Decarbonization playbook

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July /08/2024

Acknowledgements

We would like to express our gratitude for the valuable contributions to this document. The dedication and effort of everyone has significantly enriched our work. Thank you to each of you for your invaluable input!

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Logistics decarbonization glossary

- **Scope 1, 2 and 3:** These terms refer to the classification of GHG emissions into three categories: Scope 1 covers direct emissions from sources owned or controlled by the organization. Scope 2 covers indirect emissions from purchased electricity, heating, steam or cooling. Scope 3 includes all other indirect emissions in the organization's value chain, outside of its direct ownership or control.

- **Climate change:** According to the United Nations Framework Convention on Climate Change (UNFCCC), It is defined as a change in climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

- **Decarbonization:** is the process of reducing carbon dioxide (CO2) and other greenhouse gas emissions produced by human activities. This is particularly critical in sectors like energy, transportation, and manufacturing, which are major contributors to climate change. This includes moving to low- or zero-carbon energy sources such as solar, wind, hydroelectric and nuclear, and using more efficient and sustainable technologies.

- **Renewable energy:** These are energy sources obtained from inexhaustible natural resources that are constantly renewed. They include solar, wind, hydroelectric, geothermal, and biomass energy.

- **Greenhouse Gases (GHG):** These are gases that trap heat in the atmosphere, essential to keep the Earth habitable. The main greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbon gases (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). The greenhouse effect is a natural phenomenon, but human activities such as burning fossil fuels, agriculture, and deforestation have increased its concentration, driving climate change and global warming.

- **Carbon footprint:** It refers to the total amount of greenhouse gases (GHG), expressed in carbon dioxide equivalents (CO_2), that are emitted directly or indirectly by an individual, organization, event, or product.

- **Freight transport:** Freight transport is an essential component of value networks and the global economy, enabling the distribution of raw materials, intermediate products, and finished goods.

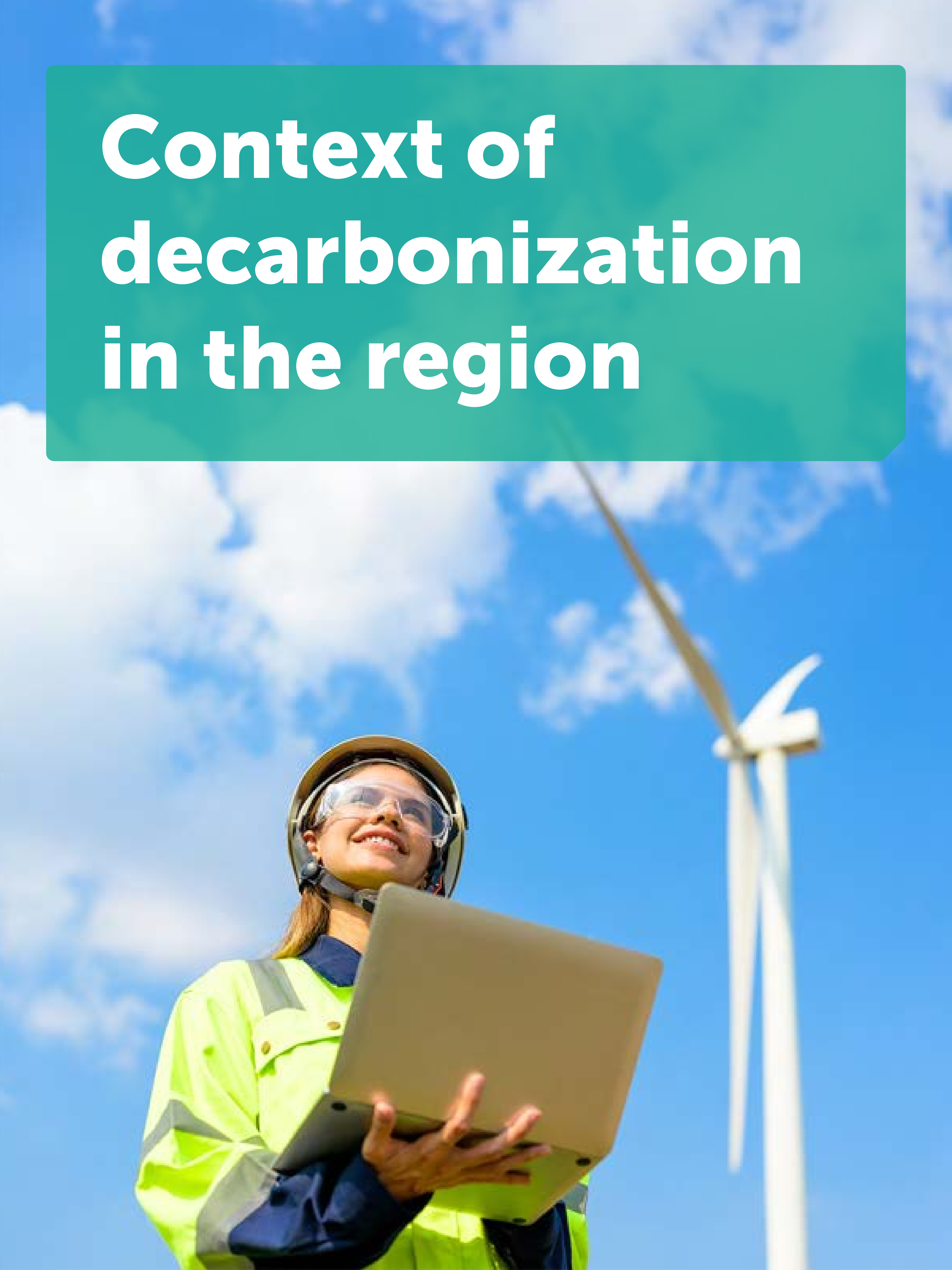
- **Carbon neutrality:** Carbon neutrality refers to the balance of greenhouse gas emissions and elimination. It is achieved by minimizing emissions with energy efficiency and renewable, and offsetting remaining emissions with reforestation or carbon capture, a crucial strategy in combating climate change and limiting global warming.

- **Mode of transport:** This refers to the way goods or people are transported, such as by road, rail, air, or sea.

- **Means of transport:** refers to the specific vehicle employed to carry goods or passengers. The choice of vehicle depends on factors like the nature of the cargo, the distance to be covered, the required speed, and the mode of transport being used.

- **Redes de valor:** Collaborative Ecosystems for Enhanced Value Creation. Value networks represent the interconnected relationships between organizations, suppliers, partners, and customers within a specific industry or ecosystem. These networks foster collaboration and knowledge sharing to optimize the creation and delivery of value

Context of decarbonization in the region



Logistics operations play a fundamental role in the decarbonization agenda, their impact is essential in reducing emissions and ensuring the improvement in competitiveness and productivity that allows for business sustainability.

Climate change is associated with ecosystem changes caused by the increase in the average temperature of the Earth's surface. Over the last 200 years, anthropogenic activities have significantly contributed to this increase through the generation of greenhouse gases. This is primarily driven by population growth, industrialization, and a higher rate of consumption (see figure 1).

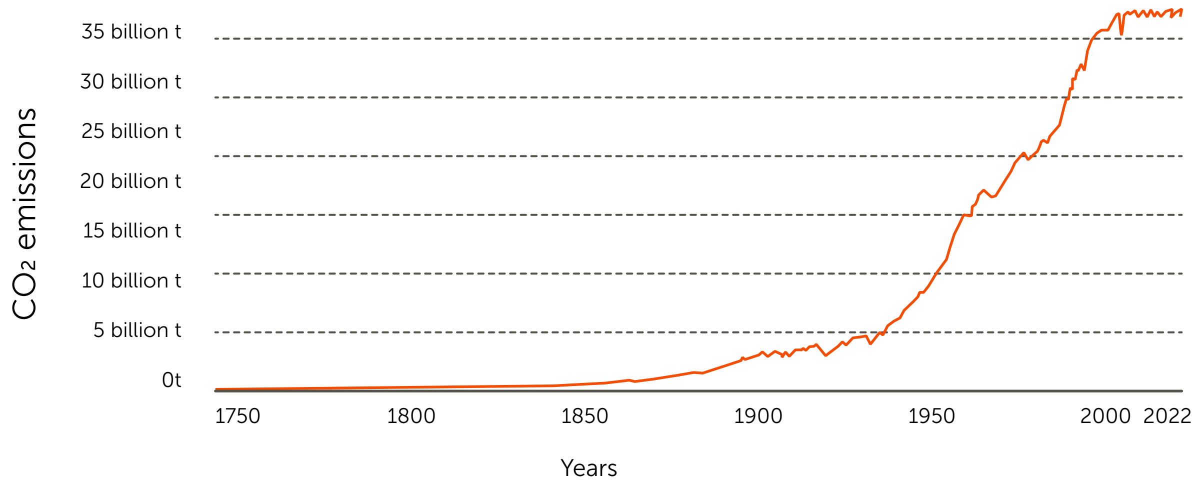


Figure 1. Annual CO2 emissions for the years 1750 - 2022
Source: Ritchie & Roser (2020)

In 2020, the average concentration of CO_2 in the atmosphere was 416.21 parts per million (ppm), the highest since measurements began in 1958, increasing by more than 100 ppm since the first measurement (UNEP, 2020).

Increases above 1.5 °C above pre-industrial levels can alter the dynamics of our ecosystems (UNFCCC, 2015), affecting flora and fauna and causing the melting of ice bodies. This compromises the sustainability of populations living in coastal areas due to rising sea levels, floods, and natural disasters. Furthermore, these impacts disrupt the flow of materials and the continuity of logistics operations.

The floods in Europe in July 2021 increased late shipments between 26% and 32%. Several recent disruptions have been recorded, such as the unexpected power shutdown in Texas, USA, on February 2021, which caused the suspension of activities at three semiconductor plants, exacerbating the global shortage of these components (Cervest., 2022).

Furthermore, other examples include the reduction in ship carrying capacity on the Rhine River in Europe due to extreme weather conditions. Flooding in Central China impacted commodity supply chains. These floods also caused the closure of a Nissan plant. Hurricane Ida in the US damaged key industrial facilities and disrupted transport routes (Cervest, 2022).

According to the risk index developed by Germanwatch in 2021, most LAC countries have a high (ranking 1-10) or medium (ranking 21-50) risk index, as shown in Figure 2. This means that they have experienced the greatest economic and human losses due to floods, forest fires and hurricanes for the year 2021.

