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Transportation NAMAs: A Proposed Framework

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ABOUT CCAP

Since 1985, CCAP has been a recognized world leader in climate and air quality policy and is the only independent, non-profit think-tank working exclusively on those issues at the local, national and international levels. Headquartered in Washington, D.C., CCAP helps policymakers around the world to develop, promote and implement innovative, market-based solutions to major climate, air quality and energy problems that balance both environmental and economic interests. For more information about CCAP, please visit www.ccap.org.

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1 Executive Summary

Any realistic strategy to reduce global GHG emissions must address transportation in the developing world. Most of the growth in transportation GHGs by 2050 will be in the developing world, and by 2030, more than half of all vehicles will be in non-OECD countries. Failure to address this sector will shift mitigation responsibilities and costs to other sectors, such as electricity generation, or jeopardize achieving targets for atmospheric CO_2 concentrations.

There may be no other sector where sustainable development and GHG mitigation are as closely aligned as in the transportation sector – most emissions reduction measures produce significant co-benefits, such as improved air quality and economic development. This sector also provides unique opportunities for transformational policies that can catalyze low-carbon growth. Implementing measures such as BRT, land-use policies, and congestion pricing in an integrated manner can have many times the impact of putting these same measures in place independently.

Some transportation-sector characteristics inhibit its ability to obtain climate funding: difficulty in determining the business-as-usual baseline; uncertainties in estimating the emissions reductions from mitigation measures (since these often contain a component of human behavior); and high up-front costs but long-term CO_2 benefits that tend to grow with time (making short-term cost-effectiveness evaluations misleading). Thus, policymakers in developing countries often find it extremely frustrating to develop plans to address GHG emissions from the transportation sector.

Nationally Appropriate Mitigation Actions (NAMAs) provide a new framework that can potentially overcome these difficulties and achieve substantial reductions in transportation emissions in developing countries. Broadly defined, NAMAs are actions voluntarily proposed by developing countries that significantly reduce emissions below business-as-usual levels. NAMAs can be categorized into three groups.

Unilateral NAMAs are autonomous actions taken by developing countries to achieve emissions reductions without outside support or financing. These are typically low-cost mitigation measures and are an important piece of a climate policy package for transportation, representing developing countries' own contributions to mitigation efforts. There are numerous revenue-generating and low-cost mitigation options in the transportation sector, including fuel taxation reform, fuel economy standards, and smart growth land-use planning.

Supported NAMAs are developing-country actions undertaken with financial or other support from developed-country Parties; they also represent developing countries' contribution to climate mitigation. For the transportation sector, these could include capacity-building measures, particularly the design and implementation of Low Carbon Transportation Plans; policy and regulatory measures, such as congestion pricing; and physical infrastructure, such as Bus Rapid Transit. Support could come in the form of direct financing, loans, technology transfer, or capacity-building assistance.

Credit-generating NAMAs are actions that could be partially or fully credited for sale in the global carbon market after an agreed-upon crediting baseline has been reached. These are not as promising for the transportation sector, as credit-generation programs for policies and bundles of projects are likely to face two of the same challenges – quantifying emission reductions with certainty and demonstrating additionality – that have virtually excluded transportation from the existing Clean Development Mechanism. Vehicle efficiency and fuel-switching policies seem to be the most promising transportation-sector mitigation measures, at least in terms of the potential to develop feasible methodologies, to be proposed as credit-generating NAMAs.

Overall, supported NAMAs provide the greatest opportunity to truly transform the transportation sector in developing countries. To realize this opportunity, CCAP proposes that the following principles be established to promote effective adoption of supported transportation NAMAs:

- **Develop Low Carbon Transportation Plans for countries and metropolitan regions.** Low Carbon Transportation Plans chart a course for short-term and long-term GHG reductions through a comprehensive set of policy, infrastructure and fiscal measures; assessing full costs and sustainable development co-benefits; modeling GHG emission reductions; and identifying key implementation steps. An effective plan would include public transportation; bicycling/walking infrastructure; smart growth land-use planning; efficient vehicles; low-carbon fuels; and economic measures such as congestion pricing.
- **Create a transportation "window" in the Copenhagen Green Climate Fund with dedicated, sector-specific funding and evaluation criteria.** Appropriate evaluation criteria for supported transportation NAMAs include: consistency with a comprehensive Low Carbon Transportation Plan; long-term GHG reduction potential; cost effectiveness of the integrated bundle of measures; sustainable development co-benefits (e.g., economic development, public health); local implementation capacity; and cost-sharing.
- **Earmark planning and capacity-building funding.** Some of the most important long-term actions, such as planning, economic studies and professional education, do not directly translate into emission reductions but are the backbone of effective mitigation.
- **Fund bundles of projects and policies.** The funds available to support NAMAs should be leveraged by funding "bundles" of projects and policies established in Low Carbon Transportation Plans. Each bundle will include some low- or negative-cost policies that the host country will implement unilaterally, as well as more expensive measures that require support. The most attractive "bundles" will consist of packages of synergistic measures in which unilateral NAMAs serve to improve the overall appeal of the bundle.
- **Accept uncertainty**. There will be considerable uncertainty in modeling emissions reductions and developing baselines, especially for some of the most transformational projects. At least initially, evaluation decisions will need to take account of this uncertainty and focus on funding packages that are directionally correct, i.e., those that reduce emissions, even though the exact volume of reductions may be uncertain.

There is a clear funding gap for sustainable transportation projects in developing countries, due to the high costs of transportation infrastructure and the limited resources available. There are also many mitigation opportunities (e.g., pricing, vehicle regulation, and land-use policies) that generate revenue or can be implemented with minimal public expenditure. These negative-cost opportunities have not been pursued due to a range of barriers, including local political challenges or a lack of implementation and enforcement capacity. CCAP's proposal for Low Carbon Transportation Plans and bundling of NAMAs addresses both of these issues while also encouraging the use of synergistic measures. It uses the "carrot" of funding for supported NAMAs to leverage the negative-cost opportunities that would otherwise be difficult to incentivize through an international fund. These negative-cost measures also improve the cost-effectiveness and competitiveness of the overall Plan or bundle.

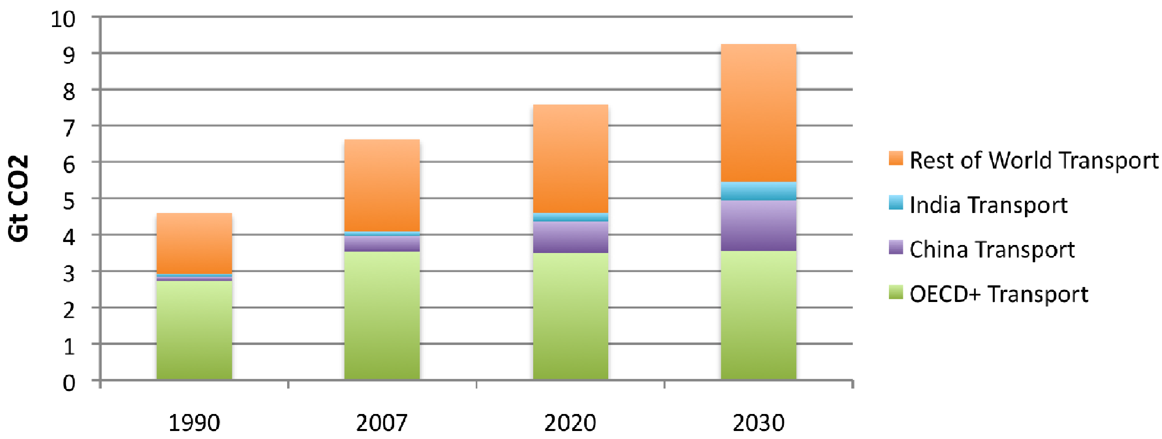
CCAP's proposed framework shows how NAMA financing can be leveraged to help direct more substantial financial resources from public and private investment toward lower-carbon transportation choices. The benefits for climate may be large, but the local impacts may be even larger, as improved travel choices foster economic development, better quality of life and reduced air pollution. Climate funding cannot be the only driver, but it can help catalyze the transformation to an environmentally and economically sustainable transportation system.

2 Introduction

2.1 Transportation Emissions in the Developing World

Transportation in the developing world must be a focus of any realistic strategy to reduce global greenhouse gas emissions. Globally, transportation accounts for 23% of energy-related CO_2 emissions.[1] In many industrialized countries, including the U.S., gains in fuel economy are leading to stable or declining overall emissions, as vehicle ownership and travel may be showing signs of saturation.[2] Many developing countries, in contrast, are still in the early stages of motorization, and transportation emissions are rising rapidly (see Figure 1). For example, India's transportation emissions are expected to increase more than fourfold by 2030, under the International Energy Agency's (IEA's) reference scenario. China's transportation emissions are expected to more than triple over the same period.[3] In fact, almost all of the growth in greenhouse gas emissions from transportation in the first half of this century will be in the developing world, and by 2030, more than half of the world's vehicles will be in non-OECD countries.[4]

Figure 1. Projected Transportation Emissions 1990-2030



Source: IEA Reference Scenario (IEA 2009).

Failure to address the transportation sector will increase the costs of tackling global climate change. Inaction in the case of transportation can certainly be compensated for by more aggressive measures in other sectors, but at potentially far greater cost. Indeed, many measures to reduce transportation emissions come at negative cost, meaning that they pay for themselves (see Box 1). Vehicle lightweighting and other fuel economy improvements reduce fuel expenditures. Congestion pricing and abolition of fuel subsidies generate government revenue and increase economic efficiency, as well as reducing emissions. Smart growth land-use development can yield large savings in infrastructure costs and household transportation

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[1] International Energy Agency (2009b).
[2] Millard-Ball and Schipper (2010).
[3] International Energy Agency (2009b).
[4] Dargay, Gately, and Sommer (2007).

expenditures. And the "co-benefits" of many public transportation infrastructure projects – travel time savings, reduced local air pollution and increased economic development – outweigh the expenditures, even before factoring in reductions in CO_2.[5]

In fact, there may be no other sector where sustainable development and GHG mitigation are as closely aligned as in the transportation sector – one of the most attractive features of mitigating greenhouse gas (GHG) emissions in the transportation sector in developing countries is that these actions generally catalyze the achievement of other sustainable development benefits as well. This sector also provides unique opportunities for transformational policies that can catalyze low-carbon growth. Implementing measures such as BRT, land-use policies, and congestion pricing in an integrated manner can have many times the impact of putting these same measures in place independently.

However, some transportation-sector characteristics inhibit its ability to obtain climate funding: difficulty in determining the business-as-usual baseline; uncertainties in estimating the emissions reductions from mitigation measures (since these often contain a component of human behavior); and high up-front costs but long-term CO_2 benefits that tend to grow with time (making short-term cost-effectiveness evaluations misleading). Thus, policymakers in developing countries often find it extremely frustrating to develop plans to address GHG emissions from the transportation sector.

