



Carbon Credit Opportunities for the Rail Sector

Document Purpose

This paper was produced in partnership between the International Union of Railways (UIC) and Zeroca for the purpose of information and discussion with UIC platforms and working groups. The paper sets out the mechanisms and opportunities presented by carbon credits for railways around the world.

Introduction

In 2009, developed countries pledged to mobilise USD 100 billion annually by 2020 to support climate action in developing nations, a goal first met in 2022. With COP29 in Azerbaijan approaching, negotiators are developing a more ambitious target to replace this goal, addressing the substantial financial needs of developing countries, estimated to require trillions annually to combat climate change. This goal must support high-quality climate finance, ensuring funds are concessional, accessible, predictable, and effective, and include transparent mechanisms to track progress.

Increasing financial support should enable developing countries to step up their climate ambitions in the next round of national climate plans (Nationally Determined Contributions), which are due in 2025. In light of those two important milestones faced by the COP Presidency Troika (UAE, Azerbaijan and Brazil), UIC is working with partners to build up knowledge on how such policy and finance instruments can drive decarbonisation of the transport sector, through significant modal shifts to rail, public transport, and active mobility.

To support countries that wish to increase their climate policy ambition, UIC developed “Rail in Nationally Determined Contributions (NDCs) Analysis and Recommendations”, in which all of the latest 168 NDCs representing 195 Parties were analysed on the commitments made by countries regarding the rail sector. NDCs are critical instruments for international cooperation, as developing countries can identify opportunities for delivering enhanced ambition through conditional measures – meaning, countries can indicate further mitigation potential if international financing is made available, a mechanism that opens doors for carbon markets. It was found that only around 25% of the Parties mention rail as a climate solution and that only 10% have specific targets for the rail sector, usually referencing specific infrastructure projects and estimating the CO₂ emissions avoided. Findings of the analysis and recommendations will be transposed into a capacity-building program which will help countries increase aspirations for, and the specificity of, rail measures in the next cycle of NDCs.

Launched on the First UN Sustainable Transport Day in November 2023, UIC, together with partners ALSTOM, the University of Birmingham, and Roland Berger, published “Bridging the Rail Finance Gap: Challenges and Opportunities for LICs and LMICs”. It advocates for coordinated efforts from international finance institutions, governments, the rail industry, and the international community. The report highlights that rail investment in Low-Income Countries (LICs) and Lower-Middle-Income Countries (LMICs) can significantly impact climate goals and economic benefits. Without action, transport emissions in those countries could increase global emissions by 16%. By quadrupling rail’s modal share to 8%, these nations could avoid 1.8 Gt of carbon emissions by 2050.

The World Bank collaborated in the development of the white paper and, in early 2024, released its own report on “Mobilizing Climate Finance for Railways”. It highlights that railways offer a low-carbon way to access

opportunities and transport goods, but LMICs need USD 25-80 billion annually to realise those benefits. Various climate finance sources and instruments exist but railways struggle to access such funds. Amongst others, the report identified the role of standards in carbon markets. Every climate-specific financing instrument has different standards for verifying climate friendliness, meeting Key Performance Indicators (KPIs), and achieving greenhouse gas (GHG) savings. To improve rail access to those funds, uniform standards across instruments are recommended, along with specific standards for rail in carbon markets and results-based climate finance mechanisms.

UIC is working with partners to address those challenges so that UIC members can better access carbon markets for rail investment and funding stream. By strategically leveraging carbon credits alongside climate finance and traditional sources, those institutions can help unlock the potential for sustainable railway investments in LMICs and this report is a first step in bridging that gap.

1. Carbon Footprint versus Carbon Credits

In transportation, the carbon footprint of a company or activity is the GHG emissions per activity level, which is typically expressed in gCO₂ per ton-km of freight transported or gCO₂ per passenger-km. In general, the carbon footprint is based on a life-cycle approach, which includes construction-related emissions (rail infrastructure and rolling stock) as well as operational emissions (energy usage, maintenance). However, it can also be based on operational emissions only. The carbon footprint can be a very useful measuring tool for companies aiming to reduce their carbon emissions, with one potential measure being shifting their freight from road to rail. However, a company cannot claim carbon credits on the basis of a carbon footprint calculation.

