THE CIRCULARITY COMPASS

Advancing Circular Economy Innovation in Public Transport Systems

Interreg CENTRAL EUROPE
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CE4CE

Imprint

About the CE4CE project

The CE4CE project empowers circular economy system thinking for actors in public transport from Central European countries to reduce waste and create value along new life cycles of infrastructure and rolling stock. To do so, CE4CE jointly develops solutions that increase knowledge and capacities for the sector, help reduce barriers and costs,and initiate the development of new services and skilled jobs, as well as strategies and action plans that improve policy development, learning and exchange on the regional and transnational level. CE4CE aims at bringing circular economy principles into the public transport sector and, thus, reduce waste, increase efficiency in the sector and improve the ecological footprint of public transport.

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Title

THE CIRCULARITY COMPASS Advancing Circular Economy Innovation in Public Transport Systems

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1. Why does the transport sector need a circular economy approach

In recent decades, industrialized nations have experienced unprecedentedly rapid economic expansion, driving substantial development in the energy, industry, agriculture, construction, and transport sectors. However, this growth has been marked by a troubling tendency to treat natural resources as disposable commodities - used once and then discarded. This approach neglects the bold reality that these resources are finite and disregards the natural processes and timeframes needed for restoration, which leads to the critical exhaustion of entire ecosystems. This unsustainable, wasteful linear economy has precipitated the profound triple crises we perilously confront today: the alarming loss of biodiversity, the escalating impacts of climate change, and the pervasive pollution.

Undisputably, the road transport sector has been a major contributor to the current environmental crisis. In Europe alone, emissions from road transport have steadily increased over the last half of a century and now represent about a fifth of total emissions. While sectors like energy have managed to cut emissions since the 1990s, the road transport sector has continuously surged, nearing the all-time high pre-COVID-19 levels of almost 700 $MtCO_2$ as of 2023[1].

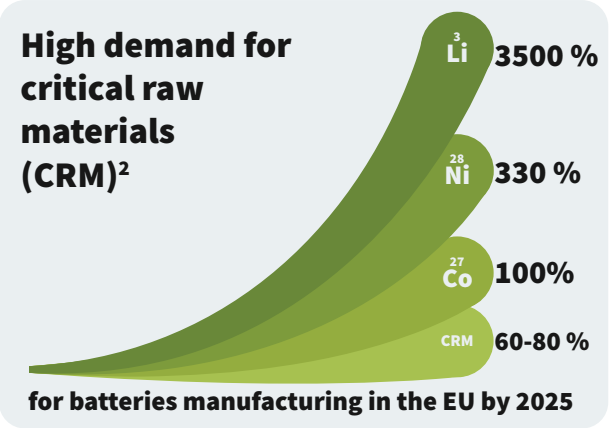
However, the problem does not stop at tailpipe emissions: the road transport sector also demands vast amounts of resources, indirectly causing emissions through, for instance the production of steel for vehicles, gasoline for cars, lithium for batteries, and cement for infrastructure construction.

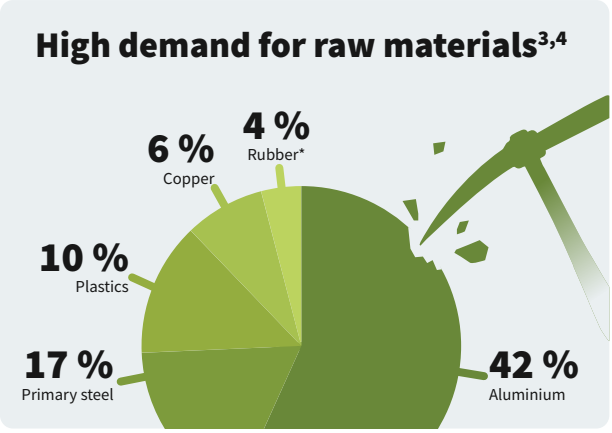
In the face of these facts, circular economy is positioning itself as an all-encompassing, cross-system alternative model where the use of primary energy and materials is reduced to only what is essential as opposed to the linear one. It continuously retains the highest value for resources over the longest possible time and ensures that the end-of-life output from one process becomes an input for another one. In a fully circular economy, emissions are reduced to nearly net zero, and waste is effectively non-existent.

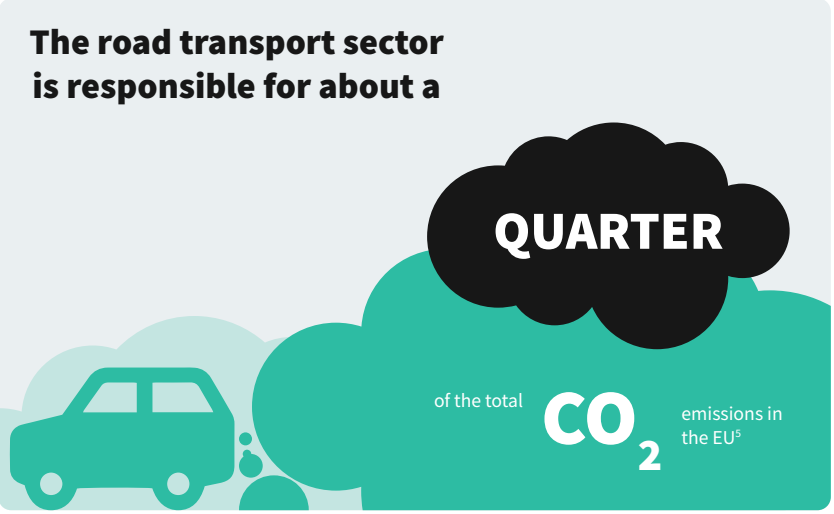
Transport is one of the most important elements of the economy allowing people's access to goods, services and opportunities at the right place, at the right time. Thus, applying a circular economy approach in the transport sector can effectively support tackling the wide range of impacts and emissions throughout the entire transport value chain - from resource extraction, through use and maintenance, to finally the end-of-life of products. This change of the mindset alternative approach has immense potential to significantly reduce the ecological footprint along the whole life cycle while ensuring transport systems that provide maintaining access to the goods and services essential for a high quality of life.

