The transportation sector’s significant contribution to greenhouse gas (GHG) emissions, primarily through fossil fuel consumption by motorized vehicles, remains a critical concern. In this industry, maritime transportation independently contributes to 2.89% of total global greenhouse gas emissions, displaying a persistent upward trend even in the face of enhanced efficiency measures implemented in port facilities and vessel operations. In response to this urgent concern, nations and international organizations have been formulating approaches aimed at mitigating greenhouse gas emissions in this transportation sector, encompassing the implementation of economic incentives. This article presents the findings of an exploratory-descriptive research endeavor, which aims to identify incentive policies implemented across various countries to expedite the adoption of electromobility in maritime and river transportation, thereby reducing GHG emissions from vessels. Data was gathered from authorized government websites, various organizations, maritime and river transport companies, and port authorities in each respective nation. Furthermore, this study classifies the incentives according to their methodologies and conducts a comparative analysis with the existing landscape in Colombia regarding the adoption of economic incentives for electrifying river transportation within the country. Through this analysis, some insights and recommendations can be derived to promote sustainable and environmentally-friendly practices in Colombia’s river and maritime transportation sectors.

Key words: economic incentives; greenhouse gases; river transportation; maritime transportation; emission reductions.

Abstract

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Identificación de incentivos económicos para la electrificación de los modos fluvial y marítimos: propuesta para el caso colombiano

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Abstract

La importante contribución del sector del transporte a las emisiones de gases de efecto invernadero (GEI), principalmente a través del consumo de combustibles fósiles por los vehículos motorizados, sigue siendo una preocupación crítica. En este sector, el transporte marítimo contribuye de forma independiente al 2.89% del total de las emisiones mundiales de gases de efecto invernadero, mostrando una persistente tendencia a alza incluso ante las medidas de mejora de la eficiencia aplicadas en las instalaciones portuarias y las operaciones de los buques. En respuesta a esta urgente preocupación, las naciones y las organizaciones internacionales han venido formulando enfoques destinados a mitigar las emisiones de gases de efecto invernadero en este sector del transporte, que abarcan la aplicación de incentivos económicos. Este artículo presenta los resultados de una investigación exploratoria-descriptiva cuyo objetivo es identificar las políticas de incentivos aplicadas en varios países para acelerar la adopción de la electromovilidad en el transporte marítimo y fluvial, reduciendo así las emisiones de gases de efecto invernadero de los buques. Los datos se recogieron de sitios web gubernamentales autorizados, diversas organizaciones, empresas de transporte marítimo y fluvial y autoridades portuarias de cada nación respectiva. Además, este estudio clasifica los incentivos según sus metodologías y realiza un análisis comparativo con el panorama existente en Colombia en cuanto a la adopción de incentivos económicos para la electrificación del transporte fluvial en el país. A través de este análisis, se pueden derivar valiosas percepciones y recomendaciones para promover prácticas sostenibles y respetuosas con el medio ambiente en los sectores del transporte fluvial y marítimo de Colombia.

Palabras claves: incentivos económicos; gases de efecto invernadero; transporte fluvial; transporte marítimo; reducción de emisiones.

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Introduction

According to a comprehensive report by the International Maritime Organization (IMO, 2020), the transportation of goods and passengers emerges as a prominent source of greenhouse gas emissions worldwide. This crucial sector significantly contributes to approximately 2.89% of the total annual emissions. To address this environmental challenge, sustainable transportation solutions have become a focal point in the quest for mitigating climate change impacts. The Intergovernmental Panel on Climate Change (IPCC) emphasizes the importance of adopting sustainable transport practices to reduce carbon emissions and achieve global climate goals (IPCC, 2021). It is evident that the reduction of emissions in the transportation sector is a critical element in the pursuit of a sustainable and greener future.