Nationally Appropriate Mitigation Actions (NAMAs), a concept introduced under the Bali Action Plan of 2007,[6] provide a framework for developing countries to reduce their greenhouse gas emissions through a mechanism that provides funding support, technical assistance and global recognition for their efforts. This paper makes the case that NAMAs can provide a framework to bring about substantial reductions in transportation emissions in developing countries. However, NAMAs themselves will have little impact unless they are implemented in a way that leverages other sources of funding and changes investment priorities and policies. Globally, more than $800 billion per year is invested in road and rail infrastructure, with a further $1.5 trillion in vehicle purchases.[7] This paper proposes that the next international climate change framework establish a transportation NAMA "window" within the Copenhagen Green Climate Fund – a mechanism by which dedicated support for transportation NAMAs can help reorient at least some of these trillions toward more climate-friendly transportation systems. The concepts of NAMAs and NAMA windows are discussed in Section 2.3.

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[5] In Mexico, for example, the World Bank evaluated nine transportation interventions: bus system optimization, urban densification, Bus Rapid Transit, nonmotorized transportation, border vehicle inspection, vehicle inspection and maintenance, fuel economy standards, road freight logistics and railway freight. All had substantial co-benefits that outweighed project costs, with the net benefit ranging from $12-$97 per metric ton of CO_2 reduced. See Johnson, Alatorre, Romo, and Liu (2009).

[6] See http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=3, p. 3-7.

[7] Datamonitor (2009).

Box 1. Understanding the Cost of Transportation Mitigation

There are two main ways to understand the cost of mitigation measures in terms of cost per tonne of CO_2 reduced. The first and most common way is to divide the incremental expenditure (defined below) on a mitigation project or policy by the volume of emissions reduced. This is the simplest approach, particularly for privately financed measures in the energy and industrial sectors. It accounts for benefits that accrue directly to the project developer, such as fuel savings. However, it ignores the co-benefits of mitigation projects. Evaluated under this approach, some transportation projects will be "negative cost," such as pricing measures that raise revenue, but others will have very high costs, particularly transportation infrastructure.

The second way to understand mitigation costs is to divide the net social cost exclusive of CO_2 reductions of a mitigation project by the volume of emissions reduced. Social cost includes both private costs and benefits to consumers, firms and the government; and external costs and benefits. The net social cost of Bus Rapid Transit, for example, would take into account travel time savings, economic development and air pollution impacts, as well as the fiscal outlay. This approach is particularly valuable for public sector projects, which may have external benefits as their main justification. These measures may require a net expenditure but have a net negative social cost (total benefits, including external benefits, outweigh total costs).

In this paper, we generally use "cost" in the first sense, i.e. total net expenditure by consumers or firms, or the net fiscal outlay by a government entity, as this is the normal practice in climate policy. While many, if not most, transportation measures will be negative social cost, developing countries will not usually have the resources to implement all of them in the absence of external funding. Therefore, this narrow definition means that even some of the most 'expensive' abatement measures may actually be negative cost in social terms. For example, a recent study concluded that smart growth and travel efficiency measures can deliver compelling economic benefits, including avoided infrastructure costs, leveraged private investment, increased local tax revenues and consumer vehicle ownership and operating cost savings.* So while we use the first method of estimating costs for purposes of this paper, it is important to understand that this can make transportation mitigation measures appear misleadingly expensive when measured solely on a cost per tonne of CO_2 reduced basis. It can also make them seem misleadingly easy to achieve, as measures with a net benefit often face high up-front costs that are only recouped over a very long timeframe.

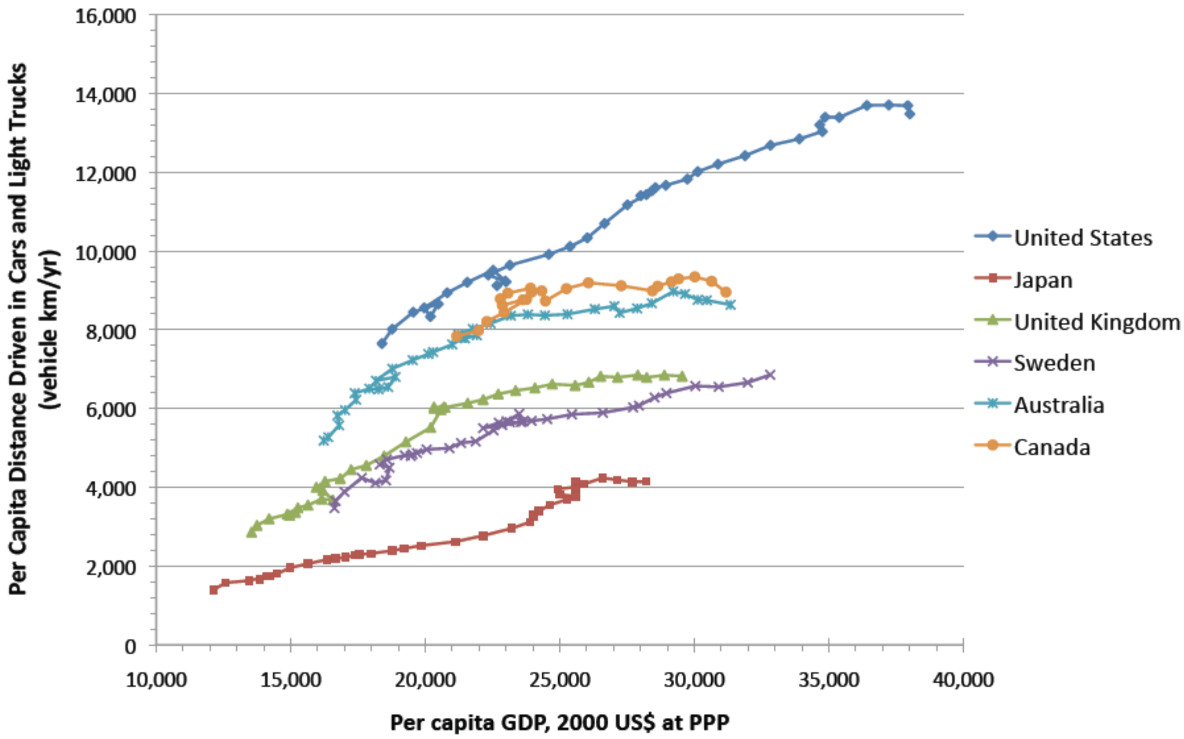
Another complication is that typical cost effectiveness calculations consider incremental costs – i.e., the difference in costs between the "business as usual" option and the "low emission" option. For transportation infrastructure mitigation projects such as rail or Bus Rapid Transit systems, it can be difficult to define the business as usual option. If public transportation is an alternative to road expansion, then the incremental cost may be very low or even negative. Typically, however, it is difficult to identify the precise alternative to public transportation infrastructure, and so a "do nothing" business as usual scenario is applied. This is the simplest method, but again it can make transportation mitigation measures appear misleadingly expensive in some instances.

* See Winkelman, Bishins, and Kooshian (2009).

2.2 Reducing Transportation Emissions

Rising transportation emissions are partly a product of economic growth. Yet, the relationship is far from deterministic, and decoupling of transportation emissions from GDP has begun to occur in many OECD countries. Within the U.S., there is a *negative* relationship between GDP and vehicle travel, i.e., the most affluent states have the lowest vehicle travel per capita.[8] Also in the U.S., the distance driven per capita in cars and light trucks declined slightly from 2003-2007, while GDP rose by 7% over the same period. Similar trends involving the decoupling of GDP and VMT can be observed in other industrialized economies, including Japan, Australia and Canada (see Figure 2).[9]

Figure 2. Travel Activity in Cars and Light Trucks 1970-2006/7



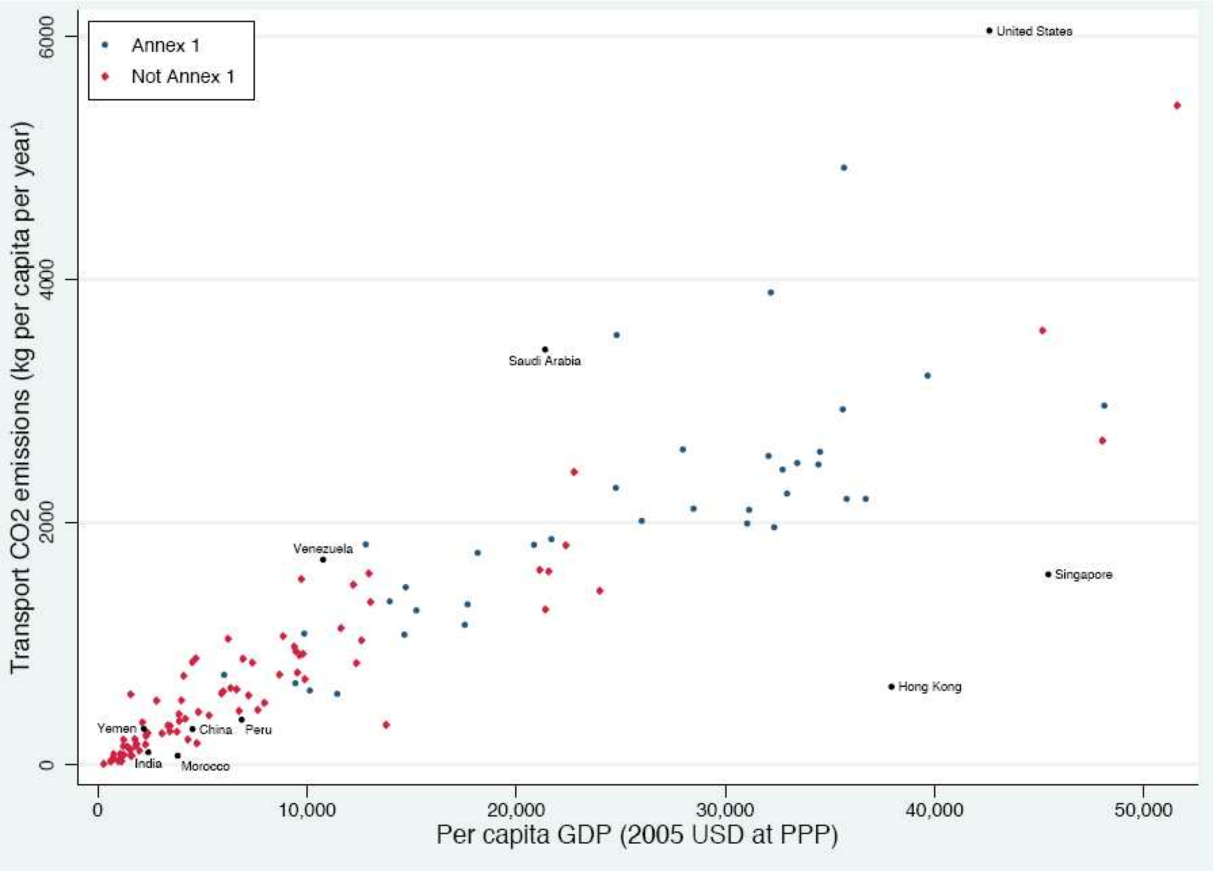
Source: Millard-Ball and Schipper (2010).

