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THE DEVELOPMENT OF A CIRCULAR EVALUATION (CEV) TOOL – CASE STUDY FOR THE 2024 BUDAPEST OLYMPICS

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Abstract

According to the early candidate intentions, The Budapest 2024 Bid Committee goal was to submit a responsible and sustainable Games plan to the IOC. In doing so, it became evident that a superior approach would be needed than that adopted by cities hosting earlier versions of the Olympic and Paralympic Games. In recent years, Olympic Games were successfully organised from the perspective of handling sustainability. The previously applied low-carbon standards aimed to mitigate the greenhouse gas (GHG) emissions comparing to business-as-usual (BAU) processes. However, the carbon management strategy is still limited to the decarbonization of material stocks assigned to certain functions. This is the reason for the appearance of a new economic perception, Circular Economy which is built on sustainable material flow and reasonable resource utilization. While the low-carbon concept aimed to optimize the application of stocks, circular economy rather applies services for the same functions. Therefore, the mechanism eliminates the potential emission sources in the first place. This paper aims to introduce a calculation method which helps to assess the stock intensity of activities throughout the Olympics lifecycle (preparation, host of games, legacy periods). The outcome of the methodology, the Circular Economic Value (CEV) highlights the main improvement points on the initial BAU plans. This theoretical model will be used for the future evaluation of the Budapest 2024 Olympic Games, where future researches are expected to associate cost-benefit ratios to this value and enable decision makers to apply the accurate circular planning tools to enhance circularity of the long term Olympic programming.

Keywords

circular planning, Budapest Olympic Games, circular economic value, sustainable games, circular economy model, closing loops, priority levels of circularity

1. Introduction

According to the early candidate intentions, The Budapest 2024 Bid Committee goal was to submit a responsible and sustainable Games plan to the IOC. In doing so, it became evident that a superior approach would be needed than that adopted by cities hosting earlier versions of the Olympic and Paralympic Games. To realise this, they wish to make use of the business solutions and methods employed by the planning of circular economic systems.

In recent years, Olympics were successfully organised from the perspective of handling sustainability [1, 2]. The Olympic Games in London and Rio de Janeiro were examples, where resource systems and greenhouse gas (GHG) emission levels were intentionally controlled, and related management systems were expressly established for this purpose [3, 4]. Due to the success of these cases, the International Olympics Committee made it a requirement for any applicants to prepare a 'Carbon Management Strategy' and a 'Resource Management Strategy' to their feasibility study. In the Carbon Management Strategy, they estimate the GHG emission balance, and work out compensational measures [5, 6]. In the Resource Management programme, they calculate the changes in energy-, water-, and material usage, and the waste flows' processes [7]. Regarding the 'Carbon Management Strategy', and the 'Resource Management Strategy', the technical solutions are planned on the applicable technological level, abiding by the given economic conditions [8].

The circular economic perspective is based on the holistic planning, which is built on all long term sustainable planning processes [9, 10, 11]. It summarises the special business solutions and circulation strategies, which can be used to elevate sustainability planning to a higher level [12, 13]. The life cycle of products can be extended [14], the system can be kept close to a 'zero waste' state [15], and the material- and energy flows can be organised into mostly closed cycles (Figure 1).

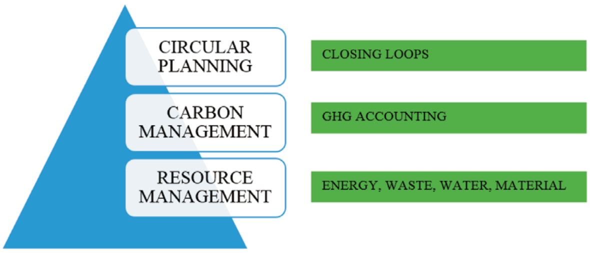

Figure 1. Interconnections of sustainable planning processes, and analysed systems

The carbon footprint calculations made for previous Olympic Games were conducted using the international calculation method, mostly on the Scope1 (direct emissions) analysis level [16, 17]. In this case, the direct energy, material and waste process flows have the most influence [18]. The GHG calculation methodology of earlier Olympic Games simply considered procurement items included in the Olympic host city's operational budget. These are e. g. the emission rates related to the internal transport / traffic, airway travels, internal waste emission rates, construction of roads or other infrastructure related to the Olympics (most of which were demolished after the Olympics), and emission rates related to these [19, 20]. Indirect emissions, which are on the analysis level of Scope2, show the amount of energy purchased, and the ratio of green energy used [21]. This means GHG emissions coming from energy usage which is not under the influence of the organisers (they're produced without control from the perspective of the user). Based on the reduction logic of Scope2 (mitigation of indirect emissions), this volume can be diminished, if we increase the self-produced energy's share within the total energy consumption [22]. The Scope3 analysis level (additional indirect emissions) contains advised elements [23, 24] which are often hard to describe with data. Therefore, this segment is rarely calculated in practice.

