Development of Clean Fleet Bus Program for India

Clean Air Asia Center
November 2012
About Shakti Sustainable Energy Foundation

Shakti Foundation works in support of clean energy policies that enhance the energy security of the country and sustain development. Shakti Sustainable Energy Foundation is committed to help our country do just that. We work to secure the future of energy in the country by supporting the design and implementation of policies that promote both the efficient usage of existing resources as well as the development of new and cleaner alternatives. Our efforts are concentrated in four specific areas with great clean energy potential: power, energy efficiency, transport and climate policy. We act as a systems integrator, bringing together stakeholders in strategic ways to enable clean energy policies in these fields.

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Executive Summary

Over the last few decades, the number of motor vehicles in India has greatly increased. Substantial investments in the transport sector and rapid economic growth have translated into explosive growth in both urban and intercity transport activities. The number of vehicle registrations rose from 1.8 million in 1971 to 105 million in 2008.1

Interestingly, during the period from 1950 to 1960, buses comprised 11% of the total number of vehicles. But in 2009, buses comprised only 1.3% or 1,486,000. Amid economic development, the growth in the number of buses has fallen due to the increase in the number of private vehicles.

Bus Transport has a rich history in India, with instances of buses services operating as early as 1912 by the TVS Group in Madurai.2 The North Bengal State Transport Corporation has its origins in 1945 with the services inaugurated by the King of Cooch Beehar, starting with three buses and three trucks.3

The State Road Transport Undertakings (SRTUs) set up under the Road Transport Corporation Act of 1950 carry about 70 million4 passengers per day performing about 501 billion passenger-kilometers (pkm) annually. In the nonurban sector, the SRTUs perform about 477.5 billion (pkm) of service, clearly indicating the importance of bus services in linking the villages and cities of India. With rising costs, especially that of fuel, which makes up almost 35% of the expenses, there is an urgent need to improve fuel efficiency from buses in order to improve the financial viability of the bus companies and to reduce their environmental and related health impacts.

To achieve a large-scale impact in reducing emissions in a shorter time span, it is easier to work with vehicle fleets carrying goods and people. State-owned and private fleets comprise large number of vehicles and as they are managed by an overarching organization and it is easier to implement changes especially when there is an economic benefit. Therefore, the adoption of clean fleet management program for buses can cut costs, lower emissions, and help improve the image of bus companies and improve road safety.

The Clean Bus Toolkit developed for such a purpose is largely based on the Clean Fleet Management Toolkit, provides a good basis for clean fleet management programs in India and Asia. The latter toolkit was developed by the United Nations Environment Programme and TNT, a global goods delivery company in 2006.

Sample data collected from bus corporations showed that there is scope of improving fuel efficiency through various interventions ranging from redistribution of buses, switching to better tires and wheels, driver training, data analysis, introducing process improvements etc. A multi-stakeholder approach was adopted with consultations with key industry players - transport agencies, manufacturers, government officials, research institutions and nongovernment organizations.

Based on the sample data analysis and strings of meetings and discussions with stakeholders, a framework for a clean fleet bus program has been developed which lists the numerous systemic and technical measures that can be carried out to improve the fuel efficiency of buses.

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1  2008. MOSRTH. Ministry of Shipping, Road Transport and Highways Website (See http://morth.nic.in/)
2  http://southernroadways.com/aboutus.htm
3  http://en.wikipedia.org/wiki/Transport_in_India
It is estimated that with the introduction of the program nationally, 2200 million liters of fuel can be saved annually, translating into 6.3 million tons of CO$_2$ savings. While the fuel savings are significant and important too, the co benefits of standardization of processes, effective maintenance, eco driving, improving organization structure among others, is huge and will bring about a positive change in the way buses are perceived and operated too. Considering that the bus is primary mode of public transport in cities and in rural areas and with growing intercity travel, a focused approach is essential, especially with rising personal vehicle ownership, to reduce emissions.

It is imperative that such a program is institutionalized with the support of the government and all the stakeholders to bring about long-term change in the way buses are operated.
List of Abbreviations

ASRTU  Association of State Road Transport Undertakings
BMTC  Bangalore Metropolitan Transport Corporation
CiSTUP  Centre for Infrastructure Sustainable Transport and Urban Planning
CO2  Carbon Dioxide
CSE  Centre for Science and Environment
DTC  Delhi Transport Corporation
EGR  Exhaust Gas Recirculation
IEA  International Energy Agency
ITDP  Institute for Transport Development and Policy
JNNURM  Jawaharlal Nehru National Urban Renewal Mission
KSRTC/ KnSRTC  Karnataka State Road Transport Corporation
KMPH  Kilometers per hour
KMPL  Kilometers per litre
NOx  Oxides of Nitrogen
PCRA  Petroleum Conservation Research Association
PM  Particulate Matter
PMPML  Pune Mahanagar Parivahan Mahamandal Limited
SCR  Selective Catalytic Reduction
SETC  State Express Transport Corporation
SRTC  State Road Transport Corporations
SRTUs  State Road Transport Undertakings
UNEP  United Nations Environment Programme
1. Introduction

Road transport consumes 60% of the world’s petroleum supply and contributes to 23% of the total carbon dioxide (CO$_2$) emissions. Transport can contribute to up to 70% of air pollution in Asian cities. In India, CO$_2$ emissions from transport are expected to grow at 7% to 8% per year and the majority of passenger transport emissions would be due to intercity travel. In the cities, it has been estimated that if the current trip mode share were retained, then CO$_2$ emissions would increase two- or three-fold between 2008 and 2025 due to a rapid growth in urban population and an increase in the number of trips.

To bring down this increase in CO$_2$, there is an urgent need to target large-scale impact in a short time span. Fleets carrying passengers and goods are easier to target as they have a structured organization, and it becomes easier to impact operations, especially when there is an economic benefit. Bus fleets meet these criteria, and the adoption of clean fleet management programs can deliver financial savings, lower emissions, improve the image of the bus companies and improve road safety.

Though buses are vital public transport vehicles in the urban sphere, their mode share has been declining. In contrast, the numbers of two wheelers and cars are increasing. In intercity travel, buses dominate cars in distances less than 300 kilometers (km). It is also surprising to note that the bus industry is dominated by private fleet operators, which make up almost 90% of the buses in India. The SRTUs own less than 10%.

It is important to note that of the 56 SRTUs, only a handful is profitable while the others reel under heavy financial loses. It is imperative that the bus corporations maintain healthy bottom lines by improving their operations and adopt fuel-saving measures. Since fuel consumption makes up 30% to 40% of the expenses, SRTUs would do well to reduce their fuel spending.

Even small measures, such as reduced idling time and reduced dead km or rerouting efficient buses on longer routes, can provide significant savings. Then there are important and long-term measures such as Bus Rapid Transit systems, high-occupancy vehicle lanes and bus priority signals, which can galvanize the bus corporations’ brand image, increase ridership and ultimately improve their balance sheets. All these measures will ultimately reduce CO$_2$, particulate matter (PM) and nitrous oxide (NOx) emissions and improve air quality.

This report describes the various policies that govern bus transport in India and the current state of the industry. It also discusses case studies involving a few major bus city and intercity operators. This study aims to determine the potential of a national-level implementation of best practices to improve fuel efficiency, to reduce emissions and to change the image of bus transport.
1.1 The Status of Bus Transport in India

Over the last few decades, India has been rapidly motorizing. The number of vehicle registrations increased from 1.8 million in 1971 to 105 million in 2008.⁵ Even though the total number of vehicles in 2008 was high, ownership levels, at 100 vehicles for 1,000 people, were low. Some experts expect a rise in vehicle ownership levels in the coming decades with the growth nearly twice as fast as per-capita income in India.⁶

![India Vehicle Population (in million)](image)

**Figure 1.** India–Composition of Vehicle Population

Two wheelers and cars constitute more than 85% of total vehicles. The share of buses in total vehicles was only 1.3%, or 1,486,000 buses, in absolute numbers in 2009. Interestingly, during the period from 1950 to 1960, the share of buses in total vehicles was 11%. Amid economic development, the growth of buses has not matched the growth of private vehicles. The preferential shift of passenger trips towards private vehicles instead of public transport in the country is shown in the table below.⁷

<table>
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<tr>
<th>Sl. No</th>
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<th>PT Trips (%) RITES Study 1994</th>
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<td>Above 8</td>
<td>35.2 to 54.0</td>
<td>59.7 to 78.7</td>
<td>Decrease</td>
</tr>
</tbody>
</table>

**Table 1.** Comparison of Mode Shares of Public Transport, 1994-2007

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⁵ 2008. MOSRTH. Ministry of Shipping, Road Transport and Highways Website (See http://morth.nic.in/)


Another important aspect of the Indian bus industry is that private bus operators manage most of the buses. In 2008-2009, it was estimated that 52 State Road Transport Undertakings (SRTUs) had a total number of 1.17 lakh buses of varying fleet size and accounted for only 8% of total buses.

In 2007, organized bus transport services were available in only 24 cities in India. In order to improve urban transport, the Indian Central Government formulated the National Urban Transport Policy in 2006 with a vision to provide the growing number of city residents with affordable, quick, comfortable, reliable and sustainable access to jobs, education, recreation and other needs. The policy was supported by the launch of the Jawaharlal Nehru National Urban Renewal Mission, which facilitated the funding for urban services. The above figure shows an improvement in the public transport in 2007 after the implementation of the policy.

In 2009, the Government of India provided a stimulus package to improve city bus transport by providing financial incentives for purchasing buses to the city governments that implemented a set of reforms as prescribed by the national government. As per the financing mechanism, all cities with populations of more than 4 million as per the 2001 census would get central assistance equivalent to 35% of the project cost. For cities with populations ranging from 1 million to 4 million, the grant available was 50% of the project cost. For cities with populations of less than 1 million, the share was 80%.

