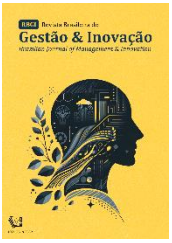
Vol. 11, N° 1 January – April / 2024

RBGI - Revista Brasileira de
Gestão & Inovação
Brazilian Journal of Management & Innovation
journal homepage: https://sou.ucs.br/etc/revistas/index.php/RBGI/index



Expansion and electrification of the public transport system in Curitiba, PR: an analysis based on SDG 11 and the transformative innovation policies (TIP)

Expansão e eletrificação do sistema de transporte público de Curitiba, PR: uma análise baseada no ODS 11 e nas Políticas de Inovação Transformadoras (TIP)

ISSN: 2319-0639
OPEN ACCESS

Sérgio Luis Dias Doliveira [1]
https://orcid.org/0000-0001-9957-225X

Sieglinde Kindl da Cunha [2]
https://orcid.org/0000-0003-1936-8422

Flavia Massuga [1]
https://orcid.org/0000-0003-2490-6678

[1] Universidade Estadual do Centro Oeste – UNICENTRO
[2] Universidade Federal do Paraná – UFPR

HIGHLIGHTS

- The electrification of Curitiba's Inter Line 2 illustrates how public policies can align urban mobility with Sustainable Development Goals, promoting accessibility, sustainability, and social inclusion across the metropolitan region.
- The initiative is analyzed as a transformative innovation policy (TIP) experiment, providing practical evidence of how sociotechnical transitions can lead to tangible outcomes in urban systems based on sustainable transport.
- The study applies a mixed-method approach interviews, document analysis, and diagnostic data to assess the project's alignment with SDG 11.2 and ISO 37120:2018 urban mobility indicators.
- Fleet electrification, sustainable terminals, enhanced accessibility, and digital technologies contribute to carbon emission reductions and improved quality of life for public transport users.
- The research offers theoretical and practical contributions by showing how Global South cities can lead sustainability transitions and inspire other urban centers to implement TIPs addressing climate and mobility challenges.

Received on:
May/2023

Approved on:
November/2023

Editor:
Mateus Panizzon, Dr.
PPGA UCS

Assistant Editors:
Catiane Borsatto Ma.
PPGA UCS
Bianca Libardi Ma.
PPGA UCS

Evaluation Process:
Double blind peer review

Reviewers:
Reviewer 1
Reviewer 2

Este artigo não possui nenhum arquivo associado
This article does not have any associated files.

HOW TO CITE:

Doliveira, S. L. D., Cunha, S. K. da, & Massuga, F. (2024). EXPANSION AND ELECTRIFICATION OF THE PUBLIC TRANSPORT SYSTEM IN CURITIBA, PR: AN ANALYSIS BASED ON SDG - 11 AND THE TRANSFORMATIVE INNOVATION POLICIES (TIP). *Brazilian Journal of Management and Innovation (Revista Brasileira De Gestão E Inovação)*, 11(1), 40–50. https://doi.org/10.18226/23190639.v11n1.05

KEYORDS

Sustainable development

Sustainability transitions

Agenda 2030

Urban mobility

Innovation Policies

ABSTRACT

Objective: The main objective of this study is to describe the project to improve and electrify the Inter Line 2 of the Integrated Transport Network in the city of Curitiba-PR, in order to understand its compliance with the requirements of the SDG-11, target 11.2 and the relationship with transformative results from Transformative Innovation Policies (TIP) in a context of socio-technical transitions.

Methodology: It is a descriptive and exploratory study of mixed approach, using documents, diagnosis materials, and semistructured interviews. The data were assessed through content analysis.

Originality/Relevance: Cities correspond to places with great urgency for change. Understanding transition initiatives and associated TIPs is necessary to encourage the transformation to more sustainable ways of life in urban centers.

Results: The results show that the expansion and electrification project for the Inter Line 2 is in accordance with target 11.2 of SDG-11 and will provide improvements in the quality of life for the population of the entire metropolitan area. Moreover, it corresponds to a strong niche of socio-technical transformation and its benefits are configured as a transformative result in accordance with the TIP.

Theoretical and Methodological Implications: The study's theoretical contribution illustrates the TIPs theory from the transition perspective, presenting an innovative project that meets the SDGs and configures itself as a transformative result in the socio-technical urban mobility system.

Social contributions to management: It also serves as an example for other urban centers with regard to the establishment of public policies aimed at sustainability.

PALAVRAS-CHAVE

Desenvolvimento sustentável

Transições de sustentabilidade

Agenda 2030

Mobilidade urbana

Políticas de Inovação

RESUMO

Objetivo: O objetivo principal deste estudo é descrever o projeto de melhoria e eletrificação da Linha Inter 2 da Rede Integrada de Transportes na cidade de Curitiba-PR, a fim de compreender o seu atendimento aos requisitos do ODS-11, meta 11.2 e a relação com os resultados transformadores das Políticas de Inovação Transformativa (TIP) num contexto de transições sociotécnicas.

Metodologia: Trata-se de uma pesquisa descritiva e exploratória de abordagem mista com utilização de documentos, materiais de diagnósticos e entrevistas semiestruturadas. Os dados foram avaliados por meio de análise de conteúdo.

Originalidade/Relevância: As cidades correspondem a locais com grande urgência de mudança. Compreender as iniciativas de transições e as TIPs associadas se faz necessário para estimular a transformação para modos de vida mais sustentáveis nos centros urbanos.

Resultados: Os resultados mostram que o projeto de expansão e eletrificação da Linha Inter 2 está de acordo com a meta 11.2 do ODS-11 e proporcionará melhorias na qualidade de vida da população de toda a região metropolitana. Além disso, corresponde a um forte nicho de transformação sociotécnica e seus benefícios se configuram como um resultado transformador de acordo com o TIP.

Implicações teóricas e metodológicas: O estudo contribui teoricamente ao ilustrar a teoria das TIPs na perspectiva da transição, apresentando um projeto inovador e como ele atende aos ODS e se configura como um resultado transformativo no sistema sociotécnico de mobilidade urbana.

Contribuições sociais à gestão: Também serve de exemplo para outros centros urbanos no que diz respeito ao estabelecimento de políticas públicas voltadas para a sustentabilidade.

1. Introduction

The concern raised by sustainability, with environmental, social and economic considerations, has been growing in recent years, making it increasingly necessary and relevant (Klarin, 2018). Sustainability, therefore, is configured as a field of knowledge that has contributed to the understanding of phenomena such as poverty, environmental deterioration, social inequality, climate change, and ways to mitigate these major difficulties, especially through transformative and innovative processes.

Innovation studies oriented towards sustainability have gained recent attention, and a new field called "sustainability transitions" has been gaining ground (Markard, Raven & Truffer, 2012; Markard, Geels & Raven, 2020; Loorbach, Wittmayer, Avelino, Von Wirth & Frantzeskaki, 2020). A sustainability transition refers to a set of processes that result in transformations in existing socio-technical systems giving rise to new products, business models, and technological and institutional structures that are more sustainable (Markard et al., 2012; Loorbach, Frantzeskaki & Avelino, 2017; Köhler et al., 2019). These changes are essential in the areas of energy, mobility, food, water, health, and communication, that is, in the overall systems of contemporary society (Grin, Rotmans & Schot, 2010; Schot & Steinmueller, 2016).

Cities play an important role for transitions, as they correspond to places with great urgency for change and present many sustainability initiatives and interventions (Fuenfschilling Frantzeskaki & Coenen, 2018; Wolfram, 2018; Frantzeskaki, Broto, Coenen & Loorbach, 2019; Frantzeskaki, 2022). Specifically, the transport sector consists of an urban socio-technical system that demands radical and systemic transformations (Goyal & Howlett, 2018). It is challenged by traffic, air pollution, use of non-renewable resources such as fossil fuels, and CO^2 emissions (Geels, Kemp, Dudley & Lyons, 2011), with the potential to cause a range of environmental and health problems (Organization for Economic Cooperation and Development [OECD], 2020).