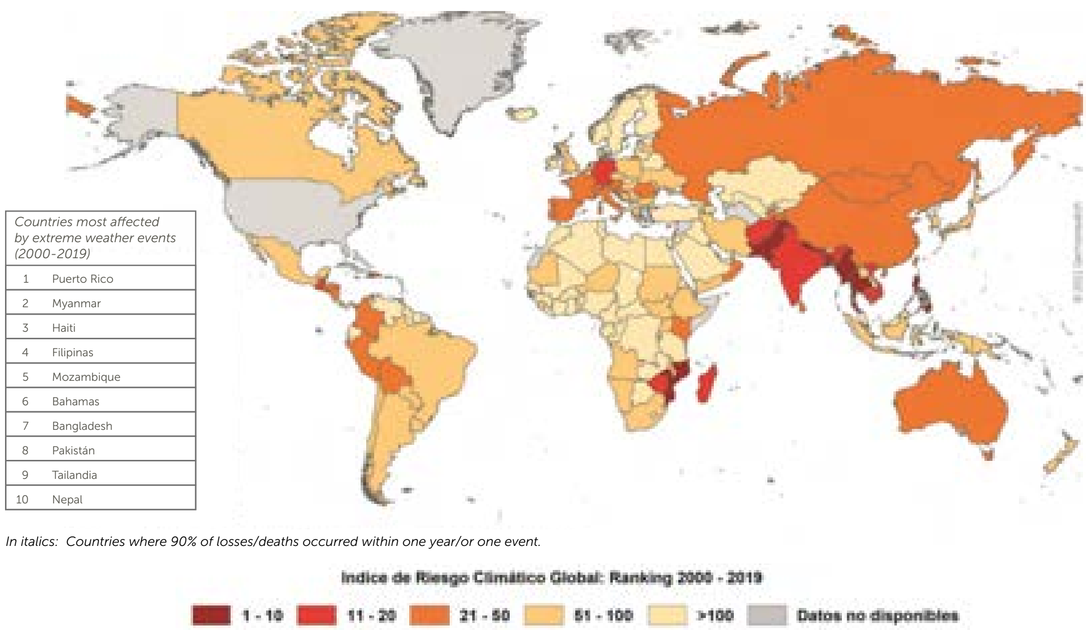


Figure 2 . Global climate risk index for the years 2000-2019
Source: Germanwatch (2021)

Greenhouse gas emissions are generated by key sources such as industrial activities (25% of emissions) and transport (14% of emissions). Of these transport emissions, 40% is from passenger mobility and 60% from freight transport (United Nations Environment Programme [UNEP], 2023). These sectors rely heavily on fossil fuels as their main source of energy. The 2015 Paris Agreement established a global agenda to reduce dependence on fossil fuels.

Today's value networks must build resilience to respond to climate change disruptions. They need to transform their operations into sustainable, innovative, and customer-centric models. This includes maximizing efficiencies and promoting collaborative initiatives.

Some companies in Latin America have adjusted their strategies to achieve carbon neutrality by 2030-2050.

The region's heavy reliance on road transport poses challenges for logistics efficiency and sustainability. Efficiency is impacted by the high proportion of deadhead miles (approximately 40%) and low vehicle occupancy, which averages 60%.

According to the World Bank's Logistics Performance Index (LPI) for 2023, Latin America and the Caribbean (LAC) had an average score of 2.6 out of 5. Categories like infrastructure (2.6), tracking and traceability (2.7), and customs time (2.5) are the most problematic. This is because investment generally fails to keep pace with demand and technological advances (The World Bank, 2023)

LAC contributes 9% of global CO_2 emissions generated by the transport sector, compared to 32% from Asia Pacific and 28% from North America (IDB, 2023).

Transport infrastructure and logistics operations in Latin America and the Caribbean (LAC) are particularly vulnerable to the impacts of climate change. This vulnerability stems from factors such as the region's geographical location, limited infrastructure, and lack of adaptation measures (IDB, 2023).

As shown in Figure 3, LAC countries rely heavily on road transport compared to other countries with more diversified freight transport systems. Countries like the United States, Russia, and China demonstrate a more balanced distribution across various modes of transport, including rail, maritime, and pipelines.

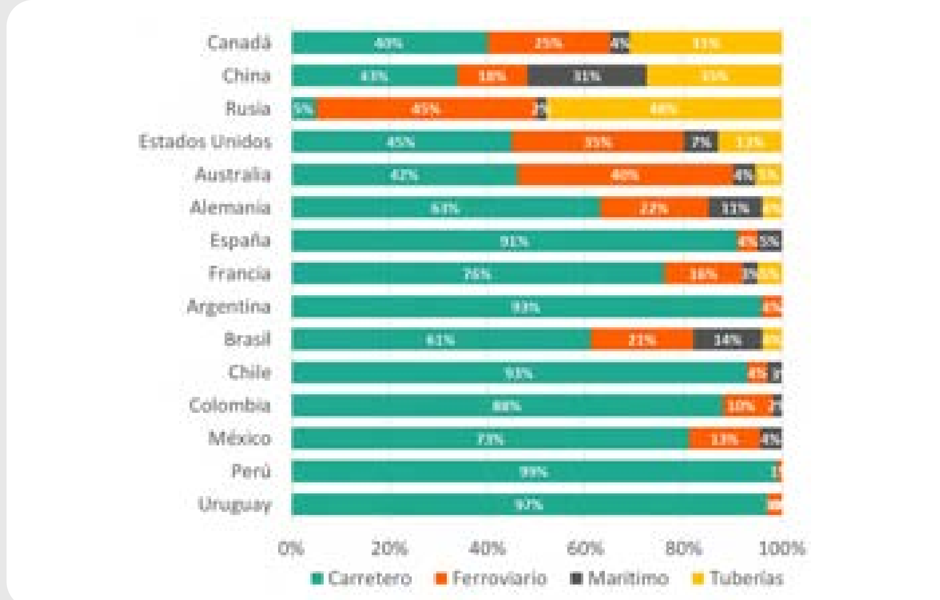


Figure 3. Modal split of freight transport in LAC and other countries
Source: Prepared by the authors with data from Barbero et al. (2020)

Regarding the carbon intensity of different modes of transport, which is expressed in gCO_2 emitted per tonne-kilometer, it has been found, according to Figure 3, that air transport is the most inefficient, generating approximately four (4) times more emissions per tonne-kilometer than road transport and more than 20 times that generated by rail.

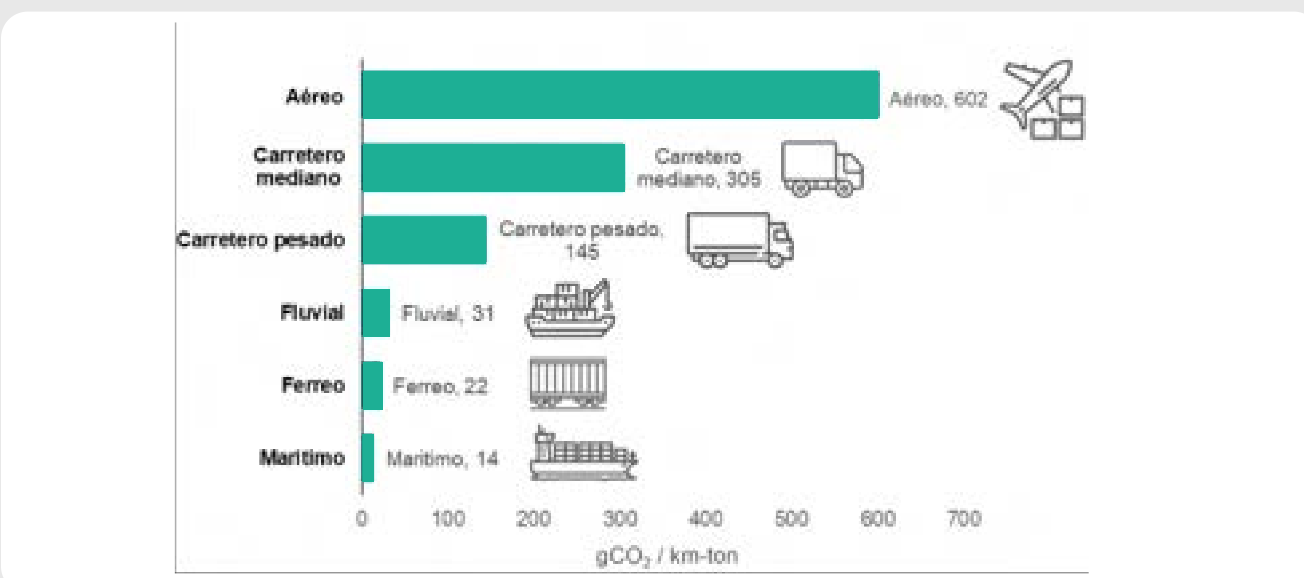


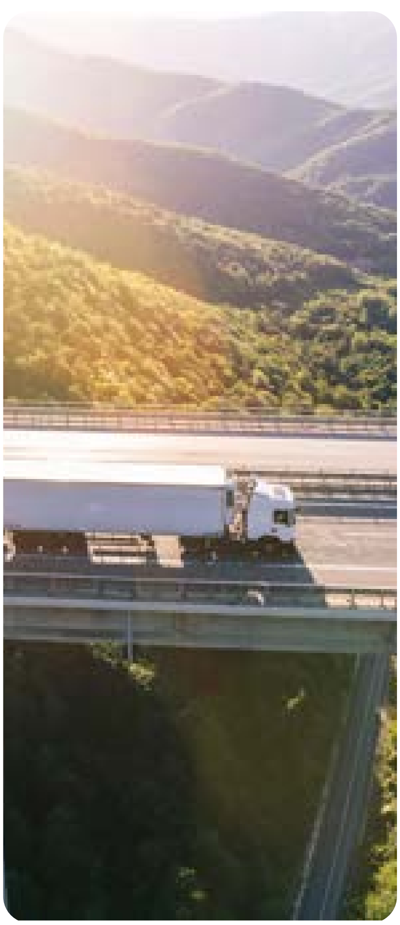
Figure 4. Carbon intensity of different modes of transport. Figures are in tons of CO_2 / km.

Of all land-based modes of transport, rail is the most efficient, generating up to 14 times less gCO_2 /ton-km (grams of CO_2 per tonne-kilometer) than road transport. This fuel efficiency not only enhances the environmental sustainability of operations but also reduces operational costs by lowering fuel consumption..

The transport sector is closely linked to socioeconomic development in the region. It acts as a catalyst for social inclusion and equity, and provides access to job, health, and education opportunities. The transport sector directly influences 76 targets of the Sustainable Development Goals (SDGs)

Increase in GHG emissions from freight transport

In LAC, the increase in demand presents unique challenges, given the state of existing infrastructure, logistical inefficiencies, and the fact that government policies may not be prepared to handle the growth of operations in a sustainable manner.



The dependence of transport on fossil fuels is especially high in low-income countries (LMICs). In LAC, the transport sector has historically been a major contributor to total CO_2-eq emissions, showing an increasing trend over the last 20 years.