Recognizing the urgent need to address these detrimental environmental impacts, multiple initiatives and research sources emphasize the imperative of emission reduction in the transport sector. For instance, the Net Zero Emission by 2050 Scenario proposed by the International Energy Agency underscores the urgency of achieving a 20% reduction in the transport sector’s emissions by 2030 and striving for a substantial 50% reduction specifically in maritime transport emissions by 2050 (IEA, 2022). These recommendations align with the global commitment to combat climate change and underline the vital role of the naval sector in achieving sustainable and environmentally friendly transportation solutions.

Due to the increase in fossil fuels, in human industrial activity and the growing energy demands caused by population growth (United Nations, n.d.), this reduction will be possible mainly through the use of technologies aimed at reducing emissions, based on the decarbonization of energy sources, as is the case of the use of alternative energies and electric power in the system (McKinsey & Company, 2021). Although in the fluvial and maritime mode the inclusion of these technologies, such as electric energy is just incipient, due to the low electrification of ships and cargo vessels (Balcombe, 2019; Xuan et al., 2022), to achieve the proposed environmental goals it is necessary to propose initiatives for the inclusion of this technology to encourage and motivate the transition to these new motor sources.

In search of the above, it is possible to find policies and programs around the world, that seek to encourage the inclusion of electric energy in maritime and river transport modes, which can arouse the interest for different actors and entities involved in transport to opt for including these technologies in their processes, such as incentives that grant financial resources (Kim, 2022; Backer et al., 2020) for the acquisition of these technologies, the reduction of port tariffs (Backer et al., 2020) or obtaining tax subsidies (Port of Stockholm, 2022), among others.

In general terms, subsidies, discounts and project financing programs by governments and private institutions are mechanisms that instead of charging polluters, encourage them to find ways to obtain grants, low-interest loans, discounts or tax exemptions, among others, as a reward for using new methods or technologies to reduce pollutant emissions (Camargo, C. et al., 2022).

To present different alternatives of incentives granted internationally by governments and other private institutions, this paper conducts a search in different countries of such ways to economically encourage the penetration of electric power in maritime and river modes around the world. This work is derived from the research entitled Ferrofluvial 4.0, funded by the Mining and Energy Unit - UPME and the Ministry of Science, Technology and Innovation of Colombia, with the objective of: Formulating a plan for the penetration of electromobility in the rail and river modes for both cargo and passengers, through the evaluation and prioritization of technological alternatives in order to generate a roadmap that strengthens the productive linkages of the country in the medium and long term.

The identification of economic incentives at the global level is fundamental for the Colombian government and other countries to be able to deploy policies and programs aimed at getting
stakeholders to appropriate these technologies and thus achieve the environmental commitments agreed upon at the national and international level.

Methodology

To find different financing mechanisms to encourage the use and development of electromobility in Colombia in the maritime and river modes, an analysis was made of these actions in different countries of the world considered as a reference for Colombia and which are recognized for their performance in this area.

The countries in which information was sought were Colombia, Argentina, Brazil, Ecuador, Chile, Uruguay, Costa Rica, Sweden, Norway, Spain, Germany, Holland, the United States, Canada and Japan.

Through extensive research in official government documents, as well as institutions and organizations within the transportation sector, a meticulous analysis has been conducted. Additionally, a wide range of technical reports and scientific articles related to the topic have been considered. This rigorous approach has enabled the identification of various incentives implemented in different countries. Based on these findings, a comprehensive proposal of short-term, medium-term, and long-term incentives has been developed to stimulate the adoption of electromobility solutions in Colombia. These initiatives aim to drive a transition towards a more sustainable transportation system, providing economic and environmental benefits in the process.

It is crucial to recognize that this proposal is built upon successful international experiences and takes into account the specific characteristics and needs of Colombia. By incentivizing the penetration of electromobility in the country, significant economic advantages can be achieved, such as reducing dependence on fossil fuels. Moreover, it will make a substantial contribution to greenhouse gas emissions reduction and climate change mitigation, aligning with global sustainability commitments.