Scope2 and Scope3 measurements, and planned decreases had less significance even in the case of earlier (London, Rio) Olympics. This was mainly caused by the timeframe of the GHG footprint measurement which was only extended to the duration of the Olympics. Thus, the precise measurements of the emission rates in the preparation and afterlife phases was impossible to conduct (most notably for indirect services).

Apparently, the hierarchic relations between the low-carbon and the circular economy principles both show the methodological difference between the two evaluation methods. While the carbon footprint calculations focus on decreasing the emission rates related to internally controlled systems (Scope1) [25], the circular economic development concept aims to increase sustainability levels within Budapest's 2024 sustainability procurement policy [26]. These can mainly be found within the Scope2 or Scope3 indicator groups [27, 28]. In other words, the previously applied low-carbon standards aimed to mitigate the GHG emissions comparing to business-as-usual (BAU) processes. The carbon management strategy is still limited to the decarbonization of material stocks assigned to certain functions [29]. In the case of the circular planning, the applied functions are achieved by the employment of services [30]. The mechanism eliminates the potential emission sources in the first place [31]. The described logic indicates that carbon footprint analyses can only partially, or simply cannot support the mechanisms of circular economic system design. This is the reason for the emerging need of unusual applications throughout the planning of the future Olympics. According to previous research findings, the desired movement of stock and flow rates – to the direction of a higher service content – can be accomplished through the increased utility of stocks. This paper aims to introduce a calculation method which enables decision makers to estimate the possible material and energy flow of certain activities. The elaborated methodology helps to assess the stock intensity of actions throughout the Olympics lifecycle. The outcome of the calculation is supposed to identify the necessary tool to ensure a higher level of utility. The present study determined these tools based on the priorities of circular economy.

2. Scientific background

Priority levels for circular solutions

The approach which gained fame as '3R' has been in the curriculum of public education since 1818, and means the three basic capabilities (Reading, wRiting, aRithmetic), promoting their importance. After a while, environmentalists also created their own 3R - to symbolise their priorities - which means Reducing the quantity of waste (which was on the rise rapidly during the second half of the XX. century), Recycling it, or completely preventing its creation by Reusing products [32, 33].

These 200 years old pillars are the basis of the alternative economic perspective named circular economy [34], a notion that gains more and more ground nowadays. The concept was designed as an answer for the linear economic model which reigned until the beginning of the XXI. century. Linear economy advertises production based on new resources, and throwing products away after their effective life cycle is over (End-of-Life) [35]. In the circulation of natural ecosystems, the waste of one life form is always the nutrient for yet another [36, 37]. It is impossible to imagine that any life form in nature would produce an 'output' which will not become an 'input' for another [38, 39, 40].

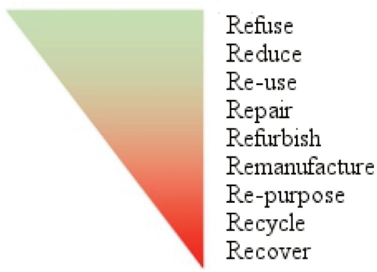

Figure 2. Priority levels of circularity [42]

During the design of circular theses, researchers rely on the previously introduced, 'R-signed' methods. The toolbox of waste treatment and prevention was expanded until 9R nowadays [41, 42], which are called the priority levels of circularity (Figure 2).

