicle gates. In this case, the installation of hybrid battery units has radically changed the use of the generators: first, they were continually working for the whole 24 hours producing shallow energy such as 1-4 hour; then after the installation of the hybrid units, the generator has a whole runtime of 2-4 hours for producing the same amount of energy. This energy was then distributed from the hybrid unit's battery storage over the course of the day, leading to a much higher kWh per hour of generator runtime - up to 130 kWh per hour.

Festival Republic organization

Festival Republic is a promoter and organizer of music festivals for eight major international festivals: Download, Community, Wireless, Latitude, Leeds, Electric Picnic, Big Chill, Reading and RiZe. Since 2011, the organization has been interested in delivering its festival, minimizing their carbon footprint. Thanks to the help of a sustainability coordinator, they can connect their team with contractors and suppliers aiming to focus on sustainability issues and developing innovative solutions. They also implement an onsite system in which the audience can participate in, providing the opportunity for encouraging positive behaviour change. They also signed the Festival vision 2025 petition, aiming to reduce carbon emissions to 50% by 2025 (following the Paris Agreement).
They also take part in Julies Bicycle's Green Certification, awarding four to five stars at their festival Latitude, Download, Reading, Leeds Electric picnic and the BBC Hyde Park event.
Their sustainability development can be defined in the following results
- avoiding Single-use plastic
- waste production with material recovery: their previously mentioned festivals were zero waste to landfill events
- travel, heavily encouraging sustainable optsuch as coaches and trains
- Water consumptions
- Food quality
- Energy aiming to reduce the 15% of total fuel of the generator to be waste vegetable oils bio-diesel and hybrid generators on Latitude, Reading and Leeds, the organization has introduced the usage of biodiesel generator and hybrid system and solar powers. The first trial was given in latitude, where one of the power contractors has invested in a number of these batteries tailored to their technical needs to add to their own fleet, showing that Festival Republic's dedication is indirectly supporting fuel efficiency in the broader events industry.

The organization has also provided many partnerships with sustainable organizations such as Green Peace, Julie's Bicycle Energy revolution, Powerful Thinking and Festival Vision 2025.
The analysis of Julie's bicycle report has made us understand how the organization has been able to move to reduce the major points of sustainable criticality. Hence, the significant sources of carbon emissions derive in order from travel and energy. What is interesting is to compare the energy compared to fig. 1, where it is understandable that energy is the carrier of 87% of the emissions within the festival, but at the same time, it is only 20% if we also analyze emissions from travels.
Therefore, among the future objectives of the organization to reduce emissions for the energy component include:
- switching to 100% renewable sources for National republic onsite offices
- the possibility of installing mains supply cabinets that would allow them to connect to the national grid and supply clean energy at the festival.
- monitoring an individual trader's energy use to trial a pay per use system and engage them on improving energy efficiency
- Continue to engage with the biofuel industry ensuring that the Festival Republic make the case to potential biofuel providers for tracing their supply to the farm level and establishing public grievance systems.
- Continue to engage with the biofuel industry ensuring that the Festival Republic make the case to potential biofuel providers

FESTIVAL	CAPACITY	AUDIENCE DAYS	FOOTPRINT EXCL. AUDIENCE TRAVEL (TONNES CO^2E)	TOTAL FOOTPRINT (TONNES CO2E)	TOTAL FOOTPRINT (KG CO2E PER AUDIENCE DAY)
Electric Picnic	55,000	165,000	341	1,022	6
Reading	99,999	299,997	458	1,243	4
Leeds	89,999	269,997	502	2,637	10
Latitude	39,999	120,000	313	1,206	10
RiZe	30,000	60,000	121	164	3
Download	120,000	360,000	389	3,236	9
BBC Live in Hyde Park	48,000	86,000	106	213	2
All festivals	482.997	1,360,994	2,230	9,721	44

Melt Music Festival

The Melt festival is a pop electronic music festival based on the museum of large mid-20th-century industrial machinery which is located just outside. For environment climate protection, strategic measures began to be applied as early as 2010, while designing them to apply on the long term and to be developed step by step every year.
The process is based on selecting a project area and, collaborating with some sustainable initiatives such as the Green Music Initiative, they will work together for elaborating solutions to climate issues. In 2010, the focus was on the leading cause of greenhouse gases at festivals: the travel emissions. The focus was on the visitors' traffic to and from the festival.
Aiming to solve many energy issues, the Ferropolis open-air Museum - (which is the venue area) - acquired a solar plant that was installed on the roofs of buildings on the festival site. A total of 2901 m2 are covered with solar panels from Q-Cells, producing about 170,000 kW of electricity per year and can supply 50 households with electricity. The Melt! Festival consumes 73 000 kW of electricity in one weekend. Thanks to the installation of a 3000 m2 solar roof, , the whole festival can be powered entirely by renewable energy, also exporting the energy generated by the PV during the year in the national grid.
For providing another solution to the energy issues, they have also introduced a partnership with Electric Hotel, whereas the attendees will find a mobile charger land. This area is totally provided by renewable energy supplies: photovoltaic panels, wind turbines, bike-generator. Festival visitors can hand in their mobiles, which will be recharged for a small fee by using regenerative energy only; however, if festivalgoers choose to pedal themselves, their mobiles will be recharged for free.
Referring to the mobility issues, they have launched a specific train line that offers accommodation to the attendees, enabling a comfortable journey directly to the festival grounds. Already in the first year of launch, the train line was fully booked. The organization have also calculated that a festival visitor who takes the hotel train instead of a car halves the carbon footprint of their journey from 64 kg to only 31 kg. Further ideas for travel mobility have been created. They offer an advantage ticket for those who decide to get to the venue by public transport and have collected car-sharing offers.
For promoting environmental protection during the event, they have provided the M! Eco area inside the venue, where festival visitors will receive energy-saving tips and the free of charge and last "Rock and Roll Air-Guide", explaining how an individual can contribute to a climate-friendly festival.
Other sustainable approaches have been the introduction for a tax on waste, cooperation with local caterers for fewer pollutant foods offered and the collaboration with charity associations for the donation of leftover and usable food.

LOCATION:	Ferropolis open-air museum, Gräfenhainichen, Germany
SIZE	medium event.
VENUE SIZE	up to 2 km^2
ATTENDEES	up to 20'000.
TYPOLOGY	open-air music festival.
ACTIVITY:	three days in June.
NUMBER OF STAGES	1

Shambala festival

Typology: open-air festival
Activity: cotemporary performing arts and music, workshops, debates.
Number of main stages: 1
This organization is one of the most interested in sustainable development, as well as one of those that have achieved the greatest successes within the event to date. For achieving significant results, they have collaborated with over 20 partner associations for elaborating sustainable concepts. At the moment, the company is more than five times of carbon positive through renewable energy investments.
Over the last five years, Shambala has consistently reduced its fuel dependency by transitioning to renewables and improving efficiency.
The event is powered by 100% renewable energy divided into a mix of vegetable oil generators, photovoltaic panels and hybrid units. They also reduced the energy requirement by moving to energy-efficient equipment. In 2015, the set-up included 22 bio-diesel generators, the full range of Firefly's Cygnus Hybrid Power, 35 portable solar fold-arrays and ten power packs. All of the site lightings was LED, 12km of festoon lighting and 105 LED Floods; the tower lights were all HPG.
It is also built into their contract that fuel savings are expected year-on-year, with a fixed fee on biofuel costs to create an incentive for the contractor to reduce usage wherever possible.
In addition, the organization stipulates a detailed energy monitoring throughout the whole event, a generator-by-generator post-event report, and recommendations for future efficiency gains.

The event also reduced its energy-related GHG emissions per audience day by 39.5% between 2013 and 2014 and has reduced its overall onsite carbon footprint by 81% over five years.
In 2015, energy (including bottled gas for traders) accounted for 19.6% of the onsite carbon footprint and only 8.53% of the overall footprint when including travel.
Their commitment to the sustainable development of open-air music events is among the most important in the sector. The most successful issues determined by their sustainable development are:

- *carbon footprint reduction by over 80%*
- *as said before, 100% renewables;-*
- *avoided disposable plastics;*
- *Recycled 80% of recyclables matters;*
- *Introduced onsite recycling deposits and reusable cups*
- *Sustainable promotion areas inside the area*
- *Introduced majority compost loos across a site*
- *Implemented radical low-carbon travel plans*
- *started a charity association - Energy Revolution - for funding a forest in Africa.*

LOCATION:	Northampton, UK
SIZE	medium event.
VENUE SIZE	up to 2 km^2
ATTENDEES	more than 15'000
TYPOLOGY	open-air music festival.
ACTIVITY:	Five days in June.
NUMBER OF STAGES	1

Sunplugged Festival

The initiative was launched by the Finnish organisation Energy Company, to test the ability of solar energy to produce the energy needed to power a festival. The only forms of energy supply on site were solar power and kinetic energy. The initiative was promoted to implement global initiatives to combat global warming.
According to the organisation, they wanted to use this type of renewable energy both as an innovation factor within the events, but also to give a clear signal to the scepticism present in northern Europe in favour of photovoltaics, due to the prolonged periods of overcast skies during the winter seasons. The initiative was promoted together with energy supplier Väre. Together, the two organisations wanted to generate a twofold effect on spectators: firstly, raising awareness of sustainable energy, and secondly, helping the national emotionals psyche during periods of 'kaamos'. For this reason, as a second energy supply, it was decided to intervene with the kinetic energy generated by the bicycles pedalled on the event site by the participants themselves. Twenty bicycles were installed for the festival goers to use.
The idea, according to Prudition director Christopher Keravuori, was to raise awareness (if you can power a huge concert with solar panels, think what else you can do with it domestically!" he argued). For this reason, during the event, people were also given the opportunity to learn more about the possibilities of installing photovoltaic panels in their neighbourhood. The mission also embraced cooperation

LOCATION:	Helsinki FI
SIZE	Small event
VENUE SIZE	up to 1 km^2
ATTENDEES	more than 500
TYPOLOGY	open-air music festival.
ACTIVITY:	one day
NUMBER OF STAGES	1

with the required performers on stage, who were chosen according to the criteria of sustainability. As the production manager state, they needed to be popular, hip and be appealing to a big audience' but also to incorporate into their activities awareness of climate change and the unselfishness about these aspects.
At the end of the concert, it was found that a supply of 100KWh was generated, when the concert actually needed only 15 kWh.For this reason, according to the organisations aims, the next step is to find new ways to leverage alternative energy sources to power gigs and festivals; sensitising this issue, by being able to offer an example of an entire event completely powered by photovoltaics, allows us to show the capacity of a small-scale show to be ready to significantly reduce the polluting emissions generated by energy supply, in addition to the previously mentioned waste, design, and travel emissions.

LOCATION:	Indio, California
SIZE	medium event.
VENUE SIZE	up to 2,8 km^2
ATTENDEES	more than 250'000
TYPOLOGY	open-air music festival.
ACTIVITY:	Four days (2+2).
NUMBER OF STAGES	8

Coachella Valley Music and Arts Festival

This event is certainly one of the most characteristic as well as one of the longest-running in the history of festivals. The event is still one of the major events in the world, and one of the most important attractions during the spring festival.
.Their interest in sustainability moves across a wide spectrum of different initiatives for the social, economic and environmental improvement of the event. Undoubtedly, the plastic-free and water-saving approach was developed, but special attention was also given to workshops, low-carbon technologies, adopting the principles of the circular economy, donating all unwanted goods to local community partners and sharing best practices:

- *A carpool service was an initiative run with the Global Inheritance organisation. The long running programme ensured that individual travellers who chose to travel with four or more passengers in the car could win backstage passes, VIP upgrades, and even VIP tickets for life. Participation in the initiative was possible by attaching a Carpoolchella insignia on their vehicle. Shuttles programme, a mobility programme set up by the organisation to reserve a spot for attendants on a transport service for the eventThe campsite was promoted as an initiative to lower the carbon footprint by avoiding driving to and from the show every day.*

Many of our food vendors offer vegan dishes and 100% are required to provide a vegetarian option.

Speaking about water conservation, an initiative promoted for participants, called 10 for 1 Bottle Exchange, promised to give back to those who leave plastic and disposable items in recycling bins tickets to receive merch and food vouchers. Speaking about energy provision, Coachella proved to be a great park for experimenting with new and exciting technologies.
Firslty, the Energy FACTory DJ Mixer gives aspiranti DJs a chance to perform at Coachella, while recruiting 20+ people. These attendant must ride in in hamster wheels, ride energy swings, turn hand cranks, pedal bikes and rock the energy see-saw, to power each 40 minute set.
Moreover, in order to raise awareness of renewable forms of energy, a campaign called Energy Battle Royal was also launched, which With a full lineup of 14 energy sources - from Petroleum and Solar to Nuclear and Ethanol, to propose new forms of supply
In addition,. the Energy Playground was set up to raise awareness of the impact they can have on energy production. According to Global Inheritance, this installation "offers participants the opportunity to collaborate with others for the chance to play like a child again, all while powering mobile phones, arcades, music shows, snow cone machines, outdoor movies or other energy-driven activities".
A final interesting initiative offered visitors areas to explore different forms of renewable energy, with hands-on demonstrations, workshops, and installations explaining the energy provisions.It is called the Energy Factory, as it also shows how to make your own biodiesel.

Terraforma Festival

LOCATION:	Arese, Milan
SIZE	medium event.
VENUE SIZE	up to 0,4 km^2
ATTENDEES	more than 8'000
TYPOLOGY	open-air music festival.
ACTIVITY:	three
NUMBER OF STAGES	2

The event takes place in Italy, on the outskirts of Milan, in an unspoilt forest area. Its location reflects the greater intent of the organisers, focusing the event on the message that art and music can promote greater awareness of each individual's environmental impact. Thanks to the contribution of Etica SGR, the event aims to foster a sense of belonging, while experiencing a moment of regeneration: musical experimentation and environmental awareness become the protagonists of each edition of the festival.
The organisers propose to be a microcosm in which to set an example of sustainable measures, creating a direct contract for each participant The event therefore focuses on four areas: mobility, energy, waste, and environmental protection

Speaking about mobility, they created a model of sustainable mobility, involving travellers in the journey to the festival, starting from Milan. They promoted the use of electric vehicles, and with the collaboration of the guests, they encouraged the use of trains and shuttles to reach the event, by avoiding individual mobility. Already thanks to this first intention, the emission of 2300 kg of CO2 in the air during the 2019 edition was avoided.

As far as energy is concerned, the event is completely isolated from the national grid. a method of supplying it from within the festival was requested. For this reason, the community has been encouraged to keep electricity wastage low within the campsite. In addition, it is intended to experiment with renewable

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energy on the basis of the benefits that the area can offer as a source. For this reason, the organisation wants to bring the festival, by the edition of 2022, to power the entire camping area with renewable energy.

A proposito dei rifiuti, l'impegno con la collaborazione è stato fonamentale per reduce environmental impact. Single-use plastics have been abolished, and waste has been reduced by 35%. By giving up plastics, the organisation decides to opt for recyclable and biodegradable materials, promoting circular economy practices. In addition, 70 ecological islands have been set up in the park to separate waste. These methods were able to separate up to 84% of all the waste produced during the festival.

Environmental protection is proposed within the framework of initiatives, hosting, opportunities and building new professional skills. The idea is to bring the festival to a positive impact, for people and the environment as well. The idea is to bring about a positive impact, for people and the environment as well, and to extend the scale of sustainability to interactions outside the event area.

Among other sustainable commitments, the organisation is committed to protecting the land, with programmes of gardening though land recovery, gray water and extensive cleaning procedures. Attention is also paid to the individual participant, who is given a portable ashtray and organic sopa for minizing the indivual environmental impact.

Hence, Architecture features prominently within the sustainability project, and in this process Terraforma is one of the most unique cases. The stage design derives from a process of engaging the local community, involving young professional architects, to develop the facilities with mostly renewable materials. All materials are then included in a circular economy process that reduces waste and gives a second life to disused objects such as tables, benches, bins, sinks and showers.

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We love Green

This festival is defined as one of Europe's most sustainable music events and is also one of the pioneers of new forms of innovative renewable energy. Thanks to numerous partnerships with ECOSIA, Jane Goodall Institute, Eden Forestation projects, they have been able to plant more than 80,000 trees worldwide for restoring around 4,000 tonnes of CO2 of the festival emissions. They have also developed software available to all the festivalgoers and music acts that are bale calculate their carbon footprint caused by travelling to the festival, thus offsetting the emissions by financing ecosystem restoration projects with PURProjet.

They also applied the Green Events project named "Green Deal Circular Festivals", agreeing to strive for 2025 a 100% circular economy of the whole event.

The event is managed by 100% renewable resources, i.e: biofuel generators, photovoltaic panels and bike-generators

They are also pioneers of some innovative energy supplier technologies: they introduced a series of new kinetic energy playground toys as WhirlyGen roundabout, Teedlegen see-saw and LumberGens. These toy-generators are connected to software that shows, in real-time, how much energy is being generated. Furthermore, an innovative concept of flexible solar panels has been used for increasing the amount of solar energy powering one of the main stages.

LOCATION:	Paris, France
SIZE	Large event.
VENUE SIZE	up to 2 km^2
ATTENDEES	more than 15'000
TYPOLOGY	open-air music festival.
ACTIVITY:	3
NUMBER OF STAGES	1

Another great concept is the developing of a clean hydrogen-powered prototype generator identified using blockchain-enabled networks. The whole event is also supplied for 95% of the festival is fitted with energy-saving light bulbs / LED, including the stages, the food stands and even the set design features.

The main stage was powered by a solar-biodiesel hybrid system consisting of a synchronized pair of 180 kVA biodiesel generators linked to a 120 kVA HPG system and a 30 folding solar PV arrays

In addition, there were provided twenty biodiesel and solar hybrid system deployed across the site to deliver power for the second sponsor zone, LED festoon and floodlighting site and production facilities.

The entire site power infrastructure was delivered using no fossil fuels, and the use of hybrid technology reduces the biodiesel usage by 35%, saving over 3.5 tonnes of CO2.

The festival is also attentive to recycling. He also defined ten types of onsite recycling centres: household waste, recyclables, compostable materials, toilet waste, wood, glass, cooking oils, bulky waste, batteries & light bulbs and cigarette butts. With a great help from a team of 110 volunteers from the Brigade Verte, the festival has been able to recycle 81% of its waste in 2019 (compared to 74% in 2018), . In this way, the festival was able to recycle 400kg of plastic, 22,000 L of generated compost.

Among other initiatives, there is also the promotion of public transport, up to 76% of which is the preferred medium for all attendees.