The target was to procure 15,260 buses. This stimulus scheme over the last two years has resulted in a visible improvement in bus numbers in many cities, but the public transport agencies are still at financial risk. In the period 2009-2010, only five state transport units made profits while the total combined loss was over Rs 50.8 billion.

“In Rural India, bus is the only means of transport as most people cannot afford personal vehicles for their mobility needs. Therefore improving bus services is vital” – S K Patra, Director (Technical) ASRTU

In Rural India, bus is the only means of transport as most people cannot afford personal vehicles for their mobility needs. Therefore improving bus services is vital – S K Patra, Director (Technical) ASRTU

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9  http://www.slideshare.net/jaaaspal/bus-system-reform-in-india-through-jnnurm
12  The public transport service should not be designed for generating profits but to provide social benefits and equitable access.
Important Guidelines for Financing Purchase of Buses under JNNURM-I

1. The financing for buses under JnNURM is exclusively for urban transport.
2. The para-statal/Urban Local Bodies shall commit to maintenance of these buses in top most condition throughout their useful life and put them in operation immediately.
3. All million plus cities should procure buses as per the Urban Bus Specification.
4. At least 20% of the buses procured under JnNURM for all million plus cities should be low floor buses.
5. The buses procured shall be in line with the Auto Fuel Policy approved by Government of India in 2002 which lays down roadmap of tighter emission norms up to 2010 i.e. introduction of Bharat stage-III and stage-IV vehicles.
6. To improve the average speed of buses and their efficiency, all the million plus cities would be required to have either dedicated bus lane or demarcated bus lane on all the arterial roads.
7. Setting up of a regulatory / institutional mechanism to periodically revise fares for all public and intermediate public transport system.
8. The State government and Urban Local Bodies ULB waiving off / reimbursing all its taxes on urban buses & city bus service/BRTS.

Box 1. Important Guidelines for Financing the Purchase of Buses under Jawaharlal Nehru National Urban Renewal Mission-1

Intercity bus transport services, which are often neglected, are equally critical as they are growing rapidly. This increase has coincided with the following factors: large-scale expansion of national highways that link different cities in India; high economic growth; and comparatively smaller growth in the Indian railways. It has been observed that for trip lengths below 300km, buses and cars dominate the passenger trip mode share when compared to railways. Among the road-based intercity passenger transport, the mode share of the bus (85%) dominates the mode share of the car (15%), indicating that majority of the trips of less than 300km are made by bus. Furthermore, for trip lengths above 300km, railway dominates the road modes. However, the road and rail mode share remains constant with 40% and 60% for distances beyond 300km, and it is mainly dependent on the infrastructure availability.

The SRTUs set up under the Road Transport Corporation Act of 1950 carry about 70 million passengers per day and perform about 501 billion passenger-kilometers (pass-km) annually. In the nonurban sector alone, the SRTUs performed about 477.5 billion pass-km of service. This figure indicates the importance of intercity operations.

80% of the bus sales are from the two manufacturers, Tata Motors Limited and Ashok Leyland. The other manufacturers present in India are Eicher, Volvo, Isuzu, Mahindra Navistar, Mercedes Benz, Corona etc.

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13 Institution of Transportation Policy Studies - A Study of Mid/Long-Term Railway Networks

1.2 Prospects

The rate of annual growth of passenger traffic in terms of billion passenger-kilometers (pass-km) during 1980 to 2010 was 8.8% per year. The latest estimate from the working group on Twelfth Five Year Plan, 2012–2017 suggests that in 2012 the total billion pass-km for road transport is 8,150. Comparing total road transport passenger activity in pass-km with urban transport passenger activity provides the demand for intercity road transport of about 7,300 billion passenger-km travel.

If above trend continues, the Ministry of Urban Development (2008) estimates the following about urban transport demand, which is based on a business-as-usual scenario growth of urban travel in 87 cities from 2007 to 2021:

i) The per-capita trip rate for all modes, including non-motorized transport, is estimated to increase from 0.8 to 1.5 to 1 to 2 for cities of various sizes.

ii) The future public transport share will decrease from 5%-46% to 2%-26%.

iii) Expected average journey speeds on major corridors in future for various city categories will fall from 26-17 kilometre per hour (kph) to 8-6 kph.

iv) The daily trips in the 87 urban centres are anticipated to double from 2,286 to 4,819 lakhs (i.e., 228.6 to 481.9 million).

v) There will be 2,156 million passenger kilometres per day in 87 urban centres in India in 2011, or around 800 billion passenger kilometres per year.

The Working Group on Urban Transport for India's Twelfth Five Year Plan, 2012–2017 made the following bus-related recommendations:

i) Provide organized public transport in all 0.2 million population cities.

ii) Require an additional number of about 39,500 buses.

iii) Improve public transport trip mode share to 60% of all motorized trips by 2030.

iv) Add Bus Rapid Transit (BRT) systems at 20 km for 1 million population in each of the 51 cities with populations of more than 1 million.

v) Propose investments for buses, BRT systems and bus infrastructure of around Rs520 billion.

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15 Report of the Sub-Group on Passenger and Freight Traffic Assessment and Adequacy of Fleet and Data Collection and Use of IT in Transport Sector in the Twelfth Five Year Plan
The International Energy Agency forecasts estimate that there will be a 0.5 bus per 1,000 people in India by 2025.¹⁶ The estimates from Schipper et al. and the ADB/Clean Air Asia Center are more optimistic with numbers of 1 to 0.75 bus per 1,000 people. The Central Institute of Road Transport (CIRT) recommends at least 40 buses for one lakh population (0.1 million) for Indian conditions to match the demand. The ministry of urban development in India¹⁷ recommends the following minimum requirements:

i) 50 buses per 0.1 million people for a city with a population greater than 4 million;

ii) 40 buses per 0.1 million people for a city with a population between 3 million to 4 million; and

iii) 20 buses per 0.1 million people for a city with a population less than 3 million.

The total requirement of urban and intercity buses for road transport in the Twelfth Five Year Plan, 2012-2017¹⁸ was estimated at 1,435,062 to 1,471,182 by 2016-2017. There is a major discrepancy in the way bus requirements have been projected for future as the buses registered in 2009 was approximately 1,486,000.

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2. Study Rationale and Objective

Improved public transport is an important element for improving mobility and reducing emissions. There is an urgent need to improve fuel efficiency from buses in order to improve the financial viability of the bus companies and to reduce their environmental and related health impacts. Also, to achieve a large-scale impact in reducing emissions in a shorter time span, it is easier to work with vehicle fleets carrying goods and people. State-owned and private fleets comprise large number of vehicles and as they are managed by an overarching organization it is easier to change operations, especially when there is an economic benefit. Bus fleets meet these criteria and the adoption of clean fleet management programs can deliver financial savings, lower emissions, help improve their public image and improve road safety.

A systematic approach to clean fleet management will ensure that improvements do not stop with ad hoc measures but are instead institutionalized in the system. In practice, fleets often start with low-cost measures, such as driver training and better maintenance, which often result in 10% or higher fuel savings. Then the fleets move to more expensive measures, such as installing new technologies.

![Figure 4. Maintenance Pit at Tumkur KSRTC Depot](image)

The Clean Fleet Management Toolkit, developed by UNEP and TNT and launched in Asia by Clean Air Asia and tested in the Philippines, and the Green Trucks Toolkit, developed by the Clean Air Asia under the Greater Mekong Sub region Core Environment Program Biodiversity Conservation Corridors Initiative, provides a good basis for clean fleet management programs in India and Asia. The potential benefits of such a program are listed in Box 2.
Potential Benefits for Clean Fleet Management for Bus Fleets

1. Reduced fuel use, \( \text{CO}_2 \) and air pollutant emissions

2. Financial savings in replacement of parts and in fuel costs. The combined savings will lead to greater financial flexibility for expansion of fleet, incentives to staff and promotion and support for other projects, like Bus Rapid Transit systems and ITS, which can garner more ridership and make public transport attractive.

3. Greater ridership, reducing the number of private motor vehicles on the roads and increasing the bus speed

4. Improved image of the bus industry. A smoke-belching bus is a commonly used example of air pollution. Under a national program, a media campaign could be launched to change the perception of people from dirty buses to green buses.

5. Improved safety, as eco-driving has been shown to also improve safer driving

6. Potential for replication to other vehicle fleets, such as trucks, taxis and corporate fleets

7. Capacity building among fleet managers and mechanics, to give them best practices’ knowledge and optimize their operations

Box 2. The Potential Benefits of Clean Fleet Management for Bus Fleets

The main objective of the study is to investigate the potential for fuel and \( \text{CO}_2 \) emission reductions of bus fleets in India and to design a framework for a national clean bus fleet program.

The project outcomes are the following:

i) An understanding of whether the emission reduction potential is significant enough to start a clean bus fleet program for bus fleets in India

ii) A framework for such a program, including policy areas where emission reduction targets and measures for state bus fleets could be incorporated and government agencies and other organizations that could support achieving emissions reductions from state bus fleets across India
3. Study Methodology

The study methodology is described below. A multi-stakeholder approach was adopted with consultations with key players in the bus industry, public transport agencies, government, research institutions and nongovernment organizations. The foundation of the study is the development of a clean bus toolkit that can help bus fleet managers to understand baseline emissions and their contributing factors. The toolkit defines a range of measures that can be undertaken to reduce emissions and to improve the efficiency of the operations.

![Figure 5. Study Methodology](image)

The toolkit was applied to sample depot data from three public transport agencies that participated in the study by sharing data and management insights. The analysis of data and consultations helped establish the potential improvements that can be undertaken by bus fleet agencies across the country. The potential savings from scaling the program up to the national level were quantified. Several stakeholders were provided their insights on the bus industry and on methods to improve the efficiency of the bus fleets.

The section below describes the steps in detail.