The concept seen on Figure 2 is designated in accordance with major two aspects. The first one is the 'function before the material' policy, which aims to lengthen the usage of the product for its intended purpose for as long as possible [43]. The second priority is to minimise the energy used. In other words, after the effective life cycle is finished, the product should be treated with the lowest possible energy requirement [44]. The different levels will also indicate the strength of their role in the various circular mechanisms. It must be stressed, that the hierarchy of the tools may differ in certain countries, due to the deviation in development levels. For instance, some theories might prefer re-use over reduction. Their logic indicates, that while the reduction of production reduces waste as well, reuse at some cases could even prevent its generation [38, 45]. Although, this argument might be valid at some points, it does not apply to the Hungarian conditions. Regarding re-use, the second-hand culture is widely anticipated in the country. However, the products offered at second-hand stores are mostly manufactured in the Britain. Therefore, it is rather a BAU resale process than a resource efficient reusing activity. Another example is the application of maintenance tools (e. g. repair). In the case of Hungarian infrastructure, a lot of transportation and building stocks are over their originally planned life cycle [46, 47]. Even though the circular priorities prefer to maintain the function of products, the improvement of obsolete systems can easily lead to major deadweight losses in the long-term [48, 49, 50]. After the examination of possible logical paradoxes, the detailed introduction of the certain priorities is presented:

Refuse: this method is one of the most effective interpretations for circularity. In this case, the production of a new product does not take place at all, since consumers refuse to purchase it. In general, this is the point which cause hardships to most people who attempt to understand it, and it is also the most critical point of circular economy. Many do not understand how processes can be circular, if the material flow is not even created. Furthermore, others believe that increasing production is indispensable for sustaining economic growth, whereas circularity only has to integrate into the system via recycling. However, critics advertising these requirements fail to take two fundamental aspects into consideration. One is the creation of the many externalities. If experts could arrange a monetized value to all these effects and account them, economic processes would display an entirely different picture [51, 52, 53, 54]. The other aspect is the materialist policy, which constricts most critics into the theoretic framework of the linear economy.

In the recent decades, many notions aiming to move the current stock economy towards the flow economy, which is based on a service thought process, were born [26]. In theory, the concept of ‘performance economy’ has been designed a long time ago [55], and practical examples for ‘sharing economy’ has been taking ground steadily nowadays [56]. Though the theoretic background, or the practical implementation may differ, the idea behind these perceptions stresses the same interpretation. Their message is that modern economies need business models which help members of society, so they do not need to own products to gain their services [57].

Reduce: in this case, it refers to reducing at both ends of the product chain. On one hand, the utilization of less resources to produce less products in the beginning of the process. On the other hand, the decreasing consumption of products which leads to less amount of waste. The question remains - which end of the market does the circulation start, from the consumer, or from the producer? Though early, classic economic theories were born on markets where a low amount of products had to deal with over-demand, these trends did change by now. Currently, the demand for products determines the supply, and has done so for the last century. Moreover, supply often goes beyond the demand these days [58]. Thus, tools to artificially stimulate demand became 'popular', such as marketing, loan, or planned obsolescence [59, 60]. These methods induce, create opportunities, or force people to increase their consumption, which in turn increases the waste they produce [39]. Therefore, the answer to the question is obviously on the side of the consumer. People themselves are responsible for the amount of products on the market. If they decide to decrease their consumption, they can force producers to stop creating so many unnecessary products [38].

Reuse: this method has very simple characteristics. It can be applied when someone wants to get rid of a product they own, even though it still fulfils its function. Therefore, they do not discard the product, but take it to a second-hand shop instead [61]. The present, and preceding methods can be considered the most efficient solutions, as these make people capable of preventing the creation of waste.

Repair, Refurbish and Remanufacture: one of the most notable mottos of the XXI. century's consumer society: "I recommend to buy new, it's cheaper than the repair costs". This perspective was, in the beginning, used for the technological products which appeared with the digital age. The society began to realise the intent behind the phenomenon, as the motto was extended even for wares which were easy to repair before. In some terms, this trend can be considered as the extension mechanism of planned obsolescence. This time not only the actual lifetime of the product becomes shortened during production, but it even prevents the consumer from lengthening it. To combat this, circular economy created the definition of 'circular design' [62]. Its essence is for manufacturers to not only make sure of the long lifetime, but also to equip consumers to maintain it. The first variant is when after the product malfunctions, it can simply be repaired. Refurbishing is a bit different, as it focuses on the compatibility attributes of the product. Nowadays, often the malfunction of a single element forces people to throw away the entire product. Therefore, circular design prefers the creation of products that are easy to disassemble, to make the various parts easy to exchange with new ones. Finally, in the case of remanufacturing, the new product is assembled from the elements of used ones [62].

Up-cycling: this is the first tool which shows some similarity with current trends to some extent. This is caused due to the so-called 'retro' perspective being a fad all around the year, which supports the various methods of reusing already used products. Therefore, this branch managed to take considerable advantage during the last two decades, and multiple companies happily use it during their CSR projects [63]. Its essence is that we find alternative methods of usage for products which lost their original function.