Figure 3 plots transportation CO_2 emissions per capita against GDP (adjusted for purchasing power parity). Hong Kong and Singapore are two notable examples that have achieved economic prosperity with very low emissions. As well as their dense development (partly a product of geographical constraints), both have high taxes on car ownership and motor fuels, and each has successfully pursued compact development oriented around a high-quality public transportation system. Singapore also operates a congestion pricing system. But countries such as India, Morocco and Peru also have far lower transportation CO_2 emissions than their economic development would suggest. India's per capita transportation emissions have been roughly flat since 2000, despite per capita GDP increasing by more than 50% over the same period.

[8] Winkelman et al. (2009).
[9] Millard-Ball and Schipper (2010).

In other words, there is no fixed relationship that dictates that vehicle travel (or emissions) must increase along with rising incomes, particularly past a certain threshold. Variations in emissions between countries of similar income levels can often be attributed to past and current policy choices. One study shows that up to 94% of the variance in per capita transportation emissions in 46 global cities can be explained with just four variables: population density, transit service, income and gasoline price.[10] Fuel subsidies provide a clear example. Several of the countries with higher emissions than would be predicted by GDP alone, as indicated by Figure 3, have some of the lowest fuel prices in the world. They include Venezuela, Iran, Saudi Arabia and Yemen – all oil-producing states where gasoline sells at or below the price of crude oil on the world market.[11]

Figure 3. CO_2 Emissions from Transportation vs. GDP, 2006



Source: Transportation CO_2 Data from IEA

What, then, might a comprehensive strategy to reduce transportation emissions look like? It would include physical infrastructure: Bus Rapid Transit and rail systems, bicycle lanes and

[10] Salon (2001). Another study (Kennedy et al. 2009) looks at a smaller sample of 10 global metropolitan regions and explains 94% of the variance with just two of these variables: population density and income.
[11] GTZ (2009).

paths, sidewalks and pedestrian crossings, and reduced emphasis on road construction. It would include land-use change: density, mixed uses and urban design that reduces the need to travel and makes public transportation, walking and cycling feasible. It would include vehicles that are more fuel-efficient and use lower carbon fuels. And it would include economic measures: fuel taxation and abolition of fuel subsidies; congestion pricing; and a tax structure that incentivizes cleaner vehicles. Some of these measures will have immediate effects, while others will take shape over the longer term. Fuel economy standards, for example, only apply to new vehicles, and thus take 15-20 years or longer to completely penetrate the stock of vehicles.

Reducing greenhouse gas emissions does not necessarily require increasing the expenditure rate on transportation infrastructure; instead, this can often be achieved by simply redirecting future investments. If a city continues on a path of building urban motorways, a Metro system may have some incremental impact on emissions, but far less than in the case where Metro is a substitute for, not an addition to, growth in urban roads. Thus, climate funding will have greater impact if it is used to leverage the redeployment of funds from other transportation spending. To take another example, subsidies for cleaner cars in isolation might increase emissions through increased vehicle ownership, and in turn, vehicle travel. Instead, climate funding will have most leverage if it is used to introduce incentives for consumers to purchase cleaner cars *instead* of more polluting vehicles. A good example is feebates, i.e. rebates on the most fuel efficient vehicles that are funded through levies on the least efficient vehicles.

Transportation emissions – and the policies to reduce them – can be more easily understood by decomposing them into four elements: activity, modal structure, intensity (or vehicle efficiency), and fuel carbon content (see Box 2). Some measures – particularly fuel taxation and the abolition of fuel subsidies – can reduce emissions through all four of these channels. These types of pricing measures encourage consumers to purchase more efficient vehicles and use lower-carbon fuels; increase the cost of driving relative to public transportation, walking and cycling; and reduce overall motorized travel activity. Most other measures, however, focus either on *vehicles and fuels* (reducing intensity and fuel carbon content), or *land-use and infrastructure* (reducing motorized travel activity and private car mode share). These two sub-sectors are discussed in turn in the following subsections.

2.2.1 Vehicles and Fuels

Even "new" vehicles in developing countries tend to be older models that are not the most fuel efficient for their weight class. Outdated technology may be employed in order to make vehicles affordable to a larger fraction of a developing country's population. In some cases, multinational automobile manufacturers may be reluctant to export the latest fuel-saving technology to developing countries due to, for example, concerns over intellectual property rights. There can be a five-to ten-year lag before new technologies enter non-OECD markets, although this may be starting to change in fast-growing markets such as China.[12]

[12] International Energy Agency (2009a).

Box 2. Understanding Emissions: The ASIF Framework

A useful way to understand passenger transportation emissions is to decompose them into four elements via the ASIF framework*:

- **Activity (A)** is the total amount of travel (passenger kilometers).
- **Modal structure (S)** is the share of travel accounted for by each mode (air, private car, bus, train, taxi, walking, cycling, etc.).
- **Modal energy intensity (I)** is the energy required to move a passenger by each mode (MJ per km). It is affected by load factors and congestion, as well as the technical characteristics of vehicles.
- **Fuel carbon content (F)** is the weighted average of the life cycle carbon intensity of the energy content of each fuel used by each mode (kg CO_2 per MJ).

Policies and projects to reduce transportation GHG emissions can target one or more of these elements. Examples include:

- **Transit-oriented development**, which reduces both travel distances (A) and shifts trips to more efficient modes (S).
- **Transit infrastructure**, such as rail or Bus Rapid Transit, increases the share of public transportation trips (S) and improves the efficiency of public transportation (I). However, new infrastructure may also increase activity (A).
- **Fuel taxes or subsidy removal**, which reduces travel distances (A), shifts trips to more efficient modes (S) and promotes fuel-efficient cars (I). Taxes that vary by fuel type can also be used to promote lower-carbon fuels (F).
- **Plug-in hybrids** improve energy intensity (I) and, depending on the electricity generation mix, fuel carbon content (F) as well. If they reduce the cost of driving, however, they may increase private vehicle travel (A and S).

For freight transportation, the ASIF framework can also be used, except that activity is expressed in tonne kilometers rather than passenger kilometers.

* See Schipper, Marie-Lilliu, and Gorham (2000).

This technology gap provides substantial opportunity for technical efficiency measures to reduce emissions in developing countries, especially if this gap can be addressed before vehicle ownership rates grow significantly. This will permit developing countries to develop in a more climate-friendly manner than developed countries were able to do. Lightweighting, variable valve timing and the use of hybrid gasoline-electric power trains are just a few examples – many of which can be implemented at "negative cost" per tonne of CO_2 reduced due to fuel savings.[13] In the longer-term, plug-in hybrids and second-generation biofuels may also be possible. Electric bicycles are already commonplace in Chinese cities.

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[13] McKinsey & Company (2009).

Decisions on vehicles and fuels are typically made in the private marketplace. Consumers choose between the models offered by (mainly multinational) vehicle manufacturers. With the exception of Korea and to a lesser extent China, most developing countries have little in the way of an indigenous automobile industry, although domestic manufacturing may be important through Foreign Direct Investment or joint ventures.[14] Even so, national governments have a range of tools to influence purchase decisions and the pricing and product offerings of domestic and foreign manufacturers:

- **Fuel economy standards** have been implemented in several developing countries, such as China and South Korea, as well as the U.S., European Union, Japan and Australia.[15] They can offer benefits to a country beyond reduced CO_2 emissions. In China, fuel economy standards have been seen as a way to balance a desire for a strong auto industry with its concern for oil security; to force foreign manufacturers to transfer clean and efficient technologies to Chinese production facilities; and to push domestic manufacturers to improve the vehicles that they produce.[16]
- **Taxes and rebates** can be designed to provide incentives for fuel-efficient vehicles and lower-carbon fuels. For example, vehicle purchase taxes or registration fees can be linked to fuel economy or fuel type, with rebates provided for the most economical vehicles. In Brazil, tax reductions of 15-28% for ethanol and flexfuel vehicles have helped them gain more than 75% of the market for light-duty vehicles.[17]
- **Fuel carbon content standards** or similar programs to require the use of lower-carbon fuels are being implemented in California and the European Union. In some Indian and other Asian cities, alternative fuels are required by law for certain vehicles, such as Compressed Natural Gas for buses. Differential taxation of fuels, meanwhile, can provide an incentive to switch to electricity, biofuels and other lower carbon fuels. Avoiding a large tax differential between gasoline and kerosene (if it results in kerosene being much cheaper than gasoline) also reduces the temptation to adulterate fuels.
- **Inspection and maintenance programs** have been implemented in several developing country cities, such as Mexico City. In India, minor repairs to two-wheelers, conducted during inspection and maintenance "clinics," improved fuel economy by 17%.[18]

2.2.2 Land-Use and Infrastructure

Land-use patterns in a metropolitan region have a strong influence on both overall travel demand and the modal shares of private cars, public transportation, bicycling and walking. In particular, high densities, a mix of residential and non-residential uses, low parking provision, and pedestrian-friendly urban design are associated with lower car use and transportation emissions.[19] On a global scale, cities with the lowest transportation emissions for a given level

[14] In India, for example, the largest domestic firm, Tata Motors, has 17% of the new car market, while Korean manufacturers claim two-thirds of the Indian market. Source: Datamonitor.
[15] An, Gordon, He, Kodjak, and Rutherford (2007).
[16] Oliver, Gallagher, Tian, and Zhang (2009).
[17] Ribeiro and Andrade de Abreu (2008).
[18] World Bank (2002).
[19] See, for example, Ewing, Bartholomew, Winkelman, Walters, and Chen (2008).

of economic development tend to be compact and with little city-center parking: Hong Kong and Tokyo are two examples. Within a region, modeling shows how transit-oriented land-use patterns can reduce emissions in places such as Santiago (up to 67%) and Bangalore (up to 36%).[20]

Infrastructure decisions affect travel decisions by shaping land-use patterns, and more directly, by changing the relative time costs of different travel modes. New public transportation investments such as Bus Rapid Transit (BRT) and rail lines can shift travelers from private cars. In Bogotá, 10% of passengers on the TransMilenio BRT system previously drove to work.[21] Investments that promote cycling and scale back road construction have similar effects, and pricing can play an important role as well: congestion pricing on tunnels in Seoul reduced peak-period passenger vehicle volumes by 34%.[22]

However, the most effective emission reduction strategies will not be made up of unconnected individual measures but will instead comprise packages of measures in the framework of a comprehensive metropolitan plan for land-use and transportation. This is because considerable synergies between different measures exist: for example, compact land-use patterns provide a market for public transportation, which BRT or rail investments can then serve.[23]

In contrast to decisions on vehicles and fuels, which are generally made by private actors on economic grounds subject to regulatory constraints, land-use regulations and infrastructure decisions are typically policy choices made by metropolitan regions that are influenced by a wide range of factors. Cost-benefit analysis may be one, but not necessarily the most important, criterion. Many projects exist that can reduce emissions at minimal or negative cost, even ignoring wider social benefits. In these cases, funding constraints may not be the main barrier to implementation.

