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IMPLEMENTATION COMPLETION AND RESULTS REPORT
(TF-99076)

ON A

GRANT

FROM THE GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF USD$4.2 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

GUANGDONG GREEN FREIGHT DEMONSTRATION PROJECT

June 22, 2016

China and Mongolia Sustainable Development Unit
Transport and ICT Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

Currency Unit = Renminbi (RMB)

Appraisal Effective August 2011	Completion Effective December 2015
RMB 1.00 = US$0.149925	RMB 1.00 = US$0.153998
US$ 1.00 = RMB6.67	US$ 1.00 = RMB6.49

FISCAL YEAR

January 1 －December 31

ABBREVIATIONS AND ACRONYMS

CAA	Clean Air Asia
CGFI	China Green Freight Initiative
CPC	Communist Party of China
CPS	Country Partnership Strategy
DBDS	Driving Behavior Diagnose and Operation Monitoring System
DoF	Department of Finance
DoT	Department of Transport
EMM	Environmental Management Manual
EPA	Environmental Protection Agency
FM	financial management
GEF	Global Environment Facility
GF	gap fairings
GHG	greenhouse gases
GOC	Government of China
GPS	Global positioning system
ICR	Implementation Completion and Results Report
LRRT	low rolling resistance tires
LWST	light weighted semi-trailer
M&E	monitoring and evaluation
MoF	Ministry of Finance
MoT	Ministry of Transport
MTR	Mid-Term Review
OECD	Organization for Economic Co-operation and Development
PDO	Project Development Objective
PLG	Project Leading Group
PMO	Project Management Office
RF	roof fairings
SS	side skirt
TPMD	tire pressure monitoring devices

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People's Republic of China
Guangdong Green Freight Demonstration Project

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A. Basic Information

Country:	China	Project Name:	GEF Guangdong Green Freight Demonstration Project
Project ID:	P119654	L/C/TF Number(s):	TF-99076
ICR Date:	06/22/2016	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	MINISTRY OF FINANCE
Original Total Commitment:	USD 4.20M	Disbursed Amount:	USD 3.68M
Revised Amount:	USD 3.68M		
Environmental Category: C		**Global Focal Area: C**	
Implementing Agencies: Guangdong Provincial Transportation Department			
Cofinanciers and Other External Partners:			

B. Key Dates

Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	02/24/2010	Effectiveness:	08/30/2011	08/16/2011
Appraisal:	11/22/2010	Restructuring(s):		12/18/2014 12/05/2015
Approval:	04/12/2011	Mid-term Review:	03/31/2013	
		Closing:	03/15/2015	12/31/2015

C. Ratings Summary

C.1 Performance Rating by ICR

Outcomes:	Satisfactory
Risk to Global Environment Outcome	Low or Negligible
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance

Bank	Ratings	Borrower	Ratings
Quality at Entry:	Moderately Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Satisfactory
Overall Bank Performance:	Moderately Satisfactory	**Overall Borrower Performance:**	Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating**
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	None
GEO rating before Closing/Inactive status	Satisfactory		

D. Sector and Theme Codes

	Original	Actual
Sector Code (as % of total Bank financing)		
General energy sector	46	46
General transportation sector	50	50
Public administration- Transportation	4	4
Theme Code (as % of total Bank financing)		
Climate change	50	50
Pollution management and environmental health	50	50

E. Bank Staff

Positions	At ICR	At Approval
Vice President:	Victoria Kwakwa	James W. Adams
Country Director:	Bert Hofman	Klaus Rohland
Practice Manager/Manager:	Michel Kerf	Ede Jorge Ijjasz-Vasquez
Project Team Leader:	Binyam Reja	Ke Fang
ICR Team Leader:	Binyam Reja	
ICR Primary Author:	Mengling Shen	
	Chuntai Zhang	

F. Results Framework Analysis

Global Environment Objectives (GEO) and Key Indicators(as approved)

(a) Demonstrate the global and local environmental benefits of the application of energy efficiency vehicle technologies and operating techniques, and (b) Support improving energy efficiency and reducing greenhouse gas emissions in the road freight transport sector in Guangdong.

Revised Global Environment Objectives (as approved by original approving authority) and Key Indicators and reasons/justifications

The PDO was not revised during implementation.

(a) GEO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	: Improvement in fuel economy of participating trucks (L/100 km)			
Value (quantitative or Qualitative)	32 (24.18, see Comments below)	30.4		23.39
Date achieved	05/07/2012	06/08/2015		06/08/2015
Comments (incl. % achievement)	The baseline and target values were set for heavy trucks mostly, not on trucks that would participate in the pilot. With the revised values, the project achieved 3.3% reduction in fuel economy versus 5% planned at appraisal. See Annex 5.			
Indicator 2 :	Reduction in operating cost of truck fleets ($/100 ton-km)			
Value (quantitative or Qualitative)	25.6 (2.41, see Comments below)	24.3		2.31
Date achieved	06/05/2012	06/09/2015		06/09/2015
Comments (incl. % achievement)	The PMO was unable to collect all operating expenses, except fuel consumption, as trucking companies do not share financial data. With newly calculated baseline and target for fuel cost only, the project achieved a 4% reduction versus 5.1 % at appraisal.			
Indicator 3 :	Total amount of CO2 emission reduction (tons CO2/100 ton-km)			
Value (quantitative or Qualitative)	1.50	1.43 (4.7% reduction)		Reductions of 3.3% and 4.1%
Date achieved	06/05/2012	06/09/2015		06/09/2015
Comments (incl. % achievement)	Fuel consumption for technology demonstration and for logistics demonstration were measured in different units and the original value was miscalculated. Reduction in CO2 emission was 3.3% for technology demonstration and 4.1% for logistics demonstration.			

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Total private sector investment leveraged through the project ($ million)			
Value (quantitative or Qualitative)	0	1.00		8.02
Date achieved	06/05/2010	06/09/2015		06/05/2015
Comments (incl. % achievement)	The project successfully leveraged US$8.02 million of private sector investment (eight times the estimate at appraisal).			
Indicator 2 :	Number of existing or newly purchased trucks installing green truck technologies			
Value (quantitative or Qualitative)	0	1200		1349
Date achieved	06/05/2010	06/09/2015		06/09/2015
Comments (incl. % achievement)	Exceeded by 12%.			
Indicator 3 :	Number of drivers participating in the project training program			
Value (quantitative or Qualitative)	0	1200		3272
Date achieved	06/05/2010	06/09/2015		06/09/2015
Comments (incl. % achievement)	Exceeded by 173%.			
Indicator 4 :	Establishment of a Project website			
Value (quantitative or Qualitative)	0	1		1
Date achieved	06/05/2010	06/06/2011		06/06/2011
Comments (incl. % achievement)	Achieved. See: http://www.gdlshy.com/EnIndex.aspx			
Indicator 5 :	Indicator 5: Number of government officials and enterprise representatives trained through Project			
Value (quantitative or Qualitative)	0	160(g) 3000(e)		200(g) 3,000(e)
Date achieved	06/05/2010	06/09/2015		06/09/2015
Comments (incl. % achievement)	(g) = government - exceeded by 25% (e) = enterprise - Achieved			
Indicator 6 :	Organization and implementation of green freight trade fair			

Value (quantitative or Qualitative)	0	1		2
Date achieved	06/05/2010	06/05/2011		06/09/2014
Comments (incl. % achievement)	Exceeded by 100%.			
Indicator 7 :	Policy recommendations to address critical institutional and regulatory needs			
Value (quantitative or Qualitative)	0	Policy notes completed and submitted to the Provincial Government		Policy notes completed and submitted to the Provincial Government
Date achieved	06/05/2010	06/05/2015		06/05/2015
Comments (incl. % achievement)	Achieved. Three studies were conducted and their recommendations have been incorporated in the Guangdong 13thFive-Year Plan.			

G. Ratings of Project Performance in ISRs

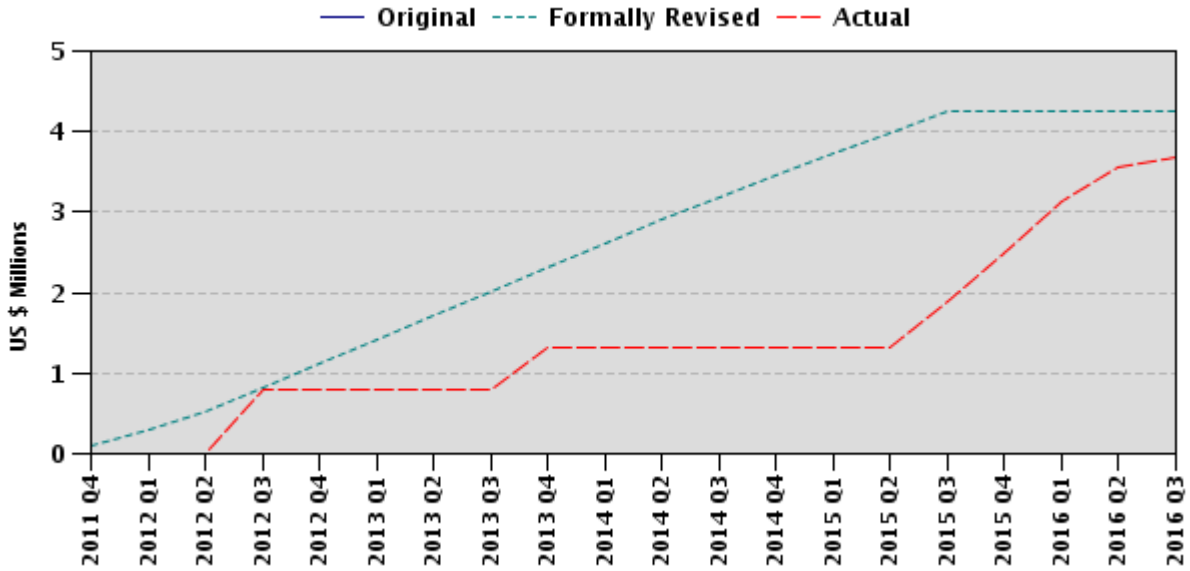
No.	Date ISR Archived	GEO	IP	Actual Disbursements (USD millions)
1	09/22/2011	Satisfactory	Satisfactory	0.00
2	11/12/2012	Satisfactory	Satisfactory	0.80
3	06/23/2013	Satisfactory	Moderately Satisfactory	1.32
4	12/21/2013	Satisfactory	Moderately Satisfactory	1.32
5	06/21/2014	Satisfactory	Moderately Satisfactory	1.32
6	12/13/2014	Satisfactory	Moderately Satisfactory	1.32
7	06/28/2015	Satisfactory	Satisfactory	2.48
8	12/09/2015	Satisfactory	Satisfactory	3.13

H. Restructuring (if any)

Restructuring Date(s)	Board Approved GEO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		GEO	IP		
12/18/2014		S	MS	1.32	(i) Extension of the Grant closing date by nine months, from March 31, 2015 to December 31, 2015; and (ii)reallocation of Grant proceeds among disbursement

Restructuring Date(s)	Board Approved GEO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		GEO	IP		
					categories.
12/05/2015		S	S	3.13	Reallocation of Grant proceeds among disbursement categories.

