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ESMAP
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About CAI-Asia
The Clean Air Initiative for Asian Cities (CAI-Asia) promotes better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors. CAI-Asia was established in 2001 by the Asian Development Bank, the World Bank and USAID, and is part of a global initiative that includes CAI-LAC (Latin American Cities) and CAI-SSA (Sub-Saharan Africa).

Since 2007, this multi-stakeholder initiative is a registered UN Type II Partnership with almost 200 organizational members, eight Country Networks (China, India, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, and Vietnam) and the CAI-Asia Center as its secretariat. Individuals can join CAI-Asia by registering at the Clean Air Portal: www.cleanairinitiative.org. Its flagship event, the Better Air Quality conference, brings together over 700 air quality stakeholders.
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1. Background to the Guangzhou Green Trucks Pilot Project

The World Bank (WB) initiated a pilot project – dubbed “Guangzhou Green Trucks Pilot Project” in support of Guangzhou’s efforts to improve air quality in preparation for the 2010 Asian Games. The goal was to develop a “proof of concept” for a truck program in Guangdong Province, and possibly China, that aims to:

- Enhance the fuel economy of the truck fleet
- Reduce black carbon and other air pollutants from trucks
- Consequently obtain greenhouse gas (GHG) emission savings.

The project was implemented by the Clean Air Initiative for Asian Cities Center (CAI-Asia Center), in cooperation with Cascade Sierra Solutions, US EPA and World Bank, and with support from Guangzhou Environmental Protection Bureau (GEPB), Guangzhou Transport Committee (GTC), and Guangzhou Project Management Office (PMO) for the World Bank. The project received financial support from the Australian Government (AusAid) and the Energy Sector Management Assurance Program (ESMAP).

The pilot project aimed to contribute to addressing three problems related to trucks in Guangzhou and the wider Guangdong province simultaneously: (a) fuel costs and security; (b) air pollution and associated health impacts, and (c) GHG emissions and climate change.

The scope of the pilot was limited to Guangdong Province, focusing on diesel trucks accessing or passing through the city of Guangzhou and surrounding cities, like Shenzhen. Aside from GHG emissions, the scope includes black carbon and other air pollutants from trucks because of their potential interacting effects and contribution to climate change, and because air pollution is an important local concern.

The pilot project consisted of the four components, each with its own output (provided separately):

1. **Background Analysis Report**, which analyzes numbers, growth, operation, fuel use in Guangzhou; relevant institutions and policies in China; and available fuel economy and emissions reduction strategies and technologies.

2. **Guangzhou Truck Sector Survey Report**, which summarizes the results of a survey of 1040 truck drivers and 43 companies. The survey intended to fill the gaps in information needed for the program design and for determining the potential fuel savings and emission reductions through a wider green freight program in Guangdong. It covered company details, truck details (ownership, type/size, age, brand, replacement), and operation details (km traveled, average speed, number of trips, route, maintenance, training, record keeping).

3. **Smart Drivers for Trucking in China Training Course**. Training materials for truck fuel efficiency were developed and tested, which can be the basis of a training component under a future green freight program. A 1 hour summary course in the form of 72 presentation slides in English and Chinese tailored to Chinese drivers based on feedback received from 20 drivers and operators from the Guangzhou pilot companies who took the course was prepared. Further information is provided in 6 supporting presentation modules based on an existing Smartway course (planning; truck specifications; components and accessories; maintenance and inspection; driving practices; smart driving summary).

4. **Technology Pilot Report**, with results from the technology pilot, which tested a tire equipment package (to reduce the weight and rolling resistance of the tires) and an aerodynamics equipment
package (to reduce air resistance and drag) on long-haul trucks (heavy duty trucks), short-haul trucks, and garbage trucks of three Guangzhou-based companies. It also presents recommendations for future pilots based on this pilot and estimates the potential for fuel and emissions reductions for Guangdong Province using heavy duty trucks as an example. A 10-minute video was produced of the technology pilot in English and Mandarin. Freight is not yet getting enough attention compared to other transport modes and the video thus allows results to be shared more easily with a larger audience.

