



The carbon footprint of Way Out West 2019

An updated assessment based on data for 2019. A preliminary assessment based on data from 2018 was published in August 2019.

Maria Nordborg (maria@svalna.se)
David Andersson (david@svalna.se)

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Abstract

Oatly, one of the main sponsors of the Way Out West festival, contacted Svalna (www.svalna.se) in June 2019, and asked Svalna to calculate the carbon footprint of Way Out West, in line with Oatly's campaign for increased carbon transparency. This report presents the final results for Way Out West 2019. A preliminary assessment was published in August 2019.

The carbon footprints that Svalna have calculated include the *largest* emission sources associated with *arranging* the festival, and that Luger, the festival organizer, directly controls. Visitors' emissions associated with transportation, accommodation and consumption of food and drinks are not included. The system boundaries were defined based on what is considered necessary to fulfil the *main purpose* of the festival, that is; providing paying visitors with music and other cultural events on the festival grounds. Emissions associated with sponsors, and with provision of food and drinks, were therefore excluded from the assessment.

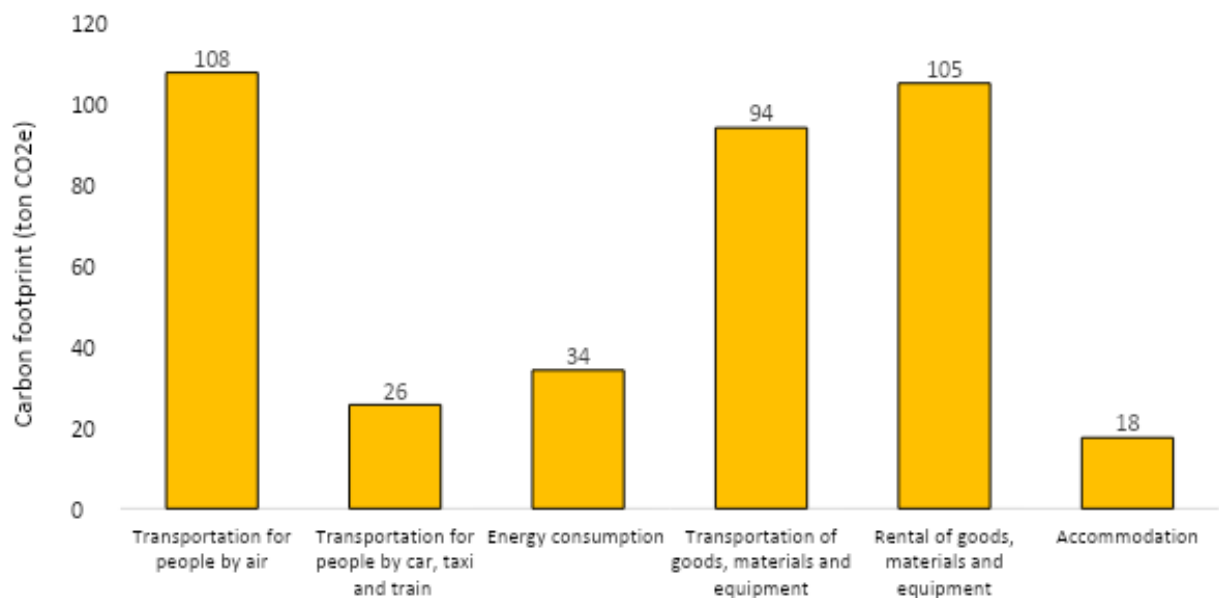


Figure 1 The carbon footprints associated with arranging Way Out West 2019.

Emission factors for different materials, products and activities were obtained from life cycle assessments, and from so-called “environmentally extended input output analyses” by Statistics Sweden. The results are presented in emissions of greenhouse gases in carbon dioxide equivalents (CO₂e), associated with different objects and activities at and around Way Out West, and for the entire festival.

The carbon footprints represent the emissions associated with *arranging* the festival, in the areas of transporting people and goods to and from the festival, renting equipment, material and goods required to arrange the festival, accommodating artists and Luger employees, and consumption of energy. In the first part of this project, conducted during the summer of 2019, Svalna also calculated the carbon footprints of various items used at the festival, e.g., staff clothes, a coffee machine, Oatly's DJ booth, mobile phone charging, etc. Those results are presented in the report published in August 2019 (available here: [\[link\]](#)).

https://svalna.se/sites/default/files/rapport_wow_2019.pdf), but not included here. This report only includes an updated assessment for the whole festival.