The Sustainable Development Goals (SDGs) recognize this demand and constitute themselves as a tool of different dimensions that make the transformative process possible (Schot, Boni. Ramirez & Steward, 2018; Lundin & Serger, 2018). SDG 11 - Sustainable Cities and Communities - is linked precisely to the promotion of more sustainable urban, environmental, social and economic conditions. Specifically, target 11.2 denotes the need to provide access to safe, accessible and sustainable transport systems (United Nations [UN], 2015).

These initial considerations point out that traditional political orientations should build and shape themselves in accordance with the SDGs. The Transformative Innovation Policies (TIP) have made a fundamental contribution to this discussion, with actions that generate transformative changes at the system level (Schot & Steinmuller, 2016). Transformative innovations stem from local initiatives that challenge established regimes, and it is important to assess the different approaches applied in different contexts (Loorbach et al., 2020; Boni, Velasco & Tau, 2021).

Despite the growing literature about policies of transformative innovation from the perspective of socio-technical transitions, it is necessary to understand how innovation policies can be employed to face sustainability challenges based on more practical evidence (Haddad, Nakic, Bergek, & Hellsmark, 2022). In particular, there is little understanding or empirical data on how the TIPs are made operational and implemented to achieve the SDGs and transformative results (Bugge, Berg & Tømte, 2023). Thus, understanding different contexts and paths that might create transformative results in the urban area is relevant (Grainger-Brown, Malekpour, Raven & Taylor, 2022). Specifically, studies about contexts in the Global South, where innovation systems are usually incipient, are encouraged (Bugge et al., 2023).

The city of Curitiba, in Brazil, is recognized for its environmental initiatives and urban mobility solutions. It is a signatory of the SDGs with the OECD, and strongly considers them in the development of its projects (Kaick et al., 2020; Moura, Nobre, Serafini & Nogueira, 2020). Among its actions, the project for the improvement and electrification of the Interbairros Line 2 and Inter 2 Direct Line, which is part of the Curitiba More Agile program of the 2022-2025 Multiyear Plan (PPA for its Portuguese acronym), stands out and challenges the existing regime. It is therefore questioned how this project meets what is proposed by SDG-11, target 11.2, and whether it constitutes a transformative result amidst the socio-technical transitions in the area of mobility and transport.

This study aims to describe the project to improve and electrify the Inter Line 2 in the city of Curitiba, PR, in order to understand its integration with the SDG-11, target 11.2, and the relationship with transforming results from the TIP, as a set of articulated actions in a context of socio-technical transitions.

In this sense, the study contributes by illustrating the TIPs theory from the transition perspective, presenting an innovative project that meets the SDGs and configures itself as a transformative result in the socio-technical urban mobility system. Therefore, the theoretical contribution happens through a case study of a developing experience that offers a new perspective, different from the usual, due to the idiosyncrasies of the field of study: the Integrated Transport Network (RIT is the acronym in Portuguese) of the city of Curitiba, State of Paraná, Brazil. A practical contribution is also evident, as the experiment presented serves as a reference for other urban centers that may be able to use the proposal as a reference in the development of their TIP, aimed at SDG-11, specifically target 2, leading to sustainable development.

Next, the theoretical model used to carry out the research is presented based on the discussion of sustainability transitions in the area of urban mobility, ODS-11.2 and ISO 37120:2018 with associated indicators, and innovation policies with attention oriented to TIP. Then, the methodological assumptions, results, discussions, and conclusions of the study are presented.

2. Theoretical Framework

2.1 Sustainability Transitions and Urban Mobility

Several environmental and social problems still persist in the field of sustainability, such as climate change, poverty, hunger, loss of biodiversity, and depletion of natural resources. These challenges result from unsustainable production and consumption patterns of current socio-technical systems in the areas of electricity, mobility, and agri-food, for example (Markard et al., 2012; Schot & Steinmueller, 2016; Köhler et al., 2019; Truffer et al., 2022), and stimulate discussions about sustainability transitions (Loorbach et al., 2020).

Sustainability transitions that require radical changes to new types of socio-technical systems are necessary to achieve sustainable development (Grin et al., 2010; Loorbach et al., 2017). This can be seen in recent years from the growth of publications, and the emergence of institutional structures as supporters for the formation of a research agenda (Geels, 2002; Grin et al., 2010; Köhler et al., 2019).

Conceptually, transitions to sustainability are considered a long-term, multidimensional, systemic, structural and non-linear transformation process from existing socio-technical systems to more sustainable modes of production and consumption (Markard et al., 2012). The approach, therefore, takes a critical stance against dominant policies and institutions that focus only on incremental and path-dependent changes (Loorbach et al., 2020).

Transformations towards more sustainable ways of life are the result of several changes at different levels and domains that interact and reinforce each other in order to change a complex system (Köhler et al., 2019). According to the multilevel perspective, sustainability transitions correspond to activities at niche, regime and landscape levels. The niche refers to the place where radical innovations emerge and put pressure on existing regimes for change. The regimes aim to maintain the stability of the socio-technical system and are pressured by the niches. The landscape, on the other hand, corresponds to a macro level that involves external factors that change slowly, contributing to the trajectories that are being defined (Geels, 2002).

In this discussion, Fuenfschilling et al. (2018) point out that cities are places with greater urgency for sustainability transitions and system innovation, due to high energy consumption (about two-thirds of global demand), CO^2 emissions (about 70%) and population growth. On the last point, it is estimated that by 2050, about 6.7 billion people will live in urban

centers (UN, 2018), which corresponds to almost 70% of the planet's population (Marvuglia et al., 2020).

These considerations place cities as possible agents of transformative change, given their political capabilities that directly affect citizens in all domains of life, such as education, health, employment, consumption, mobility, and in different socio-technical systems (Wolfram, 2018; Fuenfschilling et al., 2018).

The mobility and transport sector also constitutes a socio-technical system, formed from networks of actors and institutions that characterize it (Markard et al., 2012). The existing urban transport is not sustainable, and it corresponds to a complex challenge that demands technological, cultural and political innovation. The regime is formed by the prevalence of combustion-powered cars, automobile industries, supporting infrastructure and regulations. A culture focused on the symbolic meanings of the car is also evident, which has created sustainability issues such as pollution, energy inefficiency, noise, traffic, and safety issues (Goyal & Howlett, 2018). Goyal and Howlett (2018) also emphasize that changes in the landscape such as globalization, individualization, and an increase in the standard of living stabilize the system. On the other hand, increased demand for mobility, climate change, and resource depletion put pressure on regimes and pave the way for niche innovations.

Other studies also address sustainability transitions in the urban mobility sector. Kivimaa and Rogge (2022), for example, discuss mobility in Finland which was planned towards a mobility free of greenhouse gas emissions, with a strategy for smart transport, institutional change, and a fusion of transport policy and innovation. Trencher, Truong, Temocin and Duygan (2021) similarly denote the strategies used in electric mobility transitions in China, Japan and California. According to Loorbach et al. (2020), there is an advance in the socio-technical transition from combustion engines to electric vehicles. However, other paths with social, economic and environmental benefits are needed, such as encouraging public transport and shared mobility.

2.2 SDG-11, Target 2 and ISO 37120:2018

The Sustainable Development Goals (SDGs), defined by representatives of the sovereign states at the United Nations Headquarters in 2015, constitute a tool of various dimensions that make the transformative process possible (Schot et al., 2018; Lundin & Serger, 2018). In all, there are 17 goals and 169 targets to be achieved by 2030. With an emphasis on the environmental, social, and economic pillars of sustainability, they aim at greener production, greater social justice, and new patterns of consumption and economic growth (Schot & Steinmueller, 2016; Lundin & Serger, 2018; Ramirez, Romero, Schot & Arroyave, 2019).

Considering high population growth and urbanization, and understanding the role of cities in the pursuit of sustainability, the SDG-11 entitled "Sustainable Cities and Communities" specifically focuses on making cities and human settlements inclusive, safe, resilient and sustainable (Franco, 2022). SDG-11 is composed of seven targets that, among other issues, advocate access to safe, sustainable and accessible housing; public space and transport systems; inclusive and sustainable urbanization; protection of cultural and natural heritage; reduction of deaths, affected people and economic losses from catastrophes; and the reduction of the environmental impact caused by cities (UN, 2015).