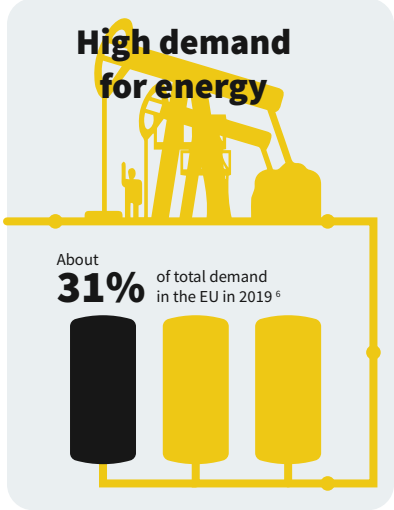
1 European Environment Agency, (2024). Transport and Mobility.

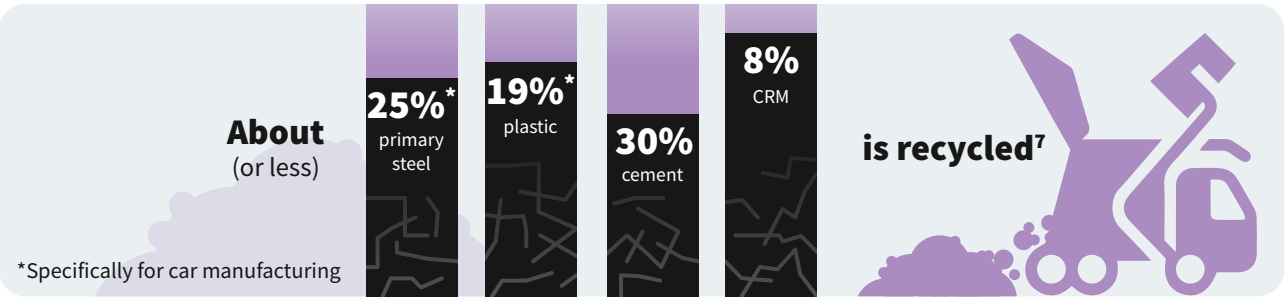
The real ecological footprint of the road transport











[2] Gregoir,L., van Acker,K., (2022). Metals for Clean Energy: Pathways to solving Europe's raw materials challenge.
[3] Laroche, P. C., Schulp, C. J., Kastner, T., & Verburg, P. H. (2022). Assessing the contribution of mobility in the European Union to rubber expansion. Ambio, 51(3), 770-783.
[5] European Environment Agency, (2024). Transport and Mobility.
[6] Eurostat (2022). Final energy consumption in transport.
[7] WorldAutoSteel (n.d.). Recycling Steel and Iron Used in Automobiles. Automotivedive (2023). Automakers blast EU proposal to make cars more recyclable. Concrete Europe (2014). Recycling construction & demolition waste. Institute for European Environmental Policy (2023). Circularity gaps of the European Critical Raw Materials Act.

2. Why a focus on circular economy in the public transport sector

Public transport is arguably the most environmentally friendly options for reducing direct emissions in the transport sector as it promotes cost savings, reduces traffic congestion, and improves urban air quality. While private cars transport 1,000 to 2,000 passengers per hour, public transport options far exceed this, with buses moving 5,000, light rail handling 18,000 to 20,000, and heavy rail accommodating 40,000 to 60,000 passengers per hour1.[8] Even diesel buses, allegedly the least eco-friendly public transport option, can potentially emit fewer carbon emissions per passenger kilometre (3.2 grams) compared to fully occupied electric car (9.4 grams)[9]. Public transport is also much more efficient in terms of land use compared to private cars.

Despite its many benefits, public transport still remains energy, material, and emission intensive. Data from the Amsterdam Public Transport Authority revealed that one-fifth of emissions of all public transport systems come from operation and maintenance (direct emissions), while the largest amounts were emitted in their mobility system during manufacturing and at the end-of-life stages of the product life cycle[10]. Adopting a circular economy approach in the public transport sector would be a way forward to address the selected challenges of public transport systems throughout the entire value chain.

Although the concept might initially seem complex, the reality is that public transport systems are already well-versed in implementing circular economy practices. For example, public transport operators in Central and Eastern European cities since the very start of their public transport systems have developed invaluable expertise in repairing and upgrading fleets and infrastructure beyond their official lifespan due to a lack of supply of new parts or entire units in the market. More recently, the accelerated adoption of electric buses in place of internal combustion engine counterparts has proven to be an effective measure to significantly reduce emissions over their entire lifecycle, bringing them to minimal levels when vehicles are powered by renewable energy.[11]

The differentiating and complementary aspect of the circular economy concept is its proposition for a complete redesign of public transport systems that purposefully and primarily minimize the extraction and use of primary resources from the outset, prioritize the use of byproducts as the base input for new assets, and ensure these assets are maintained for an indefinite period while in function.