Burning Man

As in the case of the Terraforma Festival, Burning Man also aims to include, within the festival concept, a community inclusion of the participants. The aim of this festival is to create a community, as well as a temporary city, or as defined by the organisers, a 'global cultural movement' based on 10 practical principles. Analysing these criteria, we can see that sustainability in all its forms is a fundamental cornerstone of this event, creating a unique global panorama of event types.
First and foremost, there is the 'leaving no trace' concept, which requires each participant to take care of their host environment, leaving it with the same care and natural environment with which they found it.
In 2020, the event's sustainability mission was made even more specific in their sustainability report. In fact, the year before, they had already proposed their so-called sustainability roadmap, according to which, their sustainability would be carried out over 10 years, to achieve the following objectives entitled: - No matter out of place', i.e. take care of your waste and treat it ecologically
- 'Be regnerative', i.e. create a positive environmental impact on the environment
- 'be carbon negative', with the intention of removing more carbon footprint than you put in. The whole process thus makes it possible to define the parameters for the future outlook.
In future goals, they intend to eliminate all non-sustainable waste streams from Burning Man events and operations. to be regenerative, instead, their slogan is defined as making Burning Man able to create projects that can promote and help communities. Seventeen ideas were presented that relate to regeneration, and these ideas implement solutions to integrate local communities, create a turnkey toolkit for disaster reliefs recovery growths, create a network for creative interventions, redirect war bduget to art, and many other concepts that aim to make communities take ownership of the sense of living in harmony with nature, so that nature comes back into harmony with man as well.
In accordance with the objectives set for the previous year, the organisation is also developing programmes for 'carbon negative' actions. In this case, carbon offsetting in the area becomes the most successful and most accredited option.
Nevertheless, the organisation is actively interested in the field of renewable energies. Their programme for this purpose is called the 'pilot solar project', and aims to generate energy for the entire city through the use of photovoltaic panels. a feasibility study has therefore been presented for a request of 20 MW on 75 acres of the territory within Black Rock City for installing solar panels. Moreover, the generation of energy also allows a reinvestment of the energy by selling the over-demand and earning a carbon offsetting profit.

LOCATION:	Black rock city, Nevada, USA
SIZE	Major event.
VENUE SIZE	up to 20 km^2
ATTENDEES	more than 78'000
TYPOLOGY	open-air music festival.
ACTIVITY:	15 days
NUMBER OF STAGES	+100

Oyafestivalen

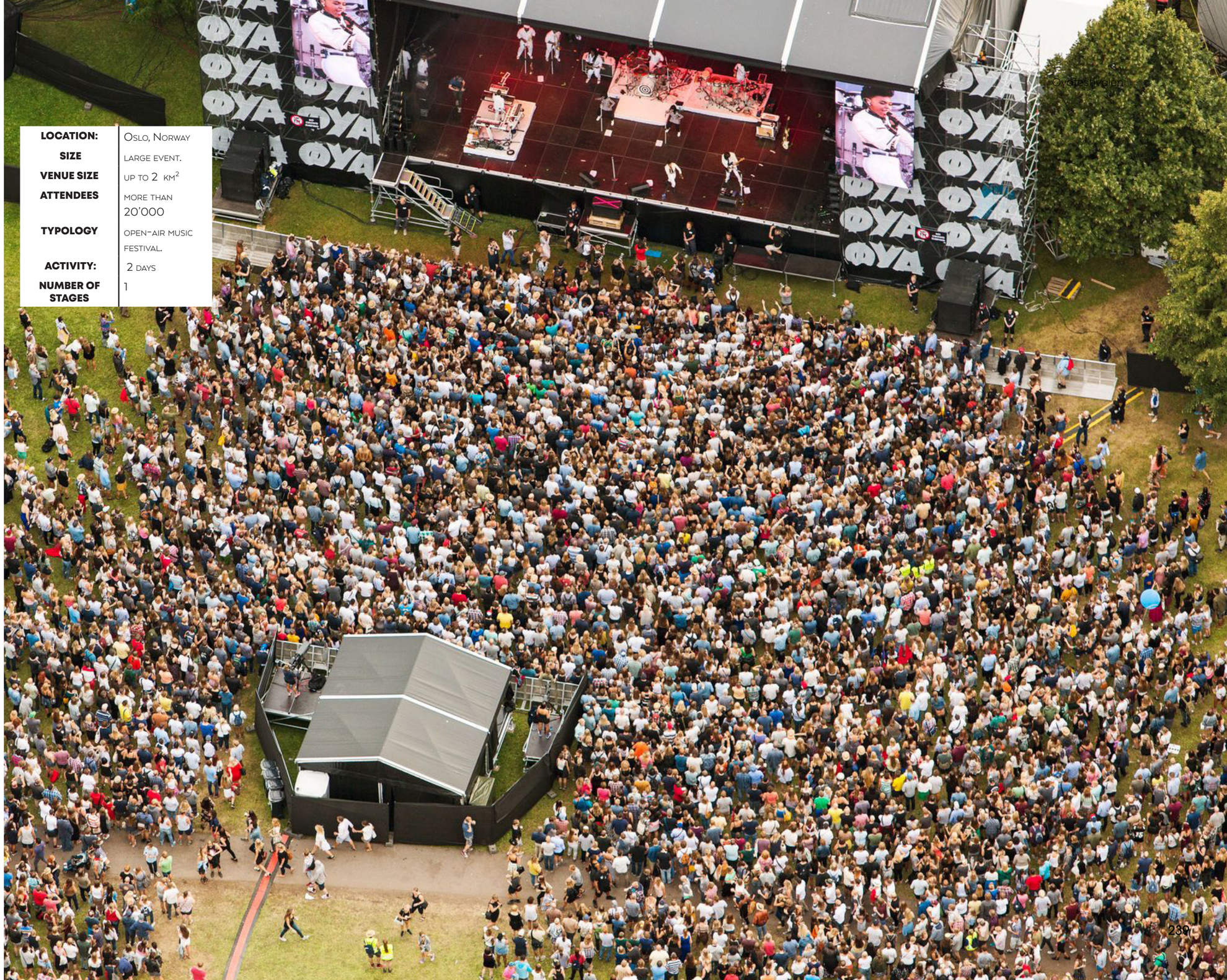
This festival was launched in 1999 and grew from 1,200 visitors to be one of the biggest and most important festivals, welcoming over 60,000 people. Starting from the 2010 edition, Oya Has started prioritizing efforts for being as sustainable as possible. They have introduced renewable energy.

Øya's aims to be a pioneer of green events: leading by example and inspiring fellow promoters, businesses and audience members. Øya has received a multitude of awards, including two 'Green'N'Clean' awards, and 'A Greener Festival' award for the previous six years. In 2010, Øya switched from diesel generators to exclusively grid/mains power, which is 98% renewable-derived (mainly through Norway's hydroelectricity generation) and has removed virtually all on-site emissions. The switch was implemented gradually, with a mix of generators and mains power in 2009. It required a major investment in new infrastructure for the festival, which the Øya was able to undertake through a partnership with the municipality of Oslo and their main sponsor at the time, Hafslund (a Norwegian power company who continue to supply the festival through the grid today).

Øya also made significant year-on-year electricity consumption reductions These energy reductions are the result of a variety of efficiency projects and awareness-raising campaigns with staff, volunteers and external vendors. Øya has integrated energy efficiency within the festival's technical operations by rationalizing the size of light and sound mixing tables, and using LED lighting and LED-based strobe lights wherever possible.

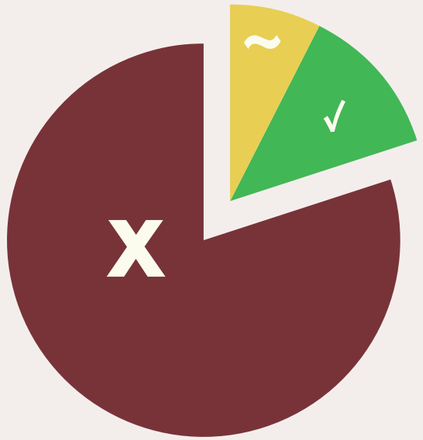
- *The festival has been run on renewable energy from the grid since 2009*
- *Over 90% of all food served is organic*
- *The cater serves only plastic-free food and drinks service, substituting with only compostable packaging*
- *98% of all audience arrive by walking, biking or using public transportation.1*

LOCATION:	Oslo, Norway
SIZE	large event.
VENUE SIZE	up to 2 km^2
ATTENDEES	more than 20'000
TYPOLOGY	open-air music festival.
ACTIVITY:	2 days
NUMBER OF STAGES	1



Oyafestivalen

12. INTERVIEWS WITH FESTIVAL ORGANIZERS



40

ORGANISATIONS

- **11** *festival*
- **22** *production agencies*
- **2** *architectural studies*
- **3** *energy renting companies*
- **2** *theatres*
- **1** *web journal*

5

FAVOURABLE

- Cirko Vertigo
- zioGiorgio.it
- Barley Arts
- Puglia Sounds
- GP Eventi
- Teatro Colosseo

3

'MAYBE'

The first aim of our research project has always been to refine existing energy privision techniques, while highlighting the actual improvements already implemented with possible future developments. Therefore, it was also essential for us to know what forms of energy supply are already in place for the purposes of the experimental analysis while bringing about a considerable renewal of the possible future effects.

As shown in the adjacent figure, we were mainly interested in the contribution of event production agencies and possible festivals to get their feedback on energy sustainability. However, many prominent figures related to the event itself made a considerable contribution to the realisation of this chapter. For example, the contribution of the newspaper we contacted, ZioGiorgio.it, was very interesting. This newspaper took an active interest in the project and put us in touch with Barley Arts, one of the leading production agencies in Italy. Their contribution gave us a clear perspective on the current state of energy supply methods in Italy.

Nevertheless, thanks to their contributions from all the companies that decided to participate in the research, we were able to recognise the supply of energy in very different areas. The result is a picture outlined in the polarity of the main instrument: the diesel generator occupies a preponderant role in many festival categories,m just as it does in many systems that require rapid energy and in off-grid situations. In addition, the Italian sustainable system, which the interviewees recognise as one of the most innovative, still suffers from obsolescence. Biodiesel remains a severally under-exploited method, and many of the leading renewable sources (wind turbines and photovoltaic panels) are defined as irresponsible energies.

For these reasons, these interviews were fundamental in outlining the path of our work. We needed to understand in which methodologies the temporary events industry needed a great improvement. Now, our work can intertwine its path even better with the actual case of need.

The main critical points of the interviews are presented in the following pages, with a subsequent summary in the conclusion of the chapter.

Each agency is divided into a short presentation, followed by explaining its main sustainable intentions and considerations regarding the current sustainable scenario, including how it could be improved.

The first approach was to look for contact possibilities through preferential information channels. We tried to contact festivals of national and international importance within the panorama of events directly, but the response was almost always negative. The reasons for this lack of interest, we believe, are not primarily linked to a lack of interest in the field of sustainability, as the organisations contacted also include organisations that are firmly committed to an essential step towards sustainable development. However, it was interesting to outline a profile that could be presented to the organisation to be as clear as possible in the first email exchanges when carrying out the interview.
The question was mainly about the presence or absence of sustainable practices. In addition, at the time of the interview, the purpose of this work was limited to carrying out a study on sustainable procurement methods. On this basis, therefore, much of the information that has been reported relates primarily to sustainable development from an energy perspective. However, this basis does not exempt the same organisations from investing in sustainability through different fields. In this case, the organisations were instead all included within sustainable development.
The first contact came about thanks to the interest of a newspaper in this work, zioGiorgio.it. Thanks to an initial interview, we were able to find out about the practicalities of producing a festival or major event. Mainly, the management of the event is the responsibility of two central bodies: the part of the managerial implementation, which is responsible for developing the entire concept of the event. At the same time, the logistical production is the one that physically takes care of supplying the site with the requests of the managerial part made during the planning phase. On this basis, we wanted to direct our interest towards these production agencies, i.e. those companies able to supply any event with the necessary technical, audio and video equipment. Besides, by contacting the event organisations, we tried to build up a complete picture of the current situation.

Barley Arts

Barley Arts provided the first availability from the organisations, an organiser of nationally and internationally renowned events that stage festivals, theatrical events and concerts in arenas, and shows that are not only musical. What emerges from this initial interview is that, just as studied in the previous chapters, the event is the realisation of a complex microcosm that requires an iron organisation like an entire assembly line, according to which each procedure is linked to the previous one necessarily and inevitably. However, in the realisation of an event, the onsite process is already subject to a high degree of innovation both in terms of timing and the final perception of the product. Events as significant as twenty thousand people can even be set up in five consecutive days of work, allowing for enormous flexibility in the realisation of an event tour.
From an energy point of view, however, the innovations in the sustainable development of renewable sources for permanent buildings are not always compatible with what happens in temporary structures. The installation of photovoltaic panels is a supply system subject to a greater risk than more polluting sources but with a more excellent guarantee of efficiency. In this case, the possibility of adverse weather events may affect the final success of the event, resulting in general dissatisfaction among the event users. This disapproval, in the case of large events, could sometimes be too great a setback for both the organisation and the artist performing, and it is for this reason that photovoltaic energy, as well as other forms of energy supply that are strongly conditioned by weather conditions, are still at a primordial stage of development to entrust the entire supply of the event to just one of these renewable energies. Nonetheless, there is some support for using these supply techniques for lower percentages of the event, perhaps supporting only those areas that are subject to lower energy demand and, therefore, easier to store in the event of short-term scarcity.
The event is a complex organisational machine that must guarantee the success of the situation at an excellent level for all the parties involved. The organisation must take into account the projection of the event towards the performer and his crew, but also towards the retail services, and nonetheless also towards the public. This synergy is so essential that rather than risking a lesser result, one tries to invest and deploy even more resources than necessary to achieve an excellent success of the event.
For this same reason, all generators used for energy supply are always bi-generators, as they must guarantee electricity even if the main generator fails. Not only that, since the success of the event is the only acceptable outcome, it is believed that very often, the artist's agencies tend to ask for more than the actual energy demand that will be used during the event so that the demand will always be met by the service provided during the event. Therefore, from a sustainable point of view, energy is a parameter that must undergo substantial

improvement, but the organisation is not the cause of this deadlock. Instead, it is the current technological state of innovation in the realisation of renewable energies that do not yet allow the technical barriers to be overcome for the total realisation of an event of twenty thousand spectators using, for example, photovoltaics. However, the possibilities of good parts of the event being supported by this choice remain viable and identified within the previous case studies.

In addition, a proposed alternative to diesel fuel is biodiesel. At present, the possibility of using this type of fuel is feasible. However, fuel management in Italy still presents some difficulties in interfacing with this type of event.

From the EXPO 2015 case study, the possibility of transforming the event into a small smart city capable of supporting the entire event through an interconnection of energy sources emerged; however, this activity would cause a certain amount of dispersion within the cables that run for kilometres inside the venue, thus not allowing for energy efficiency. However, this key point is also proposed as a solution to be developed in the long term.

However, this organisation's commitment to sustainability is a relevant point to consider in the panorama of significant Italian events. According to Claudio Trotta, the promoter and artistic producer of Barley Arts, sustainability can be the driving force behind the realisation of the event, which is currently in a severe crisis due to the global health emergency. The time needed to return events to open-air stages, in front of the same number of people as before the emergency, has been extended to 2022 and, for now, the only strategies that can be integrated are those of sustainable planning, both from an environmental and social point of view, but also economic, due to the scarcity of funds that the current forms of public transport can provide.

The A Greener Festival organisation also promoted barley Arts' interest in forms of environmental sustainability during the production of the "Dieci Giorni Suonati" festival, which received a two-star certification as the only festival in italy to be nominated for the Green Inspiration Awards. The available initiatives concerned gastronomy, staging, communication and promotion of food and water, packaging, waste, services, energy, mobility of people, CO2 emissions, and companies' involvement attentive to social and environmental issues and often pioneers in their field. Students from the University of Gastronomic Sciences in Pollenzo, led by Prof. Franco Fassio, also contributed to the project's innovation.

Fig.
Infographic produced by the '10 Giorni Suonati' festival team to illustrate the sustainable strategies applied to the event
© 2012, UNISG

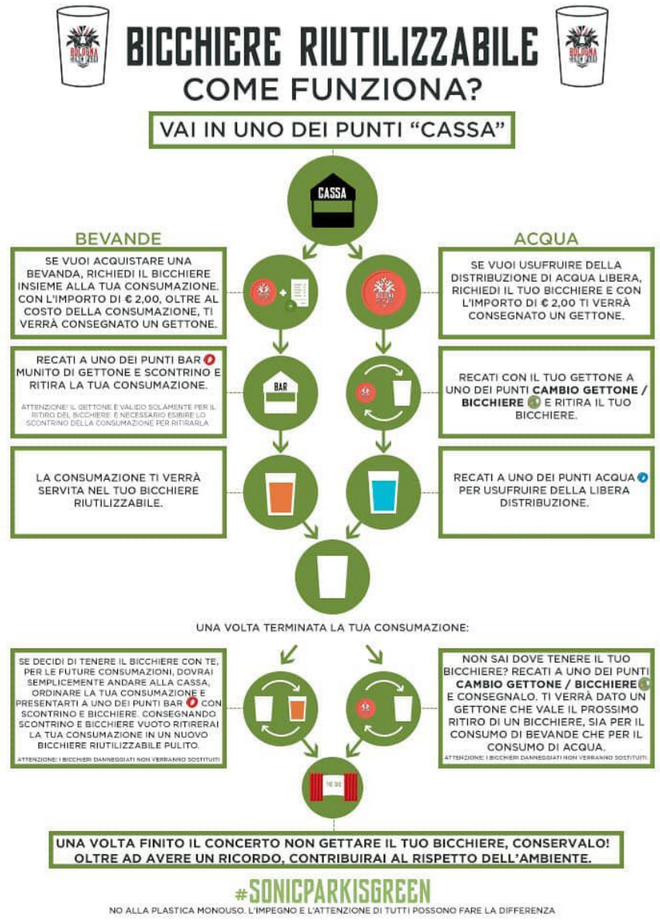
Cirko Vertigo

The second organisation that responded favourably to the interview is cirko vertigo. The second organisation that responded favourably to the interview was Circus Vertigo, which organises cultural events with contemporary circus performances near Turin. The organisation has logistical and managerial aspects and has fixed structures that can accommodate up to 500 spectators. In addition, the association promotes circus with workshops and group activities and, finally, also holds training courses to teach circus arts.
The main performance venues are indoor theatres for 150 to 200 spectators, where new energy-saving technology has recently been implemented. The audio and lighting equipment has been replaced with more efficient methods, reducing overheating in the enclosed spaces and considerably reducing consumption, as indicated in the chapter on sustainable approaches to energy.
The idea of sustainability for the organisation, however, has to be combined with the possibilities offered by subsidies. as for many Italian cultural associations, the primary source of sustenance, especially during this period of a health emergency, is the state subsidies and the patronage of bodies interested in the project.
In this case, however, sustainability presents itself with a double motive of self-sustenance, reducing both wastes towards an environmental improvement and economically for the organisations themselves. It should be pointed out that some practices that require a refurbishment of facilities, or an adjustment, or compensation in monetary terms, are elements that tend to be challenging to organise within these theatre companies, as the first problem relates to subsidising the costs of ordinary activities. Sustainability, however, presents itself in areas that are combined with several other factors.

