ADVANCING GREEN FREIGHT IN BANGLADESH:
A BACKGROUND PAPER

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This background paper was developed by Clean Air Asia as a supporting material for the implementation of country-level activities in Bangladesh, as part of the "Global Green Freight Action Plan" Project of the "heavy-duty diesel engines and vehicles initiative" of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC). Please click the link below for more information about the CCAC and its heavy-duty diesel engines and vehicles initiative.

AUTHORS

Sudhir Gota
Sameera Kumar Anthapur, Clean Air Asia

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ABOUT CLEAN AIR ASIA

www.cleanairasia.org

Clean Air Initiative for Asian Cities (Clean Air Asia) promotes better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse emissions from transport, energy, and other sectors.

Clean Air Asia was established as the leading air quality management network for Asia by the Asian Development Bank, World Bank and USAID in 2001, and operates since 2007 as an independent non-profit organization. Clean Air Asia has offices in Manila, Beijing and Delhi, networks in eight Asian countries (China, India, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, and Vietnam) and is a UN-recognized partnership of almost 250 organizations in Asia and worldwide.

Clean Air Asia uses knowledge and partnerships to enable Asia’s 1,000+ cities and national governments to understand the problems and identify effective policies and measures. Our four programs are: Air Quality and Climate Change; Low Emissions Urban Development; Clean Fuels and Vehicles; and Green Freight and Logistics.

The biennial Better Air Quality (BAQ) conference is the flagship event of Clean Air Asia, bringing experts, policy- and decision-makers together to network, learn, and share experiences on air quality management. Past BAQs have proven to influence policies, initiate new projects, and establish partnerships.

ABOUT CLIMATE AND CLEAN AIR COALITION

http://www.ccacoalition.org/

The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) is a voluntary global partnership of governments, intergovernmental organizations, business, scientific institutions and civil society committed to catalyzing concrete, substantial action to reduce SLCPs (including methane, black carbon, and many hydrofluorocarbons [HFCs]). The Coalition works through collaborative initiatives to raise awareness, mobilize resources, and lead transformative actions in key emitting sectors.

Since the Coalition’s launch in February 2012, the partners have been working to identify quick-start actions that will ensure rapid delivery of scaled-up climate and clean air benefits by reducing key short-lived climate pollutants, including methane, black carbon, and HFCs. These initiatives seek to promote near-term reductions of short-lived climate pollutants at a substantial scale worldwide and to engage high-level stakeholders, including economists, reducing black carbon emissions from heavy-duty diesel vehicles and engines. The CCAC Heavy-Duty Diesel Vehicles and Engines Initiative (HDDI) aims to catalyze major reductions in black carbon through adoption of clean fuel and vehicle regulations, and supporting policies. Our efforts focus on diesel engines in all economic sectors. Our work entails laying the technical and political groundwork that will enable global black carbon emission reductions from new and in-use vehicles by developing:

- A global fuel sulfur strategy that addresses the major hurdles facing low sulfur fuels today, from financing to obstructive subsidies and political inertia;
- National programs to address emissions from the existing vehicle stock, including retrofits, scrappage, inspection, and maintenance; and
- A high-level coalition of industry, country, and NGO leaders in support of the Green Freight Call to Action to improve the energy efficiency and environmental performance of freight operations worldwide.

LINK TO THE HEAVY-DUTY DIESEL VEHICLES AND ENGINES INITIATIVE OF THE CCAC:
EXECUTIVE SUMMARY

The global growth in freight volumes and emissions are expected to be driven by developing economies. Countries in developing Asia, for example, are expected to account for more than half of the total global surface freight transportation by 2050. Bangladesh is in a similar trajectory. It is a growing economy that has moved up to lower middle-income status and aims to be seen as an export country and freight activity has grown at 8% per annum, outpacing its GDP’s 5%. Freight motorization and activity levels are set to increase rapidly until 2050 under a business-as-usual scenario, which implies that even a small increase in GDP will lead to high increase in freight activity. This paper provides a look into the characteristics of freight transportation in Bangladesh, the relevant policies and institutions related to freight, and discusses potential options for moving towards greening the freight sector in the country.

Road transport is now dominating freight transport in Bangladesh. Other transport modes such as inland waterways and railways, although present, are yet to be maximized in transporting goods in the country. Relatively high allocations of transport investments has been made in the road sector in the recent past, which now is estimated to perform more than 65% of the ton-km activity in the country. This has led towards the high contribution of trucks in transportation-related emissions such as Carbon dioxide (CO2), criteria air pollutants such as Particulate matter (PM) and short-lived climate pollutants (SLCP) such as black carbon (BC). The road freight industry in Bangladesh remains to be a fragmented one that is experiencing low profitability due to inefficiencies brought about by issues such as overloading, poor technology penetration, among others. Urban freight is also a strategic issue to discuss in the context of greening the freight sector in Bangladesh. Dhaka and Chittagong, for example, accounts for more than half of vehicle registrations in Bangladesh, 30% of these registrations are freight vehicles. Instituting programs on improving urban freight also provides opportunities to significantly reap health benefits due to lowered air pollution levels in highly congested cities.

Bangladesh has taken significant strides in putting forth policies towards improving freight transport and reducing the associated externalities. There have been transformation efforts through well laid-out policies such as the National Multimodal Transport Policy, and action plans such as the National Action Plan on reducing SLCPs, but gaps are present in terms of addressing the freight sector comprehensively. Reviews and discussions conducted in the process of developing this paper reveal that there is a general need to raise the awareness of local stakeholders in concepts relating to green freight. The interviews also point to a general lack of information on available technologies and practices and their impacts.

This paper discusses suggestions and potential course of action for moving towards a greener freight sector in Bangladesh. Establishing a national “green freight program” — which builds on public–private collaboration to accelerate the adoption of green freight practices and technologies — can be an option in Bangladesh. A Green Freight Corridor in the nation’s busiest route between Dhaka and Chittagong to test various initiatives including technologies to improve fuel efficiency is also discussed. A green port project
in Chittagong is also a potential measure. Stricter vehicle emission standards and fuel standards are also discussed. Urban freight schemes can also encourage cities to develop city-level programs that can reduce the negative impacts of freight at the local level. Lastly, the concept of online freight exchange in Bangladesh is also discussed. As a first step for implementation, it is recognized that a national-level, broad-based long-term action plan is required to provide a sustainable pathway for the freight sector, through consultations with multiple stakeholders. Given the wide range of issues, actions need to be prioritized, depending on the urgency and the impact on air quality and health, and aligning with the climate goals of the country.
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1. INTRODUCTION

Freight transportation is a vital element towards attaining sustainable development. Inefficient movement of goods does not only impend economic growth, but also results in various externalities such as air pollutants, greenhouse gas (GHG) and short-lived climate pollutants (SLCPs). The global growth in freight volumes and emissions are expected to be driven by developing economies. The International Transport Forum, for example, estimates that developing Asia will account for more than 50% of global surface freight transport in 2050, from its current share of 35% (OECD/ITF, 2015).

The movement of goods has been and is still a rapidly growing contributor to GHGs, traditional air pollutant emissions, and SLCPs such as black carbon (BC). Heavy-duty vehicles, for example, are projected to be the largest emitter of carbon dioxide (CO$_2$) in the transportation sector by 2035 (Façanha, Blumberg, & Miller, 2012). BC or soot is a key component of particulate matter (PM) and has been implicated as a significant climate forcer and a dangerous air pollutant with multiple impacts on the public’s health. Short-term epidemiological studies have stated the evidences of the association between BC concentration and short-term changes in health.

SLCPs have drawn significant policy attention in the recent years due to their potential impact on air quality and climate and can have significant impacts to human health, agriculture, and ecosystem productivity (UNEP and WMO, 2011). The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) was established in 2012 to catalyze time sensitive actions towards mitigating SLCPs, driven by the recognition within global scientific and policy communities that addressing climate pollutants that remain in the atmosphere for shorter periods of time can significantly contribute towards reducing the amount of warming that can occur in the future.\(^1\)

One of the primary objectives of the CCAC is to reduce BC emissions from heavy-duty diesel vehicles and engines through its Heavy-Duty Diesel Vehicles and Engines Initiative (HDDI). Further recognizing the growth in freight movement, the environmental impacts of freight, and the potential for efficiency gains in this key economic sector, the CCAC chose to support the green freight movement as a platform to help advance the goal of reducing BC. In November 2013, the high level assembly of the CCAC endorsed the Global Green Freight Call to Action to bring together countries and companies around the globe to put in place strategies to reduce energy use, GHG, and BC emissions from heavy-duty freight. In September 2014, 50 organizations (including states from Latin America, Europe, Africa, Asia, and North America) committed to support the development and implementation of the Global Green Freight Action Plan at the UN Secretary General’s Climate Summit in New York. (CCAC, 2015).