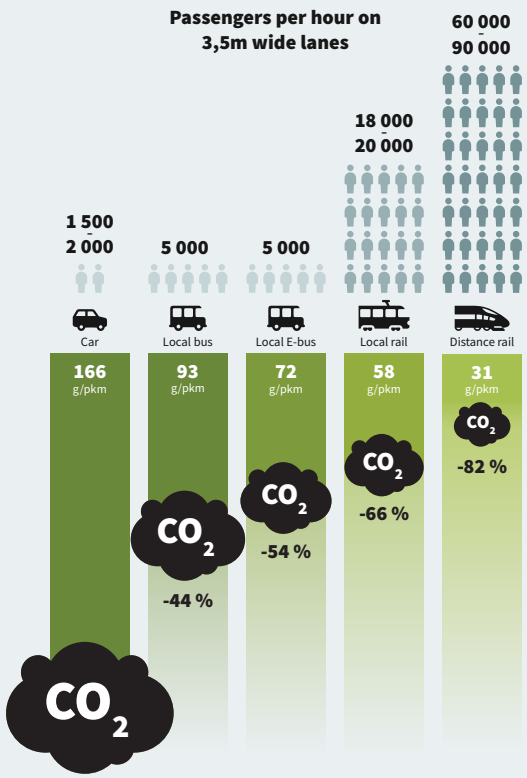
The circular economy is therefore an integrative and systemic approach that blends the best of traditional practices with modern advancements to move ambition forward in the public transport sector. It champions the revival of valuable old

[8] Transformative Urban Mobility Initiative (2019). Passenger Capacity of different Transport Modes.
[9] Based on own calculations, assuming an average private car occupancy of 1.5 persons and a bus occupancy of 9 persons, divided by the average CO_2 emissions data available on Our World in Data's carbon footprint for travel.
[10] Vevoerregio Amsterdam (2023). Circular Mobility System Factsheet.
[11] International Council of Clean Transportation (2021). Life-cycle greenhouse gas emissions.

Why circular economy in public transport?

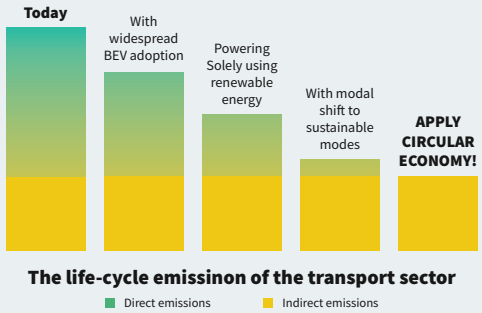
REASON 1

Public transport is already the most sustainable transport solution[12]



REASON 2

A holistic circular economy approach can „finish the job“ in the transport sector[13]



REASON 3

PT is (has been) at the forefront of transformative change in the sector[14]

Battery-electric buses represented

36 %

of total bus sales in 2023 in the EU

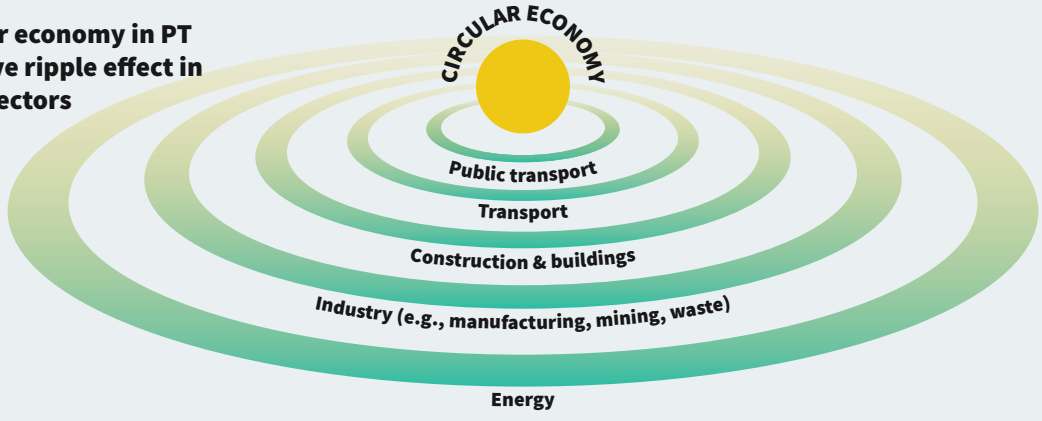
compared with

14,6 %

Share of battery electric passenger car sales in 2023 in the EU

REASON 4

Circular economy in PT can have ripple effect in other sectors



[12] Transformative Urban Mobility Initiative (2019). Passenger Capacity of different Transport Modes. German Federal Environment Agency (2022). CO2 emitted by bus, train, car & co.

[13] This figure is illustrative and is inspired in estimate yet not complete life-cycle data.

[14] European Automobile Manufacturers' Association (2023). New car registrations: +13.9% in 2023; battery electric 14.6% market share. Sustainable bus (2023). 42% of the city buses registered in Europe in 2023 are zero emission.

practices, such as lifelong maintenance and the use of less carbon-intensive products, while simultaneously promoting the adoption of more modern and efficient technologies with reduced energy demand and emission impact. This transition is further propelled by a new aspect of advanced high-tech innovations in data analytics of material and energy flows and the adoption of digital twins for assessment and simulations, to name a few.

Last but not least, adopting a circular economy in public transport would not only drive transformation within these systems themselves, but spark the shift in the entire transport sector. For example, public transport has pioneered the testing and adoption of battery-electric vehicles, even when the private sector was hesitant. Bold moves from the public transport sector have proven to pave the way for other public bodies and the private sector to join forces in accelerating the rollout of innovative approaches, not only in other transport sectors such as private passenger vehicles, passenger shared fleets, and urban freight, but also on other economic sector such as industry, construction, and energy.

All in all, public transport can be seen as the "low-hanging fruit" for public authorities, offering fewer technical challenges and involving less shared influence among stakeholders than other sectors, which helps streamline the transition. The public procurement system plays a critical role in driving this change. With these advantages, public transport is well-positioned to spark this revolution, acting as a beacon and leading the shift from a linear to a circular economy across the entire transport sector and beyond.

3. Introducing the Circularity Compass for Public Transport systems

Although the concept of a circular economy is gaining momentum and its value and benefits are increasingly recognized, many remain uncertain about how and where to start, with the public transport organizations and stakeholders across the value chain being no exception. One reason is that the circular economy often remains an abstract theoretical framework, lacking clear, actionable steps specific to the transport sector. Additionally, while there are numerous ongoing pilots and initiatives, they often fail to be placed within a unified comprehensive strategy that provides a framework to this process, outlines a vision, clarifies priorities, and uncovers interlinkages and dependencies with other sectors across the entire value chain.