Considering particularly the mobility and transport sector, target 11.2 of the SDGs aims to provide access to safe, accessible, and sustainable transport systems, with the expansion of public transport considering the needs of people in vulnerable situations, women, children, the elderly, and people with disabilities (UN, 2015; Tiwari & Phillip, 2021).

The indicator for SDG 11.2 proposes to measure the proportion of the population that has access to public transport, by gender, age, and people with disabilities (Ribeiro, 2019). However, in order to better understand the process in which the SDG-11 for more sustainable cities is inserted the international standard ISO 37120:2018 - Sustainable Development of Communities: Indicators for urban services and quality of life was developed (International Organization for Standardization [ISO], 2018). The standardization determines a set of indicators in order to measure the performance of urban services and the quality of life, taking into account sustainable development. It can, therefore, guide public policy and the decision-making process (Ribeiro, 2019).

In the thematic axes of transport, two essential indicators were established, being the total number of kilometers of public transport system per hundred thousand inhabitants, and the annual number of public transport trips per capita. In addition, it consists of five more supporting indicators and two profile indicators (ISO, 2018).

These considerations point out that traditional political guidelines should be shaped to meet the SDGs, an aspect that becomes a basic assumption and that will guide society's demands more and more clearly. In this sense, innovation policies must be reformulated considering their objectives, instruments, and processes (Lundin & Serger, 2018), towards a transformative innovation policy which represents a great influence in the promotion of more sustainable urban, environmental, social, and economical living conditions.

2.3 Innovation Policies and Transformative Innovation Policy (TIP)

The literature on Science, Technology and Innovation (STI) is approximately 50 years old. However, their analyses are going through a crisis. Issues related to excessive consumption, environmental externalities resulted from climate change, and unsustainable growth based on fossil fuels are important problems that are little discussed, as they should, at least, by STI policy (Soete, 2019). One of the central problems addressed by Loorbach et al. (2020) is that innovation policies are primarily aimed at optimizing existing regimes, that is, innovation can prevent transformative change towards sustainability. This is mainly because they translate into incremental improvements, the diffusion of which is delegated to the market mechanisms themselves.

To transcend this idea, it is necessary what the literature understands as Transformative Innovation Policies (TIP). TIP are developed in a context of sustainability transitions with a broader understanding of the innovation process considering environmental and social challenges. In this sense, TIP differ from traditional Innovation Policies as they change the focus to socio-technical transitions, prioritizing the mitigation of environmental exhaustion and the improvement of people's conditions, especially in urban areas (Haddad et al., 2022).

This signals, according to Diercks, Larsen and Steward (2019), that TIP imply ruptures with past political domains, which were focused only on economic aspects, considering competitiveness, growth, and employment. In fact, TIP emphasize the transition to sustainability and assists in changing socio-technical systems, when these are not sustainable, to meet the basic needs of the population, such as healthy food, energy, mobility, materials, water, and resources in general, resulting in transformative changes (Silva, 2021). For Ramirez et al. (2019), transformative innovation is the result of investments in Research and Development, normally financed with public resources that are consistent with the SDGs.

Transformative outcomes are defined by Ghosh, Kivimaa. Ramírez, Schot and Torrens (2021) as processes or interventions that lead to profound changes in the sets of rules that guide actors (individuals, groups, and organizations) in their behavior. In order to enable an evaluation, Molas-Gallart, Boni, Giachi and Schot (2021) propose a model with twelve types of transformative results: 1. Niche building – Shielding; 2. Learning; 3. Network; 4. Navigating expectations; 5. Niche expansion and incorporation – Upscaling; 6. Replication; 7. Circulation; 8. Institutionalization (formal and informal rules); 9. Opening regimes and unblocking of destabilizing and misaligned regimes; 10. Unlearning and deep learning of regime actors; 11. Empowering niche – interactions with the regime; and 12. Changing perceptions of landscape pressures. From these points, therefore, the reflective evaluation of the TIPS becomes possible.

3. Methodology

The focus of the present study is to describe the project to improve and electrify the Inter Line 2 in the city of Curitiba, PR and its relationship with the SDG-11 (Sustainable Cities and Communities), target 11.2, and the transformative results from the TIP. Therefore, the assumptions of the theory of Sustainability Transitions are integrated (Geels, 2002; Loorbach et al.,

2017; Köhler et al., 2019; Markard et al., 2020; Loorbach et al., 2020), SDG-11, target 2 (UN, 2015), as well as Transformative Innovation Policies (Molas-Gallart et al., 2021; Ghosh et al., 2021; Silva, 2021).

It is, therefore, a descriptive and exploratory study (Collis & Hussey, 2005), of mixed character, integrating quantitative and qualitative assumptions (Creswell, 2010). Data collection was carried out based on documental research and semi-structured interviews with managers of the Municipal Institute of Public Administration of Curitiba (IMAP for its Portuguese acronym) and the Institute of Research and Urban Planning of Curitiba (IPPUC for its Portuguese acronym).

The documents used correspond to information on the expansion and electromobility project of the Inter Line 2, the 2022-2025 municipality's Multiyear Plan, and the research carried out by the IPPUC that denotes data regarding municipal urban mobility. It should be noted that, due to the pandemic, in the year 2021, the surveys were not updated and, therefore, the most recent data available and that still match the evidenced reality were used.

The interviews, in turn, were oriented towards a better understanding of the Inter Line 2 improvement and electromobility project, as well as serving as support for questions, after document analysis. They were granted by an IMAP coordinator and a technical team from IPPUC, in which they are referenced throughout the text in the presentation of the results.

From the collection of data and information, a methodological triangulation was carried out that seeks to analyze the object from different points of reference, which complement each other in the final considerations of the study (Vergara, 2006). This triangulation took place through: a) documentary research (qualitative); b) semi-structured interview (qualitative); c) diagnostic data that indicate the current mobility situation to be modified by the project (quantitative).

The results were analyzed through content analysis, which seeks to describe the content of certain messages and gain knowledge related to them. The analysis employs a systematic procedure involving pre-analysis, exploration of the material, and treatment and interpretation of the results (Bardin, 2011). Specifically, the results of the Inter Line 2 project were evaluated and interpreted based in accordance with the ISO 37120:2018 (ISO, 2018), considering the topic of transport and its essential (2), support (5) and profile indicators (2). They were also evaluated regarding the fulfillment of target 11.2 of the SDGs (UN, 2015) and regarding the configuration as a transformative innovation policy and its transforming results (Molas-Gallart et al., 2021)

Subsequently, the results are presented with an initial characterization of the investigated reality and a presentation of the Inter Line 2 and its alteration projects. Next, an overview with urban mobility data of the city in accordance with ISO 37120:2018 is elucidated and, finally, the evaluation between the Inter 2 project, ODS 11.2 and Transformative Results is presented.

4. Results and discussions

4.1 Characterization of the investigated reality

Curitiba is the capital of the state of Paraná (See Figure 1), with an estimated population of 1.9 million people (Brazilian Institute of Geography and Statistics [IBGE], 2023). Its metropolitan area is made up of 29 municipalities with approximately 3.5 million inhabitants, that is, 31% of the population of Paraná (Curitiba, 2019a).

Curitiba is characterized as a city open to transformations, since the discussion of the Master Plan, in the late 1960s, as in the Urban Mobility Revolution in the early 1970s, through the exclusive structural axes for public transport (Curitiba, 2020b). Several aspects have changed in recent years, and that provided conditions so that Curitiba could approach the search for better meeting the SDGs 2030 Agenda. By becoming a signatory to the Agenda's proposals, the SDGs started to be pursued more systematically in urban planning, as well as in the various areas served by the city government. According to information provided by the IPPUC technical team, planning actions are in line with world initiatives such as the Paris Agreement, the 2030 Agenda and the new UN Urban Agenda that synthesize major contemporary urban challenges. The city incorporated the 2030 Agenda strategies in 2017 and, in the same year, joined the global pact to foster the engagement of companies in social responsibility and sustainability policies. In 2018, the municipality also signed the City of Curitiba's Letter of Commitment to the Deadline 2020 report, referring to the Climate Action Planning (PAC for its Portuguese acronym), whose goal is to make the city achieve carbon emissions neutrality by 2050. In IPPUC's view, the commitment to these international agreements is fundamental to the establishment of a long-term municipal sustainability policy.