Incentives for electromobility

As a result of the review of possible incentives applicable in the maritime and river mode in 15 countries analyzed, it was not possible to find economic support alternatives in Colombia, Chile, Ecuador and Uruguay. The incentives found in the rest of the countries are:

In the Latin American context, incentives were found granted in Argentina through Resolution No. 50 of 2017: Bonus for sustainable ships1 - General Ports Administration, which offers discounts between 5% and 10% to vessels that have low gas emissions and are environmentally friendly. In Brazil it was possible to find Discounts for sustainable ships in the Port of Pecém2, in which up to 10% can be discounted in the rate for the use of berthing facilities for "sustainable ships". In Costa Rica, the Green Hydrogen Law3, grants tax exemptions, levies, fees or contributions, as well as immigration waivers for foreigners who invest in green h2 and specific credits with terms, interest rates, guarantees and special procedures, with a duration of 15 years from the law’s entry into force.

In the U.S. context, there is the FAST Electricity Act 20214, which establishes a 30% investment tax credit for any electric propulsion vehicle that is not an on-highway passenger car or truck. In addition, there is the EPA’s Port Initiative5, which provides funding to port authorities and public entities to

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2 Pecém grants discounts for sustainable ships and becomes the first Brazilian port to be recognized by the Dutch foundation (August 5, 2020). Retrieved from Governo do Estado do Ceará: https://www.ceara.gov.br/2020/06/05/pecem-se-torna-primeiro-porto-brasileiro-reconhecido-por-fundacao-holandesa-ao-conceder-descontos-para-navios-sustentaveis
3 Costa Rica: the Green Hydrogen Bill passes a new stage on its way to approval (December 3, 2021). Retrieved from Strategic Energy: https://www.energiaestrategica.com/costa-rica-el-proyecto-de-de- ley-de-hidrogeno-verde-supera-una-nueva-instancia-camino-a-su-aprobacion/

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help them overcome barriers to the adoption of cleaner diesel technologies and strategies. There is also the Clean Vessel Incentive Program Port of New York / New Jersey\(^6\), which rewards vessels for using shore power and the cleanest vessels according to the ESI score, values can be found on the Port’s Official Port Portal and Public Law 117-58. Port Infrastructure Development Program until 2026\(^7\) that provides financing for projects that allow the development of port infrastructure of GHG polluting ports.

Canada has the Salish Sea Marine Emission Reductions Fund\(^8\) which allows financing the purchase and installation of technology to reduce emissions in the operation of ships. This can be directed to fleet modernization, change of fleet or marine vessel to electric, hybrid or zero-emission technology, hull or propeller modifications, etc. Per fiscal year, funding will not exceed $250,000 per nonprofit recipient and $200,000 per for-profit recipient. In this country there is also the Clean Technology Initiative\(^9\) which allows the financing of pilot projects with clean technologies in maritime mode and the EcoAction Program - Port of Vancouver\(^10\), which offers reductions in port duty rates for shipping companies according to the qualification obtained in the following ranges:

**Gold:** port duty rate reduced by 47%; **Silver:** port duty rate reduced by 35% and **Bronze:** port duty rate reduced by 23%.

In the European context Sweden has the Electricity


In Spain there is Directive 2014/94/EU - OPS Master Plan for Spanish ports\(^14\) in which shipowners who switch off their auxiliary engines in port and connect to the electricity grid will receive a subsidy of €9.6/ton of CO2. Ships will pay as a supply tax the symbolic amount of 0.05 euro cents per kWh for switching off their auxiliary engines and connecting to the general grid. In the United Kingdom there is the Environmental Ship Index Program - Port of London Authority\(^15\), in which ships that are registered in the Environmental Ship Index scheme will receive a discount on their Vessel Conservancy Charges (excluding Estuary Charge) if they comply with the requirement established in the tariff program in force.