The same organisations and partners invited to participate with the organisation are also interested in the same objectives. They often choose to re-use stage elements and props, eliminate waste, and run workshops on promoting environmental and social sustainability. The accommodations are often temporary camps with the most negligible environmental impact, such as tents and caravans, and efforts are made to consume as few resources as possible not to incur both consumption and unnecessary expenditure. Therefore, we could define this project, as being rooted in sustainability as the very concept of realising the event, since the cornerstones that form the very environment of the show are inherent in the realisation of the reduction of pollution, consumption and the elimination of the superfluous.

Cometa Group

The third interview was with an important Italian and international production agency to produce large events and shows. The idea of Gruppo Comete is to include within the cooperative agencies specialised in the management, cooking and production of large and medium-sized events.
This organisation's experience is preceded by more than twenty years of implementation, in which interesting forms of sustainability have been experimented with, such as the testing and innovation of new techniques. In the field of energy, too, it has been possible to focus on experimentation thanks to the interest of some artists in this theme. For example, thanks to the collaboration with Subsonica, the entire audio-lighting service was converted to a 24-volt current to reduce the general burden of energy demand. Another interesting experiment took place with the event 'Volume A Idrogeno', in Turin, on the occasion of the presentation of an encounter between music and literature, on the occasion of Turin as the world capital of books. Letterasturas and music are shown in performances which, just as the title suggests, are powered by hydrogen generators. The fact that this show was staged in 2006, in conjunction with the 20th Olympics in Turin, is also the scene of great innovation in environmental sustainability, which is still a cornerstone of current and future development.
Not only that, but the organisation also engages in other forms of sustainability through active cooperation with performers who are interested in these



topics. With Radiohead, biodiesel was used to power the generators, and the plastic bottles used during the event were made from recycled plastic. Moreover, within the festivals, the widest margins of freedom in experimentation were also found for this organisation, thanks to the multiple activities involved in the realisation. In particular, during the Bologna Sonik Festival, sustainable waste management was introduced in Italy. It was decided to use refill cups, branded with the event logo, to transform the object into a souvenir that would not want to be abandoned, increasing pollution, and all the food & beverage was expanded with biodegradable plates and cutlery.

Puglia sounds - Medimex

The following interview is about the organisation Puglia Sounds, an administrative branch of the regional government of Puglia, Italy. This branch was created to encourage the region's musicians to enter the international music industry and to improve the region's music scene. The organisation also runs and implements Medimex, an international festival held every year since 2011, which brings together local artists with international guests in a regional tour in several stages. The aim was to respect sustainable improvement practices, low-carbon economy, environmental protection, preservation of biodiversity, and enhancement of environmental assets at the regional level for music users and music operators. Thanks to these principles, routes for the disposal and reuse of plastic were introduced. The plastic bottles collected during the event will be recycled to make plastic plates using photo voltaic-powered 3D printers, while the organisation will manage recycling for the duration of all events. Sustainable implementation was also introduced through the international ISO 20121 standard.

Fig.
2017 edition of Medimex in Taranto
© Medimex, 2017

evidence from interviews

most significant environmental impacts within the festival

- **stage energy demand: about 300 kW per concert (audio + video + lights)**

  "If you think about it, a Beatles concert was much more sustainable than a modern-day concert."

- **diesel generators among the most polluting but most efficient forms of all**

main efficiency improvements already implemented

+ **LED lights :** reduce energy requirements by 2/3
+ **Digital Audio amplifiers :** reduce energy requirements by half

proposed sustainable solutions and their issues

swtich to: fotovoltaico e / o eolico ?

- inefficient compared to a 100 kW generator
- insufficient battery capacity
- impossible due to the exaggerated energy demands of the artist's management
- irresponsible' energy:

"who can guarantee me sunshine for the duration of the event?"

swtich to: biodiesel?

- low integration from companies
- hardly available
- lack of knowledge about specifications for use and efficiency

swtich to: national grid?

- less efficient than the big-group generator
- unsuitable on-site provision by administrations (piazze con 20 kW di allaccio)
- irresponsible' energy

swtich to: pedal power?

- not very efficient (350 W per cyclist) - but usable for small events

swtich to: microgrid?

- too much dispersion in the cables (average lengths of 3 km to be reached)

proven innovative solutions

- **kinetic energy** for small events
- **hybrid generators**
- **hydrogen generators**
- **photovoltaics per portion of the event**

the views of organisations on sustainability

sustainability as 'a surplus' - such as carbon offsetting

- due to the limited funds they receive from the administration most theatre associations cannot employ sustainable techniques

"the events are not of public utility to the State"

- it is hardly possible to avoid waste, as it is the artist's management that requires it.

the future will certainly be sustainable

- the use of energy mixes is envisaged, including
  - electrical network for pre-event phases
  - hybrid generators
- renewable energies in a timely manner, for example:
  - kinetic floor to charge the phone, like the electric Hotel

"Anow sustainability has a much closer eye. Almost all promoters are moving towards sustainability."

13. A NEW SRTRATEGY FOR SUSTAINABLE EVENTS

This work has the objective of giving a new approach to sustainable innovation, promoting carbon emission reduction and increasing efficiency of sustainability approaches already implemented. For this reason, in this chapter we present the path we have taken, the methodology and the new resolution to the problem for the future of sustainability in major events.

As we have seen at the beginning of this work, the presence of events which have already been realized in terms of sustainability are not in vain in the past. On the contrary, we may consider that the concomitance of development events, with sustainability growing interest, has favoured the realization of the event with always a view to savings and reduction of the raw materials used. Also, the event organizer has to operate both in assembly and disassembly and favour good feedback on the territory that carries the event; one could incur organizational difficulties. From this concept, it follows that an event is a complex machine that always incorporates the space for sustainability from various points of view; in some cases, an event may address sustainability through direct and active practices, and sometimes indirectly. This is the case with clear strategies, such as offsetting, which require the elimination of the carbon footprint caused by the event itself, and which are in parallel with the economic and environmental requirements implemented, such as switching to more efficient equipment, to reduce consumption in step with the financial demands of bringing the event into operation.
The event's planning becomes an event itself, advancing behind the scenes of the venue itself, having much more extended periods of activity than the few days available for the performance. The temporary structure uses many more actors who can make space available for the performers and all the figures related to them, portraying that microcosm of which we have found a relationship in the various areas. Each microcosm has its administration, as in this case, the organization of the event itself. And in each event, there are different users, inimical figures who have the meticulous task of ensuring that the event carries out its activities in synergy. The event prefigures itself as a step by step progression, a chain in each of its activities, which, however, concerns its presence within the different spheres of application. At the same time, two activities may overlap, and these activities may also be very different from each other. These activities have been unlinked within this work, aware that their intertwining and co-operation is vital for the event's success. In this chapter, we find the bottom line of this analysis and experimentation, in which we now want to lead the reader to a clear view of a new approach to sustainability that would have been impossible to achieve without a careful analysis of the event's activities afterwards.

REMARKS FROM THE ANALISYS

In this work, we have observed event sustainability among different perspectives, relying on a link that we were sure would be found between the world of sustainability and events. Also, from the first steps of this project, we have observed what has made sustainability so important within the temporary event. Therefore, the development of the temporary event was formed on this inescapable head, which, together with its celebration activity, began to gather within it the proto-values of social, environmental and economic sustainability. Subsequent developments have then revealed these elements. We had seen how this sustainable development began to be inextricably linked to the historical context as early as the early 1960s when the relationship between pollution and global warming began to be present in the associations and the events. Then, we concluded that, in the early 2000s, an already more aware society brought to the attention precise demands for a reduction in consumption, paving the way for a ground that in the following years, (we could also identification in the next decades since this phenomenon is still developing) will lead to the international guidelines and regulations for the protection of the planet and the avoidance of climate change. It is on this basis that the event develops the cornerstones of its interest in sustainability. The five categories we have discussed above are certainly not the only ones that can be assimilated into the event, but as we have seen, they are certainly part of the main ones.
Energy provision, design of spaces and equipment, transport, water consumption and rubbish are all present in every temporary event, and a specific main matrix can be then deduced from them. Moreover, we have been able to figure from the analysis of these categories that the aspects analysed are mainly interlinked, even when they are not all present to the same extent in every event. For example, one-day themed events will produce far less rubbish than those who, by offering campsites, face the problem of camping gear abandonment, just as those who decide to set up a stage in an uncontaminated environment will have far less carbon impact generated by the design of large spaces. However, these aspects are always present, which is why we must take them fully into account in our research and development.
Speaking about energy, what emerges is that the main current issue is determined by (as some reported during the interviews) a standstill in terms of technological innovation; although always in constant progress, the audio, video, and lighting systems are determined by another level of energy efficiency. At the same time, the energy supply of large temporary structures is forced to rely on diesel engines because they are considered capable of providing a greater guarantee than all the others, which may incur problems arising from adverse weather conditions (in the case of renewable energies) or malfunctioning of the international grid. These elements mean that the current energy supply situation is defined as being in a state of technological avant-garde, although

it is constantly being improved. This migration is already seen in forms of experimentation. Events such as Coachella, Melt Festival, Shambala and Glastonbury have already included areas where the energy supply of renewable energy can cover the needs of small sites not linked to the main stage. Therefore, even if it is not possible to cover the entire mass event with renewable energy, it is still a highly implementable and efficient option in the demands of an event. Nevertheless, as the Sunplugged festival showed us, experimentation continues, indicating that the future of powering a stage with renewable energy is already presenting the beginning of the next innovation.
Similarly, active energies within the festival allow festival-goers to participate in sustainability in this field, offering activities that will enable the user to be part of the event's energy supply in the same way as they usually would. Bicycles, platforms and other systems within the event allow users to generate energy by doing the same activities they are called upon to do. In these areas, it is almost impossible to separate the environmentally sustainable component from the social and ecological part since the event is a microcosm containing many activities and systems that work in synergy. The aggregations work together in multiple ways to provide various benefits to all categories.
The same approach refers to the development of an event design. The modular construction of scaffolding and holding structures remains the best current solution for constructing a diverse range of possible solutions. The same modular systems can be used for any temporary construction, from the stage to the FOH points and reception facilities. These structures are fundamental in the realisation of the temporariness of architecture. They are the central core that allows the realisation of temporary structures following the same guidelines and the same theoretical study on the mechanical and physical feasibility of the system. Indeed, it has been proven that some possible sustainable solutions are already present. For example, the substitution of the stage with wooden structures or the realisation of the scenography with recycled materials. in this case, the structure assumes a relationship of reuse and recycling that is surely linked to the factor of environmental and economic sustainability. Therefore, although these implementation possibilities are present, we must also stress that aluminium, after various experiments within the safety factors of an event, remains the most suitable solution for the realisation of temporary structures for mass events: it can not be avoided.
However, we are also aware that these basic principles, on which innovation represents today's modernity, are also the starting points where architecture and engineering will offer great revolutions in the coming decades.
Therefore, in this work, we wanted to embrace this sense of revolution, but also of the actualisation of a possible solution, searching for a more sustainable and eco-scientific design, given the possibility of understanding these structures in their role as embodied energy and embodied carbon, so that, although they may, in any case, have a negative impact on the environmental impact of the planet, the possibility of possible compensation remains unavoidable.
In this case, mobility and transport are essential components of the final result of the emissions from an event, but they are not directly affected by the venue. Transport activities occur in the days leading up to and during the event and are not always easily controllable by the organisation. Among multiple possibilities, the attendant can choose to be brought to the event by ship or by plane, of which it is hugely more difficult to quantify a single result of this analysis. Some studies have been able to quantify a demission fact per km for each user, from which we have taken the data later for experimentation. Therefore, travel emissions remain one of the most relevant factors in vehicle emissions. Several activities are taking place within many events to develop better transport sustainability: active carpooling and sharing have greatly improved the emissions situation, and coach and train event tickets allow travel costs to be assimilated into a discount on ticket prices, promoting more sustainable transport activities. In this case, more facts inflict the realisation of transport through practices that have less impact on the environment. From the analysis we have carried out, we can see that two main factors are extremely discriminating in the choice of route: the demographic and the geo-localisation of the user. According to the users' typology attending the event, travel choices are different; moreover, a strong influence is also given from the road that needs to be covered. It is also possible to include in these activities a part of the compensation in the form of a carbon tax to be charged, which, according to the interviews analysed in this work, it turned out to be a proposal that about 50 per cent of the interviewees would be willing to support. We then proceeded to analyse the impact factors of waste and water. The reduction of consumption is the basis for these two actions.
While previously the energy requirements were already planned and controllable at the beginning of the event, in this case, emissions resulting from these two aspects are still developed during the event. In contrast, awareness-raising during the event still is a method that can create a significant difference at the end of the activities. There is a need to promote waste disposal practices properly. Also, the organisation needs appropriate collection schemes, as these activities are not always well present in all areas. Nevertheless, a proper clarification of the actions towards the participants avoids mistakes in the waste disposal, which could frustrate the intention of many users to carry out the removal. Among the most important event, it is interesting to note that the Shambala festival has created a different approach to waste disposal. It charged a pecuniary compensation for whom carried out the differentiated collection in a correct way to the 'recycling stage' area; furthermore, the waste of most materials becomes one of the main improvements commonly applied and applicable by many different organisers, in which the water refill concept is introduced for all those who need to drink. The avoidance of disposable plastics also becomes an effective method of encouraging compostable items that,

while still being offered to customers, become a way of taking material to the end of its life more easily and reconverting it into something equally useful less harmful to the ecosystem.

There are many strategies for modernising these systems, and these activities are mainly found in all categories of events. For this reason, it was interesting to analyse all of them as part of a single weave of aspects. From this analysis, we concluded that when one wants to improve an event's sustainability, it is impossible not to consider all these event aspects as a cooperating act. Each element has the cornerstone of sustainability at its core, so any event that wishes to implement the sustainable mission (hoping that the future will favour not just voluntary implementation but an effective mandatory norm) will be faced with a set of effective policies.
In the current historical context, we have concluded that the event is already configured as a chain of important innovation dedicated to avant-garde on certain aspects, which, however, shows some gaps in its implementation chain. The systems implemented can be regularly taken as a factor for analysis, yet, as some organisations such as liftgate and Julie's bicycle have advanced, their conjugation in a final benchmark proves the actual efficiency of the entire event. This benchmark is also the basis for the event's ability to establish its emissions and achieve an exact carbon footprint offset. Therefore, from the analysis we have carried out, what emerges is that the way to reduce an event's emissions is through the co-operation of aspects. for this reason, we now want to proceed to clarify this concept for the reader, and show how these aspects can be brought together in an efficient way
The management of sustainability within the event involves several factors. Like any organisational machine, the event introduces management with various actors within it. For this reason, in the chapter on the approach to the problem, we have researched the main actors who must be involved in sustainability in order to obtain an efficient synergy of forces leading to a real reduction in polluting emissions. The main users who have shown themselves to be interested in sustainability are
the organising team and designers
the companies that partner with the event, and
the users who voluntarily participate in the show.
In any show production, these figures will always show themselves in a sometimes inseparable way or more concealed in complementary actors; these actors' involvement is crucial for synergy. Let's say that, at an event, there are areas equipped for recycling, but none of the users provides the service; waste reduction strategy would be lost. Similarly, if users want to save the emissions polluted by their journey, they do not receive adequate support for transport services from the organisation and local authorities. Even in this case, the effort for a sustainable event would still be lost. Therefore, we do not want

to introduce a fourth element of CO2 offsetting as the overall solver of the problem regardless of what happens, as the cost of this offsetting falls on the responsibility of the three organisational elements, partners and end-users.
Therefore, the concept of synergy is an integral part of the realisation of a successful low environmental impact effect. Trust, co-operation, and active promotion by all users will be the key to realising the fundamental innovations that the event can now propose. However, rather than being an avant-garde strategy, it remains a point of reference that has crossed the history of the event more or less unconsciously; we need only think of the incredible resonance obtained by the first Woodstock festival, which proclaimed the concept of communication with Nature, as well as the forms of mobility of the city moving in the era of Archigram. Synergy is the mission but is part, together with the listed activities, of the central core of sustainability and the very nature of an event as a space of aggregation. In this case, sustainability becomes only the theatre of implementing the choices and strategies of improving the era in which it takes place.

Previous Attempts

The thesis aims to find innovative solutions for the long term with a high level of conceptuality and integrate the requests made during the interviews with the tangible reality.
Firstly, the aim of the thesis has always been to make the event take ownership of new methodologies and strat egies to solve a problem concerning its large GHGs emission. To fulfil this task, we wanted to proceed from the analysis of the energy within a festival and understand if there were possible improvements in the technology used. In this case, before being able to implement in the reality of the experiment the idea that was born during the first phases of analysis, we proceeded to create a possible solution in conceptual terms. The first idea was to enclose the festival within a microgrid to make the entire event communicate from a single operations centre, as happened in EXPO 2015 and the new microgrids that are emerging. Within this system, the event would host different energy sources to communicate with each other to send and receive energy in the different areas of the event and then send the supernumerary point outside the microgrid if needed. The idea was to bring into the event energy creation activities that required human effort and did not require it but relied only on atmospheric agents; in this case, we talked about photovoltaics, wind power, and energy as kinetic energy and pedal power. A microgrid with storage devices was essential to implement the energy storage process due to the evening hours during which part of the event is held. Although the idea is partly feasible in terms of energy sources, at the same time, it was answered

that, at the current state of the art, photovoltaics could not cover the entire supply of an event that can accommodate 10,000 spectators and that, at the same time, a transformer conversion factor is required which would not be totally easy and energy-efficient as things stand. Furthermore, being an area of several hectares, it is believed that transporting energy without losses over kilometres could more disadvantage the propagation of power within the microgrid than benefit a single process. Finally, the solution was still considered economically unviable due to the high cost of storing energy for about 300 kWh.
However, there were some interesting points where the idea still had solid foundations: based on some case studies, such as the SunPlugged Festival, it became clear that it was possible to use photovoltaic energy - together with kinetic - to supply a concert; however, still in small quantities, as the stage held up to 600 spectators. However, these results made us realise that, although microgrids were very disadvantageous in the current state of energy innovation, the solution of implementing photovoltaics and other active energies during the event could still be attractive.
Similarly, we set out to improve design to reduce its environmental impact by finding alternative materials. At state of the art, we looked at the regulations in Italy, the UK and the USA. In these three similarities, we noticed that the development of the legislation was mainly based on an extreme need following unfortunate equipment accidents. Following accidents on two significant stages in Italy, new safety regulations were created, and a similar cause was encountered in the development of regulations in the UK. Therefore, organic materials such as bamboo have never been used in the construction of stage structures, as the state of the literature and experiments have never been able to implement a stage made of bamboo due to the lack of safety; not only that, the costs of experimentation would be much higher and the bureaucratic process would still be very long to implement this technique in the short term. Iron, however, has been replaced by steel, and recently the structures are made of an aluminium alloy to ensure that they are sturdy and light when dismantled. Moreover, technologies favour the ability to assemble and dismantle in a concise space of time rather than the search for innovative mateirals with low embodied energy and carbon. In short, it is presumed that the search for current innovation is more about creating temporary structures incorporated into motorised trucks that, with the minimum demand for workers and time, can produce a stage of the same size as that used with the aid of modular aluminium scaffolding, or at least trying to include bamboo or another organic material in the construction. The concept of reusing or recycling materials have indeed been taken into account. It has already been explained how the Terraforma festival has created the current stage design and part of the furniture from objects in the structures of previous years. For this reason, the possibility of reuse is still proposed as an interesting and feasible solution in the short term; in parallel, the new concept of materials will be proposed in future implementations. Finally, in the case of design, it is clear that carbon offsetting of pollutant emissions can be introduced. This practice is increasingly advancing to be implemented, and already shipping and airline companies are obliged to pay a carbon tax for unavoidable emissions.
In the current state of art, it would therefore seem that the introduction of quantification of pollutant emissions to proceed with the compensation process is one of the best possible procedures.
Even in the subsequent analysis of transport emissions, however much the reduction of fuel consumption per person, or the use of public transport or event-driven routes, a carbon tax is still proposed. Unfortunately, even after numerous improvements in vehicle technology, there is still no innovation to the extent that pollutant emissions are not realised throughout the vehicle's life cycle. However, instead, emissions are made considerably lower by more efficient technologies and means of transport. Therefore, even in this case, the offsetting solution remains a way to make the environmental impact, even more zero, if not positive. Similarly, once the production processes of waste and water during an event have been analysed, it can be seen that in parallel with good practices to reduce overconsumption, a remaining part of the emissions can be offset through careful quantification of CO2.

