MoreTRAINS
Global Rail Vision 2030

Whitepaper

CARBON MARKETS AND RAIL

How to overcome missed opportunities

INTERNATIONAL UNION
OF RAILWAYS

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CONTENTS

EXECUTIVE SUMMARY

CARBON MARKETS AND SUSTAINABLE MOBILITY

How can rail issue carbon credits?

Integrating reduced and avoided emissions from rail as a low-carbon transport mode could help progress sector decarbonisation, support rail project development, and strengthen climate mitigation, with carbon credit eligibility being based on electrification, renewable energy, energy efficiency, and modal shift initiatives.

- Electrification
- Energy efficiency
- Modal shift

What are the methodologies?

Despite the existence of three Clean Development Mechanism (CDM) methodologies tailored to rail, few rail projects have used these for carbon credits, although, one notable success story is the Delhi metro project. Unfortunately, as of yet, no projects have received carbon credits specifically for a modal shift to rail, although some are registered or under development.

The Delhi Metro pioneered carbon credit profits through the CDM, transforming urban mobility and collaborating with JBIC to operationalize carbon funding for railways.

The Tanzania-Burundi railway project could save 178,915 tonnes CO2e annually, generating $1.5 million USD in carbon credits, which can attract investment and reduce financial risks.

What are ITMOs and what is Article 6.4?

Internationally Transferred Mitigation Outcomes (ITMOs), introduced in Article 6 of the Paris Agreement, allow for GHG reduction transfers between countries under strict "corresponding adjustments" to prevent double-counting. With ITMO prices, typically at $15-40 USD/$tCO_2$, exceeding those in voluntary markets, it represents a significant source of revenue for the rail sector.

If 1.8 Gt of carbon emissions are avoided by 2050, and at a assumed price range of $15-40 USD per ITMO, the potential revenue generated could be between $27 and $72 billion USD.

POLICY ACTIONS

Adopt rail into the new Article 6 ITMO process

Advocate for rail-specific methodologies in Article 6 to enable precise emissions tracking, emphasising avoided emissions and including modal shifts in SBSTA negotiations before 2028.

Leverage conditional NDCs to enable ITMO agreements

Set ambitious rail targets in Nationally Determined Contributions (NDCs) 3.0, aligned with ITMOs to validate carbon credits, and leverage Article 6 to exceed national commitments through clear policies.

Integrate carbon markets in early project feasibility

Include carbon credit potential early in rail feasibility studies, with transport ministries, export credit agencies (ECAs), and multilateral development banks (MDBs) providing guidance, and UIC supporting these efforts.

Build capacity for rail sector carbon credits

ECAs and MDBs can play a crucial role in providing technical assistance, training, and resources to help project promoters and rail operators to understand and effectively participate in carbon markets.

CARBON MARKETS AND SUSTAINABLE TRANSPORT

COP29 marks an important turning point for international carbon markets by establishing a comprehensive approach to fully implement Article 6 of the Paris Agreement. Despite the Article 6.4 standard on methodologies being adopted on Day 1 in Baku, the work on Article 6.4 is still incomplete, and parties must continue to develop further guidance to help the mechanism develop. The remaining critical elements of the agreement must start to deliver the much-needed funds for projects that will reduce greenhouse gas emissions, with both transparency and rigor, and UIC will be advocating for the transfer of carbon credit methodologies for railway projects into the new mechanism.

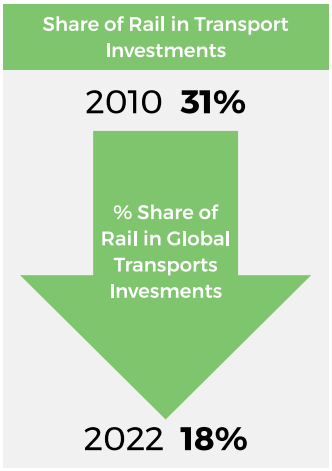
Increased carbon neutrality requires investment. Adopting sustainable practices it crucial for the transport sector as they help consume less energy and reduce carbon emissions.

Currently, rail is the only mode of transport to have reduced its carbon emissions in the past decade, through concerted efforts to increase energy efficiency and electrify its network. It can also avoid emissions by shifting people and goods from high emitting modes like road or air transport, to public transport or rail freight.

These costs can be supported through carbon credit revenue. While the United Nations' Clean Development Mechanism has been able to generate income for projects using one of its methodologies since 2005, only a few projects have successfully raised funds and these have mostly been for reforestation or renewable energy projects, only a limited number have been directed towards sustainable mobility projects. Developing the railways offers an opportunity to build connections for people and goods at reduced emissions, whilst also delivering economic development through healthier and more inclusive societies.

PARADIGM SHIFT: RAIL AS A TOOL FOR DECARBONISATION

To keep global warming below 1.5°C, transport emissions must fall by 59% by 2050. For this kind of change, the Intergovernmental Panel on Climate Change (IPCC) report (WG3 6th AR, 2022) concludes that systematic change is required, with high-accessibility transport solutions being prioritised which minimise the amount of mobility required to meet people's needs and favours transit and active transport modes[i].



The rail sector must play a key role in decarbonising transport. Rail is currently the most energy-efficient mode of mass transport for passengers and freight, carrying 7% of global passengers and 8% of freight while accounting for only 1.2% of total transport energy demand[ii]. The International Energy Agency (IEA) net-zero scenario sees the need for train travel to grow. By 2050, approximately 15% of flights should be moved to high-speed rail, as well as more than 2% of private vehicle road travel.

The latest UIC data shows that rail is losing its share of the market to roads, and that the funding gap is growing with public money going to rail projects decreasing from 31% in 2010 to just 18% in 2022[iii].

Financing rail projects presents several challenges, primarily due to the upfront capital required and the need for continued public investment.