I. Disbursement Profile



1. Project Context, Development Objectives and Design

1.1 Context at Appraisal

Country, macroeconomic and sector background

1. At appraisal, China was responsible for up to 60% of the global increase in carbon emissions over ten years, and was among the world's largest emitters of greenhouse gases (GHG).[1] Recognizing the need to stem recent energy consumption trends and the impacts of that consumption – air pollution, greenhouse gases, and threats to energy security – the Chinese leadership announced at the Copenhagen climate negotiations in December 2009 an ambitious target of a 40 to 45% improvement in national energy efficiency from the 2005 levels by 2040. Leading up to and in support of this goal since 2005, the Government of China (GOC) adopted a series of laws and regulations to improve energy efficiency and mitigate GHG emissions, and established a series of national energy efficiency targets. For example, in 2008, the Ministry of Transport (MoT) committed to reduce road freight sector energy intensity from 2005 levels by 12% by 2015, and 16% by 2020. The transport sector was a significant energy consumer and a major source of GHG emissions in China. The sector comprised 30% of total national crude oil consumption in 2008 and emitted about 290 million tons of CO_2 in 2004. Further, GHG emissions from transport were expected to grow to 522 million tons and 1.108 billion tons by 2015 and 2030, respectively. Within the transport sector, road-based freight transport, which primarily includes trucks, accounted for 54% of total transport sector fuel consumption.[2]

2. Guangdong province had experienced a significant increase in freight traffic since the turn of the century. For example, total freight traffic tonnage moved by trucks increased by more than 125% since 2000. Over the same period, the provincial highway network grew at an average rate of 11% per year, and the number of registered trucks grew by 56%. Road-based freight accounted for 70% of transported goods in 2008. Despite the growing importance of this sector, energy efficiency in Chinese road freight transport, including in Guangdong Province, remained very low. One major challenge was truck technology. According to MOT's estimation, the fuel efficiency of Chinese trucks was about 30% lower than in Organization for Economic Co-operation and Development (OECD) countries. This was mainly because advanced fuel saving technologies and practices had not been widely adopted in China. This market failure occurred because: (a) the market lacked information on the performance, cost and availability of fuel efficient technologies; and (b) the lack of investment capital or credit lines for small companies.

3. The second obstacle to improved energy efficiency in this sector was logistics management. Similar to many industrialized countries, the trucking industry in China was largely operated by the private sector. The sector was fragmented and most companies were very small – often single truck owner operators. However, unlike other countries, there were no clear sector leaders in China (with at least 1% of road freight market) that could play a role in leading innovation and improvements in operational management. Lack of modern logistics brokerage made it difficult to share information and coordinate operations among carriers. As a result, there were a large number of annual empty back-haul kilometers (reported to be more than 30% of all

[1] Stockholm Environment Institute (SEI). November 2009. "*Going Clean – The Economics of China's Low Carbon Development*." Stockholm Environment Institute and the Chinese Economists 50 Forum.

[2] Ministry of Transport, September 25, 2008, *Medium and Long Term Plan for Energy Conservation in Road and Waterway Transport in China*.

freight vehicle-kilometers traveled) in Guangdong Province.

Rationale for Bank assistance

4. The project provided an opportunity for the Bank to work on a global environmental issue by improving the road freight transport sector in Guangdong and to demonstrate innovative technologies to improve fuel efficiency. The Bank's support for the pilot program was crucial to overcome the market failure associated with trucking companies investing in technologies for environmental benefits. The Bank was able to show that such investments also had commercial benefits, thereby creating a win-win situation. The Guangdong Transportation Department placed high priority on this project and spent much time communicating and coordinating with companies, which laid the foundation for the success of the project.

Higher-level objectives to which the project would contribute

5. The objectives of the Project were consistent with the Bank Group's China Country Partnership Strategy (CPS) for 2006-2010 (Report No. 35435-CN) discussed by the Board on May 23, 2006. Specifically, the project supports the third pillar "managing resource scarcity and environmental challenges," and the fourth pillar "deepen financial intermediation, by expanding access to financial services (especially among small and medium enterprises)."

6. The proposed project was also fully consistent with the GEF climate change focal area, specifically in terms of climate change mitigation, where GEF "supports projects that reduce or avoid greenhouse gas emissions in the areas of...energy efficiency, and sustainable transport." The project also supports the objectives of the GEF Technology Transfer Fund, as it facilitates broader application and deployment of innovative energy efficiency technologies in China.

1.2 Original Project Development Objectives (PDO) and Key Indicators

7. The Project Development Objectives (PDO) are to: (a) demonstrate the global and local environmental benefits of the application of energy efficiency vehicle technologies and operating techniques, and (b) support improving energy efficiency and reducing greenhouse gas emissions in the road freight transport sector in Guangdong.

8. The list of key performance indicators is in the data sheet.

1.3 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification

9. The PDO and the three Key Indicators were not changed. During implementation the initial targets were found to be inappropriate for assessing the performance of the project as the size of the participating trucks[3] changed. Both baselines and targets for outcome indicators required revision; however, they were not revised officially. See Annex 5 for details.

1.4 Main Beneficiaries

10. At appraisal, the project beneficiaries were expected to be: (a) more than 500,000 trucking companies (including individual truck owners and operators) registered in Guangdong Province seeking to reduce operating costs; (b) about 96.4 million residents in Guangdong

[3] At appraisal, it was anticipated that large trucks with the average baseline fuel consumption of 32 liters per 100 vehicle-km would participate in the pilot. However, most of the participating trucks were medium-sized, with much lower fuel consumption per vehicle-km.

Province (about 47.2 million of whom are women), particularly those living in urban areas (about 63% of the total population); (c) suppliers of energy efficient technologies; and (d) shippers (and enterprises that use carriers to transport their goods) seeking to reduce the carbon footprints of their businesses.

1.5 Original Components (as approved)

11. **Component 1: Green Truck Technology Demonstration.** This demonstration project facilitates communication and cooperation among energy efficient vehicle technology suppliers, freight carriers, freight shippers, and other key stakeholders, and provides project participants access to government and commercial financing, including the provision of financing of Green Freight Technology Rebates and Performance-Based Payments. Component activities include: (a) participation criteria development; (b) selection of eligible technologies; (c) supplier management (trade fair); (d) identification of certified suppliers and establishing initial contact; (e) incentives; (f) driver training curriculum development and implementation; and (g) vehicle monitoring and evaluation.

12. **Component 2: Green Freight Logistics Demonstration.** This demonstration conducts market studies for "drop-and-hook" [4] logistics methods and a proposed provincial logistics brokerage platform, and assists in demonstration exercises of such methods and platform through the provision of financing of Green Freight Technology Rebates and Performance-Based Payments. Component activities include: (a) logistics brokerage modernization study and pilot implementation; and (b) drop-and-hook study and pilot implementation.

13. **Component 3: Capacity Building.** This component provides technical advisory services for the preparation of green freight policy research papers, delivery of training for government officials and enterprise managers, and promotion of the Project and green freight development, including support to the Guangdong green freight websites. The component activities include: (a) green freight policy research; (b) training for government and enterprises; and (c) promotion of the project and green freight development.

14. **Component 4: Project Implementation Support.** This provides technical advisory services for Project implementation, stakeholder consultations, Project results evaluation and dissemination, as well as Project management.

1.6 Revised Components

15. Project components remained unchanged during implementation except for some changes in scope. Project outputs are summarized in Annex 2.

[4] "Drop-and-hook" is a term used in the trucking sector, referring to a type of freight operations that is able to drop a loaded trailer at the consignee, hook to an empty or loaded trailer and not have to wait for the first trailer to be unloaded live before leaving.

1.7 Other significant changes

16. **Change in scope of the logistics pilot.** Due to the rapid development of Guangdong's logistics sector, the Bank agreed to the Project Management Office's (PMO) request to modify the project scope. Instead of the PMO conducting studies to propose and design the pilot, the modified approach called for proposals from more than 10 logistics companies that had already participated in MOT's logistics demonstration program. Guangdong Lin'an Logistic Development Co. was the first to be selected to implement the logistics pilot. The Grant was used to upgrade the Lin'an logistics information platform, which includes online logistics transection, logistics management (planning, dispatching and supervising) and a mobile app for truck drivers. Because of strong enthusiasm from the logistics companies, an additional platform pilot was proposed by the PMO, approved by the Bank in April 2015,[5] and was implemented by Guangzhou CITIC Xintong Logistic Co. Ltd. Unlike the first platform which was designed for individual truck owners, the second platform was used to assist CITIC (one of the biggest logistics companies in Guangdong) in managing its drivers and fleets. The Grant was used to subsidize half of the truck driver's payment (US$16 per trip) in order to attract more users. The GEF fund for this sub-component was doubled and the total number of pilots and their cost increased approximately sevenfold, which was mainly financed by the participating enterprises.

17. **Change in scope of the drop-and-hook pilot**. The original design was to carry out a study and pilot testing to promote drop-and-hook in Guangdong. Not long after the project became effective, a nation-wide drop-and-hook testing was implemented under the "China Green Freight Initiative" that was announced by MoT. This subcomponent was modified, with the approval of the Bank, to improve management and information technology among the drop-and-hook enterprises in Guangdong Province. The participating enterprise (Guangzhou City Star Transport Company) was chosen to implement the pilot and received funding from central government and local government. They decided to use imported trailers instead of domestic trailers, which led to a nine fold cost increase; the additional cost was mainly financed by the government.

18. **Additional study on green freight sustainable development under "The Belt and Road Initiative**.*"* In 2013, President Xi Jinping announced "The Belt and Road Initiative"[6] with the stated aim of connecting major Eurasian economies through infrastructure, trade and investment. Since Guangdong is an important transport hub on the economic corridor, the PMO proposed a study on green freight sustainable development under "The Belt and Road Initiative" to assist Guangdong province in aligning its plans to the initiative. The Bank approved this study. As a result of the study, a set of policies and measures for sustainable green freight transport development in Guangdong Province was proposed.

19. ***Grant closing date extension and reallocation of Grant proceeds.*** In December 2014, the project underwent a Level II restructuring. The Grant closing date was extended by nine months to December 31, 2015 to allow for the completion of all agreed subprojects. Grant proceeds were reallocated among disbursement categories during the first restructuring and again in the second restructuring in November 2015.

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[5] World Bank, April 17, 2015, *Letter of No Objection to the Project Implementation Scheme of Intelligent Logistic Platform*. GTIDR

[6] "The Belt and Road Initiative" was later specified to contain two international trade connections: The land-based "Silk Road Economic Belt" and ocean-going "Maritime Silk Road."