Take, for example, the removal of requirements for developers to provide a minimum number of parking spaces. These minimum parking requirements are common in the developing world, either as a response to poor on-street parking management or a desire to promote Western-style automobile-oriented development. To the extent that parking requirements for new development distort urban land markets and provide an implicit subsidy for parking, their removal would bring economic benefits (as less land and capital expenditure would be required for parking), as well as emission reductions.[24] Implementation might require modest expenditures for technical and other studies, but it is unlikely that the availability of funding is the main barrier to removal of minimum parking requirements.

Infrastructure investments might therefore seem the area in which climate funding could provide the greatest benefit, given that access to finance is often the major determinant of a project's ability to move forward. Bus Rapid Transit, rail systems and bicycle networks are examples.

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[20] Browne, Sanhueza, Silsbe, Winkelman, and Zegras (2009); Lefèvre (2009).
[21] Wright and Fulton (2005).
[22] World Bank (2002).
[23] See, for example, Cambridge Systematics (2009).
[24] See, for example, Shoup (2005).

However, the short-term climate benefits of infrastructure projects are typically dwarfed by other social benefits, such as travel time savings and local air quality improvements. In Mexico City, for example, savings in CO_2 account for just 2% of total BRT project benefits at a low carbon price of $5/metric ton of CO_2 emissions reduced. Even at $85/metric ton, three-quarters of the project benefit comes from time savings, fuel savings and reductions in local air pollution.[25] In other words, transportation infrastructure is typically driven by sustainable development co-benefits, and the value of greenhouse gas emission reductions will tend to be very small in relation to both project costs and social benefits. (Conversely, a small amount of transportation CO_2 reductions will often capture significant co-benefits.) Rather than expecting large short-term emission reductions from infrastructure projects themselves, these should be seen as long-term investments that serve as the backbone of a comprehensive policy bundle that includes land-use change, pricing and non-motorized transportation. More importantly, as mentioned above, these types of projects significantly enhance a country's ability to meet other important sustainable development objectives.

2.3 The NAMAs Framework

In the Bali Action Plan, developing countries agreed to undertake nationally appropriate mitigation actions (NAMAs) that are measurable, reportable and verifiable (MRVable) in return for financial, technological and capacity-building assistance that is also subject to MRV. These NAMAs can be broadly defined as actions voluntarily proposed by developing countries, in accordance with their capabilities, that significantly reduce emissions below business-as-usual levels[26] and can be categorized into three groups of mitigation actions.

The first group, *unilateral NAMAs*, are autonomous actions taken by developing countries to achieve emission reductions without outside support or financing. *Supported/cooperative NAMAs* are developing-country actions undertaken with financial or other support from developed-country Parties; these could include more aggressive versions of proposed unilateral NAMAs. Finally, *credit-generating NAMAs* are actions for which emissions reductions could be partially or fully credited for sale in the global carbon market after emissions fall below an agreed-upon crediting baseline. The applicability of these three types of NAMAs to the transportation sector is discussed in the following three sections of the paper below.

Unilateral and supported NAMAs are designed to produce emission reductions by developing countries that are their contribution to reducing global CO_2 emissions. Since unilateral NAMAs would be implemented without international support, these will probably be focused upon cost-effective and low cost-per-ton mitigation measures. Supported NAMAs will primarily consist of the moderate-to-high cost mitigation options. Neither of these types of actions would produce offsets to help developed countries in meeting their commitments to reduce their domestic emissions. In general, CCAP has argued that credit-generating NAMAs should concentrate upon the highest-cost measures in developing countries. However, as described in Section 5, potential

[25] Schipper, Deakin, McAndrews, Scholl, and Trapenberg Frick (2009).
[26] This section is taken from a separate CCAP paper which discusses these cross-sectoral issues in full; see Center for Clean Air Policy (2009b).

credit-generating NAMAs for transportation may encompass a wider range of cost-effectiveness levels.

A range of activities, including individual actions or groups of actions, may qualify as NAMAs. Taking the form of regulations, standards, programs, policies or financial incentives, these may include:

- **Capacity-building**, including identification of mitigation opportunities, data-gathering, institutional development, implementation studies, training in technology operation and maintenance; and development of sectoral and national low-carbon development strategies.
- **Emission reduction and sink enhancement NAMAs,** including emissions-intensity standards and targets; demonstration and deployment of low-carbon technologies; energy-efficiency and energy-pricing programs; and carbon pricing through taxes or cap-and-trade programs.
- **Transformational NAMAs,** including research and development of low-carbon technologies; and development and implementation of economy-wide and sectoral strategies that transform energy use, development patterns and related policies in both the short and long terms.

NAMAs would not generally include individual GHG mitigation projects, scientific research, or sectoral strategies that do not demonstrate deviation from BAU emissions. However, NAMAs are intended to be a broad umbrella, and some individual large projects in the transportation sector, such as public transportation infrastructure, might be eligible to be a NAMA.

3 Unilateral NAMAs

3.1 What Could Qualify as Unilateral NAMAs?

Unilateral NAMAs are measures taken by developing countries to reduce emissions, without financial, technological or capacity-building assistance from high-income countries. They would be implemented as part of a global agreement to reduce greenhouse gas emissions and would represent a portion of the contribution from developing countries toward addressing climate change.

To reach any of the proposed goals for limiting the average increase in global surface temperatures, developing countries must contribute to the protection of the atmosphere through domestic emissions reductions that do not serve as offsets for developed countries. One of the key objectives of unilateral NAMAs is to help developing countries to do this by allowing them to keep the low-hanging fruit – the cheapest emissions reductions, such as those that have made up a large proportion of CDM projects – for themselves. Therefore, as mentioned above, even though any program of emission reduction measures could be a unilateral NAMA, in practice, these would likely be directed toward win-win actions – i.e. those that generate government revenue or require relatively low public expenditure – and actions that a country intends to pursue for reasons other than reductions in greenhouse gas emissions.

Unilateral NAMAs can consist of any measures that a country chooses to implement without assistance. Some examples in the transportation sector might include the following (but note that these could also be supported NAMAs, depending upon the specific needs of a developing country to effectively implement such measures and its capacity to do so on its own):

- Reductions in fuel subsidies, which will be strongly revenue-generating for the government (even if the revenue is used to compensate affected low-income groups);
- Differential taxation of vehicles based upon their greenhouse gas emissions;
- Public transportation investments with significant sustainable development co-benefits, particularly in middle-income countries that have the capacity to self-finance these projects; and
- Smart growth land-use planning, including high-density, mixed-use zoning around transit and the abolition of minimum parking requirements.

Some developing countries may not be in a position to propose unilateral NAMAs due to their limited capacities. However, low-income developing countries could still implement the programs suggested above, if capacity-building assistance or funding were provided to them by developed countries. In this case, the NAMA would become a supported NAMA, as discussed in Section 4.[27]

3.2 Rewarding Unilateral NAMAs

Since unilateral NAMAs will by definition not be supported with multilateral funds, it is important to provide a framework that recognizes and documents a developing country's own efforts. To this end, several proposals by developing country Parties to the UNFCCC suggest an international NAMA Registry as a mechanism to provide such recognition. Such a registry could serve four main functions:

- Provide a way to recognize and measure the contributions of developing countries toward climate mitigation (even if these measurements are somewhat uncertain). There is no place in current climate frameworks to do this, which has led some individuals, particularly in Annex 1 countries, to conjecture that developing countries are not taking any actions that will reduce their future emissions;
- Help manage domestic political opposition to a controversial measure – an international commitment to a specific policy, such as a fuel tax increase, may allow a government to more easily deflect domestic calls for its reversal;
- Serve as a best-practice clearinghouse with examples of emission reduction programs across the developing world; and
- Increase knowledge about the impacts of specific emission reduction measures.

[27] This issue is still unresolved, and some analysts prefer to include NAMAs implemented with capacity building assistance in the "unilateral" category. However, this is simply a matter of terminology, and for purposes of this paper, CCAP assumes that capacity building assistance pushes a NAMA into the "supported" category.

There is still a major debate as to whether unilateral actions by developing countries should be measured, reported and verified. Many developing country parties do not object to reporting their actions and associated emission reductions, but they would like to measure them according to their internal rules and methodologies and oppose international verification. In fact, the Copenhagen Accord calls for domestic MRV of unilateral NAMAs, with results reported every two years through countries' National Communications. From a broader standpoint, the key is to have sufficient knowledge of unilateral NAMAs to ensure that global emissions remain on the pathway needed to achieve the ultimate goal of the next climate framework.

3.3 Conclusions: Prospects for Unilateral NAMAs

Unilateral NAMAs are an important piece of a climate policy package for transportation, representing developing countries' own contributions to mitigation efforts. However, the ability to designate a measure as a unilateral NAMA may provide little incentive for a country to implement a policy or project. In other words, there may be insufficient incentives for developing countries to propose unilateral NAMAs in the first place. It may be more attractive for unilateral NAMAs to instead be pledged as part of a bundle of measures, some of which will attract external funding or capacity-building support. In essence, the unilateral NAMAs may make the overall bundle more competitive for external support. This concept of bundled NAMAs, and how they may incentivize greater unilateral efforts, is discussed in more detail in the following section.

4 Supported NAMAs

4.1 What Could Qualify As Supported NAMAs?

Supported NAMAs would be eligible for up-front financing (up to the incremental cost of the action) or other forms of assistance (technology transfer or capacity building) from developed nations. In common with other sectors, financing would come from the new Copenhagen Green Climate Fund. However, as described in Box 4, accurately determining the emissions reductions that will occur from transportation projects is difficult. Therefore, transportation-sector mitigation measures will generally be unable to compete with projects from most other sectors for international support, if cost per tonne of CO2 reduced is the determining factor in making such decisions. To remedy this, a transportation NAMA window should be established that has dedicated allocation criteria and a technical panel to evaluate proposals for supported NAMAs.[28] In other words, transportation NAMAs should not necessarily be evaluated using the same criteria adopted for other sectors. The concept of a transportation window is discussed further in Section 4.5.

Broadly speaking, there are likely to be three types of supported NAMAs for transportation (Table 1 provides additional concrete examples of each):

- **Capacity building, including:**

[28] Center for Clean Air Policy (2009b).

  - **Planning and Research**, such as the development of Low Carbon Transportation Plans for a country or metropolitan region, land-use modeling, and the design of fuel economy test procedures. These types of NAMAs will not necessarily lead to direct reductions in emissions. However, planning and analysis are a prerequisite for the implementation of many actual emission reduction projects. For example, Low Carbon Transportation Plans, discussed in Section 4.2, are a mechanism for countries and metropolitan regions to show how specific projects mesh with the overall vision for the transportation system and to demonstrate synergies between different projects. Many developing countries lack the capacity to develop such comprehensive plans.
  - **Data Collection.** Important activities in this category will include development of methodologies and procedures for data collection, as well as the actual collection of the data.