Figure 1. Curitiba's location

Source: Own elaboration.

Several initiatives that direct growth and development, integrating environmental, social and economic concerns are observed in the 2022-2025 PPA. The programs fall under the thematic axes of solidarity, ethics, and sustainability. In the sustainability axis is the "Live a More Agile Curitiba" program, with projects directed towards the construction of an integrated and intermodal system of metropolitan sustainable mobility. Its objectives are aimed at decarbonizing the public transport fleet, attracting users to public transport, promoting active mobility and creating a culture of data management and innovation (Curitiba, 2021a). One of the actions of the Live a More Agile Curitiba program corresponds to the improvement and electrification of the Interbairros 2 and Inter 2 Direct Line, which is the focus of analysis of this study, being described in the sequence.

4.2 Integrated Transport System, the Inter Line 2

The improvement of Curitiba's Integrated Transport Network (RIT for its Portuguese acronym) has been discussed for several decades, at least since 1960. Within this proposal, the Interbairros Line 2 was created in 1979 to facilitate the displacements between the structural axes, without passing through the central area of the city. This allowed the improvement of the integrated system bringing agility and rationalization to displacements (Curitiba, 2019a).

The Interbairros Line 2 and the Inter 2 Direct Line, which operates in the same itinerary, but without intermediate stop points on the route, correspond to a circular line of great importance due to the high number of passengers that they transport. Currently, Interbairros 2 contributes to the displacement of 64 thousand passengers a day with a frequency interval of 10 minutes (clockwise) and 8.5 minutes (counterclockwise). The route is covered in a period of 145 and 137 minutes clockwise and counterclockwise respectively, with an average speed of 18.3 km/h (Curitiba, 2019a). The Inter 2 Direct Line is responsible for transporting 91,000 passengers/day, with a frequency interval of 2.5 minutes (clockwise) and 4.5 minutes (counterclockwise), and the route is covered in a period of 106 and 103

minutes clockwise and counterclockwise respectively, with an average speed of 22.30 km/h (Curitiba, 2019a).

Inter 2 is part of the public transport system that, in its entirety, meets a demand of approximately 1.4 million people per day. The system has 21 integrated terminals, with 342 boarding and disembarking stations. It consists of express lines, direct lines, feeder lines and interzone lines and has approximately 1,400 buses, of which 4.4% are low-emission vehicles, 1.85% biarticulated and approximately 2.15% are hybrid buses (Curitiba, 2019a).

A new improvement project was developed in 2019. In it several advances are planned in order to decrease the route time such as the electrification of the route, as well as the implementation of stations with a new self-sustainable structure, with internal climate control through the use of renewable energy. It is also planned to implement exclusive lanes and one-way streets that will improve the speed in the road system. The sidewalks will also be revitalized throughout the itinerary and performed improvements in the public lighting system (Curitiba, 2019a). According to IMAP's coordinator, when planning interventions on additional roads to the main itinerary of Inter 2, they are accompanied by lighting projects with LED system implementation, which are more economical in financial and environmental cost.

For the IPUCC:

> The Inter 2 Project is one of the initial milestones of the transformation expected for the urban mobility of Curitiba and consists of an expressive intervention with the renovation and modernization of terminals; the implementation of new, wider, more comfortable, intermodal, and self-sustaining stations connected to a micro smart grid system. The implementation of exclusive lanes, revitalization of sidewalks and landscaping sensitive to gender, and the renewal of the fleet with the adoption of electric buses complete the planned interventions (IPPUC technical team, 2022).

Objectively, it is planned to increase the line's capacity by 16.77% of the current 155 thousand passengers/day. Considering that the itinerary of this Line covers 38 km, passing through 28 neighborhoods, improvements should occur with the implementation of roads to be upgraded with exclusive lanes. Five self-sustaining mini terminals will also be built that will have photovoltaic plates, as well as smart grid networks. This system provides conditions for bidirectional energy and information flow and is being developed through a partnership between the City Hall and the Electric Company of Paraná (COPEL for its Portuguese acronym). Other benefits are also foreseen, such as Wi-Fi access, automatic doors, electronic ticketing, surveillance and stations for recharging electronic devices (cell phones and tablets) (Curitiba, 2021c). Other transport terminals will also receive sets of renewable energy, seeking to reduce the demand for energy in RIT. According to the IPPUC technical team (2022) the promotion of inclusion is also observed from physical interventions on the axis of transport and adoption of better vehicles adapted for people with special needs. Actions such as sidewalk readjustments along the transport corridor and improvements in accessibility conditions at transport terminals also have this purpose of facilitating the system's use by people with disabilities, elderly, mothers and fathers with baby strollers, and other people with mobility limitations.

This project to increase the speed of the Inter 2 Direct Line and the Interbairros Line 2 features a loan from the Inter-American Development Bank (IDB), signed in December 2020. The IDB has an action plan for climate change aimed at supporting Latin America and Caribbean regions to achieve sustainable development and climate resilience (IDB, 2021). About US $ 106.7 million will be loaned from IDB and another US $ 26.7 million in counterpart from Curitiba's City Hall (Curitiba, 2020a; 2020c). These funds are intended for the modernization of the RIT, in which the project to increase the speed of the Inter Line 2 is the first to go into execution (Curitiba, 2022c).

This proposal was built in a context where changes in demand arise due to the greater access to vehicles, the use of transport applications, health concerns that expand the use of bicycles, and even the use of electric scooters, which influence and alter the flow of passengers, especially in relation to smaller routes (IPPUC, 2018). The average speed gain, expected to be around 40%, will provide improved mobility results due to the expansion of available vehicles at times of rush hour, reduced operating cost, speed gain, and increased vehicle frequency (Curitiba, 2019a). Also, it is noteworthy that with the creation of new interconnections outside the central area of the city, greater job opportunities are expected to arise for areas far from the center which will be more easily accessed. According to reports of the IPPUC technical team (2022):

> This greater diversification of uses and integration between new employment centers and the transport system may stimulate the economy, facilitating access to jobs and increasing the income level of the population that lives further from the center. Also, the reduction in travel time can generate impacts on the quality of life of users, who will be able to spend more time with their families, and it will also allow them to have more time to dedicate themselves to other activities and/or access other types of services.

In addition, according to IMAP's coordinator, the reforms will also result in a reduction in the vehicle fleet, made possible through the new planned interconnections, which positively impacts the emission of pollutants. Public transport accounts for 6% of the emissions of greenhouse gases (GHG) on land in the city. Despite being a relatively low number, it is necessary for public transport to receive investments that will provide the implementation of new technologies, which will be replicated in other similar experiences, in different urban centers (Curitiba, 2019b).

Curitiba's RIT is being prepared for electrification as of 2025, when the current concession will end, and a more sustainable system in environmental terms, and more efficient in operational terms, can be implemented. This study is named, "Modelling for the concession of low-emission public transport service for the Integrated Metropolitan Transport Network of Curitiba" (Curitiba, 2019a, p. 104).

The electrification of Interbairros Line 2 and Inter 2 Direct Line will be the first stage of electrification, meeting the requirements of the 2016 electromobility project. The project proposes to provide an adequate service, in accordance with current legislation, with evaluation of quality indicators and population participation. There is even a Curitiba Transparent Program, whose premises are "fiscal prudence, less bureaucracy, transparent performance, and quality in the use of public money", under the responsibility of the city's Planning, Finance and Budget Department (Curitiba, 2021, p. 91). Furthermore, this action seeks to contribute to carbon emission neutrality by 2050 (IPPUC, 2016a; Curitiba, 2021b).

