TRANSFORMATIVE CARBON ASSET FACILITY

Transformative Carbon Asset Facility (TCAF)

Feasibility assessment and conceptualization note for the Transport Sector

Objectives of the Note:

- *Navigate TCAF strategic direction and value proposition in supporting the transport sector*
- *Guide the identification of cost-effective TCAF transport programs by scoping out a list of mitigation policies/actions eligible for crediting with analysis on their abatement potential and ease of implementation*
- *Outline the key design features of crediting methodology to get the transport GP colleagues' feedback.*
- *Present how TCAF guidelines can be applied to transport-sector emissions reduction*

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1. Transport sector and climate mitigation

Global target to reduce GHG emissions and stabilize warming at 2 degrees Celsius will fall short without including transport sector: The share of the transport sector in the world's total final energy consumption was increased from 25.3 percent in 1990 to 29 percent in 2017[1]. This puts transport in second place behind "electricity and heat generation" in its contribution to GHG emissions from fuel consumption in 2017, accounting for 24.5 percent. Within the transport sector, road transport accounts for almost three-quarters (74.1 percent) of this total[2]. In many of the World Bank member countries, transport is the largest emitter of GHG emissions comparing with other sectors. In Latin America for example, transport is the largest emitting sector in 16 of 25 countries[3], bringing the regional transport average to 36 percent of total emissions[4]. The below figure 1 shows the increasing share of transport sector energy consumption in the world total final consumption from 1973 to 2017.

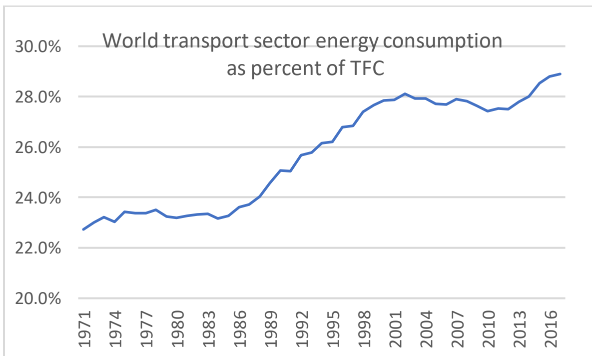

Figure 1 - Transport sector share of world total final consumption of energy (Mtoe) Source: IEA WORLD ENERGY BALANCES (2017 edition)

GHG emissions from the transport sector continue to rise. Transport sector GHG emissions are likely to increase faster than emissions from the other energy end-use sectors, from the current levels of 8 Gt CO2eq/yr in2017 to around 12 Gt CO2eq/yr by 2050[8]. This accelerated growth has two principal causes:

- Rising income in developing countries, together with infrastructure development is leading to increasing personal mobility and a rising private vehicle population. Whilst a strong slowing of light-duty vehicle (LDV) travel growth per capita has already been observed in several OECD cities suggesting possible saturation, this is not the case elsewhere and the current population of around 950 million passenger cars[5] could reach nearly 3 billion in 2050[6] driven by increasing transport demand per capita in developing and emerging economies.
- A similar situation exists for freight, where worldwide on-road freight traffic (freight ton-km) has been closely coupled to GDP growth with a certain decoupling being evident in Europe and some other countries. This is reflected in the global truck market outlook, where from 2014 to 2024, annual growth of > 3% is expected, mainly driven by global GDP growth, estimated at 3.3% per year. Little momentum is expected in Brazil, China, and Japan (estimated at 1% per year) with the U.S. also trailing the global average at 2%. However new growth markets are

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[1] In 2017, 2808.15 Mtoe out of a total final energy consumption of 9717.29 Mtoe Source: IEA WORLD ENERGY BALANCES (2019 edition)
[2] In 2017, the transport sector emitted 8040 million tons of CO_2 (from fuel combustion with electricity and heat allocated to consuming sectors) of which 5,958 million tons was from road. World total CO_2 emissions in that year were 32,840 million tons CO_2. Source: IEA CO_2 EMISSIONS FROM FUEL COMBUSTION (2019 edition)
[3] The IEA reports a total of 25 countries and country groups in Latin America
[4] Source: IEA CO_2 EMISSIONS FROM FUEL COMBUSTION (2019 edition)
[5] https://www.statista.com/statistics/281134
[6] IEA Transport Energy and CO2, 2009

appearing in Eastern Europe (10%), Russia and Central America (5% each) and in the ASEAN countries (4%) with the highest expected growth in India (9% CAGR)[7].

The IPCC AR5 concludes that the continuing growth in passenger and freight activity could outweigh all mitigation measures unless transport emissions can be strongly decoupled from GDP growth[8].

Countries are taking notice of transport sector in their NDCs target setting and implementation. The importance and potentials of transport sector for GHG mitigation are commonly highlighted by various countries' National Determined Contributions (NDCs). Among 160 NDCs representing 187 countries that were submitted as of Aug 1, 2016, 75% explicitly identify the transport sector as a mitigation sources, and more than 65% of them propose transport sector-specific mitigation measure. More specifically, 9% of NDCs have a transport sector emission reduction target. For instance, Bangladesh set an economy-wide reduction target of 5% compared to BAU by 2030 including an estimated 9% reduction in transport. Cambodia's 27% target by 2030 consisting of a 3% reduction target for transport. Passage transport and freight transport are two major transport modes highlighted by NDCs[9].

Policy crediting approach brings new opportunity in awarding policy-level interventions against increased mitigation ambitious. CDM provided a learning experience on emissions crediting that can form a background to policy-level crediting, such as, energy efficiency standards. However, this experience has been very limited in the transport sector: only 30 out of 7,632 registered CDM projects are transport related and half of them are for BRT and metro projects[10]. Policy crediting is a new concept and it looks to increase the appetite for expanding mitigation efforts by using a payment-for-results mechanism against emission reductions generated from the implementation of a policy action. From TCAF perspective, a methodology to credit policies in the power sector (i.e. fuel or electricity subsidy reduction) was developed and is currently tested in Morocco Power sector. This note aims at advancing the thinking on how the policy crediting approach could be used to increase ambition for mitigation measures in the transport sector.

2. Potential role for TCAF to play

Given the above context, the transport sector requires increasing attention to achieve the needed GHG mitigation, however it presents a higher level of complexity for GHG emission reduction and crediting than other sectors. The below highlights associated with transport sector reality pose both challenges and opportunities for TCAF to engage:

i. The price elasticity of demand for transport is low so putting a direct price on carbon will have limited effect
ii. Transport has significant externalities in addition to GHG reductions
iii. Transport sector GHG improvements are often complex because of institutional arrangements
iv. Transport has significant investment needs
v. There is a sense of urgency in transforming many of the transport decisions to avoid lock-in

2.1 The price elasticity of demand for transport is low so putting a direct price on carbon will have limited effect

Since transport is a derived demand, its average price elasticity is generally low[11]. For road freight transport that usually used diesel as fuel, price elasticity values of -0.1 to -0.2 are typically used in most developing countries with slightly higher elasticity values for gasoline-fueled personal mobility[12]. Sensitivity to fuel price rises is even lower, as fuel prices represent

[7] Source: Deloitte Truck Market 2024 Sustainable Growth in Global Markets (https://www2.deloitte.com/content/dam/Deloitte/de/Documents/strategy/DELO_Truck-Studie-2014-s.pdf)
[8] IPCC AR5 Ch8
[9] http://www.ppmc-transport.org/wp-content/uploads/2015/06/NDCs-Offer-Opportunities-for-Ambitious-Action-Updated-October-2016.pdf
[10] The CDM is a market based mechanism driven largely by private companies to generate income thorough emissions reductions. As it was a project-by-project approach the administrative costs of individual CDM projects was high, driven by a highly conservative approach to ensure that the buyer could purchase CERs with total confidence that that did not have diminished value through uncertainties or double-counting. This resulted in projects focusing on "low hanging" mitigation projects concentrated principally in China and India leaving more complicated transport sector mitigation largely ignored.
[11] Oum, T., W. Waters, and Y. Jong (1990), A Survey of Recent Estimates of Price Elasticities of Demand for Transport, working paper, World Bank
[12] Dahl, Measuring global gasoline and diesel price and income elasticities,2012

on average 20% to 30% of total vehicle operating cost. Further insights come from a study by Significance and CE Delft[13] on potential freight modal shift resulting from changes in relative prices. Overall, the demand for transport of commodities was found to be relatively inelastic for both rail and road modes, tending to confirm the view that the potential for achieving modal shift through price changes alone is limited. Even with oil prices rising to US$200/bbl, rail's share of total freight volume in the EU27 would only increase by around 2%.

Since World War II, gasoline has been heavily taxed in Europe as a luxury good to fund reconstruction. This has led to far higher prices at the pump than in the US. The current difference in prices would be equivalent to adding a carbon tax on US fuel prices of around US$390 / t CO_2[14] and despite this, the fuel prices to the user in Europe are not by themselves sufficient to resolve the growth in GHG emissions from transport.

Interestingly, having a higher fuel efficiency in light duty vehicles generates an increasing benefit during the different stages of the active service life of a vehicle and for the different owners during its lifetime. In Europe, light duty vehicles have average ownership periods of about 5-7 years, and average 3-4 different owners during the lifetime. The purchaser of the new vehicle may not offset the initial price premium of a more efficient vehicle through fuel savings. However, as the vehicle gets passed from hand to hand, lower income groups proportionally benefit more from the fuel efficiency. Thus, fuel efficient passenger cars have a positive price premium in the second-hand market. The value of this premium is estimated to be of around €22 per gram CO_2 emitted per kilometer[15]. This result is statistically significant at a very high rate, and robust to plausible changes in model specification or the removal of outliers in the dataset

2.2 Transport has significant externalities

Transport, and particularly road transport, is responsible for significant external costs[16] that only marginally accrue to the individual transport user or investor:

- Congestion;
- Accidents;
- Noise;
- Air pollution;
- Climate change;
- Other environmental impacts (costs of up- and downstream processes);
- Infrastructure wear and tear for road and rail.

Under a "polluter pays" principal these would be charged through to the transport user. Whilst there are notable cases of this partially occurring (for example carbon based vehicle registration taxes, congestion, and high emission-charge zones), in general the transport user or investor does not have to figure-in these additional charges in his purchase and use decisions. **Error! Reference source not found.** shows the main issues and cost drivers per cost component of transport externalities.

From the perspective of the local authority (such as a city's mayor) that is responsible for transport choices and regulations, the externalities that most effect his decisions are likely to be those that most impact his constituents which often puts climate change in one of the lower importance positions.