Recycling: regarding the concept of circular economies, this mechanism is the first to come up in people's minds. However, the idea based on circulation is more than simply returning material into the process [64]. During recycling, circularity policies are only implemented in a faded manner, since it does not sustain the product function, or create a new one. Recycling focuses on the material composition of the objects, which can be used in the production processes as secondary resource materials.

Recovery: recovering energy from waste is basically one of the most primitive forms of waste treatment. People usually associate to energy produced in trash combustors when thinking about this method, which may have a significantly different efficiency due to differences in the actual facility [65]. These facilities often cause more negative externalities during their operations – e. g. air pollution – in comparison with the benefits at the end of the process. Nothing is better proof of this than the fact that in the world, there are currently no trash combustion facilities operating with a profit (not even in western countries). This is a perfect example of how the method is simply weak, instead of a difference between the development levels of countries.

The presented circular priorities were all ranked according to their material and energy intensity. The higher the activities are ranked, the better their resource productivity is. This is due to the increased utility achieved by longer lifespan and lower material/energy need of processes. The top of the hierarchy represents not only a novel approach by the prevention of waste but a whole new economic paradigm by indicating the idea of sharing. Although, it has become clear that the top priorities cannot be feasible in all cases. When a system operates only on a low level of circularity, the application of much higher methods might cause serious malfunctions. Therefore, the purpose of the presented calculation methodology will be to determine the current state of circularity and appoint the most applicable tool for development.

3. Material and methods

Ensuring eco-efficiency through the application of the MIPS method

The novelty of circular economy is that while earlier concepts mainly focus on environmentally friendly waste management, this perspective aims to prevent waste in the first place [38, 41]. The most effective method to avoid producing waste is to not even make the product which would inevitably become waste later [31, 66]. Therefore, of all preferred methods, the most important is where people refuse the consumer attitude leading to the manufacture of new products [65]. In these cases, it is better to repair or reuse older products, by which the manufacturer's side must either produce less, or manufacture products of excelsior quality [62]. An important driving force behind the activities on the top of the hierarchy is the service-based perspective. In this case, the consumer discovers more and more the possible ways to use products, without actually buying them [30, 55].

Therefore, one of the main policies of circular economy is to discard the 'consumer' description, in favour of 'user' [61]. A suitable basis for evaluating service content is the eco-efficiency (Equation 1).

$$EE = \frac{S}{Mi} \qquad (1)$$

This basically means the reverse interpretation of the MIPS method (Material Input Per Service), which shows the rate of service by unit of material [67]. The importance of the connection between these two factors was highlighted by the researchers of the German Wuppertal Institute in the 1990's [68]. The logic of Equation 1 shows that an activity will be the most efficient (from an environmental standpoint), if the least possible amount of material resources (and energy, obviously) are used for it [26, 69]. To illustrate this, the best example is the usage of cars. Owning a personal vehicle is considered as the least efficient stocking, as even people who use their car intensively, only utilize it for a short time during a single day [70, 71]. In the remaining time, there is no use for it, its value deteriorates, the owner must consider its placement and safe storage, and taxes have to be paid for it. This is one of the reasons why the platforms related to sharing economy concern the new method to use traffic systems [72]. So, the fact is commonly accepted, that a car – similarly to many other products – satisfies its function in the most efficient manner, if it's always in use [73, 74, 75]. Therefore, based on the logic of eco-efficiency, the travel distance taken via taxi (or other mass transport or vehicle sharing platforms) is much more advantageous than being personally owned by the user.

Tracking the material flow

Recent researches which tried to measure the level of circularity, mostly included the development of metric methods. There are two mainstream branches of the topic. One of them comes from the study conducted by the Ellen MacArthur Foundation [76], while the other was created by a single engineer called Maurits Korse from the University of Twente [77]. Therefore, during the elaboration, the methods will be referred by the names of their creator. The MacArthur concept basically deals with the material flow (Figure 3) during production, and the usefulness of manufactured products.