- **Policy and Regulation**, such as the establishment of fuel economy standards, fuel taxes, and other fiscal measures. Some NAMAs will have low implementation costs, or (as in the cases of taxes or congestion pricing) revenues may more than cover program costs. However, technical or other forms of assistance may be required for successful design and implementation of a policy (e.g., choices regarding technologies and fee structures in a congestion pricing program).
- **Physical Infrastructure**, such as alternative fuel filling stations, BRT systems, and transit-oriented development. In these cases, funding of up-front capital and other costs is likely the main barrier to implementation, and a developing country would request support to fully or partially fund a NAMA. Technical support and other capacity building assistance may be requested as well.

Table 1. Examples of Potential Supported NAMAs

	Planning and Research Activities *(primarily capacity building)*	Regulation and Policy Implementation *(primarily capacity building)*	Physical and Technical Infrastructure *(primarily finance)*
Vehicles and Fuels	• Economic studies for fuel economy standards • Development of fuel economy test procedures • Development of emission factors	• Fuel economy standards • Vehicle taxation and rebates for fuel-efficient vehicles	• Alternative-fuel infrastructure (e.g. biodiesel refineries, charging/filling stations) • Retooling factories and R&D for fuel-efficient or alternative fuel vehicles • Transfer of intellectual property rights • Inspection and Maintenance facilities
Land-Use and Infrastructure	• Low Carbon Transportation Plans for individual metropolitan regions • Public outreach • Corridor studies and district plans • Integrated land-use and transportation models • Household travel surveys • Trip generation studies	• Congestion pricing • Land-use policies and incentives to promote compact, mixed-use development • Abolition of minimum parking requirements • Parking fees • Scaling back road construction • Educational campaigns	• Public transportation infrastructure • Bicycle and pedestrian infrastructure • Intermodal facilities for freight rail or barge transportation
Cross-Cutting	• National Low Carbon Transportation Plans • Project evaluation • Data collection • Study tours for senior civil servants and elected officials • Professional development for planners and engineers	• Fuel taxation • Removal of fuel subsidies	

4.2 Low Carbon Transportation Plans

Low Carbon Transportation Plans should be the centerpiece of any mechanism for supported NAMAs and would fold into a country's cross-sectoral Low Carbon Development Strategy.[29] These plans would chart a course for short-term and long-term sustainable development and greenhouse

[29] For a more detailed discussion of the role of Low Carbon Development Strategies, see Ibid.

gas reductions by specifying a comprehensive set of policy, infrastructure and funding measures, assessing full costs and co-benefits, modeling GHG emission reductions and identifying key implementation steps. Low Carbon Transportation Plans would be "no lose" in the sense that there would be no penalty for failing to achieve targets or implement the entire plan. Rather, the plans would provide a framework to guide a coherent package of mitigation measures.

At the national scale, a Low Carbon Transportation Plan would address inter-city freight and passenger movement, vehicles and fuels. Any policy to regulate fuel economy, reform fuel taxation and subsidies, support domestic vehicle manufacturers to develop fuel-efficient vehicles, or promote biofuels would be identified and analyzed in the national Low Carbon Transportation Plan. At the scale of the metropolitan region, an effective Low Carbon Transportation Plan would include infrastructure investments for public transportation, walking and bicycling; smart growth land-use planning; and economic measures such as congestion pricing and parking fees. The plans would identify policy and regulatory measures, specify infrastructure needs and costs, and model greenhouse gas emissions.

Some countries and regions already have proposals for emission reduction projects and policies that could serve as starting points for Low Carbon Transportation Plans. The development of a Low Carbon Transportation Plan itself could also be proposed as a supported NAMA, although the evaluation criteria used to approve requests for support should take into account a country's ability to finance the plan's development domestically. In the long-term, the plans will provide the greatest benefit if they take a comprehensive approach, but at least initially, capacity limitations may lead some countries to focus on a smaller set of policies and projects while their full Low Carbon Transportation Plans are being developed.

4.3 Bundling in Low Carbon Transportation Plans

One of the most difficult aspects of NAMA design is to provide a structure that incentivizes countries and regions to implement emission reduction measures that may require low or negative public expenditure and yield broad social benefits. Examples can include zoning and land-use policy changes to promote compact, mixed-use development; congestion pricing; and fuel economy standards. While implementation costs could be funded and capacity building provided as a supported NAMA, these are not necessarily the most important barriers to implementation; instead, political and public acceptability considerations often dominate.

CCAP proposes that Low Carbon Transportation Plans provide a way to address this challenge, through bundling measures in a plan into a proposal for a supported NAMA. The bundle would consist of supported measures, which require external assistance, and unilateral measures. While the unilateral measures would by definition be implemented with domestic resources, the country or region might pledge to implement them only if funding were forthcoming for the supported elements of the bundle (see Box 3).

Box 3. Bundled NAMAs – How They Would Work

A metropolitan region – say, Jakarta – develops a Low Carbon Transportation Plan, which itself is funded as a supported NAMA. The plan projects 2 million tonnes of CO_2 reductions per year, after Phase I of implementation in 2020, from policies and projects including: (i) an expanded BRT network with five new corridors; (ii) switching taxis to Compressed Natural Gas; (iii) a comprehensive bikeway network; (iv) land-use reforms on BRT corridors, including incentives for transit-oriented development and maximum parking requirements; (v) a national reduction in fuel subsidies; and (vi) cancelling a ring-road project.

Full implementation of Phase I costs approximately US$500 million, with most of the cost being for the BRT network. However, the BRT network alone would only contribute a small percentage of the overall emission reductions. The region's Bundled NAMA application could be structured in two ways:

- *Full plan.* In return for US$200 million in international support for three BRT corridors, Jakarta pledges to unilaterally implement all remaining measures in Phase I of the plan. If international support is not provided, some portion of the other measures may not go forward unilaterally due to political barriers.
- *Multi-part plan.* Particularly if the amount of funding to implement the entire plan is large, donor countries or the NAMA fund may only be able to fund specific projects. In this case, low- or negative-cost projects would be bundled together with larger infrastructure investments. For example, two BRT corridors might be funded as part of a package including land-use reforms on the corridors; and the funding for the bikeway network might be packaged with cancellation of the ring-road project.

A bundled approach within the framework of Low Carbon Transportation Plans brings several advantages:

- It promotes the implementation of measures that would be otherwise difficult to incentivize through an international fund, such as smart growth land-use planning and congestion pricing.
- It uses NAMA funding to leverage wider changes in investment priorities. As discussed in Section 2.1, the amount of likely funding for greenhouse gas mitigation will be small in relation to current investments in transportation. If a transportation NAMA fund is to have an impact on emissions, it cannot fund every mitigation measure directly but must instead help to redirect current investments toward lower-carbon development.
- It helps infrastructure projects such as BRT to be more competitive on a cost per tonne of CO_2 emissions reduced basis, as discussed in Section 4.5.
- It helps achieve synergies between measures such as public transportation improvements and fuel subsidy reductions. Emission reductions from bundles of measures can sum up to more than reductions from the individual measures themselves.[30]

[30] See, for example, Cambridge Systematics (2009).

- Most importantly, it combines measures into a broader package that addresses the transportation sector in a more comprehensive manner.

4.4 NAMA Governance

CCAP suggests that NAMAs for all sectors would be proposed through a National NAMA Coordination Committee in each country.[31] However, city and metropolitan regional governments will usually play a key role in the development of transportation NAMAs, particularly for land-use and infrastructure measures. While these entities would channel their proposals through the national committee, local and regional governments should take a lead role in developing these types of NAMAs. Private-sector organizations, such as freight haulers and vehicle manufacturers, would also be able to propose supported NAMAs through the National NAMA Coordination Committee, which would then assess the national "appropriateness" of the proposed actions.

4.5 Allocating Funds

To ensure that support for NAMAs does not all flow to a limited number of sectors or types of mitigation measures, NAMA "windows" have been proposed by several Parties to the UNFCCC; these cover a range of activities from capacity building to reductions in deforestation to transportation strategies to large-scale emission-reducing NAMAs in large industrial sectors. For example, establishing separate windows for these four distinct activities would ensure that they would not compete with one another for financing. Each window would have its own funding priorities, would adopt its own agreed evaluation criteria for NAMAs falling within that window, and would draw upon experts in the relevant field to assist in assessment of the proposed NAMAs.

4.5.1 Direct Access and Competition

Many developing countries propose that support for NAMAs be provided through direct access, similar to the Adaptation Fund, where priorities are determined domestically by developing countries and money is allocated to countries by a Board according to COP-decided distribution principles. Other countries (principally potential donors) argue for cost-effectiveness and the size of potential GHG emission reductions as the key criteria for choosing among NAMA proposals for developed country support, creating a "race to the top" designed to maximize the global environmental benefit.

CCAP suggests that the establishment of different NAMA financing windows provides a way to resolve this difference in philosophy.[32] In the transportation window, the allocation criteria proposed below in Section 4.5.2 represent a hybrid that incorporates both the direct access and the competitive approaches. For example, the income level of countries would be one criterion used to allocate funding, ensuring that a small number of large developing countries do not totally dominate the market. However, cost-effectiveness is also important in order to leverage

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[31] See Center for Clean Air Policy (2009b).
[32] Ibid.

the maximum volume of emission reductions. Some degree of competition is required in any case, as investment needs will almost certainly exceed the amount of money available for supported NAMAs. Even in OECD nations, there are usually more worthwhile transportation projects (i.e., those for which social benefits exceed costs) than available funding.

The allocation criteria proposed below are designed for use by the NAMA governing Board, which would administer the new Copenhagen Green Climate Fund. However, they could also inform decisions by Annex I countries on bilateral assistance. In practice, both multilateral and bilateral funding structures may coexist with the NAMA framework.