The Netherlands has Directive 2003/96/EC\(^16\),

\(^15\) ESIIncentives. Retrieved from the Environmental Port Index Web Portal. https://www.environmentalshipindex.org/port
which is a measure to apply a reduced tax rate of 0.50 EUR/MWh to installations that supply electricity entirely or almost entirely (90% or more) to non-private ships and pleasure craft. There is also the Environmental Ship Index Discount - Port of Rotterdam\(^{17}\), which gives a 10% discount on the port fee to ships that perform above the legal standard. The discount applies to all ships with an ESI score of 31 or more at the time of arrival (ATA) in Rotterdam. The discount is doubled if the ship also has an individual ESI-NOx score of 31 or more. This discount applies to each call in a quarter, with a maximum of 20 calls per ship per quarter.

The Netherlands also has the Incentive Scheme Climate - Friendly Shipping - Port of Rotterdam\(^{18}\) which aims to give an incentive contribution and amounts to a maximum of 40% of the costs to support projects that may be difficult to implement without financial assistance. There is also the Port of Rotterdam’s Green Award Vessel Discount\(^{19}\), in which the Port Authority will grant vessels with a Green Award certificate between 15% - 30% discount on port charges when they arrive in Rotterdam and the Port Charge Discounts for electric and low GHG emission vessels in the Port of Amsterdam\(^{20}\), an incentive where inland vessels with Green Award labels can receive up to 20% discount on port charges for inland navigation.

In Germany there is the Environmental Ship Index Program - Port of Rostock\(^{21}\) which grants a 5% discount on port fees for ships that score 40 points or more, a 7.5% discount on port fees for ships that score 50 points or more, and a 10% discount on port fees for ships that score 60 points or more. There is also the Blue Angel - Port of Hamburg\(^{22}\) which grants a 2% discount on the environmental component of the port fee for vessels with Blue Angel certification and the Green Award Program - Port of Hamburg\(^{23}\) which generates a 3% discount on port fees for oil tankers, chemical tankers and methane tankers of any size that have the Green Award certificate.

In Asia, Japan has the Enviromental Ship Index Program - Port of Tokyo\(^{24}\) which grants a 30% discount on port fees for vessels with an ESI score between 20.0 and 29.9, a 40% discount on port fees for vessels with an ESI score between 30.0 and 39.9 and a 50% discount on port fees for vessels with an ESI score over 40.0. They also have the Green Award Program - Nagoya Port Authority\(^{25}\) which offers a 10% discount on port fees for all Green Award certified maritime vessels and the Environmental Ship Index Program - Port of Yokohama\(^{26}\) which in turn grants a 15% discount on port fees for vessels with ESI scores over 30 points.

Possible incentives acquired from electric charging infrastructure benefits.

The incentives presented in the previous section are those found specifically to enhance electromobility in river and maritime modes. However, it is possible to find a set of incentives associated with the recharging infrastructure in these countries that, although they are mostly aimed at land transport, can serve as a guide to produce incentives in river and maritime modes. Among the initiatives found along these lines, the most common were:


\(^{21}\) ESI Incentives. Retrieved from the Environmental Port Index Web Portal: https://www.environmentalshipindex.org/ports


\(^{24}\) ESI Incentives. Retrieved from the Environmental Port Index Web Portal https://www.environmentalshipindex.org/ports


In Brazil, Resolution 819 of 2018\(^{27}\) was found, which allows those interested in providing the service (distributors, gas stations, shopping centers, ventures, etc.) to charge for the electric car charging service. In Uruguay, the Regulatory Decree 02/12 of Law 16,906\(^{28}\) allows the exemption from Wealth Tax of fixed assets included in paragraphs A) and B) of Article 7, acquired as from the effective date of this law. The referred goods will be considered as taxable assets for the purposes of deduction of liabilities and generates an exonation of the Value Added and Specific Internal Taxes, corresponding to the import of the goods referred to in the previous paragraph, and refund of the Value Added Tax included in the acquire of these goods. Decree 57/022 - UTE Commercial Discount\(^{29}\), which allows the change of the contracted power at no cost, off-peak tariff (0 to 7AM) at 50% in UTE recharge stations, medium consumer and double residential tariffs at 50% in off-peak hours (from 6 to 10 PM).