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

20. **Soundness of background analysis.** The project benefited from sound background analysis. The sector and regional background, lessons from previous pilot testing, and government strategies were thoroughly studied and analyzed. The rationale for Bank intervention was strong, as discussed in Section 1.1. Several rounds of consultation with key stakeholders were completed at preparation. Government and the Bank adjusted the scope of the project based on the priorities of Guangdong Government and included a sub-component on improving logistics operation and management. A US SmartWay training was conducted for PMO staff on November 13, 2010 with experts from US Environmental Protection Agency (EPA). The Environment Management Manual was completed, cleared by the Bank, and disclosed on local websites as well as the Bank InfoShop website on October 10, 2010.

21. **Assessment of project design.** The project concept was highly innovative and the design was appropriate to achieve the PDO. The project was the first Bank-financed project to address the climate change impact of trucks. The project team developed an innovative, market-based business model, including a price rebate at the purchase of the technology and a performance-based award, and worked in partnership with public and private sector stakeholders. The project design also incorporated a strong capacity building component to facilitate the dissemination of results from on-going pilots, help government officials and manager learn good practices from other countries, and enhance capacity for policy making, investment planning and operational management.

22. A weakness in the project design was the design of the monitoring and evaluation (M&E) framework. Indicator 1 (fuel economy) was calculated based on the assumption that certain types of trucks would participate in the pilots; however, trucks that participated in the pilots were quite different. Indicator 2 (operating cost) was defined on data that were not available. Indicator 3 (CO_2e emission reduction) was wrongly calculated. In sum, the M&E framework should have considered the demonstration nature of the project and should have allowed for a more flexible M&E design.

23. **Borrower commitment and participatory processes**. Guangdong Government was strongly committed to the development of green freight as evidenced by the involvement of the secretary of Guangdong Communist Party of China (CPC) Committee and directors of various provincial level departments. A Project Leading Group (PLG) of senior officials from various relevant governmental departments - including DoT, Development and Reform Commission (DRC), Department of Finance (DoF), Department of Public Security, Environment Protection Bureau, and Economic and Information Commission - was established early on during project preparation, which enabled strong government support and coordination among the line departments. The PLG designated DoT as the leading agency for the preparation and implementation of the project.

24. **Assessment of project risks.** At appraisal, the overall risk of the project was rated medium likelihood, low impact. The most critical risks identified as design risk and delivery quality risk. To mitigate these risks, project preparation included intensive communication and collaboration among different stakeholders. This inclusive process was further enhanced during project implementation to obtain inputs from key stakeholders (including managers from trucking companies, logistics companies and technology vendors) on detailed design and project implementation. Further, the green technology demonstration only included technologies verified

by the US EPA SmartWay Program or similar national energy efficient trucking technology accreditation systems.

2.2 Implementation

25. **Green truck technology demonstration and early implementation delays**. The GEF grant became effective in August 2011 and the project was launched in October 2011. The green truck technology demonstration was the first to be implemented. Despite the promotional activities conducted by the PMO, most of the transport enterprises were unsure about the project at the beginning and were reluctant to participate. By the end of September 2012, only 145 trucks agreed to participate in the pilot. To avoid further delay, the Bank and the PMO decided to switch to a phased approach, with the Phase I pilot testing six technologies on the 145 participating trucks. The six technologies - low rolling resistance tires (LRRT)[7], roof fairings (RF)[8], tire pressure monitoring devices (TPMD)[9], side skirts (SS)[10], gap fairings (GF)[11], and driving behavior diagnose and operation monitoring system (DBDS)[12] - were all verified by US EPA. However, the installation and testing of the Global Positioning System (GPS) supported monitoring device encountered a number of unexpected technical problems and delayed implementation further. These unexpected events caused about a one-year delay in the implementation of the green truck technology demonstration. Phase I commenced in February 2013 and ended in February 2014.

26. **Mid-term review (MTR)**. During the June 2014 MTR, the slow implementation progress of the project was reviewed and it was agreed to extend the Grant closing date by nine months to make up for the lost time during the early implementation period. It was not until then that the issues with the original Results Framework became apparent. And the Bank advised the PMO to propose a modified Results Framework. However, due to the lengthy domestic procedures, the Bank received the request to modify Results Framework from Guangdong Government only in September 2015, i.e., three months before the Grant closing date. The Results Framework was therefore not revised. At MTR, a consultation workshop was also held with experts and key stakeholders to review the results of Phase I of the green truck technology demonstration and discuss the further development of green truck technology demonstration during Phase II. In addition, the Bank commissioned Clean Air Asia (CAA) to review the effectiveness and economics of green truck technologies and assess enterprise perspectives and the views of government agencies on green truck technology adaptability. The CAA study

[7] "Low rolling resistance tires", as the name suggests, reduce the rolling resistance of tires on the road and thus reduce fuel use.
[8] "Roof fairings" (an integrated air deflector mounted on top of the cab) are supposed to improve truck tractor aerodynamics and reduce aerodynamic drag (wind resistance).
[9] "Tire pressure monitoring devices" can reduce the rolling resistance of tires and thus have a good potential to reduce fuel use and emissions, but their success depends on proper installation of the system and instruction of the drivers on how to operate them.
[10] "Side skirts" (panels hang down from the bottom of a trailer to enclose the open space between the rear wheels of the tractor and the rear wheels of the trailer) are meant to reduce wind resistance underneath the trailer.
[11] "Gap fairings" reduce air turbulence by reducing the tractor-trailer gap.
[12] "Driving behavior diagnose and operation monitoring system" is a system for remotely tracking vehicle and driver behavior, which comprises an on-board vehicle monitoring device, a proximity sensor communicatively coupled with the on-board vehicle monitoring device, and a getaway device. It allows the driver's behavior to be monitored and analyzed, which can help reduce unsafe driving and improve fuel economy.

concluded that only three of the six technologies were effective, namely LRRT, RF and DBDS. Further, the Study and stakeholder workshop recommended: (a) ensuring the selection of most appropriate technologies for carriers' fleets; (b) providing better assistance for new technology applications; and (c) improving the consistency and accuracy of data monitoring, analysis and reporting. Based on these recommendations only the three proven technologies from Phase I were to be applied in Phase II; in addition, light-weighted semi-trailers (LWST)[13] were added to test their energy savings potential. The PMO's dissemination of the Phase I pilot improved awareness of the energy efficiency technologies among trucking companies; as a result, the number of participating trucks for the Phase II demonstration increased substantially to 1,204 trucks from 11 companies.

27. **Green freight logistics demonstration**. Implementation of this demonstration was delayed due to the changes in scope described in Section 1.7. Lin'An Logistics Company was chosen in June 2013 as the first pilot company. The first pilot was conducted from July 2014 to May 2015. The logistics information platform developed by Lin'An Logistics Company registered about 200,000 shippers and 1.8 million drivers. Over 50,000 trades are observed on the platform daily. The logistics information platform includes online logistics transection, logistics management (planning, dispatching and supervising) and a mobile app for truck drivers. Based on the M&E report, 42.36 million ton-km freight turnover volume was loaded using the information platform, which accounts for 92.1% of the total turnover. The average waiting time for loading using the mobile app was 7 hours, which was 56.8% shorter than the previous waiting time (16.3 hours). The evaluation concluded that the information platform and the mobile app contributed to a 4% fuel efficiency gain, resulting in 4.54 million liters of fuel savings and 12,100 tons of CO_2e reduction. To further promote the use of the logistics platform and to attract more users, CITIC Logistics Company was chosen in March 2015 as the second pilot company. The pilot lasted from May 2015 to September 2015 and more than doubled the number of registered drivers using the platform. Based on the M&E report, the fuel efficiency gain was 4.15%, which translated to a total of 10.92 million liters in fuel savings and 29,200 tons of CO_2e reduction. Both logistics platform pilots have demonstrated significant benefits in fuel saving and GHG emissions reduction.

28. The pilot company for the drop-and-hook technology demonstration was selected in April 2014 and the information system was upgraded in September 2014. The entire process of drop-and-hook operation was managed and monitored through the information system, which greatly improved the efficiency of the participating trucks. The pilot started in September 2014 and was completed in April 2015 with 54 truck tractors and 120 semi-trailers operating on three trucking routes (Foshan-Shanghai, Foshan-Beijing and Foshan-Wuhan). According to the M&E report, the fuel economy was between 1.170~1.242 L/ton-100 km for the three trucking routes, compared to baseline values between 1.233~1.314 L/ton-100 km, thus achieving a 4.52% fuel efficiency gain. The total reduction in fuel consumption was 41,000 L and the total CO_2e emissions reduction was 108.4 tons

29. **Project restructuring**. Project implementation experienced some delays early on, but picked up pace quickly. To facilitate implementation, the project was restructured in December 2014 to: (a) extend the Grant closing date by nine months from March 31, 2015 to December 31,

[13] "Light-weighted semi-trailers" are aluminum trailers that can reduce empty truck weight, improve fuel efficiency, and reduce GHG emissions.

2015; and (b) reallocate Grant proceeds among disbursement categories.[14] The project was restructured again in November 2015 to reallocate Grant proceeds among categories. Such project restructuring facilitated the achievement of the PDO and effective utilization of Grant proceeds.

30. **Utilization of GEF Grant.** At Grant closing US$0.5 million (11.9% of the original Grant) was undisbursed. As detailed in Annex 1, the majority of the savings was from undisbursed incentive payments. This is because: demonstration technology packages implemented varied from those envisaged at appraisal; and in Phase II only three proven technologies were demonstrated, which further reduced utilization of the Grant. Despite its small size, the GEF Grant was a catalyst to significant development impact and successfully leveraged US$8.02 million of private sector investment and US$11.47 million of government funds. The project has been responsible for initiating a number of other new initiatives in the sector, including a similar green freight initiative in Brazil and the "China Green Freight Initiative" led by MoT, CAA and China Road Transport Association.

2.3 Monitoring and Evaluation Design, Implementation and Utilization

31. **Design.** As mentioned in Section 2.1, Assessment of Project Design, the M&E framework was weak. All three PDO indicators measure achievement in absolute values, which proved to be too rigid during implementation. The design of the result framework should have been more flexible to incorporate changes that often occur during a demonstration project. It would have been better if the Results Framework had used relative values (percentages) to measure improvement in efficiency gains and fuel economy. In addition, an indicator was defined on data that were not available and others were wrongly calculated. On the other hand, there was no indicator to measure the impact of local pollutants, such as NOx, SOx, and other emissions that may not be directly related to fuel consumption. Finally, the causal links between the PDO and the PDO-level indicators were somewhat weak. For a demonstration project, the focus should have been on the demonstration effect of the project rather than the fuel saving potential of each technology/operating technique. Alternative indicators, such as "number of green truck technologies demonstrated", "number of trucking companies willing to adopt the green truck technologies", and "number of registered drivers using the logistics platform" would have provided a more meaningful indication of the results of the demonstration.