The Global Green Freight Action Plan was launched in May 2015 with an aim of enhancing the environmental and energy efficiency of goods movement in ways that significantly reduce the climate,

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1 SLCPs are potent climate-warming agents that have atmospheric lifetimes of a few days to about a decade.
health, energy, and cost impacts of freight transport around the world. It supports three key goals that are envisioned to be advanced by a range of actions and activities including targeted work in selected countries:

- Aligning and enhancing existing green freight efforts through knowledge sharing, peer-to-peer partnerships, and government-industry exchanges that will build a bridge between policy makers, business leaders, and civil society at the global level;
- Identifying ways to incorporate BC, PM, and other air pollutant emission reduction calculations in green freight programs; and
- Expanding or improving green freight programs in interested countries.

The term “green freight” can be inclusive of activities that reduce the emissions of the freight sector through a combination of market-driven voluntary actions undertaken by private sector stakeholders (carriers, shippers, and logistics providers), and in partnership with governmental or administrative authorities. This may include the adoption of uniform systems to measure the carbon footprint of a supply chain, and/or the adoption of various after-market technologies and strategies that increase vehicle fuel-efficiency (such as higher-quality or low-rolling-resistance tires, aerodynamics, telematics devices, etc.), drawing on the experience of existing programs globally (CCAC, 2014). The United Nations Center for Regional Development refers to green freight as a set of strategies, policies, and practices targeted at movement of goods that aim to reduce environment, climate, and public health impacts through reduced air pollution and GHG emission intensity; improve social conditions, including road safety and health and working conditions of people involved in freight movement; and enhance economic development through improved energy efficiency, fuel security, and efficiency and competitiveness of the freight sector overall.

Bangladesh is one of the founding state partners of the CCAC and is also an endorser of the Global Green Freight Action Plan. This paper has been developed with the support of the CCAC to aid the process of moving towards a better understanding of the freight sector in the country and to provide insights on how the concept of green freight can be advanced in the country.

The country’s economic momentum provides an opportunity for the government to improve the quality of life of its citizens. Just recently, the World Bank has announced that Bangladesh has moved up in income brackets, and has moved up from being a low-income country to a lower-middle income country (World Bank, 2015). The country’s growth trajectory is expected to continue to rise. Exports are growing (12% annual growth rate in 2014, up from 10.7% in the previous year), influenced by higher demands from large buyers such as the EU and US in markets such as ready-made garments (ADB, 2015a). With growth estimated to continue along with the Government’s efforts to boost manufacturing and position the country as a leading export-oriented one, quality and efficient transport of goods will play a key role in the extent of success.

Bangladesh pays a very high cost for inefficient freight transport and its logistics cost is much higher than that of its neighboring countries. It has been well established by various studies that the freight transport
costs could well pose a greater barrier to trade than tariffs (International Monetary Fund, 2013). The investments in the road sector, the largest mode of freight, will have to be augmented with various initiatives to transform the freight industry into a green, sustainable, and efficient one. Transport is also one of the leading causes of BC in Bangladesh, and within transport, heavy-duty diesel engines are well known to be a major source, as later discussed in this paper.

It is important to note that even though Bangladesh only contributes only 0.2% of carbon dioxide emissions globally, it is one of the top countries at risk from the impacts of climate change.2 The country faces severe impacts of climate change and is one of the most vulnerable in the world. In an assessment carried out by the German Watch (Kreft, et al., 2015), Bangladesh was ranked sixth as the most affected country from climate change related disasters from 1994 to 2013, and the Maplecroft Climate Change Vulnerability Index ranks Dhaka as one of the five most climate vulnerable cities in the world.

This background paper has been developed with a general objective of providing a brief overview of the status of the freight sector in Bangladesh and identifying potential opportunities for greening the sector, particularly on road freight transport, due to its current importance in terms of freight activity and on externalities such as emissions. It also provides an overview of the stakeholders and policies that are relevant for the sector. Opportunities and potential next steps for green freight have also been developed briefly, based on analysis of the information collected, as well as best practices from other countries that have developed a green freight program. This report has been developed through detailed research of reports and news articles, and has been reviewed by experts from Bangladesh and other countries. Selected interviews to reinforce the findings have been carried out with stakeholders.

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2 Fuel combustion CO₂ emissions, based on the data of IEA (2012).
2. FREIGHT ACTIVITY AND MODES

The country’s freight transportation system is served by various modes such as road, rail, and inland waterways. Surface freight transportation is dominated by road freight (up to 80% of the freight mode share) as depicted in Figure 1.

![Figure 1: Freight transport mode share (billion ton-km)](source: World Bank (2009))

Bangladesh has 21,365 km of major roads, including national and regional highways, and zilla roads (district roads); 2,877 km of railways and 3,824 km of perennial inland waterways, which increases to 6,000 km during the monsoon season (Bangladesh Bureau of Statistics, 2013). Chittagong is the major port handling 95% of the volume by sea and the country has three international airports at Dhaka, Chittagong, and Sylhet as well as eight domestic airports (Bangladesh Bureau of Statistics, 2012).

Freight traffic is growing at an average of 8% per year (2.6 billion ton-km in 1975 to 31 billion ton-km in 2008 and has outpaced GDP growth (5% growth in the same period). The growth in freight transportation has mostly been accommodated through road, which has dominated the freight mode shares in the recent decades.\(^3\) High allocation of transport investments for the road sector in successive five-year plans have been observed.\(^4\) Road construction in Bangladesh has been prioritized over the development and maintenance of other competing modes such as railway and inland waterways, and has resulted in the strengthening of the relative significance of road freight in terms of mode share as seen in Figure 2 (Road and Highways Department, Ministry of Road Transport and Bridges, 2009). The government has recognized the importance of strengthening the other modes and has passed the National Integrated Multimodal Policy in 2013 to pave the way towards a more cost-effective, safe, and efficient transportation system. Moreover, the 2008–2028

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\(^3\) According to Alam (2015), the latest estimate is 60%, but previous estimates show 70% to 80% of the ton-km are done through roads.

\(^4\) Five-year plans are developed by the government to outlay the infrastructure requirements and investments for a five-year period.
Road Master Plan emphasizes the repair and maintenance of existing roads rather than the construction of new ones.

![Figure 2 Transport investment (%) and freight mode share (ton-km)](image)

Source: World Bank (2009); Road and Highways Department, Ministry of Road Transport and Bridges (2009); Alam (2015)

Railways have played a limited role in freight movement, due to the slow expansion of infrastructure and improvement of services, compared with competing transportation modes (World Bank, 2009). Railways enjoyed a monopoly and carried most of the principal commodities in the past decades, but with gradual emergence of road transport, railways gradually lost its share and declined from 30% in 1975 to 4% in 2005 for both passenger and freight transport. Currently, railways still dominate in carrying certain commodities such as stone, iron, steel, and food grains, i.e. commodities that are seaport- and land port-based (ADB, 2015b). There has been a sharp decline in the rail ton-km from 2010 to 2013 (from 770 thousand ton-km to 611 thousand ton-km; Alam, 2015). As previously mentioned, there are 2,877 km of rail track in the country, with a target of 3,252 km by the end of 2015 as per the sixth five-year plan; however, it is unlikely that this target will be reached.

The inland waterway system is not being used to its full potential, partially due to issues such as inadequate dredging and shortage of berthing facilities. While lack of resources is the main cause, the quality of sector management and services provided by the operators has also contributed to inland water transport’s (IWT) overall decline. Tariffs regulated by the Government are insufficient to generate a reasonable profit, and as a result boats are overloaded, which is the cause for more than half of the accidents on waterways. Improving the waterways can potentially reduce transport costs for bulk cargo and can also provide better access to areas where road transport is limited (Alam, 2015). It is estimated that water transport is the only transportation mode available to nearly 10% of the total area of Bangladesh (MMM Group and BCL Associates, 2012).