In Ecuador, the National Finance Corporation\(^{30}\) will cover 70% of the costs of new projects and up to 100% of expansion projects, while the Organic Energy Efficiency Law (LOEE)\(^{31}\) offers preferential financing conditions for energy efficiency projects. The regulation will establish preferential rates for public and private electric transportation and incentives for a 10-year period to encourage the use of electric vehicles, such as exempting these vehicles from traffic restrictions due to congestion.

In Costa Rica there is Law 9518 - Law of Incentives for a 10-year period to encourage the use of electric vehicles, such as exempting these vehicles from traffic restrictions due to congestion.

In Canada, the BC Hydro\(^{35}\) could be found which offers incentives in different categories such as:

\(^{28}\) Regulation of the methodology for the evaluation of investment projects (February 2, 2012). Retrieved from Official Information Center: https://www.impo.com.uy/bases/decretos/2-2012

In the United States, the Energy Efficiency 2021 program was found\(^{34}\), which is a Zero Emission Airport Vehicle and Infrastructure Pilot that provides financing to airports for up to 50% of the cost to acquire ZEVs and install or modify the supporting infrastructure for the acquired vehicles. It also allows financing of up to 80% of project costs and will be available for both development phase planning activities and the acquisition and installation of alternative fuels or charging infrastructure.

In Canada, the BC Hydro\(^{35}\) could be found which offers incentives in different categories such as:

rebate of up to 50% of the costs to purchase and install an eligible Level 2 EV charger, up to a maximum of $700 for single-family homes, including duplexes and townhouses with private garages or dedicated parking; rebate of up to $3,000 for the creation of an EV Ready plan for Apartment Buildings and condominiums; reimbursement of up to $4,000 per charger, up to a maximum of $14,000, to purchase and install Level 2 on-grid electric vehicle chargers for workplaces; and reimbursement of up to 75% of eligible EV charger purchase and installation costs for Indigenous communities. Also, in this country

The Fortis BC\(^6\) has a rebate of up to 50% of the purchase and installation costs of an eligible Level 2 EV charger, up to a maximum of $700 and a rebate of up to 50% of the eligible purchase and installation costs*, up to $4,000 per station, up to a maximum of $14,000 per application; the Manitoba Hydro\(^7\) with a maximum eligible amount for financing is $3,000 per EV charger, including installation, the Arctic Energy Alliance\(^8\) with A rebate of up to $500 for a Level 2 charger (220 or 240 volt), the Home Energy Loan Program\(^9\) in which Toronto homeowners can obtain a low-interest loan of up to $75,000 to cover the cost of home energy improvements. These include the installation of chargers for their EVs and The Roulez vert Program\(^10\) with rebates of up to $600 for the purchase and installation of a Level 2 EV home charging station.

In Sweden there is the Electric Vehicle Charging Incentive under Commission Regulation (EU) No. 1407/2013\(^11\), which covers the cost of up to 50% of the equipment for powering electric vehicles, up to a maximum cost per charging point of up to SEK 10,000 (€1,000) for individuals and SEK 15,000 (€1,500) for companies, municipalities, councils, and institutions. In Spain there is Royal Decree 569/2020 - Plan MOVES II\(^12\) in which citizens with private vehicles and company vehicles can receive subsidies of between 30-40% (up to a total amount of 100,000€) of the cost of purchase and installation of public or private chargers and Royal Decree 266/2021 - Plan MOVES III\(^13\) with Subsidies of up to 80% for private vehicles, self-employed and for the administration without economic activity and subsidies of up to 60% for companies and public entities with economic activity. There is also Decree 72/2019\(^14\) for electric vehicle charging infrastructure, which offers a subsidy of 30% of the eligible cost for private companies and 40% for individuals.