The project team received full support from the GEPB, GTC and PMO, who provided general guidance for the project and information for the Background Analysis Report, obtained support from Guangzhou Municipality for the technology pilot, and supported that the pilot project would lead to a larger pilot for Guangdong Province. GTC identified and secured commitment from the three truck companies to participate in the technology pilot; obtained police clearance for the testing of technologies where needed; helped identify survey sites and obtain clearance to conduct surveys at logistics centers and other locations; and supported the filming of the video on the pilot at various locations in Guangzhou. Government support was critical for the success of the pilot project and will be critical for a larger project in Guangdong Province and for the establishment of a Green Freight China program in the future.
2. Main Conclusions and Recommendations

The main conclusions and recommendations of the pilot project are presented below. As the goal of this project was to develop a “proof of concept” for a truck program in Guangdong Province and China, the results of the four project components are summarized within this context. Conclusions and recommendations are presented in three groups:

- Technology pilot and potential for the trucking sector
- Need for a nation-wide program sector to improve fuel efficiency and reduce emissions from diesel trucks
- Considerations for the design of a Green Freight China program

2.1 Technology pilot and potential for the trucking sector

The purpose of the Technology Pilot was in the first place to demonstrate that technologies applied in the US and other Western countries can also work in China, identify factors of influence for China, and determine the potential for fuel and emissions reductions for Guangdong Province under a future program. The pilot results are promising but a larger pilot is needed to confirm savings potential. For this reason the results from the technology pilot should be considered as indicative only and must be verified under a larger pilot.

The Technology Pilot component of the project tested a
- Tire equipment package to reduce the weight and rolling resistance of the tires, and consisting of aluminum wheels (heavy duty trucks, HDTs, only), low rolling resistance tires, tire pressure monitoring system
- Aerodynamics equipment package to reduce air resistance and drag, and consisting of a nosecone, cabin fairing, and trailer skirts.

2.1.1 Summary results for truck companies

Three companies participated in the pilot: Star of the City Logistics (SOCL), Xinbang Logistics (XWBL), and Baiyun District Guangzhou. Detailed results are included in the Technology Pilot Report. However, due to the many variables, and in particular the data collection methods applied, the results of XWBL are not considered reliable, and are therefore not included.

At SOCL, tire and aerodynamics equipment were tested on 2 long-haul HDTs. Investment costs were US$ 16,333, and annual savings are 3557 liters (6.64%), 9.18 tons CO2, 33.21 kg NOx, and 1.41 kg PM10. This results in a payback period of 5.1 years. A main reason for lower than expected fuel savings was that the average speed of pilot trucks was 50-60 km/hr (influenced by load weight, weather conditions -- the pilot was conducted during months with frequent fog --, highway construction, and traffic congestion), and the highest benefits from aerodynamics equipment is achieved at speeds above 75 km/hr. Based on the pilot results, if the equipment package were to be installed for the entire long-haul fleet of SOCL, consisting of 30 HDTs to which the package can be applied, then this would require US$ 489,996, resulting in 106,704 liters of fuel savings, which is equivalent to US$ 96,033. The payback period would be 5 years. Emissions reductions would be 276 tons CO2, 996 kg NOx and 42 kg PM10 per year. It is important to note that SOCL is considering
purchasing several equipment for its fleet, and is most confident about nosecones, cabin fairings, aluminum wheels and low rolling resistance tires.

For Baiyun District Guangzhou company, tire equipment was tested on 2 garbage trucks. Investment costs were $6320, and annual savings would amount to 2520 liters fuel (18.5%), 6.71 tons CO2, 23.53 kg NOx and 1 kg PM10. The payback period is 3.1 years, but is actually considered to be 1.5 years if the longer life of LRR tires compared to existing tires is considered. If the equipment package were to be installed for the entire Baiyun District garbage fleet, 1500 garbage trucks, then this would require US$ 9,487,500. This would result in 3,780,250 liters of fuel savings, which is equivalent to US$ 3,402,225 (at $0.9 per liter). The payback period would be 3.09 years. If the costs for the LRR tires were to be adjusted based on a 5 year lifetime for LRR tires compared to 8 months for currently used tires, then the total investment costs for 1,500 garbage trucks would be US$ 4,557,000 and the payback period would be reduced to 1.49 years. In both cases, annual emissions reductions would be 9,761 tons CO2, 35.3 tons NOx and 1,501 kg PM10 per year.