The long-term benefits of rail, such as reduced emissions, decreased congestion, and regional connectivity, often do not translate into immediate commercial returns, making it difficult to attract private investors.

The rail sector must be able to access more climate-related financing and funding opportunities. The UIC paper, Bridging the Rail Finance Gap: Challenges and Opportunities for Low and Lower-Middle-Income Countries, published in 2023, identified a high potential for carbon savings through the expansion and modernisation of rail networks in emerging economies. Analysis undertaken for this study shows that if low and middle-income countries (LMICs) were able to expand their rail infrastructure to match that of the top-performing countries among them (95th percentile), they could quadruple rail's modal share to 8%, and avoid a total of 1.8 Gt of carbon emissions by 2050.

The main challenge to this expansion is the lack of adequate financing and funding. Closing this rail infrastructure gap in LMICs would require annual rail investment of USD 80 billion per year through to 2050, which demonstrates that the market potential for carbon credits in rail is significant. Based on the same study, with 1.8 Gt of carbon emissions potentially avoided by 2050, and at an assumed price range per Internationally Transferred Mitigation Outcome (ITMO) of 15-40 USD, the potential revenue generated could be between 27 and 72 billion USD.

Carbon instruments are also discussed in the World Bank's Mobilising Climate Finance for Railways, where carbon markets were specifically identified as offering an additional funding pathway and new source of revenue.

HOW COULD RAILWAYS ISSUE CARBON CREDITS?

This paper examines the opportunities for integrating the reduced and avoided emissions from increasing rail usage, which could accelerate sector decarbonisation, catalyse rail project development, and enhance the drive to mitigate climate change.

Rail projects could be eligible for carbon credits in three different ways:

Electrification and renewable energy projects

Energy efficiency through technology and digitalisation

Modal shift to rail

Action to reduce greenhouse gas (GHG) emissions through rail can be measured using three rail-specific methodologies which were established under the Clean Development Mechanism (CDM)[iv] [1], for saleable certified emission reduction (CER) credits.

All of these are based on an energy efficiency from the shift from a more-carbon-intensive mode of transport. While the CDM was created under the Kyoto Protocol (197), the methodologies can also be used for other standards and can be transferred to the new process under Article 6 of the Paris Agreement.

CARBON CREDIT METHODOLOGIES FOR RAIL

There are three CDM methodologies that specifically apply to the use of carbon markets for rail projects (see Figure 1 below). However, there are very few examples of these methodologies being applied and the carbon credits for projects using them being issued.

ACM0016: Mass Rapid Transit Projects

Establishment and/or expansion and operation of rail or bus systems in urban or suburban areas

AM0090: Modal shift in goods transport from road to water or rail

Modal shift of freight cargo to rail from a higher emission mode of transport

AM0101: High-speed passenger rail system

The upgrade to, establishment or expansion and operation of an electrified high-speed (>200 km/h) rail pasenger transport system between urban areas

Figure 1: The three rail-specific CDM methodologies

1. CDM methodologies can also be used for all other standards.

As of January 2024, the following projects were listed: Metro Delhi, Mumbai Metro One, Metro Gurgaon, Mexico Line 12 Metro, LRT Tunis, and Guiyang Metro.

Under Verra's Verified Carbon Standard (VCS): Metro Lima, Metro Buenos Aires, Metro Line 9 Seoul, Bursa LRT.

Though domestic standards: road-to-rail projects in Switzerland, and Korail's KTX Honam high-speed rail, registered in the Korean domestic offset system.

To date, there is no precedence for carbon credits being issued for a modal shift to rail (AM0090 for cargo), though projects have been registered or are in the process thereof.

One project was registered in India, but did not generate carbon credits, and one VCS project is being developed in the USA[v] and one is being validated in India[vi].

Electrification

Rail is the most electrified mode of motorised transport[vii], with three out of four passenger trains running on electricity[viii]. It also uses the largest share of renewable energy. Thanks to higher energy conversion rates, trains are inherently more energy-efficient, and are even quieter and cleaner when electrified. On top of the extensive network of electrified tracks, alternative fuels and onboard energy storage bring a groundbreaking advantage to fully electric trains on non-electrified and semi-electrified tracks. Railways are integrating additional renewable energy generation into their infrastructure, for instance, solar and wind at stations, car parks, and alongside tracks or nearby land. Particularly when planned using renewable energy supply projects, railway electrification cuts emissions and makes projects a stable investment and drives efficiency. Its measurable and quantifiable impact on reducing emissions should entitle rail to receive carbon credits.

Rail has the highest share of renewables in transport, at 15%

Energy efficiency through technology and digitalisation

Technology and digitalisation play a pivotal role in the transport sector, as they can help the industry achieve groundbreaking efficiency gains while reducing the impact of operations on the environment. Innovative energy-saving strategies include regenerative braking, digitalised traffic management, and modern, digitalised signalling that enhances train driver insight, allowing them to use less fuel and decrease wear.

Eco-driving systems and techniques can reduce energy consumption by 11%[ix], and modern systems enable real-time traffic management, making disruption management increasingly efficient, anticipating energy losses and adapting speed profiles.

Moreover, new sensor-based heating and cooling management is greatly improving energy usage. Smart grids are enabling railways to play a crucial role in smart energy transmission, connecting electric vehicles and other storage capabilities to capitalise on the connected renewable energy generation plants and increase transmission efficiency over the rail network.

Smart infrastructure monitoring and digital twins will help optimise the (already long) lifecycle of equipment with just-in-time maintenance.

These technologies are just a few of the tangible measures that the industry uses to reduce emissions and energy use related to its activities. Enabling investors in carbon markets to co-finance proven emission reductions through technology is an especially promising solution for railways situated in the global south.