The carbon footprint of Way Out West 2019 is estimated to 385 ton CO₂e. The largest emission sources are air travel (28% of the total), rental of goods, materials and equipment (27% of the total), and transportation of goods, materials and equipment (24% of the total), see Figure 1. The carbon footprints per ticket are estimated to 4,7 and 14,0 kg CO₂e for one- and three-day tickets, respectively. These values should be interpreted as the greenhouse gas emissions associated with buying a ticket, based on what is included in the price for a ticket (food and drinks are for example not included, hence not included in the carbon footprint of a ticket).

The results presented here should be considered uncertain, mainly due to difficulties obtaining data, and the many assumptions we had to do to make up for lack of data. Many key parameters are associated with large uncertainties, for example flight data, transport distances, and the weight of goods and materials. It is also important to remember that the carbon footprints calculated here do not include *all* emissions, although we have tried to include *the most important* ones. The results should therefore be interpreted with some caution. No qualitative assessment of the uncertainties has been done.

Despite limitations and uncertainties, this assessment is an important step forward towards greater climate transparency of festivals (and cultural events in general), and towards higher climate literacy among people. Better carbon footprint estimates mainly require more detailed information about where artists fly from, weight and transport distances for the most important goods and materials, and more information about the goods, materials and equipment that Luger rents.

A future assessment with a wider scope could potentially also include the emissions from transportation of food and drinks, as well as the energy used by food stall, bars and sponsors. In that case, the emissions associated with transportation and accommodation of bar staff and sponsors should be included as well, in order to maintain consistent system boundaries.

The largest changes compared to the preliminary assessment published earlier this year (in August 2019) are that the emissions associated with energy consumption are 36% lower, and that the emissions associated with transportation of goods, materials and equipment are 34% higher. The most important reasons for the changes regarding energy use are 1) results from on-site measurements during the festival 2019 showed that the conversion efficiency of the generators used to power concerts was higher than previously estimated (22%, instead of 20%), and 2) a lower emission intensity for grid electricity (47 instead of 125,5 g CO₂e/kWh; see Appendix 2). The emissions associated with transportation of goods, materials and equipment, increased due to upwards adjustment of the weights and transport distances for some goods (in particular the stages, light and sound systems).

Overall, the updated results are similar to the results from the preliminary assessment. The total carbon footprint for the whole festival only increased by 3% (from 375 to 385 ton CO₂e).

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Background

Oatly, one of the main sponsors of Way Out West, contacted Svalna in June 2019, and asked Svalna to calculate the carbon footprint of Way Out West, in order to increase its carbon transparency, in line with Oatly's campaign for increased transparency¹. By showing visitors the carbon footprints of specific objects and/or activities at and around the festival, and providing information about how the numbers were calculated (in the form of this report, information online and a leaflet that was freely available to visitors at the festival), Oatly and Luger want to contribute to increasing the carbon literacy among visitors, and encourage other companies and event organizers to become more climate transparent as well.

Luger, the organizer of the festival, also became involved in the project at an early state, and agreed to provide the necessary data. Another company, CarbonCloud, calculated the carbon footprints of the food and drinks served at the festival. This report presents the final results for Way Out West 2019. A preliminary report was published in August 2019.

System boundaries

The system boundaries define which emissions are included in the assessment, and which emissions are excluded. Svalna's ambition has been to include the *largest* emission sources associated with *arranging* the festival, and that Luger, the festival organizer, is directly responsible for, or controls. Specifically, the assessment includes the emissions associated with:

- 1) Transportation for artists and Luger employees to and from the festival, by airplane, car, taxi and train.
- 2) Accommodation for artists and Luger employees in association with the festival.
- 3) Energy consumption associated with arranging concerts and other cultural events on the festival grounds.
- 4) Transportation of goods, material and equipment required to arrange the festival.
- 5) Rental of goods and equipment required to arrange the festival.

The "festival grounds" are defined as the areas called Flamingo (the main stage), Azalea (the second largest stage), Linné, Dungen, and Højden. Emissions from energy use associated with concerts and other events at Bananpiren and Stay out West are not included.

The system boundaries were defined based on what is considered necessary to *fulfil the purpose* of the festival, and that Luger, the organizer, to some degree can control. The purpose of the festival is to provide paying visitors with music and other cultural events on the festival grounds. The largest emission sources associated with this purpose were therefore included in the assessment.