It is noted that a more favorable payback period would be achieved if:

• Equipment would be factory-installed on trucks
• Equipment would be purchased in bulk (current costs are based on low number purchased as part of the Guangzhou pilot project)
• The longer life time of LRR tires compared to existing tires would be considered for the HDTs of SOCL as this would lower the LRR tire investment costs over a certain time period

2.1.2 Lessons about technologies tested

A general conclusion is that technologies applied in the US may thus not always be suitable for China. With regards to the individual technologies tested, the following lessons can be drawn for consideration in future pilots and a broader program:

• Tires form a key area for fuel efficiency gains and emissions reductions. Low rolling resistance (LRR) tires were tested to, as the name suggests, reduce the rolling resistance of tires on the road and thus reduce fuel use. Single-wide LRR tires would provide the largest savings but could not be tested due to legislation in China that does not allow making changes to the truck structure. Dual LRR tires appear to generate enough savings for them to be economically feasible, especially due to the longer life span compared to normal tires. An important observation was that the improved stability of tested garbage trucks with the LRR tires likely contributed to the large savings, because the former tires were of poor quality. This could mean that simply improving the quality of conventional tires used on trucks could already result in significant savings. Aluminum wheels could be considered as part of the tire package especially if factory installed instead of replacing existing steel wheels. The first verified SmartWay Chinese made tire, Double Coin Holding is a very important influence for developing SmartWay technology verification to technologies manufactured and distributed in China.1
• Tire pressure monitoring systems have a good potential to reduce fuel and emissions, but hinges on good installation of the system and instruction of the drivers on how to operate it.

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1 See: http://fleetowner.com/green/archive/china-made-first-smartway-0322/
• Nosecones and cabin fairings were considered successful technologies because of reasonable savings, even at lower speeds, and relatively low investment costs. For this reason SOCL indicated to install these equipments on the entire long-haul fleet.
• The trailer skirts, aimed to reduce drag, were less successful because the long-haul trucks did not reach average speeds of 75 km/hr above which fuel savings can be significant. At lower speeds the added weight of trailer skirts offsets the fuel savings from reduced drag. Reasons why high average speeds may be more difficult to achieve in China compared to the US are speed limits on roads, traffic congestion, weather conditions, quality of the road. The weight of truck loads also plays an important role, as overloading of trucks is common and renders driving at high speeds unsafe. The pilot found a wide range of truck load, which is not always measured because customers often pay per freight volume or units transported.

A future pilot project should have a stronger focus on domestic trucks, such as DongFeng, HOWO, STEYR. These trucks manufacturers could be involved in a pilot by installing selected technologies at the time of assembly of trucks, providing financial support for the pilot project in return for the use of the pilot results to promote their trucks. Global engine manufactures that have agreements with Chinese engine manufacturers could also be asked to financially support pilot projects to test new technologies, such as JAC and Navistar.2

2.1.3 Lessons about process

The process is equally important to a successful application of technologies. The main lessons for consideration in future pilots and a broader program are:
• Training of drivers can greatly add to fuel and emissions savings, including training on eco-driving as well as on the equipment itself. For example, drivers mistakenly took pressure monitoring sensors off when increasing tire pressure because instructions on handling the equipment had not covered this. Technology training to the drivers of pilot trucks directly by the technology supplier or OEM supplier would be preferred.
• Clear and detailed pilot protocols for data collection are essential. Their implementation can be difficult, and if not implemented correctly, the margin of error may exceed the savings percentage, thus rendering unreliable results as was the case for XWBL. At SOCL the protocols were initially not correctly followed, and it was due to strong personal interest and commitment from top management that the right incentives were provided to pilot drivers during an expanded pilot to ensure the data collected was reliable. Ideally, data collected for equipment tests should be integrated into a company’s overall monitoring system.
• Conditions for pilot and control trucks need to be kept as close as possible. Of particular importance are the load weight / daily load factor, same driver, with same training, same cab-trailer combination, and same routes.
• Participating companies were keen to be considered leaders in their sector. Identification of leading companies that would profile fleets that advance emission reduction and fuel savings in the transportation sector would benefit a future pilot or program.

2 http://fleetowner.com/trucking_around_world/archive/navistar-chinese-engine-maker-1030/
2.1.4 Potential for fuel and emissions reductions for Guangdong Province

Based on the results from the pilot, US experience, the survey, and literature, the potential to determine fuel and emissions reductions for Guangdong Province using the estimated 826,520 heavy duty trucks (HDTs) registered there as an example. It can be concluded that this potential is significant (see Table 1), especially when it is considered that conservative figures were applied, including for fuel % reductions, annual vehicle km traveled (VKT) and diesel price.