4.5.2 Allocation Criteria

Cost per tonne of CO_2-equivalent reduced is the most natural criterion for allocating NAMA funding between competing proposals from developing countries. In principle, allocating funding to proposals with the lowest cost per tonne would maximize the emission reductions for a given level of funding. However, a narrow focus on cost effectiveness has several drawbacks for the transportation sector:

- **A large part of emission reductions cannot be quantified with certainty.** For transportation, there tends to be an inverse correlation between the scale of emission reductions and the ease of quantifying those reductions (see Box 4). The wider impacts of projects such as Bus Rapid Transit can be only roughly estimated. Thus, costs per tonne are likely to compare unfavorably to other sectors if eligible emission reductions are defined in a narrow way; indeed, this has been the experience for transportation projects under the Clean Development Mechanism.
- **Cost per tonne of CO_2 does not consider co-benefits.** Transportation projects, particularly land-use and infrastructure investments, yield a range of economic development, local air pollution and other sustainable development co-benefits that can far outweigh any climate benefit (see Section 2).[33] As well as yielding local sustainable development dividends, favoring projects with large co-benefits can help align local priorities with CO_2 emission reductions. (In contrast, a project that reduces CO_2 but brings no other direct benefit to a nation or metropolitan region may be implemented only half-heartedly.)
- **Some NAMA measures may have no direct impact on CO_2 emissions.** Planning and data collection provides a critical foundation for the successful implementation of emission reductions projects and policies and for the development of a Low Carbon Transportation Plan itself. However, there is no direct link between these enabling actions and CO_2 reductions. A narrow focus on cost per tonne would neglect the need for longer-term capacity building and planning efforts.
- **Many benefits are long term and grow over time.** However, costs tend to be incurred in the early stages of mitigation activities. Therefore, near-term cost-effectiveness criteria, say for 2020, will not reflect longer-term impacts. This is particularly important

[33] See also Center for Clean Air Policy (2009a).

for land-use planning measures, if densities and mix of uses grow over time as neighborhoods evolve.

- **Transformational change requires risk-taking.** The impacts of some NAMA-supported efforts may be highly uncertain. However, risk or uncertainty over the volume of emission reductions should not be viewed as a reason to decline support for a project. Some of the most successful developing country models, such as Bus Rapid Transit in Bogotá, Colombia, were the result of risk-taking by a visionary mayor. Emission reductions need to be maximized over the NAMA portfolio as a whole, which provides the opportunity to take risks on innovative projects, as long as the country or metropolitan region makes a good-faith effort to implement its proposals.

Based upon these considerations, CCAP proposes adopting the following framework for allocating funds for supported NAMAs. First, the transportation NAMA window should include a set-aside for planning and capacity-building. Developing countries and metropolitan regions would request money from this set-aside for activities that are not directly tied to emission reductions themselves but lay the planning and analysis groundwork for future reductions. Eligible uses would include those listed in the “Planning and Research” column of Table 1, with priority given to the development of Low Carbon Transportation Plans.[34] These would be similar to but broader in scope than the “Enabling Activities” funded under the Global Environment Facility. Allocation decisions for planning and capacity building would be based upon several criteria, including:

- Long-term emission reduction potential, including the size of a metropolitan area and expected emissions growth;
- Long-term sustainable development potential, such as improvements in air quality and economic growth;
- The country’s implementation capacity and track record in fiscal stewardship (except for projects that are specifically designed to improve implementation capacity); and
- Cost-sharing by the national or regional government, with the desired proportion of the cost share dependent on the income level of the country or region.

[34] For more details, see the forthcoming CCAP paper on data and monitoring issues for NAMAs; and the forthcoming paper on capacity building under the *Bridging the Gap* initiative.

Box 4. Quantifying Transportation Emission Reductions: Is Perfection the Enemy of the Good?

In the transportation sector, precise estimates of emission reductions can be difficult to establish, especially in the data-poor environment of many developing countries. More importantly, an emphasis on precision and certainty may cause longer-term transformations in land-use and infrastructure to be overlooked. Phase II of the TransMilenio Bus Rapid Transit system in Bogotá, which was the first BRT project to be registered under the Clean Development Mechanism (CDM), provides an instructive example.

The TransMilenio project reduced 59,000 tonnes of CO_2 in 2006, 70,000 tonnes in 2007 and 69,000 tonnes in 2008, according to the CDM monitoring reports. Most of those emission reductions have been achieved through technological changes and operational improvements, such as replacing many aging minibuses with a smaller fleet of articulated buses; centralized dispatch and control; and dedicated lanes and other priority measures that reduce idling. The mode shift from private automobiles to public transit accounts for a small share of the emission reductions in Bogotá that are credited through the CDM methodology.

However, existing methodologies (both for the CDM and other purposes) are poorly suited to capturing these mode shift impacts. First, it is difficult to quantify how people would have made trips in the absence of the BRT system. A survey-based approach can capture some impacts, but not longer-term effects, as individuals' decisions on vehicle ownership and residential location adjust to take advantage of the BRT system. (Asked, "How would you make this trip in the absence of BRT?," a respondent might answer, "Walk," whereas in reality they may have chosen to move to another neighborhood and own a car or motorcycle if the BRT system did not exist.)

Second, transit investments tend to have a "multiplier" effect through their impact on urban development patterns. By enabling denser, transit-oriented development and reducing vehicle ownership, transit systems tend to promote walking and cycling and reduce trip lengths. This multiplier ranges from 2 to 9 times the direct impact of mode shifting from private cars to buses. In other words, emission reductions can be 2 to 9 times those that are measured by any of the methodologies employed for carbon offsets to date.* In large part, this multiplier takes the form of longer-term climate benefits as supportive land use, non-motorized transportation, and other features develop on the backbone of the public transportation infrastructure.

Third, more important that the "mode shift" promoted by BRT may be "investment shift." When compared to a baseline of "do nothing," BRT may bring about modest emission reduction benefits. In practice, however, BRT may be an alternative to increased road construction, and here the emission reductions from the "road" to the "BRT" package may be very large. However, it is difficult to quantify with certainty what emissions would have been if a city had increased highway investment as an alternative to a BRT network.

Thus, an approach that values the certainty of emission reduction estimates is likely to neglect the longer-term, more transformational impacts of BRT and other infrastructure projects. A focus on certainty is likely to make some projects seem more expensive than they are in reducing emissions, and also bias funding against projects that may be riskier but also have the greatest long-term potential.

* Holtzclaw (2000); Pushkarev, Zupan, and Cumella (1982); Newman and Kenworthy (1999); Neff (1996); Bailey, Mokhtarian, and Little (2008).

Second, bundles of emission reduction projects and policies would be financed from the transportation NAMA window of the Copenhagen Green Climate Fund according to the following allocation criteria:

1. Consistency with a Low Carbon Transportation Plan and the quality of that plan. Any proposed supported NAMA should be part of a Low Carbon Transportation Plan in order to be eligible for funding. The exception is in the initial years of operation, while Low Carbon Transportation Plans are still being developed. This is not an onerous requirement, given that the plans themselves should reflect the desired vision of a country or metropolitan region and can evolve over time. However, this condition provides at least some check that a NAMA is consistent with the country's overall strategy. In addition to plan consistency, this criterion should also consider the quality of the plan and the overall level of ambition – in other words, how comprehensive and transformational the plan is.

2. Long-term GHG reduction potential. A qualitative assessment of the project's ability to catalyze long-term change can complement estimates of short-term CO_2 reduction. For example, projects that bring a new technology such as plug-in hybrids to market may make a greater long-term contribution than subsidies for existing technologies. Similarly, public transportation systems that can catalyze smart growth development patterns may have greater long-term potential than shorter-term incentives or information campaigns. Another aspect of this criterion is the ability of a project to motivate similar initiatives in other regions. All else being equal, a BRT system in Cairo might be ranked higher than one in Guadalajara, since several BRT corridors have already been implemented in Mexican cities. A Cairo system, in contrast, could serve as a model for that region.

3. Cost effectiveness of the integrated bundle of measures. Cost per tonne of CO_2 reduced is the natural measure of cost-effectiveness. However, CCAP proposes considering two important modifications to a traditional cost per tonne analysis:

- It is important to estimate the total emission reductions from a proposal and not just the portion of the emissions reductions that can be estimated with a high degree of certainty. While certainty is desirable, the lack of precise methodologies should not be a reason to ignore a particular source of emission reductions, such as the "multiplier" effect of public transportation infrastructure in promoting non-motorized travel. Transportation-land-use models will be an important tool in estimating project benefits.
- Cost-effectiveness should be determined on the basis of the NAMA bundle rather than project-by-project. In the example above (see *Box 3*), emission reductions from fuel subsidy reductions and other unilateral measures would be bundled with those from Bus Rapid Transit, in order to create a more competitive proposal with lower cost per tonne.

4. Sustainable development co-benefits. The sustainable development co-benefits of transportation projects are often substantial and can far outweigh the climate benefits. Almost every transportation project that reduces CO_2 through reducing fuel consumption – including public transportation, vehicle efficiency and pricing measures – will improve local air quality. Economic development, reduced travel times and lower consumer expenditure on transportation are other typical co-benefits. As well as providing gains for local sustainable development, co-benefits are an additional justification for CO_2 mitigation, as they indicate that greenhouse gas mitigation efforts are aligned with a country's own interests.

5. Local implementation capacity. This would involve an assessment of the likely success of the host country or region to implement the project or policy as proposed and their track record in fiscal stewardship. Evidence of public support, the presence of complementary policies, and market acceptance are three specific issues to evaluate here.

6. Cost-sharing by the national or regional government, with the optimal proportion of the cost share dependent upon the income level of the country or region. For middle-income countries, funding through the transportation window could take the form of a revolving loan fund; for the least developed countries, support would be provided through direct grants. Cost-sharing is important not only in enabling the resources of the Copenhagen Green Climate Fund to stretch further, but also in signaling local political commitment to a project.

7. Alternative implementation opportunities. While a country or metropolitan region could propose any project in a Low Carbon Transportation Plan as a supported NAMA, in many instances alternative funding opportunities will be available. An example is rebates or tax reductions for fuel-efficient vehicles: a country would need to justify why this could not be implemented on a revenue-neutral basis through higher taxes on less efficient vehicles (for example, through showing how the external assistance can overcome political barriers).

4.6 Monitoring, Reporting and Verification (MRV)

In contrast to the credit-generating NAMAs discussed in Section 5, estimating the volume of emissions reductions would not be the primary purpose of Monitoring, Reporting and Verification for supported NAMAs.[35] Instead, MRV would have two higher priority purposes: first, to learn about the effectiveness of different types of policies and projects to inform future funding decisions (CCAP's "Do, Measure, Learn" approach); and second, to ensure that projects and policies were implemented as pledged. While emissions would also be subject to MRV, supported NAMAs are still "no lose" measures in the sense that countries are not penalized if the estimated volume of emission reductions is not attained.

The first MRV goal – learning about project effectiveness – is probably not best-served by evaluating the effectiveness of all projects funded under the NAMA framework. Instead, it may make sense to conduct this type of more focused research only for large, innovative or other specific types of projects.[36]

The second goal – ensuring that projects and policies were implemented as pledged – is critical to the credibility of a supported NAMA framework and must occur for all supported NAMAs. MRV needs to ensure not only that the funded measures are built (such as a BRT network or biodiesel plant) but also that other measures in the bundle (such as a reduction in fuel subsidies)

[35] Note that MRV issues for transportation will be discussed in greater detail in a forthcoming CCAP paper.
[36] This approach was recommended following a 10-year evaluation of the Congestion Mitigation and Air Quality Improvement (CMAQ) program in the U.S. See Transportation Research Board (2002).

are implemented as pledged. Funding agreements should include clawback provisions in the event of policy reversals – for example, if a new mayor decides to pursue a road-centered transportation plan instead of Bus Rapid Transit, or elects to abandon a congestion pricing scheme, then any NAMA funding received for these measures should be repaid.