3.1 Design the Clean Bus Toolkit

A clean bus toolkit modeled on Clean Air Asia’s Green Trucks toolkit and the UNEP – Clean Fleet Toolkit philosophy was developed. The tool is not a measuring device, like a tachometer that measures fuel consumption and emissions. It is a Microsoft Excel file with a series of tabs. Each tab serves different functions of input, interventions, summary etc. The objective of the tool is to provide fleet managers with a sense of direction on different strategies to improve the fuel efficiency of buses.

The tool was tested with representative field data from three public transport agencies. The detailed methodology is explained in separate report ‘Clean Fleet Bus - Methodology of Toolkit’. The main objective of the toolkit is to consider the current bus activity data, to calculate CO₂ emissions and to
benchmark the efficiency parameters with various other Indian bus fleets. The tool provides an overview of various measures that could be undertaken to reduce emissions and fuel consumption. It provides an estimate of costs involved and fuel savings accrued over the impact life.

Figure 6. Flow Chart of the Clean Fleet Tool

The clean bus toolkit is aimed at bus fleet managers and consultants working on bus fleets. It helps them understand baseline fuel consumption and CO\textsubscript{2} emissions and pollutants such as PM and NOx. Data on the bus operations, such as fuel consumption, trip details and the like serve as input, which are analyzed with the tool. With the help of various fuel-saving steps listed in the tool, the stakeholders will be in a position to make informed decisions to improve fuel efficiency and reduce emissions. These steps pave the way for better earnings per kilometer traveled and help stakeholders rebrand the fleet as an eco-friendly one.
3.2 Establish the Potential Impact of a National Clean Bus Program

In order to establish the savings that may result from the development of a national clean bus program, the CO$_2$ emissions generated by the bus industry operation in India were quantified and projected till 2030 under a business-as-usual scenario and under a national clean bus program scenario. For developing the baseline estimates, the bus numbers were projected till 2030 considering a constant bus motorization index in a business as usual scenario.

To develop the baseline for the business-as-usual forecast, fleet bus type distribution, the fuel efficiencies per bus type and bus activity in km travel were considered constant to the base year. For the clean bus program scenario, a 2% annual increase in fleet fuel efficiency from 2015 to 2030 was assumed. This assumption was based on discussions with fleet operators, the clean bus fleet case study report and a literature review. A maximum capping limit of 5.8 kmpl for an ordinary bus and 4 kmpl for a low-floor bus is considered while considering the increase in fuel efficiencies.

Below are the main findings:

i) The CO$_2$ emissions from the entire bus industry is shown in the below table for both the scenarios. A 10.8% reduction is observed from the business-as-usual scenario for the entire cumulative period of 2012-2030.
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Table 2. Comparison of Mode Shares of Public Transport, 1994-2007

ii) If the program is established across India, the fuel saved due to the program is estimated as 2,200 million liters per year. Considering the diversity in the sector, it may be difficult to persuade the entire bus fleet to participate in the bus program. Conservatively assuming that only 10% of the buses do participate, more than 200 million liters of diesel consumption can be reduced every year. The decrease in fuel consumed would result in a reduction of 0.6 million tons of CO$_2$ per year.

iii) The bus fleets of urban SRTUs contribute only 2% of total bus industry operation CO$_2$ emissions. The bus fleets of intercity SRTUs contribute 12% of total bus emissions as seen in figure 8.

iv) The total contribution of SRTUs is approximately 14%. This is logical considering the bus ownership data i.e., SRTUs have only 8% of total bus fleet.

v) Assuming similar occupancy values of 40 persons for urban and private buses and 30 persons for intercity buses, the share of SRTUs in passenger kilometers.

vi) The analysis debunks the concept that bus industry is dominated by SRTUs. The Indian Planning Commission in the Eleventh Five Year Plan$^{19}$, has indicated that the “The Billion Passenger-Kilometer (pass-km) for the SRTUs is assumed at 0.004 derived from the actual data for latest available 4 years (2001-02 to 2004-05) of reporting SRTUs. The billion pass-km per private sector bus is assumed to be 0.007, which is the modal value of the better-performing SRTUs." The report assumes that the split in the bus fleet output, i.e. passenger km travel is 36% for SRTUs and 64% for private industry, thereby

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downplaying the impact of private sector led bus industry operation. Most initiatives are driven by SRTUs, and they are documented. In contrast, the initiatives on private sector bus industry players are not well known in terms of performance, emissions and operational efficiencies. If a clean bus program is developed, it should focus extensively on the private sector.

### 3.3 Consult the Stakeholders to Determine Issues

Table 3 provides the potential list of stakeholders and experts consulted in order to understand the following elements:

i) Fleet owners and operators come from both government and private sectors. While the main objective of government fleet operators is public service, profits and industry survival motivate the private sector. Any operator's main needs are incentives and subsidy to provide public transport services and ways to improve the ridership of buses.

ii) Bus manufacturers are mainly concerned with bus sales, regulations and taxes involving buses. They would like the bus market to increase.

iii) Public authorities at the local, regional and national levels are concerned with developments in the bus industry, as are agencies involved in urban development, infrastructure development and maintenance, planning and environmental management.

iv) Non government agencies and research Institutions are concerned with the quality of public transport and environmental impact. They play an important role in monitoring the impact of interventions, knowledge sharing and best practices and capacity building.

v) Bus commuters, who consider the bus a lifeline, are concerned with the quality of the bus service. They are also concerned about its image as a mode of transport that is polluting and also the fare system.

vi) Motorists often consider the bus as a threat, that is, as a large vehicle which causes congestion.

The main stakeholders in bus fleet fuel efficiency improvement are the following:

<table>
<thead>
<tr>
<th>Fleet owners and operators</th>
<th>Nongovernment agencies and research institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangalore Metropolitan Transport Corporation</td>
<td>SIAM</td>
</tr>
<tr>
<td>Karnataka State Road Transport Corporation</td>
<td>Indian Association of Bus Manufacturers</td>
</tr>
<tr>
<td>State Express Transport Corporation</td>
<td>CSE</td>
</tr>
<tr>
<td>Delhi Transport Corporation</td>
<td>Embarq</td>
</tr>
<tr>
<td></td>
<td>ITDP</td>
</tr>
<tr>
<td></td>
<td>Parisar</td>
</tr>
<tr>
<td><strong>Bus manufacturers</strong></td>
<td><strong>Others</strong></td>
</tr>
<tr>
<td>Tata Motors</td>
<td>ADB</td>
</tr>
<tr>
<td>Volvo</td>
<td>iMacs</td>
</tr>
<tr>
<td>Ashok Leyland</td>
<td>GIZ</td>
</tr>
<tr>
<td></td>
<td>PCRA</td>
</tr>
<tr>
<td><strong>Public authorities (regulators and policymakers)</strong></td>
<td></td>
</tr>
<tr>
<td>Ministry of Road Transport and Highways</td>
<td></td>
</tr>
<tr>
<td>Ministry of Urban Development</td>
<td></td>
</tr>
<tr>
<td>Association of State Road Transport Undertakings</td>
<td></td>
</tr>
<tr>
<td>Central Institute of Road Transport</td>
<td></td>
</tr>
<tr>
<td>The Automotive Research Association of India</td>
<td></td>
</tr>
</tbody>
</table>

*Table 3. List of Potential Stakeholders*
Based on literature review and discussions with stakeholders, the following points emerge,

i) The cost of Diesel is about 32% of the total cost of Bus companies (ownership, management, maintenance, employees etc.). Over the past decade, the fuel cost per kilometre of bus travel has increased from Rs 3.64 in 2000 to Rs 7.24 in 2009. The contribution of fuel cost would escalate further if the Diesel prices are decontrolled.

ii) Fuel efficiency of state road transport units has increased from 4.4 in 1995-96 to 4.91 in 2009-10 (5.13 for rural operation) but there still seems to be a lot of scope for improvement.

iii) The fuel efficiency showed wide variation by same manufacturer type (table 4). This can be attributed to the route, driver and maintenance or age of the bus.

iv) In the State Road Transport Units, around 25% of the buses have exceeded scrapping age i.e. beyond the productive life.

v) Average fleet utilization i.e. ratio of buses on road to buses held is almost constant for the last decade and it’s approximately 92%. It is surprising to note that the fleet utilization of intercity transport is higher than city transport.

vi) Increasing speed of the buses is important for ensuring greater productivity. Intercity buses on an average travel 350 km/day while city buses travel only 195 km/day. Within city bus fleets – the difference range from 156 km/day to 379 km/day. Speed of the buses impact productivity and fuel efficiency.

vii) The occupancy ratio of SRTUs has come down significantly from 71% in 1995-96 to 66% in 2008-09. There is a sharp decline in passenger numbers by 2-4% per bus.

viii) The Majority of buses are built on drive-away truck chassis by large number of bus body builders (>6000 in unorganized sector).

ix) Performance, emissions and operational efficiencies of buses operated by private sector are not known while they dominate the service. For establishing any National level program on improving fuel efficiency of buses, private sector should be an integral part of it.