Table 1. Fuel and Emissions Reduction Potential for Heavy Duty Trucks Registered in Guangdong Province

<table>
<thead>
<tr>
<th>Package 1 – Tires</th>
<th>Per HDT</th>
<th>Guangdong HDTs (826,520)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel savings</td>
<td>2,093</td>
<td>1.73 million hectoliter</td>
</tr>
<tr>
<td>Fuel cost savings</td>
<td>US$ 1,883</td>
<td>US$ 1.56 billion</td>
</tr>
<tr>
<td>CO2 savings</td>
<td>5.4 tons</td>
<td>4.47 million tons</td>
</tr>
<tr>
<td>NOx savings</td>
<td>19.5 kg</td>
<td>16,156 tons</td>
</tr>
<tr>
<td>PM10 savings</td>
<td>0.84 kg</td>
<td>692 tons</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Package 2 – Aerodynamics</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel savings</td>
<td>1,590</td>
<td>1.31 million hectoliter</td>
</tr>
<tr>
<td>Fuel cost savings</td>
<td>US$1,431</td>
<td>US$ 1.18 billion</td>
</tr>
<tr>
<td>CO2 savings</td>
<td>4.1 tons</td>
<td>3.39 million tons</td>
</tr>
<tr>
<td>NOx savings</td>
<td>14.9 kg</td>
<td>12,279 tons</td>
</tr>
<tr>
<td>PM10 savings</td>
<td>0.64 kg</td>
<td>526 tons</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Package 1 &amp; 2 – Tires &amp; Aerodynamics</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel savings</td>
<td>3,683</td>
<td>3.04 million hectoliter</td>
</tr>
<tr>
<td>Fuel cost savings</td>
<td>US$ 3,315</td>
<td>US$ 2.74 billion</td>
</tr>
<tr>
<td>CO2 savings</td>
<td>9.5 tons</td>
<td>7.9 million tons</td>
</tr>
<tr>
<td>NOx savings</td>
<td>34.4 kg</td>
<td>28,435 tons</td>
</tr>
<tr>
<td>PM10 savings</td>
<td>1.47 kg</td>
<td>1,218 tons</td>
</tr>
</tbody>
</table>

Notes:
Total number of trucks registered in Guangdong Province 1,230,000 (Guangdong Statistics Yearbook 2001 – 2008), multiplied by 67.2% HDT of total trucks surveyed in Guangzhou as part of the pilot project, results in 826,520 HDTs.
Fuel savings for the tire package is assumed 5% and for the aerodynamics package 3-7% compared to a US experience of 6-8% and 10-13% respectively.
Diesel price $ 0.9 per liter
Emissions factors: CO2 = 2.582 kg CO2/liter based on the IEA SMP Model [http://www.wbcsd.org/web/publications/mobility/smp-model-document.pdf]); NOx = 9.34 g/liter and PM10 = 0.40 g/liter, based on China National emission factors (provided by Tsinghua University)

Similarly, the potential for reductions can be calculated for all trucks (HDT, MDT and LDT) registered in Guangdong Province. This assumes the application of the tire package for all trucks and the aerodynamics package for HDT only. Table 2 presents the results and it is noted that the investment costs applied are high because they do not consider bulk purchase, and the reduction percentages and emissions factors used are the same as for Table 1.

Table 2. Fuel and Emissions Reduction Potential for All Trucks Registered in Guangdong Province

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of trucks registered in</td>
<td>1,230,000</td>
<td>67.2% HDT (826,520); 19.8% MDT (243540); 13.0%</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guangdong Province</td>
<td></td>
<td>LDV (159,900) based on the ratios found in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>trucks survey</td>
</tr>
<tr>
<td>Total investment costs (tires and</td>
<td>12,137,461,109</td>
<td>$12 billion dollars</td>
</tr>
<tr>
<td>aerodynamics)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total fuel savings (liters per year)</td>
<td>3,962,456,995</td>
<td>4 billion liters</td>
</tr>
<tr>
<td>Total fuel cost savings ($ per year)</td>
<td>3,586,066,990</td>
<td>$3.6 billion</td>
</tr>
<tr>
<td>Total CO₂ savings (tons per year)</td>
<td>10,233,591</td>
<td>10 million tons</td>
</tr>
<tr>
<td>Total NOₓ savings (kg per year)</td>
<td>37,009,348</td>
<td>37000 tons</td>
</tr>
<tr>
<td>Total PM savings (kg per year)</td>
<td>1,584,983</td>
<td>1584 tons</td>
</tr>
<tr>
<td>Payback period in years</td>
<td>3.38</td>
<td></td>
</tr>
</tbody>
</table>

