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## Development of a Blockchain Solution for Food Waste Management

**George Plakas<sup>1\*</sup>, Stavros Ponis<sup>1</sup>, Eleni Aretoulaki<sup>1</sup>, Dimitra Tzanetou<sup>1</sup>, Antonios Kitsantas<sup>1</sup>**

<sup>1</sup>Operations Research and Logistics Laboratory, School of Mechanical Engineering, National Technical University of Athens, Athens, Greece

\*Corresponding author: [plakasg@mail.ntua.gr](mailto:plakasg@mail.ntua.gr)

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### ABSTRACT

Food waste is a problem with serious and multidimensional implications ([Manika et al., 2022](#)). Environmentally, it contributes to greenhouse gas emissions and depletion of water and land resources ([Sun et al., 2018](#)) and economically, it represents a significant loss of resources and money for both enterprises and society as a whole, as it causes almost \$1 trillion per year in economic damages ([FAO, 2014](#)). Socially, food waste coexists with hunger and food insecurity, hence exacerbating disparities. Actions against hunger (SDG 2) and the impacts of food waste (SDG 12.3), are both parts of the Sustainable Development Goals, implemented by United Nations. Especially in metropolitan areas, Food Service Establishments (FSEs) contribute significantly to the problem's development, due to a variety of reasons. Overproduction, insufficient inventory management, poor portioning, plate waste, inefficient food preparation procedures, and customer behaviour ([Canali et al., 2016](#); [Özbük & Coşkun, 2020](#)) are some examples of these. Viable strategies are needed to reduce the problem's incidence and, in this context, business owners and consumers should cooperate to adopt effective waste reduction programs, which are able to overcome the complexities and ramifications of food waste. To address food waste in urban FSEs, a holistic approach including all stakeholders is required, and the use of effective technology solutions can play a crucial role towards this direction, especially in the context of smart cities. Local governments and municipalities can also be critical in assisting waste reduction efforts, through legislation and regulations ([Treutwein & Langen, 2021](#)), by rewarding business owners and citizens with sustainable habits. In this paper, a project is presented that aspires alleviate food waste in FSEs, by offering free or discounted meals to consumers, especially to food insecure citizens.

The research project presented in this paper, namely BLOCKFOODWASTE, lies in the intersection of two scientific areas e.g., food waste management and blockchain technology. The project's final product is a decentralized application (dApp) that operates as a marketplace providing to its users supply of and demand for food surplus from FSEs. The back-end of the application, as implied by its type, runs on a blockchain network. The Ethereum blockchain was chosen by the project partners, due to its public nature and the capabilities it provides to programmers for the development of smart contracts, which play a critical role for the project's scope. FSEs (supply) and consumers (demand) consist the two main user profiles of the application, but the integrated system provides open access to all stakeholders that can benefit from the project's implementation, i.e., municipalities, local governments, NGOs etc. The main function of the solution, is the supply of food meals, that otherwise would be disposed of, by the FSEs in real time and the reservation and pick up of these meals by the consumers. As a result, food waste transforms in safe and nutritious meals for possibly food insecure citizens, with the complete anonymity provided by the blockchain technology.

The keystone of the proposed ecosystem is the project's token (BFW), which is used as a mean of exchange for the purchase of meals by the consumers, directly through the application. A blockchain wallet is incorporated in the dApp, to provide users with a secure and convenient way to manage their tokens. For the creation of BFWs, solidity language is utilized, in order to develop the project's smart contract that controls token supply and distribution. Food surplus offered by FSEs, acts as the underlying asset that is transformed in BFWs, in this tokenization process. Given that the project's smart contract is a node of a public blockchain, the solution is secure and transparent to anyone and it supports widespread adoption and engagement. The project's token tracks food waste reduction and encourages participation and behavioural change, as it is offered as incentive. Initially, each citizen is given a number of tokens to spend

upon registration and afterwards, the smart contract releases more tokens to both parties (supply and demand) for every successfully completed pick up of food surplus. Citizens utilize the tokens as currency to buy meals or other things from participating business units. This encourages users to participate in food waste reduction efforts in a regular basis. On the other hand, every participating establishment receives tokens as a reward for every portion of food saved from waste, in addition to the tokens that are transferred to it directly, by the consumer. FSEs can use their tokens to gain access to valuable data analytics and advertisement by the platform, transfer the tokens directly to food insecure citizens or gain benefits from the application's stakeholders. Municipalities or waste management companies, are able to offer discounts to the business owners through the application in exchange for their collected tokens, in a way to further motivate FSEs in food waste reduction efforts. Blockchain sets its rules and conditions for token transfer, to guarantee that tokens are utilized effectively and their use is aligned with the project's goal. The authors are currently in the phase of assessing the potential value of the token and the overall tokenomics of the BLOCKFOODWASTE application, by assessing market demand along with basic token characteristics such as, supply, distribution, utility and economics.

Food waste mitigation efforts are essential and possible, especially in metropolitan areas that are characterized as "smart cities". FSEs may considerably reduce food waste, promote sustainability, and contribute to a more resilient and equitable food system by implementing comprehensive initiatives that incorporate all stakeholders, like the blockchain-based approach suggested in this research paper. Due to the solution's ability to guarantee the anonymity of the consumers and its tokenization capabilities, the dApp offers significant advantages to its users, in an effort to promote a sustainable behavioural change towards food waste reduction. So, the above-mentioned blockchain characteristics play a crucial part in the integrated system and the project's ecosystem, which is built around the BFW token, can transform into an integrated solution to tackle food waste on every step of the food supply chain.

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