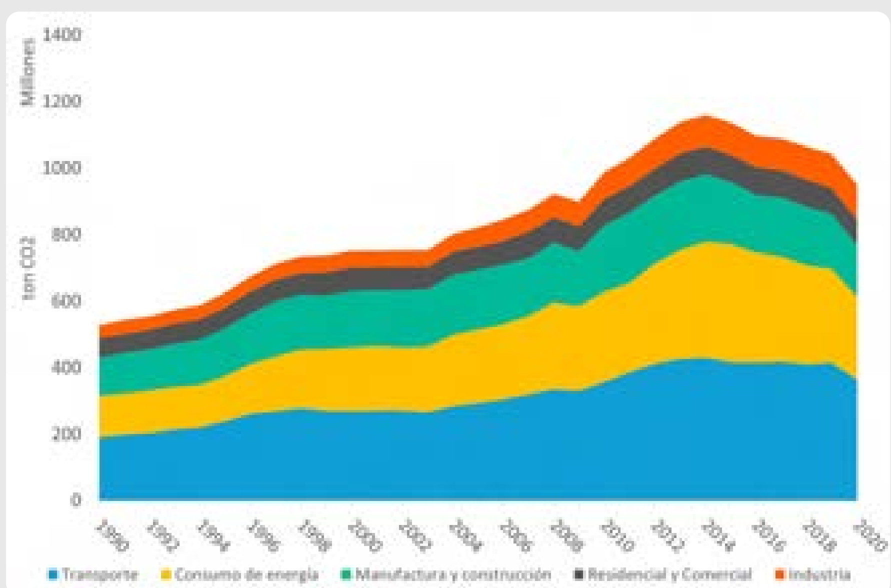


Figure 5. Historical Trend of CO2 Emissions in Latin America and the Caribbean (LAC). Source: Analysis based on data from Ritchie, H. (2024). Our World in Data.

We have identified at least four key factors that contribute to the increase in emissions associated with freight transport

1. Intermodality:

A significant factor contributing to increased emissions in the freight transport sector is the lack of adequate infrastructure for intermodal transport. This includes a lack of efficient intermodal terminals and well-developed rail and river networks. This deficiency hinders the shift towards more sustainable modes of transport, such as rail and maritime shipping, which typically offer greater fuel efficiency and lower emissions per ton-kilometer compared to road transport.

Consequently, Latin America and the Caribbean (LAC) remains heavily reliant on road transport, which accounts for up to 85.9% of total cargo movement. This dominance is primarily due to the greater availability and accessibility of road infrastructure compared to other modes. However, road transport is generally the least efficient mode in terms of fuel consumption and CO2 emissions per ton transported. This reliance on road freight exacerbates the environmental impact of transport operations in the region.

2. Fleet age:

A significant portion of the truck fleet in LAC uses relatively obsolete and inefficient technology. This significantly increases fuel consumption and emissions. The average age of the fleet in the region exceeds 15 years. In some countries, more than 60% of roads are unpaved, which increases vehicle wear and tear and fuel consumption (IDB, 2023).

3. Logistical inefficiency:

Inefficient operations in the region worsen the emissions associated with freight transport. Poor planning and management of transport demand lead to underutilization of freight capacity and an unnecessary increase in trips, resulting in higher emissions. Furthermore, the logistics chain in LAC is highly fragmented. It involves numerous actors, and there is a lack of coordination among them. This creates inefficiencies such as redundant routes, long waiting times, and low utilization of freight capacity

4. Increased demand / changes in consumer dynamics

The rise of e-commerce and shifting consumption patterns have significantly impacted the freight transport sector. This has led to a surge in demand and transport operations, contributing to increased greenhouse gas (GHG) emissions. These impacts include:

- **Increase in home deliveries:** The growth of e-commerce has fueled a significant increase in home deliveries. This trend results in a greater number of short, frequent trips made by delivery vehicles, which are often less fuel-efficient and produce more CO_2 emissions per item delivered than traditional high-volume shipments.

- **Greater delivery frequency:** Consumer expectations of fast and frequent deliveries have driven a surge in shipment frequency. This heightened demand puts significant pressure on transportation and logistics networks, resulting in increased vehicle journeys and consequently, higher emissions.

- **Excessive packaging:** Online shopping is often characterized by excessive packaging, which increases the weight and volume of shipments. This leads to less efficient use of cargo space in transport vehicles, contributing to higher fuel consumption and emissions per unit transported.

- **Returns and failed deliveries:** The high rate of returns and failed deliveries in e-commerce also contributes to increased GHG emissions. These shipments generate additional trips with no payload, creating inefficiency in the transport system and causing unnecessary emissions.

Main challenges for the decarbonization of freight transport

Transport operations face unique challenges in LAC, which actively contribute to high GHG emission rates and barriers to decarbonizing the sector.

Decarbonizing Transport is one of the main trends that is transforming logistics operations, increasing the sector's competitiveness, reducing environmental impacts and enabling sustainable development in the countries of the region (ICCT, 2023). The goals of the Paris Agreement impose structural changes to the development model and decarbonisation of urban activities.

However, the Emissions Gap Report 2023 (UNEP, 2023) indicates that current climate commitments are insufficient to limit global warming to the Paris Agreement targets. Based on current pledges, the Earth is on track to warm by 2.5-2.9°C this century, significantly exceeding the agreed-upon limits. To keep warming below 1.5°C, greenhouse gas emissions must be cut by 42% by 2030.

As shown in Figure 6, the main barriers to decarbonizing the sector are related to various challenges. These challenges include regulatory, financial, infrastructural, technological, human resources, research and development (R&D), and cultural aspects.

Figure 6. Barriers to decarbonization of the sector
Source: Own elaboration (2023)

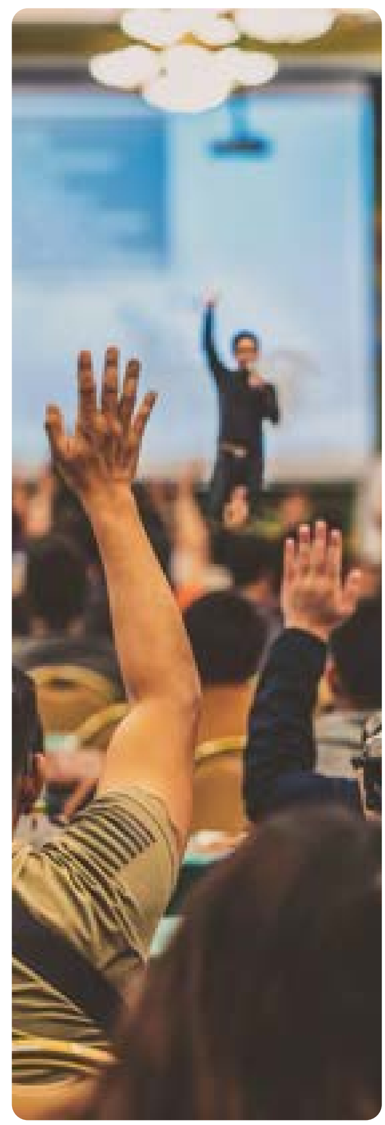
POLICIES:

One of the main barriers to decarbonizing transport in the region is the lack of strong, coherent regulatory frameworks that incentivize sustainable practices. In many countries, emissions standards for heavy vehicles are less stringent than in developed countries, which leads to more polluting vehicles on the roads. For example, the distribution of ultra-low sulfur diesel (<15 ppm) is delayed in the region. This type of diesel is necessary for the advanced after-treatment systems required to meet Euro VI and EPA 2010 standards.

Furthermore, mechanisms for inspecting and monitoring compliance with emissions standards are often inadequate. This allows polluting vehicles to operate without penalty, limiting the effectiveness of regulations.

It is also important to develop new regulations that implement tax incentives or provide subsidies for electric vehicles and low-emission technologies. This will encourage their adoption by the private sector, especially small and medium-sized enterprises (SMEs).

Ultimately, decarbonizing freight transport in LAC requires a comprehensive approach. This includes reviewing and strengthening existing regulatory frameworks and promoting innovation and technological development. Collaboration between governments, the private sector, academia, and civil society organizations is crucial. By working together, the region can move towards a more sustainable and climate-resilient freight transport system.



FINANCING AND INVESTMENT:

The high initial costs of electric vehicles, compared to traditional vehicles, coupled with limited access to financing, hinder their adoption and fleet renewal in the LAC freight transport sector, especially for small and medium-sized companies.

Furthermore, the region's lack of familiarity with low-emission electric vehicles for freight transport can lead to difficulties in accessing credit, such as higher interest rates or stricter lending requirements.

1. Limited Access to Financial Services:

• Fewer specific financial products are available for acquiring electric vehicles, such as green loans or specialized financing plans.

• Limited availability of insurance, maintenance, and repair services for electric vehicles.

2. Higher interest rates:

• The uncertainty and risk perceived by financial institutions in relation to the new technology could translate into higher interest rates for loans intended for the purchase of electric vehicles.

• Higher costs associated with financing the development and installation of charging infrastructure for electric vehicles pose a significant barrier to wider adoption..

3. Limited flexibility in credit terms:

• Financial institutions could be more conservative when granting loans for the purchase of electric vehicles, establishing shorter payment terms and less flexible conditions.

• Difficulties in accessing long-term financing for charging infrastructure projects.

INFRASTRUCTURE:

The decarbonization of freight transport in Latin America (LAC) faces several challenges, including deficiencies in existing infrastructure. Below are some of the main infrastructure issues that hinder this process:

1. Road infrastructure deficiencies:

• **Poor road conditions and lack of maintenance:** The poor quality of roads and their lack of maintenance in many regions of Latin America and the Caribbean (LAC) increases fuel consumption and CO_2 emissions from freight transport, as it generates Potholes, congestion, and greater wear and tear on vehicles result in higher fuel use and emissions.

• **Limited road infrastructure:** The lack of adequate road infrastructure, such as highways, bridges and tunnels, limits options for more efficient and less polluting routes.

2. Poor railway infrastructure:

- **Underdeveloped rail network:** The rail network in LAC is relatively underdeveloped compared to other regions, limiting the use of this more sustainable mode of transport.
- **Lack of modernization:** Many rail lines in the region operate with outdated technology and low efficiency, which increases fuel consumption and emissions.
- **Poor connectivity:** Lack of connectivity between national rail networks hampers intermodal transport and limits rail's potential to reduce emissions.