### 2.2 Need for a nation-wide program for trucks to improve fuel efficiency and reduce emissions

Improving fuel efficiency and reducing emissions from diesel trucks in China is imperative. It makes economic and environmental sense to establish a program for diesel trucks in Guangdong Province and China for the following reasons:

- Trucks represent a major share of diesel vehicles in China and are expected to at least double by 2050 compared to 2010.
- The vast majority of freight in China was transported by highways in 2006 (72%) and has remained stable since 1980. The railway share has decreased from 20% to 14% over the same period, although railways may increase its share in the future again.
- Diesel is the “dirtiest” fuel from an air pollution perspective and diesel consumption in Guangzhou is 50% higher than gasoline sales.
- Policies are usually first developed or strengthened for LDVs and much later for trucks, such as vehicle emission standards and fuel economy standards and this contributes to relatively higher fuel use and emissions.
- Diesel costs represent the largest share of operational costs of trucks in China, thus there is a strong financial incentive to improve fuel efficiency. One interviewed fleet manager reported as much as 52%.

A trucks program could be initiated in Guangzhou and Guangdong Province but should eventually be expanded to China, and ideally be designed with China in mind.

- A small percentage of trucks are registered in Guangzhou and Guangdong Province. The number of trucks registered in Guangzhou in 2007 was approximately 185,300, which is only 15% of the total 1.23 million trucks registered in the entire Guangdong Province. The survey found that almost 80% of 469 surveyed drivers who worked for truck companies are registered outside of Guangdong Province. A small number of past surveys conducted by other organizations show similar findings.
- Truck routes matter more than where the trucks are registered. More than 80% of 845 surveyed drivers at Guangzhou Logistic Centers started their trip outside Guangdong Province and ended in Guangzhou. Truck routes extend beyond Guangdong Province. One interviewed fleet manager explained that the most popular route is Guangzhou to Changsha, which is 670 km away and that his four-axis trucks make 6 roundtrips per month.
• Policies at the local, provincial and national level are needed to make the freight sector more efficient and greener. For example, current national policies do not allow for changes of truck, which makes the application of certain technologies difficult, such as single-wide based tires or trailer skirts. Important examples of plans, laws and policies include
  o Transport: 11th Five-year Plan of the Transport Sector (2006-2010) and various regulations on road transportation, including road freight transport
  o Energy: Energy Conservation Law; Fuel efficiency standards for commercial freight vehicles
  o Environment: Environmental Protection Law; Air Pollution Prevention and Control Law; emission standards and policies relevant to diesel vehicles
• A national program provides a greater chance of sustained efforts, as these can fill the gaps of local and provincial projects and provide a basis for nation-wide efforts to reduce fuel use and emissions from the freight sector. A national program would also provide a better model for other countries that want to establish such programs, especially developing countries.

2.3 Considerations for the design of a Green Freight China program

A Green Freight China program should be designed with the lessons from the pilot in mind as described in section 2.1 and the detailed reports. Other considerations are:
• Focus on fuel, climate change and air pollution
• Focus on different type of trucks
• Bringing costs of equipment down
• Ensure broad stakeholder participation
• Build on existing successful programs but be tailored to China

2.3.1 Focus on fuel, climate change and air pollution

With a growing international concern about climate change, programs tend to shift in focus to reducing CO2 emissions, but thereby risk losing the focus on important national and local issues, most notably fuel costs and security, and air pollution and associated impacts.

Fuel costs and security
• The 10 million trucks on Chinese roads, more than a quarter of all vehicles in China, are a major reason China accounts for half the world’s annual increase in oil
• Total energy used for passenger and freight in China accounted for 5.34% of the total worldwide in 2005 and will account for 9.9% in 2035
• With international crude prices fluctuating from US$120 to US$140 a barrel in 2008 before dropping to $40 a barrel in late 2008, economists still expect that fuel prices will be higher in the future.
• Surge in diesel truck sales (in 2008 this was nearly twice as many as in the US), and subsequently diesel supplies cannot keep up with demand for diesel at service stations, causing rationing and shortages