<table>
<thead>
<tr>
<th>SRTU</th>
<th>Manufacturer</th>
<th>Sample Size (nos)</th>
<th>Maximum Variation in Annual Fuel Efficiency Values Observed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMTC</td>
<td>Ashok Leyland</td>
<td>65</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Tata Motors</td>
<td>95</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Volvo</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KSRTC</td>
<td>Ashok Leyland</td>
<td>85</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Tata Motors</td>
<td>73</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Volvo</td>
<td>137</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Mercedes Benz</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Corona Sleeper</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>SETC</td>
<td>Ashok Leyland (AC)</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Ashok Leyland</td>
<td>42</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 4. Variations in Fuel Efficiency

22 http://indiatransportportal.com/2011/10/disorganisation-of-the-bus-industry-in-india/
23 http://www.dimts.in/pdf/Symposium-on-Publi-Transportation/Review-of-Requirements-.pdf
Based on initial discussions, the following points, which are relevant to the development of a clean bus program, were raised:

i) Various low cost interventions are available to improve fuel efficiency of in-use buses that also generate co-benefits.

ii) Both efficient and inefficient buses travel on the road. There is a need to identify the “gross polluters” for corrective actions such as scrapping, maintenance and technology retrofit.

iii) Except a few, most Fleet managers have low awareness and almost no incentives to adopt various strategies to improve fuel efficiency. Fleet operators have limited resources to expand ridership and to improve fleet efficiency.

iv) The bus transport sector is dominated by a fragmented private sector, which is not as organized as the public transport agencies.

v) Many operators do not accurately track fleet fuel use and bus activity. Some initiatives, like using better tires to improve fuel efficiency, are not considered effective due to lack of appropriate monitoring. The margin of error may exceed the savings percentage if not monitored properly.

vi) Stakeholders lack confidence in the impact of technologies and training methods adopted, on improvement of fuel efficiency. Demonstrating the technology, training and proper communication can help address this issue. New methods to train drivers on are also needed. The development and sharing best practices and case studies are also important; Studies by Ford Motor Company, Isuzu, the Ministry of Economy, Trade and Industry (METI) Japan, (as well as many others) indicate the average driver can attain closer to a 25% improvement in fuel mileage; and with continued training, feedback, and incentives - most drivers can maintain these improvements over time.

vii) The bus sector needs to have better branding, and the current onus on low-carbon transport and public transport is a great opportunity to do so.

viii) The bus body-making industry is highly fragmented by large number of builders. In order to have a common platform, the Indian Association of Bus Manufacturers was established.

ix) The World Health Organization has confirmed that diesel engine exhaust causes lung cancer. Since buses run primarily on diesel, reducing bus emissions is of prime importance. The pressure on the bus industry to address this health concern would increase.

“With rising costs it is essential that a clean fleet management that helps bus corporations improve fuel efficiency is set up with the involvement of all stakeholders” – Anjum Parwez, MD, BMTC

24 http://www.nsc.org/products_training/Products/MotorVehicleSafety/Pages/ProfessionalTruckDrivers.aspx
25 http://www.brightfleet.com/fleet-eco-driving-program/
4. Future Scenarios for Bus Carbon Emissions

The CO\(_2\) emissions generated by the bus industry operation in India are quantified and projected till 2030 using the business-as-usual scenario and the national clean bus program scenario. The steps below explain the methodology, assumptions and results.

4.1 Base Year

The share of buses in total vehicle numbers is only 1.3%. In 2009, the official total number of registered buses was 1,486,000. Interestingly, out of the total number of registered buses in 2008-2009, it was estimated that the 52 SRTUs had a total number of 0.117 million buses of varying fleet size accounting for only 8% of total bus fleet.

In India, there are no estimates available on vehicles on the road. General data on vehicle registration is available. The data is cumulative; it does not consider scraping and retirement of vehicles. Every commercial vehicle has to go for a mandatory fitness test, and the renewal period for fitness certification is two years for new commercial vehicles (after registration) and every year thereafter. Thus the data on vehicle registration is reasonably accurate. However, the official data available from the Ministry of Road, Transport and Highways does not provide segregation based on fuel type, bus type and emission standard category.

In order to consider buses in active use, a utilization rate of 92.3% based on the CIRT report on SRTUs 2009-2010 is considered; only 92.3% of buses registered are in active use.

The CIRT report provides an excellent detailed breakdown of various operational parameters per fleet and was considered for analysis at three levels: government urban buses, government intercity buses and private buses. The market shares of various categories of buses follow: government urban buses (1.5%); government intercity buses (6.5%); and private buses (92%).

To segregate the carbon emissions according to the bus type, only two types of buses were considered: ordinary buses and low-floor air-conditioned buses. Based on the available data from SRTUs and discussions with some experts, it is assumed that ordinary buses account for 98% and low-floor air-conditioned buses account for 2%. The buses were generally diesel powered as the CNG buses account for less than 1%, according to the CIRT report and discussions with experts.

The following assumptions about the average bus VKT were based on the CIRT report on SRTUs 2009-2010: government urban buses, (91,000 km per year); and government intercity buses (124,000 km per year). The figure for private buses, 60,000 km per year, was based on a review of past work done by researchers – International Energy Agency SMP model, India Vision 2020 Report and Clean Air Asia-ADB study – “Transport and Carbon Dioxide Emissions: Forecasts, Options Analysis, and Evaluation.”

The fuel efficiency of buses was based on the analysis of the current fleet level data provided by the SRTUs. The fuel efficiency of private ordinary buses was considered 10% lower than that of government intercity buses as the private buses are likely to be poorly maintained and used in both intra-city and intercity operations.
<table>
<thead>
<tr>
<th>Bus Type</th>
<th>Fuel Efficiency (Kmpl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td></td>
</tr>
<tr>
<td>Ordinary bus</td>
<td>4.34</td>
</tr>
<tr>
<td>Low floor bus</td>
<td>2.80</td>
</tr>
<tr>
<td>Intercity</td>
<td></td>
</tr>
<tr>
<td>Ordinary bus</td>
<td>5.11</td>
</tr>
<tr>
<td>Low floor bus</td>
<td>2.80</td>
</tr>
<tr>
<td>Private</td>
<td></td>
</tr>
<tr>
<td>Ordinary bus</td>
<td>4.6</td>
</tr>
<tr>
<td>Low floor bus</td>
<td>2.80</td>
</tr>
</tbody>
</table>

Table 5. Approximate Fuel Efficiency Values

4.2 Forecast

To develop the baseline estimates, the bus numbers were projected till 2030 considering a constant motorization index. The 2009 bus motorization index of 1.23 was based on bus registration values. Due to the rapid urbanization and development of National Urban Transport Policy, which prioritizes public transport, the bus motorization index based on registration has steadily increased from 0.78 in 2005 to 1.23 in 2009.

However, along with the increase in bus motorization index, the number of over-age buses has steadily increased with agencies still operating buses which have exceeded the scrapping target to cater for demand. The CIRT report on SRTUs indicates that 22% of the over-age buses were intercity, 21% were in hilly services and 16% were in urban areas. Our analysis of the bus data and scrapping limit from the CIRT report indicates that 25% of buses exceed the scrapping target.

Thus for estimating future bus estimates, a constant bus motorization index of 1.25 was considered. However, considering only buses in operation (92.3%), the motorization index for forecast works out to be only “1”. Thus the forecast closely matches with the work of Prof. Lee Schipper27 for India.

To develop the baseline for the business-as-usual forecast, fleet bus type distribution, the fuel efficiencies per bus type, bus activity (bus kilometer travel) are considered constant to the base year.

For the clean bus program scenario, a 2% annual increase in fleet fuel efficiency from 2015 to 203028 is considered based on discussions with fleet operators, the clean bus fleet case study report and a literature review. A maximum capping limit of 5.8kmpl for ordinary bus and 4kmpl for low floor bus is considered while considering the growth rates.

27 Bus Motorization Index of 1 - CO\textsubscript{2} Emissions from Land Transport in India: Scenarios of the Uncertain - http://metrostudies.berkeley.edu/pubs/reports/003_India-09-uploaded.pdf
28 Based on ‘Clean Air Project Jakarta’ by Swiss Contact where 10% to 15% savings was achieved on implementing a clean bus program. This is further corroborated by the ESMAP’s ‘Best Operational and maintenance Practices for City Bus Fleets to Maximize Fuel Economy’ where 7 to 15% savings were achieved. ‘http://www.esmap.org/sites/esmap.org/files/FINAL_EECI-BusGuideNote_BN010-11.pdf. On driver training, resources available at http://cleanairinitiative.org/portal/sites/default/files/Ecodriving_experience_and_training_Combined_file_April_19.xlsx
4.3 Results

The CO₂ emissions from the entire bus industry are shown in the below table for both scenarios. For the entire commutative period of 2012-2030, a 10.8% reduction is observed from the business-as-usual approach. If the program is established across India, the fuel saved due to the program is estimated as 2,200 million liters per year.

<table>
<thead>
<tr>
<th></th>
<th>CO₂ Emissions (Million Tons)</th>
<th>2012</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>Cumulative - 2012-2030</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business-As-Usual</strong></td>
<td>Urban</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Intercity</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>42</td>
<td>43</td>
<td>45</td>
<td>47</td>
<td>49</td>
<td>865</td>
</tr>
<tr>
<td><strong>Entire Bus Industry</strong></td>
<td>Operation</td>
<td>49</td>
<td>50</td>
<td>52</td>
<td>54</td>
<td>57</td>
<td>1,001</td>
</tr>
<tr>
<td><strong>Clean Bus Study</strong></td>
<td>Urban</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Intercity</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>42</td>
<td>43</td>
<td>41</td>
<td>39</td>
<td>39</td>
<td>769</td>
</tr>
<tr>
<td><strong>Entire Bus Industry</strong></td>
<td></td>
<td>49</td>
<td>50</td>
<td>47</td>
<td>45</td>
<td>45</td>
<td>893</td>
</tr>
</tbody>
</table>

Table 6. CO₂ Emissions Projections from the Bus Sector

It is interesting to note the following:

i) The urban SRTUs bus fleet contributes only 2% of total bus industry operation CO₂ emissions. The intercity SRTUs bus fleet contributes 11% of total bus emissions.

ii) The total contribution of SRTUs is approximately only 14%. This is logical considering the bus ownership data, i.e., SRTUs have only 8% of total bus fleet.

iii) Assuming similar occupancy values—40 persons for urban and private buses and, 30 persons for intercity buses—the share of SRTUs in passenger kilometers is 12% (on account of travelling more per year).

iv) The analysis debunks the concept that bus industry is mainly dominated by SRTUs. The Indian planning commission in the Eleventh Five Year Plan indicated that the “The Billion Passenger-Kilometer (pass-km) for the SRTUs is assumed at 0.004 derived from the actual data for latest available 4 years (2001-2002 to 2004-2005) of reporting SRTUs. The billion pass-km per private sector bus is assumed to be 0.007, which is the modal value of the better-performing SRTUs.”

v) The report assumes that the split in the bus fleet output, i.e. passenger kilometer travel, is 36% for SRTUs and 64% for private industry, thereby downplaying the impact of private sector led bus industry operation. The majority of initiatives are driven by SRTUs, and they are documented, whereas the programs in the private sector bus industry players are not well known in terms of performance, emissions and operational efficiencies. If a clean bus program is developed, it should focus extensively on the private sector.