Goal

Test the efficiency of the EcoRail, an AI-powered app to reduce fuel consumption and GHG emissions.

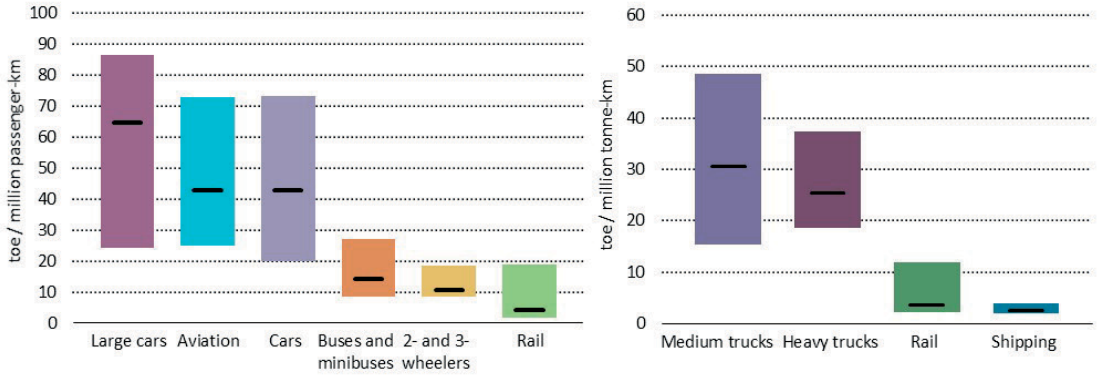
ViaRail Canada expects fuel consumption to be reduced by up to 15% through this method, exemplifying how technology can enhance efficiency in the railway sector.

Source: ViaRail Canada

The power of a modal shift

The single most important solution for decarbonising transport is for rail to take more traffic, which becomes clear when emissions within the sector are analysed. Significant differences exist in the total emissions according to the mode of transport and the per capita emissions per kilometre. Rail's "well-to-wheel" emissions amount to just 22 grams of CO_2 per passenger kilometre, which is ten times less than that of a passenger car[x].

The advantages are also evident in freight transport, where rail can carry larger loads with far greater efficiency than other modes. This stems from rail's high load capacity and, in contrast to trucks, lower energy losses, as it does not have factors such as tyre friction and air drag to account for. Furthermore, tonne-kilometre data demonstrates that freight consumes the least energy when transported by rail, underscoring the potential for substantial energy savings through rail projects. Recognising the emissions avoided by passenger and freight trains as eligible carbon credits could further incentivise this shift to lower-carbon transport.



Notes: toe = tonne oil equivalent. The boxes in this figure indicate the range of average energy intensity in various countries, while the horizontal lines represent the world averages.

Sources: IEA Mobility Model (IEA, 2018a), using assessments based on UIC (2018a); UITP (2018d); ITDP (2018a); National Bureau of Statistics of China (2018); Eurostat (2018); Indian Railways (2018a); Japan Ministry of Land, Infrastructure and Tourism (2018); AAR (2017) and Russian Federation State Statistics Service (2018).

Key message • Rail is the most energy-efficient means of motorised passenger transport, much more energy efficient than road freight.

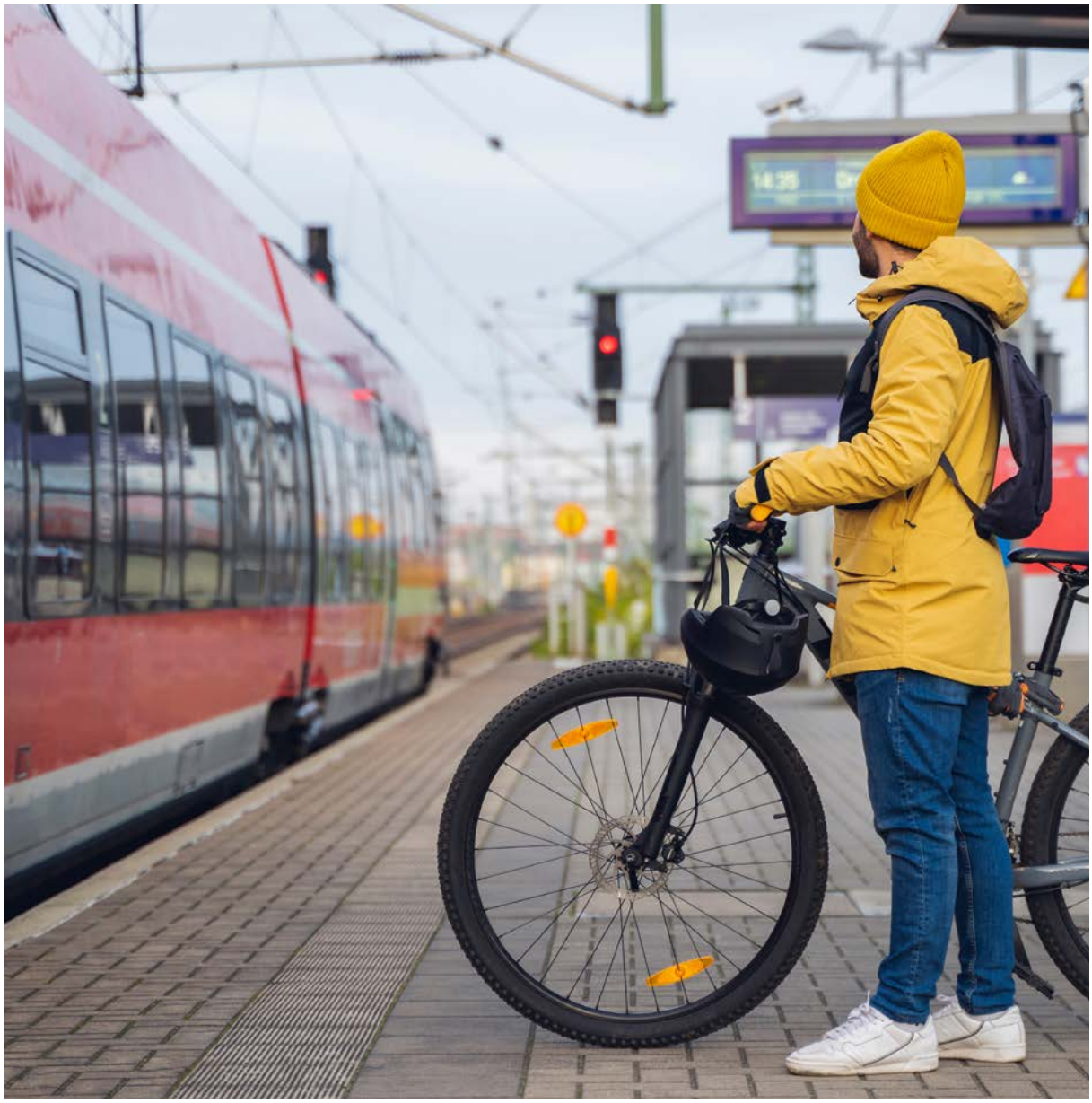
Figure 2: Energy intensity per capita and passenger-kilometres[xi] and tonne-kilometres across different modes of transport[xii]

