Sustainability in the audiovisual sector. Assessment of the climatic and economic impacts of applying the 'Green Film' environmental quality label.

Abstract
The film sector shows a growing attention towards the environment, also through the willingness to realise more sustainable audiovisual productions. The Green Film rating system and the related certification label developed by Trentino Film Commission are an example of this. The economic-environmental assessment carried out within the framework of the Green Film Research Lab project by means of a life cycle analysis methodology specifically developed for the purpose confirms that the application of the criteria of the rating system effectively reduces the greenhouse gas emissions of productions. For most of the criteria, this does not imply an additional cost but rather results in economic savings.

1. Introduction

The world of cinema is an area that in general is little considered when thinking about human activities that generate impacts on the environment and possible mitigation actions. In reality, activities related to film productions consume electricity, make use of means of transport and generate different types and discrete amounts of waste. In Italy, according to the report "Cinema in classe A" (Disi and Gisotti, 2016), the film industry produces about 5600 tonnes of CO_2 per year, corresponding to the emissions of 5600 Rome–Dakar return flights. Undoubtedly, there are more impactful production sectors, but the time is ripe to trigger a paradigm shift in this economic sphere as well. Encouraging the film sector to pay more attention to the environment also has a multiplier value, given the strong communicative power of the world of cinema.

The economic-environmental analysis presented here is part of the activities of the GREEN FILM Research Lab, a study and research project in the audiovisual sector promoted by Trentino Film Commission, financed by the Italian Ministry of Culture and supported by the collaboration of Anica, CineRegio and the Provincial Agency for Environmental Protection of the Autonomous Province of Trento. The aim of the project is to provide solutions and tools for the growth of the culture of sustainability within the filmmaking sector.

1.1. Objective and scope

The objective of the study is to assess, throughout the life cycle, the climatic and economic impacts of applying the Green Film rating system to audiovisual production. The comparative analysis considers the impacts and investments generated by a sample of 5 Green Film-certified representative productions and a sample of 5 representative productions made using "traditional" methods.

The scope of the analysis includes audiovisual productions shot in Italy, with the exclusion of documentaries to which a specific rating system applies. The activities covered by the analysis are exclusively those considered by the individual criteria of the Green Film rating system, with the exception of the two prerequisites and the communication activities (criterion

F). Further activities carried out by the productions, but not directly referable to the criteria of the rating system, do not fall within the scope of the analysis.

1.2. The Green Film rating system

For an in-depth description of the criteria considered, please refer to the Rating System itself (https://www.green.film/), where both the requirements and the observations and suggestions addressed to the productions for fulfilment are listed. In order to obtain the "Green Film" certification label, productions are obliged to meet the two Prerequisites, namely the adoption of a Sustainability Plan and a Transport Optimisation Plan. The adoption of the various Criteria (optional prerequisites) leads to the attribution of a score, subject to verification by an accredited body: a score of 20 points is required to obtain the label.

2. Materials and Methods

In the study, the main international references were followed to conduct a comparative analysis with the Life Cycle Assessment (LCA) methodology:

- UNI EN ISO 14040:2021. Environmental management - Life cycle assessment - Principles and framework.
- UNI EN ISO 14044:2021. Environmental management - Life cycle assessment - Requirements and guidelines.
- UNI EN ISO 14067:2018. Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification.

Different functional units were used in the study, one for each sub-criterion analysed, as each is defined by a specific function. In general, in order to be able to compare audiovisual productions of different type and size, a specific unit was adopted per shooting day and per person involved in the production (limited to the crew and main actors), which can be summarised as: quantity of product/service used per person of the crew and per shooting day (quantity/p*d). The system boundaries adopted are also different for each of the analysed rating system criteria. Where applicable and where consistent with the analysis methodology of the individual criterion, the "cradle to grave" approach was used.

The methodological assumptions adopted for the study refer to the principles set out in ISO 14026:2018 for benchmarking. Specifically:

- the systems compared share the same functional unit, and are as equivalent as possible in the qualitative level of satisfaction of the function;
- the types of activities and the frequency with which they take place are identical;
- the criteria for including inputs and outputs from the analysed system are identical;
- data quality requirements are the same;
- life cycle inventory units are identical;
- the calculation procedures are similar;
- allocation rules are equivalent;
- the impact categories and characterisation factors selected are identical (ISO 14067, GWP100).