32. **Implementation.** A team from Guangdong University of Technology was hired as a third-party to monitor implementation and evaluate the effectiveness of the demonstrations of the green truck, drop-and-hook, and brokerage platforms. Monitoring was mainly for participating trucks in fuel consumption and related driving behaviors. The monitoring was carried out in two stages – baseline data were collected during the preparation period and monitoring data were collected during the demonstration period.[15] Issues with the Results Framework became apparent during the last year of the project implementation at the time of evaluating the achievements of

[14] World Bank. December 18, 2014. Letter to Ministry of Finance: "*GEF Guangdong Green Freight Demonstration Project (GEF TF099076) – Amendment to the GEF Grant Agreement*". Beijing

[15] The demonstration periods for the Green Truck Demonstration were September 2013 – February 2014 for Phase I, September 2014 – June 2015 for Phase II; September 2014 – April 2015 for the Green Logistics Demonstration; May 2015 – September 2015 for the Smart Cloud System; and September 2014 – May 2015 for Li'an Logistics Information System.

the project. The PMO found it difficult to report and evaluate results against the targets; as such, the PMO collected baseline and target data on trucks that participated in the pilots and evaluated and reported on project outcome indicators.

33. **Utilization.** Although the original Results Framework was flawed, monitoring and evaluation still proved to be strong tools to support project management and decision-making. Because of the initial low response from trucking companies to participate in the technology demonstration, the pilot was conducted in two phases. CAA carried out an independent evaluation to assess the energy efficiency of the six technologies piloted in the first phase, which led to a sharpened design of the Phase II pilot. The green freight website established to support the project is still maintained by DoT. The internal website enables staff to access a database of all registered trucks in the province, which was used as an on-line management and monitoring platform and M&E system by the project management team. The external website provides relevant industry laws and regulations, news, information about green technologies, and information on the Project. Technology vendors and trucking companies could also access the on-line application system to submit applications to participate in the project. DoT intends to expand the websites to cover all green freight activities to be undertaken by the Department and has set aside a separate budget for on-going maintenance and operations.

2.4 Safeguard and Fiduciary Compliance

Rating: **Satisfactory**

34. **Social safeguards**. At appraisal, it was assessed that the project would have positive social impacts in Guangdong Province. Project implementation was not envisaged to impact ethnic minority communities and would not involve relocation of people or land acquisition. The key stakeholders were consulted through expert consultations, questionnaires, symposia, and interviews. During implementation, the project did not involve land acquisition or relocation of people and did not generate negative impacts on ethnic minority communities.

35. **Environment safeguards**. At appraisal, the project was classified as Category C because only minimal adverse environmental impacts were envisaged. An environmental screening was conducted, which concluded that the project would bring significant positive environmental impacts, including reduction of greenhouse gases. The Environmental Management Manual (EMM) was prepared to provide guidance to the PMO for managing environmental issues. Preventive and mitigation measures, monitoring measures, and training required during implementation and operation were also identified in the EMM to either eliminate negative impacts or minimize impacts to an acceptable level. The EMM was disclosed at the websites of the PMO and the relevant government agencies in October 2010. It was also disclosed at the Bank Beijing Office website and the InfoShop in Washington, D.C. on October 10, 2010. During project implementation the EMM was adhered to.

36. **Financial management (FM)**. At appraisal the financial management capacity assessment concluded that the project's financial management arrangements would satisfy the Bank's minimum requirements under OP/BP 10.02. Actions to strengthen FM capacity were agreed upon with the relevant implementing agencies. During implementation, the project FM system was continuously maintained by the PMO through closing. Guangdong Government allocated sufficient counterpart funding to the project in a timely manner. Project accounts were

audited by the Guangdong Provincial Audit Office annually [16] and the audit reports were submitted to the Bank on time; the Bank found the audit reports to be acceptable. Overall project FM performance was Satisfactory and the Bank's FM requirements were complied with.

37. **Procurement and contract management**. The PMO was responsible for preparing the procurement plan and for procurement. The procurement capacity assessment at appraisal concluded that the PMO had adequate experience and capacity to carry out project procurement. Measures to further strengthen the PMO's procurement capacity were agreed upon. All procurement activities were documented in the Procurement Plan, which was cleared by the Bank at appraisal. A procurement agent was hired to assist the PMO in procurement. Contracts financed by the enterprises were procured by the enterprises themselves. The project procurement plan was updated several times based on changes in procurement requirements. Procurement for activities funded by the Grant were carried out in compliance with Bank procurement guidelines. Procurement under the project is rated Satisfactory.

2.5 Post-completion Operation/Next Phase

38. To ensure the sustainability of project results, an innovative financing mechanism has been put in place to mobilize more funds from the private sector to enable more enterprises to adopt green trucking technologies. An "Agreement on Cooperation for Green Freight Development in Guangdong" was signed between the Industrial Bank and DoT to mobilize funds from commercial financing institutions for future wide application of energy efficiency technologies in the trucking sector. Guangdong Government will continue to mainstream green freight in the province to tackle energy efficiency, air quality and climate change issues in the road freight sector.

39. Guangdong will be a part of the proposed next GEF project, which will focus on freight logistics and will be applied on a larger scale in Guangdong. The PMO will continue to be the project management entity for the proposed next GEF project. The green freight website established under the project will continue to serve as a technology dissemination platform where Guangdong Government can test, ratify and promote fuel-saving technologies, and thus encourage the further development of new technologies.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

Relevance of objectives

Rating: **High**

40. Project objectives of improving energy efficiency and reducing greenhouse gas emissions in the road freight sector remain highly relevant and consistent with the government's priorities set out in China's 13th Five-Year Plan (2016-2020), which addresses the on-going challenge of natural resource depletion and environmental pollution, and gives greater prominence to low-carbon transport. The PDO is also in line with the Bank Group's China CPS for 2013-2016. Under the strategic theme of supporting greener growth, the CPS includes the objectives of "improving transport efficiency through city-specific transport investments" and "piloting institutional and technological innovations that have potential for scale up in cities throughout

[16] The first financial audit report was for two years, 2010 and 2011. Audit reports for 2012–2014 were by prepared annually.

China" as part of promoting low-carbon urban transport. The objectives set for the project placed an aspirational tone drawing attention to green development in the freight and logistics sectors in China. In a regional context, this focus remains highly relevant for the priorities of Guangdong Province, as it is an important transport hub under "The Belt and Road Initiative." Guangdong Province has placed great prominence on improving energy efficiency in the transport sector in its 13th Five-Year Plan. In addition, the project remains highly relevant to the current global efforts to tackle climate change under the COP21 UN Conference on Climate Change and to the Bank's commitment to increase climate financing from the current 21% of its portfolio to 28% by 2020.

Relevance of design and implementation

Rating: **Substantial**

41. As indicated in Section 2.1, project design focused on activities essential to the achievement of the PDO. The design of Component 1 (Green Truck Technology Demonstration) allowed different energy efficient technologies and a variety of technology packages to be tested in the pilot program. The phased implementation also allowed a sharpened design of Phase II, based on the results of Phase I. Project design offered flexibility to adapt to new situations as they emerged. Activities under Component 2 (Green Freight Logistics Demonstrations) were modified to assist Guangdong in aligning its plans to the nationwide "China Green Freight Initiative" launched by MoT. However, as discussed in Paragraph 31, the Results Framework was not appropriate to measure the achievement of the PDO.

3.2 Achievement of Project Development Objectives

Rating: **Substantial**

42. The PDO related to "***demonstrate the global and local environmental benefits of the application of energy efficiency vehicle technologies and operating techniques***" was measured by the three PDO indicators that were largely achieved. The project piloted seven US EPA verified vehicle technologies (LRRT, RF, TPMD, SS, GF, DBDS, and LWST) and three operating techniques. Among these, LRRT, RF and DBDS from the Phase I pilot performed the best with 3.91%, 2.86% and 2.65% fuel savings, respectively. LWST, the additional technology piloted in Phase II, achieved a fuel efficiency gain of 5.88%. These fuel savings translated into a significant reduction in GHG (826 ton CO_2e during the pilot period and 8,662 ton CO_2e in 8 years – which is the typical life span of a truck in China) and could have tremendous global and local environmental benefits.

43. Three low-carbon logistics operating techniques were also piloted through two logistics platform pilots and a drop-and-hook pilot. Each technique achieved fuel savings of 4% - 5%. The project also included a strong public education and outreach component. The green freight website was established to provide better information on the performance of proven energy efficiency technologies. A series of training programs, workshops and symposiums were organized to advertise and promote green freight concepts. Over 3,200 truck drivers, a significant number of managers in logistics enterprises, and government officials in the freight and logistics sectors received training. The project demonstrated to them that significant fuel savings and GHG emission reduction could be obtained from a relatively low-cost investment.

44. The PDO related to "***support improving energy efficiency and reducing greenhouse gas emissions in the road freight transport sector in Guangdong***" was fully achieved as well. The fuel savings rates were 3.3% on average for green truck technologies and 4.1% for operating techniques. The total GHG emission reduction generated directly from the demonstration during the project period was estimated to be over 42,000 tons. The project resulted in a strong

demonstration effect, as all participating enterprises intend to use LLRT to replace old tires. S.F. Express, a pilot participant and a leading enterprise in the express industry, plans to install DBDS in some 7,000 trucks. RF has been installed in almost all new trucks in Guangdong. The use of the logistics platform has on average shortened the waiting time for loading by 56.8% from 16.3 hours previously to 7 hours. The recommendations from three studies under the capacity building component have been incorporated in the Guangdong 13th Five-Year Plan.

3.3 Efficiency

Rating: **Substantial**

45. An incremental cost analysis was carried out at appraisal. The main benefits of the project come from improving fuel efficiency of Project vehicles, thus lowering fuel costs and reducing GHG emissions. The ICR assessed the project's efficiency based on the cost effectiveness of the GEF Grant for fuel savings and CO_2 emission reduction.

46. **Cost effectiveness of the GEF grant for emissions reduction.** The short-term net benefits from fuel savings from Component 1 and Component 2 combined were about US$61.2 million (see Annex 3 for details), almost three times the total project cost. The project reduced CO_2 emissions by 161,430 tons at a GEF grant cost of US$23 per ton, which is much higher than the US$3.5 per ton estimated at appraisal; see paragraph below for a discussion of the reasons. However, the project compares well with the other GEF projects in China, e.g., the GEF City Cluster Eco-Transport Project, where the GEF contribution per ton of CO_2 directly reduced is US$24.5.

47. Energy efficiency improvements from the application of the seven technology packages are in the 1-6% range, which is much smaller than the appraisal estimate of 7-26%t. This is because trucks in the Guangdong pilot did not reach average speeds of 75 km/hour or above for the aerodynamic fairings/trailer skirts to achieve their fuel saving potentials. At lower speeds, the added weight of fairings/skirts offset fuel savings from reduced drag. The reasons for the failure to achieve the average speeds under the pilot (compared to the average speeds in the US) are speed limits on roads, traffic congestion, and road pavement conditions. The demonstration highlighted the important point that the technologies verified by the US EPA SmartWay were unable to produce the same benefits in Guangdong.