Many companies, "sponsors", support and participate at the festival. These companies typically have tents, staff members that visitors can talk to, and they carry out different activities on the

¹ Read more about Oatly's work with calculating and communicating the carbon footprints of their products here: <https://www.oatly.com/uk/climate-footprint> (accessed 20 Dec, 2019)

festival grounds. All emissions associated with sponsors were excluded from the assessment, for practical as well as logical reasons. Sponsors are not considered strongly associated with the main purpose of the festival. Their activities should be considered marketing activities aimed at the festival visitors, and their emissions should not be allocated to the visitors.

Emissions associated with the provision of food and drinks were also excluded from the assessment, since eating and drinking is not considered a main purpose of the festival, as indicated by the fact that it is not included in the price for a ticket (the carbon footprints of food and drinks served at the festival were however calculated separately by CarbonCloud).

In addition, emissions from the following sources and activities were excluded from the assessment:

- Use of electricity at Luger's office, and other emissions associated with office activities.
- Transportation of food and drinks to and from the festival.
- Purchase and rental of services such as cleaning, catering, communication and internet, and rental of land and buildings on the festival grounds.
- Transportation, accommodation and consumption of food and drinks of visitors.
- Concerts and other events at Bananpiren, and at Stay out West (i.e., at clubs around Göteborg).

We acknowledge that it is tricky and far from straightforward to define the system boundaries; it can be done based on boundaries in time and space, and/or based on what is included in the price of a ticket. To illustrate the challenges associated with defining the system boundaries, consider the provision of food and drinks. While it is not included in the ticket, and partly out of Luger's control, all food stalls and bars do have permission to sell food and drinks, and they have to comply with Luger's decision to only sell vegetarian food. Luger also makes sure that the food stalls and bars have the power they need, and one may argue that food and drinks is in fact an important part of going to a festival. A future assessment with a wider scope could potentially also include the emissions associated with sponsors, food stalls and bars.

Method

The carbon footprints calculated here represent the emissions of greenhouse gases in carbon dioxide equivalents associated with different activities associated with arranging a festival. Emission factors were derived from life cycle assessment studies, or from so-called "environmentally extended input output analyses" by Statistics Sweden.

Emission factors from Statistics Sweden are expressed on the form g CO₂e/SEK and were used to estimate the emissions based on financial data; this method was used to estimate the emissions associated with rental of goods, materials and equipment, and transportation for people by car, taxi and train. All other emissions were estimated based on physical data. Transport-related emissions, for example, were estimated based on the weight of the transported goods, the transport distance, the energy consumption associated with heavy trucking, and the emission intensity of road transport diesel consumption.

All results are reported in ton of carbon dioxide equivalents (CO₂e). This is the standardized way of expressing the global warming potential of different greenhouse gases on a common scale.

The carbon footprints of separate parts of the festival

Svalna assessed the largest sources of greenhouse gas emissions associated with *arranging* the festival, in the areas of transporting people and goods to and from the festival, renting equipment, material and goods required to arrange the festival, accommodating artists and Luger employees during the festival, and energy consumption associated with arranging concerts and other cultural events on the festival grounds.

Transportation for people by air

Method and data

Svalna estimated the greenhouse gas emissions from air travel using the information in Tables 1 and 2, and an emission factor of 170 g CO₂e/person/km, as suggested by Kamb & Larsson (2019). We used the same emission factor for all flights since the increase in emissions due to take off for short haul flights is approximately the same as the increase due to non-CO₂ effects for long haul flights, according to Kamb & Larsson (2019).

Table 1 Flight distances from selected cities in different regions, and average flight distances used for calculating the carbon footprints of air travel in association with Way Out West 2019.

Region	Departure / arrival	Flight distance to Göteborg (km)
Nordic countries	Umeå	815
	Stockholm	397
	Oslo	255
	Helsinki	791
	Reykjavik	1769
	Average	805
Europe	Berlin	584
	Paris	1171
	Budapest	1230
	Madrid	2225
	London (3 times higher probability)	1038
	Rome	1760
	Average	1261
USA	Manhattan	6000
	Kansas City	7290
	San Francisco	8580
	Average	7290

Flights were divided into three regions: Nordic countries, Europe and USA, and we assumed that the flights departed from a selection of geographically representative cities with equal probability, see Table 1. An exception was made for Europe, since many artists performing at Way Out West 2019 come from Great Britain. London was therefore given three times higher probability than the other cities in Europe.

Flights with an intermediate landing were assumed to be 30% longer, and business class flights were assumed to have a 50% higher emission factor, than economy class tickets. We included the emissions from flight both to and from Way Out West for all artists and Luger employees (artists are responsible for almost all flights).