In Norway you can find Free Charging Chips - Fortum\(^15\) to encourage electric mobility, making it easier for EV owners to experience charging in public parking lots and the Free EV Charging incentive in the municipality of Asker\(^16\) which offers free charging of electric vehicles in parking lots in the center of Asker municipality. There are also EVSE (Charging Station Installation) Grants for Housing Associations in Oslo\(^17\) for a maximum of 20% of the EVSE investment and installation costs, up to NOK 5000 (€450) per charging point and NOK 1 000 000 (€91 000) per housing association

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\(^17\) Ladeinfrastruktur til borettslag og sameier (2022). Retrieved from klimatilskudd: https://klimatilskudd.no/ladeinfrastruktur-til-borettslag-og-sameier
or co-ownership, where external consultancy and engineering costs can be included in the grant costs; the EVSE (Installation of Charging Stations) Grants for Housing Associations in Skedsmo\textsuperscript{48} for a maximum of 20% of the EVSE investment and installation costs, up to NOK 5000 (€450) per charging point and NOK 250,000 (€23,000) per housing association or co-ownership; and EVSE (Charging Station Installation) Grants for Housing Associations in Asker\textsuperscript{49} for a maximum of 50% of the cost of and installation of EVSE, up to NOK 5000 (€450) per charging point and NOK 50000 (€4500) per housing association.

In the Netherlands there is the Environmental Investment Allowance for Companies (MIA)\textsuperscript{50} which is a subsidy that allows the company to deduct a percentage of its investment costs from taxable profit. This is in addition to regular depreciation. And as a result, the company pays less tax. The percentage of the deduction depends on the company's operating assets and the environmentally friendly investments that qualify on the Environmental List among them. Using the MIA, companies can receive an investment deduction of up to 36% of the amount invested in a charging point.

In Germany you can find the KfW-Bank Incentive for charging stations (private)\textsuperscript{51} which grants a subsidy of 900 euros per charging point, the Program: Public charging infrastructure for electric vehicles in Germany (2021 - 2025)\textsuperscript{52}, which, according to the type of grid connection the financing can vary up to a maximum amount of 10,000 euros. And depending on the type of charging point the installation can be financed up to 60% which is equivalent to 20,000 euros and the NRW-FÖRDERUNG, North Rhine-Westphalia\textsuperscript{53} which depending on the type of applicant and the characteristics of the system, the financing can be up to 1,500 euros.

In the UK there is the EV charger grant for homes\textsuperscript{54} which offers a subsidy of up to 75% of the total cost of purchasing and installing EV chargers for the home. Company cars and leased cars can also apply for the incentive and the On-Street Residential Charge point Scheme (ORCS)\textsuperscript{55} in which local authorities can receive a grant to partially fund (75%) the capital costs associated with the purchase and installation of on-street EV charging point infrastructure in residential areas\textsuperscript{56}.

In Japan there is a subsidy for the purchase and installation of charging points - Tokyo\textsuperscript{57} that allows subsidizing the purchase cost of charging equipment, construction and installation costs, energy conversion equipment, solar energy generation systems and storage batteries, as well as equipment operation costs.

Analysis of possible types of incentives

From the review of incentives, a total of 26 economic incentive programs and initiatives were found to promote electromobility in maritime

\textsuperscript{50} Wijzigingen in de Milieulijst MIA (2022). Retrieved from Rijksdienst voor Ondernemend Nederland: https://www.rvo.nl/subsidie-en-financieringswijzer/miavamil
\textsuperscript{51} Ladestationen für Elektroautos. Retrieved from Bank Aus Verantwortung Web Portal https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestehende-Immobilien/FA%C3%BFderprodukte/Ladestationen-FA%C3%BCr-Elektroautos-Wohnegeb%C3%A4ude-440/440
\textsuperscript{52} Bundesministerium für Verkehr und digitale Infrastruktur. Retrieved from Bundesanstalt für Verwaltungsdienstleistungen Web Portal https://www.bav.bund.de/DE/4_Foerderprogramme/6_Ladeinfrastruktur_fuer_Elektrofahrzeuge/6_2_Ladeinfrastruktur_oeffentlich/Ladeinfrastruktur_oeffentlich_node.html
\textsuperscript{53} NRW-FÖRDERUNG. Retrieved from the Web Portal of Elektromobilität NRW https://www.elektromobilitaet.nrw/foerderprogramme/nicht-oeffentlich-zugaengliche-ladeinfrastruktur/
\textsuperscript{57} Subsidies for installation of charging points. Retrieved from the Web Portal of the Tokyo Metropolitan Center for Climate Change Action https://www.toko-co2down.jp/subsidy/mansion-evcharge
and river modes in the countries analyzed. The country with the highest number of incentives was the Netherlands with a total of 5 initiatives, followed by the United States with 4 and Canada, Germany and Japan with 3 each. Sweden had 2 incentives and the rest of the countries (Argentina, Brazil, Costa Rica, Norway, Spain and the United Kingdom) had 1 initiative.