Carbon credits are based on operational emissions only, i.e. basically combustion-related emissions. Each carbon credit corresponds to one ton of CO₂ avoided, prevented or captured and is calculated based on the difference between baseline emissions (the baseline being the most probable case in the absence of the project, i.e. typically gas- or diesel-fuelled modes of transportation), and project emissions (i.e. typically electrified modes of transportation, taking into account the electricity grid factor of the country). Carbon credits can only be claimed for new investments and not for activities using existing infrastructure. All current operations are indeed non-additional, since the core additionality concept of carbon credits is based on the assumption that the investments would not have occurred in the absence of climate financing. Therefore, although a rail system is reducing GHG emissions with current operations, those are not eligible for carbon credits; only expansion, renewal or other new investments which result in further emission reductions are eligible (see Section 3 for potential projects).

2. Types of Carbon Markets

Various markets to register and sell carbon credits coexist, namely:

- Voluntary carbon markets;
- National (and regional) offset markets;
- Internationally Transferred Mitigation Outcome (ITMO) market.

Although there are similarities and bridges between those different markets, the carbon credits registered and traded on each of them are basically different products with their own rules, their own buyers and their own prices.

2.1 Voluntary Carbon Markets

There is an international market for voluntary reductions with different standards. The most recognised international standards are Verra's Verified Carbon Standard ([VCS](#)), the Gold Standard ([GS](#)) and the Global Carbon Council ([GCC](#)).

Verra was founded in 2007 and is located in Washington, DC, USA. Verra is registered as a non-profit corporation under the laws of the District of Columbia. The terms Verra and VCS are often used interchangeably. Verra develops and manages standards that are globally applicable and advance action across a wide range of sectors and activities. Verra's VCS program is the world's most widely used voluntary GHG program, with around 1,800 registered projects.

The **Gold Standard** was established in 2003 by WWF and other international non-governmental organisations, with the goal of supporting projects which reduce carbon emissions with high levels of environmental integrity and also contribute to sustainable development. It is a not-for-profit organisation headquartered in Geneva, Switzerland. Whilst other standards mandate that a project reduce GHGs but not harm sustainable development, the GS also requires a positive and monitored contribution towards sustainable development goals. The GS has around 1,400 projects registered to date.

The **Global Carbon Council** (GCC) is a new standard based in Qatar with less stringent procedures. As of February 2024, it has 52 registered projects and 920 submitted projects in the approval process.

Other registries which are recognised by the largest potential buyers like the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) of the International Civil Aviation Organization (ICAO) include¹:

- The American Carbon Registry (ACR), based on the State of California's Registry Offset Credits or California Early Action Offset Credits, both of which are however related to Californian program offsets and thus not applicable for international rail projects².
- Architecture for REDD+³ Transactions (ART);
- China's GHG Voluntary Emission Reduction Program;
- Climate Action Reserve (CAR): CAR is for the North American market (USA, Mexico, Canada) and does not cater for other offset projects⁴;
- Forest Carbon Partnership Facility (FCPF).

Voluntary (or verified) emission reductions (VERs) are emission reductions generated in the voluntary carbon market. VERs do not have to be entered into a national inventory because they are not created to meet a legal requirement. A host country may, if it so wishes, apply a corresponding adjustment to VERs leaving its borders,

¹ [CORSIA Eligible Emissions Units March2023.pdf \(icao.int\)](#)

² [Membership — American Carbon Registry and California Offset Program — American Carbon Registry](#)

³ Reduced emissions from deforestation and forest degradation

⁴ [About Us - Climate Action Reserve : Climate Action Reserve](#)

but this is not mandatory (unlike ITMOs, see next sub-section). However, some countries, some standards, and some buyers also request (or are considering to request) corresponding adjustments for VERs. A registration of voluntary market projects and transactions at host country level is expected to be established in the near future in most countries.