2.1. Inventory analysis

The sampling of the 10 audiovisual productions was carried out over a period of one year, from November 2021 to October 2022. For each production, an on-site visit was carried out, whereby data and evidence were directly collected in order to quantify the energy consumption and material flows associated with the production's significant processes. Examples of the data collected during the inspection are: the type and number of lighting systems used; the type of electricity supply; the vehicle fleet used; the accommodation facilities used and the number of nights of accommodation spent by the troupe and actors; the type of water and meals supplied; the type of hot drinks purchased; the type and quantity of the main materials used to make the

sets and costumes; the origin of these materials and their fate at the end of production; and finally, the type of waste management implemented. The on-site visit also made it possible to train and instruct an internal production contact person to complete the collection of data and information. At the same time, data and economic information was collected on the investment associated with each aspect related to the rating system criteria investigated. This activity was also completed through interviews with production contact persons and through market surveys.

Concurrently with the collection of site-specific primary data, a collection of secondary data was carried out, i.e.: from databases and scientific literature. Thanks to the research work and bibliographic analysis, 63 scientific studies related to the field of audiovisual productions were found and analysed, of which 33 use the LCA methodology and another 30 use different methodologies.

2.2. Scenarios for benchmarking

As mentioned in section 1.1., two samples of 5 productions each were chosen for the benchmarking. However, as the adoption of the individual criteria by the productions applying for the label is optional, there is no uniformity of behaviour within the 5 "Green Film" productions. For this reason, the "Green Film" sample varies according to the criterion analysed: in the analysis of each criterion, only the productions that scored for the specific criterion were considered. The "Green Film" (GF) scenario is therefore constructed on the basis of a variable number of productions, depending on the criterion analysed.

Table 1 summarises the criteria, the score obtainable from the fulfilment of each, and the adoption of the different criteria and their options when present (cells in green), by the five certified productions in the sample. Cells in red indicate that the criterion was not selected, or that the requirements were not met during verification. Criterion F1 was not considered for benchmarking purposes, as the environmental benefit obtained from the implementation of the sustainability publicity and promotion activity is not objectively quantifiable via LCA analysis.

Criteria		Productions				
Description	Score	Prod #1	Prod #3	Prod #4	Prod #6	Prod #7
A1. Temporary connections to the electricity distribution grid	3					
A2. Green electricity	3	option 1				
A3. LED lights	3					
B1. Euro 5 vehicles	1					
B2. Euro 6, hybrid, natural gas, LPG and/or electric vehicles	4					
B3. Accommodation: within 10 km of the set	4					
B4. Accommodation: certified accommodation	Max 3					
C1. Drinking water	Max 4	option 2b	option 1a	option 2a	option 2a	option 2b
C2. Catering	Max 4		option 1	option 2	opt 1 + opt 2	
C3. Reusable crockery	2					
C4. Hot drinks on set	3	option 2	option 2	option 2	option 2	
D1. Suppliers and certified products	Max 3					
D2. Recycled or reused materials	1					
D3. Reuse of props	2					
D4. Printed communications	1					
E1. Separate collection	4					
F1: Publicising and Promoting Sustainability	*Max 5*					
Total score	Max 50	28/50	31/50	23/50	21/50	26/50

Table 1. Overview of the Green Film rating system criteria and the 5 certified productions included in the sample

Conversely, the 'Business as Usual' (BAU) scenario is always constructed on the basis of all 5 'traditional' productions which did not apply for the label.

During the inventory phase of the primary data from the productions, it was observed that some "traditional" productions, for various reasons, had nonetheless adopted behaviours and implemented actions that complied with the requirements of the rating system. Consequently, in order to be able to fully assess the benefit due to compliance with the rating system, it was decided to construct a third 'worst-case' scenario, in which compliance with the requirements would not be envisaged under any circumstances or in any way. This hypothetical scenario was named "Worst" (W).

The criteria: A2 - option 2, B4, C4 - option 1 were not optioned by any of the sampled 'Green Film' productions. In these cases, the Green Film scenario was also constructed in a hypothetical way, starting from the criterion fulfilment requirement.