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3 Sustainable Mobility Project, www.iea.org
4 http://www.baq2008.org/preevent-fuels
5 http://www.lifeofguangzhou.com/node_10/node_37/node_85/2008/09/28/122258050352278.shtml
Climate change

- Greenhouse gas (GHG) emissions are rapidly rising in Asia, especially in cities. The Kyoto Protocol covers six main greenhouse gases.
- Air pollution and greenhouse gas emissions have similar causes (mostly energy-related), and there is increasing evidence that their effects are interacting. The strongest evidence points to black carbon, the carbonaceous component of soot (particulate matter) that is produced mostly by burning of biomass, diesel and coal. In addition to its contribution to air pollution, black carbon and is a dominant absorber of solar energy.
- Recent scientific studies suggest that black carbon is the second largest contributor to global warming following CO2. From a climate change perspective it thus makes sense to address black carbon emissions through the reduction of soot and particular matter.\(^6\)

Air pollution

- Diesel is “dirtiest” fuel, emitting, amongst others, SO\(_2\), NO\(_x\), VOC, and particulate matter (PM)
- At the city level, air pollution is considered a bigger problem than climate change in Asia and a main focus of the Guangzhou authorities in preparation for the Asian Games 2010.
- Air pollution has replaced cigarette smoking as the first cause of lung cancer in Guangzhou. In the recent decade the number of lung cancer cases has doubled.\(^7\)
- In Hong Kong, approximately 1,600 people died each year as a result of air pollution, mostly from heart attacks, stroke, pneumonia and other lung diseases.\(^8\)
- Air pollution results in smog/haze and acid rain that affects agriculture, forests, and buildings

2.3.2 Focus on different type of trucks

Efforts to improve fuel efficiency and reduce emissions from trucks should focus differently on different types of trucks.

- Heavy and medium duty trucks are usually used for long-range freight travel and combined with higher fuel consumption per km, they have the greatest potential for fuel economy improvement and GHG emissions savings through technology applications. Programs in the US have mostly focused on these truck categories.
- Low and mini duty trucks have less, but still significant, potential for fuel efficiency through technology applications. However, there are other reasons why a trucks program starting in Guangzhou may include these trucks. First, in Guangzhou, 77% of registered trucks are light duty trucks and registrations have increased more sharply compared to other truck types. Second, these trucks may be installed with particulate filters with the introduction of Euro IV fuel standards prior to the Asian Games if it can be confirmed that these trucks predominantly stay within the province. Third, there may be a potential for fuel savings through improved logistics, as these appear to be used more in urban environments and shorter trips. Finally, if these trucks mainly operate within

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Guangzhou boundaries, most of the air pollution generated would also be emitted in and around Guangzhou.

2.3.3 Bringing costs of equipment down

Bringing the costs of equipment (tires and aerodynamics equipment packages, but also others) must be given priority to realize rapid penetration of fuel and emissions reducing equipment. Financing green technologies will be challenge for China for the following reasons:

• Limited tax policies exist for the truck sector relevant to energy and emissions management
• Investment costs are too high for many companies, even if potential savings are high and payback periods short. This is partly caused by the low number of suppliers of technologies and the low production and sales rates at this moment, making them relatively costly. Furthermore, for imported truck equipment, the Chinese tariffs on can be in excess of 110%
• The truck sector is not considered the most reliable sector for lending, especially small companies and individual truck driver owners
• ESCOs (energy service companies) have been successfully established for industry but these have no experience with trucking fleets
• A capacity weakness exists amongst financiers as knowledge and tools for financial appraisal are lacking. This has thus far prevented the trial and introduction of innovative financing mechanisms, such as revolving funds.

Any future project or Guangdong or China based program should therefore have an explicit and significant focus on financing.

Furthermore, diesel particulate filters (DPFs) and other equipment to reduce air pollutants should be included in any program to effectively reduce air pollution from trucks. Current barriers are

• Low sulfur diesel is required (right now diesel in China has too high sulfur levels, except for main cities, but trucks travel across country)
• High investment costs and no financial savings, therefore DPFs should be legally required and ideally be included in a technology package installed on trucks
• Maintenance needed especially for retrofitted DPFs
• Low speeds in urban traffic which may impact the regeneration of the filter.