[13] De Jong, Gerard (Significance) & Schroten, Arno (CD Delft) & van Essen, Huib (CD Delft) & Otten Matthijs (CD Delft) & Bucci, Pietro (Significance) (2010), Price sensitivity of European road freight transport: towards a better understanding of existing results, Report 9012-1, 2010

[14] Author's calculations based prices for regular gasoline on 9/28/2017 of US$2.52 per US gallon average in Maryland and US$6.01 per US gallon in Germany

[15] Source: Data gathering and analysis to improve the understanding of 2nd hand car and LDV markets and implications for the cost effectiveness and social equity of LDV CO2 regulations. EC DG Climate Action 2016

[16] Source: Ricardo-AEA Update of the Handbook on External Costs of Transport, 2014 for the European Commission –DG Mobility and Transport

Table 1 - Main issues and cost drivers per cost component of transport externalities

Cost component	Cost elements	Critical valuation issues	Cost function	Data needs	Main cost drivers
Congestion costs (road)	Time and operating costs Additional safety and environmental costs	Speed-flow relations Valuation of economically relevant value of time (reliability)	Increasing marginal cost in relation to traffic amount, depending on time of the day/week/year and region	Speed-flow data Level of traffic and capacity per road segment	Type of Infrastructure Traffic and capacity levels, mainly depending on: • Time of the day • Location • Accidents and constructions
Scarcity costs (scheduled transport)	Delay costs Opportunity costs Loss of time for other traffic users	Valuation approach as such (measurement of opportunity costs, WTP enlargement costs, optimisation model)	Increasing marginal cost in relation to traffic amount, depending on time of the day/week/year and region	Level of traffic, slot capacity per infrastructure segment	Type of infrastructure Traffic and capacity levels, mainly depending on: • Time of the day • Location
Accident costs	Medical costs Production losses Loss of human life	Valuation of human life Externality of self-induced accidents in individual transport Allocation of accidents (causer/victim related)	Only limited correlation between traffic amount and accidents; other factors (such as individual risk factors and type of Infrastructure)	Accident database. Specification of the number of fatalities and heavy/slight injuries very important.	Type of Infrastructure Traffic volume Vehicle speed Driver characteristics (e.g. age, medical conditions, etc.) Others
Air pollution	Health costs Years of human life lost Crop losses Building damages Costs for nature and biosphere	Valuation of life years lost Market prices for crops Valuation of building damages Valuation of long term risks in biosphere	Correlation with traffic amount, level of emission and location	Emission and exposure data (exp. PM, NOx, SO2, VOC)	Population and settlement density Sensitivity of area Level of emissions, dep. on: • Type and condition of vehicle • Trip length (cold start emissions) • Type of Infrastructure • Location • Speed characteristics
Noise costs	Annoyance costs Health costs Rent losses	Valuation of health and annoyance impacts	Declining marginal cost curve in relation to traffic amount	Noise exposure data (persons) House price data for applying hedonic pricing methods.	Population and settlement density Day/Night Noise emissions level, depending on: • Type of Infrastructure • Type and condition of vehicle • Vehicle speed characteristics
Climate change	Prevention costs to reduce risk of climate change Damage costs of increasing temperature	Long term risks of climate change Level of damage in high altitudes (aviation)	Proportional to traffic amount and fuel used (marginal cost close to average cost)	Emission levels	Level of emissions, depending on: • Type of vehicle and add. equipment (e.g. air conditioning) • Speed characteristics • Driving style • Fuel use and fuel type
Costs for nature and landscape	Costs to reduce separation effects Compensation costs to ensure biodiversity	Valuation approach as such (replacement versus WTP approach)	Most of the costs are Infrastructure related, and do not vary very much with traffic volumes	GIS information on Infrastructure	Type of Infrastructure Sensitivity of area
Additional environmental cost (water, soil)	Costs to ensure soil and water quality	Valuation approach as such (avoidance versus damage cost approach)	Complex: Increasing marginal cost curve in relation to traffic amount	GIS information Infrastructure, emission levels	Level of emissions Type of Infrastructure
Additional costs in urban areas	Separation costs for pedestrians Costs of scarcity for non-motorised traffic	Valuation approach as such (Avoidance versus WTP approach)	Increasing marginal cost curve in relation to traffic density	Infrastructure data in urban areas (network data, data on slow traffic)	Type of Infrastructure Level of traffic

2.3 Transport sector GHG improvements are often complex because of institutional arrangements

Because of the low price-elasticity of transport demand and the extent of transport's externalities, most large scale transport improvements in GHG emissions tend to be driven principally by regulations, rather than market forces.

This is further complicated by the institutional arrangements that often impact transport operation. Figure 2 illustrates the Institutional Arrangement for Urban Transport Administration and Operation in China. Here it can be seen that at least three levels of government are involved in significant GHG emissions improvements from the national-level (emissions and fuel economy standards; authorization to manufacture or import vehicles etc) through provincial-level control on freight modes and routes to local area demands for passenger mobility which can involve more than one urban authority.

Additionally, many transport measures can be seen as negatively affecting literally millions of voters, requiring changes in habits (such as foregoing the use of hard-earnt private vehicles in favor of public transport, parking restrictions etc). This can make it very hard for an elected local official to fully support such measures. Getting all these stakeholders to work together towards a goal that may not be of primary importance to any of them individually can be a major challenge in many countries.

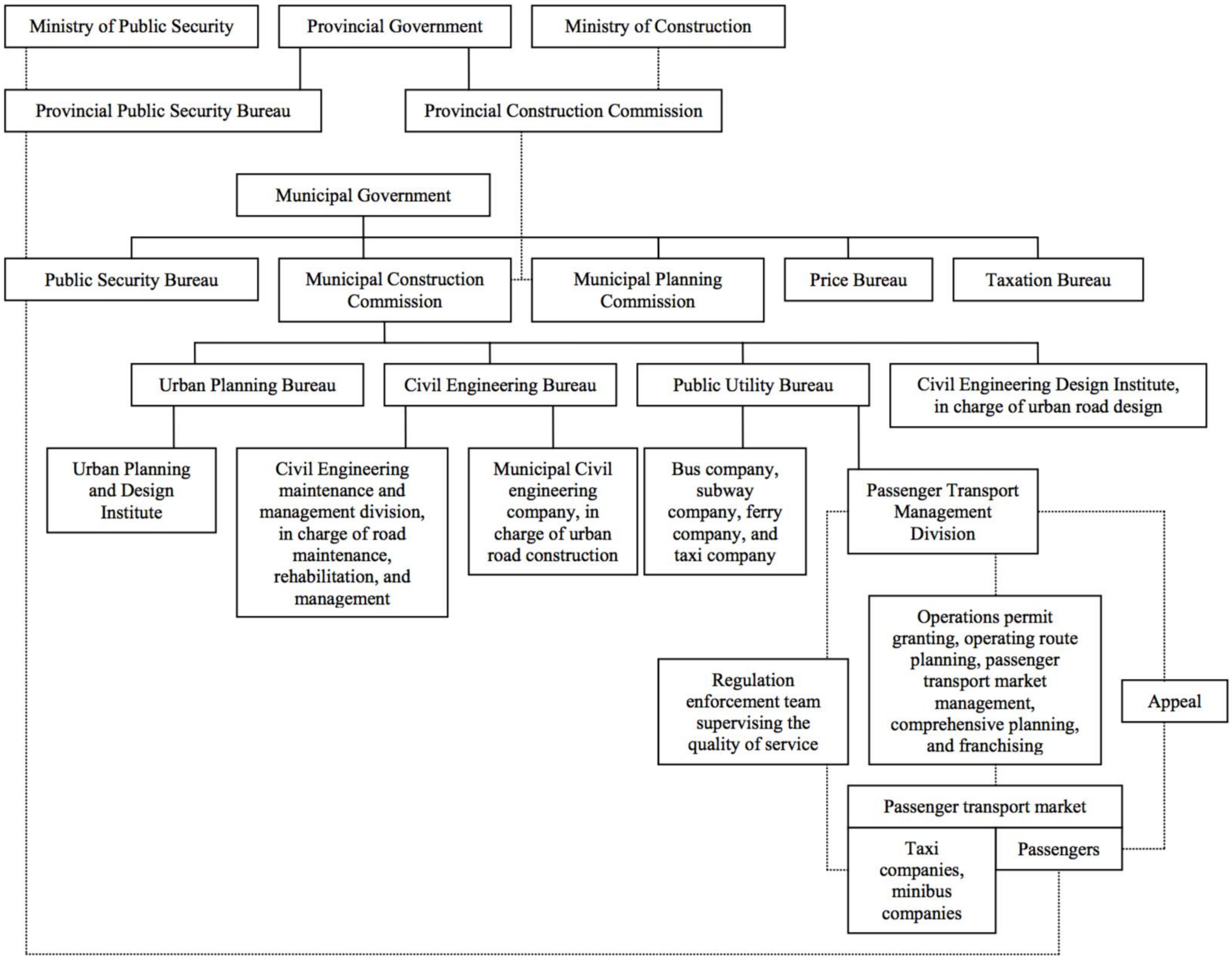


Figure 2 - - Institutional Arrangement for Urban Transport Administration and Operation Source: China's Urban Transportation System: Issues and Policies Facing Cities, Chris Cherry, WORKING PAPER UCB-ITS-VWP-2005-4, UC Berkeley Center for Future Urban Transport

2.4 Transport has significant investment needs

Additional Investment of around $3 trillion is required to increase the sustainability of existing and new transport systems and mitigate climate change over the 2015–35 period. This is in addition to existing annual investments estimated at $1–2 trillion[17]. Around 85 percent of this additional financing would need to be directed to fast growing developing countries, in contrast to 60% of investments in developed OECD countries today[18].

[17] Partnership on Sustainable Low Carbon Transport (SLoCaT) 2014
[18] Climate Finance as the Engine for More Low-Carbon Transport SLoCat 2015

In October 2015, the MDBs agreed to significantly ramp up overall climate finance by 2020, and transport is expected to play a key role. From 2011 to 2014, they committed more than $100 billion to climate mitigation and adaptation, including about $20 billion in the transport sector. More precisely, the World Bank Group pledged to increase its climate finance by one-third, to 28 percent of its annual commitments, by 2020. Currently, transport is second only to the energy sector in its contributions to mitigation and adaptation co-benefits in World Bank projects.

Public sector financing while an important catalyst will not be sufficient to meet these demands. Using scarce public, and international climate finance to incentivize the right choices in transport and crowd-in finance from the private sector will be important to avoid lock-in to unsustainable growth patterns in the future. So far, finance flows to the transport sector through dedicated climate instruments have been small relative to other sectors, such as energy:

The actions taken today to send the right policy signals, and establish the enabling institutions and regulations to attract the necessary private finance will be critical to support this transformation. Significant investment opportunities exist in public transport systems, vehicle efficiency improvement, and reducing the need for travel through demand management, regional development policies, and land use planning.

2.5 There is a sense of urgency in transforming many of the transport decisions to avoid lock-in.

Many transport changes have a long lead time. Not performing the change on time can lead to lock-in. A technology that is included in 100 percent of new vehicles on-sale today may still require 20 years for it to be predominant in the in-use vehicle population due to the slow scrappage rate for old vehicles. Urban design can be difficult to change once the city has been built (for example, the inner city of London has a road layout that was basically decided by the Romans two thousand years ago). So, getting public transport to work effective and well in a city that was originally designed as low-density can be very challenging.