Different types of voluntary credits or offsets exist in the market, with considerable variations in prices, contract types and standards. All standards involve the procedure of external validation and registration of the project or programme document based on a template prescribed by the registration standard, the use of an accepted GHG accounting methodology (e.g. UNFCCC Clean Development Mechanism or a VCS-approved methodology), the subsequent monitoring of project results based on a methodology defined in the project document, the external verification of the monitoring reports and the subsequent issuance of emission reduction units which can be transferred to the buyer. The buyer can be any private company or individual wishing to neutralise (part of) its emissions, although the market is dominated by large international corporations.

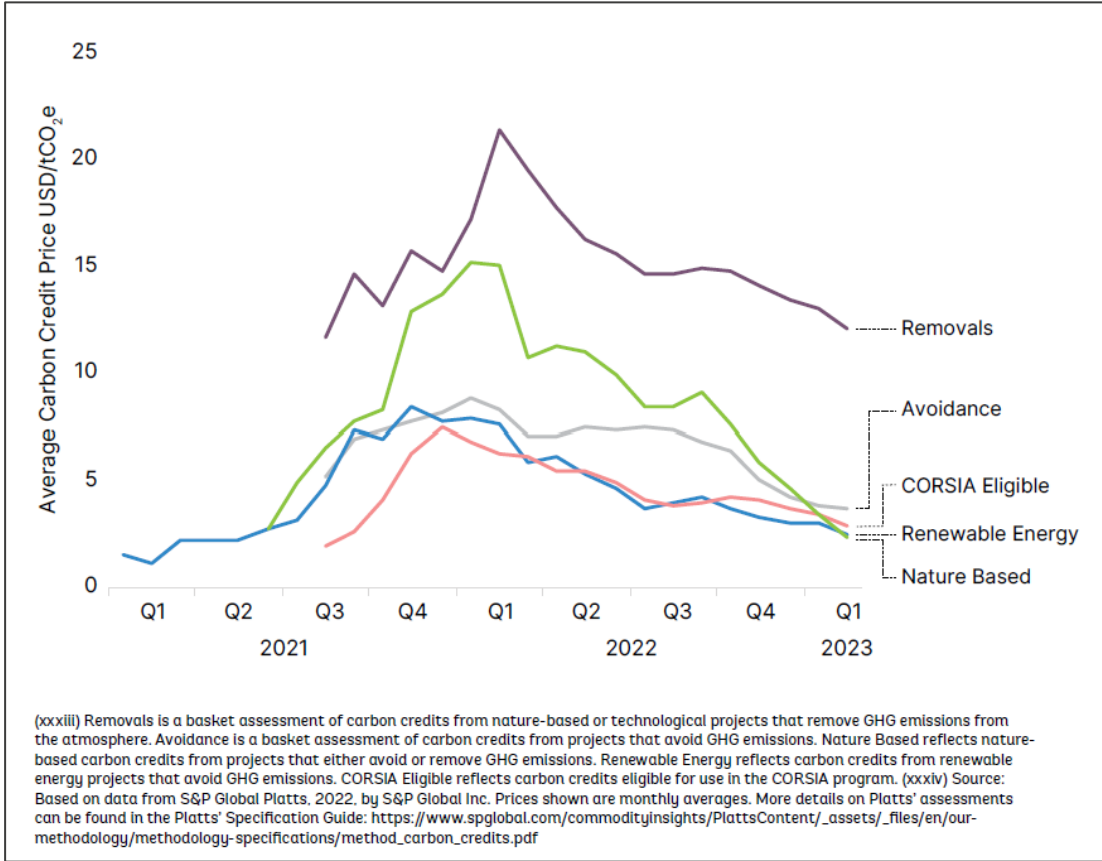
A project can be registered for a period of 10 years, i.e. it can generate VERs for a decade. VER payments are a source of revenue to the project in exchange for an environmental service and, as such, can be used for any purpose by the company owning the project. As payments are result-based and prices fluctuate, the risk that contracts will not be honoured is considerable, especially if market prices for offsets decline. Currently, the international average price for VCS credits is 4-10 USD/tCO₂, with an average price of 7 USD/tCO₂ (Ecosystem Marketplace, 2023). Higher prices are paid for projects with special characteristics, but rail projects are not expected to command a premium price⁵ (see also figure below).