2.3.4 Ensure broad stakeholder participation

A successful program will require broad stakeholder participation. A trucks program should therefore consider main government agencies and stakeholders/expert groups in Guangzhou, Guangdong Province, China and internationally. The most important ones are:

• Government agencies are important because energy efficiency, CO2 reduction and air pollution reduction are all Chinese Government priorities. Agencies at the local (Guangzhou), provincial (Guangdong Province) and national levels (China) should be involved, covering transport, environment and relevant other sectors. The following agencies are considered most relevant:
  ○ Guangzhou: Guangzhou Environmental Protection Bureau (EPB) and the Guangzhou Transport Committee (GTC)
Guangzhou Province: Guangdong Provincial EPB and the Guangdong Provincial Department of Transport

China: Ministry for Environmental Protection (MEP) and Ministry of Transport (MoT)

- Truck companies or carriers. The four categories of truck owners in Guangdong Province: large state-owned enterprises; private enterprises; self-employed truck drivers cooperating with enterprises; and self-employed truck drivers. Truck companies / carriers are particularly interested in reducing fuel costs, especially with fluctuating fuel prices.
- Shippers, which make use of carriers / truck companies to transport goods to and from factories, ports and customers. A focus on carriers would be an extension of Corporate Social Responsibility in their supply chain in China (many carriers operating in China are US/EU based).
- Technology suppliers and service providers to the freight industry, as they would increase their potential to sell technologies and expand services through a coordinated program
- Universities and research institutes, including those linked to government agencies, such as Tsinghua University.
- Associations (China Truck Association) and NGOs, who would have a greater impact through a coordinated program. Relevant international institutions and NGOs include Clean Air Initiative for Asian Cities (CAI-Asia); US; Cascade Sierra Solutions (CSS), Business for Social Responsibility (BSR); International Council for Clean Transportation; Partnership for Clean Fuels and Vehicles.
- Development agencies and banks because they would better able to identify successful projects for loans or grants. Examples are the UN, ADB, the World Bank, and the US Environmental Protection Agency / US AID.

A possible model for a freight partnership is illustrated below.

**Figure 1. Possible model for a freight partnership**

### 2.3.5 Build on existing successful programs but be tailored to China

A program should build on existing successful programs for freight and logistics. The most relevant programs are the US Smartway Program ([www.epa.gov/smartway](http://www.epa.gov/smartway)), ObjectifCO2 in France and Freight Best Practice in the UK. The SmartWay program launched by US EPA in 2004 identifies products and services that reduce transportation-related emissions. The program is a partnership among government, business and consumers...
to protect the environment, reduce fuel consumption, and improve air quality. A more detailed review of other existing programs is required.

However, a program should be tailored to China’s situation. A notable example where the Chinese situation is different from that in the US and the EU is the trucking sector:

- Fragmented industry with majority owner-driver trucks
- Multiple logistics centers thus limiting coordination of trucks
- Long-haul trucks often travel large parts of trips in urban areas. This is more similar to EU where trucks go from origin to final destination. In the US long-haul trucks travel between logistic centers and smaller trucks travel from origin / to destination.
- Trucks driving to/from Guangdong Province are often registered elsewhere in China so difficult to control
- Shippers seem to have a less direct relationships with carriers compared to the US because contracts with factories they purchase goods from, factories have contract a logistics firms, and logistic firms hire small companies / individual drivers

Furthermore, the political situation and government structure is different. In the US, the US EPA takes a stronger role in the US but in China the Ministry or Department of Transport would play a greater role. In the US, non-governmental organizations (NGOs) such as Cascade Sierra Solutions have been critical in getting the greening of trucks underway, but in China NGOs are not well developed yet while at the same time universities and research institutes are closely tied to government agencies. With regards to financing, Chinese companies are much less familiar with lending money than in the US and banks and other financial institutions have less experience with non-traditional ways of financing.

Furthermore, a future program should include a technical review process for Chinese manufactured technologies to verify emission reduction and fuel savings claims. The verification and certification process developed under the Smartway program could serve as a basis.
3. Next steps

The Guangzhou Green Trucks Pilot Project was the catalyst to a Guangdong GEF Project, a Green Freight China Program design, and various other dissemination and follow-up activities. It can therefore be concluded that the project was successful and resulted in ample leverage. A main reason for this is the successful collaboration between the various partners during the Guangzhou pilot project.