5. Determine the Feasibility of Clean Fleet Program

Analyzing the collected sample data and projecting the emissions savings, it is clear that there is a strong need to improve the fuel efficiency of buses and can be achieved.

During the discussions with the stakeholders it was agreed that there was a need for such a program that would enable bus corporations to improve their performance and achieve fuel savings and reduce emissions.

The calculations on emissions and fuel savings are elaborated in the previous chapter, where it is established that 2,200 million liters of fuel can be saved per year if a clean fleet program is established, considering 2% improvement in fuel efficiency. The savings will be as shown in table 8, with a cap of 5.8kmpl for standard bus and 4kmpl for low floor AC bus is considered while projecting the growth rates. The percentage savings keeps increasing over the years till the cap is reached and more savings can be expected due to improvements in technology and positive policies favoring bus transport.

The framework and its components are described in the following chapter 6.

<table>
<thead>
<tr>
<th></th>
<th>Fuel Consumption (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year</td>
</tr>
<tr>
<td><strong>Clean Bus Fleet Program</strong></td>
<td></td>
</tr>
<tr>
<td>Govt Urban</td>
<td></td>
</tr>
<tr>
<td>Govt Intercity</td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td></td>
</tr>
<tr>
<td><strong>Total Consumption</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BAU</strong></td>
<td></td>
</tr>
<tr>
<td>Govt Urban</td>
<td></td>
</tr>
<tr>
<td>Govt Intercity</td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td></td>
</tr>
<tr>
<td><strong>Total Consumption</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Savings</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Savings %</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Table 7. CO₂ Emissions Projections from the Bus Sector*
6. Recommendations of Framework Based on Consultations and Roundtable

A series of stakeholder consultations were held. The Clean Air Asia team met and interacted with as many as 33 individuals and 18 organisations. A Round Table was held at the Bangalore Metropolitan Transport Corporation's office on 18 October 2012. The event saw active participation of bus corporations like BMTC, KSRTC, NGOs, manufacturers and others. The Managing Director of BMTC chaired the event. Key organizations at the event were,

1. BMTC
2. KSRTC
3. Tata Motors Limited
4. CiSTUP, IISc
5. Embarq
6. PCRA

The deliberation of the round-table is present as a separate report.

Further discussions with the following stakeholders were held,

1. Mr G Dinshaw, Director, Central Institute of Road Transport, CIRT
2. Mr D P Saste, Head, Safety and Homologation, CIRT
3. Mr S K Patra, Director Technical, ASRTU
4. Mr Arun B Komawar, Sr Deputy Director, Automotive Electronics Department, The Automotive Research Association of India, ARAI
5. Mr G Mohan, Managing Director, State Express Transport Corporation, SETC
6. Mr P Nadarajan, General Manager (Technical), State Express Transport Corporation, SETC
7. Mr S Rajesh, General Manager – Bus, Bus Vertical, Ashok Leyland
8. Mr J Leo Jobai, Divisional Manager, Bus – Product Management, Ashok Leyland
9. Mr K K Gandhi, Executive Director, Society of Indian Automobile manufacturers, SIAM
10. Mr Ranjit Gadgil, Parisar
11. Mr Dipen Nathwani, Sr Transport Planner Mr Pawan Dwivedi, Transport Planner, iMacs
12. Mr Kinshuk Pal, AGM and Program Leader (Transport), iMacs
13. Mr Vikas Daihya, AGM- North and Central, Volvo Buses India Private Ltd
14. Mr Karthik Sarma, Senior Manager, Technical Governance and Homologation, Volvo Buses India Private Ltd
15. Dr H S Sudhira, Gubbi Labs
16. Ms Anumita Roy Chowdhury, Executive Director, Research and Advocacy, Centre for Science and Environment, CSE.
17. Ms Shreya Gadepalli, Director India, ITDP

The questionnaires are attached as annex2
The framework for a Clean Fleet Bus Program is based on the study, roundtable deliberations, interviews, discussions with stakeholders and literature reviews. The various parameters that should be part of a national level clean fleet program are broadly divided into technical and systemic approaches.

The following can be classified under systemic, i.e interventions that need to be brought into the management system of running the organization.

i) Management structure
ii) Capacity building
iii) Financing bus transport
iv) Brand image of buses
v) Prioritizing bus transport

The following can be classified under technical i.e interventions carried out with the help of technology.

i) Data Collection and analysis
ii) Driver Training
iii) Tires and wheels
iv) Innovative designs
v) Emission Reduction

Systemic Approach

i) Management structure and Monitoring

Though the SRTUs have come a long way, but there is a need to restructure the organization structure to make them more adaptive to the growing complexities of the work.

Separate departments with skilled personnel that look into administration, engineering and planning and operations should be created apart from the finance department such that roles and responsibilities are clearly demarcated. A team dedicated for fuel efficiency can achieve results, since in a business as usual scenario the focus on improving efficiency is usually lost. Review mechanism by top management is essential so that there is greater understanding of the situation at the ground level. Review should be separate for bus, driver and route so that impact of each is understood correctly such that corrective and preventive steps can be taken.

Suggestions:

• Vision of the SRTU should be clearly mandated. Inculcating ISO standards and methods will enable maintaining the processes.

• The best practices of the SRTUs and those of the manufacturers and research institutes should be documented and those practices should be made mandatory to all SRTUs and fleet operators though a governing body such as ASRTU or the Ministry of Road Transport and Highways. The Heads of the SRTUs should be proactive in implementing the best practices even if there is no written order or mandate etc. Top management should ideally set an example for the rest of the organization.

• ASRTU has made standard proformas, which need to be followed by the bus corporations so that faster data reach and analysis can be done.

• The impact of the implemented interventions should be continuously monitored to understand its impact. Each depot should have a set of mechanical and operational staff that look into maintenance aspects and monitor the routes and operations closely. Greater coordination and interaction among SRTUs and all the stakeholders involved will lead to improved knowledge sharing. Few organizations like APSRTC are known to have trained eco drivers and eco mechanic. “Eco Driver” is like special designation given to a driver who is known to maintain the best fuel efficiency. Similarly, “Eco Mechanic” is a designation to be earned by the mechanic who is known to provide the best setting for the bus to be most fuel efficient.
• The Service Level Benchmarks SLB for urban transport launched by the MoUD\textsuperscript{30} in 2009 should be
mainstreamed.

• MoUD and MoRTH through its organizations such as the Institute of Urban Transport (IUT), ASRTU
and CIRT which are set up for the purpose of providing technical assistance and guidance should
encourage both the urban and interstate SRTUs and coordinate among themselves. The respective
state governments govern SRTUs though broad guidelines set up by the central ministries. Greater
autonomy in fare revision, decision-making and management, will lead to improvement.

• Coordination among city level stakeholders such as the Municipal Corporation, Traffic Police is vital
in urban operations especially when implementing projects like BRTS.

• Setting up of quality control and quality assurance processes can be taken up so that a system is
established.

• Private fleet operators too should be encouraged to take up similar exercises of monitoring and
review and incentives can be provided for ISO certified operators.

• Creating fuel efficiency benchmarks and targets is also essential as it sets a target to achieve for the
entire team.

“\textit{There is a big role that technical specialist organizations like Clean Air Asia, ITDP, Embarq play. In the initial phase, it would be to demonstrate the use of data analysis to improve operations and make the right investment decisions etc. In the long run, the focus should be on capacity building}” – Shreya Gadepalli, Director, ITDP

ii) \textbf{Capacity and institutional building}

The Planning Commission Working Group on Capacity Building\textsuperscript{31} recommends large-scale
investment and campaign to train and create urban specialists and also institutes of excellence
that will provide specialized services and create more trainers. It also envisages training of Indian
Administrative Service (IAS) Officers to be trained in transportation. This is essential as IAS officers
head many bus corporations and it will give them a better and quicker understanding of their
work. Capacity building of other administration staff in management principles and logistics is also
essential. Private organizations and NGOs can play a role in this part. Training in technical aspects
such as trip planning, resource optimization etc should also be taken up by the engineering/
transport department. Targeting private bus operators here is necessary considering that they make
up almost 85% of the bus fleet.

iii) \textbf{Financing for bus corporations}

SRTUs do not have a mandate for profitability. Their basic mandate is to provide public service.
The box fare collections make up only a part of their revenue and some of the urban corporations
make use of real estate such as transit areas to increase their revenues by leasing it for commercial
ventures. The rising cost of new technology buses or even BSIV buses has made it difficult for bus
corporations to procure them. The state and central governments covers the subsidy or provide
stimulus to procure new buses once in few years. The Recommendation of Working Group on
Urban Transport for 12th Five Year Plan has also realized the importance of public transport and
has recommended creation of a cess, which is collected, from sale of private vehicle (car and two
wheelers) and sales of fuel to them. Such a fund will create long term benefit of augmenting and
renewing the fleet of bus corporations. Tax rebates on bus procurement should be provided to bus
corporations.

\textsuperscript{30} \url{http://www.urbanindia.nic.in/programme/ut/Service_level.pdf}

\textsuperscript{31} \url{http://planningcommission.nic.in/aboutus/committee/wrkgrp12/hud/wg_capacity_9%20building.pdf}
Suggestions:

- **Fare revision**: Each bus corporation has its own system of fixing ticket fares, but most are controlled by the government and operate with a service point of view. Subsidies are received to cover costs and ticket fares are kept low. Only a handful of bus corporations made profits in the year 2009-10 (ex. BMTC, KSRTC, MSRTC) and those have an independent fare revision system which depends on the operational expenses. The burden of subsidy again is difficult for a government to bear since it also has to allocate for other essentials such as power, water, sewage, roads etc. Since diesel may be deregulated in the coming months, it is imperative that bus fares are commensurate with the expenses. Therefore, it is vital that bus corporations look into measures to improve efficiency to reduce loss, while working within the system of controlled fares.