2.6 Can TCAF have a role to play to support transformation in transport?

As discussed above, many of the mitigation measures in transport are unlikely to occur due only to market forces driven by the direct price of carbon, or by the revenue generated from selling emissions reductions at market price. Many transport mitigation measures will only be effective with government intervention and this often gives rise to significant political concerns. Therefore, the achievable emissions reductions are strongly dependent on the stringency of these interventions and on the fiscal resources that can be focused on this sector.

TCAF could have an important role to play in helping to overcome barriers to effective policy implementation and operation, and reducing the perceived risk to investors/early adopters. The addition of TCAF can enhance the acceptability of a reform policy to the different stakeholders by reducing compliance costs of participants through MRV support, or by increasing the capacity of participants. TCAF can also be an important "rallying flag" to get stakeholders from different levels of government (and often different political affiliation) to pull together towards a common outcome.

- <u>Provide critical MRV support</u>: Whilst the additional funds that TCAF could add to a policy's economic analysis are small, they can be sufficient to develop and support the necessary MRV systems to evaluate the existing policy performance and inform the follow-up policy decision making. Lack of creditable database is a critical factor preventing transport decision makers in taking right and on time mitigation interventions.
- <u>Reduce uncertainty in outcome</u>: Transport finance initiatives differ in their risk perception and a lack of certainty in outcome translated into greater perceived risks. Private actors usually require higher returns to justify uncertainties or challenges. However sustainable or low-carbon transport is less well established and therefore turns to be less attractive to private investors. Through proper arrangement case by case, TCAF carbon revenue can be utilized as an effective mean in attractive private participation by reducing the uncertainty in outcome.
- Data collected from TCAF-supported MRV system can strengthen and institutionalize the sector planning process while mainstreaming "green" concept. The mitigation targets for transport sector are usually set in the absence of rigorous data analysis and sector planning. Particularly, a knowledge gap exists about how to turn the target

into economically and financially viable investments and policy intervention. Strategic planning and policy/ financial interventions are urgently needed to guide the whole sector development in cost-effective and sustainable ways. The results-based payment from TCAF can be used for data analysis and contribute to strengthening sector planning while mainstreaming “green” concept.

- “Rallying Flag”: GHG mitigation from transport requires coordination between a large number of different private and institutional stakeholders, with the latter from many different levels of government, and each with their own priorities and problems. Having a Rallying Flag that all can agree to be beneficial, can be key to building consensus and momentum to benefit a common goal, even when that goal (GHG mitigation) may not be of maximum priority for several of the actors involved. Selection of prospective transport program will be a test of the understanding of the program entities on how the performance-based incentive works for their sector as well as their ability to convene multiple stakeholders to take concerted mitigation actions

Given these, TCAF enabling support can push the governments in moving from their comfort zone towards more ambitious actions. Whilst in many sectors of the economy, transformative investment can be targeted at GHG emissions reduction, in transport it is, in many ways different. As shown in the World Bank, Climateworks Foundation report[19], many of the most effective policies and interventions to reduce GHG emissions in transport need to be promoted by focusing on the direct benefits to local stakeholders for whom, often GHG mitigation is but a minor co-benefit. However, TCAF support can in many cases be sufficient to tip the balance that allows the transformative change to occur. More precisely, it can allow stock taking and mapping of transport policy and investment interventions in the matrix of mitigation potentials and costs and by matching TCAF with targeted interventions push local and national governments to go beyond their comfort zones in decision making, financial risk mitigation, and MRV, which put together makes interventions attractive to private and institutional investors.

The left graph on Figure 3 below shows 28 illustrative transport policies and other urban interventions that can result transport GHG emissions reductions[20]. In the right graph to it, these policies/interventions are presented in two ways showing their relative abatement potential and ease of implementation. Even in those cases where TCAF funding only covers the cost of stock taking and MRV, having NDC-focused climate funding on board, TCAF can potentially leverage political and social support that could otherwise be lacking in undertaking more ambitious mitigation policies/interventions, for example, by expanding the government comfort zone from the solid blue line to the dotted blue line.

[19] see box: Climate-Smart Development, Adding up the benefits of actions that help build prosperity, end poverty and combat climate change

[20] Builds upon ICAT Transport Pricing Guidance, July 2017, INFRAS, VCS and Atkins’ report Future Proofing Cities which was produced in partnership with the UK Department for International Development and University College London in 2012

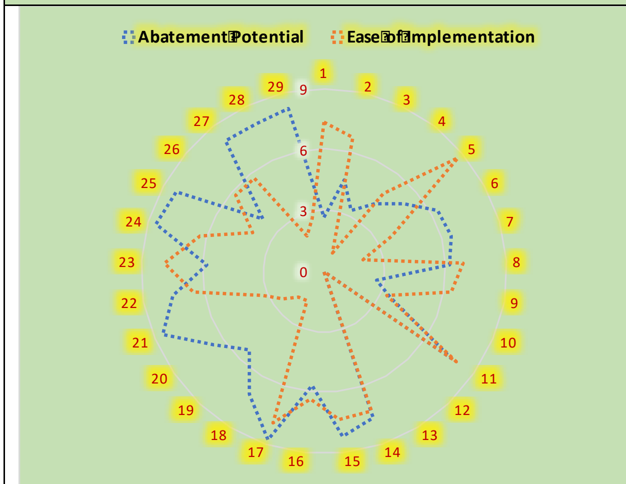
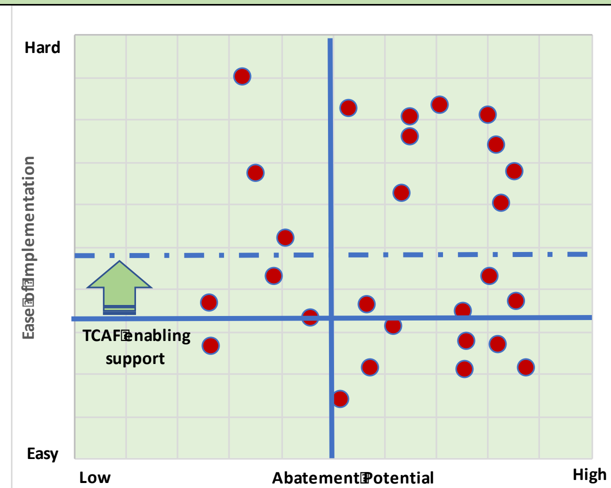
Abatement potential and ease of implementation of 29 individual mitigation policies	How TCAF enabling support can increase the number of policies that can be implemented
	

Figure 3 - The abatement potential and ease of implementation of the individual mitigation policies in transport[21]

3. Examples of TCAF applicability in transport

3.1 Mexico, liberalization of gasoline and diesel prices

Gasoline and diesel prices in Mexico have traditionally been regulated by the government and until 2015, were gradually raised on a monthly basis through the “Impuesto Especial sobre Productos y Servicios” (IEPS) a “special” tax on certain goods including fuel. Liberalization of gasoline and diesel prices was one of the pillars of the country’s energy reform in order to align domestic prices with global ones. Throughout the 36 years of IEPS it has functioned as a price smoothing mechanism, helping Mexican consumers pay below-market prices to compensate paying above-market prices while oil prices were low. However, over the last 10 years, before recent price increases it as a subsidy.

[21] The details of listed interventions can be found in Annex 1

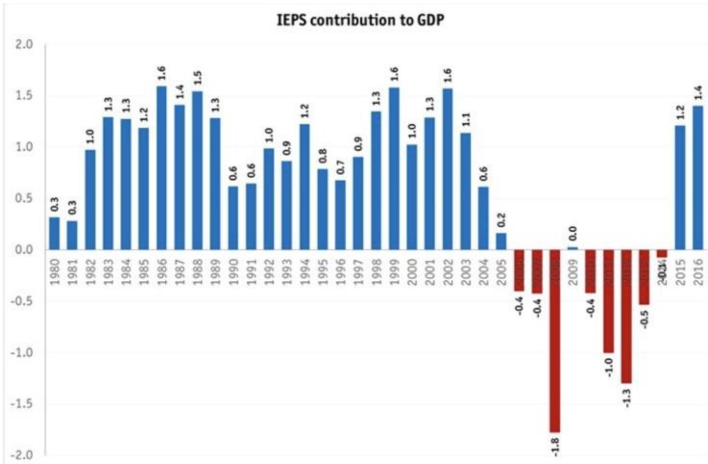


Figure 4 - Contribution of IEPS to GDP Source: SHCP (2016 is January-October). Blue is tax, red is subsidy

Whilst Mexican gasoline prices were low by global averages, fuel costs amount to nearly 3.4% of the average Mexican's real income, almost double that of the average American. However, the middle class is dependent on car ownership. Mexican cities are notoriously badly designed for mass transit, in Mexico City, the best as far as mass transit is concerned, the Metro and Metrobus (BRT) are heavily overcrowded and the remainder of the bus network is composed primarily of microbuses, operated as individual concessions with no central authority and where personal safety is a disincentive to switch from car use. The Liberalization agenda has led to a price increase of 22.5 percent on average during 2017. According to Citibanamex, if the government had wished to avoid this increase the fiscal cost would have been 145 trillion pesos. The liberalization is taking place in 2017 in five stages, with dates as shown in Figure 5.

Figure 5 - Stages of the liberalization of prices. Source: La Comisión Regladora de Energía

This national-scale price increase is leading users to switch to smaller more fuel-efficient vehicles, car-pooling and greater use of public transport, and could be a good fit for TCAF's core priorities.

3.2 Transit Oriented Development (TOD) and Non-Motorized Transportation (NMT) Development

TOD is a fast-growing trend in creating vibrant, livable, sustainable communities by creating compact, walkable, pedestrian-oriented, mixed-use communities centered around high-quality light rail, metro of BRT systems. Its main characteristic is a walkable design centered around pedestrians, not cars. Typically, successful TOD has the mass-transit station as prominent feature with public space around it. It will have a high density, walkable district within 10-minute walk circle containing a mixture of uses in close proximity (office, residential, retail, civic) and usually designed with easy use of bicycles and scooters as ancillary support transport[22]. This brings substantial benefits to people and can also avoid a lot of travel, reducing CO2 emissions as a consequence shown by below Table 2.

Table 2 - Perceived benefits of Transit Oriented Development (Source: HNTB Companies 2016)

Perceived benefits of TOD	Percent respondents
Reduced dependence on driving	57%
Allow residents to live, work and play in the same area	46%
Reduce the area's carbon footprint and negative impact on the environment	44%
Provide better access to life services	43%
Stimulate the local economy	43%
Provide better access between urban and suburban areas	42%
Provide access to better entertainment services	39%
Provide access to better jobs	37%
Revitalize urban areas	30%

Non-motorized transportation (NMT) development offers the truly green (zero-emissions), sustainable and pro-poor mobility option to urban cities by encouraging walking and cycling trips. The key to reversing the trend towards more private vehicle use is make walking and cycling attractive, together with improving public transport. An extensive, connected and safe NMT infrastructure networks are key to NMT development. This can be done by a range of activities including sidewalks and bike lanes infrastructure construction, bike sharing and parking program, bicycle intergration in mass transit system, urban planning and pedestrian-oriented development. It is increasingly recognized that NMT is a highly cost-effective transportation strategy and brings about large health, economic and social co-benefits, particularly for the urban poor.

