Applied problems and means of digital technologies for sustainable development of green economy

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Abstract
Objectives The objectives of the work are to apply digital technology for online service of the population. **Prior work** The system developed in this study differs from existing systems in that it optimizes the number of seniors served simultaneously. This reduces the number of vehicles used to deliver food and goods to seniors, thereby reducing Greenhouse Gas (GHG) emissions. **Approach** The scientific significance is the analysis of time series of public services, and its practical significance lies in the creation of a platform for servicing of seniors' requests. **Results** Calculations of the study are implemented for time series of Italian seniors. Therefore, results are justified through the study of real Italian time series. **Implications** The paper should be interesting for academics as theoretical research, for social workers supplying services to seniors, transport sector practitioners and those who are eligible for the mitigation of GHG emission. **Value** The value of the work is the analysis of time series of seniors' or disables service by creating a platform that provides the optimization of the number of seniors served simultaneously and, consequently, to mitigate environmental pollution.

Keywords: pollution mitigation, seniors, delivery.

1. Introduction
United Nations Environment Programme (UNEP) defined a **green economy** as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive". In accordance with the UNEP definition, various researchers currently offer their own approaches to defining the green economy. However, existing approaches generally describe the same core idea (ECE/FAO, 2018). The green economy aims to support the achievement of sustainable development by aligning economic goals with social and environmental processes. According to [1], the concept of a green economy encompasses the concepts of the circular economy and bioeconomy, is characterized by multifunctionality and large-scale, and is focused on innovation and technology development [2].

The diversity and innovation of technologies enable sustainable development in several areas. In particular, the transportation industry is developing with electric vehicles and the connection of vehicles to the power grid in line with the concept of integrating it with smart city infrastructure. In a "green economy," improving the social sector's provision of services to the elderly creates opportunities to improve the health of seniors by regulating food delivery orders.

Digital technologies are transforming the sustainable development of the social sector in several ways. Information technology, software, and hardware are streamlining the process of fulfilling grocery delivery orders for seniors. Advanced software technologies, such as programs that connect seniors with acquaintances shopping in supermarkets, expand opportunities for dialogue and enhance the capabilities and flexibility of the social sector. This paper examines and understands the needs of seniors for online grocery delivery services. Older adults experience disabilities, have limited physical shopping capabilities, and decreased physical strength hinders their visits and navigation through stores. Online services help eliminate these barriers and enable grocery delivery directly to the home. Currently available online services connect seniors with their suppliers. We propose an online service that searches for familiar neighbors, friends, or relatives in stores and communicates the grocery items the senior needs. This provides expanded and flexible application of online services for seniors. The software implementation of the online service is provided.

2. The concept of a green economy

The theoretical foundations of a green economy are laid within the field of green economy, a field of research aimed at reducing environmental risks in the context of economic growth and improving social well-being. The concept of a green economy is based on the principles of sustainable economic growth, its close connection with social processes, and environmental safety. The relevance of the green economy in accordance with the bioeconomic direction of sustainable development and contributing to overcoming the imbalance of the ecological-economic system and minimizing the burden on the environment is studied in the works [3, 4, 5]. The importance of the green economy in terms of its impact on economic growth is noted in the studies of [6, 7] as well applied problems and directions of decisions of green technologies in sustainable development.

The principles of sustainable development in terms of decision-making that considers the long-term consequences of our actions and the need to protect natural resources for future generations are studied in the works [8, 9].

The complex interrelationship between the economy and the environment is discussed in the work [10]. This paper introduces some key concepts and principles of ecological economics:

"1. Transdisciplinarity
Ecological economics is a transdisciplinary field that draws on knowledge from economics, ecology, and other disciplines to understand the complex interactions between the economy and the environment.

2. Ends, Means, and Normative Stance
Ecological economics takes a normative stance, emphasizing the need to prioritize environmental sustainability and social equity over economic growth. It also recognizes that economic means must be consistent with social and environmental goals.

3. The Problem of Scale
Ecological economics emphasizes the importance of understanding the environmental limits to economic growth. It recognizes that economic growth cannot continue indefinitely in a finite

ecosystem and that a sustainable economy must function within the framework of an ecosystem.