The quality of transportation infrastructure has been a major competitiveness barrier for the country. Bangladesh’s infrastructure score derived from logistics performance index surveys from 2007 to 2014.

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5 The Logistics Performance Index overall score reflects assessments of a country's logistics based on efficiency of the customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments,
reveals a decline in the quality of infrastructure. The average annual decline in score from 2007 to 2014 is – 1.1%. In the same period, global annual average increase in infrastructure quality was 1%. Limited and distorted investments have been the prime cause of this fall resulting in the logistics performance index ratings of Bangladesh to drop from 87 in 2007 to 108 in 2014. Traffic congestion, port inefficiencies and cumbersome custom processes cost the economy an estimated US$1.1 billion a year and the garment industry, the mainstay of Bangladesh’s export industry, loses about 30% of its business to competing countries as a consequence of delays from inefficient logistics. Between 2010 and 2014, Bangladesh’s export revenue grew by 13%. The recently released Global Competitiveness Report by the World Economic Forum points to inadequate supply of quality infrastructure as the top problematic factor for doing business in Bangladesh. The country ranked (out of 144 countries) 117th in terms of the quality of roads, 75th in the quality of port infrastructure, 93rd in quality of port infrastructure, and 127th in terms of air transport infrastructure (World Economic Forum, 2014). The seventh five-year plan has recognized this need and the strategy set forth in terms of transport infrastructure development inculcates a balanced 3R (rail, river, and road) multimodal transport infrastructure system.

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6 For example, between 2007 and 2014, Vietnam has increased its infrastructure score by 3% annually.
3. FREIGHT TRANSPORT EMISSIONS

The transport sector is the second-largest source of energy-related CO₂ emissions in Bangladesh after power generation. Consumption of diesel, the primary transport fuel, accounts for about 65% of the total consumption of petroleum products. In the sectoral breakdown of petroleum products usage, transportation accounts for 45% and agriculture and power generation account for a combined 40% consumption as shown in Figure 3 (Mujeri, Chowdhury, & Shahana, 2014)

![Figure 3 Sectoral breakdown of petroleum product consumption in 2010–2011](image)

Heavy commercial vehicles constitute only 7% of total national vehicle registrations; however, they are responsible for 10% to 20% of total vehicle activity and 50% to 67% of CO₂ emissions. GHG estimates by Ministry of Environment and Forest (2012) indicate that nearly two-thirds of transport GHG emissions are contributed by trucks and buses. Clean Air Asia (2012) had estimated that trucks contributed to about 59% of total transport CO₂ emissions in 2010 and 49% of PM emissions from road vehicles.

Simulations show that the annual GDP losses due to economic damage brought about by climate change impacts are projected to be at 2.0% by 2050, second only to the Maldives in South Asia. It is estimated that climate change adaptation costs 6% to 7% of the country’s annual budget at about US$1 billion and is expected to rise to US$5.7 billion by 2050 (UNEP, 2014). The government funds almost 75% of it while international donors provide the rest. Therefore, a significant amount of the country’s resources is spent on climate change, which could have otherwise been spent on various social and welfare measures.

Projections carried out by various institutions reveal that between 2010 and 2030, transport carbon emissions are set to increase by nearly 4.5 times, while BC emissions are set to increase by more than three times (Mourshed, 2015; Department of Environment, Government of Bangladesh, 2014; ADB, 2009) for Bangladesh as shown in Figure 4.

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7 The estimates vary among studies due to lack of standardized data on vehicle activity, modal structure, and fuel intensity.
In order to show the potential freight mode shift strategies in reducing national fuel consumption and transport CO\textsubscript{2} emissions, five individual scenarios were simulated using the BD2050 calculator, an open-source energy and emissions model of Bangladesh (Moursed, 2015).

- **BAU** – High road mode share (99%) with negligible freight mode share for railways and inland waterways. There is no improvement in freight efficiency or fuel intensity of trucks
- **Scenario 1** – This scenario assumes that nearly 85% of freight movement (in ton-km) is supported by roads, 5% by rail, and 10% by inland waterways. There is small improvement in fuel intensity of trucks
- **Scenario 2** – This scenario assumes that nearly 65% of freight movement (in ton-km) is supported by roads, 15% by rail, and 20% by inland waterways. There is small improvement in fuel intensity of trucks
- **Scenario 3** – This scenario assumes that nearly 50% of freight movement (in ton-km) is supported by roads, 25% by rail, and 25% by inland waterways. There is small improvement in fuel intensity of trucks
- **Scenario 4** – High road mode share (99%) but with high improvement in fuel efficiency of trucks, i.e. annual improvement of 2% after 2015
- **Scenario 5** – High road mode share (99%) but with improvement in freight efficiency, i.e. average loading and reduction of empty trips, which results in 10% reduction in ton-km by 2020 and 20% by 2030
All scenarios as seen in Figure 5 show high impact on national transport CO₂ emissions. By improving intermodal facilities, railways and waterways infrastructure on priority, significant mode shift from roads to alternate modes such as railways and waterways could be carried out.

<table>
<thead>
<tr>
<th>Transport emission growth and reduction scenarios</th>
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<tbody>
<tr>
<td>Annual transport CO₂ growth (2015–2050)</td>
</tr>
<tr>
<td>BAU</td>
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<tr>
<td>6.8%</td>
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<tr>
<td>Reduction from BAU at 2050</td>
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There are many countries in Asia that are trying to shift freight from roads to railway network. For example, Vietnam has targeted 40% of the market share for waterways and 12–14% for railways; Indonesia has targeted rail freight market share (ton-km) to increase to 5–10%; Lao PDR has established inland waterways transport target of 30%, and India has established a target of 50% for railways. This level of mode shift requires cumulative and dedicated investments on railways and waterways over two to three decades with policy and regulatory transformations. Bangladesh earlier had established a freight mode share target of 20% for inland waterways and 10% for railways for 2009–2014 (Ministry of Planning, Government of Bangladesh, 2011). However, there is no data available to corroborate the impact of mode share policies from 2009 to 2014.

Fuel consumption is one of the largest expenditures in truck operation (35%). Establishing truck fuel economy standards is challenging due to diversity of truck usage and loading as well as considering that Bangladesh does not manufacture trucks locally. The International Energy Agency (IEA, 2015), in its latest
World Energy Outlook, has established that in order to deliver a peak in global energy-related emissions by 2020 (Bridge Scenario), the annual fuel efficiency improvement required is 2% in the 2013–2030 period. If the same intensity of improvement is considered for freight vehicles in Bangladesh, transport sector emissions could be reduced by 30% by 2050.

By ensuring freight efficiency improvements, i.e. reduction in ton-km travel without reducing economic growth, transport sector emissions could be reduced by 12% by 2050. Considering that the road freight sector is highly inefficient with low penetration of heavy trucks and trailers, high intensity of empty trips and poor loading (and overloading), 20–30% reduction in ton-km could be achieved to reduce fuel consumption and carbon emissions and lower the logistics cost. It has been established that the cost of transport is a barrier for trade development and economic growth. By ensuring greener freight movement in Bangladesh, a higher magnitude of emission reductions with lowered logistics costs can be achieved.


4. ROAD FREIGHT IN BANGLADESH

Given the relative importance of the road freight sector in the country's freight activity, and also in terms of externalities, a closer look at this mode is merited. This section provides insights on the current state of the road freight sector, considering market characteristics and issues associated with road freight transportation.

![Figure 6 Truck ownership and economic growth](image)

Source: Data from the Bangladesh Bureau of Statistics (2012) and Bangladesh Road Transport Authority (BRTA, 2014)

A 2012 survey of manufacturing industries (Bangladesh Bureau of Statistics, 2012) revealed that 41% of manufacturing industries are micro types, 37% small types, 14% medium types, and only 8% were the large types. With more than 90% of manufacturing industries of micro, small, and medium scale, there is an inherent fragmentation in logistics demand. On the transport services supply side, though there are no official estimates available on truck ownership patterns on a national scale, insights from Dhaka transport plans reveal that the number of companies having 20 to 30 trucks is about 100, and about 300 owners have small fleets of five to 10 trucks (Dhaka Transport Coordination Board, 2004), while statistics on the number of single-truck owner drivers are not indicated. Figure 6 shows the truck ownership vis-à-vis the country’s economic growth (per capita) over a 20-year period, and implies that truck motorization rates are increasing more rapidly as compared with economic growth in the country.