In these initiatives it was possible to find different types of incentives, which can be grouped into the following typologies:

- **A:** Discounts to vessels in ports (port taxes/traffic rights)
- **B:** Financing equipment or infrastructure for electromobility
- **C:** Tax exemptions/reductions
- **D:** Guarantees and special procedures for electromobility projects
- **E:** Financing to port authorities

Table 2 shows the implementation of these incentives in the countries analyzed (using the above notation), from which the most recurrent type of incentive are discounts to vessels in ports (port fees/circulation rights), followed by the financing of equipment or infrastructure for electromobility and tax exemptions/reductions.

While examining the economic incentives, various certification programs were identified, which serve as evidence of the vessels’ ecological contributions. These programs are utilized by authorities to determine eligibility for the aforementioned economic benefits. The identified certification programs include:

**Blue Angel**

One notable environmental certification is the renowned German label, which serves to assess the ecological performance of services and ensures that transactions are carried out without significant adverse effects on the environment [19]. BlueAngel certification encompasses various activities, including the operational aspects and design considerations of ships (Blue Angel, n.d.). This certification allows stakeholders, including authorities and consumers, to identify and support environmentally friendly shipping practices. Additionally, this certification program holds immense value in the realm of sustainability, transportation, and economics.

**Clean Shipping Index (CSI)**

The Clean Shipping Index (CSI) serves as a valuable tool in assessing ships based on their air and water emissions, waste management practices, and staff training initiatives. This comprehensive evaluation goes beyond regulatory requirements and measures the environmental performance of vessels. Depending on the scores obtained, ships can receive certification ranging from one to five stars, with five being the highest score (Clean Shipping Index, 2022). This certification system plays a crucial role in promoting sustainability within the shipping industry. It is essential to highlight the significance of the Clean Shipping Index in driving environmental responsibility in maritime operations. By evaluating various aspects of a ship’s performance, including emissions and waste management, the CSI incentivizes companies to go above and beyond regulatory compliance. This promotes the adoption of cleaner technologies, fuels, and practices, ultimately contributing to a greener and more sustainable shipping industry.
The Green Award

Green Award is a renowned certification program that prioritizes safety, security, and environmental considerations within the shipping industry. It acknowledges and incentivizes adherence to rigorous environmental and safety standards. The certification process encompasses a wide range of environmental impacts, including air emissions such as sulfur oxide (SOX), nitrogen oxide (NOX), carbon dioxide (CO2), and particulate matter (PM/BC). Additionally, it addresses issues related to energy efficiency, antifouling paints, oil management, lubrication of mooring ropes, and other deck equipment. Furthermore, Green Award evaluates emissions to waters, such as ballast water, sewage, sludge, bilge, and waste management (Green Award, 2022).

Environmental Ship Index (ESI)

The Environmental Ship Index (ESI) is a tool that was established by the World Ports Climate Initiative in 2011 to help reduce emissions of NOX, SOX, particulates, and CO2. The scoring in the ESI system is based on the emissions of these gases as well as the vessel’s ability to use shore power supply. To receive a score in the ESI system, the vessel must have emissions that are lower than the legal requirement for NOX and SOX. The ESI score ranges from 0 to 100, with a higher score indicating better environmental performance (ESI, 2022).