Table 2 Underlying flight data used for calculating the carbon footprints of air travel in association with Way Out West 2019.

Departure (region/city)	Number of intermediate landings	Arrival (region/city)	Number of flights	Class
Göteborg	0	Europe	25	Economy
Europe	0	Göteborg	25	Economy
Göteborg	0	Nordic countries	25	Economy
Nordic countries	0	Göteborg	25	Economy
Göteborg	1	Europe	30	Economy
Europe	1	Göteborg	30	Economy
Göteborg	0	Europe	20	Business
Europe	0	Göteborg	20	Business
Göteborg	0	USA	10	Business
USA	0	Göteborg	10	Business
Göteborg	1	USA	5	Business
USA	1	Göteborg	5	Business

Results

The carbon footprint of transporting people by air is estimated to 108 ton CO₂e. This value represents the emissions of greenhouse gases in carbon dioxide equivalents associated with transporting artists and Luger employees by air, in association with Way Out West 2019.

Detailed flight data were not available at the time of the preliminary assessment, and it was not possible to obtain more detailed information during the autumn and winter of 2019. Due to the large uncertainties associated with the underlying flight data, and the many assumptions we had to do to make up for lack of data, this result should be considered very uncertain. Information about departure airports/cities would be required in order to provide a better estimate.

Transportation for people by car, taxi and train

Method and data

Svalna estimated the greenhouse gas emissions associated with transporting people by car, taxi and train based on how much money Luger spent on transporting artists and Luger employees by car, taxi and train, respectively, in association with Way Out West 2019. The carbon footprints were calculated by multiplying the money Luger spent on each transport mode, with

corresponding emission factors from Statistics Sweden (g CO₂e/SEK). The underlying data are not presented here due to financial confidentiality reasons.

The cars used for transporting artists and Luger employees are hired by Luger: the cost includes the car itself, as well as the service of driving, and can therefore be considered a taxi-service. We therefore used the same emission factor for transportation by car, as we did for taxi. In addition to the costs associated with transporting people by car, taxi and train, some transport costs were uncategorized, i.e., the means of transport was not known. Those transports were also included, by using an emission factor from Statistics Sweden that represents “*Other transport services, e.g., moving*”.

Results

The carbon footprint of transporting people by car, taxi and train is estimated to 25,7 ton CO₂e, of which car transport is responsible for more than two thirds, see Table 3. The carbon footprints represent the emissions of greenhouse gases in carbon dioxide equivalents associated with transporting artists and Luger employees by car, taxi, train and other (unknown) means of transport, in association with Way Out West 2019. The result is based on financial data from 2018, but used as a best estimate for 2019, due to lack of better data at the time of this updated assessment.

Table 3 The carbon footprints of transporting artists and Luger employees by car, taxi, train and other (unknown) means of transport, in association with Way Out West 2019.

	Carbon footprint (ton CO ₂ e)
Car	19,5
Taxi	2,2
Train	1,4
Others	2,7
Sum	25,7

Energy consumption

Method and data

Energy consumption refers to electricity used on the festival site. In 2019, 30% of the electricity used on the site (the entire site, including food stalls and sponsors), came from the grid, and 70% was generated in on-site diesel generators powered with EcoPar A; an extra clean type of diesel made from natural gas, that generates lower emissions of hazardous substances, such as nitrogen oxides, and lower emissions of carbon dioxide, than ordinary diesel (www.ecopar.se). The emissions associated with electricity used by food stalls, bars and sponsors, make up 44% of the total, and was excluded from the assessment, due to reasons explained in the section “System boundaries”.

Data on the total electricity consumption for the entire festival, and for separate activates/areas, were obtained from Luger and used as a basis for the calculations. The input data are partly based on measurements, and partly on best estimates by experts at Luger. It was, for example, estimated

that sponsors use 9% of the total electricity, and that 42% of the total electricity is used to power concerts. Luger also provided estimated shares of the used electricity obtained from the grid, and from on-site diesel generators. It was, for example, estimated that 97% of the electricity used to provide power for concerts, was obtained from on-site diesel generators. Knowing the final use of electricity obtained from diesel generators, we calculated backwards to estimate the amount of diesel (in kWh) required to supply that amount of electricity, using the conversion efficiencies of different diesel generators in Appendix 1.

Table 4 Data and information used for calculating the carbon footprints of energy consumption, and the resulting carbon footprints. Note that the energy used by food stall, bars and sponsors is not included.