According to IPPUC, from data obtained by applying the tool and methodology produced by C40 Cities in collaboration with Buro Happold Engineering, London School of Hygiene and Tropical Medicine, and Cambridge Environmental Research Consultants, by improving air quality several benefits were observed on mortality, morbidity and the consequent economic value:

> It was found that the insertion of electric buses can contribute to a 1.1% reduction in the MP2.5 concentration in the city. From a health point of view, it represents 5 (five) premature deaths avoided per year, 59 (fifty-nine) years of life gained throughout the city per year and one day of life expectancy gained at birth per citizen. The economic impact would be US$8 million of total value of deaths avoided (IPPUC Technical Team, 2022).

In parallel to these movements in the urban environment with road and infrastructure works (Curitiba, 2021a), the IPPUC develops studies with companies in China for the development and testing of engines with greater autonomy that have batteries that can be recharged during displacements. Studies are being carried out on which equipment will be more suitable and which technologies can be developed to be examined through operational experiences for a better performance of the RIT (Curitiba, 2022).

4.3 SDG 11.2 and ISO 37.120:2018

Inadequate transport and lack of mobility interfere with the quality of life, health and well-being of the population (Ribeiro, 2019). In order to verify Curitiba's compliance with the standards linked to ISO NBR 37.120:2018, and in relation to SDG-11, target 2, this topic presents the data collected on the thematic area of Transport, which has two essential indicators, five support indicators and two profile indicators. These indicators can guide public policies while measuring the performance of services and quality of life (ISO, 2018). As pointed out by Ribeiro (2019), the

indicators of ISO NBR 37.120:2018, on Transport theme, are associated with the SDG indicator 11.2.1, which refers to the proportion of the population that has adequate access to public transport. The data collected can be viewed in the following Table:

Table 1. ISO 37120:2018 Indicators - Transport for the City of Curitiba, PR

Indicator	Type	Data - Curitiba Region, PR	Source
19.1 Kilometers of public transport system per 100,000 inhabitants	Essential indicator	Not available	-
19.2 Annual number of public transport trips per capita	Essential indicator	0.86*	(CURITIBA, 2020)
19.3 Percentage of people using a mode of travel for work other than a personal vehicle	Support indicator	Not available	-
19.4 Kilometers of bike lanes and lanes per 100,000 inhabitants	Support indicator	0.002085	IPPUC (2019)
19.5 Transport deaths per 100,000 inhabitants	Support indicator	3.0	DETRAN-PR (2020)
19.6 Percentage of population living within 0.5 km of public transport, operating at least every 20 minutes	Support indicator	Not available	-
19.7 Average travel time	Support indicator	20 to 40 minutes	IPPUC (2018, p. 87)
19.8.1 Number of personal cars per capita	Profile indicator	0.33	IPPUC (2017, p. 25)
19.8.2 Number of two-wheeled motor vehicles per capita	Profile indicator	0.06	IPPUC (2017, p. 33)

Source: Adapted from ISO (2018).

* Approximate value.

Considering indicator 19.2 "annual number of public transport trips per capita", it was not possible to obtain an exact value provided by the institutions linked to the city hall. However, an approximate value can be reached. According to data obtained from Curitiba's Urban Planning (Curitiba, 2020d), RIT carries out 11,729 trips per day. When considering only working days, a total of 2,955,708 trips per year is assumed. When dividing by the total population of the Curitiba region (3,434,785), an annual per capita travel index of 0.86 is estimated.

Regarding indicator 19.4, according to information from the IPPUC (2019), the cycling network in Curitiba corresponds to 208.5 km, that is, 4.3% of the city's street. This results in an index of 0.002085 km of cycle path per 100,000 inhabitants. Within the mode of bicycle use, it is also observed that 41% of households have at least one bicycle. Thus, the average number is 0.22 bicycles per inhabitant (IPPUC, 2018). These data are also relevant, as they can point to trends of behavioral changes in the population.

As for indicator 19.5, there is an index of 3 transport deaths per 100,000 inhabitants, as pointed out by the Paraná's Traffic Department (DETRAN, PR, 2020). Another important piece of data from the Integrated Transport Network is that "the travel time within Curitiba is in the range of 20 to 40 minutes, on average" (IPPUC, 2018, p. 87), which responds to ISO 37.120:2018, indicator 19.7.

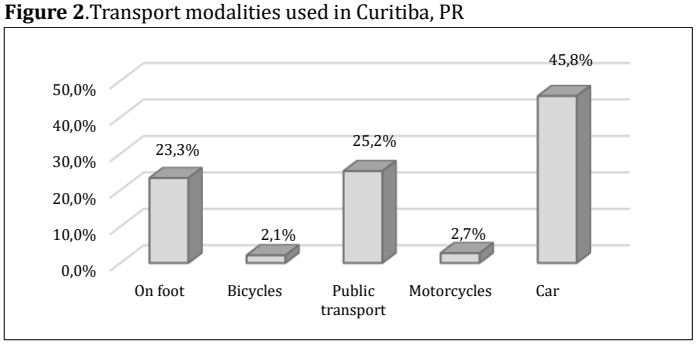
For profile indicators, the IPPUC (2017) presents an index of 0.33 personal cars per capita and 0.06 motorized two-wheel vehicles per capita considering the metropolitan region of Curitiba.

It is also worth mentioning that the IPPUC does not have information that responds to indicators 19.1, 19.3 and 19.6, which can be justified by the fact that the surveys were not recently updated. Therefore, there is a need to develop a data collection capable of providing the information required by the regulation, in order to contribute to urban planning and the development of improvement actions.

Other data on mobility issues in Curitiba are also important and were considered. It is generally observed that 6.2 million trips are carried out daily, with 29% corresponding to trips carried out on foot or by bicycle, and 71% corresponding to motorized trips (IPPUC, 2017).

These data are part of a broader context that indicates that 23.3% of the population travels on foot, 2.1% by bicycle, 25.2% use public transport, 2.7% use motorcycles and 45.8% of people use a car (IPPUC, 2016b).

Figure 2.Transport modalities used in Curitiba, PR



Source: Adapted from IPPUC (2016b)

This indicates that public transport, which is more accessible and environmentally friendlier, must improve in order to attract larger segments of the population. Greater Curitiba, composed by the city and the 29 municipalities in the metropolitan area, has a population of 3,434,785 people (IPPUC, 2017). This data points to the need for stronger alternatives of analysis, and transformative considerations supported by socio-technical transformations.

Considering the number of trips, there is a very high percentage of trips carried out in individual transport (62.5%) compared to public transport (36.4%). The average number of trips per day for the general population is 1.8, and 2.71 considering only mobile people, that is, people who travel on a daily basis. On the other hand, there is still a large percentage of immobile people (33%) (IPPUC, 2017). It is important to understand that these data reflect indicators that complement ISO 37.120 and the SDG-11.2.1 indicator on transport conditions in the urban environment, and they help in the evaluation of Curitiba's Transport System, object of this investigation. This information is summarized in the following table:

Table 2. Main mobility indicators – Curitiba Region, PR

Indicators	Dada
Residents in the studied area	3,434,785
Total trips	6,194,829
Total trips on foot	1,672,323
Total trips by bicycle	138,302
Total motorized trips	4,384,204
IT - Individual Transport	62.50%
TC - Public Transport	36.40%
TI + TC and other modes	1.10%
Average number of trips per day / population	1.8
Average number of trips/day mobile people	2.71
Percentage of people immobile	33%

Source: Adapted from IPPUC (2017).

Overall, this consolidated information provides a framework, based on SDG-11.2 and ISO 37.120:2018, that can be considered challenging. The interpretation of these data suggests that the RIT should become more attractive and that the population group that uses public transport is relatively low. There is a need to make public transport socially and environmentally better, as well as it needs to be improved in terms of efficiency. In order to offer these changes, the system needs to go through this transformative change that is designed with the implementation of the expansion and electrification of the Network, with the first stage being the Inter Line 2.

4.4 Evaluation between the Inter 2 project, SDG 11.2, and Transformative Results

The reflections listed point out the need to assess the extent to which the proposed changes to the RIT of Curitiba are linked to the SDG-11, in particular to target 11.2, and how this fact indicates that it is a "Transformative Outcome" experience, which is a consequence of a TIP (Molas-Gallart et al., 2021).