Growing evidence shows that “Avoid and Shift” strategies can account for 40-60% of transport emission reductions at a lower cost than “Improve” strategies. However, the updated Nationally Determined Contributions (NDCs) under the Paris Agreement continue to focus intensely on improving measures (52% of all measures), with Shift and Avoid measures only accounting for 38% and 10% respectively[xiii].

A modal shift to rail can avoid emissions on a large scale by redirecting travellers and freight from high-emission modes such as road and air.

This shift can be measured and verified, providing a robust framework for assessing these avoided emissions. For example, rigorous tracking, verification, and certification of emissions reductions from modal shift initiatives according to recognised protocols (ACM0016, AM0090 and AM0101) will enhance the credibility of these efforts.

Therefore, by using stringent carbon accounting standards, stakeholders can ensure that the resulting reduction in emissions is permanent and quantifiable.



CARBON MARKET OPPORTUNITIES FOR RAIL

Navigating carbon markets can be challenging due to the complexity of the process, and the variety of organisations involved and of the different schemes available. However, several types of carbon market offer opportunities for the rail sector to enhance sustainability and drive investment in low-carbon initiatives.

VOLUNTARY CARBON MARKETS

This market is dominated by large international corporate buyers. The most recognised international standards used in voluntary carbon markets are Verra's Verified Carbon Standard (VCS), the Gold Standard (GS) and the Global Carbon Council (GCC).

All of these standards involve a process where a project or programme document is externally validation and registered based on a template prescribed by the registration standard and the use of an accepted GHG accounting methodology (e.g. the United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism or a VCS-approved methodology).

Payments are results-based, and prices fluctuate. In addition, there is a considerable risk that contracts will not be honoured, especially if market prices for offsets decline. Currently, the international average price for VCS credits is \$4-10/tCO_2, with an average price of \$6.53/tCO_2 [2]. While higher prices are paid for projects with special characteristics, rail projects are not expected to command this premium price(see also Figure 3 below)[3].

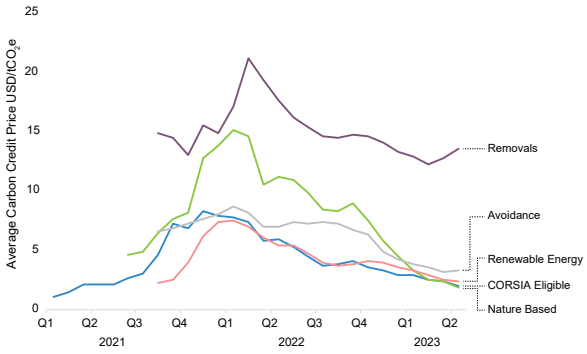


Figure 3: Price trends of voluntary carbon markets[xiv]

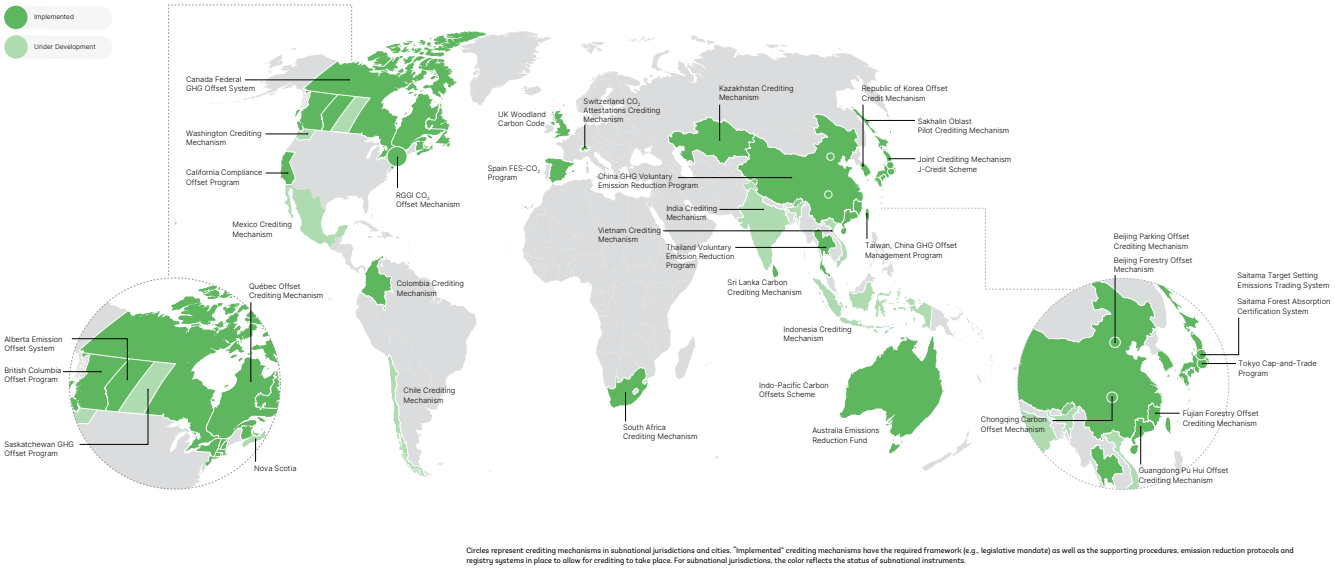
Voluntary markets can provide some revenue, but the transactions can be complex, with high upfront costs for registration. Nevertheless, voluntary market projects can be assembled across various clients and countries to reduce the unitary transaction costs of formulating, validating, registering, and verifying the project.