	Value	Unit	Source
Consumption of electricity from the grid during Way Out West 2019	6 807	kWh	Calculated based on data from Luger
Consumption of electricity generation in on-site diesel generators using EcoPar A during Way Out West 2019	27 227	kWh	Calculated based on data from Luger
Emission factor for grid electricity (average Swedish electricity mix)	47 ^a	g CO ₂ e/kWh	Table 5 in Energimyndigheten (2019)
Emission factor for diesel (EcoPar A) used in on-site diesel generators	72,4 ^a	g CO ₂ e/MJ	Calculated based on information in ICF (2012)
Carbon footprint associated with consumption of grid electricity	0,3	ton CO ₂ e	Calculated by Svalna
Carbon footprint associated with consumption of diesel (EcoPar A)	33,9	ton CO ₂ e	Calculated by Svalna
Total carbon footprint associated with energy consumption (electricity + diesel)	34,3	ton CO ₂ e	Calculated by Svalna

^a For more information, see Appendix 2.

The greenhouse gas emissions associated with diesel consumption were finally calculated by multiplying the consumed amount of EcoPar A (in energy terms) by the emission factor for EcoPar A, see Table 4. The greenhouse gas emissions associated with consumption of grid electricity was calculated in the same way, using the average emission intensity of grid electricity in Sweden.

Results

The carbon footprint of energy consumption is estimated to 34,3 ton CO₂e, see Table 4. The carbon footprint represents the emissions of greenhouse gases in carbon dioxide equivalents associated with energy use on the festival grounds, excluding the energy used by sponsors, food stalls and bars.

Transportation of goods, materials and equipment

Method and data

The greenhouse gas emissions associated with transporting goods, materials and equipment were estimated based data in Table 5 on the weight of the transported goods, the transport distances, the energy consumption associated with heavy trucking in Sweden (1,5 MJ/ton/km²), and the emission intensity of diesel consumption for road transport (79,3 g CO₂e/MJ; see Appendix 2).

Due to the limited scope of this assessment, it was not possible to include the transportation of all goods required to arrange the festival. Instead, we made a selection based on weight and transport distance, since heavy goods transported long distances cause the largest transport-related emissions.

Table 5 Information and data for calculating the carbon footprint associated with transportation of goods, materials and equipment in association with Way Out West 2019, and the resulting carbon footprint.

Type of goods	Weight (ton)	Total transport distance (km)	Origin, and information about transport distance	Emissions (ton CO ₂ e)
Arena panels, floors, fences etc.	72	1136 ^a	From Helsinki, one way	9,7
Arena panels, floors, fences etc.	72	943 ^a	From Warsaw, one way	8,1
Arena panels, floors, fences etc.	72	1076 ^a	From Cologne, one way	9,2
Arena panels, floors, fences etc.	72	315 ^a	From Copenhagen, one way	2,7
Arena panels, floors, fences etc.	72	469 ^a	From Stockholm, one way	4,0
Arena panels, floors, fences etc.	72	298 ^a	From Oslo, one way	2,6
All five stages	390	514	From Kristinehamn, two ways	24
Fences and tents	140	526	From Arvika, two ways	8,8
Circus tent	30	3090	From Peterborough, UK, two ways	11
Fork-lift trucks	84	26	From Hisingen, two ways	0,3
Light and sound systems	95	938	From Stockholm, two ways	11
Golf buggies	5 ^b	30	From Hisingen, two ways	<0,1
Golf buggies	5 ^b	938	From Stockholm, two ways	0,6
Monitors	45	60	From Kungälv, two ways	0,3
Portable toilets, "Bajamajor"	16	191	From Vänersborg, two ways	0,4
Portable vacuum toilets	50	191	From Vänersborg, two ways	1,9
Water-flushed toilets	18	191	From Vänersborg, two ways	0,4
Total carbon footprint for transportation of goods, materials and equipment (ton CO₂e)				94

^a We assumed that one sixth of the total weight of arena panels, floors, fences etc. (in total 432 ton) was transported from either one of six different plausible locations, based on information from the external company that delivers the goods. Only emissions from transport one way was included due to high demand of these goods during the festival season.

^b We assumed that 50% of the golf buggies came from Hisingen, and 50% from Stockholm (due to lack of more detailed data).

² Only for portable plastic toilets, "Bajamajor", did we use another emission factor; 2,5 MJ/ton/km (our own estimate), since portable plastic toilets take up much space, but have a rather low weight, which can be expected to increase the energy consumption associated with road transport, since more trucks are needed.