The positive aspect of the voluntary markets is that a project can receive additional revenue for free use. The critical points are the complexity and high transaction costs associated with the registration of a project and the issuance of the certificates. In addition, those costs must be paid upfront, whilst payments are results-based and only released following satisfactory monitoring. Low prices and market volatility are also negative aspects.

Voluntary market projects can be clustered over various clients and countries to reduce the unitary transaction costs of project formulation, validation, registry, and verification. A minimum size for a rail project to be financially attractive with current voluntary market prices is estimated at around 100,000 tons of emission reductions per annum.

⁵ Projects which typically command premium prices are those with large sustainable development benefits in least developed countries, e.g. cookstove projects involving women in poor sub-Saharan African communities. Projects fetching higher prices are also generally small or even micro projects, as corporate buyers value the opportunity of being the sole owner of a project.

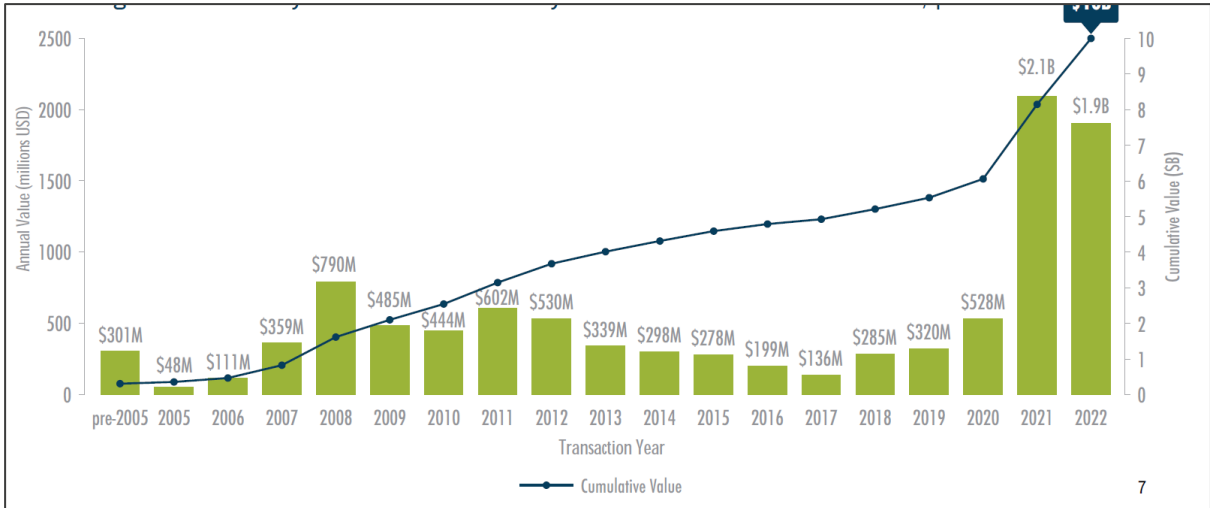
Figure 1: Carbon Price Trends of Voluntary Market