- **Innovative Contracts**: Bus corporations should mandate a minimum fuel efficiency requirement from manufacturers during the purchase and should levy penalties for non-compliance; effectively demanding better performing buses. Ashok Leyland is in such a contract with the State Express Transport Corporation. Though efficiency varies by route, driver and bus, the fleet average is maintained to the requirement. In such cases the manufacturer is pro active in the performance and constantly monitors the buses, and attends to the maintenance of a bus in the event of a problem. Another mechanism followed by Delhi Transport Corporation and Tata Motors Limited, the manufacturer is responsible for the maintenance for the entire life of the bus. The onus again is on the manufacturer to provide high quality maintenance and train the mechanics too. Such innovative business models should be created to empower the corporations while complying with the requirement ensures profitability for the manufacturers.

- **Training personnel**: To be multi skilled, introduction of automation to replace manual methods are the other options SRTUs can adopt to reduce the personnel cost, which accounts for almost 40% of the total expenses.

iv) **Brand image of buses**

Suggestions:

- **Design of a communication strategy to improve the brand image of a bus is essential.** The MoRTH or the MoUD for the urban bus needs to take the lead in designing and implementing a communication strategy on the clean bus program. Such a strategy should aim to transform the image of buses from dirty buses to green buses. Bus shelters, terminus, sign boards, websites, mobile apps and the buses themselves should have a homologous theme, so that people are able to identify it easily. Usage of a logo, colour theme is vital.

> “Punctual, effective services in clean buses are essential for attracting passengers. SETC has maintained fares which are affordable to the needs of the people as we operate with a service point of view and not for profit. We receive subsidy from the government” – P Nadarajan GM (Tech), SETC

- **It is usually a myth that branding is expensive and public transport companies cannot afford or require one.** But it should be seen in the perspective that it attracts more passengers and retains the existing ones, therefore increasing revenue. The theme or the logo should be the core principle of the service, either comfort or reliability or economical etc. The ‘airavat’ ‘club class’, ‘superia’ and ‘bliss’ branded fleet of luxury buses operated by KSRTC is a good example of branding. KSRTC has roped in leading ad agency Ogilvy and Mather for branding its luxury buses with a tag line, ‘sleep like a baby’. An example of a campaign strategy is the monthly ‘bus day’ organized on the 4th of every month by BMTC in Bangalore. Posters are put up on buses that announce the bus day and media articles carry information on ridership, the additional buses pressed into service etc. On November 1, 2012, the Pune Bus day was launched by the Pune Mahanagar Parivahan Mahamandal Limited PMPML in Pune.

32 www.embarq.org/sites/default/files/EMB2011_From_Here_to_There_web.pdf
with media support of Sakaal Times, a daily, to attract more commuters to use the bus. The event was successful and there was a major shift from private modes to public buses.

- Such events show that media or publicity campaigns are successful and there is a strong need for sustained efforts to popularize the bus, which will lead to more people shifting modes. Bus corporations should receive incentives from the MoUD and MoRTH for carrying out such practices.

> “Just creating a better public transport system is not enough, creating disincentives for private vehicle users is also equally important” – Ranjit Gadgil

- Employees who deal with the public directly such as driver and conductors are one of the best brand ambassadors of the corporation and should be trained to deal with passengers (customers) courteously. Their presence and upkeep will also make a positive impression on their job as well as on the organization.

v) Priority for bus public transport

- Vehicle speeds in urban areas are reducing considerably due to congestion. Bus corporations are facing heavy loss due to this as a bus that carries more people is also stuck because of high number of personal vehicles like cars that carry few people. The sample data collected also show that speed impact on fuel efficiency is very high.
- Funds allotted to improving public transport should go towards implement projects such as BRTS, bus signal priority, bus lanes, transit terminals, fleet renewal etc.
- The creation of mini BRT for smaller cities is a fillip for bus public transport and the industry too. The usage of mini bus (6m length) or midi buses (8m length) which are smaller in length, combined with low floor will help in attracting more people to buses in cities.
- In the soon to be launched JNNURM phase 2, bus specifications as per code AIS 052 are attempted to improve to suit local infrastructure. Buses are also being upgraded with low noise and improved AC to attract car users.
- Infrastructure should also be in place before introducing measures like BRT so that sufficient awareness is created about its benefits and usage.

> “Though the scale of change is slow, with the introduction of the NUTP and the JNNuRM the momentum towards building urban bus transport has taken off in the right direction. Reforms are now required to increase operational efficiency” – Anumita Roy Chowdhury, ED, CSE

- Introduction of Information Technology Systems (ITS) in buses is envisaged to be INR 38,000 crores or $ 7600 million by the 11th Five Year Plan. This presents a good opportunity to involve private participation, which can be provided advertisement space or air-time. ITS can also greatly improve data capture by providing real time information of bus operations, passengers etc. Cost effective measures such as usage of SMS to inform passengers of the bus location as used in BMTC and BEST can be deployed and publicized to have greater patronage.
- Equally important is the role of intermodal integration and safe and comfortable access of passengers to a bus shelter or terminus. Lack of access to bus stops should not deter passengers to
move to private vehicle use. Coordination among the civic agencies is also required to make the public transport provider a stakeholder in the city.

• In the rural areas, bus services are all the more essential are people cannot afford to own vehicles and are dependent on the bus. The census 2011 reveals that 47% of households of rural India and 37.6% households of urban India do not own a vehicle and are therefore dependent on public transport and it is invariably the bus.

• Only improvement in bus system will be one sided and will not reduce private vehicle usage and demand measures such as high price for parking, congestion pricing, restriction in number plate, along with high cost of ownership etc. This is where cooperation and coordination from other city civic agencies as well as technical support from organizations such as ITDP, Embarq etc play an important role.

**Technical Interventions**

vi) Data Collection and Analysis

For the depot manager or the top management to review performance, quality data is essential. Data collection of important parameters such as speed, occupancy, location, fuel consumption, emission, etc should be easily and accurately available. Decisions that are based on incorrect data are usually poor. Software that helps in trip planning and monitoring based on data should be incorporated in the system so that resources are optimized. Lack of Onboard Diagnostics (OBD) prevents understanding of real world issues.

**Suggestions:**

• CIRT, which collects and releases performance report of SRTUs in the country, should create standard data collection procedures, which will enable quicker and more harmonized data collection. Though ASRTU has created standard proforma for the purpose, corporations do not follow it entirely, modifying to suit their convenience. For standardization and easier analysis, it would be best to have a similar system. Making an online system of data sharing can make the system faster.

• In each SRTU an apex cell can be created that can collect and analyze data of all depots. Though organizations have a statistical department that collates weekly, monthly progress reports an evaluation team should be part of the cell, which will coordinate the issues with the concerned depot. A strong organizational structure is therefore required for an SRTU to create such departments. CIRT can play a greater role in guiding the SRTUs with the analysis.

• Use of on-board diagnostics that capture and help monitor real time data of speed, location, occupancy, idling, emissions such as PM and NOx and driver behaviour should be used. It is believed that such OBD are being considered to be made mandatory in buses by 2013. In an industry where almost 1.5 million buses are registered every year, it can lead to significant improvements in the entire data collection process in the coming years.

• It is through effective data capture and analysis that policy decisions should be made. Organizations such as ITDP, Embarq, CIStUP, CEPT, and Institute of Road Transport are already playing a vital role in assisting bus corporations in analyzing their data and helping to improve performance.

• Decisions on investment or other policy measures should ultimately be derived from data analysis.

"Quality institutions that train and certify drivers is essential to make the profession respectable and attract talent" – H Babu Rao, GM (Tech) BMTC

vii) Driver training

Driver training is a component that is unanimously agreed to be a part of a program that improves fuel efficiency. It is also one of the efforts that do not require high investment of technology or infrastructure and substantial gains of almost 15% can be achieved. Training for drivers should not be restricted to classrooms but should go beyond to simulate real world conditions. The bus used for training are usually an old model which is almost obsolete and will not help a driver to learn much about the bus that he will driving on the job. Bus corporations cannot afford to send drivers on training due to shortage of drivers or high demand of operations. Manufacturers have taken up the initiative in this regard by setting up training schools and also sending instructors to depots to assist drivers and supervisors. When new models are launched, drivers are trained to help them adapt to the new technology.

Apart from the SRTUs, Ashok Leyland, Tata Motors Limited and Maruti Suzuki India are the leading organizations that have set up driving schools of excellence through the Institute of Driving Training and Research (IDTR). Petroleum Conservation Research Association, PCRA and Society of Indian Automobile Manufacturers, SIAM, are the other organizations that are also contributing in this field. More than 40,000 drivers are expected to be trained by the industry in the year 2012-2013. Through technically sound courses even experienced drivers have been able to improve their performance and achieve better efficiency. The benefits of such training are that it also increases the life of the bus and reduces accidents.

Suggestions:

- Driver training institutions that certify drivers and make them an asset to the organization should be set up. It is not just eco driving, but also safe driving habits that is equally important. Ideally, a nodal agency such as CIRT with the assistance of IUT can take up this task and set up institutes across the country and create training modules and certify drivers who go through a rigorous process.

- The ASRTU, MoRT&H and few State Governments together is spending INR 14 crores ($ 2.5 million) each on creating Training Institutes on Driving and Research, Institute of Driving Training and Research (IDTR: Tier-I) and Regional Driver Training Centre(s) (RDTCs: Tier-II) through key vehicle manufacturers at various cities apart from the existing ones present at Namakkal, Burari, Rohtak, Bhubaneswar, Madhya Pradesh and Rajasthan. This will create an institution of excellence with access to most corporations who can benefit from them. Currently not many SRTUs employ the assistance of a professional group to train their drivers.