In response to this challenge, the Circularity Compass was designed as an easy-entry orientation and inspiring tool for public transport operators and authorities to foster circularity approaches, principles, and solutions across all stages of public transport systems, including planning, procurement, operations, maintenance, and end-of-life stages. To do so, the Circularity Compass:

1. **Proposes a vision and framework to incorporate circularity in public transport systems**
2. **Provides a self-assessment tool to gauge PT systems' current status and readiness levels for circular economy adoption**
3. **Outlines a diagram that visualizes actionable circular solutions across the entire life cycle of public transport systems.**

The Circularity Compass was designed, prepared and developed jointly by trolley:motion and all Project Partners within a CE4CE Interreg Central Europe project.

It is available at:
https://circularity4publictransport.eu/circularity-compass/

3.1. A circularity vision and framework for public transport systems

The Circularity Compass outlines our vision for a circular economy in public transport, proposing a shift from a linear take-use-throw approach to a circular avoid-extend-transform model. These stages highlight the actions and processes across planning, procurement, operations, maintenance, and end-of-life activities. The model focuses on three interdependent pillars: fleets, infrastructure, and energy. Additionally, the circular vision incorporates a fourth cross-cutting stage, enable, to address the underlying conditions required for advancing circularity. This materialized in a fourth pillar: governance.

The life-cycle phases

Avoid

The avoid stage focuses on designing products, processes, and systems to minimize the need for primary energy, raw material extraction, and waste generation from the outset. Prioritizing this phase is paramount in a circular economy. The European Commission states that 80% of a product's environmental impacts are determined at the design phase.[15] The extraction and use of primary resources like steel, lithium, and copper have immense and lasting social, environmental, and economic impacts, especially on ecosystems and livelihoods, often outside of Europe. By acknowledging these effects, the circular economy emphasizes mindful resource use, highlighting that the most responsible and cost-effective approach is to avoid resource extraction in the first place.

Extend

The extend phase focuses on prolonging the lifecycle of products and materials already part of the value chain. By ensuring that raw materials and products are repaired, refurbished, and adapted, this stage reduces environmental impact by decreasing and delaying the demand for new items. This phase requires a revolutionary shift from the current state of affairs for two key reasons: it demands an end to planned or subjective obsolescence, advocating for products designed to be repairable, modular, and durable for a lifetime. It also necessitates a cultural and mindset shift, moving away from the notion that new and modern products are always superior and emphasizing the importance of preserving and enhancing existing assets within public transport systems.

[15]European Commission (2020). Circular economy. The EU aims to transition to a circular economy to make Europe cleaner and more competitive.

The circularity compass structure

AVOID **EXTEND** **TRANSFORM**

Fleets

Self-propelled machines are designed to carry passengers between different locations (buses, trolleybuses, trams, and trains).

Vehicles | Batteries

Infrastructure

Underlying system of built and fixed structures, installations and facilities that support public transport operational activities.

Railway Infrastructure | Electric Infrastructure | Buildings

Energy

Fuels employed to generate the power, heat, or electricity essential for conducting public transport activities and operations.

Energy

ENABLE

Governance

System of policies, structures, processes, and institutions, that enable the transition to a circular economic model.

Data & Indicators | Funding & Financing | Multi-level policy | Knowledge and skills

Transform

The transform stage involves converting end-of-life resources as outputs into inputs for new processes. This includes reinserting worn-out materials and products into the value chain through somewhat industrial transformations, without significant loss of quality or value, thus minimizing raw material extraction. However, transformation actions pose significant challenges, often requiring more energy, resources, and effort - for example, recycling needs specialized, expensive processes to separate and degrade blended products back into raw materials - than initially apparent. Therefore, transformation should be considered only after exhausting avoid and extend actions.

Enable

Rather than being a phase, enable refers to the permanent an ongoing effort to create the necessary conditions for raising awareness, planning, and implementing a circular economy in public transport systems. In essence, this component underscores that “when there is a will, there is a way” with determination and commitment, progress is achievable. The Governance section in the following subchapter further details the key, “soft,” enabling factors that pave the way for a circular transition.

The public transport Circularity pillars

Fleets

Fleets refer to self-propelled machines designed to carry passengers. In the Circularity Compass, fleets are divided into vehicles and batteries. Vehicles vary by carrying capacity (e.g., trains vs. buses) and fuel type (e.g., diesel vs. electric). Batteries are addressed independently because they can outlast the vehicles they power and be reused in other vehicles or for other purposes. The growing adoption of electric vehicles, especially e-buses, underscores the importance of circular battery management, given the resource-intensive manufacturing and complex end-of-life handling involved.

Infrastructure

Infrastructure refers to the underlying system of fixed structures necessary for public transport to function. Depending on the type of vehicles used, the required infrastructure varies. This category is divided into roads, railway and electric infrastructure, accounting for rail-based systems and electric ones dependent on overhead wires or charging facilities. A common category for all systems, regardless of vehicle type, is buildings, which include facilities serving technical functions (e.g., depots and stations) or administrative purposes (e.g., offices).

Energy

The energy building block encompasses the fuels used to power transport systems, including the fleets and the supporting infrastructure This block primarily focuses on electricity, anticipating a transition away from fossil fuels. Electricity is considered across different life-cycle stages, from energy origin and production methods to its use, efficient management, and efforts to save, reuse or recover otherwise wasted energy. Emphasis is placed on electricity as essential for generating the power, heat, and energy needed for public transportation activities and operations.

Governance

The governance pillar refers to the soft, cross-cutting aspects that support decision-making and cooperation for transitioning to a circular economic model. In the Circularity Compass, governance is broken down into four categories:

Policy and Planning

This refers to multi-level regulatory instruments that set the conditions for change. For example, the EU's Energy Efficiency Directive mandates a 3% yearly renovation rate for old buildings.[16] At the local level, this can lead to concrete actions such as developing inventories and refurbishing energy-inefficient public transport stations.