Historically, the poor condition of cross drainage structures, especially major bridges, has restricted the penetration of large trucks and trailers, which is now slowly changing with the infrastructure development of new bridges and wider roads. In Bangladesh, the single-axle limit is 10 tons and the maximum combined weight for a truck is only 30 tons. The predominant truck type on road is the medium truck variety with gross vehicle weight of 15.6 tons (Road and Highways Department, Ministry of Road Transport and Bridges, 2005).

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8 According to the Bangladesh Road Transport Authority (2015), the total number of trucks registered in Dhaka is 46,500, excluding tankers and vans, as of June 2015.
Small trucks (auto tempo\(9\), cargo vans, and delivery vans), with a gross vehicle weight of 5.2 tons, account for about 22% of the truck types (Figure 7) (BRTA, 2014).

![Pie chart showing truck types](image)

**Figure 7. Freight vehicle registration in 2014**

Source: BRTA (2015)

The average profit margin for the truck operators is very low due to a variety of factors. Between 2004 and 2010, while the diesel prices doubled, the road freight charges increased by nearly three times. Currently the average road freight charges (per ton-km) are three times the cost of transport by alternate modes. For medium trucks, fuel constitutes 35% (Road and Highways Department, Ministry of Road Transport and Bridges, 2005), and maintenance costs are 33% of total road-user costs. The breakdown is provided in Figure 8. Nearly 90% of maintenance is carried out directly by the operator and not by trained mechanics in workshops or by the truck manufacturers. High maintenance costs could mean that trucks are relatively old, and that truck operators may reduce or neglect long-term periodic maintenance if they do not get adequate profits.

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\(9\) Light commercial vehicles are three-wheeled or four-wheeled with gross vehicle weight of less than 3.5 tons.
Fuel is the single largest expense at 35%, and when combined with maintenance and tires, accounts for almost 70% of the total expenses. Availability of cheap labor and lack of tolled roads keep the other costs down. Figure 9 provides a comparison of freight rates for different modes. While inland waterway and railway prices have remained stagnant, road freight rates have grown and despite this increase the ton-km by road has increased.\(^\text{10}\)

The average age of a truck is more than 10 years and some reports indicate it to be 15 years (Road and Highways Department, Ministry of Road Transport and Bridges, 2005; Subramanian & Arnold, 2001),

\(^{10}\) While railways have been subsidized for the freight rates to remain constant, there is no evidence for the road sector.
though there is no reliable data at present to accurately estimate the average age of the truck fleet. Average truck utilization (i.e. ratio of hours driven and total hours in work) is only 66% for medium trucks and 49% for smaller truck (Road and Highways Department, Ministry of Road Transport and Bridges, 2005). The utilization rate seems to be low considering that the average trip distance of freight movement in Bangladesh is only 144 km (Dhaka Chamber of Commerce and Industry, 1999).

Average truck speed varies from 15 km/h in urban areas to 25 to 30 km/h on national highways. Because of high empty trips, poor productivity levels and high movement of unidirectional commodity load, many truck operators and drivers overload the trucks to increase the profits. To facilitate overloading, operators often modify the trucks illegally. Based on a survey, it was found that almost 75% of the trucks were modified increasing the dimensions, in both length and 21% in height (Ahsan, Mahmud, & Bhuiyan, 2012). Truck operators commonly strengthen the chassis and the suspension to enable overloading of trucks.

Axle load surveys reveal that along national highways, some of the medium trucks were carrying up to six times the permissible limits and multi-axle trucks were carrying twice the permissible limit. On an average medium trucks\textsuperscript{11} are overloaded by 7–8 tons and heavy trucks by 12 tons. The impact of high truck loading is estimated to cost US$40 million per year in additional maintenance and rehabilitation of pavements (Road and Highways Department, Ministry of Road Transport and Bridges, 2009). Nearly 40% of traffic moves on regional highways and rural roads, which have higher intensity of pavement deterioration. Roughness surveys reveal that 51% of the regional highways and 75% of rural roads fall under the “poor” and “very poor” categories, respectively (Road and Highways Department, Ministry of Road Transport and Bridges, 2009).

\textsuperscript{11} Medium trucks are two- or three-axle > three-ton payload.

\textbf{Figure 10} Truck with low-density goods

Source: Mona Mijthab, July 2011, Sustainable Sanitation Alliance.
The tare (unladen) weight-to-gross vehicle weight ratio for trucks in Bangladesh is comparable with trucks in the European Union (EU) and in the US. Medium trucks in Bangladesh have a tare weight-to-gross vehicle weight ratio of 0.3; for smaller trucks this ratio is 0.5 (Road and Highways Department, Ministry of Road Transport and Bridges, 2009). By reducing the weight of the truck by substituting new, lighter weight materials, fuel and loading efficiency improvements could be achieved. It has been estimated that nearly 1% fuel efficiency improvement can be achieved with a 0.5- to 1-ton reduction in empty weight (Delorme, Karbowski, Vijayagopal, & Sharer, 2009). Further, operators can derive productivity benefits by legally increasing amount of cargo per truckload.

Heavy commercial vehicles are not manufactured in Bangladesh but imported from other countries especially India. Leading manufacturers, such as Tata Motors, Ashok Leyland, Eicher, and Daimler India, export their trucks of various categories. Tata Motors and Ashok Leyland combined constitute 75% of market share, while in the mini truck segment Tata dominates with 90% market share, as seen in Figure 12. There are significant truck body-building industries concentrated around Dhaka, Jessore, and Bogra, which have a growing market share of 20% annually (Huda, 2014).
The growth of the truck population over the past two decades has ensured rapid growth in the truck tire industry. In the truck and bus category, the tire market is split among twelve manufacturers with no predominant leader (Shamin, 2014) as seen in Figure 12. MRF currently has the highest share with 23%. In the trucking segment, there is very high penetration of bias tires with low presence of radial tires. Currently radial tire constitutes only 13% of the market share and is expected to reach 20% in the near future (Shamin, 2014). Most of the sales are based on credit and the tire industry is extremely price sensitive.

Another important aspect to note is the training and performance of truck drivers in the country. A survey reveals that only about 3% became drivers by attending driving schools and through standardized courses. Nearly 96% of the respondents learnt driving by becoming a helper for a few years. Studies reveal that heavy

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12 Radialization of the truck tire market is almost complete in China and it is growing fast in India (SFC, 2012). Nearly 90% of tires are imported from India and China.
vehicles (trucks, buses, and minibuses) account for nearly 64% of all fatal accidents despite comprising of only 15% of total vehicles. The traffic fatality rate per vehicle-kilometer is 30–40 times higher compared with that of developed countries (ADB, 2012). These facts also present an opportunity for exploring eco-driving programs that can help improve drivers’ performance in terms of fuel consumption and also help them become safer and more defensive drivers.

In the last three decades, truck ownership levels have consistently grown above the GDP per capita growth levels (see Figure 9). Current freight motorization rate in Bangladesh is extremely low compared with other developing countries, i.e. about 0.6 trucks per 1000 population (e.g. versus about six for Vietnam). Due to low truck motorization rates, small country size and diversity of modes available, the current freight activity of around 200 ton-km per capita (Mourshed, 2015) and freight intensity of 0.3 ton-km per GDP are lower than many other countries (see Figure 14).13

However, due to increased economic activity and higher reliance on trucks, freight motorization, and activity levels are set to increase rapidly until 2050 under a business-as-usual scenario. With Bangladesh aiming to become an export hub, the freight intensity is not likely to abate in the next two decades. For logistics, this implies that even a small increase in GDP will lead to high increase in freight activity.

If the road freight intensity in Bangladesh does not change significantly (assuming that Bangladesh does not shift from an industry to a service-oriented economy by 2050), freight activity could increase from 32 billion ton-km to 470 billion ton-km (Mourshed, 2015), i.e. from 200 ton-km per capita in 2010 to 2000 ton-km per capita. In order to facilitate this activity, the number of trucks on road could increase 14-fold in next 40 years, which translates to an annual growth of 7%, assuming there is no change in road freight mode share and truck productivity levels. The Bangladesh Road Master plan suggests that trucks could grow at an annual rate of 5.1% to 6.87% from 2005 to 2025 (Road and Highways Department, Ministry of Road Transport and Bridges, 2009).