3. Results and discussion

Table 2 summarises the results obtained for the environmental and economic analysis of the 3 scenarios considered. In the 21 comparisons made, from the point of view of climate-changing gas emissions, the GF scenario is the best in 19 cases, while the BAU and W scenarios are the

best in one case each. From an economic point of view, the GF scenario is the best in 12 cases, the BAU scenario in 3 cases and the W scenario in 6 cases.

A first and not at all obvious conclusion that can be drawn is the confirmation that the application of almost all the criteria of the Green Film rating system allows the reduction of impacts in terms of climate-altering emissions. Only in two cases out of 21 is the GF scenario not the best one, i.e.: for criteria B2 (Euro 6, hybrid, methane, LPG and/or electric vehicles) and C2 - option 1 (meals in restaurants).

In the case of criterion B2, the best scenario turns out to be BAU, due to a fleet of vehicles that for the most part still meets the rating system requirements, and the prevalence of vehicles with low CO_2 emissions per kilometre. Emissions in the GF scenario are only 3% higher.

In the case of criterion C2 - option 1, the best scenario turns out to be W. This completely unexpected result is justified by the high contribution to the impacts of the transport phase due to the movements of the entire crew to the restaurant in the GF and BAU scenarios. These impacts are higher than both those required to bring the meals to the set and those due to the production and disposal of the packaging of the lunch boxes through which the meal is consumed in the W scenario.

Another interesting fact to emerge from the analysis is that the application of the rating system actions in most criteria does not imply an additional cost for the producer, but results in savings in as many as 12 out of the 21 comparisons made.

CRITERIA	GF SCENARIO		BAU SCENARIO		W SCENARIO	
ID	kg CO_2 eq./(p*d)	€/(p*d)	kg CO_2 eq./(p*d)	€/(p*d)	kg CO_2 eq./(p*d)	€/(p*d)
A1	0.518	0.27 €	0.969	2.99 €	1.421	5.72 €
A2 - option 1	0.030	0.35 €	0.518	0.27 €	0.706	0.27 €
A2 - option 2	0.010	NA	0.518	0.27 €	0.706	0.27 €
A3	0.221	30.55 €	0.815	19,60 €	1.235	13.76 €
B1	0.912	6.07 €	1.183	6.35 €	1.201	4.81 €
B2	1.134	3.05 €	1.099	3.23 €	1.146	2.54 €
B3	0.816	0.36 €	1.619	0.71 €	1.619	0.71 €
B4	3.310	97.50 €	4.350	85.90 €	4.350	85.90 €
C1 - option 1a	0.016	0.01 €	0.551	0.81 €	0.573	0.83 €
C1 - option 1b	0.071	0.01 €	0.551	0.81 €	0.573	0.83 €
C1 - option 2a	0.327	1.05 €	0.551	0.81 €	0.573	0.83 €
C1 - option 2b	0.382	1.05 €	0.551	0.81 €	0.573	0.83 €
C2 - option 1	3.084	10.06 €	1.322	11.97 €	1.134	12.07 €
C2 - option 2	1.112	12.40 €	1.322	11.97 €	1.134	12.07 €
C3	0.118	0.01 €	0.165	0.31 €	0.221	0.19 €
C4	0.026	0.23 €	0.048	0.55 €	0.039	0.60 €
D1 - option 1	0.037	0.36 €	0.038	0.37 €	0.063	0.41 €
D2	0.628	2.79 €	0.995	3.47 €	1.920	5.00 €
D3	0.000	0.00 €	2.290	0.14 €	2.639	0.72 €
D4	0.001	0.00 €	0.005	0.02 €	0.009	0.04 €

E1	0.298	0.09 €	0.352	0.10 €	0.407	0.11 €

Table 2. Summary of the results of the economic-environmental analysis for the criteria and scenarios considered

Figure 1 shows the comparison between the GF and BAU scenarios, in terms of percentage. The blue bars represent climate impact values, while the yellow bars represent economic investment values. In 19 out of 21 comparisons, the GF scenario shows a reduction in CO_2 compared to the BAU scenario (up to -100% for criterion D3). In 13 out of 20 comparisons (for A2 - option 2 the costs are not comparable) the GF scenario also shows a cost reduction compared to the BAU scenario, and in 6 cases the savings exceed 90%. Among the 7 criteria for which the adoption of the GF scenario leads to an additional cost, only in one case does the increase exceed 50% (criterion A3, LED lights).