Conceptualising the idea

Once we understood the possible solutions already implemented to make the activities of a festival more sustainable, we began to propose new implementation strategies. We may suppose that the pivotal point of an event lies in its ability to inveterate, programme itself, plan itself like a step-by-step chain machine. Therefore, we asked ourselves how this synergy could become part of the sustainable development of the entire event.
We began to examine the parties involved. On the part of the organisers, the partner companies and the festival users, there had to be an approach towards sustainability that should not be overlooked. For this reason, we tried to work on three different levels of thinking, aiming to solve and bring together the problem as if there was a double discord and responsibility. The idea was that each user within the event had a possible conflict with the impact of overconsumption when they took advantage of the material without realising it, and at the same time, had a responsibility towards the other components that were part of it. On both of the three members, it was necessary to show the ability to take charge of their problem and the communication between them: in the idea, there is, therefore, business management in which the spectators are also included as an active part within the project.
We started to look for ideas of possible interweaving, as for these topics, also

'for these three components within sustainability. In this case, technological innovation also made it possible for us to take inspiration from the main activities held during a health emergency. Therefore, we could see how the different organisations could keep track of their work online, through web-based services, just as happened in the previous times for the energy management of expo 2015 where the whole electricity network was placed in charge of the management from a transversal point of the event.
Moreover, we looked for references on business management and sustainable event innovation. Firstly, considering ISO 2021, we understood in which areas the event meets with sustainability and in which aspects it is possible to deal with it. Secondly, with the analysis of 'who is involved?' we could define the parties concerned in the event. Then, with this first analysis, we answered the implicit question of 'what?' the event was asking to be innovated. Lastly, the question of 'how?' had to be answered by looking for possible solutions that would improve the event in its current state.
Therefore, we looked at studies carried out by Lifegate, Julie's Bicycle and A Greener Festival to identify the parameters that come into play when actively developing an event's sustainability. We realised the importance of having an intuitive toolkit for planning all the stages, from the initial conceptual ideas to the actual implementation of the shows. Through effective quantification, it was possible to meet in a fully automated way, but it could bring an informative mirror to the organisation needing to reduce the event's environmental impact.
However, it was clear from these three realities that, although the parties were well identified, there was no equal division of individual responsibilities. In this case, we asked ourselves how the double thread of accountability and synergy with the sustainability of each user could be carried out by the three parties. For this reason, we considered the idea of software that is active from three points of view to offer an interface that is customised according to the user who is granted access. Each user is then assigned their degree of responsibility and possible activities to implement when he decides to participate. Also, each party takes active ownership of its activities, and a performer, just like an attendant, has the same capacity to make their presence in the event sustainable and take an active part in its sustainability.
Although sustainability was the main focus of the question, we also realised that personal responsibility also required inspiration that could match any point of view. A motivational lever that came to mind was, therefore, creating a monetary resource that would give the same reward in the case of good activity within the event or a payment in the case of greater consumption. On the part of the event organiser, there is an additional payment of co2 offset i case of increased use of the resources; similarly, for the partner companies, there is a personal contribution of their own to the co2 compensation if the demand is excessive, to cooperate synergistically with the organisation. Finally, users are also called upon to participate in this motivational lever, offering them compensation in the event of lowering the environmental impact of an event or contributing to the cost of making the event as environmentally friendly as possible.
A school's electronic register system also inspired the idea of this synergy. There are mainly three parties working together within this system: the students, the teachers, and the headmaster. Similarly, within the event, there are the spectators, the performers and other partners, and the organisation of the event itself. The solution was thus born based on these ideas. We have produced the feasible concept of a toolkit that can get all parts of an audience to work together to create an environmentally friendly event that will satisfy everyone.
Therefore, the toolkit is based on the active involvement of these parties, under different platforms such as smartphones, tablets and PCs, to follow the progress of the event from the first moments of planning to the final stages of disassembly. For this reason, synergy and cooperation must also be a cornerstone of the software itself. Therefore the same ability to achieve environmental sustainability must be offered through a new means of efficient communication of data and results obtained by each of the users.
The toolkit was called HATN, where the name was inspired by a famous Beatles song, updated to the concept of sustainability of an event: (Here) All Together Now. In the next chapter, we will proceed to illustrate the composition of the service and the product.

14. INDICATORS

During their whole life phases, buildings and buildings materials almost consume the 40 per cent of the yearly global energy. Two main energy components can define this energy: embodied and operational energy; the first one is related to construction and dismantling phases, while the second one relates to the usage and maintenance phases. A used resource may also carry a carbon-emitted component that is measured apart.
Many research studies have used the Life Cycle Assessment (LCA) to calculate embodied energy in the building, material, and assemblies. On this basis, the LCA method is useful for determining the energy calculation. This method is defined by the ISO standard 14040-2006. Furthermore, European directives, such as EU 2010/31 and the Construction Products Regulation (EU) No. 305/2011 intend to constrain the design and construction choices of architecture, making the use of certified materials, embodied energy containment and controlled management necessary for construction; these are therefore closely related to the analysis we want to undertake within this work.
These four parameters of massive importance in sustainable planning because, based on the results, a Green House Gas contribution and others perceive climate change (such as global warming and ozone depletion) are determined.
On this basis, also the embodied and operational carbon are to data that are useful for our work. In this chapter, we will introduce these four leading indicators.

Embodied Energy

This definition refers to the amount of energy consumed during the process of providing such material. The embodied energy terminology, although it occurs different interpretations, the primary definition is of the energy consumed till the end of the manufacturing process, as usually said, from cradle to grave.
However, some analysis may also include the energy consumed till the end of the manufacturing process – defining it from cradle to gate – Alternatively, they may also include the process from the delivery till the construction site – defined as cradle to site; moreover, it may also include all the processes included till the end of construction. The embodied energy is usually analyzed inside building planning. When constructing a building, the embodied energy is consumed during the production phases: on this basis, the embodied energy is consumed through the construction materials, building products and construction processes that come along, such as transportation, administration and management involved1..
The embodied energies included in the analysis will also be defined in two different categories: the Direct or Indirect energy. The first one is consumed during on-site and off-site operations, such as construction – prefabrication or transportation. Secondly, the Indirect energy represents the result of all the processes that are not included in the direction to the construction of such material; they may include the analysis of the upstream and downstream processes, or during renovations, refurbishments, or either demolition.
There are latter definitions referred to this examination studies: The Gross Energy Requirement (GER), and either the Process Energy Requirement (PER). Firstly, the GER is the measurement of all the energy inputs measures for a specific material. Consequently, the PER is the energy consumed for the processes directly encompassed for material production.
Therefore, for calculating the embodied energy of material it remains a crucial point, defining the boundaries of all the production processes taken in the exam because, from this definition, there will be induced all the results of the analysis.
According to Sartori and Hestnes (2007), after the revisions of 60 cases of embodied energy analyses, the embodied energy could account for 2-38 per cent for the total life cycle of a building; however, the range relative to a low-energy building accounts the 9-46 per cent.
However, quantifying is not always an easy process. Also, the reported values of the Embodied Energy significantly vary along with the geographical and climate conditions, and data quality is involved as well. Also, some of the parameters accounted in the different results concern system boundary, embodied energy calculation methods and energy units. Other parameters taken into consideration in this issue are the incompleteness, inaccuracy, and not representativeness of data used.

1 K. Dixit, 2017

Operational energy

The Operational Energy represents the portion of energy that is only included after the production process and before of the demolotion processes. Compared to the embodied energy, this component comprises a reasonably more significant proportion of a building's total life cycle energy.[2.] The O.E. specifically comprises operation phases of a building, such as space conditioning, 1heating, lighting, and powering building appliances[3].
In essence, embodied energy differs as the energy used to produce a certain material, while operational energy is the energy that keeps it in activity.
To give an even more concrete example, let us take the case of a diesel generator. Embodied energy is the energy required to create the engine, while operational energy is the energy required to keep it running.
Therefore, although indicating two different energy requirements, the two energies are closely related. Their sum defines a Lifce Cycle Analysis of a product, service or material. Moreover whenever improviments in the operational energy efficiency are given, the relative significance of embodied energy brings an higher proportion of the total energy required in the lifetime of a building.
Hence the operating energy plays a crucial role when planning a low-energy building. This type of building is designed in order to minimize its operating energy usage. Moreover, a low-energy building could account for roughly half of the total life cycle energy.[4.]
In the following graphs we want to clairify the difference and the combination of OE and EE.
Any energy requirement for contruction is assumed to be part of the initial emobided energy,. Consequently, a latter increasement in the embodied energy is given by maintenance operations of repainting, systems replacements and other major periodi remodelling and refurbishements. This component is neverthless crucial in the life cycle analysis.
As we will introduce later, the EE and the OE can be analiysed with the LCA method, as well with the Early Deisgn Model methodology.

Embodied Carbon

This is a latter definition still related to the previous Embodied Energy analyses, but it nevertheless explains a different physical dimension. Similarly to the Embodied Energy, it is used for the calculation of the impact of any material source depletion, but the GHG emissions may be very different. Practically, the main pollutant emissions will depend by the primary fuel consumed and

2 Hegner S., 2007.
3 (K. Dixit, 2017)
4 Thomark 2007

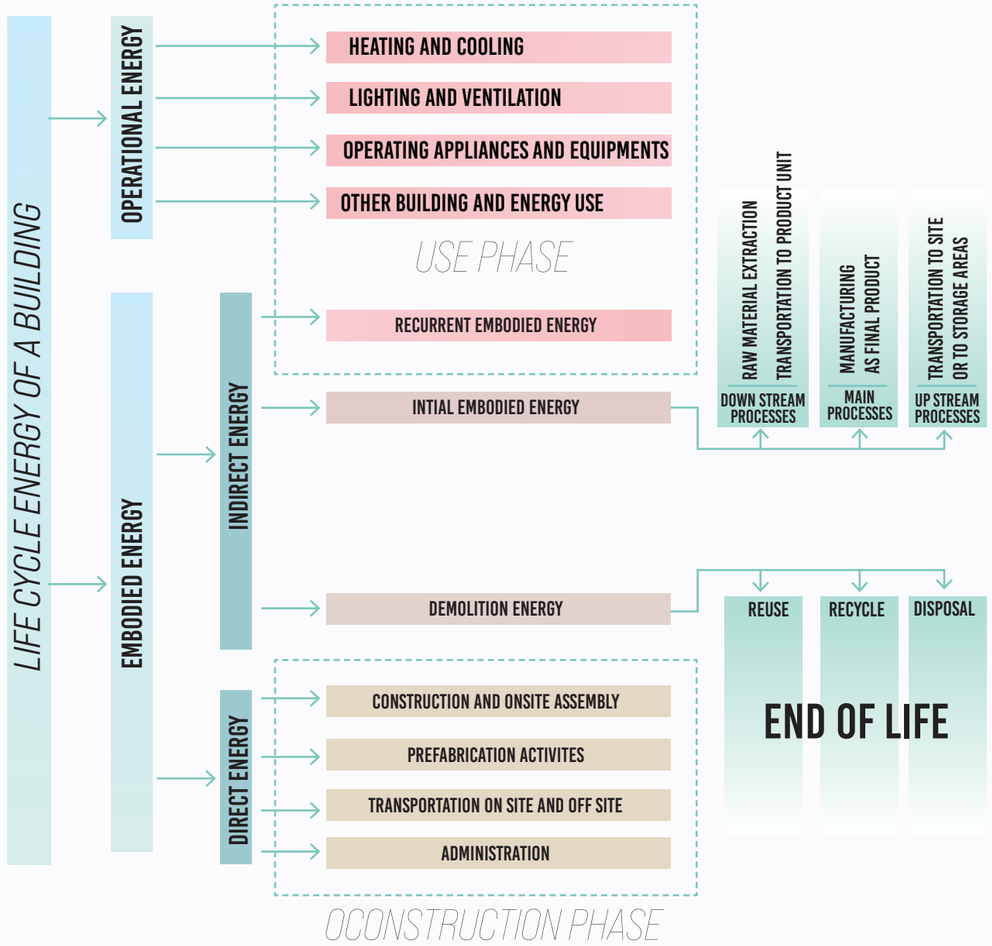


Fig. 2. Life cycle energy model for a built facility . Adapted by Pears A., 1996

thus the generation of electricity; therefore, consumptions of renewable energy sources may be considered as zero emissions and, similarly, nuclear energy. Therefore, the embodied carbon is used for defining the whole quantity of carbon emissions during the production processes. Also, there are some cases in which the result is expressed in a negative form; Trees, short term cops, for example, have been naturally produced by nature while sequestering the

atmospheric carbon emissions needed for their growth. During the industrial processes that contain these materials, the weight of carbon emissions used may be less than the emissions produced during the natural development of the raw material.
The embodied carbon is fastly playing a more significant role in the life cycle carbon emissions of a building, and this relevance is giving more attention to the different material choices available for the same building. According to Dixit et al., there is a need for an approved and standardized measurement protocol for embodied carbon.

Operational carbon

This parameter reflects the range of consumption achieved during the operational phase of a product, material or building. It, therefore, includes emissions from the use and maintenance of the product. However, unlike the other three parameters, this one indicates carbon dioxide emissions due to the operational phase of the product. It is therefore closely related to all three, as each is configured in a different area of the same product assembly.

Parameters involved inthe Life Cycle Assessment

As we have said above, the main objective of an LCA analysis is to define the Embodied Energy of any resource. To achieve this result, several parameters must be taken into account for an efficient calculation process. Thanks to the research carried out by Dixit, (2010), we can see that there are ten factors responsible for the variation and inconsistency of the data, and we will describe them in detail below.

System boundaries

The boundaries are the limits of the processes taken in analysis. They can range from raw material extraction to demolition and ultimate disposal. The analysis carried different limits of the boundaries, and many times a significant difference between boundaries does not allow a direct comparison of the results. Its definition is one of the most critical issues that could make a significant difference in the embodied energy calculation.

Methods of analysis

There can be several different methods, such as process analysis, statistical analysis, input/output analysis and hybrid analysis. From these different methods, results are also expected to be different, due to separate inherent limitations. These methods are also explained in the following paragraphs

- *Process-based*: it is defined as one of the most widely used methods of the Embodied Energy analysis because it is stated to deliver more accurate and reliable results. The analysis starts with the building material and works backwards in the upstream of the primary process so that it can take into account all possible direct energy inputs or sequestered energy. This analysis is, however, ascertained to be impracticable and incomplete, because there is the exclusion of many upstream processes, based on the definition of the

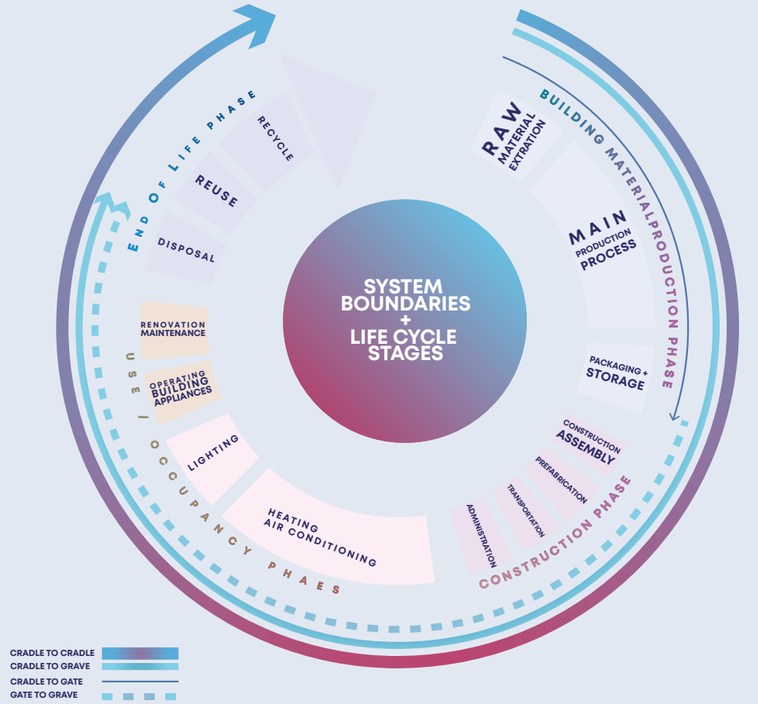


Fig.3
System boundaries and life cycle stages of a building.
K. Dixit, 2009

boundaries system.

– *Input/output-based analysis:* : in this process are taken into account direct, and indirect energies, and thus is considered relatively complete. In the process, the input and output parameters are defined as money flow among different sectors of industry. Tables made by the national government acquires the data, thus transcribing economic flows into energy flows by applying average energy tariffs. The analysis is calculated by multiplying the cost of the product by the energy intensity of that product expressed in MJ/$1000 or GJ/$1000 and then dividing it by $1000.