48. **Leveraged private sector investment.** In addition to the fuel savings and CO_2 reductions discussed above, an intermediate outcome was the total private sector investment leveraged through the project. The Grant successfully leveraged US$8.02 million of private sector investment (eight times the estimated amount at appraisal), the major portion of which came from the two logistics companies that implemented the logistics platform pilots and the trucking company that implemented the drop-and-hook pilot. This is mostly due to the increased awareness of the benefits of energy efficiency technologies and operating techniques, as well as Guangdong's efforts in mainstreaming energy efficient practices in the freight and logistics sector.

49. **Administrative efficiency**. As discussed in Section 2.2, the slow start up and delays resulted in the Grant closing date requiring an extension of nine months. Further, as shown in Annex 1 (and as discussed above), while the Grant leveraged both government funds and private sector contributions much more than envisaged at appraisal, about 12% of the GEF Grant itself was unutilized at Grant closing.

3.4 Justification of Overall Outcome Rating

Rating: **Satisfactory**

50. The overall outcome of the project is rated Satisfactory. Relevance of the PDO was high and the relevance of design at appraisal and through implementation was substantial. The PDO was achieved and the efficiency of the project was substantial. Additional evidence from project monitoring shows a strong trend of private enterprises adopting green truck technologies as a direct result of the demonstration effect of the project.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

51. The project did not specifically aim to alleviate poverty, but it is well known that the urban poor suffer more from poor living environments, so they are likely to have benefited most from improved local air quality. Emission reductions benefited all people in Guangdong Province, including women who constitute 47.9% of the population. Most truck drivers are low-income and improved air quality of trucks is a direct health benefit for truck drivers. However, no monitoring program was designed and implemented to track social impacts and changes in the project area.

(b) Institutional Change/Strengthening

52. Over 200 PMO staff and other government officials were trained in project management, green truck technologies, logistics platforms, and drop-and-hook logistics operations. Studies included in the capacity development programs assisted the government in making and implementing logistics development policies and plans. Training programs and study tours provided substantial opportunities for government staff and managers of logistics enterprises to learn advanced technologies and international good practices in green freight and logistics development. Under the guidance of the Bank, standardized management and operational procedures, regulations, and manuals were developed and used, which have increased (and will continue to increase) the government's capacity to administer and manage logistics sub-sector development in Guangdong Province.

(c) Other Unintended Outcomes and Impacts

Not applicable.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

53. No beneficiary surveys or stakeholder workshops were conducted during or after project implementation. However, the project had several rounds of outreach activities with logistics enterprises and truck drivers, as well as other stakeholders. The project organized four working conferences, two trade fairs, training programs for managers and drivers, as well as substantial promotion, coordination, and public consultation activities. These activities provided opportunities for an interactive exchange of ideas among stakeholders and provided a platform for disseminating project achievements. The project wrap-up conference was held on December 18, 2015 with more than 100 participants from international organizations, related provincial government agencies, and representatives from logistics enterprises in Guangdong Province.

4. Assessment of Risk to Development Outcome

Rating: **Low**

54. There is little doubt that Guangdong will continue to build low carbon transport systems, especially in the freight sector. Guangdong has set targets for reducing energy intensity and CO_2 emissions of trucks by 18% and 20%, respectively, by 2020. The promotion of green truck technologies and logistics platforms has been widely endorsed by Guangdong Government as the effective approach to tackle energy efficiency, air quality and climate change issues in the road freight sector. One particular concern was the lack of a financing structure for private trucking companies to adopt energy efficiency technologies after the project. This risk has been mitigated through an innovative financing mechanism, whereby the Industrial Bank mobilizes funds from financial institutions for wide application of energy efficiency technologies in the freight sector.

5. Assessment of Bank and Recipient Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry

Rating: **Moderately Satisfactory**

55. To ensure an innovative and quality project design, the Bank mobilized a wide array of global expertise from the world's leading green energy organizations (US EPA SmartWay Program, CAA, Energy Foundation) for project design, and developed the project concept jointly with the Guangdong Government. The Bank committed substantial effort and time to prepare this highly innovative project. The project facilitated an innovative market-oriented incentive-based intervention that: (a) provides trucking companies concessional finance to adopt fuel-saving technologies; and (b) creates a technology dissemination platform where government can test, ratify and promote fuel-saving technologies, and thus encourage innovation. The background analysis was sound, as previously mentioned in Section 2.1. The relevance of the PDO was high and the risks were assessed realistically. During preparation, the Bank provided substantial training on fiduciary arrangements, financial and procurement procedures, environmental and social safeguards, and technical considerations. A weakness in project design was the inadequate Results Framework, as discussed in Section 2.3. On balance, the Bank's performance in ensuring quality at entry is rated Moderately Satisfactory.

(b) Quality of Supervision

Rating: **Satisfactory**

56. During the four and half years of implementation, the Bank undertook 10 implementation support missions between September 2011 and November 2015. The Bank retained a strong task team for the project and ensured high quality project design and implementation. The Bank closely supervised implementation progress, actively identified and helped to resolve problems, and effectively ensured compliance with Bank policies. The slow momentum at project start was quickly identified as resulting from low awareness and response from trucking companies. The Bank guided the implementing agencies to quickly develop a set of remedial measures, e.g., adopting a phased approach, providing additional awards, and expanding outreach programs to interest more private trucking companies in participating in the pilots. The decision to adjust the

scope of the green logistics demonstration component was sound and allowed the project to effectively utilize the GEF grant.

57. The MTR was held on schedule in June 2014 to evaluate the performance of the Phase I technology pilot, and adjustments were made subsequent to the project. Government requests to restructure the project, including extending the Grant closing date and reallocation of Grant proceeds were processed in a timely manner. As discussed earlier, issues with the original Results Framework became apparent only at MTR and could not be resolved.

58. Supervision reporting (aide memoires, management letters, and ISRs) was sufficiently detailed and correctly identified the issues and solutions. Fiduciary and safeguards aspects were supervised well through desk reviews and implementation support missions. The Bank worked closely with Guangdong Province on post-completion operations and in the development of the proposed follow-on GEF activities in the Province.

59. Overall, the quality of Bank supervision is rated Satisfactory.

(c) Justification of Rating for Overall Bank Performance

Rating: **Moderately Satisfactory**

60. The Bank's overall performance is rated Moderately Satisfactory based on the ratings for Bank Performance in Ensuring Quality at Entry (moderately satisfactory) and Quality of Supervision (satisfactory).

5.2 Recipient Performance

(a) Government Performance

Rating: **Satisfactory**

61. Guangdong Government demonstrated strong commitment to the PDO and initiative during project preparation and implementation. A PLG and a PMO were established early on during preparation, which enabled strong government support and coordination among line departments. During implementation, the Government provided the necessary support to solve key issues, as required. The Department of Public Securities provided support by giving special permission for truck retrofit (GF, RF and SS) for the purpose of demonstrating aerodynamic technologies. Other government agencies, such as Economic and Information Committee, Development and Reform Commission, and Finance Department were also supportive of the relevant parts of the project to enable the project to be successfully implemented. The government not only provided the initially envisaged counterpart funding of US$2.37 million but also supplemented it with over US$9 million of additional funds to fully leverage the GEF Grant. The overall performance of the government is rated Satisfactory.

(b) Implementing Agency or Agencies Performance

Rating: **Satisfactory**

62. The PMO established under DOT was the main agency for coordination of project implementation. It had strong staffing during project preparation and implementation with experienced staff who had previously worked on Bank projects. When early implementation

encountered challenges, the PMO made substantial efforts to raise awareness by expanding outreach activities. The PMO then worked actively with the participating enterprises and conducted training for truck drivers and company managers. The workshops and training programs organized by the PMO were successful in disseminating green transport concepts and the demonstrated technologies. The PMO also gained significant experience in implementing a demonstration project and increased its capacity to manage logistics development. Project accounts were properly managed and audited, and all required project reports were submitted to the Bank on time. The PMO ensured that the project complied with Bank procurement guidelines and safeguard policies and also facilitated Bank missions capably. The overall implementing agency performance is rated Satisfactory

(c) Justification of Rating for Overall Recipient Performance

Rating: **Satisfactory**

63. Based on the above ratings for government performance and implementing agency performance, the overall performance of the grant recipient is rated Satisfactory.

6. Lessons Learnt

64. **Results Framework should be clear, measurable and flexible**. The design of the Results Framework should ensure that data is available and the values are properly assessed. The Results Framework should also be flexible and be able to adapt to changed circumstances. Rather than having indicators based on absolute values of fuel saved and GHG emissions reduced, it would have been preferable to have used percentage changes as the project targets. The M&E system should also provide the information necessary to adjust project parameters in response to changing circumstances and results and to support future evaluations and impact assessment.

65. **Strong government leadership is key to successful implementation, especially for demonstration projects.** From the Secretary of Guangdong CPC Committee to the Director General of Guangdong DoT, the leadership of Guangdong placed a high priority on this project and spent much time coordinating among line departments and resolving any issues encountered during preparation and implementation. Such strong leadership, vision, and enthusiasm from senior management within Government was a key to the successful outcome of the project and should be a prerequisite for such demonstration projects.

66. **The design of a demonstration project should be flexible and include a strong outreach component**. Given the innovative nature of this demonstration project, awareness of energy efficient truck technologies was low at the beginning. The project included a strong public education and outreach component, including detailed information on energy efficiencies and cost savings, which were targeted at trucking companies and shippers in Guangdong, as well as major technology vendors. The successful outreach program increased number of trucks participating in the Phase II demonstration. Project activities were not rigidly defined at appraisal, which offered flexibility to adopt a phased approach, add new activities, and sharpen the design as new situations emerged.

7. Comments on Issues Raised by Borrower/Implementing Agencies

(a) Borrower/implementing agencies

67. The Borrower ICR is summarized in Annex 6. In view of the Bank's ICR, Guangdong

Province provided the following comments:

68. Thanks for the Bank's positive evaluation and high ratings on the grant recipient (including the government and the implementing agency). We agree with your evaluation and ratings. For the future projects, we concluded the following suggestion:

69. **Strengthen the dissemination and promotion of green freight.** Green freight requires not only the joint effort of the government, the associations and the enterprises of the transport sector, but also the active participation of the whole society. It is suggested that the project implementing agency fully utilize the sector associations, non-governmental organizations and news media in the follow-on projects, to widely disseminate and promote the project concepts, ensuring the public is aware of the importance of green freight to the energy conservation and emission reduction, and allowing people to actively support and participate in green freight.

(b) Cofinanciers

Not applicable.

(c) Other partners and stakeholders

Not applicable.