Here, TCAF may be able to see ER results generated in a quick term by selecting TOD and/or NMT projects which are half-way through their development cycle, where for example a BRT has already been built as part of city's overall transit strategy implementation, however the government is still making progress in further optimization or adjustment of TOD and/or NMT policies to achieve the goals or to maximize the impacts.

A similar example could be Vietnam which had been implementing its own energy efficiency scheme for ten years, however it wasn't as successful as expected and was discontinued after 2016. Here carbon finance is being use to reboot the sector in line with newly issued energy efficiency circulars. Because of the previous ten years awareness raising and sector experience, the carbon finance program was able to trigger the sector improvement and generate the ERs in a short term (e.g. 2 years).

In Mexico, most of the BRT transportation projects have been planned in isolation, only as corridors and for a great majority of these, complementary policies linked to TOD/NMT could increase the environmental impact. Very few routes have parking management policy in their perimeter of influence, few have integration with public bicycle systems, none are linked to inclusive housing policy. In Mexico City, the "Sistemas de Actuación por Cooperación" (SAC) have included four modal transfer centers[23] with a private trust that is generated with the developers and used to rehabilitate the polygon around the terminals. This moves action outside of the political timetable and enables things to get done.

[22] See http://www.tod.org

[23] Tacubaya (CETRAM), Chapultepec (CETRAM), Observatorio (CETRAM + Toluca Train), and Vaqueritos in the polygon near the Tec de Monterrey del Sur University

3.3. Energy efficiency or CO2 emissions standards for vehicles

Many cities in developing countries suffer chronic air quality problems caused by the emission of local pollutants[24] from vehicles. This is often also associated with severe congestion; however private vehicle ownership is seen as a positive effect of economic development which should not be overly restricted. This has led to the realization that strengthening vehicle emissions standards is a necessary step to maintain urban vitality.

Vehicle manufactures have developed their products to meet these increasingly severe emissions standards. The current (best) technology level for most manufacturers meets the European EURO 6d/VI emissions standards or the US EPA Tier 2/2010 emissions standards. At the same time the EU and USA are requiring greater fuel economy[25] leading to concurrent development that intermingles the two desired results.However, fewer developing countries have yet realized the benefits of requiring new vehicles sold in the country to meet both emissions and fuel economy standards developed together to meet EU or USA requirements to resolve similar issues.

In 2014, the G20 Energy Efficiency Action Plan established a Transport Task Group (TTG) to promote cooperation among participating G20 countries to develop domestic policies that improve the energy efficiency and environmental performance of motor vehicles. The TTG currently includes Australia, Brazil, Canada, China, the European Union[26], India, Japan, Mexico, and Russia. The status of fuel economy standards within the TTG are shown in Table 3. For the three developing countries, Mexico has legislation under development that more advanced than India or China. All need continuing assistance for these proposed standards to be finally enacted.

Table 3 - - Status of light- and heavy-duty vehicle fuel efficiency regulations in G20 TTG members. (Countries/regions are ordered alphabetically.) Adapted from Du et al. (2017).

	Light Duty			**Heavy Duty**		
Region	**Current**	**Adopted but not yet implemented**	**Under development**	**Current**	**Adopted but not yet implemented**	**Under development**
Australia			Standards under discussion			
Brazil	Inovar-Auto; Vehicle labeling (PBEV)					
Canada	Phase 1 [2012-2016]	Phase 2 [2017-2025		Phase 1 [2014-2018]		Phase 2 [2019+]
China	Phase IV			Phase 2		Phase 3
EU	PV - Regulation 443/2009; LCV – Regulation 510/2011		Regulations relating to cars and vans beyond 2020			Legislation on mission certification, monitoring, & reporting and standards
India		113 gCO2/km in 2021				
Japan	Top runner	Top runner		Top runner		
Mexico	NOM-163-SEMARANT-ENER- SCFI-2013		Aligned with U.S. LDV 2017- 2025			Aligned with U.S. HDV 2018-2027
Russia						
USA	Phase 1 [2012-2016]	Phase 2 [2017-2025]		Phase 1 [2014-2018]	Phase 2 [2019+]	

[24] CO, VOC, NOx and PM

[25] EU: PV - Regulation 443/2009; LCV – Regulation 510/2011, and USA: Phase 1 (2012 – 2016) fuel efficiency standards

[26] With individual participations of Germany, Italy, and the United Kingdom

If and when the more advanced standards are implemented across the G-20, nearly 90% of new LDVS and HDVS sold worldwide will meet world-class emissions standards, compared to only half of new vehicles sold today. The direct CO_2 emissions from light- and heavy-duty vehicles in TTG-participating countries have been evaluated under three scenarios for new vehicle efficiency and CO_2 standards[27]:

- "baseline" scenario assumes no further improvements in new vehicle efficiency after 2005
- "adopted policies" scenario includes all policies adopted as of September 2016, including those taking effect in the future.
- "world-class" scenario models the impacts of all TTG participating countries developing new vehicle efficiency standards consistent with the objectives of the G20 Energy Efficiency Leading Program (EELP). These aspirational targets include a 50% reduction in LDV fuel consumption compared to a 2005 base year by 2030 and a 30% reduction in HDV fuel consumption compared to a 2010 base year by 2030 (G20, 016).

The "adopted policies" scenario is estimated to avoid 2 billion tons of carbon dioxide (GtCO2) in 2040, whereas new world-class LDV and HDV efficiency standards applied in all TTG member countries could mitigate direct emissions from fuel combustion by an additional 2.4 $GtCO_2$ in 2040 (Figure 6). The magnitude of emission reductions achievable with continued vehicle efficiency standards—roughly evenly split between light- and heavy-duty vehicles— indicates the importance of continued activities to promote these policies among TTG-participating countries.

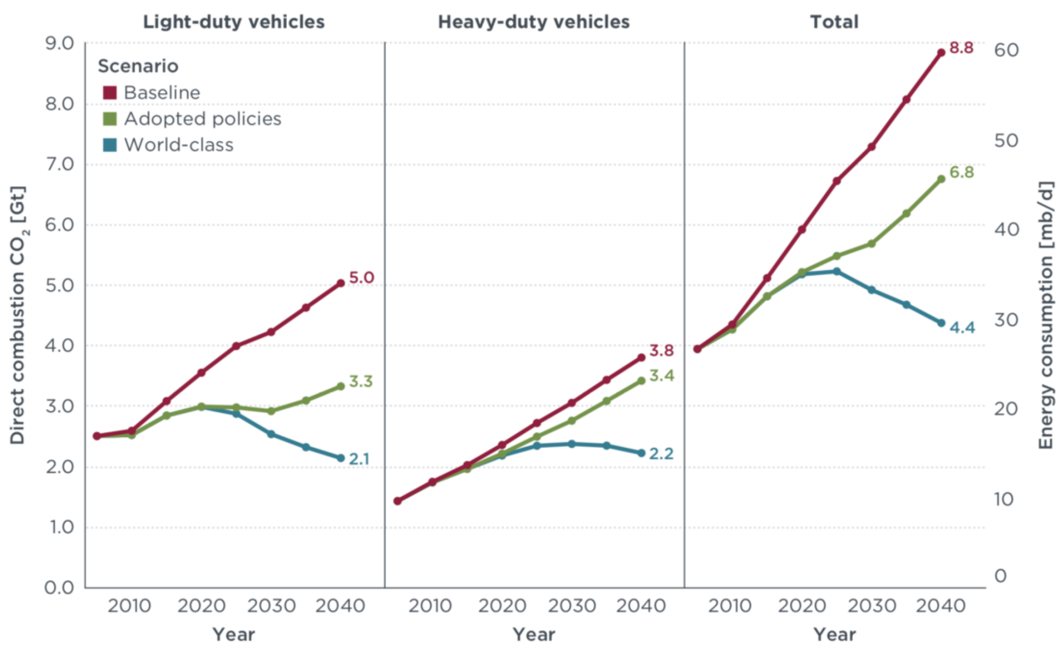


Figure 6 - Direct combustion CO2 emissions of light- and heavy-duty vehicles in TTG+EU member states under baseline, adopted policies, and world-class efficiency scenarios, 2005–2040. Figure shows historical and projected emissions for Australia, Brazil, Canada,, China, the EU-28 (including TTG members Germany, Italy, and the United Kingdom), India, Japan, Mexico, the United States, and Russia [27]

This also indirectly implies that most other developing countries that are not members of the TTG and whose fuel economy standards are non-existent or do not meet the "Baseline" shown above will also exhibit substantial mitigation opportunities if they can be assisted in aspiring to the "adopted policy" level or better. TCAF could play an important role in helping this come about.

[27] Source: Impacts of world-class vehicle efficiency and emissions regulations in select G20 countries: Josh Miller, Li Du, Drew Kodjak ICCT, January 2017

3.4 Congestion Charge Zones

Whilst TCAF would not look to credit ERs from a developed country, London's congestion charge zone provides a well-documented experience of the emissions reductions that can be achieved by this type of policy.

London's central area congestion charging scheme led to a 20% reduction in four-wheeled traffic within the charging zone during charging hours, cutting an estimated 40-50 million liters of vehicle fuel consumption inside the zone and a total 100,000 tons CO2 emissions annually across London. Approximately half of this is due to 75,000 fewer vehicles daily and half due to the remaining traffic experiencing less congestion.

Congestion charging consists of a daily charge of £8[28] for driving or parking a vehicle on public roads within the congestion zone between 0700 and 1800 on Monday to Fridays, excluding public holidays and weekends. The original zone cost £160m to set up, with annual operating costs of £90m. The charge raises £122 M surplus revenues over operating costs annually which is then spent on improving transport, including providing more buses, improving road safety and implementing energy efficiency in transport.

A TCAF involvement in such a program could provide a useful rallying flag for the different involved local and national stakeholders and provide the impetus to get it off the ground. In particular, monitoring the impact of congestion charge zone emissions performance is often inadequate and TCAF funding dedicated to improve this could provide a significant source of new information to other cities to enable its use.

4. Key Design Features for TCAF Transport Crediting Methodology

There are two broad groups that define the TCAF crediting methodology. Each has different advantages and complications. In both, as TCAF involves results-based crediting it is necessary to determine the emissions impact of measures after they have been implemented and also forecast the future effects of these measures to estimate the overall value of the program.

Intervention- or policy-specific crediting: This follows a CDM logic in which a policy or program is implemented and the emissions outcome is measured. It is also applicable to programmatic crediting, which supports a larger number of similar projects within a program—for example, several BRT corridors, possibly in different jurisdictions.

Programatic crediting is relatively simple to scale up through replication and is often accompanied by an incentive program that transforms carbon revenues into other incentive payments.

