Action A2.1 Preparation for the Enhanced Green Centres (EGCs)

DELIVERABLE A2.D5A

Techno-economic Analysis of the Athens EGC

Beneficiary Responsible: ERS, Beneficiaries Invovled: MoA, MEEN, HRA

Summary

The development of Enhanced Green Centers (EGCs), as core actions of LIFE IP Circular Economy Implementation in Greece (LIFE18 IPE/GR/000013) requires preparatory actions that will ensure the implementation of the respective infrastructures in relation with Greek legislative framework concerning public works and infrastructure, as well as maturation of the facilities in concern, from the sustainability perspective. The present study focuses on the techno-economic assessment of the Municipality of Thessaloniki EGC, through the formation of alternative scenarios, relative to its operational principles. Furthermore, detailed parameters are presented regarding the investment and operational cost, and the assessment of facility's deficit rate in order to estimate the subsidization required either from the available EU and national co-funding instruments as complementary funding, and/or from other involved stakeholders (e.g. PROs).

In particular, based on the LIFE IP CEI Project, EGCs are considered as facilities which combine two main units in relation with prevention, preparation for reuse and recycling of specific municipal waste streams, namely, Green Center (GC) which have as their core activity the temporary storage of these streams prior their further processing towards recycling and Re-Use Center (RUC) where its main purpose is to re-insert in the economic life cycle re-usable items and not recycle materials. The focus on the reception of these streams, for what concerns the operation of RUCs, is given primarily on Electric & Electronic Equipment (EEE), items from textiles (clothes, shoes etc.), usable and/or ornamental household as well as the fractions of bulky waste that refers to furniture. In addition, EGCs can operate also as typical GCs enabling the reception of source-separated recyclables like packaging waste (from ferrous and non-ferrous metals, glass, plastics, paper, wood etc.), hazardous household waste (HHW), used cooking oils as well as non-operational and/or non-usable items as downstream outputs of RUCs.

Concerning the operation of EGCs as typical GCs, citizens and other actors (e.g. businesses) can deliver voluntarily quantities of those streams in a pre-sorted form. As part of the GC's operation, the assigned personnel receives, weighs, classifies and stores the

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respective quantities prior their loading to transportation vehicles for further treatment which is mostly related with recycling and/or other means of materials' recovery (cases of used cooking oils and HHW). The operation of GCs may also include functional checking of items concerning their reusability, therefore these items can be upstreamed as inputs to the RUC. Key features of the GCs are related i) with the consideration of input quantities as waste streams ii) their primary role as well organized collection centers for the aforementioned waste fractions in a pre-sorted form and iii) as facilities which promote the active involvement of citizens by cultivating their environmental awareness. As the management of some of the fractions is already regulated by the Hellenic Recycling Agency and performed by national Public Responsibility Organizations (PROs), GCs are obliged by law to develop synergies with the respective stakeholders (e.g. for packaging waste, WEEE etc.) as providers of recyclables (which are pre-sorted according to target – materials' composition), with no undesired impurities and ready to be bailed and traded at the secondary materials' market by treatment plants operators (e.g. Materials Recovery Facilities). In the framework of LIFE IP CEI Project, GCs aim at the diversion of specific fractions of municipal solid waste (MSW) from landfilling (which currently stands as the dominant practice for commingled MSW) not through an implemented source separation scheme but *in situ*, through the active involvement of citizens. In addition, GCs act as facilities supplementary to the operation of RUCs concerning the further management of items that cannot be reused and therefore, shall be directed to the 'recycle' pathway.

The second activity integrated into the EGCs and differentiates these facilities from typical GCs is related with the operation of RUCs. RUCs which were recently added into national legislation through Law 4819/2021 (expressed as Centers for the Creative Re-Use of Materials), are facilities where the input quantities are considered as operational/usable items/objects and not as waste streams. The operation of RUCs foresees also the active involvement of citizens by promoting – besides the environmental perspective – the prevention of waste as well as subsequent social impacts derived from this action. Key feature of the RUCs is the fact that these facilities receive only operational/reusable items – as delivered voluntarily by citizens and/or other actors of tertiary productive sector (e.g. businesses) – that can be reused either directly, either after safety checks and small scale repair and/or cleaning activities which take place as part of RUCs' operation. In this framework, while GCs ensure the diversion of specific waste streams from final disposal through the 'recycling' pathway, RUCs ensure the re-insertion of operational and useful items by donating them to economic vulnerable groups of population, or by trading them at low prize at the second-hand markets. As a result, while the operation of GCs primarily has an environmental impact, RUCs also have a strong social dimension and as part of LIFE IP CEI Project, they are considered facilities that promote waste prevention through reuse. While RUCs are not characterized as waste management facilities, they can develop synergies with existing and/or to be developed PROs as well as other actors.