4. Wealth Distribution
Ecological economics recognizes that wealth distribution is an important factor in achieving sustainable development. It emphasizes the need to address issues of social equity and distributive justice in environmental policy.

5. Resource Allocation."
Environmental economics is linked to the challenges of educating the public about sustainable environmental management. In [11], the authors examine the use of eco-friendly transport and digital technologies for air quality monitoring. They argue that this approach can be used to educate the public about sustainable environmental management. Innovative programs developed by the Surabaya city government have awarded the title of the cleanest air city in ASEAN. The clean air program's developers successfully utilized digital communications technologies to monitor air quality in real time, significantly increasing the efficiency of carbon dioxide absorption.

According to [12], urban planning modeling helps cover the costs of public transportation. From this perspective, the study focuses on reducing the cost of transport services for care givers and patients. Clearly, this approach reduces carbon emissions through vehicle use. Based on the research conducted on the «15-Minute City» concept, approaches for assessing the effectiveness of its long-term implementation are proposed. The goal of implementing «15-Minute City» concept is highlighted: improving the quality of life of the population and reducing carbon emissions, while stabilizing the economic growth. Particular emphasis is placed on social participation of the population in achieving the goals of the proposed «15-Minute City» concept.

The benefits of using digital technologies to obtain information for both private and public institutions are explored in [13]. According to the authors, people with disabilities can communicate with community members and become its full members. Through the use of digital technologies, people with disabilities can fully participate in the digital world.

3. Methodology
We reviewed works on the topic of providing services to seniors and their connection to the "green economy," based on search engines (Google Scholar). This allowed us to identify the key features of the process of providing online shopping services to seniors. Existing systems and articles on the topic under study contained important information, which we used to formulate our approach for creating an online shopping service system for seniors. Our approach differs from existing ones in that it is individually targeted, as follows. The user (in this case, an elderly person) has the option of finding a grocery supplier among friends, relatives or neighbors. Thus, the online service system allows for optimization of the transportation system by reducing the number of vehicles and utilizing neighboring vehicles to provide services to several neighbors simultaneously. Existing online systems are used to deliver groceries to seniors individually, and typically, separate vehicles are used to deliver groceries to individuals living in the same neighborhood. We conducted an analysis of the use

of the online services system we developed using a simulation model and the spectral analysis method.

4. Simulation model of time series analysis of online service

We offer an online grocery delivery service for seniors, enabling delivery on request. The system allows for simultaneous delivery requests from several seniors living in the same neighborhood. This system allows for delivery to be performed simultaneously using a single vehicle for multiple seniors. The factors listed in Table 1 are considered as variables for assessing the system's effectiveness.

The online grocery delivery service we developed is an indispensable tool for seniors. This digital product allows homebound seniors to receive groceries that ensure proper nutrition and maintain their health. The system can receive orders from multiple users simultaneously, and the supporter who receives a request from multiple users in the same neighborhood can deliver the necessary groceries. Obviously, this requires the use of a single vehicle, rather than the multiple vehicles required for individual online services. The online service we developed connects users (users living nearby) as friends or neighbors and accommodates both budgetary constraints and special dietary needs. The system platform features a user-friendly interface and convenient phone ordering options.

Table 1. Factors used for the assessment of the ecological and social efficiency of the on-line seniors grocery shopping support

Indicator	Unit of measurement
PM2.5 air pollution, mean annual exposure	micrograms per cubic meter
PM2.5 air pollution, population exposed to levels exceeding WHO guideline value	(% of total)
Methane (CH4) emissions (total) excluding LULUCF	% change from 1990
Total greenhouse gas emissions excluding LULUCF per capita	t CO2 e/capita
Carbon dioxide (CO2) emissions (total) excluding LULUCF	% change from 1990
Population ages 65 and above, totalSP.POP.65UP.TOSP.POP.65UP.TO	Number

Source: World Development Indicators

Spectral analysis model (as a data source used World Development Indicators, Italian case)
Spectra assessment. Model Indicators:

- time series of population ages 65 and above
- frequencies: $\pi/113$, $\pi/170$
- PM2.5 air pollution, mean annual exposure
- time period is 1990-2023

Approach for the choice of the time series of population ages 65 and above is implemented as follows. The population used as time series is calculated as the regional population

consisting of 5% of total population. The amount of pollution is 4603.6 CO2 per car. Assumption as the service of 3 seniors by one supplier allows to consider the population getting online supply equal: (0.05 *x* population ages 65 and above)/3.
For the assessment of the PM2.5 air pollution, mean annual exposure we calculated the pollution equal: (0.05 *x* population ages 65 and above)/3) *x* 4603.6.