In the intervention and programmatic approaches, the baselines and Monitoring, Reporting, Verification (MRV) are usually based on technology. In policy-specific crediting, however, the baselines and MRV are usually based on econometric modeling.

In both, data for a year in which the intervention or policy was in operation is compared to what could be expected to have occurred if the intervention or policy had not been enabled. It can use an engineering approach to determine the GHG mitigation contribution of technical changes and use econometric analysis to determine the impact of consumer choice on transport mode, vehicle type, and activity. It often requires additional field measurements to fully quantify this activity.The methodology determines the GHG emissions of both scenarios ("with-policy" operation compared to the counterfactual "without –policy" scenario) and applies considerations to reduce leakages. The difference between the two resultant emissions values represents the mitigation for the year in question due to the application of the policy or

[28] This is the initial charge in the original zone which went into effect in February 2003, and was extended to a larger área in 2007.

intervention. The TCAF crediting volume for that year results from subtracting the mitigation amount that is needed to meet NDC targets and other commitments from this total, as is discussed in the next chapter.

Transport sector-wide crediting: This is used when a combination of instruments is implemented to achieve an emissions reduction goal and it is not necessary to assign mitigation outcomes to each of these instruments. The methodology defines a Transport sector-wide credit basically by comparing the transport-sector emissions inventory in a historic crediting period with the sector's NDC unconditional target for that year. Additional considerations are applied to reduce leakages and subtract the impact of other programs (to avoid double-counting) and then the difference between the two resultant emissions values represents the TCAF crediting volume for that year.

The advantages and complications associated with the two approaches are summarized in the below table 4.

	Transport sector-wide crediting	Intervention- or policy-specific crediting
Ease of application	X	
Requires that the transport sector share of NDC target emissions be specifically defined	X	
Less additional data collection required	X	
Best suited to large multi-policy interventions	X	
Calculates emission reduction in target year	X	X
Calculates emission reduction forecast for subsequent years		X
Best suited to specific policy or intervention analysis		X
Forecasts GHG mitigation from that policy change in future years		X
Best suited to policies and interventions that have outcomes with long response times		X
Allows flexibility in the application of the crediting volume		X
More robust causality		X

Table4 – Comparison of advantages of the different methodologies

TCAF crediting can follow ex-post impact analysis associated with discrete policies and other interventions which are under-implementation. This analysis design should be to minimize uncertainties so that the buyer of each VER[29] has full confidence that there is no double-counting or other artifact that reduces the value of the ton of CO_2 reduction that is traded. At the same time, an excess of conservativeness is to be avoided, since this can reduce the value of the traded VERS to the seller to a point that makes the exercise unmanageable.

Following the rationale that each of the policies/interventions has a direct/indirect impact channel leads to caused GHG mitigations, a counterfactual "without-policy" scenario can be developed as part of an MRV methodology. This signifies that the with-policy operation will be measurable in historical years, and the emissions mitigation due to the enactment of this policy will be determined by comparison to a counterfactual scenario that portrays what would have happened if the policy changes had not been enacted.

5. Application of TCAF Guidelines to Transport Crediting

[29] Verified Emissions Reduction

5.1. The TCAF Core Requirements

The Transformative Carbon Asset Facility (TCAF) provides funding through emission reduction transactions to stimulate, in client countries, the establishment of robust regulatory frameworks for carbon pricing, and to promote sustainable development. To achieve this, TCAF has well-defined selection criteria for participating programs.

1. **Coherence with national mitigation aims**. The program should be consistent with the country's Nationally Determined Contribution (NDC), and fully aligned with domestic policy objectives and sectoral priorities
2. **Support increased ambition**. The program should enable the country to increase its mitigation target beyond what it would achieve with its own efforts.
3. **Achieve a lasting impact**. The program should ensure the sustainability of emission reductions after the Facility's support ends.
4. **Have sustainable development co-benefits** and maintain environmental and social safeguard standards.
5. **Demonstrate a high level of environmental integrity** of emissions reductions.
6. **Avoid any distortionary effects** on international competitiveness or the sector's GHG emissions.
7. **Establish a robust baseline** for the program.
8. **Be ready to implement in the short-term**.

Short-listed candidate programs for TCAF support that demonstrate compliance with these criteria should be selected based on prioritization, transformative policy design, and political realism.

- **prioritization**, i.e., figuring out which policies or other interventions would achieve the maximum overall TCAF program emissions reduction result.
- **transformative policy design**, i.e., working out which policies would obtain maximum transformative impact, which in effect may mean maximizing the implicit carbon price on a sectoral basis; and
- **political realism**, i.e., identifying and resolving the political-economic barriers, such as how to overcome or transform, the interest of influential stakeholders in maintaining the status quo.

Key elements in defining the above, are TCAF's requirements on (i) transformational change; (ii) baseline setting; (iii) Monitoring Reporting and Verification (MRV); (iv) additionality and avoidance of double counting; (v) sustainable development; and (vi) crediting parameters and safeguarding against regrets. This section guides the application of TCAF requirements to Transport sector crediting.

TCAF criteria for transformational change are four-fold as listed below:

- **Size**: TCAF operations are expected to show their transformational quality in achieving a large volume of emission reductions, i.e., at least 5 million tons CO_2e over the crediting period] of 5-7 years.
- **Sustainability**: emission reductions must be sustainable over time.
- **Leverage**: TCAF operations are expected to enable the country selling the ER to increase its domestic emissions-reduction ambition over time.
- **Carbon pricing**: TCAF operations should contribute directly or indirectly to the development and implementation of explicit or implicit domestic carbon pricing policies. A global objective of TCAF is to catalyze a scaled-up international carbon market or another set of policy mechanisms adopted by multiple nations committed to a joint approach to rapid decarbonization.

Transport sector crediting policies that meet these criteria can be Prescriptive, Economic, Supportive, or Direct investment (see Error! Reference source not found.**)**. They are usually not project-specific unless a programmatic approach has allowed bundling. While many transformative policies are economically attractive, they often face resistance because of their size and disruptive influence of making existing technologies with higher emissions, uneconomic. Thus, they can harm the financial interests of important actors and corporations. Therefore, special care must be taken to develop politically astute transitional plans targeted at reducing this resistance.

Table 4 - Typology and examples of different measures

Typology	Mechanisms	Examples
Prescriptive	• Regulation • Agreement	Fuel economy standards CO_2 g/km standards for new vehicles Low emissions, congestion charge zones
Economic	• Carbon Tax • Direct Financial Incentive (such as Specific tax credit or deduction, Subsidy) • Cap and Trade Emissions trading	Bonus-malus tax feebate on new vehicles CO_2-based annual road tax Vehicle fuel tax US regional Transportation and Climate Initiative (TCI)
Supportive	• Identification of opportunity (such as data collection, auditing, monitoring, benchmarking) • Cooperative measures (such as partnerships and promotion) • Capacity Building	EPA SmartWay Eco-Driving Company behavior, corporate responsibility ICAO CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation)
Direct investment	• Government procurement • Technology installation	Government vehicle fleet procurement Intelligent Transport System Infrastructure Electric vehicle charging infrastructure

5.2. Baseline setting

All countries that are signatories of the Paris Agreement agreed to reduce their GHG emissions and strengthen their commitment over time. Most high-income developed countries committed to an emissions reduction in absolute terms compared to a previous year. Developing countries (in a group known as non-Annex I countries), however, typically committed to reducing the emissions intensity of their future growth. Usually, they offered in their NDCs a single-year target (for 2030) that is a percentage of the expected BAU emissions.

Many of these non-Annex Countries are candidates to receive financial and technical support to assist them in reducing their greenhouse gas emissions and managing the impacts of climate change. Some of them distinguish in their NDCs, "*unconditional targets*" that they commit to meet using their own resources from "*conditional targets*" that can be achieved only with international financial or technical support.
TCAF forms part of this international support, as it consists of results-based emissions crediting with a fund that purchases emissions reductions (ERs) at an agreed price per ton of CO2e. Some of the ERs that are purchased are transferred and are no longer available to the seller to meet its obligations. Double-counting is not allowed.

Thus, the baseline setting for TCAF operations will be defined by the selling-countries' unconditional NDC targets . Emission reductions forming part of these targets cannot be credited and need to be part of the baseline. Additionally, since the Paris agreement anticipates that the NDCs will strengthen over time, and since ERs that have been sold cannot be applied to tightening commitments, the TCAF baseline has to be stricter than the unconditional NDC target to ensure a high level of environmental integrity and compensate for uncertainties in the ER determination and calculation process. . All other ERs that have been sold (for example, through CDM) are also discounted in this way.

In practical terms, this means that TCAF will credit against a crediting threshold or ("TCAF-baseline") that is well below the BAU emissions trajectory and typically also well below the target emission trajectory (see Figure 14). Single year targets will conservatively be broken down to crediting periods (default is linear break down).

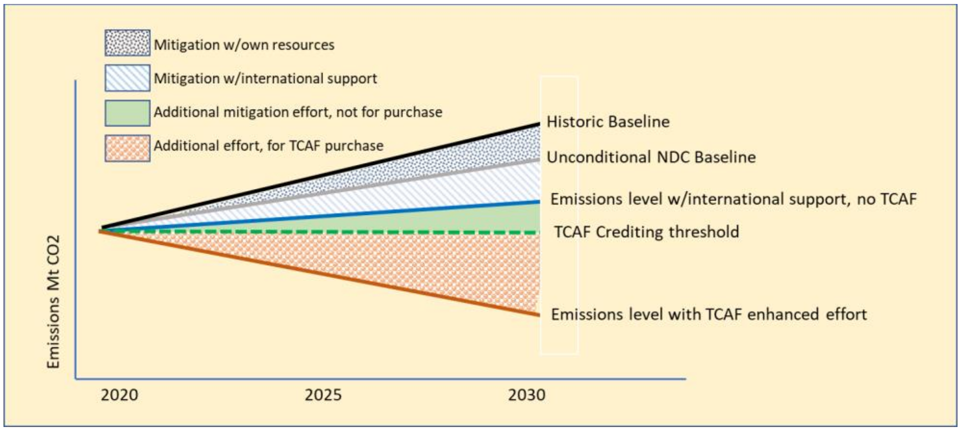


Figure 7 - BAU, baseline and crediting threshold

The diversity of NDCs amongst countries means that TCAF requires a flexible approach to tailor the baseline for each TCAF operation. Nonetheless, operations will likely fall into one of the following general categories: (i) congruent – full congruence of the unconditional NDC target area with the TCAF operation's boundary (e.g., the TCAF operation is about increasing use of electric vehicles under a NDC that has an explicit unconditional target on the uptake of electric cars), (ii) inside target - TCAF operation falls under a broader (e.g., economy-wide) target, and (iii) outside target - the TCAF operation is outside the NDC target area (e.g., in the waste sector of a country that has only an energy target – assuming for simplicity no energy components of waste sector mitigation activities).