Considering the relationship with SDG-11, the following table presents an analysis of the benefits arising from the Inter Line 2 improvement project, and its association with target Goal 11.2.

Table 3. Benefits of the Inter Line 2 improvement project, and the relationship with Target11.2

Benefits	Relationship with Target 11.2
Reduction of travel time (by 40%); Increase in line capacity by 16.77%; Dedicated lanes and one-way lanes	Availability of accessible transport systems and expansion of public transport.
Self-sustainable terminals using Renewable Energy sources; Line electrification - contribution to carbon neutrality emissions.	Access to sustainable and efficient transport systems.
Access to the Wifi network, electronic ticketing, stations for recharging electronic devices, surveillance and smart energy networks (Smart Grid).	Access to safe and accessible transport systems.
Improvements in road accessibility, revitalization of sidewalks, improvement of public lighting, vehicles with a structure better adapted for people with special needs, better accessibility at the terminals, and new interconnections outside the city's central area.	Access to accessible transport systems with attention to the needs of people in vulnerable situations, women, children, people with disabilities and the elderly.

Source: own elaboration

In this sense, it is observed that the project to improve the Inter Line 2 complies with what is expected in terms of the transport system shown in SDG 11.2. It refers, therefore, to an innovative policy, in line with the 2030 Agenda with a clear proposal to meet target 11.2, and that allows for development opportunities, and stimulates socio-technical transitions (Silva, 2019; Lundin & Serger, 2018; Schot et al., 2018; Markard et al., 2020; Loorbach et al., 2020).

Considering the transformative results of the TIP (Molas-Gallart et al., 2021) it is evident that the proposal to improve the Inter 2 Line can be considered a niche experiment. This is because it is based on the use of sustainable alternatives that differ from the practices of the mobility sector regime that is still oriented towards the use of fossil fuels and private ownership of vehicles (Goyal & Howlett, 2018).

Specifically, the electromobility project involves a mix of road transformation techniques and the development of sustainable equipment aimed at reducing greenhouse gas emissions and benefiting the population in general. It is possible to observe that the project in progress is still a strong change, possibly a transition in the socio-technical systems, in which a stable and established configuration, high in carbon emissions, begins to be replaced by practices that prioritize a zero-emission system (Geels, 2020).

The expectation that changes of this magnitude will work, that are part of SDG-11.2 and transformative results, is an exciting challenge because it entails experiments that prove to be broad (Ghosh et al., 2021). TIP demands behaviors and ways of acting that are still incipient to the current reality. However, the experiences developed in Curitiba provide elements to create conditions for Deep Transformations, which can broaden the perception of sociotechnical transformations (Geels & Schot, 2007; Grin et al., 2010).

It is therefore expected that, after the implementation of the initiatives, there will be an expansion of the niche with the dissemination of practices and replication in different contexts so that the other transformative results can be visualized in the long term.

5. Final Considerations

The present investigation proposed to analyze how the implementation of SDG-11 occurs, in particular Target 2, and the transformative results having as a field of research the experience of improvement and electrification of the Inter Line 2 that is being developed in Curitiba, in the state of Paraná. This proposal is part of a study that sought to understand in a deeper way the socio-technical transitions, in which contemporaneity is inserted and that occurs through Transforming Innovative Policies.

Curitiba assumed the SDGs of the 2030 Agenda as an important parameter to guide initiatives and the consolidation of services offered to the population. It is an arduous path, because meeting the Objectives involves long-term planning and choices for alternatives or solutions that demand persistence, as they are not consolidated structures and suggest ruptures with already established models.

Transformative Innovative Policies become an alternative in this context that requires new ways of reflecting and finding solutions to the different demands that arise. Betting on safe, accessible and sustainable means of transport that seek zero GHG emissions becomes important. In this sense, the Inter 2 improvement and electrification project is in line with target 2 of the SDG-11 and will provide improvements in the living conditions for the residents of Curitiba and the Metropolitan Region. Moreover, it becomes a key step and a strong niche for socio-technical transformations that urban clusters should develop.

The experience portrayed has been maturing since 2016, and should be completed in the medium term. There are doubts and uncertainties in these processes, given that changing what is already established as a working solution arouses distrust. This fact causes a very strong insecurity about the choices being executed, and it can be considered as a negative point or a difficulty of this process of transformation of the investigated socio-technical niche. However, its effectiveness will be more fundamental as a learning experience, which will provide improvements in the issue of urban commuting.

This study contributed to the literature in several ways. Firstly, it presented a case study of a developing experience linked to sustainability transitions in the urban mobility field. It also contributed with practical examples of how TIPs can be employed to face urban sustainability challenges. Moreover, it gave origin to an analysis of how TIPs can be made operational to achieve SDGs and transformative results in a city located in a developing country. In a practical manner, the investigation results act as an example for other urban centers regarding the implementation of public policies geared toward sustainability. As limitations, the outdated and non-existing data for the investigated reality stand out, essentially linked to the assessment of urban mobility in compliance with goal 11.2 of SDG-11.

Finally, it is emphasized that the present study, far from exhausting the theme or the experience in execution, only proposed to bring a situation that should be more and better researched in the future, as it is in its first steps and its full implementation will still take a few years. However, it is clearly perceived that there is a deep facilitating complementarity between the proposals that the SDGs direct and the benefits that the TIP provide, and that, through transformative results, they help to build a context of socio-technical changes in evidence in contemporary times.

Referências

1. Arcand, S., Grisales, R.M., Facal, J., & Dupuis, J. (2010). *Sociología de la empresa*: del marco histórico a las dinámicas internas. Bogotá: Siglo del Hombre.
2. Bardin, L. (2011). *Análise de conteúdo*. Tradução de Luís Antero Reto e Augusto Pinheiro. São Paulo: Edições 70.
3. Boni, A., Velasco, D., & Tau, M. (2021). The Role of Transformative Innovation for SDGs Localisation. Insights from the South-African "Living Catchments Project". *Journal of Human Development and Capabilities*, 22(4), 737-747. DOI: 10.1080/19452829.2021.1986688.
4. Bugge, M. M., Berg, R., & Tømte, C. E. (2023). Transformative innovation policies detached from existing systems of innovation in the global south. *Innovation and Development*, 1-24. DOI: 10.1080/2157930x.2023.2215628.
5. Collis, J., & Hussey, R. (2005). *Pesquisa em administração*: um guia prático para alunos de graduação e pós-graduação. Porto Alegre: Bookman.
6. Creswell, J. W. (2010). *Projeto de Pesquisa - métodos qualitativo, quantitativo e misto.* 3.ed. Porto Alegre: Bookman/ARTMED.