Implementation of physical infrastructure projects may be verified through site visits, where plans are compared to the actual built infrastructure, or through the provision of other evidence that the project was implemented and is being used or operated. Implementation of policies (such as land-use and parking policies, vehicle efficiency standards, or low-carbon fuel standards) may be verified by requiring the provision of evidence specific to that policy. Examples include adopted zoning language and developer site plans showing reduced parking ratios; certification data on the make and model of new vehicles registered in the country; or refinery data showing sales by fuel type. For any policy or project, the stringency of implementation monitoring may vary depending upon whether the monitoring agency performs a physical site visit, whether this agency obtains and analyzes original data, and the scope/depth of any field review or data analysis the agency conducted (e.g., comprehensive vs. sample).

Monitoring, Reporting and Verification might also be required as a performance guarantee. For example, a portion of the NAMA support might be provided as a loan that is forgiven (or rolled forward into other transportation projects in the same city) if ridership targets are achieved.

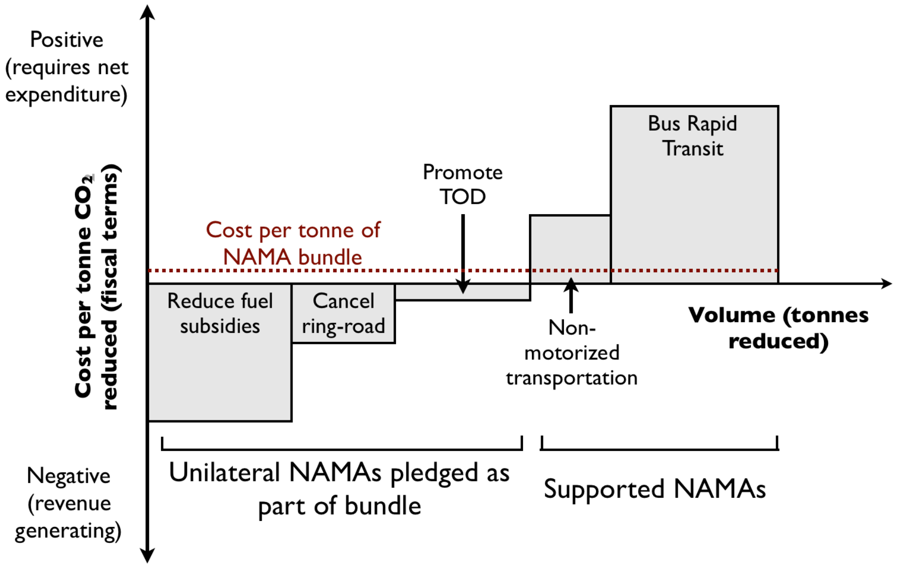
4.7 Conclusions: Prospects for Supported Transportation NAMAs

There is a clear funding gap for many sustainable transportation projects in low-income countries, due to the high up-front costs of transportation infrastructure and the limited resources available in many regions. Even though total benefits, including social and other sustainable development benefits such as reductions in local air pollution, may outweigh the total costs of these projects, even before factoring in greenhouse gas reductions, many developing countries do not have the resources to implement many of their attractive emissions reduction opportunities.

At the same time, there are also mitigation measures – especially from pricing, vehicle regulation and land-use policies – that generate revenue or can be implemented with minimal public expenditure. These negative-cost opportunities have not been pursued to date due to a range of barriers, including local political opposition or a lack of implementation and enforcement capacity.

CCAP's proposal for bundling supported NAMAs addresses both of these issues. It uses the "carrot" of funding for supported NAMAs to incentivize implementation of the negative-cost opportunities, thus increasing the overall volume of emission reductions that can be achieved. These negative-cost opportunities, particularly pricing reform, will improve the cost-effectiveness and competitiveness of the overall bundle. This concept is illustrated in Figure 4. Low Carbon Transportation Plans, developed at both the regional and the national level, would be the vehicle for identifying appropriate bundles of projects and policies.

Figure 4. Bundled NAMAs Leverage Emission Reductions



5 Credit-Generating NAMAs

5.1 What Could Qualify As Credit-Generating NAMAs?

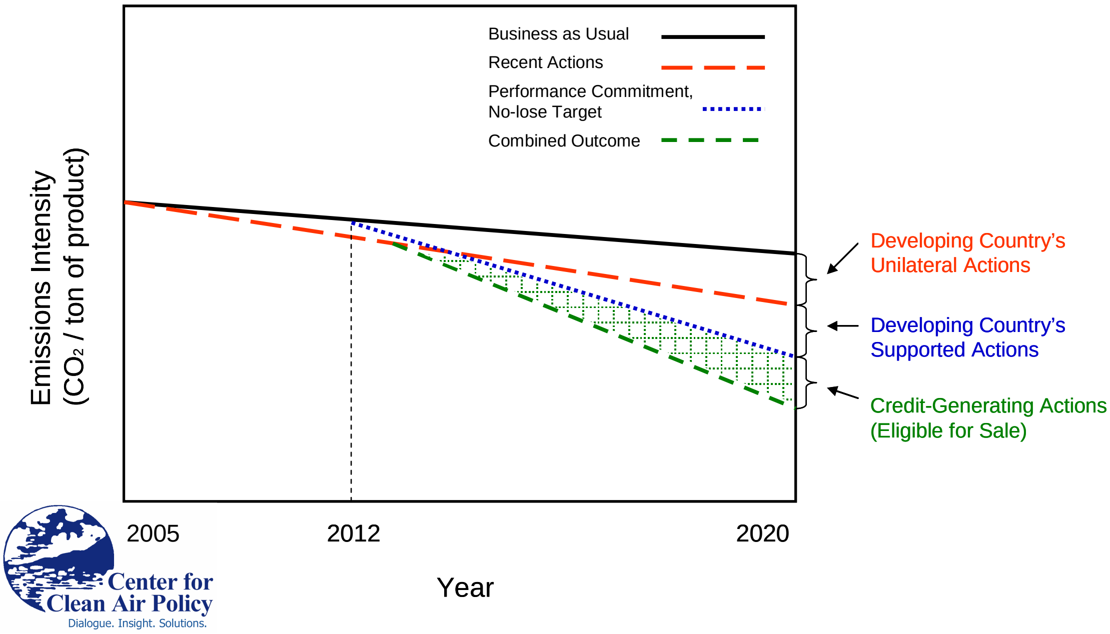
Crediting-generating NAMAs are actions that reduce emissions below a predetermined and negotiated sector-wide or policy-wide crediting baseline. Beating that baseline will produce offsets that developing countries can sell to developed countries to reduce the cost of their compliance.

While both approaches generate offsets, credit-generating NAMAs would differ from today's Clean Development Mechanism (CDM) in several important respects. First, the baseline for credit-generating NAMAs would be set significantly below the business-as-usual baseline, in contrast to the CDM, where the baseline is often BAU. Second, credit-generating NAMAs would be larger in scale and more comprehensive. The CDM exists at the scale of individual projects and programs (bundles of projects). The crediting baselines for NAMAs, on the other hand, would apply to an entire sector, a specific sub-sector or a combination of sectors.

One type of credit-generating NAMA takes the form of a sectoral no-lose target, as illustrated in Figure 5 for the case of an emissions intensity target. Countries could earn tradable emission credits by reducing emissions below a sectoral crediting baseline. If emissions remain above the crediting baseline, the country would not be penalized (hence, the "no lose" designation).

Importantly, the sectoral crediting baseline would be set well below the expected business-as-usual counterfactual.[37]

Figure 5. Concept of Sectoral No-Lose Targets



5.2 Transportation in the CDM

To date, the transportation sector has been virtually absent from the CDM. Just two transportation projects have been registered so far, accounting for 0.1% of projects and the same percentage of emission reductions under the CDM as a whole.[38] While there are substantial differences between credit-generating NAMAs and the CDM, many of the same challenges that transportation has faced under the CDM are likely to also arise under a NAMA framework.

There are several reasons for the under-representation of transportation under the CDM:[39]

- **Additionality.** As discussed in Section 2, decisions on transportation investments; land-use plans; fuel and vehicle standards; and taxation policy are based on numerous political and economic criteria. For many projects and policies, the barriers are political, rather than financial; nevertheless, the most recent transportation methodology approved under the CDM requires an investment analysis to demonstrate additionality.[40] These difficulties are compounded by the relatively small share of transportation project costs

[37] In order to avoid double counting, emission reductions from CDM would also need to be incorporated into business-as-usual to arrive at the sectoral crediting baseline. Given the paucity of transportation CDM projects, this complication is not considered here.
[38] UNEP Risø Center (2009).
[39] For a full discussion, see Browne et al. (2005); Millard-Ball and Ortolano (2010); Clean Air Institute (2008); Zegras, (2007).
[40] See Approved Consolidated Methodology for Mass Rapid Transit (ACM16).

that would be covered by offset revenue in most cases; the smaller the contribution of CDM revenue, the more difficult it is to show that the extra finance moves the project past an investment threshold. Finally, some policies (such as congestion pricing) generate revenue for the public sector. Thus, it is difficult to demonstrate that the policy or project is additional, i.e. it would not be implemented in the absence of the offset revenue.

- **Methodological.** Only two large-scale transportation methodologies (which are a prerequisite to project registration) have been approved to date. Ten others have been rejected by the CDM's Executive Board, mainly because of the difficulty in developing an acceptable baseline scenario – i.e., what emissions would have been in the absence of the CDM project. One of the fundamental problems is that analysis of large-scale transportation projects usually relies on modeling, but concerns over lack of precision and accuracy and potential gaming have made the Executive Board reluctant to accept this as a basis for CDM methodologies.[41] Since credits are used as offsets by developed countries, there is a great need to ensure that they represent "real" emissions reductions, .
- **Transaction costs.** In principle, the CDM is more applicable to the purchase of energy-efficient vehicles and lower-carbon fuel technologies, rather than infrastructure projects and policy measures. Decisions on vehicles and fuels are often taken on a marginal cost basis, meaning that CDM revenue might provide an incentive to switch to lower-emission alternatives. Methodological issues are also more straightforward for these types of measures. However, for all but the largest fleets, emission reductions from vehicle purchases are too small to be worth registering as a CDM project, as transaction costs would outweigh revenue.[42] Policy measures such as fuel economy standards can overcome this problem of scale, but the additionality of such a measure can be challenging to demonstrate.

The nature of the CDM also makes it fundamentally ill-suited to promoting transformational change in the transportation sector. Funding is based on an *ex post* analysis of emission reductions. Thus, the CDM does not provide up-front financing for major projects. For projects where emission reductions are uncertain, it may be difficult for a project to assume the additional risk that revenue may be lower than expected or may not materialize at all. Finally, the CDM only credits those emission reductions that can be measured with certainty, which for many projects (such as public transportation infrastructure and transit-oriented development) may be far lower than total emission reductions (see Box 4).