Additionally, there are two approaches to TCAF crediting. The first approach is called ***'target-based creditin***g' in which the full change in emissions caused by the interdiction is considered and evaluated. The second approach is called ***'crediting at the margin'*** in which it is assumed that TCAF funding is responsible for increasing the level of ambition of the interdiction or accelerating the introduction of the measure. Example of this could be accelerating the introduction of electric buses or in a greater number of cities, through support from a TCAF program.

Since TCAF is results-based financing, the baseline calculation methodology has to consider two schemes:

- The amount to be credited is calculated from recorded values (ex-post analysis). Here, the emissions with the policy in place is measured, and the counterfactual baseline (what would have happened without the policy) has to be determined through calculation (modeled results).
- Determining the total expected ER from the TCAF program requires a forward-looking calculation over the crediting timeframe (ex-ante analysis). In this part of the analysis, both the TCAF baseline and the expected emissions have to be modeled.

In both cases a bottom-up process is followed, and where possible existing methodological tools with relevant modifications should be used.

5.3. Monitoring Reporting and Verification (MRV)

The Paris Agreement established a universal system of transparency for MRV, with built-in flexibility taking into account countries' different capacities. The Agreement requires countries to report and be reviewed on a biennial basis on:

a. Progress with the implementation of NDCs;
b. Progress with the provision/receipt of support; and
c. Identification of capacity building needs.

A gradual strengthening of national MRV-systems should also be the framework for any TCAF MRV. To ensure legitimacy and support, TCAF's MRV must be aligned with national MRV systems (accounting methodology; computer systems; etc.). This way TCAF can also make a valuable contribution to building national level MRV capacity.

In urban transport-sector crediting, TCAF operations will typically be on a jurisdictional level. In transport policy crediting TCAF operations will typically be on a sectoral level. MRV can often build on existing methodologies developed under CDM and JI. However, simplifications to reduce transaction costs may be possible in MRV approaches developed for project-based crediting when moving to a higher aggregation level in crediting.

Policy-based crediting will require modeling approaches to MRV. The development and set-up of such MRV systems require substantial efforts but policy MRV will typically be simpler and less costly to operate than facility-level MRV. Policy MRV will also provide co-benefits in enabling a better-informed policy design and implementation process beyond a concrete TCAF operation.

Inventory boundary and leakages Defining an adequate inventory boundary can be critical to successful carbon crediting. A geographic boundary can often be defined that limits the size of the emissions inventory in the baseline and makes the ER easier to evaluate--it is easier to distinguish mitigation of a thousand tons CO_2 in an inventory of 50,000 tons than in an inventory of one million tons. For sectoral crediting, functionally is further limited to include only the sector under consideration. However, smaller boundaries can increase leakages and care must be taken to describe and reliably account for all leakage into or out of this boundary. Two examples are when a long-distance fleet fills tanks within the boundary, or commuters that travel within the boundary but fill-up outside.

Handling of uncertainty Baseline development and emission measurement are often linked to a high level of uncertainty, particularly when the expected emissions mitigation is small. A discounting mechanism can be applied to compensate for these issues.

Discounting is the process whereby the determined emissions reduction is multiplied with a discount factor that is between 0 and 1, based on the uncertainty of the data, to ensure that the buyer of the ER is not short-changed. Uncertainty can also be reduced by improving the MRV process and increasing the data that is collected. As discounting reduces the value of the ER to the seller, and improving the MRV process increases the cost of MRV to the seller, an optimal mix can be found (in which the MRV process is enhanced to what is economically practical) that maximizes the net benefit to the seller of generating each ER.

In all cases periodic verification needs to be undertaken by an independent third party.

5.4. Additionality

TCAF uses a two-layer approach to additionality:

<u>Layer one: market mechanism</u> takes into account that TCAF operations will follow a market mechanism logic as they are piloting potential new international market mechanisms under Article 6 of the Paris Agreement and seek recognition of the purchased verified emission reductions (VERs) under Article 6 as NDC compliance grade.

Additionality will be defined as the difference between the crediting threshold ("TCAF baseline") and the actual emissions (see Figure 7). This results in the "volume of layer one additional emission reductions".

Operationalization of layer one additionality will therefore be done through systematic assessment of the crediting threshold. Instead of taking for granted that NDC targets will lead to emission reductions below BAU, TCAF will establish BAU trajectories on the level of TCAF operations and relate them to NDC targets. Furthermore, crediting parameters will be defined in such a way that TCAF will only credit emission reductions relative to crediting thresholds, which are emission trajectories below the baseline. These trajectories can also be below NDC targets where appropriate. As target setting is not static under the Paris Agreement but dynamic – parties are expected to increase their NDC targets and coverage over time – increases in ambition will be reflected in baselines if they occur during TCAF crediting periods.

Layer two: finance mechanism follows a climate finance logic as TCAF operations are piloting Article 6 mechanisms through the provision of results-based climate financing (RBCF). This suggests considering the underlying financial structure of TCAF operations within an attribution approach leading to a second layer approach to additionality.

Layer two additionality will follow an attribution approach to emission reductions achieved with TCAF operations. For that purpose, all international support that a TCAF operation receives will be mapped and for each of these international support components the grant equivalent ("subsidy value") will be determined. The subsidy value of the TCAF ERPA itself is the net present value of the ERPA payments.
Next, the share of the TCAF subsidy value in the aggregated subsidy value across all instruments of international support used to support the TCAF operation will be determined. On that base, the emission reductions attributable to the TCAF operation will be derived. This will result in the "volume of layer two additional emission reductions" and ensure that no more emission reductions are attributed to TCAF than what TCAF relatively delivered in international support to make the operations happen.

Finally, the volumes of layer one additional emission reductions and layer two additional emission reductions will be compared and the lower of these volumes will define the maximum TCAF ERPA purchase volume.

5.5. Avoidance of double counting

Accounting of emission reductions under NDCs is a complex task as targets are formulated in different ways, and as there is no common unit available. However, the challenge can be resolved by rigorously applying the principle of double bookkeeping. The volume of emission reductions transferred would need to be transparently reported by the country selling the ER (for example, in an annex to its inventory report, indicating the exact nature, source, boundary, and timing of the credited mitigation activity). The corresponding volume of emission reductions purchased would need to be reported as well by the buying country, including the same additional information and the intended usage of the credits (compliance purpose or cancellation). In the case of TCAF this would need to be done by all TCAF contributors pro-rata to their share in the purchasing fund.

In policy-based crediting, there is a real risk of double-counting against individual activities ("projects") incentivized by the policy that ultimately generate emission reductions. Great care must be taken to adequately document all stages in the process. Avoidance of such double-counting requires: (i) a commitment by the country selling the ER through an approval letter to apply record keeping as outlined above to all international transfers of emission reductions (not just the transfers under TCAF operations) and to safeguard against double counting through appropriate diligence, (ii) a corresponding ERPA clause committing the TCAF operation implementing agency to the same principles, and (iii) including monitoring of compliance with the accounting rules in the due diligence of TCAF operations.

5.6. Sustainable development

All TCAF programs should ensure compliance with the World Bank environmental and safeguard standards and consistency with UN Sustainable Development Goals. Going beyond a safeguarding approach, each individual TCAF program should define relevant indicators to evaluate progress and the nature of sustainable development benefits. Examples can include indicators related to health benefits due to reduced air pollution, from vehicle emissions, positive impacts on disposable income from low income households through savings on energy bills, and reduced traffic accidents etc.

These indicators will become criteria for program selection as well as for performance monitoring and evaluation of program results over time.

5.7. Crediting parameters

Crediting parameters comprise the length of the crediting periods of TCAF operations and the share of emission reductions achieved against the respective baseline (crediting threshold) to be purchased by TCAF. It also comprises pricing (not discussed in this note).

Crediting periods will be of a duration of five to seven years, and the share of emission reductions purchased by TCAF is variable and specific for each operation. However, TCAF operations aim for purchase volumes over the full crediting period of an order of magnitude of five million tCO2e. Within this overall framework TCAF will set crediting parameters for each individual operation with the aim of safeguarding environmental integrity, increasing ambition, achieving global mitigation, promoting sustainable development, and incentivizing private sector mitigation action.

5.8. Safeguarding against regrets

Overselling, i.e., missing the NDC target because of selling a too large volume of emission reductions is a risk, that needs to be mitigated both from a selling-country perspective and also from TCAF's perspective in order to avoid reputational risk.

TCAF will require the country selling the ER to have a mitigation strategy that accounts for the TCAF operation. Such analytical work will require consideration of mitigation potential and mitigation strategy on the national level – depending on the nature of the NDC target potentially broken down to target sectors.

TCAF will count as much as possible on work undertaken in this area by the country selling the ER itself and under initiatives such as the PMR. Only in cases where these analyses cannot be provided under existing work programs will TCAF close the gap through its own efforts.

6. Blueprints for TCAF programs supporting transport sector emissions reduction

The following example illustrates how these TCAF guidelines could be applied to transport crediting. It should be noted that the numbers are fictional because it does not describe a historical case where TCAF was applied.

Applying light-duty vehicle CO_2 emissions standards in Morocco

The **Kingdom of Morocco** is a semi-constitutional monarchy with an elected parliament thatis located in the Maghreb region of North Africa. In 2019, it had a population of 36.47 million and a GDP per capita of US$3,396 (constant 2010 USD).

Transport sector's energy consumption and emissions
Its final energy consumption in 2016 was 15.37 million tonnes of oil equivalent in which the transport sector was the largest consumer with 36 percent of the total, using mainly oil products.

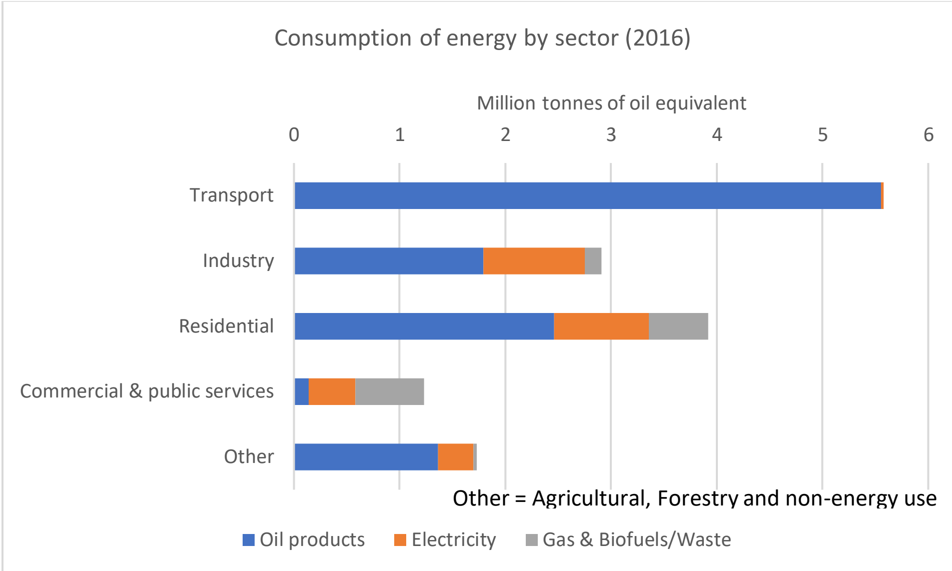


Figure 8 - Consumption of energy by sector in Morocco (2016)

Consequently, the transport sector was the highest emitter of CO_2 emissions, and within the sector, 98 percent of emissions were caused by on-road vehicles.