Thus, the time series of the pollution is calculated as ((0.05 *x* population ages 65 and above)/3) *x* 4603.6.

Using the software of the spectra assessment we calculated periods of cycles as 3.3 and 6.7 years.

The spectra are given on the Fig. 1.

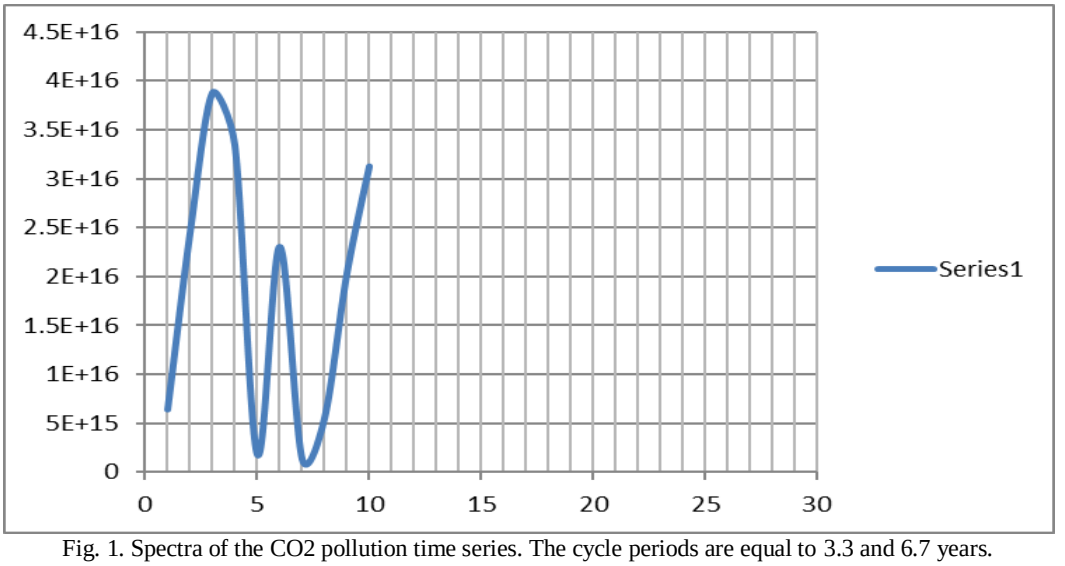

Fig. 1. Spectra of the CO2 pollution time series. The cycle periods are equal to 3.3 and 6.7 years.

The model of change of components corresponding to frequencies π/113, π/170 is given as:

$$CO_{2t} = C_1 + C_2 COS(\frac{\pi t}{113}) + C_3 COS(\frac{\pi t}{170}) \quad (1)$$

The assessment of coefficients of the model is given on the Table 2.

Table 2. Assessment of the coefficients of the model (1).
Dependent Variable: CO2
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 12/01/25 Time: 01:41
Sample: 1 34
Included observations: 34
CO2=C(1)+C(2)*COS113+C(3)*COS170

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-2.48E+10	2.21E+09	-11.24974	0.0000
C(2)	-2.35E+10	1.86E+09	-12.58543	0.0000
C(3)	4.90E+10	4.07E+09	12.04400	0.0000

R-squared	0.987531	Mean dependent var	8.90E+08
Adjusted R-squared	0.986726	S.D. dependent var	1.36E+08
S.E. of regression	15688942	Akaike info criterion	36.05891
Sum squared resid	7.63E+15	Schwarz criterion	36.19359
Log likelihood	-610.0014	Hannan-Quinn criter.	36.10484
F-statistic	1227.546	Durbin-Watson stat	0.199779
Prob(F-statistic)	0.000000		

The results from Table 2 show that p-values of the regression model (1) coefficients are equal zero. Consequently, all coefficients are statistically significant.