Proposal for economic incentives for Colombia

Colombia is positioned as one of the Latin American countries with more development of electromobility policies and benefits granted to acquire electric vehicles in the road mode. However, this commitment is null for maritime and river modes, since there are no incentives in the country to promote electromobility in these modes of transport, except for a project initiative in the Amazon River that seeks to implement the use of boats powered by electric motors or solar panels. It is therefore necessary that this good practice in the road mode be extended to other modes of transportation.

A good way forward is to adopt the initiatives and incentives that other countries are implementing and that can be applicable to some specific regions of the country or in the country in general, considering the orientation and objectives that Colombia has set for itself in terms of greenhouse gas reduction. Among the aspects to be prioritized in these incentives are the development of infrastructure, modernization of passenger transport fleets, recovery of docks, science, and technology projects. Taking as a basis some of the incentives that are in force or that have been implemented in other countries can represent an advantage to design incentives that can bring benefits for the economy, the environment and society.

Based on this analysis of incentives, the following incentives can be proposed for Colombia (See Table 1), which are presented for different time horizons and include the percentage of financing, discount, or exemption for the aspects to be favored in the maritime and river modes.

<table>
<thead>
<tr>
<th>Type of incentive</th>
<th>Short term.</th>
<th>Medium term.</th>
<th>Long term.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance premium discounts.</td>
<td>20%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Discounts on mechanical overhauls</td>
<td>15%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Reduction and exemption of import duties.</td>
<td>100%</td>
<td>70%</td>
<td>50%</td>
</tr>
<tr>
<td>Income tax reduction on infrastructure investments.</td>
<td>50%</td>
<td>35%</td>
<td>20%</td>
</tr>
<tr>
<td>Reduction in port fees for low-emission vessels.</td>
<td>10%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Reduction or exclusion of VAT on the purchase of goods and services for electromobility projects.</td>
<td>0%</td>
<td>5%</td>
<td>19%</td>
</tr>
<tr>
<td>Financing of research projects.</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Financing of river projects up to 70% of the project by the national government</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
</tr>
</tbody>
</table>

Table 2. Incentive proposals for Colombia.
Conclusions

In the review different initiatives and actions were found in the analyzed countries aimed at generating incentives for electromobility in river and maritime transportation, thus allowing the migration to environmentally friendly modes of transportation. A total of 26 different initiatives were found, most of which were aimed at generating discounts in ports for the use of environmentally friendly vessels, as well as financing projects for the acquisition of equipment and infrastructure and tax reductions.

This article demonstrates the interest of different countries in promoting electric mobility in maritime and river modes, finding more incentives in one country than in another, but in any case, it is an important commitment to generate sustainable transport systems. In the case of the Latin American countries studied, only in Brazil, Argentina and Costa Rica were initiatives of this kind found, which is an opportunity for the other countries to follow suit.

The regulations and policies on electric mobility in Colombia are oriented towards the electrification of road transport and there are no incentives to promote electric mobility in the maritime and river modes. Nor were any incentives identified that could favor the development of maritime or river electric cargo infrastructure. In order to strengthen this aspect, a set of short-, medium- and long-term incentives were proposed to favor investments in this area in the country.

As future work, there is a potential to expand the analysis to encompass additional countries, thereby uncovering alternative forms of initiatives and incentives. Furthermore, it is crucial to conduct further research to identify the financing mechanisms available to governments, which would facilitate the implementation of these initiatives and incentives. Understanding the avenues through which governments can secure funding is essential for effectively materializing such endeavors.

It is imperative to emphasize the importance of broadening the scope of analysis to gain a comprehensive understanding of the global landscape. Exploring initiatives and incentives implemented in diverse countries can shed light on innovative approaches and best practices that can be adapted to local contexts. Additionally, investigating the financing mechanisms will enable governments to allocate resources effectively and foster the development of sustainable transportation systems.

By expanding the analysis and delving into the financial aspects, researchers and policymakers can foster the creation of a supportive environment that encourages the generation and implementation of impactful initiatives and incentives in the transportation sector.

Bibliographic References