Based on the above, this study focuses on the assessment of the cost parameters regarding the required investment for the EGC of the City of Athens, as well as on the

balance between annual operational costs and potential income from trading of items at second hand products' markets. The technical description of the required infrastructure and equipment, considering the investment aspect, is firstly divided into groups of activities based on the exact character of the works. These groups include i) workload related with the preparation of the lot's surface, namely, earthmoving and landscaping, ii) works and supplementary equipment for the shelters and buildings that will host GC's and RUC's activities respectively, iii) equipment related with machinery such as press containers and large capacity vessels for the temporary storage and transportation of recyclables, iv) equipment related with small capacity bins suitable for the handling and storage of items and objects as well as toolkits for the RUCs technicians, v) equipment related with loaders, forklifts as well as with transportation vehicles for the delivery of EGC's outputs to relevant stakeholders, vi) workload related with the construction of inner roads and maneuvering areas for transportation vehicles, vii) workload related with the surrounding areas of both GC and RUC (e.g. curbside, fencing, tree planting etc.) and viii) works and equipment related with the development of utilities (sewerage networks, power and water supply networks etc.). The costs for performing additional studies are also included required (costs not covered by LIFE IP CEI Project), such as architectural and civil engineering studies. For each group, the respective investment cost is estimated for the indoor and outdoor areas of the Athens Municipality's EGC, while the summary of each group's cost provides the overall investment cost of both facilities (GC and RUC).

Concerning the annual economic balance during the integrated operation of the EGC for both facilities (GC and RUC), the first parameter which has to be estimated is the operational cost. The overall operational cost is calculated as the summary of several cost-generating activities including i) personnel and external consultants cost, ii) administrative cost (insurance, consumables, informative campaigns etc.), iii) operational cost of utilities' networks, iv) other cost parameters related with machinery and vehicles' fuel consumption, maintenance of infrastructure and equipment, cleaning services, procurement of personal protective equipment etc.. Operational cost parameters and especially those referred to personnel cost were estimated for the operation of EGC at full capacity.

As far as the second parameter of the annual economic balance, the expected income from the operation of EGC is concerned and based on the fact that this integrated facility (both GC and RUC) is the first to be developed at a national level, alternative scenarios were developed which were differentiated according to the performance (recycling to reuse) ratio of the facility as well as according to the current trading values of both recyclables and second hand items/objects. Specifically, three basic alternative scenarios were assessed, namely, i) the empiric one which is based on actual results derived from the operation of RUCs at EU level assuming also average demand for recyclables and second hand items at the respective markets, ii) the pessimistic scenario where the EGCs' outputs are considered recyclables at a range of 90% of input quantities, assuming also low demand for recyclables and second hand items at the respective markets and accordingly, iii) the optimistic scenario were the EGCs' outputs are considered reusable – second hand

items objects at a range of 90% of input quantities, assuming also high demand for recyclables and second hand items at the respective markets. Furthermore, the empiric scenario is further categorized in two variations which are differentiated according to low or high trading values of second-hand products. All five scenarios (three main plus two variations) were assessed in terms of their annual expected incomes so as to estimate the annual economic equilibrium of the plant for a period of 25 years and also to calculate the deficit rate in order to provide suggestions related with the availability of funding instruments of the EGC during both construction and operation phase.

The results of techno-economic analysis, horizontally for all five scenarios, clearly indicated the fact that EGC can be sustainable only if the outputs of the GC and RUC are traded at the secondary materials' and second-hand items' markets respectively. Based on the results of the empiric scenarios and its variations, the investment cost of EGC can be fully funded by national business programs while the sustainability of the facility during its operation requires subsidization funds from governmental authorities. It is noted that part of these funds can be obtained by PROs in the framework of bilateral synergies. Regarding the pessimistic scenario, EGC has limited sustainability as it has to be generously funded during its operation by both governmental authorities and PROs. Finally, the assessment of optimistic scenario has indicated that EGC can be a profitable investment where profits can be re-invested in terms of increasing employment similar to the social character of the plant. However, in this case, the investment cost cannot be fully covered via national funding due to the fact that state aid can cover only a percentage (appr. 50%) of the investment as the EGC generates profit. In any case, the sustainability of the EGC is strongly depending on the public participation response during the operation of the plant where EU experience has shown that EGCs can be sustainable.