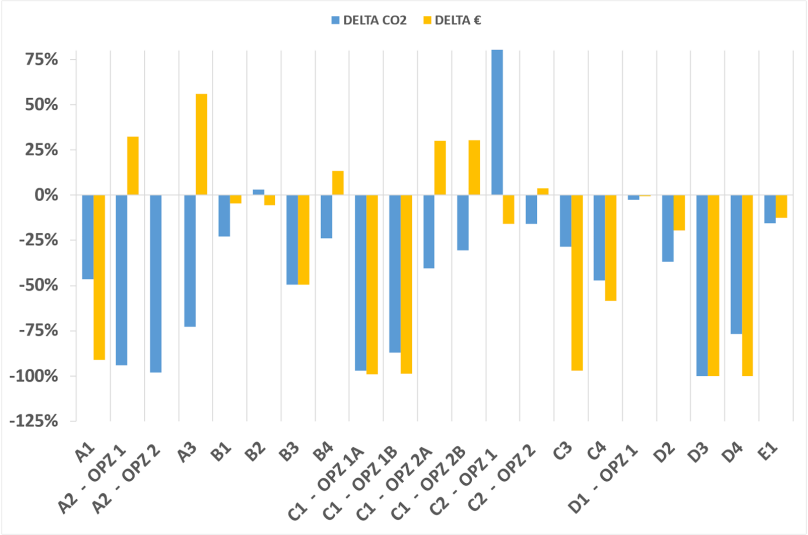

Figure 1. GF vs. BAU scenario. Percentages of reduction or increase of CO_2 and €.

Figure 2 shows the absolute reductions, measured in kg CO_2 equivalent per person-day, achievable by implementing each of the Green Film criteria, compared to the worst-case scenario. The criteria with the largest absolute emission reductions are: D3 - Re-use of props (-2.63 kg CO_2 eq./p*d); D2 - Recycled or re-used materials (-1.29 kg CO_2 eq./p*d); B4 - Accommodation: certified accommodation (-1.04 kg CO_2 eq./p*d); A3 - LED lights (-1.01 kg CO_2 eq./p*d).

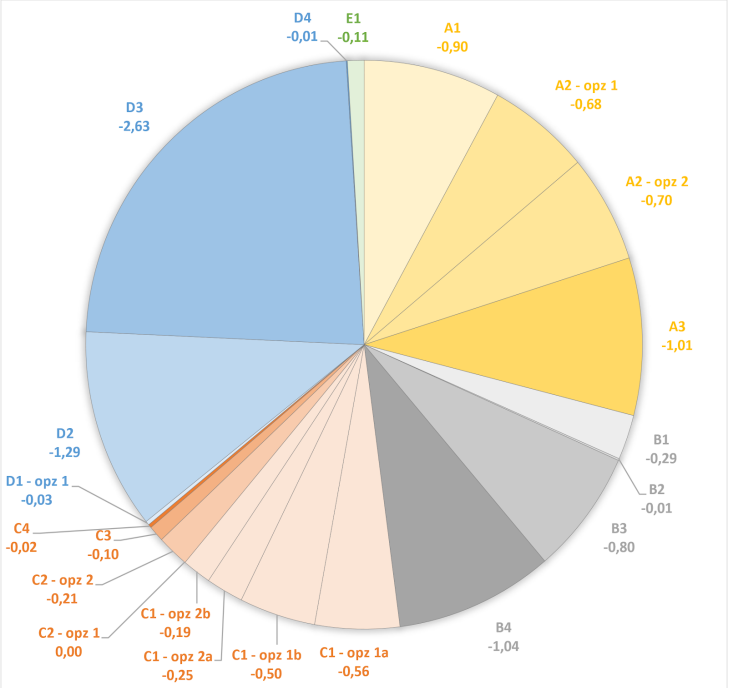

Figure 2. Absolute value reductions in kg CO_2 equivalent per person-day achievable by implementing each of the criteria of the Green Film rating system compared to the worst-case scenario

Figure 3 shows the GHG emission reduction, in kg of CO_2 equivalent per Euro, achievable through the implementation of the rating system criteria, compared to the BAU scenario. Negative values (bars pointing downwards) express the CO_2 avoided for each Euro saved, while positive values (bars pointing upwards) always express the CO_2 avoided, but for each Euro that needs to be invested, for those criteria where no savings are achieved by implementing the rating system.