3. Inadequate port infrastructure:

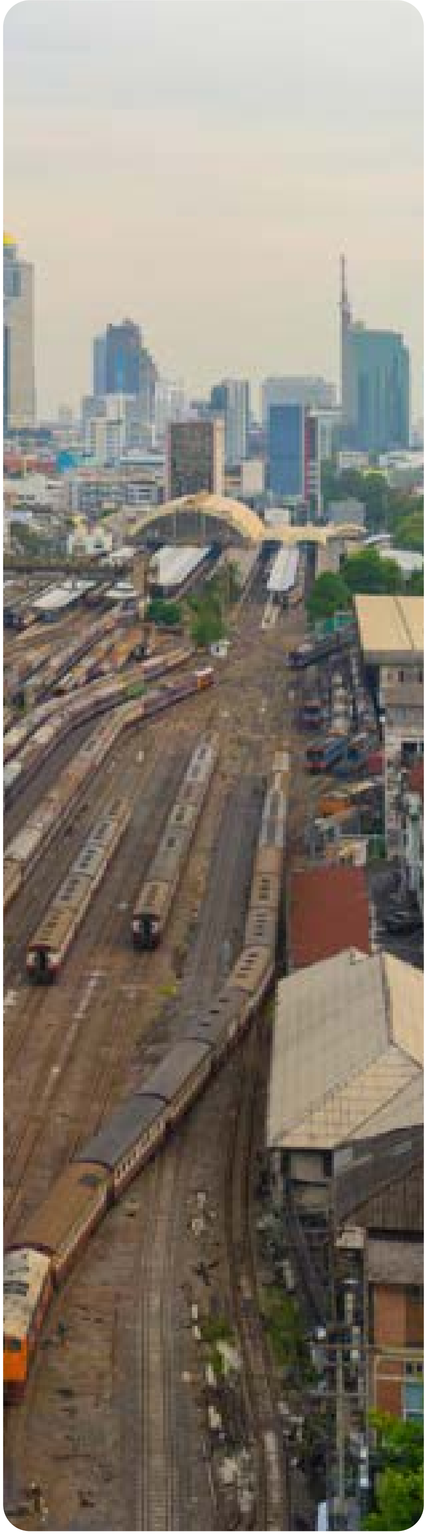
- **Port congestion:** Congestion at LAC ports causes delays in loading and unloading of goods, increasing vehicle operating time and associated emissions.
- **Lack of operational efficiency:** Lack of efficiency in port operations, such as cargo handling and paperwork management, increases vehicle downtime and emissions.
- **Limited port infrastructure:** Lack of sufficient port capacity to handle increasing cargo volumes limits ports' potential for more efficient and sustainable logistics.

4. Lack of infrastructure for alternative fuels:

- **Limited Electric Charging Infrastructure:** The lack of standardized charging systems in LAC presents a significant barrier to electric vehicle adoption. A 2023 study by the International Council on Clean Transportation (ICCT) highlights the scarcity of interurban charging infrastructure at strategic locations as a key challenge to fleet electrification. This lack of readily available charging points discourages investment in electric vehicles and hinders the transition to a cleaner transportation sector.
- **Emerging green hydrogen infrastructure:** Infrastructure for the production and distribution of green hydrogen, a promising alternative fuel, is still in an early stage of development in LAC.
- **Lack of access to sustainable biofuels:** The production and availability of sustainable biofuels on a large scale is not yet sufficiently developed in the region.

5. Lack of intermodality:

- **Poor integration between transport modes:** The lack of efficient integration between land, rail, sea, and air transport hinders the adoption of more sustainable multimodal routes.
- **Lack of intermodal infrastructure:** The lack of adequate intermodal terminals and efficient cargo transfer systems limits intermodality and increases emissions associated with transport..
- **Lack of coordination between logistics actors:** The lack of coordination between the different actors in the logistics chain makes it difficult to plan and execute efficient multimodal routes.



Decarbonizing freight transport in LAC requires significant investment in upgrading existing infrastructure, as well as developing new infrastructure for alternative fuels and promoting intermodality.

TECHNOLOGY:

While technology plays a crucial role in the decarbonization of freight transport in LAC, there are several challenges related to its adoption and effective application in the region. Below are some of the main technological aspects that hinder this process:

1. High cost of clean technologies:

• Cutting-edge technologies for sustainable freight transport, such as electric vehicles, alternative propulsion systems and recharging infrastructure, tend to have a higher initial cost than traditional options.
• This can represent a significant barrier to the adoption of these technologies by the private sector, especially for small and medium-sized enterprises.

2. Limited Access to Advanced Technologies:

• Access to certain state-of-the-art technologies for decarbonizing freight transport, such as intelligent fleet management systems or route optimization solutions, may be limited in some LAC regions.
• This can hinder the implementation of innovative strategies to improve efficiency and reduce emissions in the sector.

3. Digital Disparity in Rural Regions:

• The lack of internet access and connectivity in rural areas can limit the adoption of digital technologies for the efficient management of freight transport.
• This can create disadvantages for companies operating in these areas and hinder the implementation of technological solutions at the regional level.

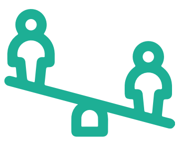
4. Need for technological adaptation:

• Clean technologies for freight transport must be adapted to the specific conditions and challenges of LAC, such as varied topography, long transport distances and diverse climates.
• Research and development focused on the region is required to develop sustainable and efficient technologies that fit local realities.

HUMAN TALENT:

The decarbonization of freight transport in Latin America (LAC) faces a crucial challenge: the shortage of trained personnel to operate, maintain and manage new clean technologies and sustainable practices in this sector. For example, in the case of Colombia, according to the survey carried out by Zonalogística (2024), 82% of participants believe that there is a shortage of human talent in the logistics professions. This may be due to working conditions and social conditions, such as salary, adaptation of rest areas on the road and the high costs of training or training personnel in new trends (Conde., 2022).

The shortage of skilled human talent in LAC poses a significant challenge to decarbonizing the transport sector and transitioning to a more efficient and sustainable system.



1. Skills gap:

• **Mismatch between academic training and sector needs:** Traditional educational programs in areas such as automotive engineering, logistics and supply chain management are not always adapted to the specific demands of sustainable freight transport.
• **Lack of specialized programs**: The shortage of training and capacity building programs focused on clean technologies, energy efficiency practices and sustainable transport management limits the availability of qualified personnel.

2. Attracting and retaining talent:

• **Competition for skilled professionals:** Demand for professionals with skills in clean technologies and sustainability is also growing in other sectors, creating competition to attract and retain talent in freight transport.
• **Unattractive working conditions:** Salaries, benefits and career development opportunities in the freight transport sector are not always competitive with other sectors, which can discourage the entry and retention of talent.

RESEARCH, DEVELOPMENT AND INNOVATION:

Although research and development (R&D) and innovation are fundamental pillars for the decarbonization of freight transport in LAC, there are several challenges that hinder progress in this field.

1. Insufficient investment in R&D:

• **Low resource allocation:** Investment in R&D for the development of technological solutions for the decarbonization of freight transport in LAC is generally lower than in developed countries.
• **Lack of public and private funding:** The lack of public funding for R&D in this sector, coupled with limited private sector investment, restricts the development of new technologies and innovative approaches.

2. Misalignment Between Research and Industry Needs:

A disconnect exists between the research conducted in academic institutions and the practical needs of the freight transport sector in LAC. This misalignment leads to research that may not address the most pressing challenges or provide readily applicable solutions for businesses seeking to decarbonize their operations

3. Limited focus on LAC realities:

• **Need for tailored solutions:** Technologies developed in developed countries are not always suitable for the specific conditions and challenges of LAC, such as varied topography, long transport distances and diverse climates.
• **Lack of regional research:** The scarcity of research focused on the needs and realities of LAC limits the development of sustainable technological solutions adapted to the region.

4. Lack of training of specialized researchers:

• **Need for qualified human capital:** The lack of training and capacity building programs in areas such as energy engineering, clean technologies and sustainable transport limits the availability of researchers specialized in the decarbonization of freight transport.
• **Brain drain:** The migration of qualified researchers to developed countries in search of better professional and research opportunities hinders the advancement of R&D in LAC.

CULTURE

Decarbonizing freight transport in Latin America (LAC) requires not only technological advances and changes in infrastructure, but also a cultural transformation that promotes the adoption of sustainable practices in this sector. Below are some of the main cultural aspects that hinder the decarbonization of freight transport in LAC.

1. Lack of environmental awareness:

• **Limited awareness of transport impact:** Lack of awareness of the environmental impact of freight transport, such as air pollution and greenhouse gas emissions, makes it difficult to take action to reduce its ecological footprint.
• **Short-Term Cost Focus:** The prioritization of short-term costs over long-term environmental benefits can discourage investment in cleaner technologies and sustainable transport solutions

2. Resistance to change:

• **Adherence to Traditional Practices:** A reluctance to embrace change and a strong adherence to traditional practices within the freight transport sector can impede the adoption of new technologies and innovative approaches to decarbonization.
• **Lack of trust in new technologies:** Distrust in new technologies and the perception that they are not as reliable or efficient as traditional options can limit their adoption.

3. Culture of excessive consumption:

• **Focus on speed and efficiency:** The culture of excessive consumption and the demand for fast and efficient deliveries can create pressure to maintain unsustainable transportation practices.
• **Lack of value for sustainable transport:** Lack of value for sustainable transport and the perception that it is not as convenient or efficient as traditional options can hinder its widespread adoption.

The efficient use of resources among various actors is a key axis for the decarbonization of the sector and the comprehensive improvement of operations. In transport, the main resources are infrastructure and vehicles, elements that require high coordination and collaboration in order to be able to share them and achieve mutual benefits between companies. Some strategies currently implemented are load consolidation, backhauling and crowdshipping, however, for these strategies to be efficient, it is necessary to have a collaborative culture within the company.

How to decarbonize freight transport?

Various approaches can effectively reduce emissions in the transport sector. One prominent framework widely used by academics and transport professionals is Avoid-Shift-Improve (ASI).

This approach was developed in the early 1990s by the German Parliament with the aim of having a mechanism to structure the environmental impact of passenger transport in urban areas; however, its applicability has been extended to freight transport, seeking to achieve significant reductions in greenhouse gas (GHG) emissions.