Culture, Knowledge, and Collaboration

Implementing a circular economy requires collective human capacities and motivations. This ranges from transferring expertise from senior staff to new employees, lifelong training in new technologies and maintenance practices, committed leadership, and close collaboration with stakeholders, such as OEMs.

Data and Indicators

Quantifiable measures track actions and provide reliable insights for decision-making. Circularity indicators largely require tracking the inflow and outflow of raw materials and energy across the entire transport value chain, challenging traditional metrics. For instance, extending vehicle lifespans might be more critical than merely renewing the fleet with electric vehicles. The most useful in this regard are KPIs linked to the objectives to be met in the future, reliable measurement systems and ongoing data analysis to calibrate the processes.

Funding and Financing

Economic resources are required to implement circular economy actions. Viewing public transport funding through a circularity lens involves critically assessing fund allocation and prioritization. Currently, investment often focuses on new electric vehicles or energy-efficient gadgets, while funding for second-hand markets, infrastructure maintenance, and developing use cases for energy harvesting and materials recycling is lacking. Circularity financing requires alignment with the “avoid-extend-transform” approach.

[16]EU Energy Efficiency Directive, 2023.

3.2. The circularity self-assessment survey

The Circularity Compass vision embraces a comprehensive approach that goes beyond previous sustainability initiatives by addressing the ecological footprint of all components of public transport across all life-cycle stages.

As indicated before, no public transport system or organization starts its transition to a circular economy from scratch. In most modern transport systems, efforts are already underway to phase out ICE technology, adopt preventive rather than reactive maintenance for infrastructure, and switch to more renewable energy sources. Nevertheless, it can be challenging and disorienting for public transport stakeholders to gain an initial understanding of their current standing in circularity adoption throughout these stages.

To address these gaps, the Circularity Self-Assessment survey has been developed. The survey provides a simple and quick entry-tool mainly intended for mass public transport agencies (PTAs) and operators (PTOs) to gauge their position on the circularity map as well as estimate their needs to progress in adopting circular economy paradigms, principles, and practices in their public transport systems.

The circularity self-assessment is structured into the above mentioned four public transport components: Fleets, Infrastructure, Energy, and Governance. The first two categories are further divided into the two and three subcategories, resulting in the seven blocks of surveys to cater to different public transport types (e.g., rail vs. road-based systems).

How is the self-assessment survey structured?

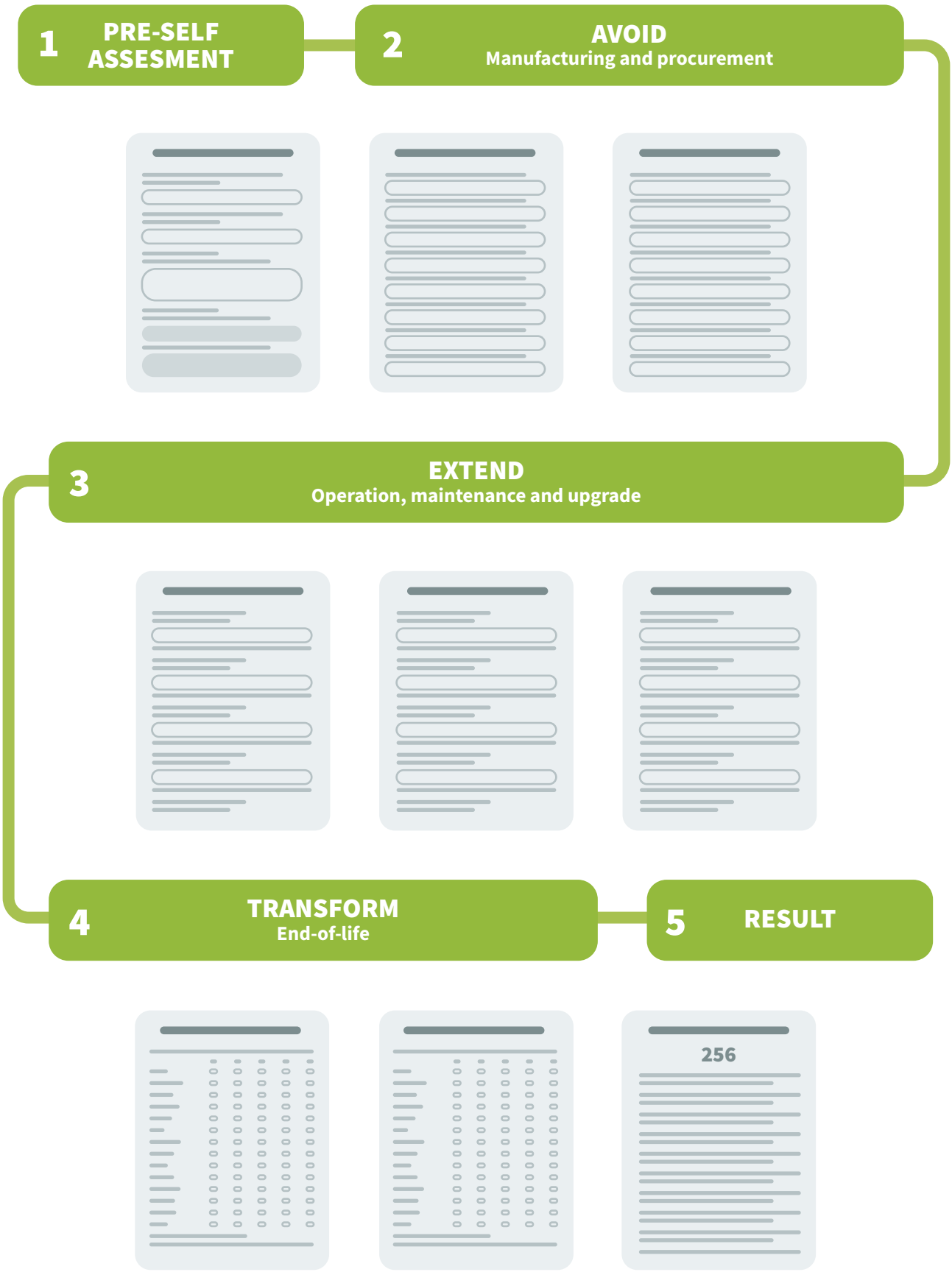
Typically, each survey block comprises three sections: the pre self-assessment section, the life-cycle section, and the results section.