In other words, the horizontal axis shows the order of preference for implementing the criteria according to the principle of greatest economic efficiency. Criterion D3 - Re-use of props is the one that achieves the greatest reduction in emissions - about 16 kg CO_2 eq./€ - for the same economic savings. Conversely, investing one Euro in the rental of LED lights allows a reduction in emissions of only 54 g CO_2 eq.

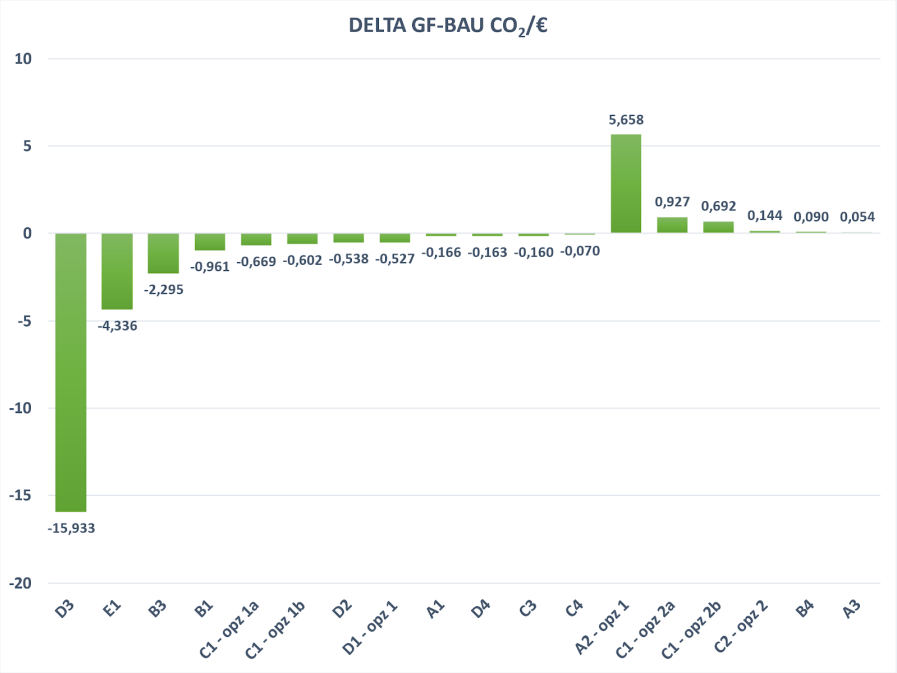

Figure 3. Absolute value reductions in kg CO_2 equivalent per Euro, saved (negative values) or spent (positive values) achievable by implementing each of the criteria of the Green Film rating system

4. Conclusions

In concluding the analysis, the main strengths and opportunities can be identified.

First of all, the creation of an *ad hoc* life cycle analysis methodology for the Green Film criteria made it possible to assess the environmental and economic impacts of their application in audiovisual productions in a scientifically sound manner. The analysis confirmed that most of the criteria are indeed effective in contributing to more sustainable audiovisual productions in terms of climate-changing gas emissions.

The results of this analysis will allow for the development of a preliminary assessment tool for the impacts of audiovisual production, a tool for expeditious analysis and at the same time for information and communication that can support producers in the realisation of climate-friendly films and TV series. At the same time, the results can be used to guide policy makers in adopting more effective and efficient policies and instruments in supporting audiovisual productions towards an ecological transition of the sector.

Thanks to the research carried out for the development of the study, a rich database was also implemented, consisting of primary and literature data, and relating to the quantities and impacts of products, processes and services linked to the main activities of which an audiovisual production is composed. This database constitutes a valuable output of the project, which can be further enhanced and expanded in future research developments.

This study and the developed methodology constitute a solid basis for an extension of the scope of the research, both in geographical terms, by including productions realised in other countries, and in terms of product system, by including audiovisual productions of different types (e.g.: documentaries or animation productions). They could also form the nucleus for the development of a sector-specific technical standard for life cycle analyses applied to the entire audiovisual production.

The main limitations found in this analysis concern:

- an incomplete return on the information required from the productions, which meant that more estimates and further market analysis were needed;

- a lack of scientific literature for some of the environmental processes and aspects involved by the actions of the Green Film criteria.

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