With current voluntary market prices, the minimum scale for a rail project to be financially attractive is estimated at approximately 100,000 tons of reduced emissions per annum.

2. Ecosystem Marketplace, "State of the Voluntary Carbon Market 2024"
3. Projects which typically command premium prices are those with large sustainable development benefits in low-income countries, e.g. cookstove projects involving women in poor sub-Saharan African communities. Projects fetching higher prices are also generally smaller-scale or even micro projects, as corporate buyers value the opportunity of being the sole owner of a project.

NATIONAL OFFSET MARKETS

Multiple national or domestic carbon markets exist (see Figure 4 below).



Circles represent crediting mechanisms in subnational jurisdictions and cities. "Implemented" crediting mechanisms have the required framework (e.g., legislative mandate) as well as the supporting procedures, emission reduction protocols and registry systems in place to allow for crediting to take place. For subnational jurisdictions, the color reflects the status of subnational instruments.

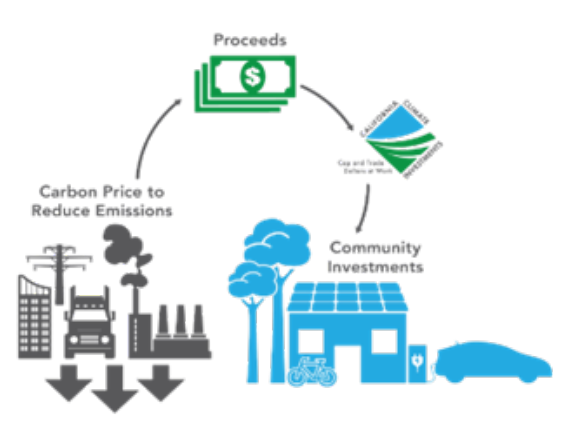
Figure 4:National and subnational carbon markets[xv]

Some schemes only allow trading between companies which are subject to CO_2 allowance regulations, while others allow for national and/or international carbon offsets to be purchased as an alternative to paying carbon taxes or to partially account for the allowances. Rules and regulations are country-specific and vary significantly, leading to wildly different prices, from below \$5/tCO_2 to over \$200/tCO_2. In general, in high-income countries, prices tend to be considerably higher for domestically traded offsets than for voluntary carbon credits.

Moreover, registration is sometimes less complex or more flexible, but a detailed understanding of local rules is nevertheless required to navigate each market.

In domestic systems, it is helpful to develop robust communication strategies to highlight the benefits of carbon credit initiatives within the rail sector. Engaging with stakeholders and the public will foster support for sustainable transport policies, encourage a wider adoption of rail as a low-carbon alternative, and increase understanding of the benefits of rail investment.

CASE STUDY:
California high-speed rail



California Climate Investments is funded by proceeds from the sale of state-owned allowances from quarterly Cap-and-Trade auctions that are deposited into the Greenhouse Gas Reduction Fund (GGRF). On a yearly basis, the Legislature distributes the money from the GGRF to programmes administered by different State agencies.

In 2014, the California High-Speed Rail Authority received a one-time appropriation of $650 million from California's Cap-and-Trade programme, as well as a 25% continuous funding appropriation from proceeds of the quarterly Cap-and-Trade credit auction. Through the November 2022 Auction, the Authority received a total of $5.4 billion of Cap-and-Trade funds.

Quarterly auctions also provide the Authority with an ongoing revenue stream for the duration of the Cap-and-Trade programme. These funds are used alongside other sources to construct new high-speed rail infrastructure within the state.

CASE STUDY:
Korail benefits from a national scheme

Korail exemplifies how a railway company can use a national scheme for measures to reduce its carbon footprint. Thanks to efficiency-improving measures, the company used less emission allowances than it was allocated by the Korean Carbon Emissions Trading Scheme (K-ETS). With its improved CO_2 performance, Korail was able to resell its excess allowances to generate profit.

CASE STUDY:
The EU Emissions Trading System (ETS)

ETS is a cornerstone of the EU's policy to combat climate change and its key tool for reducing GHG emissions cost-effectively. The EU ETS is also an important source of green transition funding and is expected to become even more important in the future.

THE ITMO MARKET

Internationally Transferred Mitigation Outcomes (ITMOs) are a new set of market-based provisions defined in Article 6 of the Paris Agreement and replace the former UNFCCC Clean Development Mechanism (CDM) system.