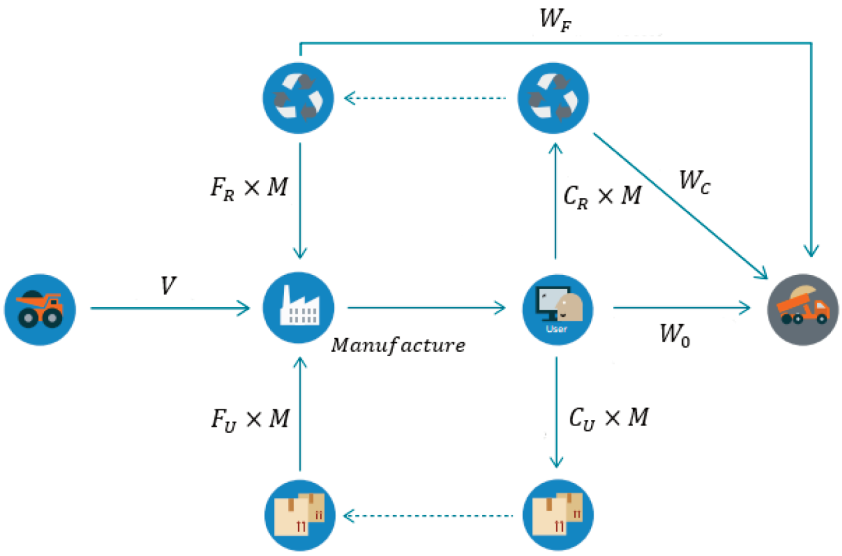

Figure 3. Process draft of the MacArthur-style material flow [76]
where: M: Mass of Product / Amount of products, V: Virgin feedstock / Primary raw material used for the product,
W: Waste created with the product, W_0: The amount of waste which is either deposited, or reallocated into energy production systems which is generated during the life cycle of the product. This material isn't included into production.
WF: The waste produced during the manufacture of secondary resource material required for the product
WC: The waste produced during the recycling of the product, CR: Volume of products which are recycled
CU: Volume of products which are reused, FR: Recycled materials used during the manufacturing of the product
FU: Reused materials used during the manufacturing of the product

The MacArthur model uses the so-called 'Linear Flow Index' (LFI) for the measurement of the material flow (Equation 2).

This theory mainly sprouts from the logic focusing on the primary resource materials consumed during the manufacturing of the products, and the waste produced during the latter phases of their life cycle.

$$LFI = \frac{V + W}{2M + \frac{W_F - W_C}{2}} \quad (2)$$

While the material flow, and the recycling of material flows are merely parts of the MacArthur mechanism, the Korse calculation (Equation 3) takes explicitly this side into consideration for calculating the circular value [78, 79, 80].

$$C = \frac{\sum_{material} m_{in} \left(r + v \times (1 - S)\right) \times \sum_{material} m_{out}\, r_{pot}\, (1 - A)}{m_{totin}2} \quad (3)$$

where:
C: Circular value
m: Material volume
r: Recycled content
v: Virgin feedstock / Primary raw material content
S: Scarcity of the raw material
r_{pot}: Recycling potential
A: Accumulation factor

The two logic frameworks can be considered as complementary factors of each other. While the MacArthur branch focuses more on the level of primary resource material usage, the Korse method analyses the opportunity for recycling both on the input and output sides. The latter contains a quite sophisticated logic, which naturally needs more data. Therefore, though the calculation presented in this paper uses the elements of the MacArthur method, it sufficiently structures them by keeping the Korse principle.

As this equation (Equation 3) also shows, the Korse-style material flow suggests a much more diversified train of thought. First, it analyses the ratio of recycled and primary resource materials in the material input (mi) used for production. For the latter, it also accounts how rare is the material on the Earth. A rare resource will obviously impact the value of the indicator negatively. Eventually, it also considers how much of the product's materials (mout) will be recyclable at the end of its efficient life cycle.

4. Results and discussion

The method of calculating the circular values for the Olympics

The Circular Economic Value (CEV) calculation [81] used two main components. The first is the material flow which is involved for the integration of the 'closing the loop' principle [82, 83, 84]. Due to the MacArthur and Korse logics' influence, the input side accounts the rate of primary resource material usage. On the output side, the amount of waste produced from the product gain significance. Therefore, the two components show the areas where system leakages might appear in terms of circularity. In case of the Olympics, not only the material flow, but the sustainable energy consumption is also important. Thus, these two became the focus points of the methodology [85]. The logic used here is similar to the handling of material flows. The input and output side perspective has been applied for describing this process as well. The former is based the amount of energy which comes from fossilized energy resources consumed for production. For the latter, it is assumed that some elements of the products will be handled through circular (E_c), whereas other elements through linear (E_l) methods. The numerator consisted of the share of linear processes. Furthermore, the denominator represents the amount of energy required for recyclability and the energy produced during the disposal. The separation of input and output sides serves to make the decision process easier. This way, the possible leakage points on both ends of the processes become visible, in addition to the unified CEV value. The calculation method for the indicator value can be seen on Equation 4.