![Figure 14 Global freight intensity and freight activity](source: Analysis done by S. Gota)

13Analysis was done by S. Gota (unpublished) with statistics from different countries.
With rapid increases in ownership, truck activity will also increase thereby increasing external costs including GHG and air pollution and its associated health-related costs, energy consumption, road injuries and fatalities, and other risks to drivers and the public. Freight activity projections reveal that freight activity (in ton-km) is set to grow at an annual rate of 7% from 2008 to 2025 (Ahmed, Fujiwara, & Zhang, 2010; Matsuoka, Fujino, Azad, & Ali, 2012). Freight will increasingly get concentrated around roads with trucks carrying about 91% of freight activity (in ton-km) by 2025 and about 99% by 2050 (Mourshed, 2015) under a business-as-usual scenario, where predominant emphasis is laid on improvement of roads with no significant investments in railways and waterways. It is also important to note that petroleum imports have grown at an annual rate of 9.5% in the last five years in Bangladesh. In 2013, the transport sector consumed 2.3 million tons or 45% of the total petroleum products consumption.
5. A LOOK INTO URBAN FREIGHT IN DHAKA

It is projected that by the year 2021 nearly one-third of the population of Bangladesh will be living in urban areas and a large proportion (54%) of the urban population will be concentrated in Dhaka, Chittagong and Khulna Metropolitan areas (Planning Commission, Government of Bangladesh, 2012). Urban freight will therefore have a significant impact on the economy and growth of the cities apart from the quality of life. Since Dhaka and Chittagong account for more than 50% of the total vehicle registrations (BRTA, 2015) and 30% of freight vehicle registrations, it is imperative that actions are directed to manage these vehicles to obtain any impact in efficiency and air quality. In the road sector, 38% of all vehicle kilometer travel is facilitated by five corridors originating from Dhaka. These five corridors account for just 5% of length of the entire road network (Road and Highways Department, Ministry of Road Transport and Bridges, 2009).

Freight activity within Dhaka is about 5 billion ton-km annually (Bose, 2011), which supports high concentration of economic activity within the Dhaka metropolitan region generating 36% of total national output (Muzzini & Aparicio, 2013). Growing traffic congestion costs about US$3 billion annually in Dhaka (The Daily Star, 2010), i.e. about 5% of national gross domestic product. Rising congestion levels (average speed of trucks is 15 km/h on highways within Dhaka City) have forced the government to ban trucks during the daytime, raising logistics costs further (Figure 15). The truck mobility restrictions are generally between 0700 and 2000 hours (Dhaka Transport Coordination Board, 2004). Covered trucks are prohibited between 0700 to 1000 hours and 1600 to 2000 hours.

![Figure 15 Impact of truck bans](image)

Source: Muzzini and Aparicio (2013)

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14 According to representatives of a voluntary association of truck owners (Bangladesh Truck Malik Samity), there are around 60,000 trucks in all of Bangladesh – 20,000 operating in Dhaka (local), 20,000 operating to and from Dhaka (inter-district), and 20,000 operating in other parts of the Country outside Dhaka - The Strategic Transport Plan for Dhaka.
High truck concentration in urban areas generates a variety of negative externalities including traffic congestion, GHG emissions, air pollution, noise pollution, traffic accidents, and land-use disruption. In Bangladesh, up to 10,000 premature deaths are associated with outdoor air pollution annually (WHO, 2009). Intensity of pollution is much more severe in Dhaka where about 15 million people reside. Source apportionment studies carried out in 2006 established that vehicles were the second largest contributors, after the brick kilns, of carbonaceous content of airborne PM in Dhaka (Department of Environment, Government of Bangladesh, 2012a). The World Bank (2009) has estimated that by reducing the exposure to urban air pollution from 80% to 20%, about 1,200 to 3,500 lives could be saved, and could also avoid 80 to 230 million cases of ill health annually. This would result in an annual saving of US$169 to US$492 million.

It has been estimated that about 6,000 premature deaths (Wadud and Khan, 2011) were avoided in Dhaka in 2009 alone due to air quality improvements resulting from the conversion of the transport fleet to compressed natural gas (CNG). Considering the health and cost advantages of CNG fuel, there has been a rapid conversion of vehicles within Dhaka in the last 10 years. Recent surveys reveal that CNG operated commercial vehicles already account for more than 50% of the total commercial vehicles in the city (Department of Environment, Government of Bangladesh, 2012a). It is also to be noted that while CNG can help reduce the PM and BC, the impacts of CNG, particularly on methane (CH₄) through leakages must be studied and taken into account.

Considering that freight emits annually about 33% of Dhaka's total transport PM emissions with only 6% of registered vehicles, freight has a significant role to play in reducing air pollution in Dhaka. There are other significant co-benefits of improving efficiency and reducing emissions from urban freight in Dhaka since growing traffic contributes 0.5 MT of CO2 annually (Bose, 2011). For example, a reduction of 100 tons of PM2.5 due to green freight activities in Dhaka could result in avoiding 183 annual premature deaths and in an economic benefit of US$12.7 million (2010).¹⁵

Due to traffic restrictions, truck productivity levels are extremely low. On average, trucks in Dhaka travel only about 50–70 km in a day. Due to low productivity and a high concentration of trucks, there is a significant oversupply of trucks for local transport in Dhaka, with about 40% of the total truck fleet being unused on a daily basis (Dhaka Transport Coordination Board, 2004).

High congestion and truck restrictions are forcing many shippers to move out of Dhaka resulting in logistics sprawl. A survey reveals that about half of the firms that relocated to peri-urban areas from Dhaka City cited a high traffic congestion and poor transport accessibility within Dhaka as the primary reason for de-concentration (World Bank, 2012). Considering the importance of Dhaka for the overall economic growth of the country, freight related economic, environmental, and social costs cannot be sustained. By improving urban freight in Dhaka, economic and social quality of life could be improved while limiting impacts on the environment.

¹⁵ Based on an analysis using the AirCounts Calculator (aircounts.com).
6. INSTITUTIONS AND POLICIES

Bangladesh has progressed in terms of issuing landmark policies relating to transportation (e.g. National Land Transport Policy, National Multimodal Transport Policy) as well as policy documents and action plans on the control and mitigation of emissions from transportation (e.g. National Action Plan on reducing SLCPs). The review of the various documents and the interviews reveal that there is still a strong need for institutional coordination, as well as capacity building in relation to sustainable transport, in general. Implementation of the transport sector policies has been hampered by the weak institutional framework governing the sector. In particular, achieving a balanced and coordinated transport system has not been possible because the Government does not have a system for coordinating development plans and budgets in a fragmented institutional framework, where multiple ministries and institutions oversee transport sector policy and development.

It is important to recognize that the public sector is responsible for the planning, development, and maintenance of the physical infrastructure of roads, rail, ports, and inland waterways and setting rules and regulations for operation of freight transport vehicles, while the private sector is responsible for the freight transport operations. While selecting appropriate policies, regulations, and projects, it is important to acknowledge that benefits and trade-offs are both significant factors at play as many green freight policies and strategy implementation may result in multiple benefits, but may also impose additional costs on some stakeholders.