Paris Agreement, Article 6(2) and (4)

Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

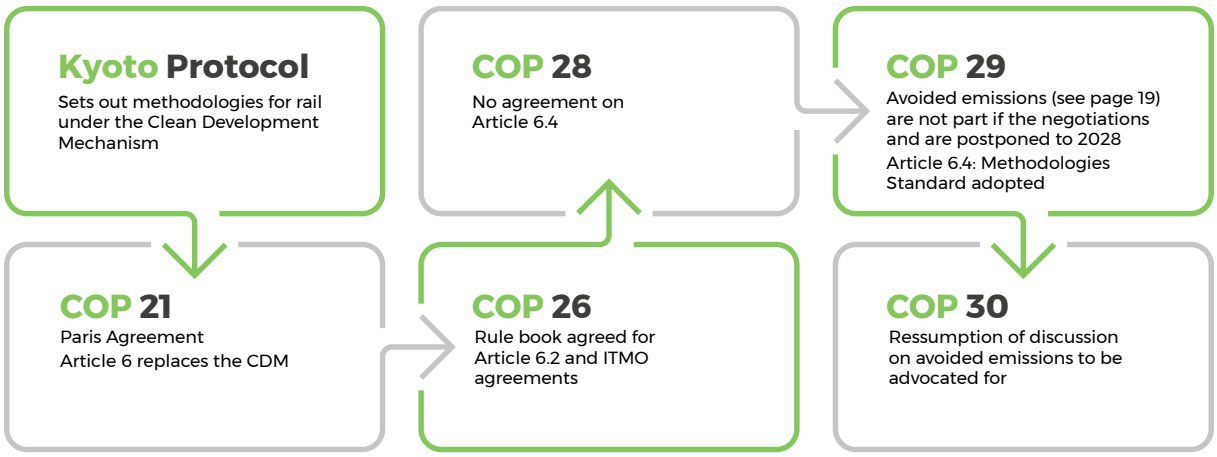


Figure 5: Article 6 negotiations throughout the different COPs

ITMOs are created by activities that reduce GHGs and make it possible to transfer allowances between countries. The Article 6 rules agreed upon at the 26th Conference of the Parties (COP26) in Glasgow require corresponding adjustments (CAs) when transferring an ITMO.

A CA means that the host country, i.e. the country where the project is located, must first authorise the transfer and then adjust its GHG inventory to reflect that the emission reductions achieved within its borders are credited to another country, thus avoiding double-counting. In a bilateral agreement, the purchasing country then adjusts its GHG inventory by the same amount.

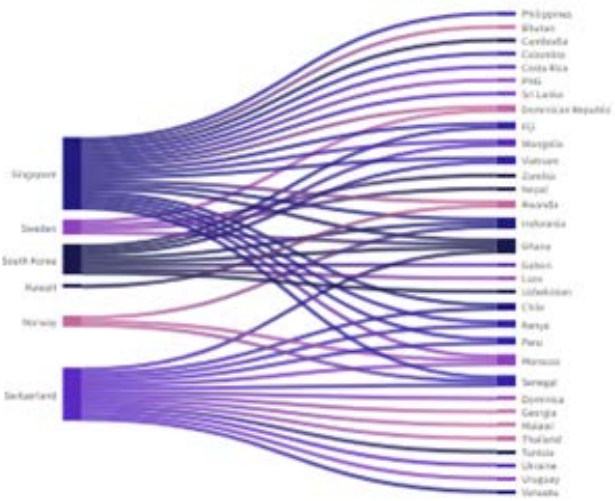


Figure 6: Art. 6.2 Bilateral Agreements or MoUs from IETA *(exc. JCMs)*

ITMOs can be generated from 2021 onwards and replace the old market mechanisms used for compliance purposes (CDM). Bilateral sales are already possible through Article 6.2, with a few buyer countries taking part, such as Australia, Japan, Norway, Singapore, South Korea, Sweden, and Switzerland. As of October 2024, the UN reports that 91 agreements were made between 56 countries[xvi].

Although now on hold, the first international transfer of ITMOs regarded sustainable mobility and took place in January 2024 between Thailand and Switzerland, based on an electric bus programme managed by Energy Absolute[xvii].

Prices for ITMOs tend to be significantly above the voluntary market, in the range of $15-40/ tCO_2 depending on the purchasing country, project and conditions. Although, in general, the registration requirements follow those observed in other markets.

For instance, Singapore requires a VCS project process and registration, as well as compliance with a list of eligible activity types previously established by the government. For ITMOs, a national registry must already exist and all projects and carbon credit issuances must be approved by a designated entity of the country in question.

Swiss-Thai ITMO deal under Art.6.2

In early 2024, a bilateral deal between the Swiss KliK Foundation and the Thai mobility provider Energy Absolute set a milestone as to how IMTOs can help finance sustainable transport in emerging countries.

The Swiss acquisition of 1916 carbon credits was executed in accordance with Article 6 of the Paris Agreement, as part of a programme aiming to roll out 4,000 electric buses in Bangkok.

RAIL AND NATIONALLY DETERMINED CONTRIBUTIONS (NDCS)

Despite the railway's potential to lower transport emissions through a modal shift, it is insufficiently represented in NDCs, both in conditional and unconditional plans. UIC's 2023 NDC analysis reported that only ¼ of NDCs mention rail as a mitigation measure, and as little as 10% of NDCs include specific targets for rail[xviii]. The investigation of 195 submitted NDCs showed that rail is significantly underrepresented, and even among the countries which acknowledge rail's potential as a mitigative solution, there are insignificant firm or specific commitments.

Additionality and the role of the "Conditional NDC"

For carbon credits to be considered valid, additionality must be proven, which means that it must be demonstrated that the project would not have proceeded without the carbon credit revenue. Carbon credits cannot be issued for projects that are including in a country's existing laws, plans and targets.

While railway projects can be included in unconditional NDCs to help contribute to a country's decarbonisation in alignment with the Paris Agreement, additional railway projects can be added in its conditional NDCs. Projects featured here are those that cannot go ahead without international financial support and so act as a call for international climate finance and carbon credits.