- Drivers who finish from this school can be paid a good starting salary, lending dignity to the profession, attracting talent and making it a sought after job.

- The partnership of the manufacturers is a must in this aspect, as the availability of new technology and the manufacturer can provide a thorough understanding of the working of the bus. Drivers should be taught about the functioning of the engine and how each part is related to the movement of the bus, which will enable them to appreciate the usefulness of a course and imbibe good habits. A standard module for training should be prepared.

- Pressurizing drivers to obtain high fuel efficiency may prove detrimental as they come from poor socio economic backgrounds. Depot managers should schedule training in a phased manner to allow drivers to attend periodic refresher courses that enable the driver to perform consistently, without affecting operations.

- CIRT, which is the nodal body of the MoRTH for approving the training tracks, layouts and courses, can be the coordinating agency to provide guideline and certification. The manufacturers can carry out the training. Usage of dynamic simulators is also preferable that will provide real world conditions. OBD such as the Carbon Pod, developed by EG Tech BV captures vital data of the driver.

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39 http://morth.nic.in/writereaddata/sublinkimages/Training_Institutes2602033819.pdfm
behaviour such as start, stop, speed (coasting, idling, speeding etc), fuel flow etc based on which tailor made eco driving courses for driver training is formulated. In such a trial run with KSRTC buses, improvements of 8.9% were achieved.

viii) Impact of tyres and wheels

Both radial and bias ply are widely used by most corporations, with radial usage being lesser. Corporations like KSRTC, it has been found to expand less to heat compared to ordinary compressed air use nitrogen filling. The perceived effect of radials is mixed with some corporations achieving improvements of 2% while some less than 1%, while at the city level no improvement at all.

Suggestions:

- Careful monitoring has to be carried out to understand the impact, as radials and low rolling resistance wheels are well-established methods of improving fuel efficiency. Retreading which was earlier restricted only to bias are now available for radials too.
- The use of nitrogen filling can be expanded once the relationship with improved efficiency is established.
- Use of low rolling resistance wheels can be tested on intercity routes where high speeds are achievable.
- Separate technologies that cater to urban and intercity operations should be framed. Tyre pressure should be checked and set accordingly to negate the impact of heavy loading in urban operations. Installation of tire pressure monitors can be made compulsory which will alert the driver when the pressure drops.
- Involvement of Research and Development divisions of tire companies is essential in this regard to provide clarity in products and to carry out trials in real time operations that establish the performance. Such trial results will encourage bus corporations to be open to adopt technologies.
- Standard practice of monitoring air pressure, especially with the number of low floor buses increasing, it is imperative that tire pressure is monitored correctly. The inner rear tire should have an extended nipple therefore usage of pit can be avoided. The pressure should be calculated based on varying loads in urban areas.

"At Ashok Leyland we are constantly evolving to meet the challenges of improved fuel performance and reduced emissions which is what keeps us ahead of competition" - S Rajesh, GM Bus, Bus Vertical

ix) Innovation in technology

New features such as power steering, pneumatic doors, air conditioners etc increase the load on the engine, requiring more fuel to be burnt; but innovations are being carried out that reduce fuel consumption at the same time. Engine oil consumption is again higher in new buses as there is more strain on the engine and more heat is produced. Introduction of certain technologies that create better combustion using the right amount of fuel have enabled manufacturers to strike a balance between reducing emissions and also improving fuel efficiency. With the demand for better and more comfortable buses from the clients and with passengers willing to pay more for comfort, innovation is the key to maintain the high fuel efficiency. With the introduction of new models it becomes a learning exercise for both the manufacturer and the user, the manufacturer should be in a position to train the mechanics and iron out technical issues related to the bus. One of the common issues in maintenance is that bus corporation mechanics do not follow the recommended maintenance schedule or use genuine parts prescribed by the manufacturer.
Suggestions:

- New models that are longer than standard buses such as 12m or 14m with higher power train of 6+1 gears are being introduced to carry more number of passengers while attaining high fuel efficiency of almost 5 kmpl.

“We see a positive approach from the industry and discussions are ongoing in different forums on fuel economy, star labeling, CAFE standards etc. We also feel industry is closing in the gap from regulations point of view by constantly trying to upgrade the product portfolio”

- Volvo Buses India Pvt Limited

- A star labeling system of energy efficiency similar to that being planned for passenger cars and two wheelers can be introduced for buses too. The Bureau of Energy Efficiency, BEE, which is a statutory body under the Ministry of Power, can be mandated to provide appropriate labeling systems.

- Manufacturers are taking up the responsibility of training mechanics when a new model is released and also provide refresher courses to them. But a system, which tracks their performances, should be created which monitors their learning curve.

- KSRTC has developed aerodynamic front and side sections with the help of National Aerospace Laboratories (NAL), which improved fuel efficiency by 7% in the express buses. Such simple and effective models can be easily replicated in other bus corporations too.

- Manufacturers benchmark the performance of their buses and try to improve the efficiency for newer models or carry out few changes when new orders are placed, to improve upon their previous performance. There is frequent interaction between the marketing and the R & D division to chalk out strategies. Volvo for example, carries out simulated engine dynamometer tests that enable them to understand real world conditions of loading drive cycle and establishes fuel efficiency values.

- Creation of technology that allows precise fuel flow in accordance to the torque requirement similar to CRDI, are some of the measures manufacturers are following.

- Ashok Leyland is innovating with 4 cylinders 230 HP instead of the usual 6 cylinders, changing the engine platform and creating twin speed acceleration among other measures.

- Kerb weight of the bus should be reduced through use of composite materials, as it can enable more passengers to be carried without affecting the fuel efficiency.

x) Emission Reduction

There is no mandate for a bus corporation to reduce emissions. The only mandate currently is the use of BSIV chassis and fuel in the major cities and BSIII in the rest of the country as laid down by the Central Government. Intercity operators are allowed to use BSIII. Some of the corporations carry our pollution under check (PUC) and smoke detection tests, these are not reflective of real conditions as the buses are loaded when in use and are subjected to diverse speed and traffic conditions therefore emission conditions are very different.

Suggestions:

- Though the presence of dual emission norms is not a deterrent for the industry, it is possible that for the sake of cheaper fuel, certain corporations may resort to using BSIII fuel. It would be better that BSIV or higher emission norm is introduced throughout the country to gain the benefits of reduced emission and better air quality.

- The Oil industry and the Ministry of Road Transport can take the lead as it involves the vehicle condition and maintenance aspects.

- Switching over to cleaner fuels such as CNG or technology such as electric hybrid, fuel cell can be brought in.
• Provision of loaded tests should be made available in major cities. Along with Inspection and Maintenance (I&M) of buses such loaded tests should also be carried out. 10 such centers are planned to be implemented across the country by 2014.

• Penalties should be levied on SRTUs or even private bus operators that are not complying with emission norms and actions such as cancelling of permits should be resorted to, to ensure that air quality is maintained through reduced emissions.

• Citizens should be empowered to report buses that are not in good condition or emitting high levels of smoke.

“Though dual emission norms may not have an impact on the bus fleet, to take full benefit of the BS IV, it is desirable that single emission norms should be implemented across the country.” – KK Gandhi, ED SIAM

**Summary of Recommendations:**

• Set fuel economy targets. In general, there are two ways of influencing the fuel economy of buses: upstream (on the manufacturers’ side) and downstream (on the operators’ side). Upstream processes, such as setting fuel economy standards for buses, will take several years. Therefore, there is a need to actively engage the different stakeholders and start the process of discussions and consultations, considering the number of years required to formulate India’s LDV standards.

• In parallel, operators need to be engaged in setting fuel economy targets for their fleets and in monitoring the impact. For example, Key Performance Indicators (KPI) of fuel efficiency targets for buses and fleets on the road should be designed for the different types of buses operating in different regions.

• Introduction of a branding scheme for the bus and bus service, such as the stars rating system. Buses or fleets that satisfy such standards need to be branded; incentives can to be packaged for such fleets. Developing a rating framework of regulatory, legal and institutional system for supporting the scheme needs to be designed. A good example of this is the proposed China’s Green Freight Initiative, a 5 leaves scheme for awarding truck operators, or China’s green and yellow labels for vehicles based on emission standards.

• Developing a national level programme for developing training capabilities. Develop regional level programme to train drivers, mechanics and operators on how to improve operational & fuel efficiency. Active participation of OEMs and other stakeholders will further enhance the quality and content of the training programmes. Current training methods must be revised to factor the technology and environmental changes. Further the training programmes should be standardized at a national level according to the need. Academic institutions can take the lead in developing a national level fleet management training program on planning, optimizing& scheduling of fleet operations. This can be imparted by technical institutes like the Indian Institute of Technology (IITs) and National Institute of Technology (NITs) and other engineering and management institutes.

• The concept of quality assurance and management of the fleets and its maintenance should also be introduced at an institutional level. Further quality control process at the depot level can be practiced.

• It is proposed that a roadmap for the SRTUs to get ISO certifications should be laid.

• For a private operator, being part of such a program will enable being part of best practices of the industry such as better maintenance, driver behaviour, understanding newer technologies that can improve fuel efficiency. For any private operator, (who does not receive subsidies) improving fuel efficiency will be key to success of the organization. Therefore, private bus corporations also have a great stake in such a national program.
Currently, Central Institute of Road Transport has been collating and publishing the performance data of buses run by the SRTUs. But standardization of the data collection process has to be brought in.

It is proposed that a similar system may be horizontally deployed for the private fleet operators. The annual reporting needs to be made compulsory and guidelines for data collection needs to be developed. The collection of data, such as distance, fuel consumption and driving behaviour, needs to be updated and automated. The annual monitoring of fuel efficiency values should be linked with incentives for good performers (awards or subsidy).

A study must be carried out to prepare a database of private operators who operate a minimum number of buses; So that a wider reach by making them apart of the interventions can be made.