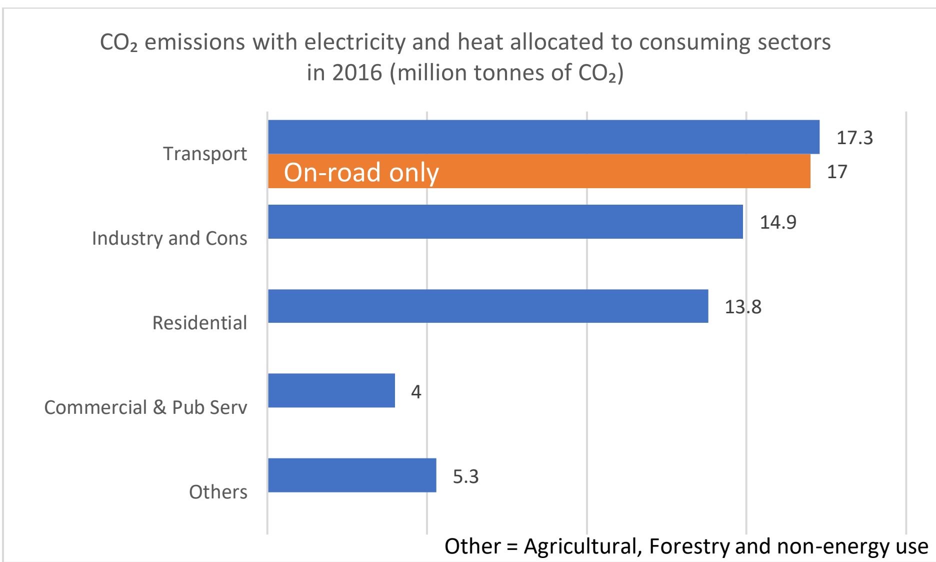


Figure 9 - CO_2 emissions by sector in Morocco (2016)

Morocco's Nationally Determined Contribution (NDC) and enhanced ambition in transport

Morocco in its Nationally Determined Contribution (NDC) committed to an unconditional reduction in GHG emissions between 2020 and 2030 of 13 percent (without AFOLU actions) and that 9.1 percent of this mitigation effort was expected to come from transport[30] in conjunction with other sectors. The measures to achieve this include creating a model, low-carbon city, the extension of the Rabat and Casablanca tram lines, and a large taxi upgrade plan. Additionally, they proposed a condition target of 25 percent that could be achieved with international assistance. Transport participation in this extra effort consists of the implementation of eco-driving training of truck drivers, improvement of maintenance and technical control of transport vehicles, a bonus-malus incentive for new car sales, upgrade of heavy-duty commercial vehicles of 20 years and older, and modal shift from road to rail.

[30] This is 9.5 % in 2020 reducing to 8.6% in 2030

The Proposal to include a fuel-economy / CO_2 emissions standard for new light-duty vehicles

These transport measures could be usefully complemented by fuel-economy / CO_2 emissions standards for new light-duty vehicles. A program to align the Moroccan market with the EU's g CO_2/km emissions standard by 2030 and maintain alignment after that, could generate, compared to the BAU scenario a reduction in CO_2 emissions in 2030 of 6.8 million tonnes CO_2 per year, representing a 19.9% reduction in on-road emissions. By 2040, the reduction in CO_2 emissions increases to 16.8 million tonnes per year (36.1% of total on-road emissions) as more vehicles that meet the standards enter the market. In further years, emissions reduction is even more significant.

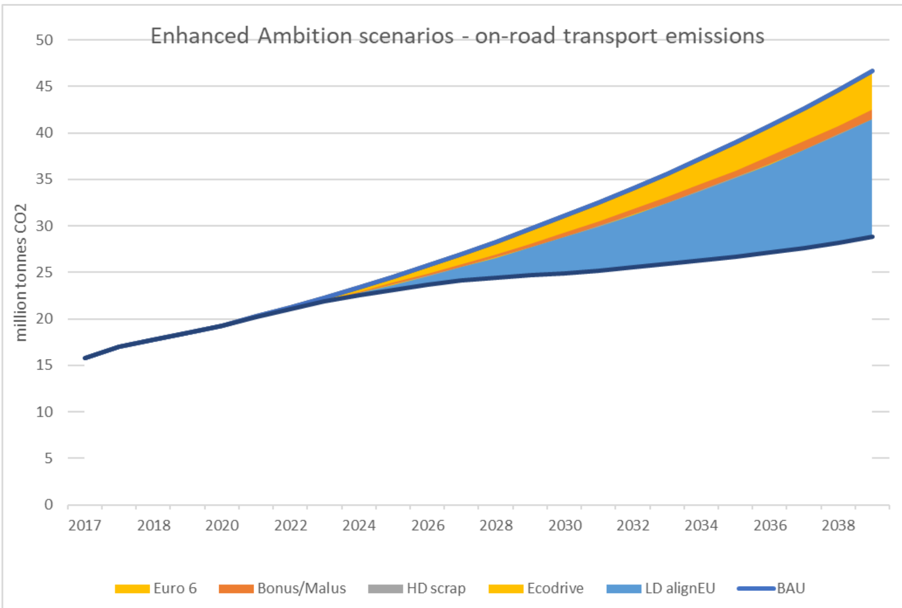


Figure 10 - Enhanced ambition scenarios for on-road transport

A regulation that aligns new light-duty vehicle GHG emissions standards to the EU's could be low cost for Morocco, since most of the new light-duty vehicles that enter use in the country are sourced from European Manufacturers that will already comply with these standards and production compliance testing is already performed by the EU. This ensures that the Moroccan consumer receives the most up-to-date vehicles, with the benefits of reducing fuel costs. This tendency to electrify the country's light-duty vehicle fleet is consistent with their ambition in the power sector to increase renewable generation and reduce the emissions intensity of electricity.

Table 5 - Ex-ante estimations of GHG emissions reduction to 2030

		Ex-ante *Emissions, Transport (MtCO2/year)*	2020	2025	2030
#	Calculation		*MtCO2/year*		
1	input	Baseline Emissions	22.10	27.80	34.20
2	input	Unconditional NDC	20.42	25.93	32.37
3	[2] - [1]	Change in emissions relative to Baseline	(1.68)	(1.87)	(1.83)
4	[3]/[1]	Change in emissions relative to Baseline (percent)	(7.6%)	(6.7%)	(5.3%)
5	input	Achievable change in emissions supported by unconditional own efforts		0.00	0.00
6	input	Achievable change in emissions, supported by international finance	(0.40)	(1.10)	(3.20)
7	[5] + [6]	**Achievable change in emissions with current program**	0.00	(1.10)	(3.20)
8	input	**Additional change in emissions with TCAF support**		(0.70)	(3.60)
9	[7] + [8]	Total achievable change in emissions		(1.80)	(6.80)

Table 5 gives an indication (using some fictitious numbers) of this proposal. Their baseline emissions are expected to increase from 17.8 million tons of CO_2e in 2015 to 34.2 Mt CO_2e in 2030. The unconditional mitigation goal gives 5.3 % reduction compared to a business as usual scenario. The international support that is considered in their current plans should generate additional mitigation by 2030 of 3.20 Mt CO2e. Adding a GHG emissions regulation for new light-duty vehicles that is aligned to the EU could contribute a further reduction of 3.6 Mt CO2e by 2030.

The crediting framework
The crediting framework that is applicable would be sectoral policy-based, tightly focused on the implementation of this regulation and how it increases the activity of low emitting vehicles in the in-use fleet.

The numbers in Table 5 represent an initial rough ex-ante estimate of the basis fo the crediting program.
Table 6 illustrates the ex-post calculation of the ERs generated by the crediting program. In this example the ERPA purchase volume in 2025 is small (0.17 million tons CO2e). Still, it increases quickly as new light-duty vehicles that meet the regulation are included in the in-use vehicle fleet. By 2030 the emissions reduction purchased is expected to reach 1.55 million tons CO2e and increase after that.

TCAF offers to purchase verified emission reductions (ERs) resulting from the enhanced ambition of the policy, at a rate high enough to compensate for any transitional or welfare losses due to the changes enacted. As TCAF is a hybrid instrument, around 50 percent of the VERs will be transferred to the TCAF donors under a carbon market transaction and will no longer be available to Morocco towards its NDC. The remainder will be funded through results-based climate finance (RBCF), and the ERs will remain in Morocco for its compliance. This is because about half of TCAF donors are not interested in receiving offsets for their own NDC compliance and want to deliver RBCF to help host countries undertaking mitigation activities.

In addition to this, the country may decide not to sell all the emissions mitigation generated by this program, keeping a portion for its own use and to resolve future uncertainties.

This crediting program could meet TCAF's requirements

Transformational change:
The estimated emission reductions in this case-study of over 2 million tCO_2e per year in 2025, rising to 3.9 million tCO_2e per year by 2030. (#8 in Table 6) meets the size criteria, and as more vehicles enter the in-use fleet with lower GHG emissions the ER is expected to rise to 7.3 million tCO2e per year by 2035, thus enabling the country to increase its domestic emissions-reduction ambition over time. When the EU formalizes CO_2 emissions standards for heavy-duty vehicles it could be expected that Morocco would seek alignment.

Baseline-setting
Morocco committed in their NDC to unconditionally reduce their transport emissions intensity by 5.3 % by 2030 compared to a business as usual scenario levels. With international assistance, they committed to an additional reduction of at least 9.5 % by 2030.

This is shown in Table 6, where the unconditional NDC baseline is given in #10 and the TCAF crediting threshold in #13. Note how the historic baseline emissions, the unconditional NDC, which is a percentage of these, and achieved mitigation (with and without international support) are all slightly different from the ex-ante estimations (given in Table 5). This is often experienced when economic and population growth, and policy enactment, in reality, are all different than that originally forecasted. As this analysis is conducted ex-post, it is possible to directly measure through the MRV systems, the level of emissions with all the mitigation actions functioning. This is shown in item #14 of Table 6.