Today, too few of the current NDCs are conditional, and therefore do not offer actionable plans for using railway development as a carbon credit provider. Those who do feature rail in their conditional NDCs include Bangladesh, Burkina Faso, Columbia and Malawi. Bangladesh's conditional NDC lists the electrification of the railway system and double track construction which would require $20bn USD, opening up opportunities for climate finance and carbon markets.

To prove the principle of additionality, the project must go beyond the unconditional targets of the nationally determined contribution in the host country and be featured clearly in its conditional NDC.

NEGOTIATIONS ON ARTICLE 6

In the COPs since the Paris Agreement, countries have been negotiating the details of how to "operationalise" the carbon offsetting mechanism given in Article 6. The rule book was agreed upon during COP26 in Glasgow, but since then, countries have failed to agree on necessary details to set up the **central carbon trading system** (Article 6.4). On Day 1 of COP29, the development and assessment methodologies standard, put forward by the supervisory body for Article 6.4, was adopted, which allows for CDM methodologies to transition to Article 6.4 methodologies.

The supervisory body will now begin the work of developing further standards and guidance outlining the future course of action, to enable all of the tools to come into use as early as 2025.

In the same year, CDM projects are required to switch to the 6.4 Mechanism. Chair of the Article 6.4 Supervisory body, Maria AlJishi, stated that the first 6.4 Credits would be issued very soon.

In her vision for a climate and Growth Agenda for COP29, Co-Chair of the International High-Level Expert Group (IHLEG) on climate finance, Vera Songwe, expressed that "*A clear space to raise funding for low-income countries is carbon markets, so to unlock that potential, we need the COP conversations to drive progress on Article 6 of the Paris Agreement. If structured effectively and transparently, carbon markets can drive a huge part of the revenue needed for green development and climate finance in places like Africa.*[xix]"

Avoided emissions

Although UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA) met in June 2024 in Bonn, Germany, there was insufficient political motivation at the time to monetise avoided emissions through Article 6. Despite the Philippines calling for carbon credits to be made available for activities that avoid emissions, further debates on the topic were postponed to the 68th Body Session to be held in 2028[xx].

Trading avoided emissions would offer a significant opportunity to accelerate the modal shift to rail, but this is hampered by the lack of agreement at SBSTA. Although it shows promise for making transport more sustainable, including avoided emissions into Article 6 comes with challenges. Notably, questions remain concerning the appropriate measurement and verification of CO_2 benefits, the regulatory framework needed for operations, and the transparency necessary for trading[xxi].

In addition, certain projects have attracted controversy on avoided emissions, for instance, where credits were used to preserve existing forests and prevent logging. Railway projects are distinctly different from these, with the following two examples highlighting that railway projects offer tangible, measurable emissions avoidance, which should make them eligible for investments prioritising additionality and having a guaranteed impact.

Railway projects offer tangible, measurable emissions avoidance, which should make them eligible for investments prioritising additionality and guaranteed impact

Carbon credits for a modal shift including all three CDM methodologies must be transferred to the new Article 6.4 mechanism.

CASE STUDY:
Delhi Metro and its opportunities on the carbon market

The Delhi Metro Rail Corporation (DMRC) can be seen as a pioneer among transport operators in the carbon market. Beyond its role in transforming urban mobility for millions of passengers, DMRC was the first operator to earn profits from carbon credits through the Clean Development Mechanism (CDM). Being the first Official Development Assistance (ODA) loan project in the mass rapid transit sector, DMRC's cooperation with the Japan Bank for International Cooperation (JBIC) offers an example of operationalising carbon funding for railways.

©DMRC

Environmental impact and carbon credits

The registration of this project allowed DMRC to earn carbon credits through its activities, including emission reduction and emissions avoidance. By applying the CDM methodology AMS III C **"Emission reductions by electric and hybrid vehicles"**, DMRC was able to register its regenerative breaking project, which cut energy consumption by 30-35%, and reduced the GHG emissions from its metro operation by 47,000 tonnes per year[4].

DMRC also used methodology ACM0016 under the CDM to generate profits by enabling the shift of passengers from private and road-based transport modes to its less polluting metro system. Additionally, a study from the Energy and Resources Institute (TERI) illustrates that the modal shift to the Delhi metro had an enormous impact in terms of avoided emissions. For example, DMRC has been able to reduce vehicle kilometres by 3.7 billion, with almost 600,000 fewer cars on Delhi's streets, saving 289,000 tonnes of fuel and 882,514 tonnes in pollutants[5]. Thanks to its quantifiable impact on carbon emissions, the project was able to generate total revenues of about $4 million USD from selling carbon credits between 2012 and 2022.

DMRC was assisted by TÜV NORD for technical auditing to provide an reliable estimate on avoided emissions according to UNFCCC standards. Grütter Consulting AG and ALLCOT AG further assisted in the project's development, aligning it to the CDM as an "authorised participant". Following the UNFCCC's Gold Standard methodology for its registration and other methodologies of various registries, DMRC set a vital precedent for pursuing additional forms of revenue generation to support its capital-intensive project. Hence, DMRC's achievements in the carbon market serve as a model for the railway industry.

Therefore, by leveraging carbon credits, railway projects can contribute to environmental goals and enhance their bankability. DMRC's example also provides an important lesson on scalability. After having successfully registered and qualified for carbon credits through the CDM, the company helped several other operators in India to do the same, showing the vast potential of knowledge sharing to streamline the registration of projects for carbon credits.

Positive externalities of rail projects beyond emissions

Having followed a stringent environmental agenda, DMRC managed to drive down emissions in Delhi and reduced the number of cars on the streets. However, the project had other positive externalities, including improved air quality, reduced noise pollution in the city, fewer road accidents, improved connectivity for the public, and time saved due to reduced congestion, all resulting from shifting passengers from individual road transport to the metro.