– *Hybrid analysis:* It is made by the unification of the two previous methods, aiming to avoid fundamental errors and limitations of each process. The analysis starts processing the readily available energy input data on the final production stage; then, it is analyzed one stage more in the upstream and then substitutes it with the input/output method, in order to achieve reliable and consistent information.

– *Process-based hybrid analysis:* This method integrates the input/output-based analysis to problematic parts of upstream processes, aiming to remove the incompleteness of process analysis information. This method is usually taken into consideration for simple material, because complex materials could pose problems, such as overestimation of different resources.

– *Input/output-based hybrid analysis* it incorporates identification and extraction of direct energy from the input/output analysis, and then it is integrated the reliable and accurate process-based data.

Geographic location of study area

The geographic and climate characteristics are fundamental for the analysis. Each location aspect also involves the raw material quality, production processes, economic data, processes of delivered energy generation, transport distances, energy use in transport and labour. Therefore, the results of the analysis may radically vary. Also, the energy tariffs in production processes may affect the different results of the embodied energy in different countries. The location is therefore assumed as a critical value of incomparability and inconsistency in different energy results of a similar material, analyzed in different locations.

Primary and delivered energy

the primary energy is 'the energy required from nature and embodied in the energy consumed by the purchaser", while the delivered energy is "the energy used by the consumer".[5] This differentiation gives the identification of two different aspects of the same material analysis. If the analysis takes into consideration the primary energy, the result may be consistent, but if it is taken into consideration also the delivered sector, the results could be ambiguous. For example, if we have to examine the Coal in an electrical grid, the primary energy is defined by the Coal consumed by the customer for generating electricity, while, the delivered sector is the energy that the consumer-generated. Therefore, different authors[6, 7] suggest acquiring only the primary energy for the embodied energy analysis.

Age of data sources

Old data are carried by an obsolete technology that does not carry an efficiency as the modern results could bring, and thus they differ in their values. For example, transportation improvements could critically affect the final result.[8] Therefore, a study made on different age data could bring to misleading and uncertain. Also, building material performances and material production efficiency will be enhanced over time and could be responsible for variations in measurements.

Different approaches to data acquisition may lead to different results. Some data derive from individual researches, while others refer to an Embodied Energy Database prepared by other researchers. Common database or individual data influence the final results meaningfully, because financial information, energy tariffs, and production costs usually diverge and affect the whole analysis.

Completeness of data

Researchers do not often have access to primary data sources, and then they rely on incomplete secondary sources of data[9]. Also, due to improper calculation methods, or to the subjective system boundaries limitations, this information is incomplete as well. In this case, system boundaries govern the completeness of data and also affect the results.

Technology of manufacturing processes

Technological representativeness is a relevant quality of the data taken into account, and it could affect inconsistency and variability in results as well[10]. Using different technologies for building materials in the same time and in the same location affect also different energy results. From the several methods, there comes large differences to the embodied energy figures [11]It is therefore asked

5 Fay and Treloar, 1998.

6 S.Pullen, 2000,
7 G. Treloar et al., 2001
8 G. Ding, 2004.
9 Menzies G.F. et al., 2007,
10 H.J. Holtzhausen, 2007, 377–385
11 A. Pears, 1996.

a technological correlation between the study and the data source. In addition, the ISO 14040 also defines the need for the technological representativeness of data while performing LCA products (ISO, 2006)

The Feedstock energy

The feedstock energy is considered in the calculation of the whole embodied energy and it includes the carbon quote taken from the atmosphere during the production process of such a material. Therefore, it is defined as a 'minus value' that removes the carbon quote from the analysis. Its inclusion or exclusion from the calculation could result in varying energy figures, many times not comparable between them.

Temporal representativeness

This is a vital quality parameter in the embodied energy analysis, because some studies are based on recently developed technologies, while other may consider a mix of old and new innovations. As Ding says, for the measurement process is difficult ro reach a universally applicable database of measured values. Therefore, it is of a great importance to state a set of guidelines to monitor the measurement process. Also, the need to accumulating becomes a fundamental aspect for a critical and clear figure of the data information consistency.

An approach of these parameters to a sustainable festival

The chosen approach must highlight all the operational and construction phases of the event, so a cradle-to-gate analysis is required, as set out in ISO 14040. In this way, it is intended to give equal importance to the construction phases, maintenance and the intrinsic capacity of the materials to give useful performance in the energy and sustainable conditions that are required for the event. The use of this methodology therefore makes it possible to offer a correlated development of a result that includes several areas.

Carbon Offset

One of the most effective and quickest ways of bringing any organisation into line with a significant sustainable improvement is through the introduction of a carbon offsetting strategy. In short, it is an operation that is carried out after the CO2e has been emitted during a certain event and the provision of a service, to which an offsetting strategy is used in order to fall within the parameters.
A method has already been proposed by the World Trade Organisation, in the form

of a carbon tax on carbon, heptrolium and utilised gas, to tax a certain quantity of used material in order to reintegrate its emission into the environment through vegetation. This taxation can also be traded through financial instruments called the Emission Trading System, in which industries and aviation present a carbon dioxide emission quota so that it can be emitted as payment to the company. Not only that, through the European Union Emissions Trading Scheme ETS, the allowances are also interchangeable and sellable at a certain price. These practices we have just described are all embedded within a regulatory scheme, where taxes are included and obligatory to be paid.
However, there is a second market, the voluntary market, where you can involve any company from any sector - and in this case also from the music event industry - that gives an additional safeguard on CO2 emissions. In this case, the integration of the forest, vegetation and forestry after the payment of a certain fee set by the organisation, allows to compensate the CO2 emitted during the concert and to favour its natural return to the environment.
In order to realise this theory, a certain quantity is thus defined, such that the use of a certain vegetation system allows a certain energy storage capacity. In order to achieve this, algorithms have been developed to define the amount of CO2 absorbed by a plant. This type of algorithm is based on the presentation of allometric equations. By allometric, we mean the ability of a body to increase proportionally with respect to all its parts at the same time.
The general equation presents that, the size of the weight of the organ concerned in the analysis is equal to the size of the body multiplied by constants that characterise its species. In the case of the vegetaizonde, numerous scientific studies have thus been able to determine growth factors that make it possible to forecast the growth of the plant over time, and thus determine the amount necessary for offsetting. However, this analysis also includes the geographical location and climatic conditions of the site to determine the capacity of a plant to absorb CO2. From this definition, a simplified predictive model is thus formed, allowing the carbon absorption potential of dry biomass to be determined. The value of the carbon thus defined by the dry biomass can thus be used to calculate the CO2 credit.
The methodology for determining storage capacity thus becomes very feasible through the following steps:
- Select a plant species
- Musing on the diameter of a species
- Use of allometric coefficients
- Calculation of mass using the allometric equation [12.]
- Assessing the CO2 credit of the plant, through the formula
CO2= M * 1,8325 gCO_2

12 The equation is $M= a * D^b$

15. HATN A TOOLKIT FOR SUSTAINABLE MUSIC EVENTS

The toolkit is called HATN, as an acronym for 'Here, All Together Now'. The primary purpose of this service is to create a virtual ground for the re-appropriation of sustainability in multiple areas of the event on different scales of operation. In order to achieve this aim, the toolkit creates cooperation between the various parties involved in the event, starting with the organising body, including the administration, the authorities, and all the promoters involved in the event itself; finally, the event-goers also have an active role and are not left on the sidelines in this implementation.

Scope

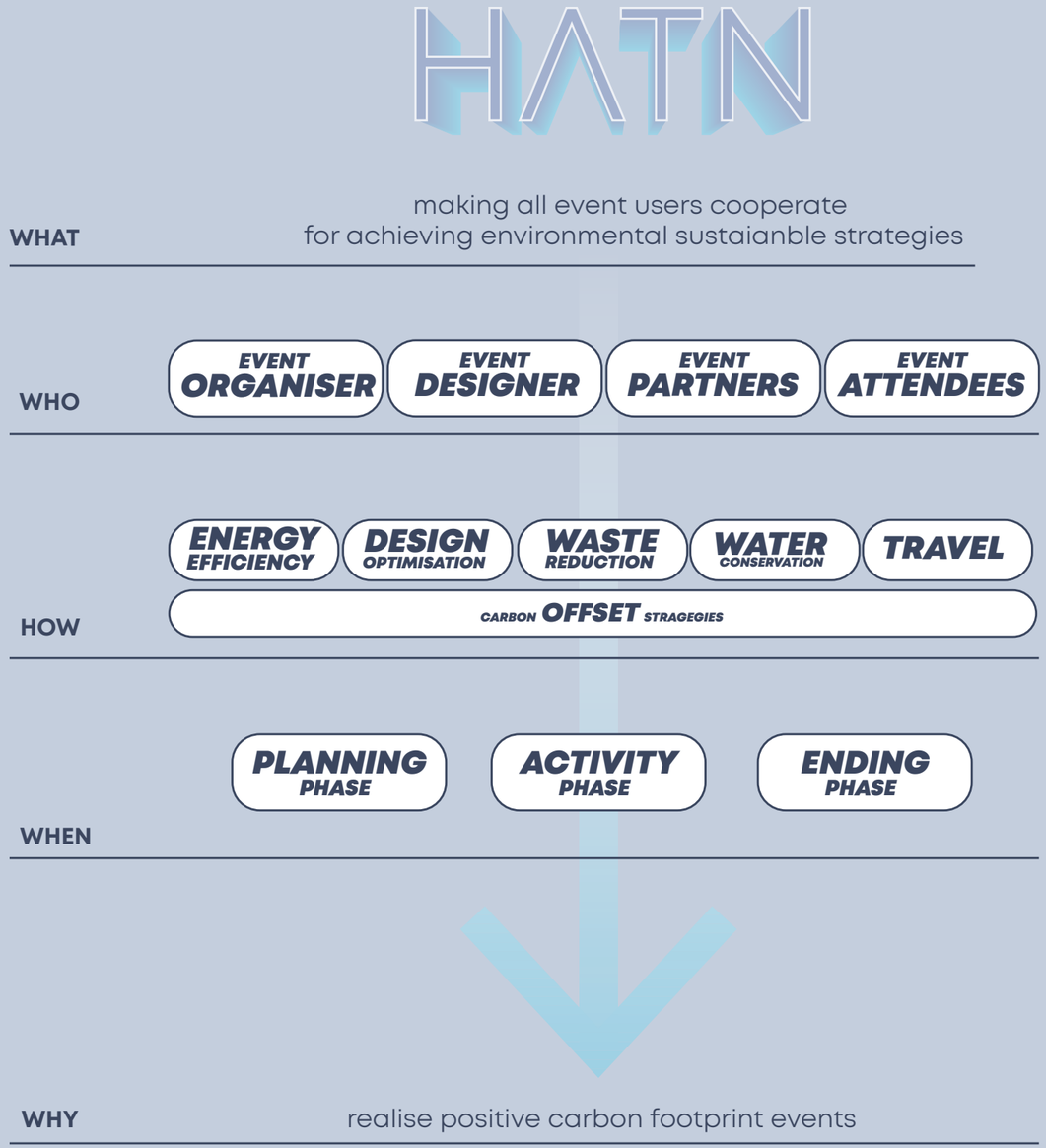
HATN aims to bring sustainability in its three fundamental principles, declining it according to the fields of application that we have been analysing at the environmental level. We believe that proper sustainable development is underpinned by a synergy of shared values that allow the process to cooperate simultaneously in its primary forms as if an entire city were to be built simultaneously from point zero. A chained and interrelated process with numerous other methods coming into play becomes how sustainability is developed within HATN.

In addition, following the typical realisation stages of an event, the software accompanies the organisation in the realisation and continuation of the work, creating a field of communication that promotes collaboration.

Goals of this strategy

Quantification of pollutant emissions is only the first provisional result that can be drawn from the programme. The planning and analysis process is already an integral part of implementing the entire event to provide the organisation with optimal and efficient calculation methods. In addition, the software offers telematic communication systems to integrate and actively involve all parties involved in the event, creating active cooperation with all stakeholders. This concept makes clear the possibility of this software to make sustainability an individual experience of each participant, in which each user benefits from a personal mission in which he is involved in the microcosm that belongs to the event. Every performer, spectator, vendor, voluntourism, or whoever finds themselves participating in the concert will have the possibility of being grouped in an active community in which, in parallel to the event, the task of making sustainability more alive in people's minds takes place.

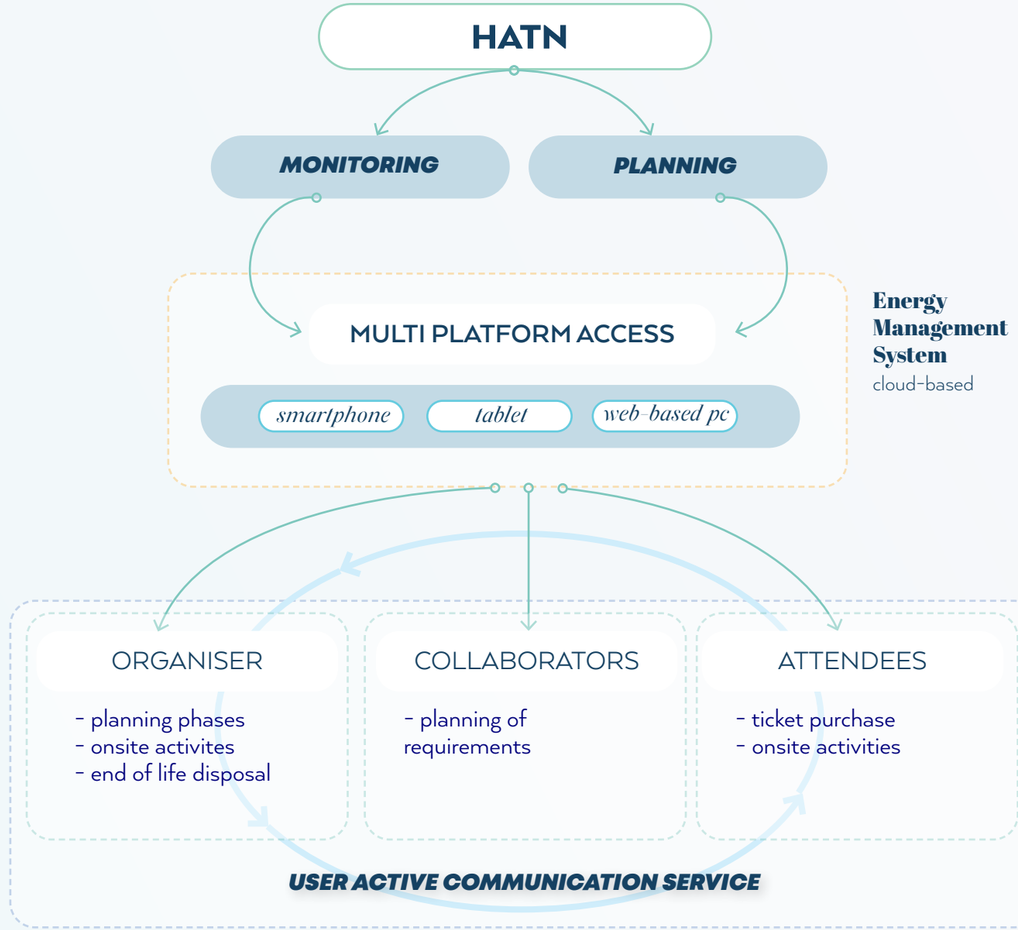
The presence of promotion, the efficiency of each, the respect, the values that make everyone join together sustainability in the process of cooperation that no longer stops at any one individual but gathers the whole community in its contemporaneity. Nonetheless, each user will have at their disposal practices



that can be implemented throughout the event. In addition, the software can render the negative impact positively generated by the event, thanks to the quantification of the final result and the subsequent programming of compensation strategies.
In summary, we could say that the final results of the programme are:
- make visible a spectrum of environmental impacts that the event causes
- create, plan, innovate event efficiency strategies reducing waste of resources and reducing polluting emissions
- involve in the process the whole community that the event creates within
- raise awareness of how sustainable practices create a real improvement in environmental impact
- make a real-time analysis of the activities that the event is producing
- setting up carbon offsetting strategies to transform the event from a negative to a positive impact on the environment
to summarise the idea, it makes cooperation as the primary and effective strategy to reduce environmental impact.

Targeting

Thanks to its involvement of different users, the software is meant for different types of use: personal computer, tablet and smartphone. Depending on the device concerned and the credentials entered, the software expands to a separate interaction space.
In computer interaction, the possible operations are those of compiling input data, visualising output data and interacting with the community. In the case of a tablet or smartphone, the possibility of using the gyroscope, accelerometer, GPS, camera and cellular data service systems allow for active interaction within the event with QR codes which, as we shall see, will call the user to enter the event in the first person with a sustainable approach.



Methodology

To explain the method used by HATN, let us consider the three parts involved in the software, illustrating the path that an event must follow to be realised from the first conceptual stages.
According to the literature review, for a correct realisation of environmental sustainability within any event, we have to include the concept of sustainability declined in its five aspects already during the first phases of the idea's ideation. Therefore, sustainability becomes a simultaneous process of conception that creates a proto-project that will be the same basis as the subsequent concept based on the concept design. Although this reasoning is somewhat intertwined in its definition, we are sure that the reader will be much more helped in understanding if we illustrate a practical example.
When planning an event, the organiser needs support in the decision-making stages to ensure that the cost-benefit ratio is met.
In this context, including sustainability as an environmental, social and economic concept becomes a process that can include the best sustainable approach in the cost-benefit ratio, thus retaining the only viable possibilities that can improve the field of reducing the negative impact generated by a festival.
This concept necessarily requires theoretical technical support, of which the software is an integral part.
Within the first decision-making phases, the organiser can include the estimation of people, skills and research of those involved in the event. By filling in the interactive form in the same way as for any registration of a building or artefact, the organiser can know from the first moment possible estimates of the sustainability of his project. For example, in the case of identifying a site, the organiser will already have available the criteria of irradiation present on the surface, the average weather, and how the event will be reached for calculating possible connections with the surrounding area.
The methodology, therefore, goes hand in hand with showing the event's ability to reduce environmental impact in a sequence of diagrams and comparisons. For this reason, all interfaces will include comparisons between a worst-

ORGANISATION
offsetting the remained
negativer carbon footprint

ORGANISATION
event design through
sustanable approac

COOPERATORS
sustainable
provisions planning

ATTENDEES
onsite
sustainable
activities

ORGANISATION
monitoring of
optimisation
methodologies

COOPERATORS
implementing
of onsite
optimisations

case level of negative environmental impact, which is then subtracted in all subsequent event planning. Nevertheless, the software is also configured as an active onsite monitoring actor, and it is for this reason that its meaning must also be included within the onsite activities. Therefore, the organiser will have access to a personal area within the software that provides for public and private spheres. In this case, after entering the software and confirming the initial choices of creating the event, it will be possible to involve partner companies and festival-goers in the project through two fields of interaction: a public community and private communication with the interested body or user. In this way, it is hoped to promote the effective communication that sustainability needs to realise its intent as a social principle. Nevertheless, as we have previously mentioned, it is necessary to include the three cornerstones of sustainability - environmental, social, and economic - sense it is itself always a synergy of the three elements that compose it.
Then, the organiser will cooperate with partner companies and users, quantifying their requests for services at the event site, which will be sent directly to the organisation in the pre-set topics. Within this phase, the software divides the application fields according to the main aspects analysed to reduce environmental impact: design, energy, travel, waste, water.
In summary, calculation methodology is presented as a summation of the positive and negative results of the service activities offered during all phases of the event. Input data pre-set by the partner organisations are directly transferred into the categories that influence the total count of pollutant emissions. Therefore each user of the event actively participates in the realisation of the service, and each user can benefit from it.