Annex 1. Project Costs and Financing

(a) **Project Costs by Components** (in USD million equivalent)

Components	Appraisal Estimate	Actual	Percentage of Appraisal
Component 1: Green Truck Technology Demonstration	9.81	2.27	23%
1.1 Trade fair	0.15	0.22	147%
1.2 Incentive payment	9.34	1.88	20%
1.3 Driver training	0.07	0.01	9%
1.4 Vehicle monitoring equipment	0.15	0.06	42%
1.5 Vehicle monitoring and evaluation	0.10	0.10	100%
Component 2: Green Freight Logistics Demonstration	1.90	18.03	949%
2.1 Logistics brokerage study and demonstration	0.54	4.44	822%
2.2 Drop-and-hook operation study and demonstration	1.36	13.59	1000%
Component 3: Capacity Building	1.65	1.87	114%
3.1 Green freight policy research	0.09	0.09	100%
3.2 Government and enterprise management training	0.25	0.35	138%
3.3 Project website	1.16	1.20	104%
3.4 Project promotion	0.15	0.16	108%
3.5 “One belt one road" strategy study	0.00	0.07	-
Component 4: Project Management	0.56	1.01	180%
4.1 Technical advisory and quality assurance	0.10	0.00	0%
4.2 Technical assistance for implementation of Green Truck Technology component	0.06	0.06	100%
4.3 Procurement agent	0.05	0.05	99%
4.4 Project completion report	0.01	0.04	409%
4.5 Evaluation and dissemination workshop	0.05	0.02	49%
4.6 PMO incremental operation cost	0.29	0.83	287%
Contingency	0.06	0.00	0%
Total Project Cost	**13.97**	**23.18**	**166%**

(b) Project Financing (in USD million equivalent)

Source of Funds	Appraisal Estimate	Actual/Latest Estimate	Percentage of Appraisal
Global Environment Facility (GEF)	4.20	3.71	88%
Government	2.37	11.47	483%
Enterprise	7.41	8.02	108%
Total Financing Required	**13.97**	**23.21**	**166%**

Annex 2. Outputs by Component

Appraisal Plan	Actual Outputs
Component 1: Green Truck Technology Demonstration	
Facilitating communication and cooperation among energy efficient vehicle technology suppliers, freight carriers, freight shippers, and other key stakeholders, and enabling project participants access to government and commercial financing, including the provision of financing of Green Freight Technology Rebates and Performance-Based Payments. Component activities include: (a) participation criteria development, (b) selection of eligible technologies, (c) supplier management (trade fair), (d) identification of certified suppliers and establishing initial contact, (e) incentives, (f) driver training curriculum development and implementation, and (g) vehicle monitoring and evaluation.	All planned activities were carried out and the expected outputs were largely achieved. Key outputs include the following: - **Phase I.** 10 pilot trucking companies with 145 trucks demonstrated six energy efficiency technologies that were verified by the US EPA SmartWay Program (low resistance tire, roof fairing, side skirt, gap fairing, tire pressure monitor, and energy efficient driving system). Monitoring data showed that LRRT performs best with 3.91% fuel saving when applied on heavy-duty trucks, while RF and DBDS performed best with 2.86% and 2.65% fuel saving when applied on large trucks. - **Phase II.** 11 pilot trucking companies with 1,200 trucks demonstrated three proven technologies (low resistance tires, roof fairing and energy efficient driving system). In addition to the top three fuel saving technologies, light weighted semi-trailer (LWST) was also applied to demonstrate its fuel saving efficiency. Results showed that LWST applied on heavy-duty trucks was the best single energy efficiency with 5.88% fuel saving. Phase I and II pilots achieved a total of 289,382.1L fuel savings and 784.74 ton of CO_2e emissions reduction. - **Pilot truck upgrading financing mechanism.** A pilot truck upgrade financing mechanism was proposed by the Bank and was developed under a separate World Bank AAA project to mobilize funds from commercial financing institutions for wide application of energy efficiency technologies in the trucking sector. The Industrial Bank worked out the details with the trucking companies, technology vendors and the relevant government agencies. An "Agreement on Cooperation for Green Freight Development in Guangdong" was signed between the Industrial Bank and DoT for future truck upgrading financing. DoT is committed to sustaining green freight and logistics practices by mobilizing more funds from the private sector to enable more enterprises to adopt green trucking technologies. - Two green freight **trade fairs** were organized in 2011 and 2014. - More than 3,000 truck drivers were trained in Guangdong.
Component 2: Green Freight Logistics Demonstration	
Conducting market studies for drop-	Due to the rapid development of the logistics sector in Guangdong, the planned activities were modified to suit the

and-hook logistics methods and a proposed provincial logistics brokerage platform, and assisting in demonstration exercises of such methods and platform through the provision of financing of Green Freight Technology Rebates and Performance-Based Payments. The component activities include: (a) logistics brokerage modernization study and pilot implementation and (b) drop and hook study and pilot implementation.	emerging situation. Details of changes in scope were described under Section 1.6. Key outputs, and include the following: - **Two logistics platform pilots.** The logistics information platform developed by Lin'An Logistics Company registered about 200,000 shippers and 1.8 million drivers. Over 50,000 trades are observed on the platform daily. The logistics information platform includes online logistics transection, logistics management (planning, dispatching and supervising) and a mobile APP for truck drivers. Based on the M&E report, 42.36 million ton-km freight turnover volume was loaded using the information platform, which accounts for 92.1% of the total turnover. The average waiting time for loading using the APP was 7 hours, which was 56.8% shorter than the previous waiting time (16.3 hours). The evaluation concluded that the information platform and the mobile APP contributed to a 4% fuel efficiency gain, resulting in fuel savings of 4.54 million liters and 12,100 tons of CO_2e reduction. The second logistics platform was developed by CITIC Xintong Logistics Company. The grant was used to subsidize half of the truck driver's payment (US$16 per trip) in order to attract more users. The pilot more than doubled the number of registered drivers using the platform. Based on the M&E report, the fuel efficiency gain was 4.15%, which translates to a total of 10.92 million liters in fuel saving and 29,200 tons of CO_2e reduction. Both logistics platform pilots have demonstrated significant benefits in fuel savings and GHG emission reduction. - **Drop-and-hook pilot.** Guangzhou City Star Transport Co., Ltd was selected to be the pilot company. The entire process of drop-and-hook operation was managed and monitored through the information system, which greatly improved the efficiency of the participating trucks. According to the M&E report, the fuel economy was between 1.170~1.242 L/ton-100km for the three trucking routes (Foshan-Shanghai, Foshan-Beijing and Foshan-Wuhan), compared to a baseline value between 1.233~1.314 L/ton-100km, achieving a 4.52% fuel efficiency gain. The total reduction in fuel consumption was 41,000 L and the total CO_2e emissions reduction was 108.4 tons.
Component 3: Capacity Building	
Provision of technical advisory services for the preparation of green freight policy research papers, delivery of training for government officials and enterprise managers, and promotion of	All planned activities were substantially carried out and the expected outputs were largely achieved. Key outputs include the following: - **Green freight website and logo.** A green freight website (internal and external) was established to support the project. The internal website enables staff to access a database of all registered trucks in the province, which was used as an on-line management and monitoring platform and M&E system by the project management

the Project and green freight development, including support to the Guangdong green freight websites. The component activities include: (a) green freight policy research, (b) training for government and enterprises, and (c) promotion of the project and green freight development.	team. The external website provides relevant industry laws and regulations, news, information about green technologies, and information about the Project. Technology vendors and trucking companies could also access the on-line application system to submit applications for participating in the project. DoT intends to expand the websites to cover all green freight activities to be undertaken by the Department and it has set aside a special budget for on-going maintenance and operations. A green freight logo was designed and displayed on the website, project documents, various project activities including training, workshops, conferences and exhibitions. - **Policy studies and research.** Two research programs were conducted, which resulted in three reports, namely Green Freight Policy Research, Green Freight Policy Proposal, and Promotion and Sustainable Development Plan of Green Freight. All three reports were submitted to Guangdong Government on December 1, 2013 as policy recommendations. An additional research topic was added to the original project design, which was the Sustainable Development Research on Green Freight of Guangdong Province under Chinese Strategy of "The Belt and Road" initiative. As "The Belt and Road" initiative had become a crucial national development strategy, it was important to incorporate green freight activities into the strategy. The results and recommendations from the studies have been incorporated into the 13th Five Year Plan of Guangdong. - **Capacity building and outreach programs.** The PMO organized a series of training programs, workshops and symposiums to advertise and promote green freight concepts. By closing, over 3,200 truck drivers had received training. Training for government officials and project management officials had totaled over 200 person-times. The capacity building programs have substantially increased the knowledge and capability of government officials in the freight and logistics sector, as well as of the managers in logistics enterprises.
Component 4: Project Implementation Support	
Provision of technical advisory services for Project implementation, stakeholder consultations, Project results evaluation and dissemination, as well as Project management.	All planned activities were carried out and expected outputs were largely achieved. Key outputs include the following: - Guangdong University of Technology was hired to assist the PMO in monitoring and evaluating the results of Component 1 demonstration. - A procurement agent was hired to assist the PMO in the procurement of 11 contracts. - An individual consultant was hired to prepare the Borrower's ICR.

Annex 3. GEF Incremental Cost Analysis

A3.1 Fuel Savings from Component 1: Green Truck Technology Demonstration

1. For the Phase I pilot, 10 pilot trucking companies with 145 trucks demonstrated 6 energy efficiency technologies that were verified by the US EPA SmartWay Program (low resistance tire, roof fairing, side skirt, gap fairing, tire pressure monitor, and energy efficient driving system). These technologies were grouped into seven packages for application on different types of trucks. Both GPS-based and manual methods were adopted for fuel consumption monitoring. The technology package selection for Phase II was based on the results of Phase I, which identified the most effective technology packages for fuel saving. In addition, light weighted semi-trailer (LWST) was also added in the Phase II demonstration as a new technology. In Phase I, results from GPS-based fuel level monitoring method often turned out to be invalid; thus only the manual method was adopted in Phase II. Eleven pilot trucking companies with 1,200 trucks participated in Phase II.

2. Data from each truck was monitored and the fuel saving effects of the installed technology packages as well as each individual technology were calculated. The results of each technology corresponding to different types of trucks are shown in Tables 3.1 and 3.2.