ASRTU or CIRT should annually publish the emissions details along with fuel efficiency details of the SRTUs. The report should be expanded to include targets, achievements and gaps. Further they should also forecast an improvement road-map.

Design of an appropriate microfinance, revolving fund, or subsidy scheme to identify the bus gross polluters and support them to upgrade the fleet/vehicles to meet higher fuel efficiency and emissions norms.

Encourage bus operators to play an active role in urban transport issues to ensure that the city transport system supports the buses as much as the buses support the city transport system. Fuel efficiency measures are directly linked to land use, ridership improvement, speed improvement and accessibility improvement measures. Therefore, they need to get involved in discussions about urban transport issues and take a longer-term and holistic view.

It is proposed that a part of the R&D fund (for both Government and Private) should be set aside by the OEMs to be utilized for the improvement of fuel efficiency of buses. A mention of the initiatives and results, specifically in the area of improvement of fuel efficiency may be included in the annual report of all vehicle manufacturers. They should also assist their clients (bus corporations) address technical matters.

The onus lies on the bus corporations and operators to improve its performance and optimize resources. With rising fuel prices, there is a greater need to perform better, especially when fare revisions are controlled.

It is clear that the creation of a national level ‘clean fleet bus program’ will have to be spearheaded by all the stakeholders and not just a single organization. It is the responsibility of the bus corporations, manufacturers, regulatory bodies, research organizations, NGOs and the government to collaborate to form such a program and implement it successfully. The focus should be on improving fuel efficiency and operations, so that there is considerable interest for all the stakeholders.
7. Recommended Next Steps

The steps to achieve the clean fleet program will be,

- It would be ideal to create an independent expert panel that involves multiple stakeholders. The groups can be headed by a Secretary of a government body like the MoRTH or MoUD. Since the MoRTH looks into the intercity transport and the MoUD, the city transport services, both should play a vital part in the program.
- It is proposed that the panel looks at the issues in a more holistic way and engages the public in more than one innovative process.
- The groups members will also include stakeholders such as the interested bus corporations headed by the ASRTU, manufacturers, OEMs, research bodies such as CIRT, ARAI, technical organizations such as IIT, ITDP, Embarq, CiSTUP, CEPT and NGOs such as CSE, Parasar etc can act as observers and recommend policy frameworks.
- Clean Air Asia can play the role of a coordinator to bring the group together and also carry out monitoring studies and assist in policy making as it is one of its strong points. Development agencies such as ADB, World Bank, Climate Foundation can assist in bring in the required financial assistance to carry out pilot studies that can be increased in scale in a phased manner.
- From the framework, steps should be carefully chosen and implemented in a phased manner. Decision on the phases can be taken such that there is steady growth in the entire program.
- Ideally during the first 5 years, measures to reduce idling, dead km, focus on training of drivers, management and technical staff can be taken up. Improved methods of data collected and analysis can also be implemented. The next 5 years can see the provision of BRT, improved road conditions, technological improvements, usage of better tires and wheels, usage of better fuels and hybrids etc. a study on the failure and success of BRT should be studied and implemented.
- The group or the body so created should create a brand for itself and start rolling out the process. The involvement of the private sector (mostly bus and equipment manufacturers) will give the necessary momentum to the program. Organizing workshops will bring together and create a platform for sharing best practices among the SRTUs.
- Ideally, pilot programs can be taken up covering one SRTU where focused interventions are made. These can be scaled up to the rest of the SRTUs once the strengths and weakness of the pilot are identified and the program can be suitably modified to suit the corporations.
- With large and fragmented private operators it is imperative that there is an incentive for them to participate. Apart from sharing of technical knowhow of maintenance, driver training, more can be done by testing of new engine technology, use of GPS etc. Assistance in data analysis can also be carried out for those who enter the program.

Figure 9. Framework of a Clean Fleet Management Program
Annex 1: Stakeholder Questionnaire

A. Bus Fleet Owners

1. What has been unique strategy adopted by you towards the goal of fuel savings?
2. What is the process of evaluation for vehicle purchase, from the point of fuel efficiency, operating cost, and emission, beyond the mandatory requirement? Does the evaluation give weightage to the enhanced features, which will reduce the emission load and improved fuel efficiency?
3. What are your views regarding fleet renewal or retrofitting? What is the active policy followed? Have you introduced /retrofitted to improve fuel efficiency?
4. Have you ever used or considered using different tyres, gadgets etc. for fuel savings or enhanced mileage? (For ex. Tubeless tires and nitrogen air for tires) If yes, what percentages of buses have them? What are the savings achieved? What are the challenges in implementing?
5. What are your views regarding different fuel options? In addition, what are the challenges?
6. Do you come across adulterated fuel as a challenge for fuel efficiency? How do you tackle it?
7. What is the process of data capture and what measures are taken to analyze it and improve efficiency and operations?
8. Do you have a ‘top management’ review system for reviewing emission and fuel efficiency Performance?
9. Do you pressure the bus manufacturers to provide better buses, which force them to innovate or import technology and designs?
10. What do you think are good measures for increased ridership? 3 measure at least
11. What are your views on driver training? Have you ever engaged any professional organization to provide such trainings? If yes, has the effectiveness in FE been studied? What has been the effectiveness?
12. Is there a monitoring and reward system for staff for improving performance?

B. Industry

1. What have been the initiatives of your organization in making the buses more fuel-efficient?
2. The country (India) has dual emission norms prevailing; does it affect your stand on controlling emissions from the buses? How?
3. Is there any study carried out by the industry to establish relation between the improved emission and fuel efficiency?
4. Does the company have any internal system of benchmarking fuel efficiency?
5. What kind of design changes have been incorporated in the latest bus models and what is the result of these enhancement (if implemented)
6. Does the company have a policy framework beyond the mandatory requirement for development of more fuel-efficient vehicles?
7. Has any white paper been published on the need and strategy for greater use of public transport?
8. Data collection and analysis is something bus corporations are struggling with. What is a manufacturer’s role in data collection and how does it assist bus corporations in analyzing them? For ex. On Board Diagnostics (OBD) or sensors etc.
9. With regards to driver training, what is the role played by your organization? Does it provide refresher courses? Collect individual driver behaviour and track their performance?
10. What do you believe is the trade off for better emissions standards? Does it have to be more fuel burnt?

11. Bus Corporations want a minimum fuel efficiency assurance from manufacturers especially with rising fuel prices. As a manufacturer what is your stand?

12. What is the challenge in balancing emissions, fuel efficiency while providing benefits of power steering, pneumatic doors, etc., since BSIV will soon be introduced all over the country.

13. In the present situation, where do you see the industry 5 years from now? What long term and short measures do you feel must be taken to improve the situation? Which are the organizations to be involved?

C. Policy Makers

1. Have you tried to position the various best practices in the country to develop a culture of best practices?

2. Right now different state road transport corporations (SRTCs) are using different log systems and of different parameters. Is there a system of standardized record maintenance?

3. Is there an effective system of analysis of data that helps SRTCs to improve their performance, in terms of operations, maintenance and best practices?

4. Is there any benefit for an SRTC to be fuel efficient? Are there any awards or incentive system in place?

5. There is so much of discussion around that better public transport would reduce pressure from private vehicles. Do you agree? Are there any efforts or policies to push that?

6. What is the incentive for a bus corporation to reduce emissions? For ex. moving to BSIV, though it may not be financially beneficial in terms of fuel savings.

7. Are policies framed based on the data trends and analysis? Can OBD be made compulsory to improve data collection and accuracy?

8. With rising costs and most bus corporations in the red, where do you see the industry 5 years from now?

9. What are the policy changes that need to be brought in to improve the present situation and to make the bus corporations financially and environmentally sustainable?

10. Can driver training schools be created which will produce certified drivers who will be an asset to the corporation as well as improve the fuel efficiency and contribute to the safety record?

11. How can transport policies favouring buses for ex. BRT/Priority signals/lanes be implemented in the urban transport scenario? How can the role of bus corporations be strengthened as a city stakeholder?

D. Research Organizations

1. There is much discussion that better public transport would reduce private vehicles on the road. Do you agree? Are there any efforts or policies to push that?

2. Is there an incentive for a bus corporation to reduce emissions? For ex. moving to BSIV from BSIII, or using retrofits though it may not be financially beneficial.

3. How can transport policies favouring buses for ex. BRT/Priority signals/lanes be implemented in the urban transport scenario? How can the role of bus corporations be strengthened as a city stakeholder?

4. What is the role played by research organizations like yours in helping bus corporations to improve their efficiency? Especially in terms of data analysis.
5. Do you feel policy decisions are being based on data analyses and research?

6. With rising fuel and labour costs and high motorization and most bus corporations in the red, where do you see the industry 5 years from now?

7. What are the short term and long term measures that need to be taken to improve the situation? Which are the organizations that need to take ownership?

E. Development Agency

1. What is the role played by a development agency like yours in promoting bus transport?

2. There is much of discussion that better public transport would reduce private vehicles on the road. Do you agree? Are there any efforts or policies to push that?

3. Is there an incentive for a bus corporation to reduce emissions? For ex. moving to BSIV from BSIII, or using retrofits though it may not be financially beneficial.

4. How can transport policies favouring buses for ex. BRT/Priority signals/lanes be implemented in the urban transport scenario? How can the role of bus corporations be strengthened as a city stakeholder?

5. Do you feel policy decisions are being based on data analyses and research?

6. What are the short term and long term measures that need to be taken to improve the situation? Which are the organizations that need to take ownership of the process?
Annex 2: Description of Buses

Figure 10. A standard/ordinary bus: Has steps for boarding and alighting and is without air conditioner

Figure 11. A low floor air conditioned city bus
About Clean Air Asia
www.cleanairasia.org

Clean Air Asia (formerly Clean Air Initiative for Asian Cities) 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 more than 240 organizations in Asia and worldwide.

Clean Air Asia uses knowledge and partnerships to enable Asia’s 1,000+ cities and national governments 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.

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