M_{lin} M_{lout} E_{lin} E_{lout}

$$CEV\% = 100 - \left(\frac{\left(\frac{M_p}{M_p + M_s} + \frac{M_d}{M_r + M_d} \right) + \left(\frac{E_f}{E_s + E_f} + \frac{E_l}{E_c + E_l} \right)}{4} \right) \times 100 \quad (3)$$

where:

CEV	Circular economic value
M_{lin}	Material volume on the input side (linear)
M_{lout}	Material volume on the output side (linear)
M_p =	The amount of primary raw materials used for the manufacturing of the product
M_s =	The amount of secondary raw materials used for the manufacturing of the product
M_d =	Amount of non-recyclable materials remaining after the product is used (linear)
M_r =	Amount of recyclable materials remaining after the product is used (circular)
E_{lin}	Energy value on the input side (linear)
E_{lout}	Energy value on the output side (linear)
E_f =	Amount of non-renewable energy used during the manufacturing of the product
E_s =	Amount of renewable energy used during the manufacturing of the product
E_l =	Amount of energy produced during disposal, after the product was used (linear)
E_c =	Amount of energy used for the product's recyclability, after the product was used (circular)

The CEV indicator designed for the circular structuring of the Olympics shows how a system element performs in the time of the analysis. In other words, which level of circulation it stands from the perspective of an optimised system. The Circular Economic Value identifies the improvement points of the material and energy usage to enhance circularity. Therefore, it visualizes which areas of the linear material and energy flows must be turned into circular systems. Furthermore, the CEV can be applied at the previously demonstrated circular priorities. The value indicates the most applicable tool which can be utilized in the certain development areas of the Olympics (e. g. transport, building, energy). Figure 4. illustrates a theoretic case when the value resulted in a performance level of 50%. For the association of the CEV with the circular priorities, the levels have been theoretically identified with oriented percentages.

In the pictured case, the tools which have a higher circularity level than the CEV, can be applied to enhance the system performance. Although, it is important that the activity with the closest value to the CEV will be the most effective to use. As it was stressed at the end of the literature session, the application of too intense interventions would lead to major system malfunctions. The pyramid which narrows on its way to the top of the figure, illustrates the decreasing cost-efficiency of the tools in comparison with the initial CEV. Obviously, the utilization of these aspects is not that simple, and most of the cases will require the combination of the certain activities. This logic shows only the significance of accurate orientation by the definition of the actions.

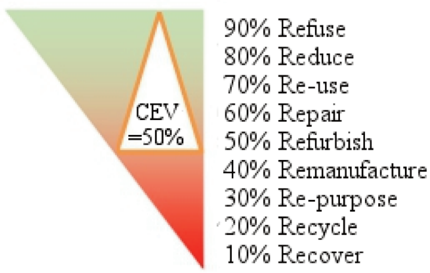

Figure 4. Priority levels of circularity interpreted in terms of CEV percentages

The measurement of the gained circularity level requires a comparison to the state which would be implemented without any circular applications. The latter case is associated as the BAU movement and the CEV must be calculated for that as a baseline for comparison. This value is called CEVBAU. Furthermore, the alternate scenario which includes the tools for circular system planning will be identified as CEVScen. The difference between these two values shows the level of transition to achieve in terms of circularity. This divergence is defined as ΔCEV (Equation 5). By assigning the costs of implementation to this value, the cost-efficiency rates of the system transformation could be calculated as well.

$$\Delta CEV = CEV_{Scen} - CEV_{BAU} \quad (5)$$

The final CEVBAU represents the level of circularity in the system. However, the accurate definition of circular improvement points requires an individual analysis on the elements of the equation. It means the consideration of the single input and output values of the material and energy flows. Figure 5 visualizes the attributes of a theoretical case in order the present the mechanism of the CEV. While the right side of the figure concerns absolute Circular Economic Values of BAU and Scenario conditions, the left side illustrates how the rates are built up. The final CEV must be as high as possible, as it is the complementary value of the linear patterns pictured on the left. On the web chart, the closer the elements are to zero, the better their circular performance is.