3.1 Guangdong Green Freight GEF Project

This project was concluded on 15 March 2010 with a Project Results Dissemination Workshop held in Guangzhou. The Guangdong Provincial Government, represented by the Department of Finance and Department of Transport, was present in relation to a potential larger project for Guangdong Province. The Global Environment Facility (GEF) approved a Project Information Form (PIF) submitted by World Bank for a Green Truck Demonstration Project with the following objective: To accelerate transfer and deployment of clean transport technologies, reduce GHG emissions from freight transport, and improve urban air quality in project cities, through a Green Truck Demonstration Project in Guangdong province. The Guangdong Provincial Government designated the Department of Transport as the leading agency (Project Management Office, PMO) for the preparation and implementation of the project. If approved, this 3.5 year 3-4 million US$ project would focus on testing technologies and commercial installation for trucks, improving freight logistics management, and institutional development and capacity building.

3.2 Design of a Green Freight China Program

The China Sustainable Energy Program (Energy Foundation) confirmed a grant to the CAI-Asia Center in April 2010 for the design of a Green Freight China Program over the next year, in collaboration with World Bank, Cascade Sierra Solutions and U.S. EPA, and making use of the US experience with the Smartway program for freight.

A program will be designed that focuses on energy efficiency and reduced GHG and air pollutants, that

- Fills gaps in national policies and institutions that aim to reduce fuel use and emissions from the freight sector, and fill gaps the Guangdong GEF project that is restricted to the Guangdong Province.
- Provides a basis for nation-wide efforts to reduce fuel use and emissions from the freight sector. The program design will build on existing programs in other countries as well as the Green Trucks Pilot Project in Guangzhou
- Could also be used as a model for other countries establishing such programs, especially developing countries.

Activities include

- Review of policies and institutional set-up in China relevant to freight sector and identify priority policy, institutional and other gaps and possible solutions that can be integrated in the design of the Green Freight China Program.
- A design framework of the Green Freight China Program, including overall design of the program and its specific components (see box). This design will be based on, amongst others, the policy and
institutional study, existing programs worldwide (e.g. especially the US Smartway Program), the
Guangdong GEF project design and the Guangzhou pilot project.

- A detailed design of the Green Freight Partnership component and the Technology and Logistics
  component of the program.

Box 1. Components of a Green Freight China Program

- **Green Freight Partnership** of shippers, carriers and regulators relevant to Guangdong, China
  (mirroring the Smartway Partnership in the US), and a Green Freight Network (comprising of broader
  stakeholder groups also including suppliers, NGOs, universities, and others, and with a global
  membership – this network will be useful to access expertise and support for the program as well as
  the GEF project)
- **Technologies and Logistics**, which also includes the policies that affects these
- **Financing**, which could include state loan programs (revolving loan funds) or provision of limited
  grants for the purchase of technologies and/or new trucks
- **Freight database**, which would include data submitted by carriers on fuel use, technology application
  and other aspects of their fleet; results from technology applications and other measures taken by
  program participants to reduce fuel use and emissions; data from surveys as part of the program;
  and data from external sources, such as national statistics, and from studies carried out by others. It
  would also include a measurement model for energy use, CO2 emissions and air pollutant emissions
  for the road freight sector.

In addition, there are a number of cross-cutting activities, including research, policy development, training,
communication and marketing, aimed at aim the freight sector, government agencies and other relevant
stakeholders in China. Examples are research on methodologies for measuring fuel and emissions reductions
from trucks; develop policy recommendations on how technologies can be promoted through national
policies; capacity building and institutional strengthening activities; training materials, videos and tools;
Outreach Center to provide a face-to-face contact with drivers directly; marketing materials; a dedicated
website on the Green Freight Program.

3.3 Other leveraging activities

Some of the known possible leveraging activities include:

- The CAI-Asia Center has been invited to prepare a Background Paper on Green Freight for the
  Environmentally Sustainable Transport (EST) Forum in Bangkok in August 2010, and organize a Green
  Freight session to be attended by high-level officials from Asian transport ministries.
- The Better Air Quality (BAQ) conference is organized for the fifth time by CAI-Asia from 9-11
  November in Singapore, and will include a session on green freight. Over 600 policy makers and
  practitioners are expected to participate in BAQ 2010.
- The CAI-Asia Center is, on its own initiative developing a green freight website, which will be
  launched in June 2010 and include, amongst others ([www.cleanairinitiative.org/greenfreight](http://www.cleanairinitiative.org/greenfreight))
  - Policies; Strategies & technologies; Financing; Programs & projects
  - Green Freight Network
  - News; Publications; Events; Training