1. **Pre Self-Assessment Section**
   This section gathers information on the respondent's profile, the organization this person represents, and initial interest and motivation in the circular economy.

2. **Life-Cycle Section**
   This core section follows the avoid-extend-transform life-cycle logic. It aims to raise awareness and provoke thoughtful consideration of aspects that have either been addressed or overlooked in the pursuit of sustainability within each block.

3. **Results Section**
   At the end of the survey, participants receive a reference score and an explanation, providing an initial idea of whether the circularity integration levels in a particular organization are low, medium, or high.

The circularity self-assessment survey sections



The exception is the governance block. As a cross-cutting aspect, it does not follow the life-cycle logic but is instead broken down into policy and strategy, skills and knowledge, data and indicators, and funding and financing.

The circularity sef- assesment survey is available at:
https://circularity4publictransport.eu/self-assessment-selection/

How can the self-assessment survey be completed?

Each of the seven sections contain between 10 to 20 questions. A person with a good level of information in each category should take between 15 and 20 minutes to complete one section thoroughly.

It is recommended that an organisation complete all pertinent sections to ensure a thorough and holistic assessment of a company's circularity status. To do so, the survey should be completed by two, three, or more respondents according to their specific expertise and responsibilities. For instance, one person may answer on behalf of the vehicle operations team, whereas another could respond on behalf of the building management team.

In addition to the available online tool, the Trolley: Motion team has adapted the self-assessment into an interactive 2-3 hour "World Café" workshop format. [15]

Value and scope of the self-assessment survey

Once respondents complete the survey, they gain a broader awareness of the entire life cycle, extending beyond their immediate scope of action. They develop a better understanding of their current standing and a clearer idea of the current and future enablers and barriers to progress.

It is important to note that the circularity self-assessment survey offers a preliminary, subjective analysis and does not replace in-depth, data-driven diagnostics. Its purpose is to shift focus from a narrow perspective to the bigger picture, spark questions, raise awareness, initiate discussions and collaborations, and encourage the adoption of a circular mindset across departments and stakeholders throughout the value chain. The self-assessment serves as a stepping stone toward more detailed evaluations, such as life-cycle analysis.

The self-assessment is publicly available and undergoing continuous improvement, so changes in wording and headings can be expected as the tool is fine-tuned.

[15] These workshops have been conducted at over five events in various cities across Central Europe, receiving excellent feedback for their effectiveness in raising awareness and facilitating cross-stakeholder dialogue and exchange. If your organisation is interested in carrying out a circularity workshop in your organisation, contact us at scharzenberger@trolleymotion.eu

4. The circularity in public transport diagram

The Circularity Compass vision provides a conceptual framework, and the self-assessment offers an initial standpoint in the circularity transition journey, identifying strengths and areas for improvement across different transport components. Naturally, the next question arises: what comes next? How do we move from ideas and diagnosis to implementation? Complementing the previous section, the Circularity Diagram presents a catalogue of concrete and actionable measures to operationalize the circular economy across various life-cycle stages and transport components.

To provide actionable measures for incorporating circularity in public transport, the Circularity Diagram adopts the avoid-extend-transform-enable approach and integrates the "R-principles," widely used in circular economy literature and strategies since the 1970s. The R-principles vary by reference and economic sector. For the Circularity Compass, seven principles have been applied throughout the life-cycle phases: redesign, reduce/refuse, reinforce, reuse, repair/remanufacture, retrofit, and recycle. Five of these principles fall into a single phase of the cycle, while redesign and reinforce are crosscutting across various phases. As a result, the diagram offers a catalogue of 30 actionable solutions to enhance circularity in public transport throughout the entire value chain.

10 R-principles for circular public transport systems

4.1. 10-R principle for the circular transport system

Redesign

This cross-cutting principle is present in various of the life-cycle phases, and it is instrumental in the circular economy as it calls for a comprehensive redesign of processes and approaches to ensure resources are used in the most responsible, sustainable, and efficient way. It involves, for example, the redesign of “hard” components, from simple spare parts and battery units to large train stations, making them durable, properly sized, and upgradable by default.

Reduce/Refuse

These two principles are critical at the avoidance stage. Reduce focuses on minimizing resource use, such as appropriately sizing vehicles and batteries to match operational needs or using less steel in bus body construction. Refuse means opting for more sustainable alternatives, like using recycled concrete instead of new concrete. In the Circularity Compass, these principles are combined and used interchangeably, as both ultimately encourage a more mindful and efficient use of resources.

Reinforce

Reinforce is also a prevalent principle across all life-cycle stages due to its procedural nature. More like other principles, it emphasizes the procedural mechanisms to strengthen and enforce concrete action. This involves, for example, translating reduction intentions into practical criteria to favour more circular assets in tenders, or switch to alternative business models such as leasing batteries instead of owning them, compelling stakeholders to find second life uses for the batteries.

Reuse

Reuse encourages the repeated use of assets without significant alteration. For public this can range from reusing a spare part of a vehicle in other or reusing windows from an old building into a new one. This principle ultimately aims to extend the functional life of functioning products and reduce the demand for new elements.

Repair/remanufacture

These principles focus on restoring damaged or worn-out components to their original or improved condition. To apply these principles effectively, it is essential to design transport components with the maximum number of elements that can be repairable from the outset, aligning with the avoid stage. Additionally, this requires an existing provision of tools, spare parts, and customer support and guidance.