Information about the weights and location of goods, materials and equipment before and after the festival were obtained from Luger, and from collaborating partners. Transport distances were obtained from Google Maps. For goods that were transported to another festival or event directly after Way Out West, only the emissions from a one-way transport to Way Out West were included in the assessment. For equipment that was returned to its “base station” after Way Out West, the emissions from transportation both ways were included in the assessment.

Results

The carbon footprint associated with transportation of goods, materials and equipment is estimated to 94 ton CO₂e, see Table 5. This value represents the emissions of greenhouse gases in carbon dioxide equivalents associated with transporting goods, materials and equipment to and from Way Out West 2019.

Due to difficulties obtaining data, especially with regard to weights and transport distances, and the many assumptions we had to do to make up for lack of data, this result should be considered highly uncertain. In order to provide a better estimate, it would be desirable to 1) review the selection of goods, materials and equipment to include in the assessment, and 2) collect more detailed information about weights and transport distances.

Rental of goods, materials and equipment

Method and data

Luger rents most of the goods, materials and equipment required to arrange the festival. Svalna estimated the greenhouse gas emissions associated with rental of goods, materials and equipment based on how much money Luger spent on rental, in association with Way Out West 2019, and corresponding emission factors (g CO₂e/SEK) from Statistics Sweden (2019).

Based on detailed analysis of Luger’s financial data from 2018 and 2019 (not presented here due to confidentiality), Svalna estimated that Luger’s rental costs correspond to approximately 45% of Luger’s total costs associated with arranging the festival (excl. payments to artists). The remaining share (55%) are costs associated with transportation of people, goods, materials and equipment, cleaning services, accommodation, energy, land rental and communication services.

Results

The carbon footprint associated with rental of goods, materials and equipment is estimated to 105 ton CO₂e. This result is associated with large uncertainties for three reasons. First, the amount of money that Luger spent on renting goods, materials and equipment is very uncertain, partly due to inherent difficulties in separating rental costs from other costs such as transport, cleaning services and other services. In most cases, Luger buys complete services where all costs, e.g., associated with renting equipment, transport and other related services such as cleaning, installation and mounting, are lumped together.

Second, Statistics Sweden only provides one matching emission factor, which represents rental of advanced technical music-, photo- and IT equipment, while a large share of the rented equipment is not technically advanced (tents, stage materials, fences, etc).

Third, the emission factor from Statistics Sweden is based on business-to-customer prices and services. It is not known how well this emission factor represents business-to-business prices and services.

Accommodation

Method and data

The carbon footprint of accommodation is based on the number of overnight stays that Luger paid for in association with Way Out West 2019, for artists and Luger employees, respectively.

Table 6 Information and data used for calculating the carbon footprints associated with accommodation, and the resulting carbon footprints.

	Artists	Luger employees	Source
Number of overnight stays in association with Way Out West (data from 2018)	960	240	Luger
Emission factors for hotel accommodation (kg CO ₂ e/night in a hotel room)	15,5 ^a	11,2	Svalna's estimates based on data in Moberg et al. (2016) and the Swedish Energy Agency (2011)
Carbon footprint for accommodation for artists and employees, resp. (ton CO ₂ e)	14,9	2,7	Calculated by Svalna
Total carbon footprint for accommodation for artists and Luger employees (ton CO ₂ e)	17,6		Calculated by Svalna

^aThe emission factor for a double room was estimated by increasing the emissions associated with heating and hot water, electricity use and laundry by 50%. All other emissions, i.e., those associated with cleaning and breakfast, were assumed to be the same as for a single room.

Svalna calculated the carbon footprint associated with accommodation by multiplying the number of overnight stays for artists and Luger employees, respectively, with the corresponding emission factors for hotel accommodation, see Table 6. We assumed that artists stay in double rooms, and that Luger employees stay in single rooms, and calculated emission factors for artists and employees based on information in Moberg et al. (2016) and the Swedish Energy Agency (2011). The emission factors include emissions from heating and hot water, electricity, cleaning, breakfast, laundry, room maintenance, etc. (construction and maintenance of the hotel building itself is not included).

Results

The carbon footprint of accommodation is estimated to 17,6 ton CO₂e, of which artists are responsible for 85%, and Luger employees are responsible for 15%, see Table 6. The carbon footprint is an estimate of the total emissions of greenhouse gases in carbon dioxide equivalents associated with accommodating artists and Luger employees in association with Way Out West 2019. The result is based on data from 2018, but used as a best estimate for 2019, due to lack of more recent data at the time of this updated assessment.