Source: World Bank (2023), State and trends of Carbon Pricing 2023, Figure 14

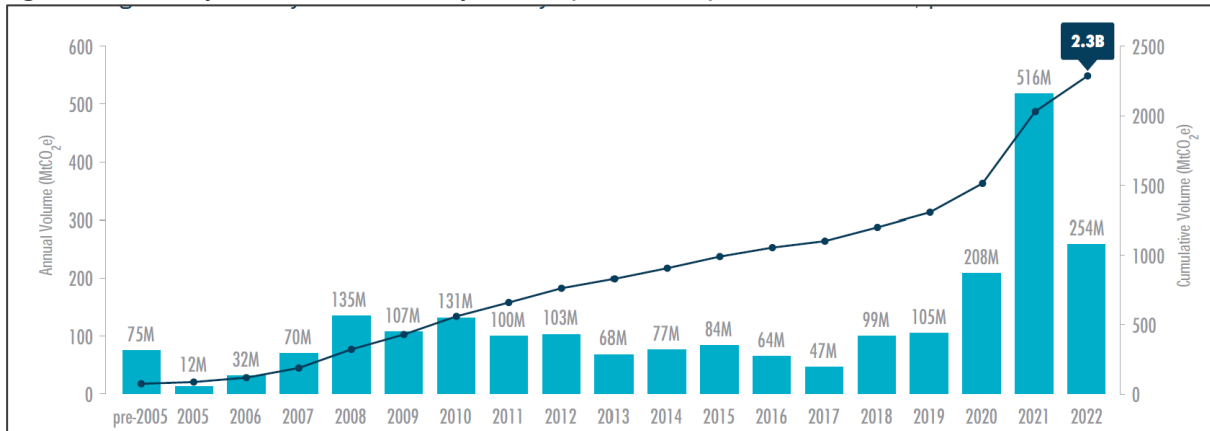
An indication of the volume of the voluntary carbon market is given in the figures below.

Figure 2: Voluntary Carbon Market Size by Value (USD)



Source: Ecosystem Marketplace (2023), Paying for Quality: State of the Voluntary Carbon Markets 2023, Figure 1

Figure 3: Voluntary Carbon Market Size by Volume (million tons)

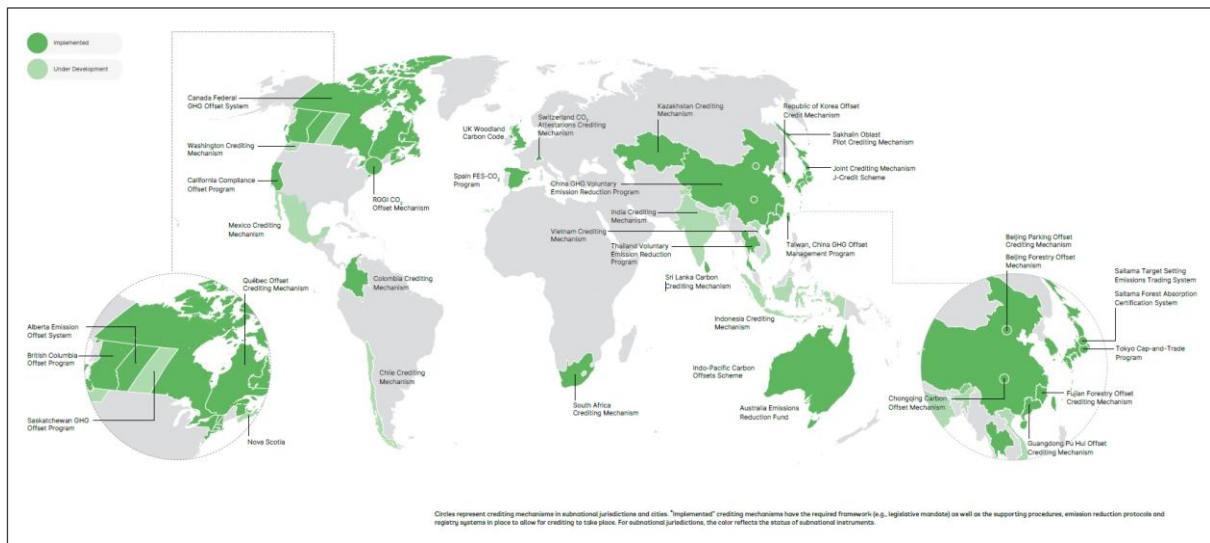


Source: Ecosystem Marketplace (2023), Paying for Quality: State of the Voluntary Carbon Markets 2023, Figure 2

2.2 National Offset Markets

Multiple national carbon markets exist (see map below for an overview).