5.3 Conclusions: Prospects for Credit-Generating Transportation NAMAs

Ideally, scaling up credit generation beyond the project level through credit-generating NAMAs would help to reduce the transaction costs of the CDM, for example in preparing methodologies

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[41] See Millard-Ball and Ortolano (2010).

[42] While the CDM has a small-scale methodology for energy-efficiency vehicles (AMS.III.C), it has scarcely been used to date. It is employed by one registered project (for regenerative braking on the Delhi Metro) and five projects at validation. Three of these five projects are for electric motorcycles; the remaining two are for freight mode shift from road to rail. See UNEP Risø Centre (2009).

and documenting emission reductions. It could also allow credit for the synergies between certain transportation projects and policies: for example, public transportation infrastructure combined with supportive land-use planning is likely to generate greater emission reductions that either would alone.

One way to scale up credit generation is to aggregate or bundle individual projects (to some extent, as already permitted under the CDM) and to extend the CDM eligibility criteria to allow policies to generate carbon offsets.[43] There are several types of policies, such as vehicle efficiency measures and low-carbon fuels, as well as the public transportation projects already allowed under the CDM, where the methodological issues can probably be overcome. However, for many important project types, such as smart growth, scaling up would not necessarily solve two of the core problems with project-level CDM, namely demonstrating additionality and developing methodologies to set baselines.

Even if sufficiently rigorous methodologies could be developed for credit-generating NAMAs, supported NAMAs are likely to provide a better framework to incentivize emission reductions. Supported NAMAs can be more risk-tolerant, by funding projects where emission reductions are uncertain, and can provide up-front financing for planning and construction.

Another way to scale up the CDM is to credit sector-wide emissions reductions, via sectoral no-lose targets, as discussed in Section 5.1. Scaling up credit-generation in this way, however, is likely to also scale up the problems with methodologies and determining additionality.[44] For transportation, it is difficult to set the crediting baseline with sufficient precision and accuracy, due to uncertainties in predicting business-as-usual. The high uncertainty of a developing country's future transportation emissions is likely to mean that the crediting baseline is set too high for some countries, which would generate tradable credits for doing nothing. In turn, this represents a financial drain on international climate funding, and a source of spurious credits that, if used as offsets by developed countries, would increase global greenhouse gas emissions. For other countries, the high uncertainty of future emissions means that the baseline will likely be set too low, and thus that it will be difficult to reduce emissions to a level where credits begin to be generated. This is a direct result of the difficulty in predicting transportation sector emissions with sufficient certainty.[45] To ensure the environmental integrity of any offsets produced by credit-generating NAMAs, crediting baselines could be required to be very ambitious, but this would also make credit-generating NAMAs less attractive to both developed and developing countries, as it would lead to fewer credits and a greater volume of uncredited emissions reductions.

Overall, credit-generating NAMAs are not a promising approach for transportation. While methodological challenges may be overcome for some policy and project types, it is questionable how big a difference they could make to the implementation of emission reduction policies and projects. Decisions on land-use,,transportation infrastructure and fuel economy regulations are

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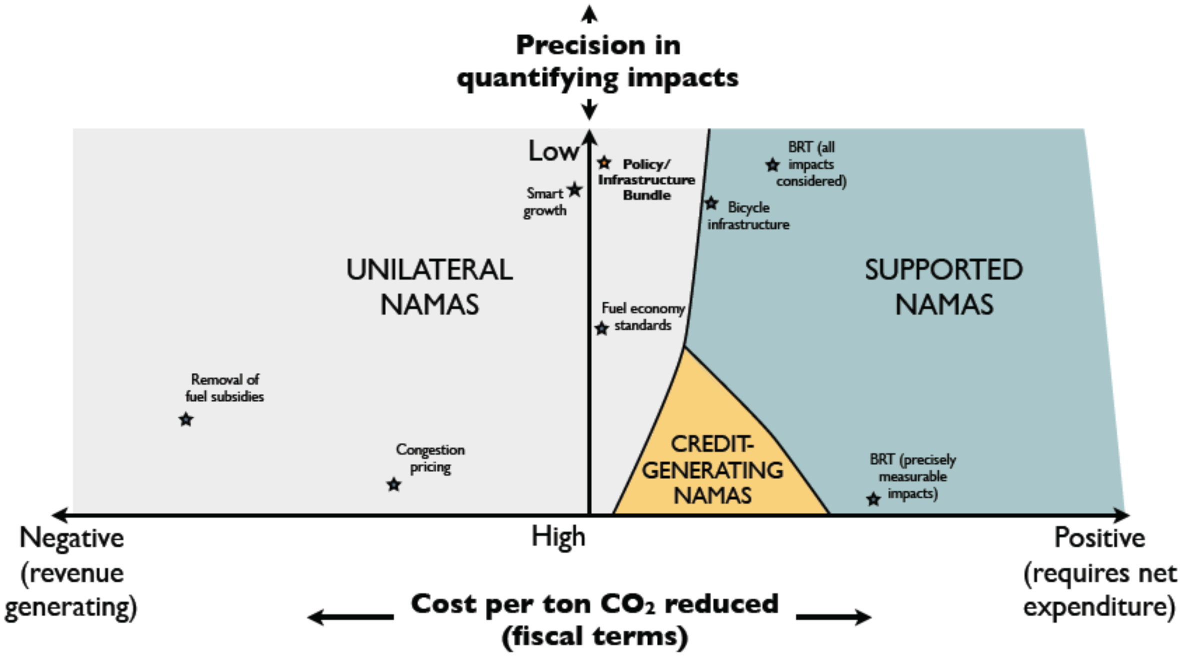
[43] Policy measures for all sectors are currently ineligible under the CDM. This was one reason for the rejection of a proposed CDM methodology for transport-efficient development.
[44] See, for example, Wittneben, Bongardt, Dalkmann, Sterk, and Baatz (2009).
[45] For a full analysis of this "adverse selection," see Millard-Ball (2010).

fairly insensitive to costs at the margin; they represent larger policy decisions. Moreover, transportation policies and projects tend to be either negative cost, or very high positive cost (excluding social benefits) per ton of precisely-known quantifiable CO_2 reduced, as shown conceptually in Figure 6. There is little in the 'sweet spot' for credit-generation where revenue from offsets ($5-$25/ton) can make a significant difference to project economics. A small volume of emission reductions may be possible, but the mechanism is fundamentally ill-suited to delivering transformational change. At worst, a scaled-up mechanism could flood the market with non-additional credits.

Figure 6. Conceptual Fit of Transportation Projects with NAMAs



Note: Cost per ton of CO_2 reduced is shown in fiscal terms, i.e. public expenditure. Social costs per ton of CO_2 reduced are could potentially be negative for all of these project types.

6 Conclusions

By virtue of their scale alone, emissions from transportation in developing countries must be a key part of any international climate agreement. Failure to address the sector will either inflate mitigation costs by requiring higher emission reductions from other sectors such as electricity generation, or jeopardize the achievement of targets for atmospheric CO_2 concentrations.

CCAP believes that supported NAMAs have the greatest potential for encouraging emission reductions from transportation in developing countries. Unilateral NAMAs can also play an important role, particularly in middle-income countries where the availability of external funding and capacity building may be less important. However, credit-generating NAMAs are not promising for transportation, and share many of the limitations of the existing CDM for transportation. Figure 6 provides an illustration of which project types are likely to be the best fit with each type of NAMA. There are few project types that have the combination of low-to-medium (but positive) cost per ton and high certainty in quantifying emission reductions that would be most suitable for credit-generating NAMAs.

Transportation mitigation measures have the potential to bring considerable co-benefits to developing countries. Indeed, CO_2 reduction is a relatively small benefit for most transportation projects compared to local air pollution, economic development, and reductions in travel times. In the context of a supported NAMA, these co-benefits are an asset. They mean that any mitigation actions are likely to be aligned with both the interests of the host country and reducing CO_2 emissions, and they will also bring broad sustainable development benefits.

Supported NAMAs, however, must be implemented with attention to the specific considerations of the transportation sector. CCAP proposes consideration of the following principles:

- **Develop Low Carbon Transportation Plans for countries and metropolitan regions.** Low Carbon Transportation Plans chart a course for short-term and long-term GHG reductions through a comprehensive set of policy, infrastructure and fiscal measures; assessing full costs and sustainable development co-benefits; modeling GHG emission reductions; and identifying key implementation steps. An effective plan would include public transportation; bicycling/walking infrastructure; smart growth land-use planning; efficient vehicles; low-carbon fuels; and economic measures such as congestion pricing.
- **Create a transportation "window" in the Copenhagen Green Climate Fund with dedicated, sector-specific funding and evaluation criteria.** Appropriate evaluation criteria for supported transportation NAMAs include: consistency with a comprehensive Low Carbon Transportation Plan; long-term GHG reduction potential; cost effectiveness of the integrated bundle of measures; sustainable development co-benefits (e.g., economic development, public health); local implementation capacity; and cost-sharing.
- **Earmark planning and capacity-building funding.** Some of the most important long-term actions, such as planning, economic studies and professional education, do not directly translate into emission reductions but are the backbone of effective mitigation.
- **Fund bundles of projects and policies.** The funds available to support NAMAs should be leveraged by funding "bundles" of projects and policies established in Low Carbon Transportation Plans. Each bundle will include some low- or negative-cost policies that the host country will implement unilaterally, as well as more expensive measures that require support. The most attractive "bundles" will consist of packages of synergistic measures in which unilateral NAMAs serve to improve the overall appeal of the bundle.
- **Accept uncertainty**. There will be considerable uncertainty in modeling emissions reductions and developing baselines, especially for some of the most transformational projects. At least initially, evaluation decisions will need to take account of this uncertainty and focus on funding packages that are directionally correct, i.e., those that reduce emissions, even though the exact volume of reductions may be uncertain.

Climate funding represents a very small part of overall transportation investment. CCAP's proposed framework shows how the NAMA financing mechanism can be leveraged to help direct more substantial financial resources from public and private investment toward lower-carbon transportation choices. Partly, this can occur through using NAMA funding to develop regulatory standards for vehicles and fuels, which in turn influence the spending decisions of private consumers and vehicle fleet managers. Partly, this can occur if NAMA funding is used to transform metropolitan development and transportation infrastructure spending. The Copenhagen Green Climate Fund would support specific infrastructure measures in Low Carbon Transportation Plans. In return, the developing country or region would implement low- and negative-cost measures in the bundle, from smart growth planning to congestion pricing. The benefits for climate may be large, but the local impacts may be even larger, as improved travel choices foster economic development, better quality of life and reduced air pollution. Climate funding cannot be the only driver, but it can help catalyze the transformation to an environmentally and economically sustainable transportation system.

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