The carbon footprint of the entire festival and per ticket

The carbon footprint of Way Out West 2019 is estimated to 385 ton CO₂e, see Table 7. This value is the sum of the individual parts, i.e., the carbon footprints associated with transporting and accommodating artists and Luger employees before, during and after the festival, renting and transporting goods, materials and equipment, and the consumption of energy associated with arranging concerts and other cultural events on the festival grounds.

Table 7 The total carbon footprint of the entire festival 2019, and of separate parts. Note that values may not add up due to rounding errors.

	Carbon footprint of Way Out West 2019 (ton CO ₂ e)	Percentage of total
Transportation for people by air travel	108	28%
Transportation for people by car, taxi and train	26	7%
Energy consumption	34	9%
Transportation of goods, materials and equipment	94	24%
Rental of goods, materials and equipment	105	27%
Accommodation	18	5%
The total carbon footprint of the entire festival (the sum of all individual parts)	385	100%

The carbon footprints per ticket are estimated to 4,7 and 14,0 kg CO₂e for one- and three-day tickets, respectively (Table 8). These values should be interpreted as the greenhouse gas emissions associated with buying a ticket, based on what is included in the price for a ticket.

Table 8 The carbon footprints for different type of tickets. Preliminary results for Way Out West 2019.

Type of ticket	Number of sold tickets in 2019	Corresponding number of sold "ticket-days"	The carbon footprint per ticket (kg CO ₂ e)
1-day ticket	13 607	13 607	4,7
3-day ticket (festival pass)	22 895	68 685	14,0

The carbon footprints per ticket were calculated based on the number of sold tickets in 2019, see Table 8. Based on the number of sold tickets per ticket category, we calculated how many "ticket-days" were sold in total, counting one-day tickets as one, and three-day tickets as three (that gives a total of 82 292 "ticket days". Then, we calculated the carbon footprint of a day-ticket as the total carbon footprint of the entire festival (385 ton CO₂e) divided by the total number of sold "ticket-days". The carbon footprint of a three-day ticket was then calculated as three times the carbon footprint of a day-ticket.

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Appendix 1: Conversion efficiencies of diesel generators

Of the electricity used on site, 70% is generated in on-site diesel generators of the type “K&Be Power - Iveco steg 3A”, powered by EcoPar A, see Appendix 2. Considerable amounts of energy is lost as heat in the conversion process. The conversion efficiency is defined as the ratio between the useful output and the input, in energy terms.

We differentiated between diesel generators used to supply power to the stages, and diesel generators used to supply power to all other electricity-consuming appliances and machines, see Table 9.

The conversion efficiency of the generators used to supply power to the stages was estimated to 22%, and the conversion efficiency of all other diesel generators was estimated to 13%, based on data from on-site measurements during Way Out West 2019, and information from J. Nilsson (pers. comm., 2019) that 1 liter of EcoPar A contains 38,0 MJ (which corresponds to 10,6 kWh/liter).

Table 9 Conversion efficiencies of on-site diesel generators. The conversion efficiencies were calculated based on the average output power per liter EcoPar A.

	Average (min-max) output power per liter EcoPar A (kWh/liter)	Calculated conversion efficiency
Diesel generators used to supply power to the stages	2,3 (1,7-3,0) ^a	22%
All other diesel generators	1,4 (0,6-2,7) ^a	13%

^a Data from Luger based on on-site measurements during Way Out West 2019. The numbers represent averages among several diesel generators.

Appendix 2: Emission factors for electricity and diesel

Diesel for road transport and for electricity generated on the site

Carbon dioxide is produced and emitted when diesel fuel (made up of hydrocarbons) is combusted. The amount depends on the efficiency of the combustion engine and on the type of diesel, e.g., what the diesel is made of. In this assessment, we differentiated between diesel used for road transport and diesel used in on-site diesel generators, see Table 10.

Diesel generators of the type “K&Be Power - Iveco steg 3A” are used on the festival grounds to generate electricity (the same generators were used in 2018 and 2019). The generators are powered by EcoPar A, an extra clean type of diesel made from natural gas, that generates lower emissions of hazardous substances, such as nitrogen oxides, and lower emissions of carbon dioxide, than ordinary diesel (www.ecopar.se).

We estimated the life cycle greenhouse gas emission from EcoPar A to 72,4 g CO₂e/MJ. EcoPar A is made from natural gas (i.e., methane, CH₄), with an energy density of 50 MJ/kg (Thomas, 2000). One kg of natural gas contains 75% carbon, which generates 2,75 kg CO₂ when combusted (A. Eklund, pers. comm., 2019). Combustion of EcoPar A thus generates 55 g CO₂/MJ. Emissions associated with extraction and production of the fuel add another 17,4 g CO₂e/MJ, based on information in ICF (2012), and the latest Global Warming Potential value for methane (34, instead of 25 as used in ICF, 2012).