Table 3.1 Fuel Saving Results of Demonstrated Technologies During Phase I

Technology package No.	Technology package	Truck categories	Number of Trucks Demonstrated	Fuel Saving
C1	Low rolling resistance tires	Small trucks (< 2 tons)	40	0.58%
C2	Low rolling resistance tires	Medium trucks (2 – 4 tons)	10	2.29%
C3-1	Low rolling resistance tires	Large trucks (4 – 8 tons)	15	1.37%
C3-2	Low rolling resistance tires + tire pressure monitoring device	Large trucks (4 – 8 tons)	15	1.61%
C4-1	Roof fairings	Large trucks (4 – 8 tons)	10	2.86%
C4-2	Roof fairings + low rolling resistance tires + tire pressure monitoring devices	Large trucks (4 – 8 tons)	10	4.48%
C5-1	Roof fairings	Heavy-duty trucks (8 – 30 tons)	7	2.16%
C5-2	Roof fairings +side skirts	Heavy-duty trucks (8 – 30 tons)	8	3.94%
C6-1	Low rolling resistance tires	Heavy-duty	5	3.91%

		trucks (8 – 30 tons)		
C6-2	Low rolling resistance tires + roof fairings + side skirts + trailer mounted gap reducers	Heavy-duty trucks (8 – 30 tons)	5	4.95%
C7-1	Driving behavior diagnostic and operation monitoring systems	Large trucks (4 – 8 tons)	7	2.65%
C7-2	Driving behavior diagnostic and operation monitoring systems	Heavy-duty trucks (8 – 30 tons)	13	0.04%

Table 3.2 Fuel Saving Results of Demonstrated Technologies During Phase II

Technology package No.	**Technology package**	**Truck categories**	**Number of Trucks Demonstrated**	**Fuel Saving**
C1-1	Low rolling resistance tires	Small trucks (< 2 tons)	118	0.58%
C1-2	Low rolling resistance tires	Medium trucks (2 – 4 tons)	35	2.29%
C1-3	Low rolling resistance tires	Large trucks (4 – 8 tons)	90	1.37%
C1-4-a	Low rolling resistance tires	Heavy-duty trucks (8 – 30 tons)	111	3.91%
C1-4-b	Low rolling resistance tires	Heavy-duty trucks (>30 tons)	10	3.91%
C1-4-a+2-2	Low rolling resistance tires + roof fairings	Heavy-duty trucks (8 – 30 tons)	15	4.95%
C1-4-b+2-2	Low rolling resistance tires + roof fairings	Heavy-duty trucks (>30 tons)	69	4.95%
C2-2	Roof fairings	Heavy-duty trucks (>8tons)	17	2.16%
C3	Driving behavior diagnostic and operation monitoring systems	Heavy-duty trucks (8 – 30 tons)	730	1.35%

C4	Light weighted semi-trailer	Heavy-duty trucks (8 – 30 tons)	9	5.88%

3. Low rolling resistance tires (LRRT), roof fairings (RF), and driving behavior diagnostic and operation monitoring systems (DBDS) were identified as the top three fuel saving technologies during Phase I. It also identified that LRRT performs best with 3.91% fuel saving when applied on heavy-duty trucks, while RF and DBDS perform best with 2.86% and 2.65% fuel saving, respectively, when applied on large trucks. Table 3.2 shows that LWST applied on heavy-duty trucks provided 5.88% fuel saving, the highest effect among the individual technologies.

A3.2 Fuel Savings from Component 2: Green Freight Logistics Demonstration

4. Component 2 was designed to demonstrate the energy efficiency of operating techniques through two logistics platform pilots and a drop-and-hook pilot.

A3.2.1 Logistics Platform developed by Lin'An Logistics Company

5. The logistics information platform developed by Lin'An Logistics Company registered about 200,000 shippers and 1.8 million drivers. Over 50,000 trades are observed on the platform daily. The logistics information platform includes online logistics transection, logistics management (planning, dispatching and supervising), and a mobile APP for truck drivers.

Table 3.3 Monitoring Results of Logistics and Trade Information Platform

	Sample	**Platform**
Number of Trucks	50	106673
Volume of Goods Transported (ton-km)	42,361,145	469,204,000
Total Fuel Saving compared to baseline period (L)	27,101	4,539,989
Rate of Fuel Saving (%)	4.0%	4%
GHGs emissions reduction compared to baseline period (tCO_2e)	72.36	12,122
GHGs emissions reduction rate (%)	4.0%	4%

6. Monitoring results show that the fuel saving effect of the sample of 50 trucks is 4.0%. The fuel saving rate of the platform was assumed to be the same as that of the sample, while the total volume of goods transport by the platform increased significantly, leading to considerable fuel saving and emission reduction. Therefore, Lin'An logistics information platform demonstrated that there was significant fuel saving and emissions reduction potential with the green freight logistics platform and it should be promoted on a larger scale.

A3.2.2 Logistics Platform developed by CITIC Xintong Logistics Company

7. The second logistics platform was developed by CITIC Xintong Logistics Company. The grant was used to subsidize half of the truck driver's payment (US$16 per trip) aiming to attract more users. The pilot more than doubled the number of registered drivers using the platform.

Table 3.4 Monitoring Results of Smart Cloud Logistics Platform

	Sample			**Platform**		
	Steel	**Container**	**Total**	**Steel**	**Container**	**Total**
No. of Trucks	31	19	50	5741		
Volume of Goods Transported (ton-km)	8,291,571	2,056,825	10,348,396	353,189,912	3,477,934	356,667,846
Total Fuel Saving compared to baseline period (L)	7,503	4834	12,337	319,484	8,199	327,683
Rate of Fuel Saving (%)	4.04	4.26	4.15	/	/	/
GHGs emissions reduction compared to baseline period (tCO_2e)	20.03	12.91	32.94	853.0	21.9	874.9
GHGs emissions reduction rate (%)	4.04	4.26	4.15	/	/	/

8. Monitoring results show the fuel saving effects of the sample of 50 trucks on steel and container transportation are 4.04% and 4.26%, respectively, and the overall fuel saving effect is 4.15%. The fuel saving rate of the platform was assumed to be the same as the sample for each business field, while the total volume of goods transport increased significantly by the platform, leading to considerable fuel saving and emission reduction effect. The CITIC logistics information platform demonstrates that there is significant fuel saving and emissions reduction potential with green freight logistics platform and it should be scaled up.

A3.2.3 Drop-and-Hook Pilot

9. This pilot aimed to create a modern information system for the existing drop-and-hook trucks. Guangzhou City Star Transport Co., Ltd was selected to be the pilot company. The entire process of drop-and-hook operation was managed and monitored through the information system, which greatly improved the efficiency of the participating trucks. An APP was also developed to connect the information system of the company with potential users. There were 54 tractors with 120 trailers selected to participate in the demonstration on three selected routes. Transportation volume, distance travelled, and fuel consumption were monitored for the three routes and are summarized in Table 3.5.

Table 3.5 Monitoring Results of Drop-and-hook

	Route		
	Foshan-Shanghai	**Foshan-Beijing**	**Foshan-Wuhan**
Number of Tractors	54		

Number of Trailers	120		
Volume of Goods Transported (ton-km)	32,378,751	23,867,575	14,344,904
Total Fuel Saving compared to baseline period (L)	20,399	16,469	3,730
Rate of Fuel Saving (%)	5.11	5.25	2.00
GHGs emissions reduction compared to baseline period (tCO_2e)	54.47	43.97	9.96
GHGs emissions reduction rate (%)	5.11	5.25	2.00

10. As Table 3.5 shows, the Foshan-Beijing route achieved the highest fuel saving rate of 5.25%, followed by the Foshan-Shanghai route. This trend matches with the order of average travel distance of the three routes, indicating that longer distances are associated with a higher fuel saving effect.

A3.3 Estimation of CO_2 Emissions Reduction

11. In terms of demonstration impacts, only the direct impacts of Component 1: Green Truck Technology Demonstration and Component 2: Green Freight Logistics Demonstration are considered. The analysis uses the same parameters and assumptions as in the PAD: (a) emission factor of 2.77 CO_2e per liter diesel combusted; (b) average life span of a truck in China is 8 years; and (c) fuel price of US$1.05/L, which was the average fuel price between 2011 and 2015.

Table 3.6. Total Fuel Savings and Emissions Reduction

	Component 1		**Component 2**		
	Phase I	**Phase II**	**Logistics Platform 1 (Lin'an)**	**Logistics Platform 2 (CITIC)**	**Drop and Hook**
Demonstration period (month)	5	10	9	5	9
Direct fuel savings during demonstration (L)	27,366	271,015	4,539,989	327,683	40,598
Expected fuel savings in 8 years (L)	525,427	2,601,744	48,426,549.33	6,291,513.60	433,045.33
Expected savings from fuel in US$	551698.56	2731831.2	50,847,876.80	6,606,089.28	454,697.60
Total expected savings from fuel in US$	3,283,529.76		57,908,663.68		**Total: 61,192,193.44**
Expected savings from fuel in tons CO_2e	8,662.26		152,768.55		**Total: 161,430.81**

12. The short-term net benefits from fuel savings from Component 1 and Component 2 combined were about US$ 61.2 million (see details in Annex 3), almost three times the total project cost. In terms of direct demonstration of emission impacts, the project resulted in reducing CO_2 emissions by 161,430 tons. Since the GEF Grant is US$3.7 million, the cost of GHG reductions equates to US$23 per ton, which is much higher than the US$3.5 per ton estimated at appraisal. This is mainly because: (a) the ICR calculated only the direct CO_2 emission reduction from project vehicles for which data were available and excluded emission reductions from the

long-term replication effects of the project; and (b) energy efficiency improvements from the application of seven technology packages only ranges from 1 to 6%, which is much smaller than the 7 to 26% estimated at appraisal. In other words, although only technologies verified by US EPA SmartWay were applied in the demonstration, they did not produce the same benefits in Guangdong. Hence the project is valuable in terms of demonstrating the true effects of these technologies in the Guangdong context. Despite this conservative estimation, the project compares well with the GEF City Cluster Eco-Transport Project, where the GEF contribution per ton of CO_2 directly reduced was US$24.5.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
World Bank Staff			
Ke Fang	Senior Urban Transport Specialist	EASIN	TTL
Shomik Raj Mehndiratta	Senior Transport Specialist	EASCS	
Holly Krambeck	Transport Economist	EASIN	
Dhruva Sahai	Senior Financial Analyst	EASIN	
Andrew Salzberg	Transport Specialist	EASIN	
Wei Winnie Wang	Transport Specialist/JPA	EASIN	
Yiren Feng	Environment Specialist	EASCS	
Yi Geng	Senior Financial Management Specialist	EASCS	
Guoping Yu	Procurement Specialist	EASCS	
Consultants			
Ron Kopicki	Freight Logistics Specialist		
Yan Peng	Air Quality and Freight Specialist		
Joel Smith	Freight Logistics Specialist		
Su Song	Transport Specialist		
Xi Zhao	Research Associate		
Shan Huang	Research Associate		
Peer Reviewers			
Buddy Polovick	Manager, SmartWay Program, US Environment Protection Agency		
Sophie Punte	Director, CAI-Asia Center		
Georges Darido	Transport Specialist	LCSTR	
Gerald Paul Ollivier	Senior Transport Specialist	EASCS	
Supervision/ICR			
World Bank Staff			

Ke Fang	Senior Urban Transport Specialist	SASDT	TTL
Yiren Feng	Environmental Specialist	EASCS	
Guoping Yu	Procurement Specialist	EAPPR	
Yi Geng	Sr Financial Management Specialist	EASFM	
Maria Luisa G. Juico	Program Assistant	EASIN	
Holly Krambeck	Transport. Economist	EASIN	
Binyam Reja	Lead Transport Specialist	EASCS	TTL
Xuan Peng	Program Assistant	EACCF	
Yunqing Tian	Team Assistant	EACCF	
Non-Bank Staff			
Runze Yu	Climate Change Specialist		
Xi Zhao	Urban Transport Consultant		
Mengling Shen	ICR consultant		
Chuntai Zhang	ICR consultant		

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
Lending		
FY10	6.96	103.09
FY11	23.25	155.70
Total:	30.21	**258.74**
Supervision/ICR		
FY11	0.30	1.05
FY12	3.40	39.53
FY13	4.41	29.97
FY14	1.65	38.27
FY15	0.67	20.48
FY16	0.00	21.94
Total:		**151.24**

Annex 5. Explanations of the Results Framework

Baseline and target values in the Results Framework were calculated on trucks than were different from trucks that participated in the pilots. The PMO had difficulty in reporting and evaluating the results of the pilots against the RF targets. The table below shows the revised baseline and target values based on trucks that participated in the pilot.