Structure of the process

Firstly, the software lands on a page where the user can access an existing project as a partner or attendant; otherwise, he can decide to open a planning programme as an event organiser.
In general, the software is divided into three major areas:
the planning & design phase,
operational phase,
the ending phase.
From an organiser's point of view, it will then be necessary to enter the essential data to open a personal page that different users can access and add partner companies.
Subsequently, partner companies will register on the website via a unique referral code provided by the organiser or, if already registered on the portal, obtain a login from the event organiser. Within a partner's page, the sub-organiser will enter data according to what they require during the event. For example, in

SITEMAP

- - - ONE-SIDED DATA TRANSFER
—— ENABLED USER ACCESS

LANDING PAGE

ORGANISER INTERFACE

SIGN UP DATA
- NAME
- COMPANY
- LOCATION
- DAYS ACTIVE
- PARTNER COMPANIES

PARTICIPANTS
- ATTENDEES
- CREW
- ARTISTS
- STAFF
- TRADERS
- BARS

SOCIAL
- PUBLIC POSTS
- PRIVATE CHAT

PARTNER INTERFACE

SIGN UP DATA
- NAME
- COMPANY
- CREW

REQUIREMENTS
- ENERGY
- TRAVEL
- DESIGN
- WASTE
- WATER

SOCIAL
- PUBLIC POSTS
- PRIVATE CHAT

ATTENDANT INTERFACE

SIGN UP DATA
- CREDENTIALS

TICKET PURCHASE
- SUSTAINABLE TRANSPORT
- EVENT CRITERIA

ONSITE ACTIVITIES
- ENABLE SERVICES
- MONITORING
- 'GREEN RANKING'

SOCIAL
- PUBLIC POSTS
- PRIVATE CHAT

PLANNING INTERFACE

DESIGN

ENERGY SOURCES PLANNING
Energy provision design based on available renewable energy sources, offereing interactive planning scneraios

ENERGY AREA PLANNING
Energy provision design based on different area requirements and specific carachteristics

ENGINE TREATMENTS
Diesel engine optimisation and treatments for reducing carbon related emissions

RESULT

ENERGY

EMBODIED ENERGY AND CARBON QUANTIFICATION
Quantification of the whole embodied energy and carbon derived from venue temporary structures

ALTERNATIVE SOLUTIONS
Implemenetation of innovative solutions

RESULT

TRAVEL

TRAVEL EMISSIONS ESTIMATIONS
Estimating the whole travel emissions thanks to the integrations with the ticket purchase interface and the organisation sign-up data

SINGLE USER OFFSET STRATEGIES
Planning of a carbon tax per user, according to the different transportation methods selected

RESULT

WASTE

MANAGEMENT STRATEGIES
Planning of waste carbon emission reductions, thanks to multiple offsite and onsite features

WASTE ESTIMATION
Based on the sign-up data and the case studies database

RESULT

WATER

CONSERVATION STRATEGIES
planning of water reduction through multiple features

ESTIMATION OF CONSUMPTIONS
Based on the sign-up data and the case studies database

RESULT

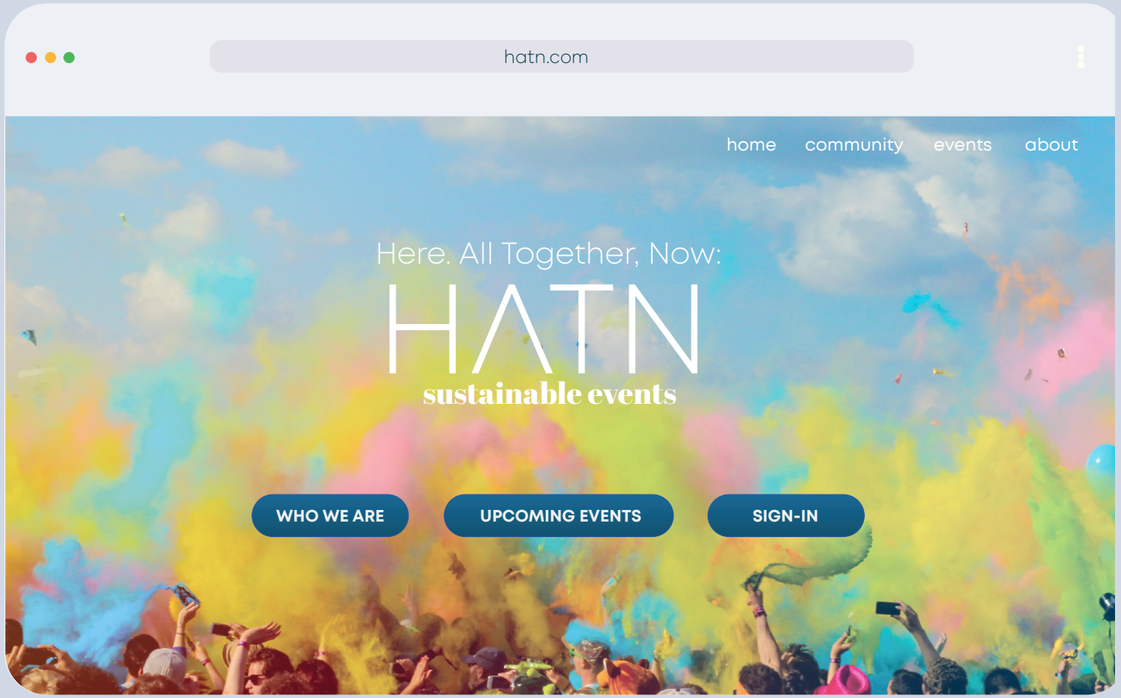
kg/CO_2 per user

OFFSET STRATEGIES

CARBON TAX	allocation of a fee to be charged to the various users
VEGETATION REDEPLOYMENT	collaboration with organisations for the emissions rehabilitation
CO_2 COIN	event currency to favour sustainable activities that will reduce the final carbon tax

BALANCED EMISSIONS

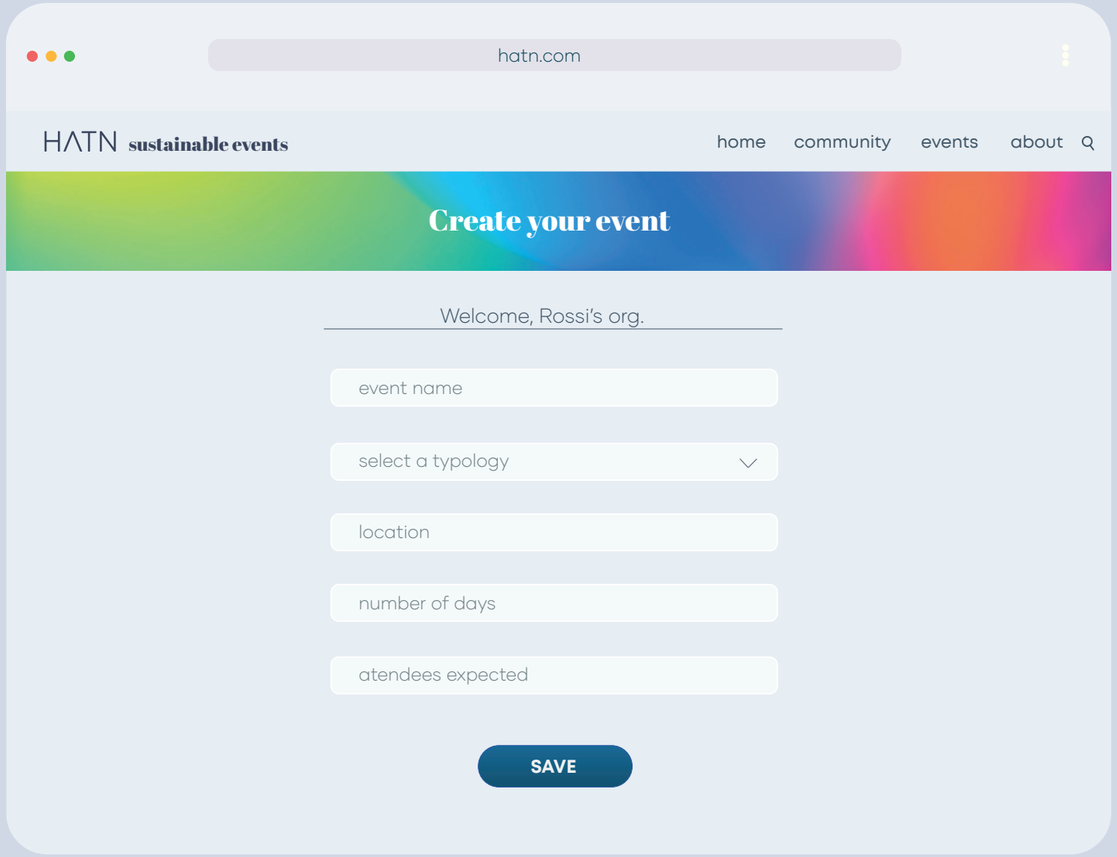
a performer's situation, he will get a screen asking his staff to estimate the lighting and video energy demand needed. Also, in the case of a trader, informations about space required for sales will be provided. Similarly, other partner companies will be guided in creating the required profile by receiving a real-time spectrum of how their requests will lead to possible consumption and environmental impacts, which could be reduced through strategies that they may decide to implement. In addition, each user included in the portal can open a private or public chat to contact the organisation or other users within the project directly.
'Communication times' will therefore be considerably reduced, as real-time priotary chat will be possible. After the first phase in which partner organisations make their requests, data will be sent directly to the planning phase of the festival organisation. Therefore, these input data are transferred directly into the software that allows the organisation to achieve the planning phase. Within the organisation planning interface, the software subdivides the categories into which it can operate: Design, Energy, Travel, Waste and Water. For each aspect, the software proposes to the organisation already feasible and innovative strategies to reduce the event's carbon footprint. Depending on the categories identified, it will be possible to obtain a strategy for quantifying the number of participants, the operational energy and operational carbon of service, the embodied energy and embodied carbon of a material, or the implementation of guidelines and criteria significantly improve the carbon footprint.
Also, the organiser can understand how the event has a more significant environmental impact and how it can still develop strategies to minimise polluting emissions in the identified areas.
In the second phase of planning, the sale of the ticket for the event will be put in place so that there is a real-time quantification of the number of participants and whether the planning results reflect the reality of the facts or the calculations need to be corrected.
The organiser becomes aware of the actual emissions that the event may generate and proceeds with other strategies to minimise the impact further. Within the structure, we then move on to the carbon offset service, which covers the current planning phase and the activities' subsequent active and end phases.
Within the offset category, further strategies can be identified to present the organisation with services that will carbon-free the event. In this phase, partnership with other festival-goers will be crucial to success.
Within the operational phase, it will also be possible get a live monitoring progress of the festival services during the event, thanks to the computerisation of the structures included; however, due to the complexity of this service, we will proceed later to explain how this service is implemented in the onsite activities.
At the end of the activities, the event quantifies the final results and the period needed to reward the carbon footprint impact. Also, a report can be produced to illustrate the most effective methods of implementation to subsequent implementations.
We shall now proceed with the presentation of the project, showing the different activities assuming the chronological order in which they will be implemented. Depending on the activities, we will also indicate the point of view from which the user interfaces.



Organiser point of view

1. Sign up

The software loads up, the organiser will be asked to enter the specific credentials of the primary user. Then, by setting up his event creator profile, he will be able to subscribe his event to a customised portal where he can start planning and monitoring activities. Within this screen, the organiser will also have a page for the standard feed where the community he chooses to include can exchange messages publicly, share news, images and videos, or private messaging service to get in touch with the event.
In the event creation area, on the other hand, the organiser will be asked to fill in preset fields:
- Name of the event, to identify the event to partners and attendees who would like to participate
- Name of the organisation, previously registered in the site registration
- Event location, selectable via APK with geolocation services
- Number of expected attendees
- Days of activity, useful to quantify the environmental impact and to coordinate choices with all members of the organisation
- Type of event, with activities included, so that subsequent partner companies can more easily have themselves in the organisation
-Identification of required spaces, such as trade, campsite, or stage areas
In addition, in a second table, it will be possible to add by username or corresponding email users as partners of the event to which wishes to involve in the team.



Design

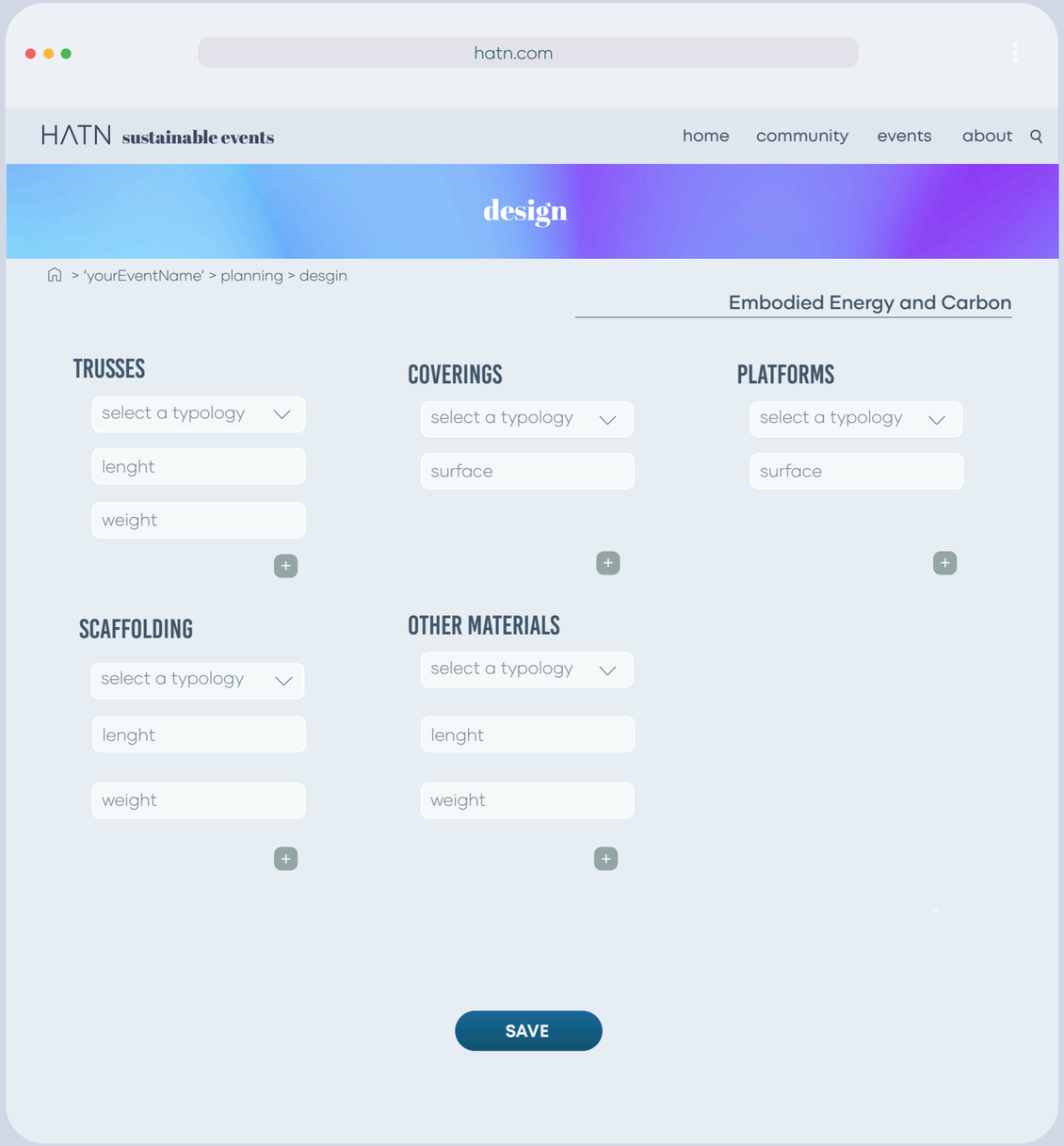
Based on the data knowledge acquired in the sign-up page, and in parallel with the design development of the event, the organiser can have the quantification of the pollutant emissions relating to the construction of the temporary facilities completed.

Embodied energy quantification

In this first strategy, the organiser is called upon to use a series of preset catalogues to define the number of materials present in the temporary structures. Thanks to the modularity of the temporary networks, within this interface, the user can specify the quantity of:
- Towers + trusses their relative dimensions
- number of platforms
- Scaffolding used

If there are additional materials, the interface allows you to add them. Alternatively, a less precise calculation can be made by entering the total area indicated for different element types:
- Stage
- FOH
- Gazebo per units
- Other general temporary structure

Upon completion, the system will respond with a calculation of the corresponding embodied energy and embodied carbon. Nevertheless, it is hoped that the interaction within the community of these forms of renewable energy will produce sustainable solutions to be disseminated and applied in the future within the programme as implementable alternatives.



Energy

In this category, the organiser chooses the primary sources of energy supply that can be used in the event. The data is interfaced with the previously assembled design category and also based on the partner companies. Just as was the case for the space request for the design category, the input data from the sign-up phase (possibility of installing photovoltaics and wind power and their maximum efficiency) is directly assimilated into this category and the energy requests from the partners who will participate in the event.

Area energy-planning

The organiser can determine which and how many areas the venue will require operational energy. In compiling the data, the organiser has the previously added quantifications as input data,
- number of areas and on design
- the estimated number of participants
the software will calculate the required input for each area, showing a population of the operational energy needed for each area

Energy sources planning

The organiser is asked to complete and confirm a planned energy amount for the event. Based on the request for operational energy, the organiser will have the option to interact with the output result. In this first strategy, the software asks the organiser to enter the possibility to implement the following Renewable Energy Sources:
- Main Grid
- Diesel generator
- Biodiesel generator
- Photovoltaic system
- Wind Turbines
- Other onsite human activated sources (i.e. kinetic energy, floor energy, urine power)

According to each event area's energy requirements and the maximum possible energy efficiency offered by each Renewable Energy Source, the software will calculate different possible scenarios for reducing pollutants from the energy supply. Nevertheless, the organiser can include or exclude one or more forms of energy supply and change the final route..