4. Information generously provided by DMRC.
5. Delhi Metro Corporation (DMRC) on request of UIC in October 2024.

CASE STUDY:
Uvinza-Musongati-Gitega Standard Gauge Railway

As part of the greater African Central Corridor Standard Gauge Railway, a project is being considered for a new rail connection between Tanzania and Burundi. Running from Uvinza to Musongati, the new railway is estimated to require a total investment of approximately $1.5 billion USD, with a second section which would require $235 million.

The Expert Service Pool of the African Union Development Agency-New Partnership for Africa's Development (AUDA-NEPAD) Service Delivery Mechanism has calculated the potential avoided GHG emission from the project by comparing the planned route against a road alternative, as well as the potential of monetising this on the carbon market.

To produce a first indicative estimate for the project's power to avoid emissions, AUDA-NEPAD considered the emission factors of a typical energy combination, the project's lifespan, and predictions on the annual usage of the new railway[xxii]. For the planned 314 km-long railway track in Tanzania, it is estimated that 178,915 tonnes CO_2e will be avoided annually, with this increasing over time due to an expected shift in cargo from road to rail. Subsequently, calculations estimate possible carbon credit revenues of approximately $1.5 million USD per year upon completion. While one tonne of carbon emissions is traded at $15-40/t$CO_2$ on the ITMO market, the model used a conservative estimate of $10/t$CO_2$ for avoided emissions.

More detailed analysis must be conducted to qualify for the applicable CDM methodology (AM0090: Modal shift in cargo transport from road to water or rail transport).

This Tanzania-Burundi case study is representative of the vast environmental and commercial potential that arises from formally acknowledging the aspect of emission avoidance on global carbon markets.

It also makes it clear how railways can provide important international connectivity and socio-economic benefits given the right investment.

In the 2023 UIC study *Bridging the Rail Finance Gap*[xxiii], it was demonstrated that affordable loans for rail infrastructure were very difficult to obtain, particularly in LMICs, and the full potential for railways to provide a solution to reduce emissions were being passed up.

Therefore, carbon credit funding could help to reduce loan-associated risks and thereby attract investment, while also diversifying revenue sources for the operator and providing money to help pay the interest on debt. For the principle of additionality to be demonstrated for carbon credits, they must be considered in the early stages of project planning and shown as essential for the decision to approve the project. In the 2024 *World Bank Report on Climate finance for Railways*[xxiv], carbon credits were identified as one of the key untapped opportunities. The study made the point that since railways typically avoid GHG emissions on a large scale, they could potentially sell carbon credits on these markets to unlock additional financing. To make this possible, the bank saw **the need for the regulations and standards governing carbon markets to be adapted to include railways.**

CHALLENGES FOR RAIL IN CARBON MARKETS

This white paper has highlighted a number of key barriers to the participation of railways in carbon markets, including:

- Lack of precedent using the all of the established CDM methodologies (now transitioning to Article 6)
- Controversy in terms of avoided emissions projects, with concerns around greenwashing and fraud investigations
- Demonstrating additionality for publicly-funded projects
- Lack of rail being present in conditional NDCs
- Low number of countries registered for the ITMO process
- Intensity of capital required and the long lifecycle of rail project investment
- Carbon market methodologies and process are complex and require specialist skills
- Low levels of awareness and expertise among policy makers and transport stakeholders

POLICY ACTION

As the rail sector seeks to enhance its role in sustainable transport and contribute to global climate objectives, a strategic approach to carbon credit opportunities is essential. To maximise the potential benefits of carbon markets, it is imperative that policy makers adopt targeted measures that support the sector's transition to low-carbon operations. The following key policy requests and recommendations outline crucial steps that can facilitate this transition, promote effective engagement with stakeholders, and ensure that the unique needs of the rail industry are addressed within the broader framework of climate negotiations and carbon markets. By implementing these recommendations, governments and organisations can create a conducive environment for the rail sector to thrive in a sustainable future.

Include rail in the new Article 6 ITMO process

Support the adoption of existing methodologies that already successfully address the unique characteristics and operational realities of the rail sector into the Article 6 processes. These methodologies facilitate accurate measurement, reporting, and verification of reduced emissions. Avoided emissions for sustainable transport projects and a modal shift must be negotiated by the SBSTA before 2028.

Leverage conditional NDCs to enable ITMO agreements

Version 3.0 of the Conditional NDCs should define and implement ambitious climate targets specifically for the rail sector. Aligning NDCs and ITMOs is crucial for enabling rail projects to demonstrate the additionality requirements for validated carbon credits. By explicitly including rail sector targets in NDCs and leveraging the Article 6 Mechanisms of the Paris Agreement, countries can establish clear baselines and create ITMO-compatible policies that support rail projects which go beyond national commitments. This approach requires differentiating between unconditional and conditional targets and implementing efficient approval processes for ITMO generation.

Integrate carbon markets in early project feasibility assessments

For feasibility studies for projects to build, expand or upgrade railways, the potential for carbon credits to help fund the operations must be accounted for early on. Early consideration will help to demonstrate additionality. Moreover, transport ministries, export credit agencies (ECAs) and multilateral development banks (MDBs) can play a crucial role in providing technical assistance and guidance on the process, with UIC standing ready to support this work.

Build capacity for rail sector carbon credits

It is essential to invest in capacity-building initiatives focused on carbon credit markets tailored to the rail sector. As stated in the previous point, ECAs and MDBs can play a crucial role in providing technical assistance, but can also help provide training, and resources to help project promoters and rail operators to understand and effectively participate in carbon markets.

In this aspect, UIC is also ready to promote knowledge sharing and raise awareness.

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