Figure 4: National and Subnational Carbon Markets



Source: World Bank (2023), State and trends of Carbon Pricing 2023, Figure 12

Some schemes only allow trading between companies which are subject to CO₂ allowance regulations, others allow for the purchase of national and/or international carbon offsets as an alternative to payment of a carbon tax or to account for part of the allowances. Rules and regulations are country-specific and vary significantly, leading to wildly different prices which can be anywhere below 5 USD/tCO₂ to over 200 USD/tCO₂. In general, in developed countries prices tend to be much higher for domestically traded offsets than for voluntary carbon credits. Sometimes registration is also less complex or more flexible but a detailed understanding of local rules is required to navigate each market.

2.3 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 Clean Development Mechanism (CDM) system managed by the United Nations Framework Convention on Climate Change (UNFCCC).

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.

ITMOs are created by activities that reduce GHGs and make it possible to transfer allowances between signatory countries. The Article 6 rules agreed 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. The purchasing country then adjusts its GHG inventory by the same amount.

ITMOs can be generated from 2021 onwards and, in that sense, replace the old market mechanisms used for compliance purposes, such as the CDM. ITMO deals can be structured bilaterally or multilaterally through the UN. Bilateral sales are already possible today with a few buyer countries such as Australia, Japan, Norway, Singapore, South Korea, Sweden and Switzerland; the multilateral channel still requires decisions which are planned to be made at the COP29, to be held in November 2024 in Baku, Azerbaijan, and is therefore not expected to be fully operational before 2025. In January 2024, the first international transfer of ITMOs occurred between Thailand and Switzerland, based on an electric bus program managed by Energy Absolute⁶.

Prices for ITMOs tend to be significantly above the voluntary market, in the range of 15-40 USD/tCO₂ depending on purchasing country, project and conditions. In general, registration requirements follow those observed in other markets. For instance, Singapore demands a VCS project approach and registration, as well as compliance with a positive list of eligible activity types previously established by the government. The major difference and increased complexity of ITMOs versus voluntary markets consist in the fact that a national registry must already exist and that all projects and carbon credit issuances must be approved by a designated entity of the host country, which typically also charges a fee for this service. In general, the project development complexity is therefore significantly higher for this approach compared to a voluntary or domestic market project. Also, the project must go beyond the unconditional targets of the nationally determined contribution under the Paris Agreement framework. What this means in practice needs to be assessed and agreed upon with the government of the host country, to confirm that offsets generated by a particular type of activity can indeed be traded.

⁶ [First ever ITMOs for NDC use \(klik.ch\)](https://klik.ch)

2.4 Summary

The table below summarises the three categories of carbon markets which are relevant for the rail sector.

Carbon markets	Registration and issuance process	Buyer	Corresponding adjustment to national carbon registry	Current prices (USD per tCO ₂)	Recommended project size (tCO ₂ p.a.)
Voluntary carbon markets	Certification through recognised standard: Verra/VCS, Gold Standard, GCC, etc.	Any private company or individual (typically large corporate entity)	Not required (may change in the near future)	4 to 10	> 100,000
National (and regional) offset markets	Based on local legislation (typically cap-and-trade scheme applicable for a particular industry)	Any private company subject to local carbon scheme or tax	Not required (intranational transaction)	5 to 200+	Depends on local price
ITMO market	Issuance by government of host country The project must meet requirements of buyer (typically inspired by one of the recognised standards + specific additional criteria)	Any government of a Paris Agreement participating country or entity appointed by such a government (in practice only a handful of buyers) Some governments (e.g. in Asia) do not buy directly but instead grant access/equivalence to their national offset market, where the ITMOs can be sold to any private company subject to local carbon scheme or tax	Mandatory	15 to 40	> 25,000

3. Options for Rail

Potential types of projects related to the rail sector include:

- Efficiency improvements, e.g. improved air conditioning or heating systems, ecodrive for locomotives, measures aiming to increase load factors, (diesel) engine efficiency improvements, etc.;
- Acquisition of new, more energy-efficient rolling stock;
- Electrification of tracks, usage of hybrid trains, H2 trains, battery-electric trains, etc.;

- Infrastructure investments which result in capacity increases of passenger and/or freight rail, e.g. new railway lines, track duplication projects, new signalling systems, etc.;
- Establishment of high-speed rail (HSR) generating modal shift from road and/or plane to rail.