Engine treatments

Based on the data previously obtained during the analysis, the diesel engine is an almost indispensable solution for every event. Although there are fields of innovation in which it is possible to avoid its use, backup generators are almost always present, especially for areas wholly disconnected from the national grid. Therefore, the system also includes in the calculation a series of engine treatments to reduce polluting emissions. The strategies are indicated in four categories: Electrical, Mechanical, Post-treatment, Internal-treatment.

Travel

In the transport quantification phase, real-time updating will allow the organisation to keep track of pollutant emissions. It has been not easy to calculate transport emissions due to the variety of data coming from all users. In this case, the toolkit, thanks to its synergy with the cooperation between the partner organisation and attendees, can track emissions according to user requirements and monitor statistical trends based on strategies proposed already in this planning phase.

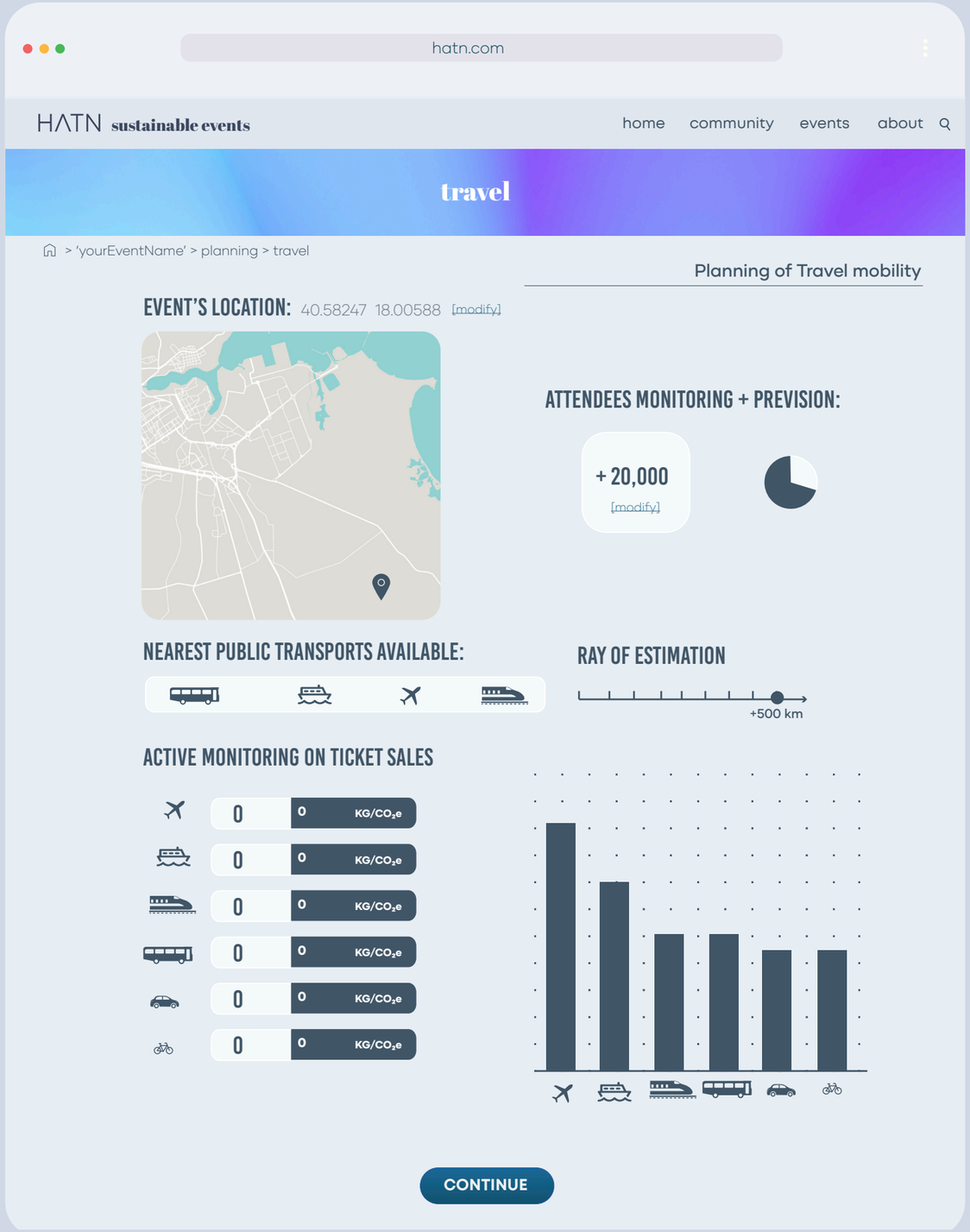
Monitoring of results

By analysing the geolocation of the event, its reachability by different means of transport, and the typical turnout percentages for each event, the organiser will receive primary data to compare the possible pollutant emission from transportation for the event. In addition, output data from partner companies and attendees will also be helpful for the calculation. As we move on to analyse the software from the user's point of view, we can see how we can input their data directly into the organisation's interface to achieve even greater efficiency and help the organisation offer the best possible service to its customers. However, the software also proposes several strategies for improvement, which we see below.

Optimisation of travel methods

In this phase, the software proposes to the organiser to reduce the polluting transport emissions, according to different solutions that can be implemented, depending on the possibilities offered by the venue with the services that can be reached in the vicinity.
HATN, in this case, proposes hypotheses of emission reduction for:
- personalised train transport
- personalised coach transport
- personalised car-sharing service
- vehicle2grid services
- scooter sharing

at this stage, cooperation through the communication service will prove practical and essential for the user so that local authorities, transport rental companies and all other organisations that can take part in the transport efficiency service can easily cooperate.



Waste

The organiser will have input data from the activities chosen by the partner companies to which he has given access in the planning of the event. Moreover, in this case, the activities can be subdivided into prioritised strategic activities and compensation strategies. This strategy is strictly determined during the onset and activities, and it will therefore be challenging to have a specific a priori forecast of the behaviour of the attendees. it is in fact from the capacity of the attendees that a good percentage of the efficiency of this service derives. For this reason, it was decided to take inspiration from the LEED protocol to create a series of checklist elements that can quantify the event's capacity to reduce the pollution deriving from waste.

Planning scenario

In this first interface, the organiser will be made aware of the provisional quantification of waste, the traders' numbers and other input credentials entered while creating the event profile. The organiser will then be provided with a vademecum on how to maximise the efficiency of storage during the event and create an appropriate number of areas according to the event.

On-site strategies

Within this panel, the organiser can follow detailed guidelines that will plan the scenario to optimise pollutant emissions. These strategies are strictly determined during the event's activities, so it is up to the organiser to follow the guidelines offered here to achieve the best possible realisation of the expected results. The software will quantify the radius within which the ecological islands can be placed, including guidelines for identifying the different areas.
There is also the possibility of including the supervision of activities which, according to statistics, receives an improvement of 50% of the final result.
Furthermore, by choosing to avoid plastics use or the use of specific compostable materials for refreshment services, further improvement will be achieved.
For campsites, where a high number of drop-outs has been observed, guidelines are provided to the organiser to maximise the return or care of the place made to the individual user. These services are predominantly predictive scenarios. For this reason, it was thought to introduce a new concept of motivational leverage within these activities, which will later be described within the offsetting strategies.

Water

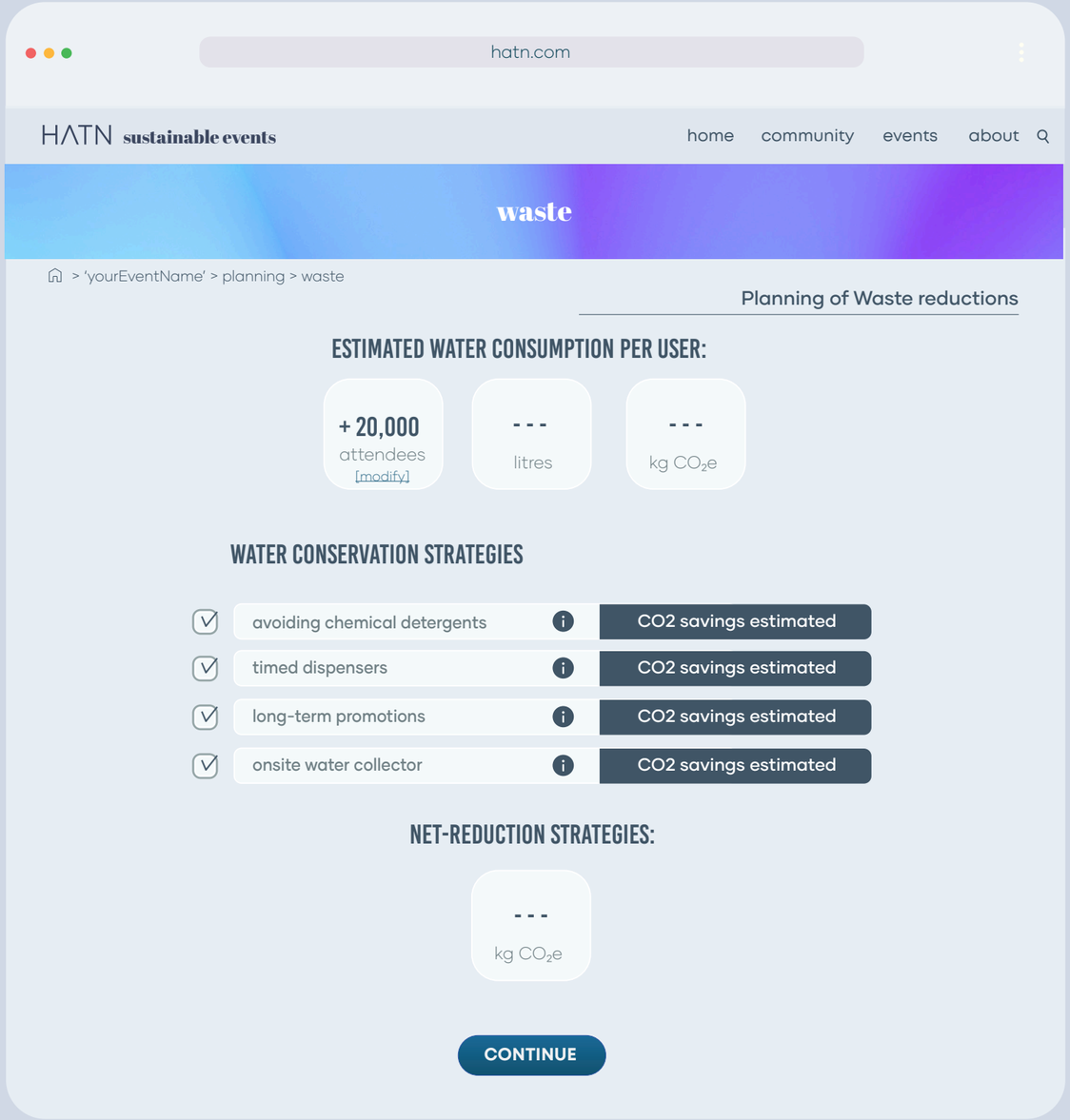
Water use is a service that can only be considered as efficient, but not as reducing it to a certain minimum threshold. For this reason, it is considered that water within the event is always available, but according to a strategy of avoiding waste. For this reason, similar to the approach taken with waste strategies, HATN provides the organiser with strategies and guidelines that allow the quantification of a practical improvement in service.

Monitoring results

Based on specific data of a minimum resource to be offered to the individual user, the software calculates the polluting emissions from water use. As water is a primary good whose use cannot avoid, the practices proposed to focus on the possibility of safeguarding the good and avoiding its waste.

On-site strategies

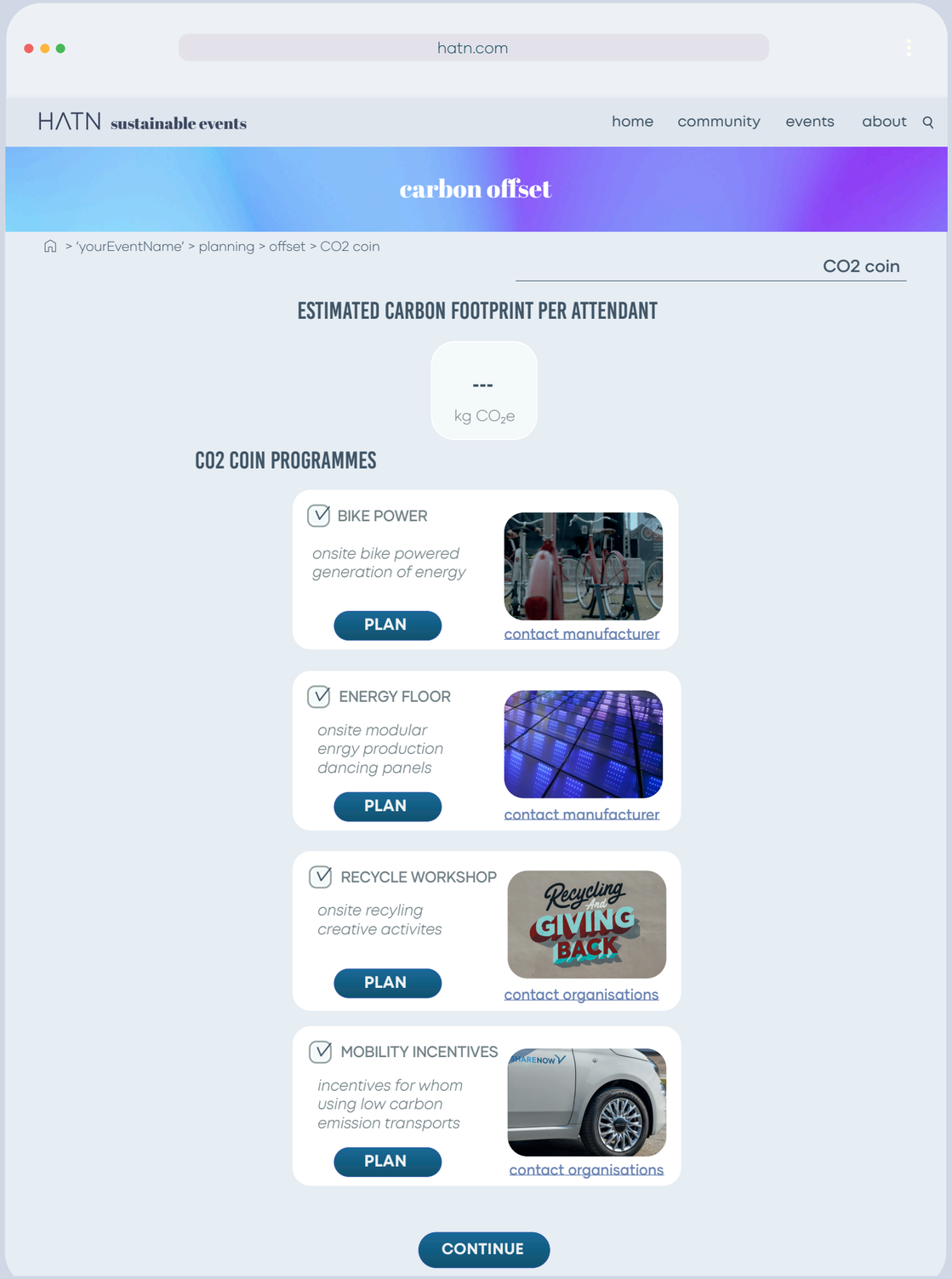
- Water collection points
- Proximity sensors for use
- avoiding chemical compunds
- promotion of long-term awareness-raising practices
- introduction of the AquaSeek service



Short-term offset strategies

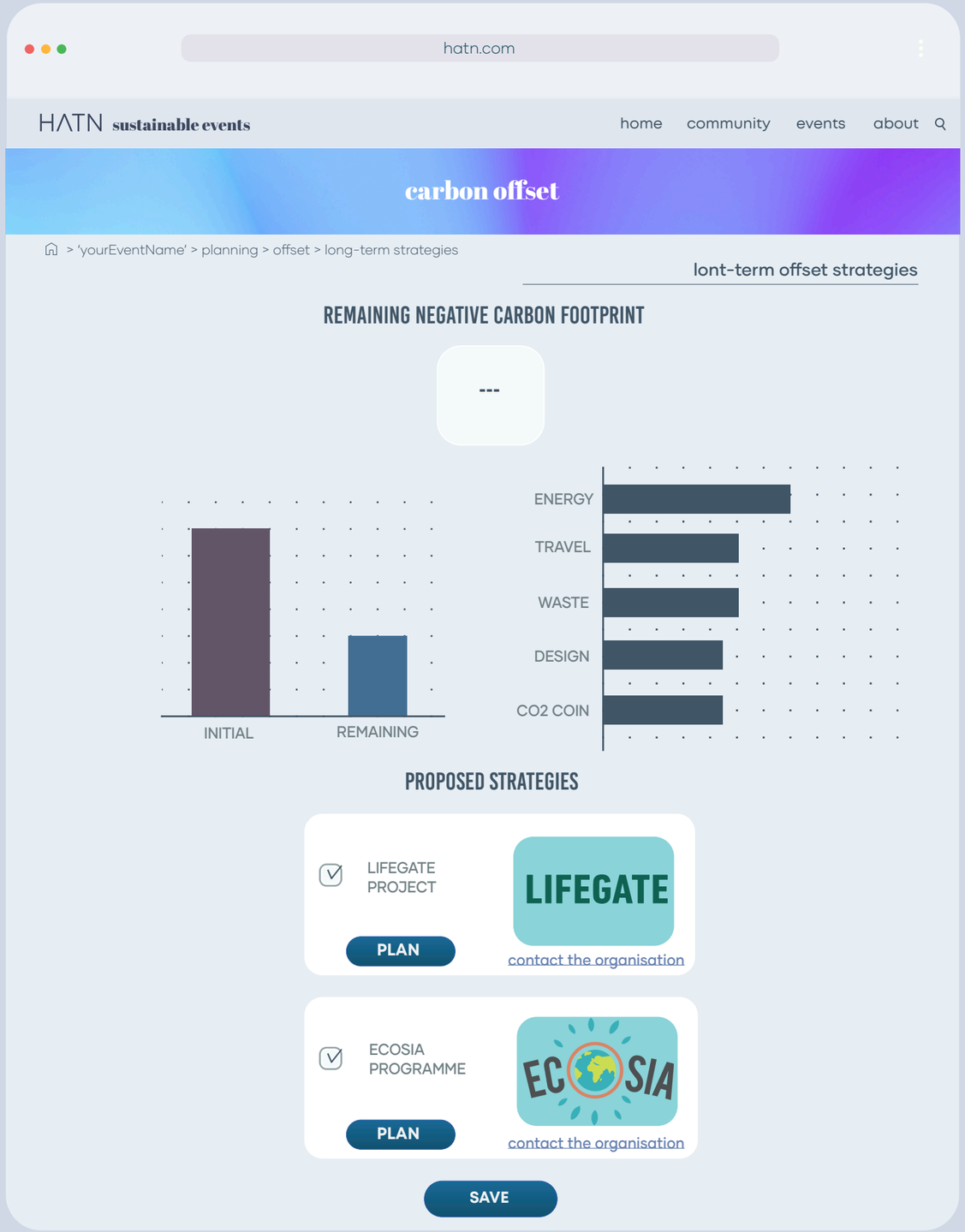
CO2 Coin

The implementation of this service is designed to be able to monitor, offset, and implement strategies to engage the organisation with users and all attendees. In summary, the co2 coin is a form of money exchanged between the organisation and all interested users, whereby a sum of money is paid to the user who performs a service that offsets or reduces expected CO2 emissions.
In this case, when a user within the organisation carries out an activity that can produce energy, participates in workshops on sustainability awareness, differentiates his waste, or contributes to a workshop to implement sustainability strategies, he will receive a sum of money corresponding to the amount that the organisation itself would have had to pay to compensate for the emissions that would otherwise have occurred. For this reason, in order to implement the currency in the event, it is necessary to be aware of the polluting emissions of the event and how much these can be converted into a carbon tax that can make the event carbon-free.
In this interface, the organisation can choose the main activities to be implemented in the event. The categories of implementation are as follows:- Energy production: with devices for generating energy with the help of human activity
- Waste reduction: by carrying out proper waste sorting or following voluntary practices that can help the organisation reduce the production of waste
- Mobility emission reduction, determined by the choice of transport methods with less environmental impact. The corresponding sum will be given to the user to use for additional services during the event, such as purchasing services from the trade areas.v
- Onsite activites: within the event, activities are planned to reduce the carbon footprint, both in terms of onsite emissions and good practices to be implemented in the future; reforestation activities are proposed, as well as workshops for the reuse and recycling of materials.