Table 6 - Ex-post estimations of GHG emissions reduction to 2030

		Ex-post *Emissions, All Sectors (MtCO2/year)*	2020	2025	2030
#	Calculation		*MtCO2/year*		
1	input	Baseline Emissions	22.30	28.30	35.60
2	input	Unconditional NDC percent change	(7.6%)	(6.7%)	(5.3%)
3	[1] * (1+ [2])	Unconditional NDC	20.60	26.40	33.70
4	[3] - [1]	Change in emissions relative to Baseline	(1.70)	(1.90)	(1.90)
5	input	Achieved change in emissions supported by unconditional own efforts		0.00	0.00
6	input	Achieved change in emissions, supported by international finance	(0.40)	(1.10)	(2.80)
7	[5] + [6]	**Achieved change in emissions with current program**	(0.40)	(1.10)	(2.80)
8	input	**Additional change in emissions with TCAF support**		(2.20)	(3.90)
9	[7] + [8]	Total achieved change in emissions		(3.30)	(6.70)
	Calculate TCAF crediting using Additionality Layer one (market mechanism)				
10	min([3],[1] + [5])	Baseline (Lowest of NDC, and Baseline less unconditional mitigation)	20.60	26.40	33.70
11	[6]	Emissions change, supported by international finance		(1.10)	(2.80)
12	input	Mitigation retained by host country for own use and to cover uncertainty		(0.11)	(0.28)
13	[11]+[12]+[13]	TCAF Crediting threshold	20.60	25.19	30.62
14	[1]+[9]	Emissions levels including TCAF effort		25.00	28.90
15	[14] - [13]	**TCAF emissions change to be credited (market mechanism)**		(0.19)	(1.72)
	Calculate TCAF crediting using Additionality Layer two (finance mechanism)				
16	[6] + [8]	Total change in emissions supported by internat finance (inc TCAF)		(3.30)	(6.70)
17	NPV[15]/NPV([6]+ [15])	Proportion of NPV TCAF subsidy value to total international NPV subsidy value (see note)	58%		
18	[16] * [17]	change in emissions due to TCAF		(1.92)	(3.90)
19	[12]	Mitigation retained by host country for own use and to cover uncertainty		(0.10)	(0.70)
20	[18] - [19]	**TCAF emissions change to be credited (finance mechanism)**		(1.82)	(3.20)
	Calculate which is applicable Layer one or Layer two				
21	[15] or [20]	Which is smaller: Total Layer two change or Total Layer one change?	Layer one is smaller		
22	[15] or [20]	Layer one and two: TCAF emissions change to be credited		(0.19)	(1.72)
23	input	Inventory weighted data quality discount (sectoral + overarching)	90%		
24	[22] * [23]	TCAF ERPA purchase volume		(0.17)	(1.55)
25	input	percent applicable for RBCF	50%		
26	[24] * [25]	Emissions reduction supported by RBCF		(0.09)	(0.77)
27	[24] * (1- [25])	Emissions reduction supported by Carbon Market Transaction		(0.09)	(0.77)
Note:	[17] should be calculated based on the net present value (NPV) of international finance contributions				
	[23] can be improved through good MRV design and implementation				

Additionality

The required two ways of calculating additionality are shown in Table 6. Additionality is the difference between the TCAF crediting threshold and the actual emissions[31]. The crediting volume as calculated under the market mechanism is shown in Item #15, and the crediting volume as calculated under the finance mechanism is given in Item #20. In this example, layer one is smaller and will be used to define the maximum TCAF ERPA purchase volume.

Note that the percentage shown in item #17 assumes that the net present value of the international support per ton of mitigation is constant when in reality, the subsidy value across all instruments of international support may vary considerably.

[31] see TCAF Crediting threshold in Figure 7

MRV and Handling of uncertainty

There are several possible mechanisms for establishing this counterfactual emissions level. In this example an emissions inventory approach was used to describe what would have occurred if no emission mitigating intervention had taken place, including those that could have been incentivized by the crediting scheme.

The discount factor used to compensate for uncertainty is shown in Table 6 item #23.

TCAF ERPA purchase volume

The calculation of the TCAF ERPA purchase volume is shown in item #24. This is then divided amongst donors into two components, carbon finance transaction and RBCF (items #26 and #27).

7. Proposed steps for moving forward

Based on the above analysis, TCAF could be a useful instrument to be explored and integrated into the technical assistance and lending operations to support development and implementation of transport sector mitigation program in the client countries. The TCAF seeks to collaborate with the transport GP to identify a pilot crediting program that the host country is interested in pursuing based on a suite of mitigation policies/interventions already in advanced planning and preparation stage. Resources are available to support both preparation and implementation of such crediting programs.

Annex I Details of listed interventions of Figure 3

	#	Policy	Description	Activity and emissions impact	Possible revenue impact	Type of Intervention			Mitigation Potential	
						Avoid	Shift	Improve	Abatement Potential	Ease of Implementation
Pricing policies that increase the variable cost of operation of	1	**Reduce Fuel Subsidies**	Removal or reduction of subsidies that reduce the price of vehicle fuel below its fair-market end-user price (including production, transport and retail)	Leads to reduced vehicle travel and can promote switching to more efficient and alternative fueled vehicles or travel in other modes	Frees-up public funds. May be used to reduce government fiscal deficit, or to reduce taxes and/or increase investment in government services		X	X	L	H
	2	**Increase tax on fuels**	These can increase government income. Tax amount may vary by fuel type which can promote fuel switching	Leads to reduced vehicle travel and can promote switching to more efficient and alternative fueled vehicles or travel in other modes	May flow through to a general kitty, or targeted to specific uses, such as poverty alleviation or transport sector improvements.		X	X	L	H
	3	**Carbon taxes**	Carbon taxes are proportional to a fuel's carbon content. Increase fuel prices, with higher increases for the more carbon intensive fuels	Can provide a large change in emissions by rewarding low carbon energy alternatives compared with traditional vehicular fuels. Can lead to reduced vehicle travel and promote switching to more efficient and alternative fueled vehicles or travel in other modes	Can be used to reduce other taxes and to fund energy efficiency programs		X	X	M	H
	4	**Road Tolls and time-of-day pricing**	These charge the user for access to roads that give lower travel time. Charge may vary by time of day or road utilization	Can enhance investment in more efficient transport modes which could reduce emissions, or fund roadway expansion which could increase emissions.	Provide funding for transport improvement		X		M	L
	5	**Congestion or low emission zone charging**	Limit access to a geographical area based on the number of vehicles operating in the area and/or on the vehicles emissions	Reduce vehicle usage in the zone and promote usage of mass transit. Can increase travel outside the zone	Provide funding for transport improvement	X	X		M	M
	6	**Parking restrictions and pricing**	These charges increase the variable cost per trip	Reduce private vehicle usage and promote usage of mass transit. Can cause other destinations to be preferred.	Increased local govt funding can be invested to reduce local traffic problems	X	X		M	H
Pricing policies that increa the fixed cost of ownership vehicle	7	**Distance-based vehicle insurance and registration fees**	These charges reduce the fixed cost of vehicle ownership and increase the variable cost per trip	Reduces vehicle travel and emissions	Generally, revenue neutral			X	H	L
	8	**Vehicle import duty**	These charges reduce vehicle ownership but can cause older vehicles to be employed	Reduces vehicle travel but can increase emissions per vehicle	May flow through to a general kitty, or target specific uses	X			H	L
	9	**Vehicle feebate based on emissions**	Increases taxes on high emitters and provides subsidies (rebate) to clean vehicles	Reduces vehicle emissions	Generally, revenue neutral			X	H	H
	10	**Vehicle special sales tax**	These charges reduce vehicle ownership but can cause older vehicles to be employed	Reduces vehicle travel but can increase emissions per vehicle	May flow through to a general kitty, or target specific uses			X	L	H
Pricing policie that promote more efficien transport mode	11	**Vehicle registration fees based on emissions**	These charges reduce vehicle ownership and promote use of more efficient vehicles	Reduces vehicle travel and move to cleaner vehicles	May flow through to a general kitty, or target specific uses			X	M	M

	#	Policy	Description	Activity and emissions impact	Possible revenue impact	Type of Intervention			Mitigation Potential	
						Avoid	Shift	Improve	Abatement Potential	Ease of Implementation
Non-pricing policies and other intervention	12	**Mass-transit fare reform and integration**	Can include reduced fares, free transfers, universal transit passes (trip integration) and more convenient payment systems (such as electronic payment cards, or mobile telephone payment.	Promotes the use of mass transit and reduces private vehicle usage	Generally, revenue neutral or reduces government take.		X		H	H
	13	**Strict efficiency and emissions stanards for new vehicles**	Regulations to ensure continus improvement from new vehjivles entering the ...	Requires lower emission vehicles	Through national regulations			X	H	H
	14	**Introducing Low-Emission Vehicles to Commercial Vehicle Fleets**	Gives incentives to fleets to adopt cleaner vehicles (removes travel restrictions etc)	Promotes low emission vehicles	Requires increase in private investment			X	H	H
	15	**Reduce max age of in-use vehicles**	Regulation and scrappage program	All vehicles. Can take >10 years to get full impact of policy. Easy to get registration but difficult to get ...	May require govt funding for scrappage program			X	M	H
	16	**Use of Biofuels in all vehicles**	Regulation on min biofuel mix	Reduces vehile emissions but care needed not to increase agricultural emissions	May require subsidies to biofuel producers			X	H	H
	17	**Development of intermodal hubs for freight**	Infrastructure that promotes mode shift to a lower carbon intensity means of freight transport	Reduces on-road vehicle activity and emissions	Additional investment may have a long payback period	X	X		H	L
	18	**Development of rail links**	Infrastructure that promotes mode shift to a lower carbon intensity means of passenger or freight transport	Reduces on-road vehicle activity and emissions	High investment may have a long payback period		X		M	L
	19	**Modal shift of freight from road to rail**	Give incentives to companies to use rail instead of road tranmsport	Reduces on-road vehicle activity and emissions	May require govt funding for improvements and subsidies		X		H	L
	20	**Modal shift of freight from road to waterways**	Give incentives to companies to use inland waterways instead of road transport	Reduces on-road vehicle activity and emissions	May require govt funding for improvements and subsidies		X		H	L
	21	**Formalize and improve standard bus services**	Improve a mass transit system with better service quality	Reduces on-road vehicle activity and emissions	Requires strong governence of municipal authorities		X		H	H
	22	**Development of BRT lines**	Infrastructure that promotes mode shift to a lower carbon intensity means of passenger transport	Reduces on-road vehicle activity and emissions	Medium investment. Can be built in political timeframe		X		M	H
	23	**Intelligent Transport Systems**	Makes it easier for passengers to use mass transit and give priority to mass transit operation	Promotes modeal shisft	Can be built in political timeframe		X		H	H
	24	**Development of metro lines**	Infrastructure that promotes mode shift to a lower carbon intensity means of passenger transport	Reduces on-road vehicle activity and emissions	High investment may have a long payback period		X		H	L
	25	**Cycling and pedestrian infrastructure**	Promotes more use of bicycles and walking	Reduces on-road vehicle activity and emissions	Usually low/medium investment	X			M	M
	26	**Electric vehicle charging infrastructure**	Promotes more electric vehicles	Reduces emissions	Requires additional investment			X	H	M
	27	**Vehicle Quota Systems**	Limits number of vehicles	Reduces on-road vehicle activity and emissions	Requires strong national governence	X		X	H	L
	28	**Transit-oriented urban planning**	Transit-oriented development (TOD) maximizes the amount of residential, business and leisure space within walking distance of public transport	Reduces the need to travel, reduces vehicle activity and emissions	Can increase local government funding by increasing land-use tax on transit corridors	X			H	L