For road transport of goods and material, we used the yearly average emission factor for diesel MK1 in Sweden in 2017, from the Swedish Energy Agency (2018). The emission factor, 79,3 g CO₂e/MJ, represents the life cycle greenhouse gas emissions associated with diesel MK1, including the emissions from combustion, extraction and production of the fuel (Swedish Energy Agency, 2018).

Table 10 Life cycle greenhouse gas emission factors for grid electricity and diesel.

	Value	Unit	Source
Diesel (MK1) used for road transport	79,3 ^a	g CO ₂ e/MJ	Table 5 in the Swedish Energy Agency (2018)
Diesel (EcoPar A) used in on-site diesel generators	72,4	g CO ₂ e/MJ	Calculated based on info in ICF (2012) and the most recent GWP-value for methane
Grid electricity (average Swedish electricity mix, data from 2018)	47	g CO ₂ e/kWh	Table 5 in the Swedish Energy Agency (2019)

^a The yearly average in Sweden in 2017 for diesel of the type MK1, including emissions from extraction and production.

The emission factor for EcoPar A is 9% lower than the emission factor for road transport (Table 10). The reason is that EcoPar A is made from natural gas, while conventional diesel (which is what is typically used for road transport) is made from crude petroleum oil, and with 50 MJ/kg, the energy density of natural gas is higher than for crude petroleum oil (37,8 MJ/kg). One kg of natural gas (i.e., methane) contains 75% carbon, which generates 2,75 kg CO₂ when combusted, while petroleum crude oil typically contains 88% carbon, which generates 4,26 kg CO₂ when combusted (A. Eklund, pers. comm., 2019).

Electricity from the grid

Approximately 30% of the electricity used on site (the entire site, including food stalls and sponsors), comes from the grid. The electricity provider God El supplied the electricity in 2019. Their electricity is based on 26% electricity from wind power and 74% from hydro power; it is labelled with the Swedish Nature Conservation Association's label "Bra Miljöval", and has an emission intensity of 11,26 g CO₂e/kWh in 2019, according to God El's own assessment (Dahlgren et al., 2019). However, instead of using the emission intensity calculated by God El, we used the emissions intensity of the average electricity mix consumed in Sweden in 2018, see Table 10. This data value is based on the EU Commission directive (2015/652) which assigns a specific electricity mix to each member state. Import and export is taken into account, and the greenhouse gas emissions are calculated with a life cycle perspective.

The main reason behind the decision to use the average Swedish electricity mix, instead of the value calculated by God El, is that the choice of buying green electricity currently cannot be considered to have any system-driving effect, in the sense that it does not create any incentive for power suppliers to increase the production of renewable energy (Gode et al. 2011), since there is an overproduction of renewable electricity in Sweden due to the large capacity of hydroelectric power generation.

The label "Bra Miljöval" used by God El does require that a small amount of money (500 SEK/GWh) is set aside to fund future internal or external energy efficiency improvements (Swedish Nature Conservation Association, 2009). This corresponds to ca 3 SEK for Way Out West 2019 (6,8 MWh purchased off the grid, see Table 4), which can hardly be considered to have any system-driving effect, or create any "additionality", i.e., a potential for emission reductions³.

One could of course argue that choosing to buy green electricity takes us one step closer towards a tipping point where the demand exceeds the supply, thereby forcing power suppliers to make the necessary investments in order to increase the production of renewable electricity, and that making this choice should merit some "credit". This reasoning is valid; however, we are not there yet, and therefore, Svalna finds it most appropriate to use the emission intensity of the average Swedish electricity mix for the time being.

Event organizers or companies who wish to reduce the carbon footprint associated with the use of electricity should primarily focus on *minimizing the use* of electricity, rather than buying electricity from any particular provider, or with any particular label. Energy efficiency improvements or saved electricity in Sweden mean increased export of rather green electricity to other countries in Europe where it displaces electricity made to a larger extent from fossil sources.

³ Although Svalna does not consider the label "Bra Miljöval" capable of creating additionality in terms of CO₂e-emission reductions, the technology-specific requirements aimed at safeguarding other environmental values that power suppliers who wish to use the label need to fulfil, surely creates other environmental benefits, but they are not included in the scope of this report.