7. Curitiba. (2019a). *Ampliação da capacidade e velocidade da Linha Direta Inter 2.* Curitiba: IPPUC. Retrieved on March 25, 2021 from: https://www.ippuc.org.br/visualizar.php?doc=https://admsite2013.ippuc.org.br/arquivos/documentos/D327/D327_036_BR.pdf.
8. Curitiba. (2019b). *Inventário de emissões de gases de efeito estufa da cidade de Curitiba: Ano base 2016.* Curitiba: Prefeitura Municipal. Retrieved on March 21, 2022 from: https://mid.curitiba.pr.gov.br/2020/00305800.pdf.
9. Curitiba. (2020a). *Novo Inter 2 abre caminho para a eletromobilidade.* Curitiba: Prefeitura Municipal. Retrieved on March 21, 2022 from: https://www.curitiba.pr.gov.br/noticias/novo-inter-2-abre-caminho-para-a-eletromobilidade/57280.
10. Curitiba. (2020b). *Plano Municipal de mitigação e adaptação às mudanças climáticas: PlanClima.* Curitiba: Prefeitura Municipal. Retrieved on March 21, 2022 from: https://mid.curitiba.pr.gov.br/2020/00306556.pdf.
11. Curitiba. (2020c). *Prefeitura Municipal de. Prefeitura e BID formalizam financiamento do Novo Inter 2.* Curitiba: Prefeitura Municipal. Retrieved on March 21, 2022 from: https://www.curitiba.pr.gov.br/noticias/prefeitura-e-bid-formalizam-financiamento-do-novo-inter-2/57268.
12. Curitiba, Prefeitura Municipal. (2020d). *Urbanização de Curitiba.* Nº de viagens realizadas pelos ônibus da RIT (dia útil). Retrieved on March 21, 2022 from: https://www.urbs.curitiba.pr.gov.br/transporte/estatisticas/viagens.
13. Curitiba. (2021a). *Plano Plurianual 2022-2025.* Curitiba: Prefeitura Municipal. Retrieved on March 22, 2022 from: https://files.elfsightcdn.com/1d706bff-010e-4da3-a65a-a436ce8f251d/ff89e4f0-7e21-4639-b80e-d2c918de4542.pdf.
14. Curitiba. (2021b). *BRT Leste Oeste: Implantação da linha expressa e ônibus elétrico.* Curitiba: IPPUC. Retrieved on March 21, 2022 from: https://www.ippuc.org.br/visualizar.php?doc=https://admsite2013.ippuc.org.br/arquivos/documentos/D327/D327_039_BR.pdf.
15. Curitiba. (2021c). *Prefeitura e BID encaminham implantação do novo Inter 2.* Curitiba: Prefeitura Municipal. Retrieved on March 22, 2022 from: https://www.curitiba.pr.gov.br/noticias/prefeitura-e-bid-encaminham-implantacao-do-novo-inter-2/58508.
16. Curitiba. (2022). *Prefeitura lança edital para construção das estações autossustentáveis do Inter 2.* Curitiba: Prefeitura Municipal. Retrieved on March 21, 2022 from: https://www.urbs.curitiba.pr.gov.br/noticia/prefeitura-lanca-edital-para-construcao-das-estacoes-autossustentaveis-do-inter-2.
17. DETRAN-PR. Departamento de Trânsito do Paraná. (2020). Anuário Estatístico 2020. Retrieved on March 29, 2022 from: https://www.detran.pr.gov.br/sites/default/arquivos_restritos/files/documento/2021-09/anuario_detran_pr_2020_xx_0.pdf.
18. Diercks, G., Larsen, H., & Steward, F. (2019). Transformative innovation policy: addressing variety in an emerging policy paradigm. *Research Policy*, 48(4), 880-894. DOI: 10.1016/j.respol.2018.10.028
19. Franco, S. (2022). Sustainable cities and communities: the road towards SDG 11. *TeMA - Journal of Land Use, Mobility and Environment*, 15(2), 341-344. DOI: 10.6093/1970-9870/9316.
20. Frantzeskaki, N. (2022). Bringing transition management to cities: building skills for transformative urban governance. *Sustainability*, 14(2), 650-677. DOI: 10.3390/su14020650.
21. Frantzeskaki, N., Broto, V. C., Coenen, L., & Loorbach, D. (2019). *Urban Sustainability Transitions*. New York: Routledge.
22. Fuenfschilling, L., Frantzeskaki, N., & Coenen, L. (2018). Urban experimentation and sustainability transitions. *European Planning Studies*, 27(2), 219-228. DOI: 10.1080/09654313.2018.1532977.
23. Geels, F. & Schot, J. (2007). Typology of Sociotechnical Transitions Pathways, *Research Policy*, 36, 399-417. DOI: 10.1016/j.respol.2007.01.003.
24. Geels, F. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy*, 31(8-9), 1257-1274. DOI: 10.1016/S0048-7333(02)00062-8.
25. Geels, F. (2020). Transformative Innovation and Socio-technical Transitions to Address Grand Challenges. *RandI Paper Series Policy Brief. Brussels:* Publications Office of the European Union.
26. Geels, F., Kemp, R., Dudley, G., & Lyons, G. (2011). *Automotive in Transition?* A Socio-Technical Analysis of Sustainable Transport. Routledge, New York.
27. Ghosh, B., Kivimaa. P., Ramírez, M., Schot, J., & Torrens, J. (2021). Transformative outcomes: assessing and reorienting experimentation with transformative innovation policy. *Science and Public Policy*, 48(5), 739-756. DOI: 10.1093/scipol/scab045.
28. Goyal, N., & Howlett, M. (2018). Technology and Instrument Constituencies as Agents of Innovation: sustainability transitions and the governance of urban transport. *Energies*, 11(5), 1198-1211. DOI: 10.3390/en11051198.
29. Grainger-Brown, J., Malekpour, S., Raven, R., & Taylor, E. (2022). Exploring urban transformation to inform the implementation of the Sustainable Development Goals. *Cities*, 131, 103928-103939. DOI: 10.1016/j.cities.2022.103928.
30. Grin, J., Rotmans, j., & Schot, J. (2010). *Transitions to Sustainable Development*: New directions in the study of long term transformative change. London: Routledge.
31. Haddad, C. R., Nakić, V, Bergek, A., & Hellsmark, H. (2022). Transformative innovation policy: a systematic review. *Environmental Innovation and Societal Transitions*, 43, 14-40. DOI: 10.1016/j.eist.2022.03.002
32. IBGE – Instituto Brasileiro de Geografia e Estatística. (2023). *IBGE Cidades*: Curitiba. Retrieved on April 04, 2023 from: https://cidades.ibge.gov.br/brasil/pr/curitiba/panorama.
33. IDB - Inter-American Development Bank (2021). *Inter-American Development Bank Group Climate Change Action Plan 2021-2025*. 1-59. Retrieved on September 12, 2023 from: http://dx.doi.org/10.18235/0003153.
34. IPPUC - Instituto de Pesquisa e Planejamento Urbano de Curitiba. (2016a). *Projeto de Eletromobilidade*. Curitiba: IPPUC. Retrieved on March 25, 2022 from: https://www.ippuc.org.br/visualizar.php?doc=https://admsite2013.ippuc.org.br/arquivos/documentos/D327/D327_027_BR.pdf.