Table 2 Relevant institutions

<table>
<thead>
<tr>
<th>Major Institutions</th>
<th>Responsibilities</th>
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<tbody>
<tr>
<td>1 Road and Highway Division</td>
<td>• Construction and the maintenance of the major road and bridge network of Bangladesh.</td>
</tr>
<tr>
<td>2 Bangladesh Road Transport Authority</td>
<td>• Controlling and regulating road transport by executing motor vehicle acts, issuing route permits</td>
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<td></td>
<td>• Conducting regular activities like issuing driving license, fitness certificates, registration certificates, and driving instructor's license</td>
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<td></td>
<td>• Organizing and conducting workshop seminars for delivering information regarding safe driving and traffic regulations</td>
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<td></td>
<td>• Making research and development for developing ideas and methodologies for safe road transport and traffic system</td>
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<tr>
<td>3 Bangladesh Road Transport Corporation</td>
<td>• Operating road transport services for both passengers and cargo.</td>
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<td></td>
<td>• Providing training facilities for drivers, mechanics, and in transport management in order to develop skilled manpower in the road transport sector</td>
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<td></td>
<td>• Researching on vehicle and engine types and safety considerations for bringing harmony in operation of truck services and to combat air pollution</td>
</tr>
<tr>
<td>4 Dhaka Transport Coordination Board</td>
<td>• Advising the concerned agencies on an integrated and safe traffic and transportation system for Dhaka and to make necessary arrangements with that purpose</td>
</tr>
<tr>
<td>Major Institutions</td>
<td>Responsibilities</td>
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</tbody>
</table>
|                    | • Coordinating the traffic and transportation infrastructure development plan with the overall development strategy plan for Dhaka as envisaged in the infrastructure plan  
• Formulating strategic planning for traffic and transport sector of Dhaka and to coordinate inter-agency cooperation |
| 5 Bangladesh Railway<sup>16</sup> | • Developing and maintaining railway tracks and station infrastructures throughout the country  
• Maintaining and upgrading locomotives, coaches, and other rolling stocks  
• Ensuring safe, speedy, and efficient train operation  
• Procuring modern technology related rolling stocks, track materials & signaling systems suitable for Bangladesh Railway  
• Managing land asset of Bangladesh Railway |
| 6 Bangladesh Inland Water Transport Authority<sup>17</sup> | • Disseminating navigational and meteorological information including publication of river charts  
• Drawing up programmers of dredging requirements and priorities for efficient maintenance of existing navigable waterways and for resuscitation of dead or dying rivers, channels, or canals, including development of new channels and canals for navigation  
• Developing, maintaining and operating inland river ports, landing/ferry ghats, and terminal facilities in such ports or ghats  
• Conducting traffic surveys to establish passenger and cargo requirements on the main rivers, feeders, and creek routes  
• Ensuring co-ordination of Inland Water Transport with other forms of transport, with major sea ports, and with trade and agricultural interests for the optimum utilization of the available transport capacity  
• Arranging programs of technical training for Inland Water Transport personnel  
• Fixing of fares and freight rates for Inland Water Transport on behalf of the Government |
| 7 Bangladesh Inland Water Transport Corporation<sup>18</sup> | • Providing services for safe transportation of passenger and cargo in inland and coastal water ways  
• Providing services for transportation of vehicles in the waterways.  
• Maintaining dockyard and repair yard for repair and renovation of vessels engaged in the above mentioned activities |
| 8 Planning Commission<sup>19</sup> | • Preparing the short-, mid-term, and long-term plans viz. Annual Development Programs, Five-Year Plan and Perspective Plans  
• Coordinating the economic policies, both short- and long-term, to be under taken by the various ministries |
| 9 Ministry of Local government, Rural | • Ministry under which all the city corporations, local development authorities are responsible for their jurisdiction |

<sup>17</sup> [http://www.biwta.gov.bd/website/?page_id=706](http://www.biwta.gov.bd/website/?page_id=706)  
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<tr>
<th>Major Institutions</th>
<th>Responsibilities</th>
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<td>Development, Cooperatives&lt;sup&gt;20&lt;/sup&gt;</td>
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</tbody>
</table>
| 10 Chittagong Authority<sup>21</sup> Port | • Largest port of Bangladesh  
• Handled more than 14 million tons of imports and exports in 2012–2013 |
| 11 Mongla Authority<sup>22</sup> Port | • Mainly caters to import of jute, frozen goods  
• Well connected with Dhaka by road (4.5 hours)  
• Capacity to handle 6.5 million tons annually |
| 12 Department of Environment<sup>23</sup> | • Training, creating awareness on environment issues  
• Developing environmental rules, regulations, acts, and ordinances |

The following table lists the relevant major policies, strategies, and initiatives in Bangladesh with regards to freight sector and the barriers they address (Table 3).

### Table 3 Overview of issues addressed by various policies

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<td>Economic incentives for behavior change</td>
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<td>Costs of freight transport</td>
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<td>Enforcement, inspection, and maintenance</td>
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<td>Overloading</td>
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<td>Managing issues relating to trucks</td>
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<td>Developing partnerships</td>
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<td>Involvement of private sector</td>
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<td>Urban freight</td>
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<td>Trade and export policies</td>
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<td>Lack of green freight methodology for quantifying emissions</td>
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<td>Access to finance for private sector</td>
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Although much work has been done in instituting policies that can transform the freight sector in Bangladesh, there are critical elements towards moving forward with greening the freight sector in Bangladesh that are not covered by the current policies, as seen from the table above.

Transport policies related to the freight sector as seen in Table 3 reveal that an overarching strategy that will address the greening of the freight sector is still lacking. This has also been confirmed through stakeholder interviews that were conducted in the development of this paper. Significant advancements in policies and actions towards addressing the state of the road trucking industry and its impacts are needed. Discussions on application of measures such as technologies, finance schemes for replacement, capacity building, and use of information technology have not evolved yet.

The traditional approach for solving environmental issues of the freight sector was to restrict truck movement during peak hours, and by diverting traffic through building bypasses and build truck terminals outside the cities. Some of the main market barriers that must be overcome to effectively address freight sector are policies and institutional arrangements, growth in freight sector, technologies, and low-cost financing mechanisms.

It is significant to note that a large number of trucks in Bangladesh are above 10 years of age and since inspection and maintenance, strengthening emission standards, and improving fuel quality are still in the nascent stages, trucks have high emission intensity and poor loading efficiency. Since, the reliability of operations is uncertain, they operate within small geographic areas (cities) and generate high emissions per activity performed.

The Government currently mandates 2,500 ppm sulfur levels in diesel. The updated national roadmap recommends the move to sulfur levels of diesel fuels to 500 ppm by 2016 and to subsequently to tighten standards to 350 ppm by 2020, and 50 ppm by 2023 (Clean Air Asia, 2015). The Government of Bangladesh has also pushed for the use of CNG for use in the road transport sector, as stated in the National Land Transport Policy. The policy initiatives of the government to promote CNG use in the sector includes dropping import duties on CNG conversion kits, storage tanks and filling stations, price restructuring of CNG and petroleum prices (although diesel is still heavily subsidized due to its agricultural uses) to give CNG more competitive advantage and strengthening the participation of the private sector. The adoption of CNG OEM procurement/conversion has been evident for several vehicle types such as cars, SUVs, minibuses, and buses. A potential downside of wide-scale adoption of converted CNG vehicles would be potential methane (an SLCP) leakage if the conversion process is not done properly (Department of Environment, Government of Bangladesh, 2012b). Moreover, the infrastructure availability to supply CNG in all parts of the country is important if the conversion is to be undertaken in a large scale. It is also to be evaluated if the loading capacity is considerably affected if converted to CNG. It is therefore essential that the entire lifecycle cost is be evaluated.
The vehicle emission standards in 2005 is Euro 1 for heavy-duty diesel vehicles, i.e. >3500 GVW. For light duty diesel vehicles, the road map indicates a move to Euro 2/Euro 3 in Dhaka and Chittagong and Euro 1/2 in rest of the country by 2014/2019 (Department of Environment, Government of Bangladesh, 2012a). Considering that vehicles are imported from other countries such as India, China, Japan, and South Korea, which follow higher standards, it could be expected that the transition to higher standards should be possible as per the roadmap.

There is still a lack of penetration of technologies that promote fuel efficiency, which are also important for reducing energy consumption from the sector. Currently, about 2% of GDP is expended for importing energy required for the transport sector (Alam, Wadud, Alam, & Polak, 2013). If low carbon transport policies are not expanded and if fuel price increases to US$120/bbl by 2030, 14% of country’s GDP might be required for importing fuel to meet the requirement (Alam et al., 2013). Some of restricting barriers for technology uptake are high investment costs, lack of confidence in technologies, and lack of finance. Though Bangladesh has a good penetration of local financing institutions specializing in financing small and medium enterprises, there is a significant lack of exposure and experience in lending energy efficiency investments within freight sector despite short payback periods for the freight sector. There is a lack of confidence in technologies among operators and government institutions. Interviews with the stakeholders in the government department, ministry, and others reinforces that the concept of green freight is still unknown amongst most people but is highly relevant to combat carbon emissions and air pollution. Creating awareness among stakeholders on the concept of green freight, demonstrating the cost benefit of technologies and partnerships amongst the stakeholders were opined essential. Gradual change in policies that approach freight in its entirety rather than just one area will help the industry have better acceptance and better cope with change.
7. OPPORTUNITIES FOR ADVANCING GREEN FREIGHT

At the national level, a broad action plan is required to provide a green pathway for the freight sector. Given the wide range of issues, there cannot be a silver bullet, but requires a suite of actions to have a sustainable long term impact. The section below depicts suggestions for priority action points can be made central in the development of a national action plan on freight. These concepts are based on practical solutions that can address the issues that have been analyzed in the earlier sections and are seen to be suitable to the state of freight transport in the country.