Long-term offset strategies

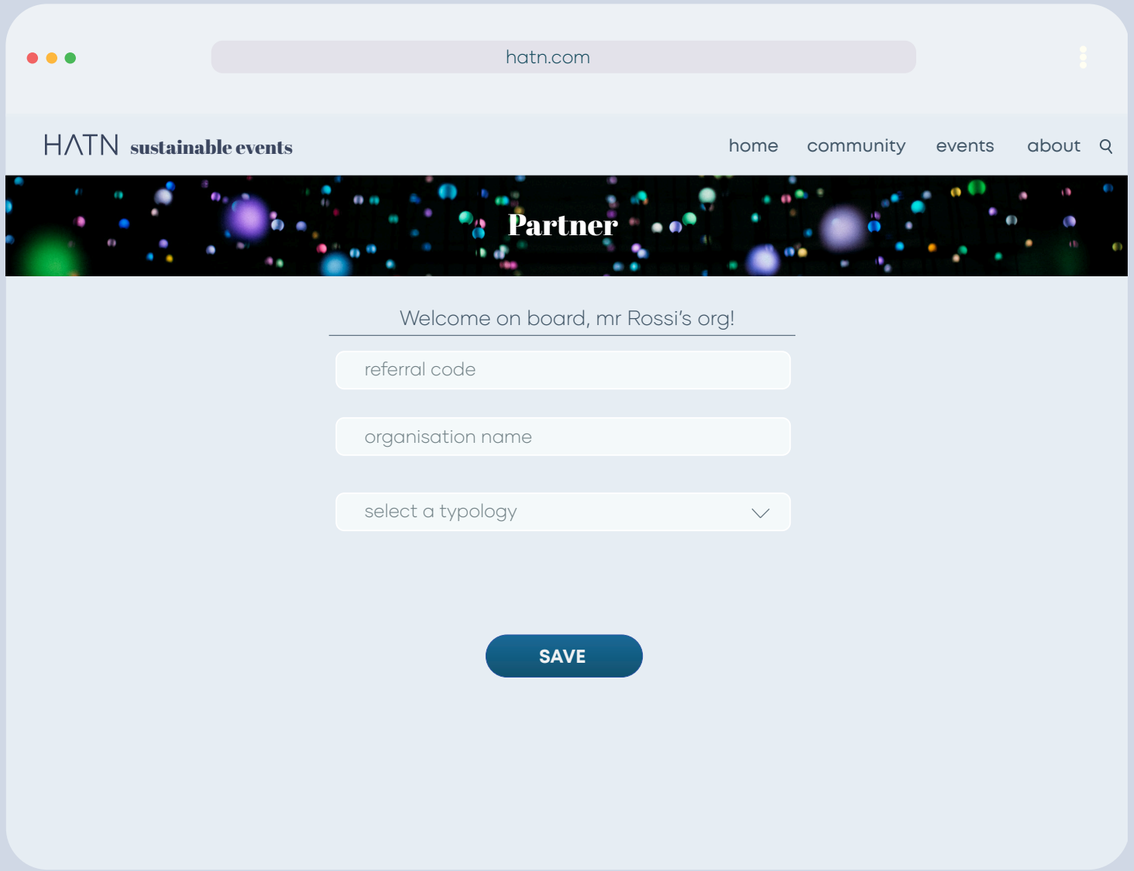
At the end of all the event's activities, the software will release an interface with the results collected with the output data coming from the different users and allow the organisation to include within the forecast data also those monitored.
From these results, the event will offset the remaining part of the event's emissions and allow the event to be carbon-free.
The automatic production of an emissions report will allow the organisation to show the event as a case study in a press release, disseminate success factors, and participate with other event sustainable management organisations for further efficiency certification.



Partner point of view

1. SIGN UP

The partner will still be asked to register as any other user, identifying himself in his basic credentials and primary professional role. This information is helpful for the organiser to determine the user and include them in the workspace. The partner will be asked to have the number of people involved in the activity and the main types based on the same characteristics.



2. PLANNING PHASE

Partner requirements

For this phase, partners are also asked to register their applications. Each partner will have the possibility to fill in the five planning categories: Design, Energy, Travel, Waste and Water. For each category and according to the partner's main activities called upon to collaborate, the required categories will be available to be filled in. For example, in the case of a performer, their management will be asked to fill in the Operational Energy values that will be required for the performance on stage, special transport or other needs that will be filled in the request. Each partner will receive a report on their activities needed as an output of the software to monitor their current conditions; in addition, through strategies proposed by the software, emission reduction scenarios will be presented for each activity. At the end of the compilation phase, the output data will be sent directly to the organisation's portal to proceed with quantifying the resource requests for the entire event.

3. ACTIVITY PHASE

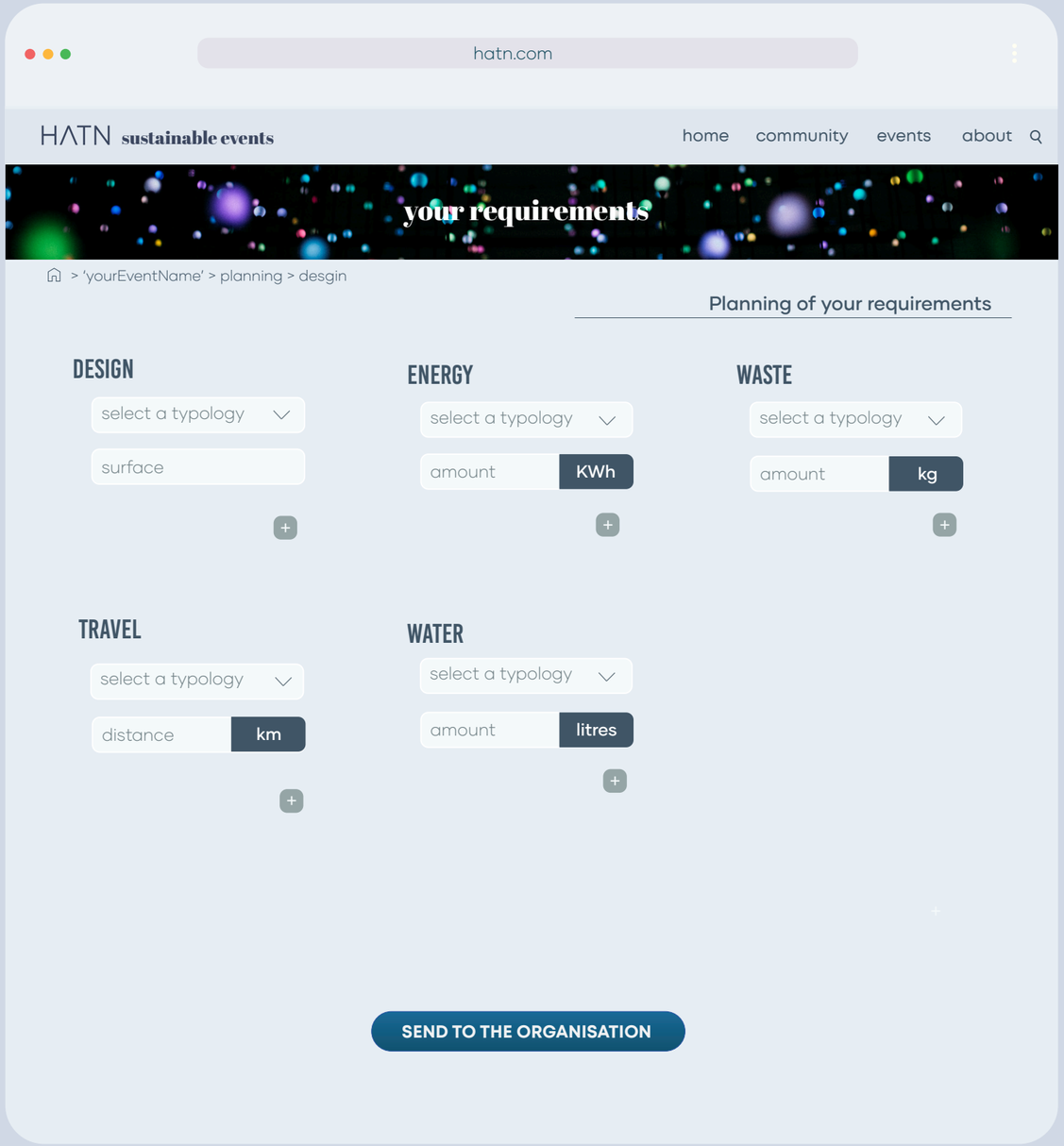
Monitoring

Thanks to the implementation of activities on smartphones and tablets, the partner will monitor the activities in his area. The monitoring of energy, waste, water will be implemented, where the actions will produce a real-time result of the trend of energy requests and emissions. The service will also be implemented in the CO2 coin system to participate together with the participants in the realisation of the CO2 offset.

4. ENDING PHASE

Final results

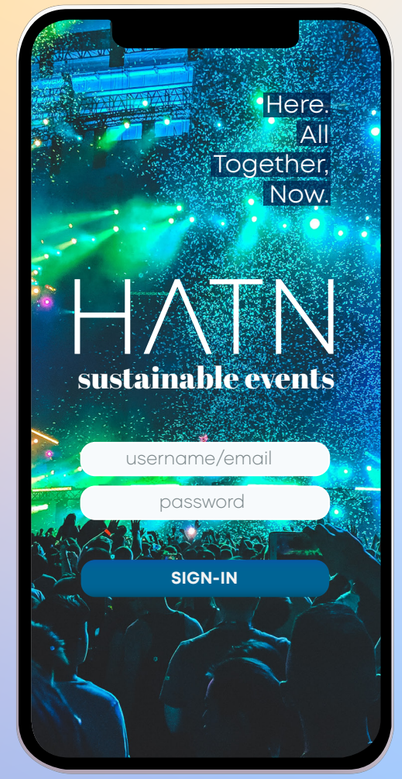
At the end of the activities, the partner will be given a report on the results achieved, which will be available to the organisation. The partners with the highest score will be ranked for the best sustainable approach to implementing their activities.



Attendant Point of view

1. SIGN UP

The attendant is also required to register so that the personal details can be helpful to both the organiser and the partner to tailor an event to their needs. It is thought that, based on the surveys analysed in the chapter on transport, surfing activities are more popular with young people than with adults. In addition, the possibility of proposing tailor-made services to customers based on specific requests for services they would prefer to have at the place of the event is also being considered. Finally, the attendant user will also log in to the community and have the same messaging and social communication functions as mentioned above.



Ticket purchase

When the user decides to participate in the event, he will go to the HATN website to access the ticket purchase service. When purchasing a ticket through the platform, he will choose different purchase methods depending on the means of transport he decides to purchase. If the attendant buys a ticket linked to a train or bus scheduled by the organisation, the user will directly receive a CO2 coin credit to use during the event.
The information concerning your details entered at the time of purchase will also be helpful to the organisation in planning the activities of the services and allometric compensation for the even

Sustainable sactivites and CO_2 coin

As mentioned in the section on organiser POV, the co2 coin is a form of monetary exchange in which both the user and the organisation can benefit from the efforts made to reduce the environmental impact of an event.
The system is designed to be adapted to a smartphone app in which the attendant, using a QR code, can access a predefined service and implement his activities to reduce environmental impact. Throughout the duration of his activity, the app on his smartphone, in connection with the HATN server, will take into account the efforts made by the user and will pay for them based on the quantification proposed during the planning stages.
The credit will be inserted directly into the user's virtual wallet. At the end of the activity, the user can use the credit for purchases within the event or keep the money in his virtual wallet, being real money spent in the event or outside in other participating activities.

Green chart

As in the case of the partner, the user will also receive a personal report in which they attest all the activities they have carried out to reduce the impact on the environment. In addition to meetings with the artists of the event, the prizes can also be thought of as cash donations or participation in subsequent editions of the event.

CONCLUSIONS

Path description

This work has attempted to delve into the study of architecture in creating ephemeral architectures and temporary events. There is no doubting the difficulty of approach that has arisen since the drafting of the first advances. The terrain of temporary events has presented itself in sometimes new knowledge, and the contemporaneity of its initial approaches makes it even more challenging to delineate present and future sustainable practices. For these reasons, we wanted to start this work by presenting the previous experiments, where the proto-sustainability among events, as we mentioned in the first chapter, was still in development even when their sustainable intents were not clear.
However, this analisys has led to a new approach to research and work. Regeneration, eco-tourism, Social community are at the foundation of the mas-event era of the postmodern period.
Therefore, the description of the sustainable complementarities among events leads to the primary key points, relevant practices and clarified to the lecturer the essential methodologies in which sustainable events are still finding paths. These paths are particularly clear in the thesis follow-up when the lecturer will know about the main regulatory framework and the main sustainable aspects.
We have now intended sustainability as the coherent synergy of different practices among several various services and applications.
Also, in the contemporary event, sustainability must face regulatory and technical issues that will not allow organisations to develop new innovation frontiers before these practices will be successfully involved in the administrative framework.
However, our architectural knowledge gave us new inspirations for the continuation of this development. Also, the principles of circular economy and life cycle assessment played a crucial role in this project. Due to its several synergic cooperations and its several realisation phases, we are now conscious that the event needs to involve a sustainable approach in each part of the step-by-step activities.

Errors and acknowldges

Nevertheless, this consciousness was not error-free, attempts and failures.
The first approach of this work was to carry out sustainable innovations only in the energy field of the event. Firstly the idea was to implement a microgrid structure with solar panels to support the internal energy supply of a mass event. However, feedbacks from current event organisations has shown that these practices, while remarkably ambitious and leading the way soon, are not being fulfilled in the current era. Renewable energies are still defined as 'not responsible enough' to safeguard the success of an event. The use of the diesel generator, at least as a backup, remains a substantial resource in almost every type of event we have been able to analyse. However, aware that the 'holes in the water' are the real guide to a successful experimental project, we continued our research, broadening our view and proposing a new approach that would first take in stage design and waste and water conservation factors. We thus came to realise that the event, in its realisation, did not so much require sustainability that could go towards technological innovation, but rather through the technological synergy between all the elements, thus favouring innovative ways of making the sustainable approach that the event is currently taking even more conscientious.

'The architectural approach'

The architecture approach was fundamental in dealing with environmental issues, and it is from this architectural background, we were able to find points of convergence. Thanks to this cooperation, following in the footsteps of the life cycle assessment and the embodied energy principles, the toolkit decides to take up the possibilities that exist at the moment and buy a new approach to efficiency.
At the end of the toolkit's design, the realisation of an event is the management of organisational machinery which converges together numerous criteria, skills and regulatory frameworks and make cooperation sustainable, as another figure which the event organiser often only has to deal. For these reasons, our aim has also been to find ways of relieving the excessive responsibility given to a single body to encourage cooperation, which is also the cornerstone of correct, sustainable planning. The synergy between different elements is adequate; just as in a motionless architecture, it is necessary to assemble all the pieces to realise the construction process fully. For this reason, the analysis has encountered severe approach difficulties, especially in the initial stages. At the moment, an event that can use this toolkit is considered to be very modern and sustainable, an event that succeeds in its entirety in conveying all the sustainable criteria that we have elicited in this work. An event with the proper approach to sustainability is aware that, as in the case of a real sustainable architecture, sustainability is a mission, a common goal, a single purpose that all those involved in the work want to achieve. Therefore, the natural conclusion that we were able to draw is a new contribution that makes everything that is now being realised within an event even more united, autonomous and cooperating in each phase of realisation and decommissioning.

Our Contribution

This studio constantly improves and supplies new methodologies, but its higher efficiency can derive from its cooperation. For this reason, the most significant contribution that we could give was to create a unique synergy to which all users can be conveyed, called to participate and act, just as it happens within an architectural project. This new approach has roots in analysing the actual experiments and the new intents that the events are bringing on. Therefore, we want to leave the lecturer and the event community all the aspects, principles, and techniques that have brought us to our innovative strategies. We aim that this work will be helpful in the future of the innovation and leaving new steps to get to the event industry new tools for going their aggregation as was born to be:
'Here, All Together Now'.

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Once, when I was little, my sister and I played a little show for mum and dad.

I loved that moment because I saw how the apparent normality of a house turned into a show for my family and me.

Also, in that moment, I realised how much I love the empathy of a concert.

This work is my humble contribution to my great lover, music, for the emotions that always give me.

This work is dedicated to all friends and to those

who will be friends.

Sustainable values are not desaturated to disappear:

they are part of the new world that brings with it the desire to create, build, and live one's life as one loves to do so.

Long live music, entertainment and friends, therefore.

Thanks to those who told me strength is our life and mother.

Thanks to those who gave me the support to believe in these pages.

Thanks to my family who gave me birth and to the friends who gave me rebirth.

Thanks all those who, when I felt alone, have told me to stay All Together, Here and Now.

I am sure that you have been the bread of my happiness, the breath of my inspiration.

Here's to always persist

here's to all of our happiness,

here's to our strength,

here's to always being lyrics to the music of our lives.