The low DW statistics of 0.1999779 strongly suggests the presence of positive first-order serial correlation.

5. CANGOO seniors grocery service system

System overview

Cangoo is a peer-to-peer (P2P) local-delivery platform designed to make urban logistics more sustainable, affordable, and community-driven. Instead of dispatching dedicated couriers, Cangoo connects people already on the move - students, commuters, or residents - who can deliver small parcels along their daily routes. Each completed delivery represents a more efficient use of existing mobility, reducing traffic, emissions, and delivery costs.

The app allows any user to act as a requester or deliverer through a single intuitive interface. Using an interactive map-first experience, users can set pickup and drop-off points, view live routes, and coordinate the delivery directly. The system is developed with React / Expo for mobile, React / Tailwind for web, and Supabase for authentication and data management, with Mapbox providing high-precision geolocation and route visualization.

Cangoo has completed its minimum viable product (MVP) and internal user testing in Pisa. The project recently won the “Innovazione per una Mobilità Sostenibile” competition

organized by CNA and PISAMO, confirming its technical maturity and social relevance. The next step is to internationalize the concept through the Circle U. Innovation Seed Funding mobility, strengthening its model with European best practices before launching pilot operations in 2026. Learn more: https://cangoo.surge.sh

Relation to selection criteria
Enrollment and Experience Level: The founders are students from the University of Pisa, part of the Circle U. alliance. Cangoo stands at an intermediate stage of development - validated in concept and design, with functional software and institutional recognition, now preparing for early-market validation.

Sustainability focus: Cangoo directly contributes to UN SDG 11 - Sustainable Cities and Communities by minimizing unnecessary vehicle travel and promoting low-impact, citizen-driven logistics. Deliveries are completed by individuals using existing journeys, often on foot, bicycle, or public transport. This approach reduces fuel consumption and air pollution while optimizing city space.

Societal impact: Cangoo transforms logistics into a collaborative urban practice. Residents can earn modest compensation while supporting neighbors and local shops. Small businesses gain access to fast, affordable last-mile delivery without managing fleets. Municipalities benefit from cleaner air, less congestion, and new models of civic participation. The inclusion of an AI-based assistant ensures that even less-digital or elderly users can easily participate.

Innovation: Cangoo unites digital innovation and social sustainability in a single model: peer-to-peer logistics based on route overlap, a unified app with both order and deliver modes, an AI assistant guiding users through every step, and future expansion toward ride-sharing and micro-hub delivery points under the same infrastructure.

Business understanding
Cangoo follows a two-sided marketplace model, combining social and financial sustainability.

Phase 1 - MVP (Current): The platform connects requesters and deliverers directly, with fees proposed by the requester and off-platform payments to encourage trust.

Phase 2 - Pilot (2026): Secure in-app escrow payments and service fees will be introduced, alongside merchant partnerships for recurring deliveries.

Long-term vision: Cangoo aims to become a modular logistics ecosystem, integrating ride-sharing, shared pickup hubs, and data-driven insights for cities. Revenue streams will include platform commissions, retailer subscriptions, analytics partnerships, and white-label solutions for municipalities. Through the Circle U. mobility, the team aims to benchmark its strategy against leading European incubators, refining its pricing, sustainability metrics, and operational model under expert mentorship.

Defined goals for the exchange
1. Collaborate with a European incubator to refine financial and operational models.
2. Conduct user testing in a different urban environment to assess adaptability.
3. Design a sustainability-impact framework tracking emissions saved and community participation.
4. Build partnerships with innovation hubs for a 2026 cross-city pilot.

Expected outcomes

- A clear, validated business roadmap and scaling strategy
- A tested framework for environmental and social impact measurement
- Collaboration with at least one Circle U. incubator or accelerator
- Strengthened entrepreneurial and intercultural competences within the team
- Preparation for seed investment or EU acceleration

6. Conclusion

The public service tool addresses the need for sustainable development of a green economy by reducing environmental pollution risks. It involves integrating socially oriented functions with those aimed at reducing CO2 emissions. The implementation of the system **CANGOO** of online service allows to increase the efficiency of the process of supply and demand between seniors and their supporters. At the same time it allows to mitigate and reduce greenhouse gas emissions through the optimal choice of population is to be served.

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