**Development of a National Green Freight Program**

Green freight programs are mechanisms that aim at improving the efficiency of and minimizing the externalities from freight transportation, e.g. reduction in air pollutant, GHG, and SLCP emissions, improve energy security, reduction in transportation costs, mitigation of congestion problems and safety, among others. Globally, the scope and characteristics of green freight programs can vary widely and can range from government- or industry-led initiatives or mode-specific programs. Green freight programs can also be beneficial in enhancing the competitiveness of a country within the realm of global supply chains, as increasing demand for standardized metrics (including sustainability-related ones) are emerging. The Global Green Freight Action Plan defines green freight programs as a combination of carbon accounting and disclosure with action plans, collaboration, and recognition for businesses’ efforts (Climate and Clean Air Coalition, 2015). Green freight “initiatives”, which are more focused on subsets of activities that support such a program, can be explored. As the drivers for green freight become stronger, numerous programs are being advanced at the sector, local, national, regional, and global levels. Successful green freight programs are primarily built upon strong cases for fuel, and therefore provide cost savings and the provision for incentive mechanisms to accelerate the adoption of efficient technologies and operating practices.

This paper has showcased the drivers for potentially establishing a national green freight program in Bangladesh. It has shown that the freight transport sector is a primary contributor to air pollution, GHGs, and SLCPs, and greening the sector shall have transformative impacts that can also support the developmental goals of the country. Internal policy drivers that support the ideas behind green freight programs are also in place, including strengthening partnerships between the government and the private sector. It can complement the action that have been mentioned in relevant government strategies, such as the National Action Plan for Reducing SLCPs, which includes transport measures (albeit no specific emphasis on freight vehicles) such as the phase out of high-emitting vehicles, encouraging diesel to CNG switch and the promotion of cleaner diesel.

Green freight programs are mainly characterized by certain key elements such as partnership building, information generation through the use of standardized tools and methodologies, and supporting financing or incentive schemes that aid the adoption of green technologies and practices in the freight sector. Such programs can also address a key barrier that has surfaced in the interviews: the lack of awareness about the
concept of green freight. Creating awareness about the concept is clearly a first step that must be taken. Another key barrier that was identified in relation to technology adoption is the lack of clear understanding of the market of what is available and what are the impacts of these technologies that can be addressed later on by technology verification mechanisms – such as one developed by ICCT, which can be included as part of the program. Moreover, specific green freight measures (technologies, operational practices) can be piloted first and the proof of concept can be built and scaled up once the local context is understood better.

A national green freight program can be led by the government or private sector or civil society to develop various metrics and establish benchmarks and work upon them. The creation of such a program can be informed by experiences in other countries such as the SmartWay Transport Partnership (SmartWay) in the US and Canada, as well as those programs and initiatives in the region (e.g. China and India).

Such a green freight program should be suited to address the concerns of various stakeholders: (a) the government – energy consumption reduction, safeguarding the environment, ensuring safety and efficiency of transportation; and (b) the private sector – minimizing costs, generation of data that can complement management of operations. Civil society can play the role of a catalyst to enable the government and the private sector to collaborate better. Since freight also interweaves with multiple stakeholders, a leading department or a ministry will have to be identified from the government side. Associations of private sector or transport or freight forwarders are best suited to be part of working committees to put forth the views of their industry. Through consultations to understand the implications and roles of various stakeholders, freight roadmap can be developed that will help chart the course of the program. A platform will therefore be developed that will help share the best practices and the learnings that will help facilitate greater awareness of green freight.

A structured program with clear objectives and roles of stakeholders will greatly help attract funding from development agencies as well as from the governments, to enable subsidizing or incentivizing fuel efficiency technologies, replacement of old inefficient vehicles and move towards cleaner fuels. The starting point for a green freight program in each country or city or region varies depending on the unique requirement. Therefore, it is essential that stakeholders get together to understand these requirements and form a nationwide program under which various initiatives can be taken up. Since the priorities for each of the stakeholders are different, discussions and engagements are essential to find common grounds for the activities. One of the important elements is the ‘visioning’ exercise, where stakeholders will have to deliberate and decide where green freight should be in the long term. Through consultations, an action plan should be developed to help achieve the vision with clear roles and activities. ‘Working groups’ can be formed to focus on specific issues of policy, infrastructure, technology, finance, and awareness building. Initial steps to start the consultations can be through green freight seminars and workshops that can help bring green freight to the discussion table, which could be a new topic for many stakeholders.

Given the multiple barriers and the roles that each of the stakeholder will have to play in the solutions, partnerships are essential to be formed. For example, carriers who operate trucks would have data of the vehicle activity, ton-km, and loading patterns, among others, which when shared with the research organizations and government can help facilitate suitable solutions of overcoming the data deficit and increasing the data flow and collection system. Other benefits of partnerships include regulation, legislation, financing, branding, benchmarks, and recognition schemes.

A Green Freight program can also integrate recognition schemes, which can provide further incentives for the shippers and carriers to shift towards greener practices. The schemes only help them to be more efficient, and save fuel and reduce emissions. Such schemes are achieved through a system of data collection and analysis, and operators are provided labelling stars. The SmartWay Partnership provides its recognition through its logo to fuel saving products ranging from tires to aerodynamic equipment that meet certain specifications. The objective of the recognition scheme is that it helps both shippers and carriers to brand themselves as a green one depending on the levels they have achieved, which will ultimately drive more business as they match sustainability requirements.

An important component of a green freight program is the availability of financing schemes for adopting technology for operators. With proven savings and short repayment periods, banks, cooperatives, and other financial institutions would ideally come forward to provide loans at low rates to help the small- and medium sized operators. Due to the small size of loans compared to loan administration costs, challenges can arise in attracting banks, and strategies to alleviate this problem are required. For many technologies, logistics, and other solutions, there will be considerable cost savings and favourable payback periods, plus their costs could be brought down if their scale of application were to be increased. However, this does not apply to all solutions. Truck companies may choose to not invest because of high upfront costs, despite favourable savings. Financing mechanisms must be part of a green freight program design in order to overcome these challenges and realize rapid penetration of fuel- and emissions-reducing technologies and logistics solutions. Financial mechanisms are especially needed to help carriers make the transition. The lending will have to be linked to fuel and emissions savings to achieve the required impact, and therefore creative financing mechanisms will have to be developed (Clean Air Asia, 2013).

Aside from the development of a national green freight program, a longer-term and holistic green freight plan can be developed, wherein other elements and activities can be fitted into, as seen in the descriptive figure below. Some of the elements that have been mentioned in the figure are discussed in the later section to give some insights on why these are important for the country.

Development of the Dhaka-Chittagong Green Corridor

In Bangladesh, freight movement is not geographically segregated but absorbed along few corridors. This creates unique opportunities and some challenges. “Green Corridors” are innovative European solutions where long-distance freight transport corridors are subjected to co-modality, alternative fuels and advanced technologies to achieve energy efficiency improvements. Green transport corridors generally reflect an integrated transport concept where short sea shipping, rail, inland waterways, and road complement each other to enable the choice of environment-friendly transport (Commission of the European Communities, 2007).

In Bangladesh, the 250-km Dhaka–Chittagong corridor carries about 85% of international maritime trade freight and supports about 50% of country's GDP (World Bank, 2009). The rail connection between Dhaka and Chittagong is primarily single, meter gauge track and is severely congested. The road corridor between Dhaka–Chittagong is a predominantly two-lane highway with intermittent sections of four lanes. The truck movements are predominantly medium trucks with 5- to 8-ton capacity (94%), with only 6% of trucks being trailers. Because of the rail corridor limited capacity, the road handles about 90% of the container cargo moving between Dhaka and Chittagong (Chittagong City Corporation, 2014). About 5000 to 6000 trucks operate between Dhaka and Chittagong on a daily basis (Ullah, Hoque, & Nikraz, 2013) commuting the 250-km journey in about 8 to 10 hours at an average speed of 25 to 30 km/h.