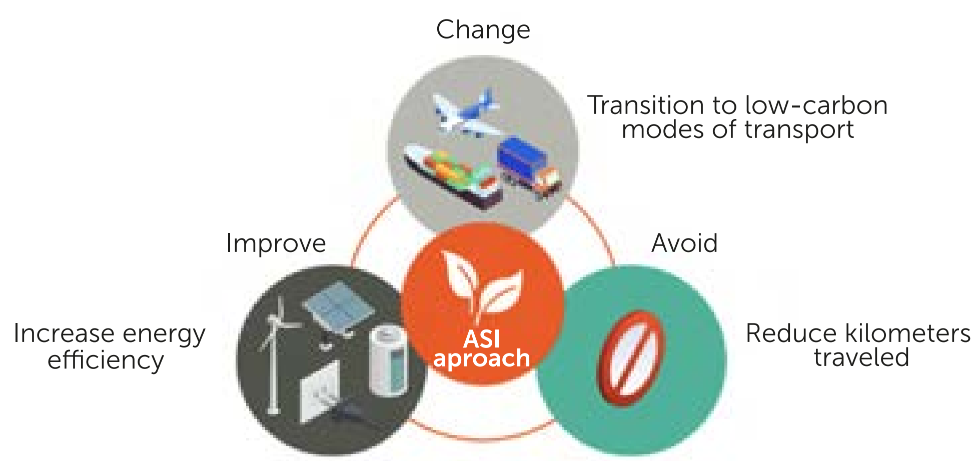


Figure 7. ASI Approach
Source: GIZ (2019)

This approach has been adapted by the Intergovernmental Panel on Climate Change (IPCCs) to take into account the particularities of improving energy efficiency in vehicles dedicated to the mobilization of goods. In this case, the IPCC established two subcategories focused on improving energy efficiency: the use of vehicles and their energy efficiency (McKinnon , 2023).

In addition, a fifth tier based on the carbon intensity of fuels was added, allowing the main strategies and mechanisms in transport decarbonisation to be disaggregated and classified (Figure 8). The five-tier approach is the recommended reference framework and the basis for classifying measures and actions to decarbonise transport.

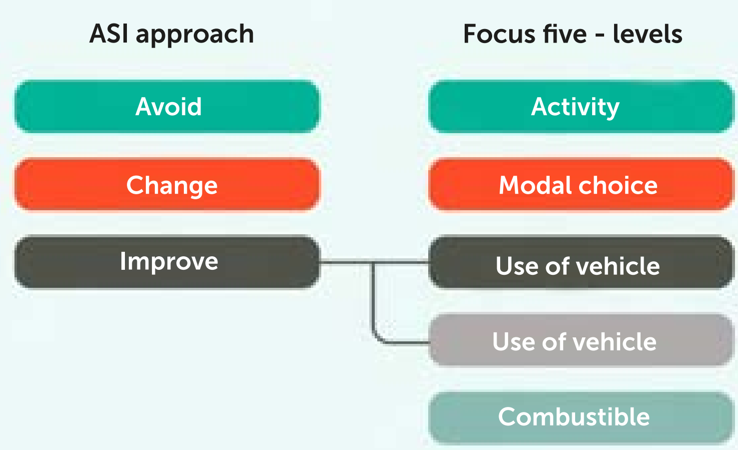


Figure 8. Approach to Freight Transport Decarbonization
Source: Adapted from McKinnon, 2018

Using this five-level approach allows us to distinguish measures that have a similar scope and that affect operational and management aspects, having important differences with major transformations in the industry that require changes in vehicle technology and significant investments in transport and energy infrastructure (Mckinnon , 2018).

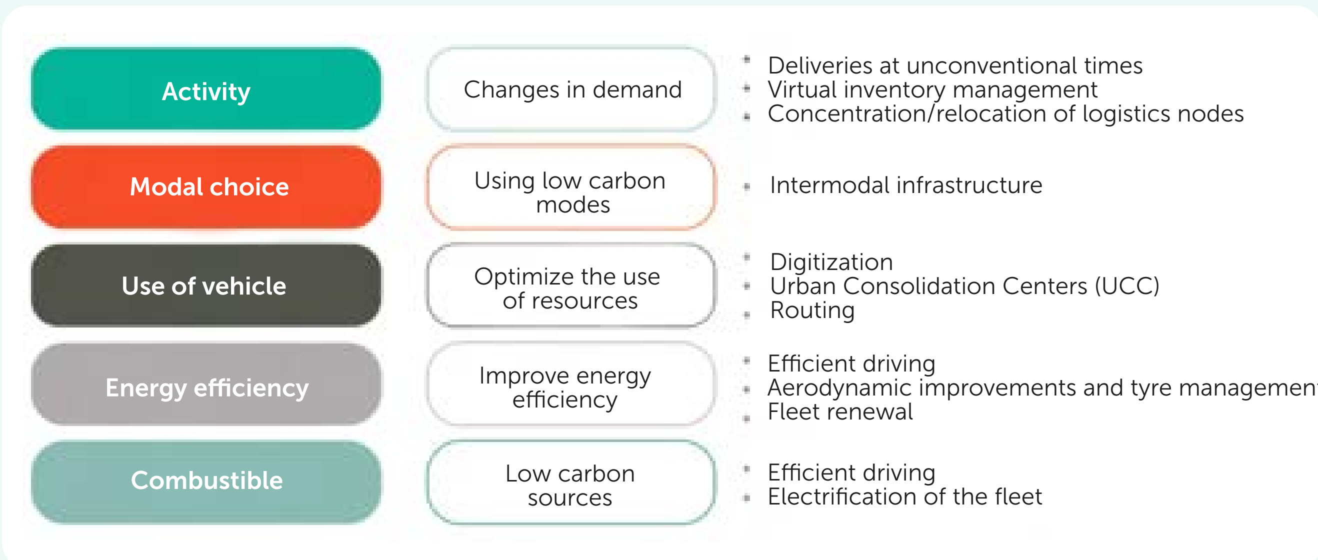
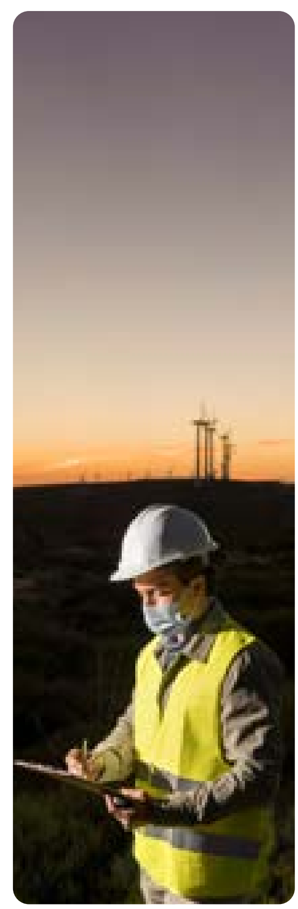


Figure 9. Measures related to each level of the approach
Source: Own elaboration

Furthermore, by articulating these five levels, it is possible to establish an organizational strategy for the decarbonization of transport operations , involving one or more measures focused on mitigating emissions through each of these levels. The importance of developing this strategy is an imperative need since decarbonization plays a key role in mitigating climate change and its impacts on operations.



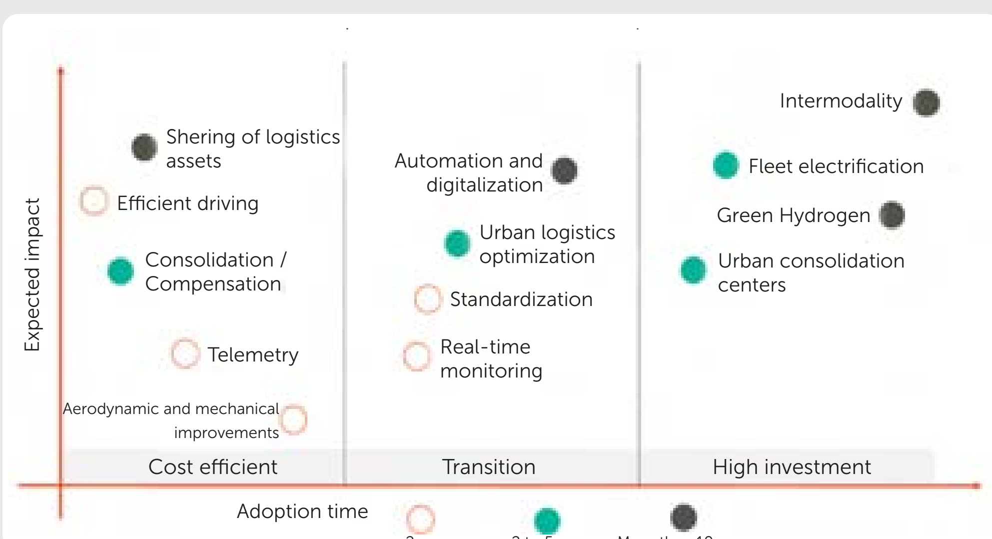


Figure 10. Projection of adoption and investment of decarbonization measures
Source: Own elaboration

In practice, there are a set of measures for decarbonization that can be classified according to the IPCC approach. However, there are other elements that can be decisive in giving a more tangible scope to the implementation costs and expected impact on emissions reduction.

Figure 10 shows a summary of the most relevant measures in the industry, observing that there are some measures that, due to their scope and investment costs, may be more viable for operations with a certain level of maturity, implying in all cases an opportunity to increase operational efficiency and reduce emissions.

An effective organizational decarbonization strategy should integrate multiple measures to maximize benefits and reduce emissions. For instance, implementing strategies like asset sharing allows organizations to leverage existing resources, optimize utilization, and adapt quickly to demand fluctuations without significant investment in new assets. However, transitioning to new models such as intermodality requires greater public-private investment in infrastructure, along with increased coordination and planning efforts.

Examples of decarbonization strategies

Decarbonization is a trend in logistics operations at a global level, therefore, various initiatives are being carried out in other countries and regions, which can provide a perspective of the expected results, as well as the barriers and obstacles that can affect the implementation of these new technologies and logistics practices.

Table 1. Examples of the implementation of strategies and technologies for transport decarbonization

Initiative	Country / City	Description	Results
Biofuels	Spain	CESPA is implementing various technologies for the use of biofuels produced from waste	Savings of up to 40% compared to traditional fuels Reductions of up to 99% of air pollutants and 90% of CO_2 There are pilots of the use of biofuels in railway operations
Biofuels	USA	UPS has committed to acquiring more than 6,000 Natural Gas Vehicles (NGVs).	UPS has invested more than $1 billion in alternative fuel technologies over the past decade. The use of Renewable Natural Gas can reduce up to 90% of emissions compared to Diesel

Initiative	Country / City	Description	Results
Biofuels	Chile	The San Gabriel Group, whose goal by 2040 is to be carbon neutral, has the largest CNG fleet in Latin America	In 2021, they inaugurated the first service station for heavy-duty LNG trucks , with a fleet of 35 vehicles. The aim is to reduce 801 tons of CO_2 per year. Some estimates indicate a reduction in emissions equivalent to 1,600 trees.
Energy efficiency standards	Chile	It is the first country in the region to adopt efficiency standards for heavy vehicles	The application for light vehicles will start in 2024, with the goal of reaching 28.9 km/l in 2030 For heavy vehicles, implementation is expected by 2028
Electrification	California, United States	The state of California has implemented an incentive program for the purchase of electric trucks	330 zero-emission trucks have been acquired in 10 years
Electrification	China	Since 2009, a policy has been implemented to encourage the electric vehicle market.	More than 47 billion dollars invested in politics In 2022 alone, China sold 36,000 electric trucks, 91% of the global value
Electrification	Grupo Bimbo, Mexico Latin America	By 2023, Grupo Bimbo had around 2,500 electric vehicles in Mexico, being one of the leading electrification leaders in the region.	The incorporation of 1322 100% electric vehicles in 2023 contributed to reducing emissions of 6.6 thousand tons of CO_2, equivalent to nearly 250 thousand trees In total, 16 thousand tons of CO2 were avoided from logistics operations.