In a nutshell, offsets can be generated either from modal shift based on increased capacity or a new service (HSR), or from activities aiming to improve energy efficiency and lower the carbon emission factor per tkm or pkm as a result of efficiency improvements or due to a change of energy carrier.

4. Available Methodologies

The following table shows internationally approved carbon credit methodologies applicable to the rail sector.

Table 1: Carbon Credit Methodologies Applicable for Rail

Methodology	Standard	Applicable area	Registered projects
ACM0016: Mass Rapid Transit Projects	CDM ⁷	Urban rail systems such as metro, LRT, tram, sub-urban rail	Various metros and LRTs, e.g. Delhi metro, Mexico City metro, Tunis LRT, or in the VCS Buenos Aires metro, Seoul metro ⁸
AM0090: Modal shift in transportation of cargo from road transportation to water or rail transportation	CDM	Modal shift cargo	One project registered in India, which however never generated carbon credits ⁹ ; one VCS project under development in the USA ¹⁰ and one under validation in India ¹¹
AM0101: High-speed passenger rail system	CDM	High-speed rail	Korail's KTX Honam high-speed rail, registered in the Korean domestic offset system

⁷ CDM methodologies can be used also for all other standards.

⁸ As of January 2024, the following rail projects were listed: CDM: Metro Delhi, Mumbai Metro One, Metro Gurgaon, Mexico Line 12 Metro, LRT Tunis, Guiyang Metro; VCS: Metro Lima, Metro Buenos Aires, Metro Line 9 Seoul, Bursa LRT; domestic standards: road-to-rail projects in Switzerland, high-speed rail project in South Korea.

⁹ Reasons may be that the project did not eventually materialise and/or that the collapse of the CDM market after 2012 made it no longer viable to claim carbon credits for the project.

¹⁰ <https://registry.terra.org/app/projectDetail/VCS/4530>

¹¹ <https://registry.terra.org/app/projectDetail/VCS/4862>

National markets follow their own regulations and can be very flexible in methodologies. For example, various rail projects are registered as carbon market projects in the Swiss domestic market based on modal shift from road to rail for freight transport¹²; those only partially follow the CDM methodology.

The number of registered methodologies and projects from the rail sector outside urban areas is very limited. For many activities, e.g. introduction of battery-electric trains, new methodologies or extensions of existing methodologies are required. Potentially, carbon credits could however bring an important contribution towards making rail projects more profitable, especially if introduced into the ITMO market.

5. Conclusion

Although they have been possible since the 1990s, transportation carbon credit projects have remained a niche within the wider carbon markets, which are currently dominated by forestry and clean cooking activities. However, the transportation sector in general, and the rail industry in particular, present many advantages in terms of additionality, measurability and permanence of the emission reductions and, when adequately structured, rail-based carbon credit activities can command fairly attractive prices from a growing pool of local and international buyers.

For many UIC members, carbon markets represent a largely untapped source of potential revenues which may be used to finance new urban rail, road-to-rail or high-speed rail projects, or accelerate the transition to low-emissions rail operations through energy efficiency improvements or the acquisition of modern rolling stock.

In particular, we encourage project owners and operators located in emerging markets to consider the opportunities offered by the new ITMO framework created under Article 6 of the Paris Agreement, which unlocks the possibility of securing valuable long-term support from foreign governments (in particular from Western Europe and Asia) to finance climate-friendly rail-related initiatives in the Global South.

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This paper was co-written by:

Joo-Hyun HA, UIC

Guillaume Remy and Jürg Grütter, [ZEROCA | The zero carbon effect](#)

hello@zeroca.world

www.zeroca.world

¹²

<https://www.bafu.admin.ch/bafu/de/home/themen/klima/fachinformationen/verminderungsmassnahmen/kompensation/inland/registrie-rte-projekte/5-1.html>