Currently, the government is working with development agencies to improve this corridor and ensure adequate and efficient transport system between the capital, Dhaka, and commercial port city of Chittagong. The main emphasis is to enhance the two-lane capacity to four- and six-lane capacities with elevated sections. Since this corridor attracts a very high volume of trucks, a green freight project along this corridor to improve fuel efficiency and reduce BC emissions from trucks could be launched. This project could be a mix of technology demonstration (rolling resistance, aerodynamics, idling), logistics improvement with measures such as freight exchange to reduce empty trips and improve loading efficiency, capacity and knowledge enhancement, improving access to low-cost finance, and promoting alternate vehicles and fuel infrastructure along the corridor. A technology demonstration will have to be carried out to determine the relevance of technologies for Bangladesh.

Green Freight Project in the Port of Chittagong

Chittagong is the country’s second largest city and holds its major sea port. It has been declared as the commercial capital of the country. Many port cities have initiated green freight activities after carrying out detailed emission inventories to determine impact of ships and port activities on air quality of the city. For example, ports of Long Beach, Los Angeles, and Hong Kong used comprehensive emission inventories to understand issues and identify best focused planning efforts and abatement strategies that exist within the city. These inventories and subsequent clean air action plan were instrumental in implementation of a slew
of anti-air pollution strategies, including the ports’ Clean Trucks Programs, vessel pollution reduction programs, and so forth. Many developed cities with intense port activities use emission inventories to track their progress in achieving emission reductions. Port cities in developing countries could develop a clean air action plan based on the emission inventory and consultations with key stakeholders and implement identified green freight measures. Some of the activities that could be carried out are the following: development of emission inventory; feasibility studies for green ship and port program; technology retrofit program for drayage trucks; and drayage trucks replacement scheme. Such a program can be explored, particularly for the Chittagong Port, which handles 92% of the country’s sea-borne export and import trade\textsuperscript{26} by involving the Chittagong Port Authority.

\textit{Standards for Fuels and Vehicles}

Vehicle and fuel standards play a critical role in reducing the emissions from the transport sector. 85% of the fuel in Bangladesh is imported and almost all the heavy-duty vehicles are imported, which also presents an excellent opportunity to upgrade to stricter standards. The compelling objective for both vehicle emissions standards and the sulphur content to be improved is that vehicle technology will work best when the sulphur content is lower. For example, 50 ppm sulfur or Euro 4 is suited for vehicles of Euro 4 and below emission standard, and 10 ppm sulfur or Euro 5 is suitable for vehicles of Euro 5 and below emission standard, makes existing vehicles cleaner, decreasing emissions of CO, hydrocarbons, and NO$_X$ from catalyst equipped gasoline vehicles and PM emissions from diesels, with and without oxidation catalysts. These benefits increase as vehicles are designed to meet higher emissions standards and sulfur levels are reduced further. This enables more fuel-efficient engine designs that are incompatible with current emissions control systems. Particulate filters achieve the maximum efficiency with 10 ppm sulfur fuels, thereby eliminating PM emissions (ICCT, 2003).

Reducing sulfur levels in fuel, both diesel and gasoline has multiple benefits since sulfur is a major pollutant and affects engine technologies too (ICCT, 2003). The updated national roadmap recommends the move to sulfur levels of diesel fuels to 500 ppm by 2016 and to subsequently to tighten standards to 350 ppm by 2020, and 50 ppm by 2023 (Clean Air Asia, 2015). Key challenges in implementing this will be the cost of the fuel and the vehicles apart from the lack of coordination amongst the stakeholders. Bangladesh developed standards for in use vehicles in 2004, and the proposal is for 65 Hartridge Smoke Unit (HSU) from 72 HSU for vehicles registered after 2014 (Department of Environment, Government of Bangladesh, 2012a). The recommendations from a Department of Environment study include creating awareness on emission standards and maintenance of vehicles (Department of Environment, Government of Bangladesh, 2012b), modernization of inspection testing centers and enforcement.

The advantage of moving to stricter standards can be augmented with a vehicle scrappage or a replacement scheme, which involves the phase-out of old vehicles with new and less polluting ones. This move will greatly benefit the truck operators as there will be a significant improvement in vehicle operations and

\textsuperscript{26} According to the Chittagong Port Authority website, http://cpa.gov.bd/
efficiency. Since most of the vehicles are imported from nations that follow higher emission standards and have fuel quality road maps in place moving at a faster rate than Bangladesh, the transition to lowered emissions can be smooth.

*Urban Freight Schemes*

Urban freight is a crucial element in the transportation system, but is usually not given much attention in policy development and planning processes and responses have mostly been limited to truck restrictions. The availability of urban freight data is invariably poor (Huschebeck, 2000). Cities need freight data to decide about local measures and policies, for future planning and to understand the performance of freight investments. Some cities in developed countries such as France and Japan have carried out extensive surveys to develop a common data collection methodology and roll out urban freight indicators. The Urban Development Directorate or the Ministry of Transport could carry out the development of baseline data and indicators for urban freight through a data collection exercise and can help put a system in place for publishing annual reports.

Cities in developed economies have carried out several experimentation projects and demonstration studies to understand investment potential, economic, and social impact, strengths and barriers for implementation. Though these experiments concern only a minor fraction of urban freight flows within a city, they are not only very effective in convincing political leaders and policy makers of possibilities but also understand changes in behavior of consumers and private sector. These demonstration studies and best practices could be communicated in form of an urban freight training course for officials. For example, over the last decade EU has implemented knowledge transfer projects such as “Best Practice Factory for Freight Transport” (BESTFACT)²⁷ which commenced in 2012 and finishes in 2016. The project is examining best practice in urban freight transport, green logistics, co-modality, and e-Freight.

Recognition schemes can be instituted once data collection systems are in place, awarding cities for best practices. Though worldwide there are many such schemes, very few cater to urban freight. One such good example is Sustainable Urban Goods logistics Achieved by Regional and local policies (SUGAR) an EU co-funded initiative launched in 2008 that aims to promote the exchange, discussion, and transfer of policy experience, knowledge, and good practices in the field of urban freight management, with regard to policy and planning levers between and among advanced and less experienced sites.²⁸

*Online Freight Exchange*

A freight exchange is an online website that allows carriers and shippers to communicate freight traffic information with each other. The main objective to develop a freight exchange is to apply modern communication and information technology for greater synergy among shippers, carriers, and logistic companies. Through improved communication networks in the logistics sector, the logistics costs, including

²⁷ [http://www.bestfact.net/](http://www.bestfact.net/)
transport costs, can be reduced. Many developed countries have successfully adopted such platforms, while developing countries in Asia are planning or in the initial stages of development for load matching as a tool for the future to reduce empty trips and improve load factors when more awareness is built into the sector.

Trucks carry a big proportion of the freight volumes, and in a fragmented and nascent industry, such tools will greatly improve the efficiency of the trucking businesses without the need for massive infrastructure investments. Considering the development plans of the other modes such as railways and inland waterways, the freight exchange platform can facilitate intermodal connectivity too. Freight exchanges help improve the communication channels and data flow in the supply chain, increasing transparency and reliability, and can provide insights on the goods and truck movement. Further, the platform can address issues of low truck productivity and overloading by providing information of goods for return trips, which will discourage drivers to overload since they are assured of backload and revenue.

The system can be ideally a public–private partnership, with the private sector operating the system, while the government plays the role of a regulator. The key benefit for the government is the collection of data on commodities, routes, rates that will give a better picture of freight demand. Since such information is invariably not available, it thereby increases the awareness of the sector and helps in framing better policies and regulations. Though there are potential barriers for the operations of such systems and its wide usage, these can be overcome once there is more awareness of the benefits. Brokers and booking agents who are the traditional sources of matching goods and trucks can adapt to newer tools and become part of the system. Further, the platform will help develop stronger networks within the sector and improve efficiency with optimal loading and reduced empty trips. Vietnam, through a directive issued by its Ministry of Transport, is now embarking on an initiative to develop a pilot online exchange project and is up to develop an overarching policy that can facilitate the widespread proliferation of such exchanges in the future with goals of aiding the improvement of efficiencies and reduction of empty miles. In India, with availability of technology and a demand for consolidation has led to many online platforms to cater to intercity and city freight operations. Enterprises that provide value added services beyond just matching goods and trucks will have an edge and find favour with users. For example, www.freightbazaar.com intends to install GPS on its members’ trucks to provide instant information of its location to its customers. Other features such as quote management, document management, innovative subscription options, multiple channels such as website, mobile applications, call centres, will help establish such tools buoyed by the rapidly rising internet and mobile penetration levels.
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