Retrofit

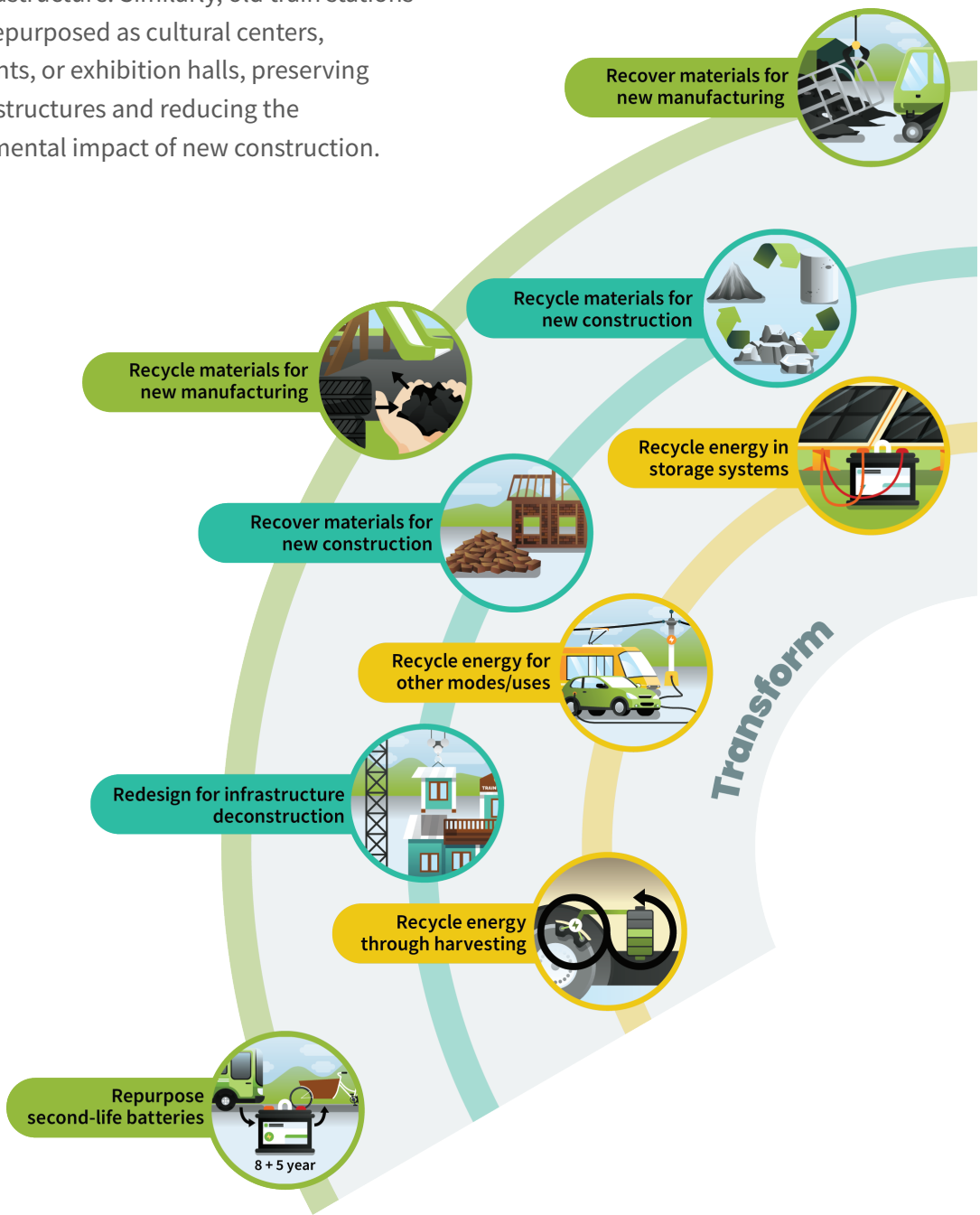
This principle involves upgrading existing assets with new technologies or components to improve performance, efficiency, and sustainability without complete replacement. Examples include converting diesel buses to electric by installing electric drivetrains and battery systems and installing triple-glazed windows and wall insulation to enhance thermal performance and reduce energy loss.

Repurpose

This principle entails using a product or material for a different function when it's no longer suitable for its original purpose. This approach involves creativity and adaptability, finding new applications that add value and prevent waste. In the transport sector, repurposing is seen, for example, in converting old buses or coaches into mobile libraries, coffee kiosks, or pop-up shops, reducing the need for new infrastructure. Similarly, old train stations can be repurposed as cultural centers, restaurants, or exhibition halls, preserving existing structures and reducing the environmental impact of new construction.

Recycle

This stage involves processing end-of-life materials to convert waste into reusable materials, retaining their core components for use in similar or new forms. In transport, materials like steel can reach high recycling rates, though recycled steel usage remains limited in the sector. Recycled plastics are also increasingly used in upholstery.



Recover

Unlike recycling, recovery focuses on retrieving energy or valuable materials from waste without retaining the original form of the material. In the transport sector, this often involves extracting specific components or resources, like reclaiming precious metals from electronic parts or recovering energy from waste materials through processes like incineration.

Rethink

Involves reconsidering the underlying socio-economic conditions that shape conventional business, design, production, and consumption patterns, aiming at their root. This principle promotes a systems-thinking approach and supports innovative models that extend product lifecycles, such as fully biodegradable and modular assets, the right (and obligation) to repair, and a shift from ownership to shared product-as-a-service models. Rethink also involves operationalisation into supportive policies, capacity-building activities, alternative funding models, and innovative indicators that pave the way for a truly circular economy.

5. Envisioning the future of the Circular Compass to Advance circularity in public transport and beyond

The Circularity Compass aims to become catalyst for advancing the circular economy in the public transport sector. Its ultimate goal is to position the transport sector as a central player in achieving Europe's climate neutrality targets, with public transport leading this transformative journey.