Initiative	Country / City	Description	Results
Biofuels	United States and Europe	Amazon has committed to reaching Net Zero by 2040, announcing an agreement to acquire more than 100,000 electric vehicles by 2030.	Amazon inició su estrategia de electrificación con más de 10,000 vanes circulando en EUA y Europa To date, more than 260 million packages have been delivered using zero-emission vehicles.
Biofuels	United States and Europe	CEMEX has put into operation the first zero-emission mixer vehicles from the Spandau plant in Berlin.	The company has announced an adjustment in its operations to achieve a 47% reduction in its emissions by 2030.
Last-mile electrification	United Kingdom / London	Transport for London (TfL) program focused on studying the use of cargo bikes for distribution in the city center	Benefits and limitations turned out to be a combination of operational, environmental, and urban factors.
Last-mile electrification	Colombia / Bogotá	With Bicicarga and the Ecologistics demonstration project, different types of zero-emission vehicles have been tested for last-mile	BiciCarga managed to establish a collaborative cross-docking platform for the use of zero-emission vehicles. With these initiatives, savings of 4.97 tons of CO_2 and up to 11% of costs were achieved.
Deliveries in unconventional hours	New York / United States	A night delivery program has been implemented tfollowing the implementation of a successful pilot between 2010 and 2015.	A route during off-peak hours saved an average average of $30,000 - $50,000 per year, reducing emissions and distance traveled by 60-70%. Scaling this initiative has the potential to reduce up to 202.7 tons of CO_2 per year.

Initiative	Country / City	Description	Results
Deliveries in unconventional hours	Colombia / Bogotá	A pilot program was carried out for the night loading and unloading of goods for 17 companies on a voluntary	Reductions of up to 60% in service time were achieved. A 13% saving in emissions generated per kilometer traveled was achieved.

Step by step towards decarbonizing freight transport

The decarbonization of transport is a crucial process in the fight against climate change, as this sector represents one of the main sources of greenhouse gas emissions. Achieving this goal requires a profound transformation that involves various actors and impacts at different levels, and goes beyond the development of isolated initiatives.

Today, a transformation towards a sustainable, resilient and efficient freight transport model is required. In this context, this roadmap (see figure 11) is presented as a comprehensive guide to navigate the path towards decarbonizing transport operations. Through a structured and systematic approach, this roadmap provides the necessary tools to establish ambitious goals, develop effective strategies, implement concrete actions and monitor progress continuously.

Figure 11. Roadmap for decarbonizing transport operations

Step 1: Setting the Course

- **1.1 Conduct a sector analysis:** Assess current greenhouse gas emissions from freight transport, identifying the predominant sources and types of emissions. Additionally, it is important to define an emissions baseline that serves as a reference point to measure the progress and effectiveness of the strategies implemented.

- **1.2 Establish a reference framework:** Define specific and measurable decarbonization goals, considering the local context and global emission reduction targets based on the analysis performed.
- **1.3 Identify barriers and opportunities:** Analyze the technical, economic, regulatory, and social obstacles that could hinder decarbonization, as well as the opportunities and resources available to move forward in this process.

Step 2: Chart Your Decarbonization Course

- **2.1 Define logistics optimization strategies:** Implement improvement measures in route planning, fleet management, load consolidation, and the use of fuel-saving technologies to reduce transportation inefficiency.

- **2.2 Evaluate low-carbon transport technologies:** Analyze the available options, such as electric, hydrogen, or hybrid vehicles, considering their technical, economic, and environmental feasibility in the local context.

- **2.3 Establish plans for technology adoption:** Design strategies for the acquisition, implementation, and maintenance of selected technologies, including personnel training and infrastructure adaptation.

- **2.4 Develop investment plans:** Detail specific action plans for each strategy, including those responsible, deadlines, financial resources, and monitoring metrics.

Step 3: Take Action

- **3.1 Execution of plans:** Effectively implement the defined action plans, ensuring coordination between the different actors.
- **3.2 Establishing performance indicators:** Define key performance indicators (KPIs) to monitor progress in reducing emissions and meeting the established goals.
- **3.3 Monitoring and evaluation:** Continuously monitor the performance of the implemented strategies, evaluating their impact on emission reduction and making adjustments when necessary.
- **3.4 Communicate progress and results:** Inform stakeholders, the community, and the general public about the achievements made in decarbonizing freight transport, promoting participation and support for the process.

Step 4: Adapt and Innovate

- **4.1 Analysis of results:** Periodically analyze the results obtained and lessons learned, identifying areas for improvement and opportunities to optimize strategies.
- **4.2 Adaptation to new technologies:** Stay up-to-date on new technologies and trends in the field of transport decarbonization, evaluating their potential application within the organization.
- **4.3 Adapt to changes in the environment:** Adjust strategies and action plans based on changes in the economic, regulatory, or social context.

This roadmap is not a one-size-fits-all solution, but rather an adaptable framework that can be adjusted to the specific needs and realities of each organization. It is a call to action, an invitation for companies in the transport sector to assume a leadership role in building a more sustainable future for our planet.

The Role of Collaboration in Decarbonization

Collaboration is essential for achieving shared objectives within a value network. It involves joint efforts and efficient processes, built on trust and strong relationships between partners.

Within the business context, an organization can act and focus great efforts on decarbonizing its transport operations, having the capacity to implement various strategies to reduce its emissions. However, individual efforts can be limited by the high costs and complexity of transforming all transport and supply processes, especially when these fall on logistics operators.

Therefore, coordination among different actors within the same Value Network is crucial. This fosters mutually beneficial outcomes, maximizing returns while mitigating investment risks.

Some cases where collaboration is the central axis of several transport decarbonization strategies include route optimization by combining complementary flows (freight consolidation), jointly acquiring electric units, and the collaborative use of assets, charging stations, and resources (Smart Freight Center, 2024).

Table 2 presents a summary of two case studies where collaboration has been the key to promoting operational improvements and reducing emissions, either by sharing information or logistical assets.

Table 2. Case studies of collaboration in decarbonizing the transport sector

Initiative	Involved / Country	Description	Results
Freight consolidation	Coffee exporters ASOEXPORT - Colombia	Development of a methodology to identify freight consolidation opportunities in exporting companies	Identification of the main consolidation opportunities on three routes involving the participation of six exporters
Collaborative Carbon Footprint Measurement	Six cargo-generating companies with operations in Colombia and Latin America	Development of a methodology for collaborative measurement of the carbon footprint of transport for six cargo-generating companies to identify freight consolidation opportunities in exporting companies.	Generating a benchmark for transport emissions in LAC and identifying common areas of opportunity

The transport sector in the region is characterized by its high fragmentation, with various actors of different sizes in informal contexts; therefore, effective decarbonization depends on a joint effort of the entire business ecosystem. This allows individual initiatives to be scaled up and provides a perspective on the opportunities that exist to decarbonize the sector.

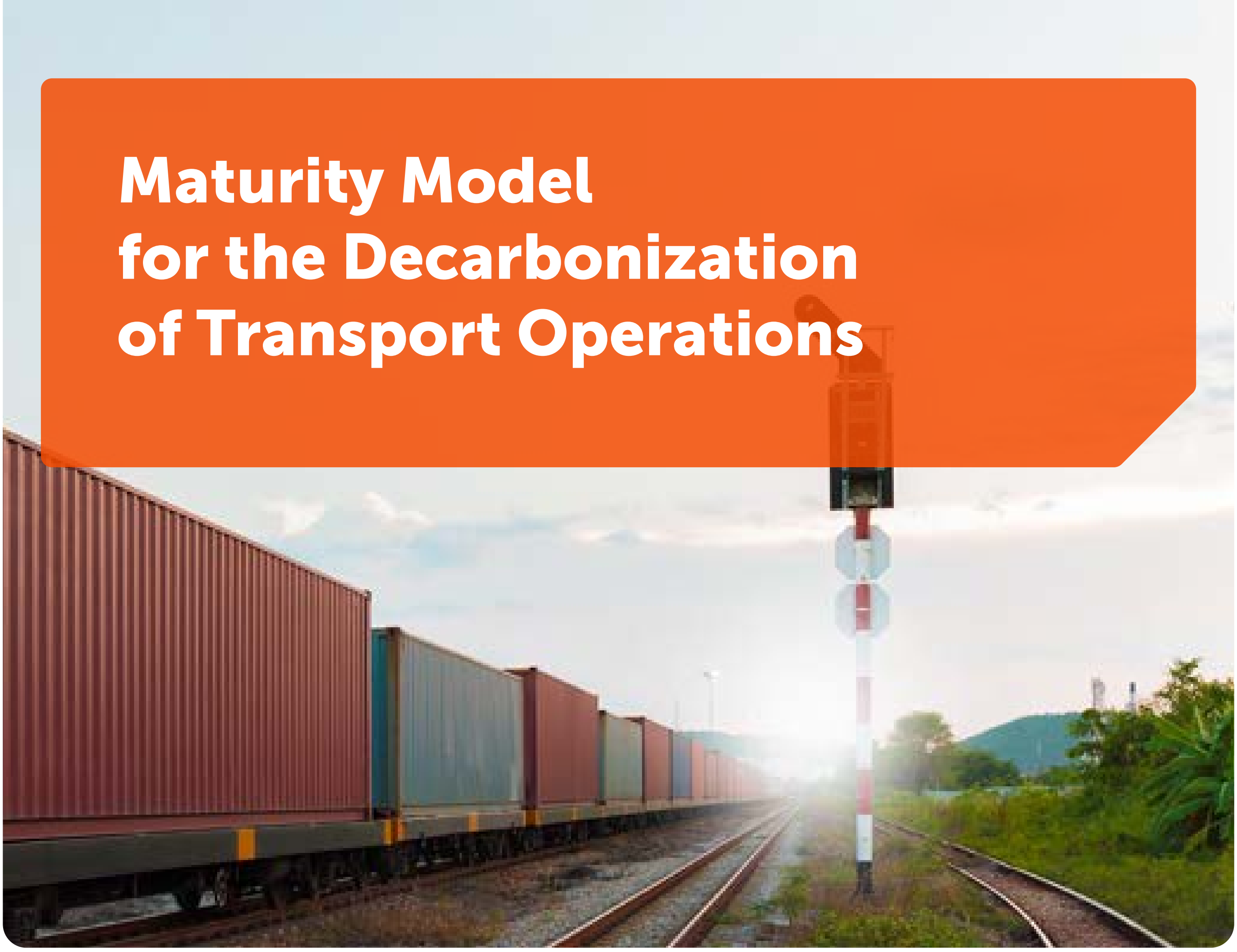
Collaboration mechanisms between organizations depend directly on the level of maturity and the type of interrelationship that exists between them, with trust being a pillar for initiatives to emerge and potential allies to be articulated who have an interest in improving the sustainability of their operations.