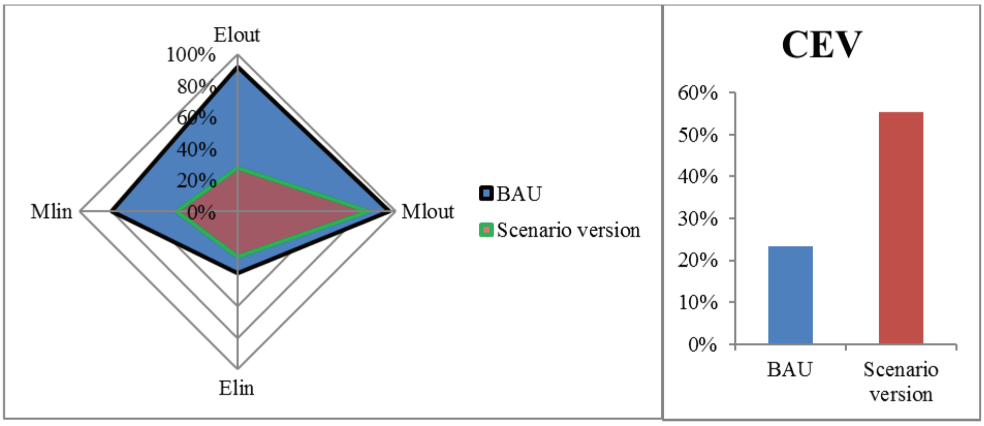

Figure 5. The illustration of differences (ΔCEV) between BAU and a possible more circular Scenario

The picture clearly indicates, that in case of the BAU, the major focus points of development should be the whole material flow and the output side of the energy processes. The input rate of energy supply already operates on a reasonable level. In comparison, the Scenario version – which consists of circular development tools – was able to tackle the input of the materials and the output of the energy flow. Although, the end of the material cycle remained a bottleneck issue and a potential room for future development. The ΔCEV was defined on 32% which is the difference in circular efficiency between the BAU and Scenario options. During the actual planning period of the Budapest 2024 Olympics, this value can be associated with cost and benefit ratios. Therefore, the ΔCEV will be the most significant outcome of the analyses employing the calculation tool presented in this paper. The cost index of the value will contribute to decision making processes at choosing the right option among several scenarios.

5. Conclusion

During the planning of circular Olympic systems, it has become clear that the traditional perspective does not contribute to the sustainable utilization of resources. In most cases, the Carbon and Resource Management Strategies – which are obligatory requirements for the organization – only maintain or strengthen the linear system patterns. For the establishment of a truly sustainable material circulation, future initiatives should focus on increasing the service content of activities, rather than the optimization of resource usage. The preference of service flows instead of stock-based mechanisms points toward the same direction as the priorities of circular economy. Therefore, in the initial planning phase, the most effective way to measure the level of circularity is to focus on the resource intensity.

The methodology presented in this paper, illustrates the stock structure of certain initiatives through the attributes of their material and energy usage. The calculated Circular Economic Value of the BAU can be further associated with the circular priority level of the current system. This movement helps decision makers to define the most applicable tools (e. g. refurbishment, repair etc.) to enhance circular performance. This theoretical model will be applied to the future evaluation of the Budapest 2024 Olympic Games. The practical application during the planning phase will give the opportunity to restructure the equation and extend its view to a broader set of elements. Based on the experimental results, the model can be developed to cover more of the service content and measure resource productivity instead of the current resource intensity. Thus, future researches are expected to develop an accurate mechanism – based on the current model – which includes the cost-benefit ratios of circular development initiatives and contribute to the planning of circular investments.

Regarding the Budapest 2024 Olympics, the most influential attribute to assess will be the decentralized organization of the games. On the one hand, it is surely a benefit in terms of circular economy, since the diffusive nature means less concentrated infrastructure. The major concern of previous Olympics was the enormous capacity built in a single location. Despite the great endeavours, the organizers could hardly manage the efficient utilization of these capacities in the afterlife period. On the other hand, the several locations will be a challenge to tackle in the case of Hungary. The sustainable planning must focus on the optimization of transport systems which will operate across the different placements.

However, the many years of preparation would give room for data generation and for the creation of circular best practices regarding future sport events. The initial circular examinations already stressed that the previously applied low-carbon development principles could be misleading in long-term. The sustainable, continuous flow of resources requires the elimination of linear system elements and the employment of circular solutions for future international sport events or Olympic Games.

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