We believe the Circularity Compass excels in several key areas that enable it to fulfill this mission:

1. Holistic Approach

The tool integrates an all-encompassing cradle-to-cradle methodology, ensuring genuine sustainability throughout the entire life cycle of materials and processes. This comprehensive approach guarantees that every stage, from production to end-of-life, adheres to circular economy principles.

2. Common Understanding and Guidelines

The Circularity Compass provides clear, accessible a shared understanding and guidance for all stakeholders. This consistency allows for the systematic implementation of circular economy practices across the sector, making it easier for organizations to align with circularity vision and strategies and contribute to broader sustainability goals.

3. Ecouraging stakeholder Cooperation

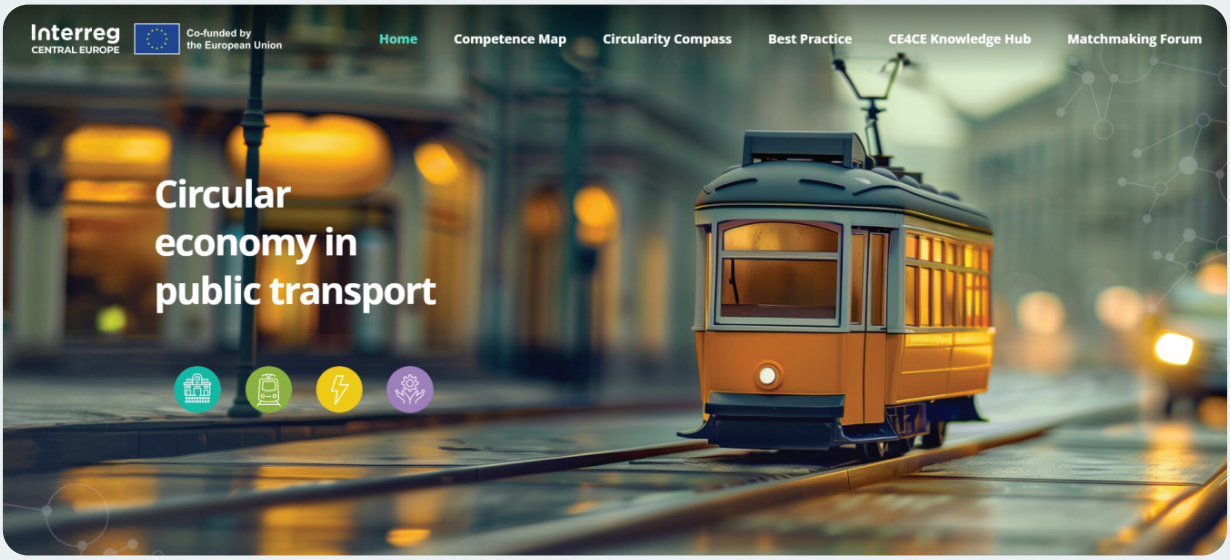
The tool inherently fosters and demands cooperation among diverse stakeholders, including public transport authorities, operators, OEMs, national and subnational governments, consultants, and academia. This collaborative framework is crucial for developing coherent strategies and maximizing the impact of circular economy initiatives.

To this end, the Circularity Compass is also integrated into a broader knowledge initiative: the CE4CE Transport Knowledge Platform. This platform leverages the compass's thematic components and life-cycle stages to serve as a comprehensive hub for knowledge, guidance, and inspiration, driving circularity in public transport.

1. **Best Practices**
Offers real-life case studies from CE4CE pilots and others to inspire and guide circularity implementation.

2. **Competence Map**
Provides publications, online training, and reading material to develop the diverse skillset needed for circularity.

3. **The Matchmaking Forum**
Is an online second-hand and match-making market for public transport used parts, products as well as PT stakeholders information-sharing spot.



The platform is available at:
https://circularity4publictransport.eu/

The Circularity Compass is already effectively moving circularity from idea to action in public transport. Within the CE4CE project, it provides a common approach to diagnose the current state and define concrete measures, resulting in the development of three transnational strategies devoted to the use optimization of Circularity Compass key areas: energy, waste energy and RES in particular (Strategy 1), infrastructure (Strategy 2) and rolling stock (Strategy 3) in public transport along new life cycle value chains.

The respective strategies form a basis and deliver guidelines for four concrete action plans for public transport systems to be adopted in Maribor (Slovenia), Leipzig (Germany), Gdynia (Poland) and Bergamo (Italy).

This effort is further complemented by three proof-of-concept pilots being implemented in these cities and driving innovation in the three strategic Circularity Compass areas of energy, infrastructure and rolling stock. Eleven partners are bringing circularity to life through three strategies, four action plans, and seven pilot projects across five cities and countries in Central Europe.

To stay updated on these strategies, action plans, and pilot projects, access resources, and participate in knowledge exchange and capacity-building activities, visit: **https://www.interreg-central.eu/projects/ce4ce/**

By advancing circular economy practices in public transport, it is possible to accelerate substantial progress toward a sustainable future and positioning public transport as a cornerstone in Europe's path to climate neutrality.


The CE4CE strategies, action plans and pilots
Gdynia, Poland
Strategy & action plan:
recapture value and optimize delivery of infrastructure and update of municipal electromobility strategy
Pilot:
simulation of e-corridor, energy flows to simulate circular scenarios for electrification upscaling
Leipzig, Germany
Action plan:
Optimize delivery of infrastructure through minimal invasive maintenance work
Pilot:
In-vehicles sensors for infrastructure predictive maintenance
Szeged, Hungary
Pilot:
Re-use of switches to extend trolleybuses' lifespan
Pilot:
Universal hardware/software replacement for trams doors
Bergamo, Italy
Strategy & action plan:
Add value on the rolling stock value chain supply chain through circular Procurement
Pilot:
Digital infrastructure and vehicle optimization trough predictive
Maribor, Slovenia
Strategy & action plan:
Closing circularity gaps in PT operations by recapturing waste energy and use of RES
Pilot:
Application of used batteries to store RES for powering a fast charger.