In this context, the emergence of groups and initiatives that promote and facilitate the involvement and interaction of organizations with great potential for collaborative work around decarbonization is key to achieving national and corporate sustainability goals.

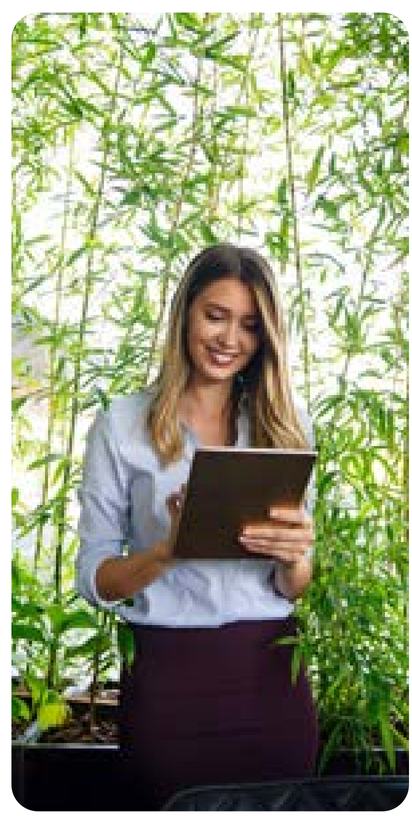
An example of this is the Steering Committee E2E Value Chain of Latin America, where actors from value networks across LATAM share a collaborative space to optimize their operations, which has placed sustainability as one of the central points in the group's discussion.

If your organization is interested in participating, write to us at bogota@theconsumergoodsforum.com and mercadeo@logyca.com

Maturity Model for the Decarbonization of Transport Operations



A maturity model is a method that assesses the capabilities and development of an organization, identifying areas of opportunity to improve its processes and competencies systematically. Thus, the model increases the operational efficiency of the organization. This model defines a series of components and maturity levels to measure organizational capabilities within a specific framework. These components and levels provide a structured approach to assess and enhance an organization's progress toward its decarbonization goals.



Maturity models originated in software engineering, focusing on the concept of capability. Its origin dates back to 1984 when the creation of the Software Engineering Institute was approved in the United States, which was a research body with the objective of developing improvement models. This Institute, around the year 1991, published the first capability maturity model applied to software (SW – CMM) (Paulk, et al. 1991), later developing in other areas, including supply chain management.

Within the framework of supply chain management, different maturity models have been proposed. However, these maturity models do not address in depth the specific complexities and challenges of freight transport decarbonization, such as route optimization, selection of sustainable transport modes, fuel efficiency management, and emission reduction. Additionally, these models do not always incorporate specific environmental metrics and criteria for decarbonization, which limits their ability to assess true progress in reducing GHG emissions.

Therefore, the Maturity Model for Freight Transport Decarbonization in Latin America emerges as an imperative need in a context marked by the urgency of combating climate change. Although companies have developed different initiatives and begun to implement strategies to decarbonize their transport operations, as mentioned in the previous section, these initiatives are still in early and disjointed stages. However, the decarbonization of freight transport requires a systematic and structured approach that goes beyond isolated actions, which is why a comprehensive framework is required to assess the progress of companies and guide them towards an effective decarbonization path.

The Maturity Model constitutes that frame of reference that allows companies to identify the existing gaps between their current situation and their decarbonization objectives, as well as opportunities to improve their environmental performance. By establishing maturity levels, the model facilitates comparison between companies and learning from best practices, promoting positive competition in sustainability. This encourages continuous improvement by providing a mechanism for monitoring and evaluating progress, which also contributes to accountability in terms of environmental commitments.

The Maturity Model does not replace the strategies that companies are already implementing, but rather complements and enhances them. It serves as a tool to assess the effectiveness of these strategies, identify areas for improvement and optimize their implementation.

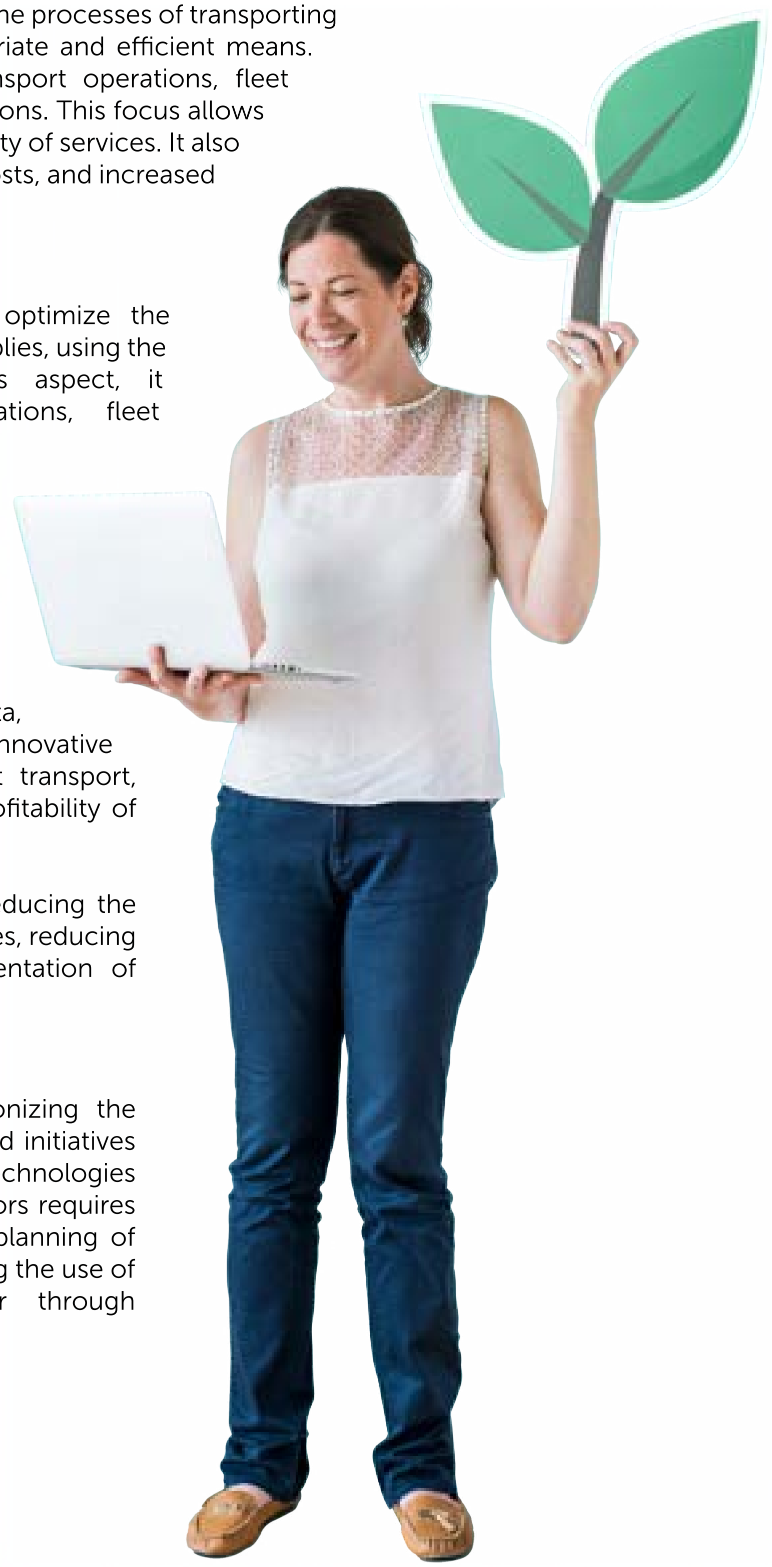
The Maturity Model proposed here is a complementary tool to the roadmap presented in the previous section to drive progress towards a more sustainable freight transport sector. While the roadmap defines a long-term strategy to reduce carbon emissions from the transport sector, establishing specific objectives, measurable goals, and a detailed action plan with initiatives, deadlines, and responsible parties, the maturity model provides a framework to assess progress in implementing the Roadmap and to identify areas for improvement, allowing for the prioritization of actions and coordination of actors.

The first step towards decarbonization is to understand where we stand and, from there, define a strategy focused on meeting goals. Below, we present the details of the model and the methodology for this self-diagnosis.

Model Description

1. Strategy:

This refers to the ability to plan, control and optimize the processes of transporting goods, products and inputs, using the most appropriate and efficient means. This component encompasses the routing of transport operations, fleet management, and the traceability of transport operations. This focus allows for improved efficiency, safety, quality, and sustainability of services. It also enables the optimization of resources, reduction of costs, and increased customer satisfaction.



2. Operations Management:

This refers to the ability to plan, control, and optimize the transportation processes of goods, products, and supplies, using the most appropriate and efficient means. In this aspect, it encompasses the routing of transport operations, fleet management, and the traceability of transport operations, which allows for improving the efficiency, safety, quality, and sustainability of services, as well as optimizing resources, reducing costs, and increasing customer satisfaction.

3. Digitization of Operations:

This aspect contemplates the adoption of tools such as the Internet of Things, artificial intelligence, big data, robotics, cloud computing, etc. These tools offer innovative and customized solutions to the needs of freight transport, improving the competitiveness, productivity, and profitability of companies.

The digitalization of transport also contributes to reducing the environmental impact of transport by optimizing routes, reducing energy consumption, and facilitating the implementation of collaborative transport models.

4. Collaboration:

Collaboration is a necessary element for decarbonizing the sector, being an integral part of various strategies and initiatives that seek to optimize operations either through new technologies or better logistics practices. The coordination of actors requires the recognition of objectives to leverage the joint planning of initiatives and projects to reduce emissions, optimizing the use of resources, implementing new technologies, or through collaborative models.