35. IPPUC - Instituto de Pesquisa e Planejamento Urbano de Curitiba. (2016b). *Distribuição Modal*. Curitiba: IPPUC. Retrieved on March 25, 2022 from: https://ippuc.org.br/visualizar.php?doc=https://admsite2013.ippuc.org.br/arquivos/documentos/D536/D536_017_BR.pdf.
36. IPPUC - Instituto de Pesquisa e Planejamento Urbano de Curitiba. (2017). *Consolidação de dados de oferta, demanda, sistema viário e zoneamento. Relatório 5 ± pesquisa origem-destino domiciliar*. Curitiba: IPPUC. Retrieved on March 25, 2022 from: https://www.ippuc.org.br/visualizar.php?doc=https://admsite2013.ippuc.org.br/arquivos/documentos/D536/D536_002_BR.pdf.
37. IPPUC - Instituto de Pesquisa e Planejamento Urbano de Curitiba. (2018). *Produto 12 – aplicação do modelo em cenários – teste de cenários de intervenção TI e TC / Relatório 12.2 – relatório com sumário de dados existentes*. Curitiba: IPPUC. Retrieved on March 26, 2022 from:https://ippuc.org.br/visualizar.php?doc=https://admsite2013.ippuc.org.br/arquivos/documentos/D536/D536_016_BR.pdf.
38. IPPUC - Instituto de Pesquisa e Planejamento Urbano de Curitiba. (2019). *Plano de estrutura cicloviária*. Curitiba: IPPUC. Retrieved on March 26, 2022 from: https://www.ippuc.org.br/visualizar.php?doc=https://admsite2013.ippuc.org.br/arquivos/documentos/D327/D327_029_BR.pdf.
39. ISO - International Organization for Standardizaton. (2018). *NBR 37120:2018 Sustainable cities and communities — Indicators for city services and quality of life.* Geneve.
40. Kaick, V. T., Cubas, S., Ugaya, C., Gadda, T., Liu, E., Fonseca, K., [...] & Bassetti, F. J. (2020). *Integra Curitiba*: a parceria das universidades no desenvolvimento sustentável da Região Metropolitana de Curitiba e atendimento dos ODS. In: Congresso Brasileiro sobre gestão do ciclo de vida. Porto Alegre: UFRGS, 7.
41. Kivimaa, P., & Rogge, K. S. (2022). Interplay of policy experimentation and institutional change in sustainability transitions: the case of mobility as a service in Finland. *Research Policy*, 51, 104412. DOI: 10.1016/j.respol.2021.104412.
42. Klarin, T. (2018). The concept of sustainable development: from its beginning to the contemporary issues. *Zagreb International Review of Economics and Business*, 21, 67-94. DOI: 10.2478/zireb-2018-0005.
43. Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., […], & Wells, P. (2019). An agenda for sustainability transitions research: state of the art and future directions. *Environmental Innovation and Societal Transitions*, 31, 1-32. DOI: 10.1016/j.eist.2019.01.004.
44. Loorbach, D., Frantzeskaki, N., & Avelino, F. (2017). Sustainability Transitions Research: transforming science and practice for societal change. *Annual Review of Environment and Resources*, 42, 599-626. DOI: 10.1146/annurev-environ-102014-021340.
45. Loorbach, D., Wittmayer, J., Avelino, F., Von Wirth, T., & Frantzeskaki, N. (2020). Transformative innovation and translocal diffusion. *Environmental Innovation and Societal Transitions*, 35, 251-260. DOI: 10.1016/j.eist.2020.01.009.
46. Lundin, N. & Serger, S. A. (2018). *Agenda 2030 and a transformative innovation policy:* conceptualizing and experimenting with transformative changes towards sustainability. Science Policy Research Unit: Lund University.
47. Markard, J., Geels, F. W., & Raven, R. (2020). Challenges in the acceleration of sustainability transitions. *Environmental Research Letters*, 15(8), 081001. DOI: 10.1088/1748-9326/ab9468
48. Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: an emerging field of research and its prospects. *Research Policy*, 41(6), 955-967. DOI: 10.1016/j.respol.2012.02.013
49. Marvuglia, A., Havinga, L., Heidrich, O., Fonseca, J., Gaitani, N., & Reckien, D. (2020). Advances and challenges in assessing urban sustainability: an advanced bibliometric review. *Renewable and Sustainable Energy Reviews,* 124, 1-12. DOI: 10.1016/j.rser.2020.109788.
50. Molas-Gallart, J., Boni, A., Giachi, S., & Schot J. (2021). A formative approach to the evaluation of transformative innovation policies. *Research Evaluation*, 30(4), 431-442. DOI: 10.1093/reseval/rvab016.
51. Moura, J. M., Nobre, A., Serafini, P., & Nogueira, G. M. F. (2020). Diagnóstico da adesão aos ODS no Brasil: uma análise da incorporação da Agenda 2030 nos governos estaduais e em suas capitais. In: Congresso Internacional del CLAD sobre la Reforma del Estado y de la Administración Pública. Lisboa, Portugal, 25.
52. OECD - Organization for Economic Cooperation and Development. (2020). *OECD Economic Surveys*: Brazil 2020. OECD Publishing, Paris. DOI: 10.1787/250240ad-en.
53. UN – United Nations. (2015). *Transforming our world*: the 2030 agenda for sustainable development. New York: United Nations
54. UN – United Nations. (2018). *World Urbanization Prospects: The 2018 Revision.* New York: UN.
55. Ramirez, M., Romero, O., Schot, J., & Arroyave, F. (2019). *Mobilizing the Transformative Power of the Research System for Achieving the Sustainable Development Goals*. SPRU working paper series.
56. Ribeiro, T. S. V. (2019). *ISO 37120 e Objetivo do Desenvolvimento Sustentável 11*: convergência frente à Agenda 2030. São Paulo: Universidade Nove de Julho.
57. Schot, J., & Steinmueller, W. E. (2016). *Framing Innovation Policy for Transformative Change* – Innovation Policy 3.0. SPRU working paper series, September.
58. Schot, J., Boni. A, Ramirez, M., & Steward, F. (2018). *Addressing the sustainable development goals through transformative innovation policy*. TIPC Research Briefing. Science Policy Research Unit.
59. Silva, E. (2021). *Interferência da convergência discursiva na direcionalidade do biogás no Brasil.* Curitiba: Universidade Positivo.
60. Silva, E. R. A. da. (2019). *ODS 11:* tornar as cidades e os assentamentos humanos inclusivos, seguros, resilientes e sustentáveis — o que mostra o retrato do Brasil? Brasília: IPEA.

61. Soete, L. (2019). Science, technology and innovation studies at a crossroad: SPRU as case study. *Research Policy*, 48, 849-859. DOI: 10.1016/j.respol.2018.10.029.
62. Tiwari, G., & Phillip, C. (2021). Development of public transport systems in small cities: a roadmap for achieving sustainable development goal indicator 11.2. *Iatss Research*, 45(1), 31-38. DOI: 10.1016/j.iatssr.2021.02.002.
63. Trencher, G., Truong, N., Temocin, P., & Duygan, M. (2021). Top-down sustainability transitions in action: how do incumbent actors drive electric mobility diffusion in China, Japan, and California? *Energy Research and Social Science*, 79, 102184. DOI: 10.1016/j.erss.2021.102184
64. Truffer, B., Rohracher, H., Kivimaa, P., Raven, R., Alkemade, F., Carvalho, L., & Feola, G. (2022). A perspective on the future of sustainability transitions research. *Environmental Innovation and Societal Transitions*, 42, 331-339. DOI: 10.1016/j.eist.2022.01.006.
65. Vergara, S. C. (2006). *Métodos de pesquisa em administração*. São Paulo: Atlas.
66. Wolfram, M. (2018). Cities shaping grassroots niches for sustainability transitions: conceptual reflections and an exploratory case study. *Journal of Cleaner Production*, 173, 11-23. DOI: 10.1016/j.jclepro.2016.08.044.

EDITORIAL DETAILS AND AUTHOR CONTRIBUTIONS

Detalhes Editoriais e Contribuições Autorais

Financial support:
Not informed by the authors.

Open Science:
Doliveira, S. L. D., Cunha, S. K. da, & Massuga, F. (2024). EXPANSION AND ELECTRIFICATION OF THE PUBLIC TRANSPORT SYSTEM IN CURITIBA, PR: AN ANALYSIS BASED ON SDG - 11 AND THE TRANSFORMATIVE INNOVATION POLICIES (TIP). *Brazilian Journal of Management and Innovation (Revista Brasileira De Gestão E Inovação)*, 11(1), 40–50. https://doi.org/10.18226/23190639.v11n1.05

Interest conflicts:
The authors declare that they have no conflicts of interest.

Copyright:
RBGI owns the copyright of the published content.

Plagiarism Analysis:
RBGI performs plagiarism analysis on all its articles at the time of submission and after approval of the manuscript using the iThenticate tool.

Author 1
Sérgio Luis Dias Doliveira
Universidade Estadual do Centro Oeste
https://orcid.org/0000-0001-9957-225X
http://lattes.cnpq.br/6877990196326427
sldd@uol.com.br

Author 2
Sieglinde Kindl da Cunha
Universidade Federal do Paraná – UFPR
https://orcid.org/0000-0003-1936-8422
http://lattes.cnpq.br/2056351159333574
skcunha21@gmail.com

Author 3
Flavia Massuga
Universidade Estadual do Centro Oeste
https://orcid.org/0000-0003-2490-6678
http://lattes.cnpq.br/0985578089719837
flavia.massuga@gmail.com

Authors' statement of individual contributions (*Not informed by the authors.*)

Roles	Contributions		
	Author 1	Author 2	Author 3
Conceptualization			
Data curation			
Formal analysis			
Funding acquisition			
Investigation			
Methodology			
Project administration			
Resources			
Software			
Supervision			
Validation			
Visualization			
Writing – original draft			
Writing – review & editing			

Editorial flow of double-blind peer review managed by PPGA of UCS Business School (AACSB Member)
Owned/Editing/Layout by Publisher EDUCS from UCS - University of Caxias do Sul.