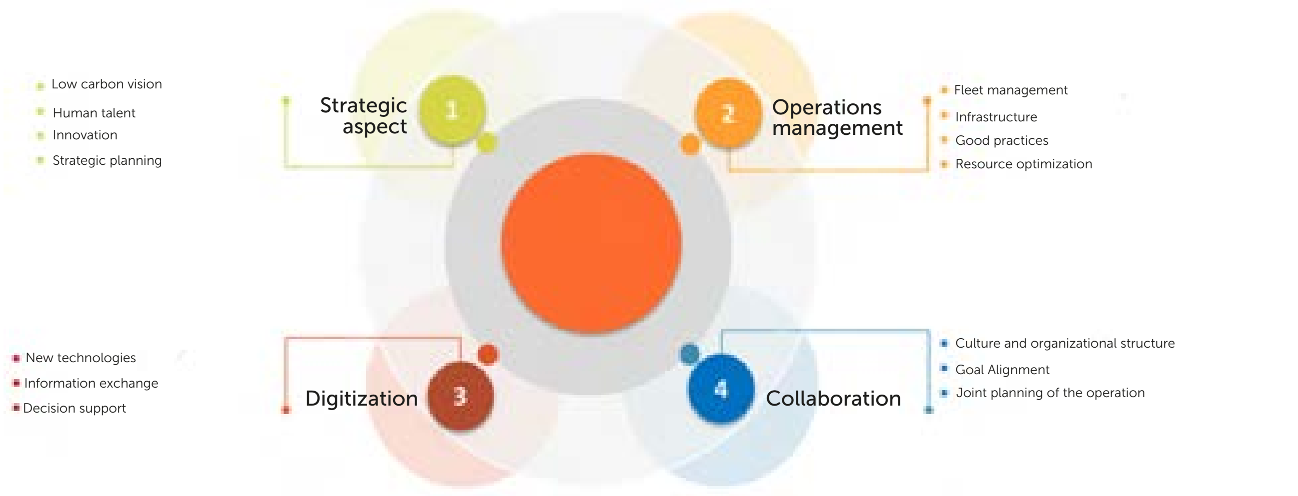


Figure 12. Conceptualization of the Maturity Model for the Decarbonization of Transport Operations
Source: Own elaboration

The Model's four strategic pillars serve as the foundation for establishing four distinct maturity levels, detailed below:

1 To react At this level, the organization does not have a clear methodology for measuring and monitoring its emissions, nor a clear strategy to reduce them. Its focus is on complying with regulations and customer expectations, without seeking opportunities for improvement or innovation.

2 To optimize. At this level, the organization has a greater awareness of its emissions and seeks to improve its energy efficiency and reduce its operating costs. Its focus is on implementing low-cost, short-term measures, without radically changing its processes or products.

3 To transform. At this level, the organization has a comprehensive view of its emissions and is committed to a long-term decarbonization goal. Its focus is on developing and implementing innovative and disruptive solutions that require significant changes in its processes, products, and business models.

4 To lead. At this level, the organization has a systemic view of its emissions and positions itself as a leader in the market and in society. Its focus is on promoting collaboration with other actors in the value chain, the sector, and the ecosystem to generate a positive and sustainable impact.

Each level contemplates different steps that can guide companies and actors in the transport sector to develop a more holistic decarbonization strategy, which actively contributes to the path of carbon neutrality in the medium and long term.

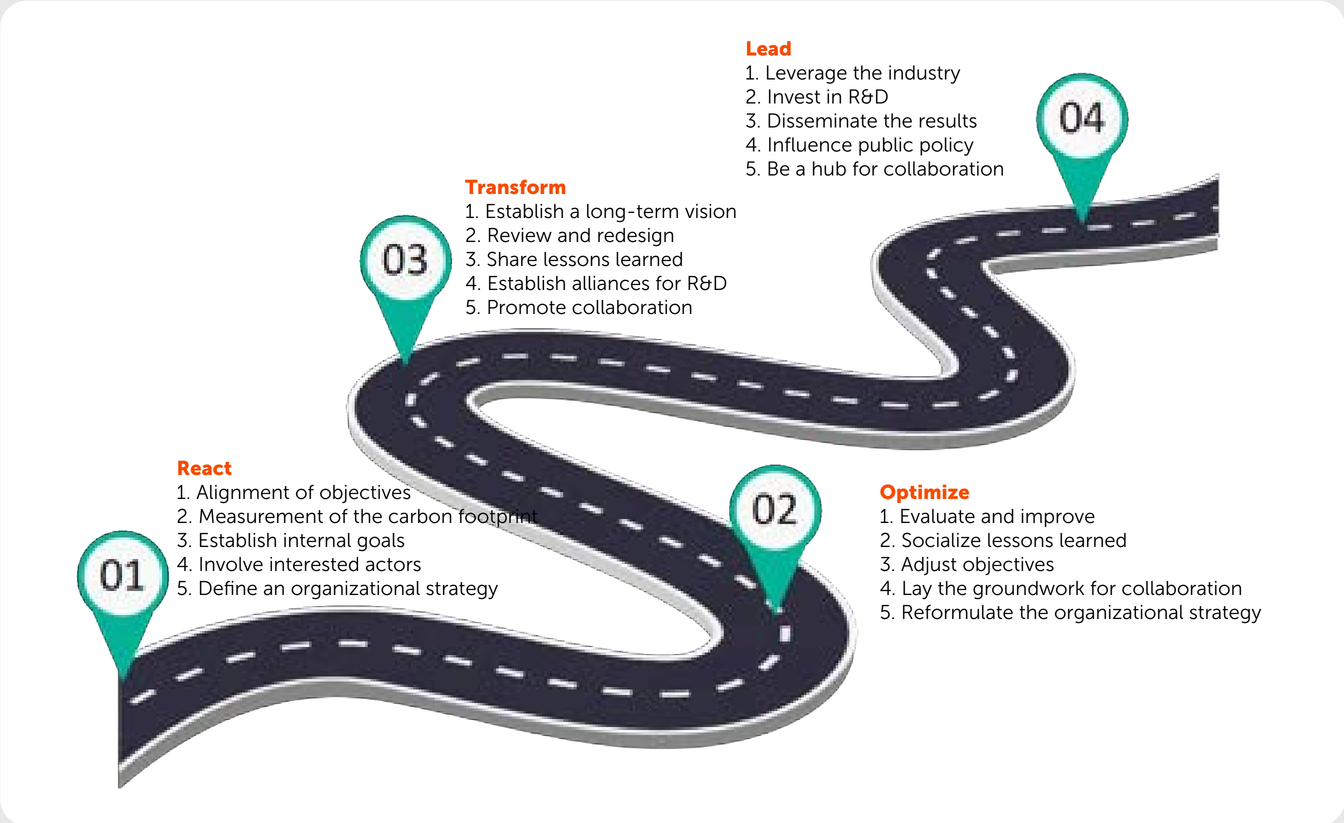


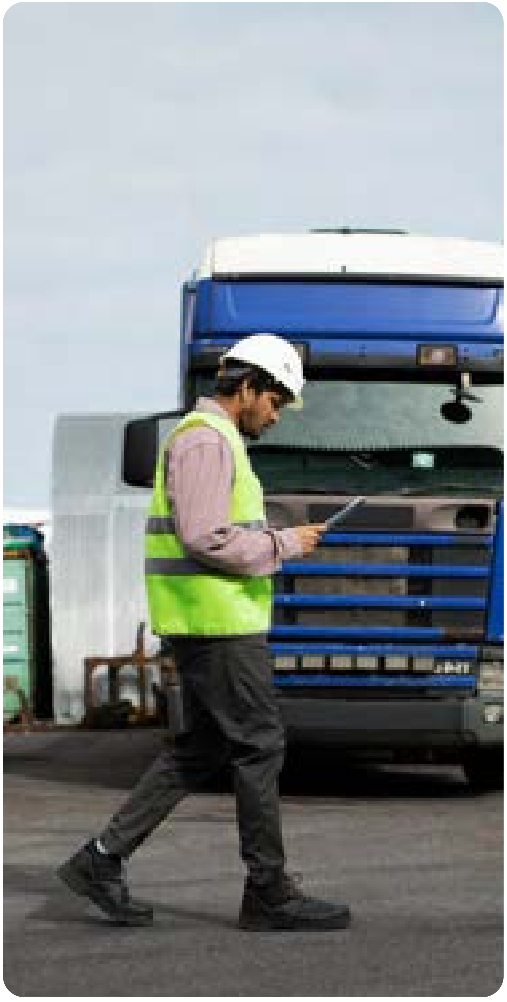
Figure 13. Steps to work on the decarbonization strategy at each maturity level

Conclusions

The decarbonization of freight transport in LAC is an unavoidable imperative in the fight against climate change. The transport sector, as one of the main emitters of Greenhouse Gases (GHG) in the region, has a crucial role to play in the transition to a low-carbon economy.

Throughout this handbook, we have explored the challenges and opportunities that LAC faces in this process, as well as the strategies and tools available to move towards a more sustainable future.

The decarbonization of freight transport in LAC is a crucial but achievable challenge. It requires a comprehensive approach that involves collaboration between governments, companies, and civil society. Through the implementation of solid public policies, investment in infrastructure and technology, the promotion of innovation, and the fostering of collaboration, it is possible to achieve a significant reduction in Greenhouse Gas (GHG) emissions in the transport sector.



The road to decarbonizing freight transport is a continuous process that requires planning, action, and adaptation.

The roadmap presented in this handbook, which ranges from initial analysis and goal setting to strategy implementation and adaptation to new technologies, provides a clear and structured guide for companies to move forward in this process. Each step of this roadmap is essential to achieve an effective reduction in GHG emissions and to build a more sustainable and resilient transport system.

The maturity model, on the other hand, is a valuable tool for companies to assess their progress in decarbonization and develop effective strategies. By understanding their maturity level, companies can identify areas for improvement and take concrete steps to reduce their carbon footprint. This model not only allows companies to evaluate their current performance, but also provides them with a roadmap to advance to higher levels of decarbonization maturity.

The combination of the roadmap and the maturity model provides a comprehensive framework for companies to address decarbonization systematically and effectively. By following these guidelines, companies can not only reduce their environmental impact but also improve their operational efficiency, reduce costs, and strengthen their competitiveness in the market.

Collaboration among the different actors in the value chain is essential to drive the decarbonization of freight transport. By working together, businesses, governments, and civil society can share knowledge, resources, **and best practices** accelerating the adoption of **clean technologies** and fostering innovation in the sector.

The decarbonization of freight transport is not only an environmental responsibility but also an opportunity to drive innovation, technological development, and job creation in the region. By investing in cleaner and more efficient transport solutions, we can build a future in which freight transport is an engine of sustainable development and an example of leadership in the fight against climate change.

Ultimately, the decarbonization of freight transport in LAC is a long-term commitment that requires continuous and collaborative effort. Through innovation, investment, and cooperation, we can build a future in which freight transport is an engine of sustainable development and an example of leadership in the fight against climate change.

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