Revised Results Framework

Original						**Revised**			
PDO Level Results Indicators	**Unit of Measure**	**Baseline**	**Target**	**Percentage change**	**PDO Level Results Indicators**	**Unit of Measure**	**Baseline**	**Achieved**	**Percentage change ratio**
Indicator One: Improvement in fuel economy of participating trucks.	Liter/100 km	32	30.4	5.0	No revision	Liter/100 km	*24.18*	*23.39*	3.3
Explanation: The deadweight of a truck (heavy or lightweight) affects fuel economy. The original baseline values were calculated based on a weighted average of 24% small trucks, 45% medium-large trucks, and 31% heavy trucks. However, the composition of participating trucks was 28% small trucks, 46% medium-large trucks, and 26% heavy trucks. In addition, the technology combination implemented varied substantially from that planned at appraisal. The baseline value for the implemented combination would be 24.18 L/100km. The value achieved was 23.39 L/100km, representing a 3.3% reduction.									
Indicator Two: Reduction in operating cost of truck fleets managed by participating companies.	$ /100 ton-km	25.6	24.3	5.1%	No revision	$ /100 ton-km	*2.41*	*2.31*	4.1%
Explanation: The originally defined operating cost of truck fleets included fuel consumption cost, administrative expenses, office expenses, and personnel cost. During implementation it was difficult for the PMO to collect data on operating costs, except fuel consumption cost (as the trucking companies do not share data on other costs). The baseline fuel cost was $2.41/100 ton-km. The reduction in fuel consumption based on monitoring data was about 4% and the reduction ratio remains roughly the same.									
Indicator Three: Total amount of CO_2e emission reduction directly generated from fuel savings throughout the duration of the demonstration.	tons CO_2/100 ton-km	1.50	1.43	4.7%	**Indicator Three (a):** Total amount of CO_2e emission reduction directly generated from fuel savings throughout the duration of *the green truck technology demonstration.*	*kg CO_2/100 km*	*64.46*	*62.46*	3.3%

<table>
<tr><td colspan="10">Explanation:
Separate one indicator into two. The Green Truck Technology Demonstration and the Green Freight Logistics Demonstrations (including the Drop-and-hook Transport Demonstration and the Logistics Transaction Information Platform Demonstration) should be evaluated separately because fuel consumption for the two demonstrations were measured in different units.
Change the baseline value.
The original value of CO_2 emissions is very large compared to the PMO's calculation.
From the EPA website, "CO_2 emissions from a liter of diesel is 2.64 kg." The fuel economy of a medium-sized truck is about 1.5~2 L/100 ton-km. Hence, the CO_2 emission value should not be more than 6 kg/100 ton-km, but the original value is in tons.
This difference is likely caused by a miscalculation when converting various types of GHG to CO_2e. Since the PMO could not re-calculate the original numbers, the baseline data has been changed. Reduction in CO_2 emissions for the Green Truck Technology Demonstration was from 64.46 kg CO2/100km to 62.46 kg CO_2/100km, representing a 3.3% reduction.</td></tr>
<tr><td colspan="5"></td><td>Indicator Three (b): Total amount of CO_2e emissions reduction directly generated from fuel savings through the duration of the Green Freight Logistics Demonstration</td><td>kg CO_2/100 ton-km</td><td>6.12</td><td>5.87</td><td>4.1%</td></tr>
<tr><td colspan="10">Explanation:
For the logistics demonstration, CO_2 emissions were reduced from 6.12 kg CO_2/100ton-km to 5.87 kg CO_2/100ton-km, representing a 4% reduction.</td></tr>
<tr><td colspan="10">There are no changes to the intermediate indicators.</td></tr>
</table>

Annex 6. Summary of Borrower's ICR and/or Comments on Draft ICR

The Guangdong Green Freight Demonstration Project was launched in October 2011 as a partnership between the Guangdong Government, the World Bank (WB) and the Global Environment Facility (GEF) to demonstrate the environmental benefits of energy efficient vehicle technologies and operating techniques. The project implementation was led by the Department of Transport of Guangdong Province and was supported by relevant departments such as Department of Finance, Reform and Development Commission, and the Economy and Information Commission. Two components, namely Green Truck Technology Demonstration (Component 1) and Green Freight Logistics Demonstration (Component 2) were included in the demonstration in two phases. Component 1 in Phase I included 10 companies with 145 vehicles. Component 1 in Phase II was modified and supplemented based on results from Phase I. It included 10 companies with 1,204 vehicles. Component 2 in Phase II included the Logistics and Trade Information Platform, Smart Cloud Logistics Platform, and Drop-and-hook.

Both qualitative and quantitative indicators were designed prior to the demonstration to evaluate the performance of the demonstration., After Phase I was completed, modifications were made to the key indicators to allow for valid evaluation of the project. The table below shows that improved fuel economy from green truck technologies and reduced operating cost of pilot companies were realized and both met their target values. Moreover, the emissions analysis shows that green truck technology met the pre-defined target and green freight logistics performed much better than the target, particularly the Logistics and Trade Information Platform (LTIP), which measured a 39% reduction in fuel consumption and corresponding emissions. Therefore, it is concluded that the project has accomplished the set targets defined by the key indicators.

		Modified baseline	**Modified target value**	**Actual achievement**
Fuel economy (L/100km)		20.37	19.92	19.81
Operating cost ($/100ton-km)		2.78	2.67	2.31
Total amount of CO_2 emission	Green Truck Technology (kg CO_2/100km)	54.38	53.18	52.88
	Green Freight Logistics (kg CO_2/100ton-km)	6.12	5.87	4.65

The project ex-post economic and environmental analysis shows that, for green truck technology, low rolling resistance tires (LRRT), roof fairings (RF), and driving behavior diagnostic and operation monitoring systems (DBDS) are financially feasible and environmental friendly; however, light weighted semi-trailer (LWST) showed poor financial performance and had limited emissions reduction potential. Results further show that for green freight logistics operations, logistics brokerage platforms are much welcomed both financially and environmentally, but drop-and-hook is not financially attractive.

In terms of intermediate indicators as listed in the table below, all met or exceeded the targets. Indicators that exceeded target included investment leveraged from the private sector, number of

drivers and government officials trained, and number of green freight trade fairs successfully organized.

Indicators	Target of achievement	Actual achievement
Total private sector investment leveraged through the Project (million USD)	1	8.02
Number of existing or newly purchased trucks installing green truck technologies	1200	1349
Number of drivers trained	1200	3272
Establishment and maintenance of the project website	To establish website of project in 2011	Project website established in 2011
Number of government officials and enterprise representatives trained	160 from government and 3,000 from enterprise as of 2014	More than 200 from government and more than 3,000 from enterprise as of 2014
Development and organization of the Green Freight Logistics and Technology Trade Fair	Implementation of green freight trade fair within 2011	Green freight trade fair was implemented on 1 Sep 2011. World Bank Green Freight Fair was held in 2014
Provision of policy recommendations to Guangdong Provincial Government on reduction of carbon footprints from the sector	Institutional and policy needs deliver to Guangdong provincial government. in 2013	Policy notes completed and submitted to Guangdong provincial government. on 1 Dec 2013

Moreover, carriers, drivers, technology suppliers, and shippers have all benefited from the project implementation, including operating cost reduction for carriers, salary increase and capacity improvement for drivers, supply channel broadened for technology suppliers, and transportation efficiency improved for shippers.

Performance of the World Bank (WB), the Guangdong provincial government, and the Project Management Office (PMO) were evaluated. It is concluded that the World Bank made sufficient preparation for the project, conducted strict project management, and provided timely support to the PMO on financial and technical issues. The Guangdong government played a significant leading role to the project and was supported by Head of Guangdong Province Government, Guangdong Department of Transport as the leading agency played its role diligently and other departments sitting in the Steering Committee of the project provided support within their responsibilities, ensuring the project was implemented according to the schedule and budget. The PMO communicated directly and regularly with companies and provided timely support and feedback on questions raised by companies. However, both World Bank and PMO personnel changes as well as the complex payment requirements lengthened the payment period and delayed project implementation.

Finally, key experience and lessons learned examined project design, implementation and institutional mechanisms. With respect to the project design, strong political will from then Head

of the Guangdong Province Government during the project initiation phase ensured timely and active coordination between departments. This is a key factor in the success of the demonstration project because new areas of work, such as green freight development, require more proactive actions from government agencies and closer coordination between agencies than normally needed for existing work areas. In addition, a two-phase design was beneficial. The PMO revised Phase II based on its experiences from the previous phase. This improved the effectiveness of the demonstration as a whole. Based on feedback from pilot companies, it is recommended that companies be engaged as early as possible, perhaps as soon as 3 to 12 months prior to the start of demonstration. This will depend on which vehicle parts need to be changed and the investment needed, as companies have their own procurement procedures and business plans. Advanced knowledge of a future demonstration project allows companies time to incorporate it into their business plans.

With regards to project implementation, the team noticed the problem of low awareness of green freight early on and used all possible opportunities to raise awareness among government officials and companies. This outreach was effective in terms of attracting companies to join the project and getting support from responsible officials. Moreover, that project content was adjusted effectively based on actual results from Phase I and the needs of participating companies, which improved the effectiveness of the project. For example, once it was evident that the GPS-based fuel level monitor method did not work for collecting data during Phase I, it was not used in Phase II.

Lastly, both World Bank and PMO staff demonstrated a strong sense of responsibility, which enabled successful project implementation despite personnel changes. It is recommended that long-term positions should be created for the PMO under such an important 5-year project.

Annex 6. List of Supporting Documents

1. Project Appraisal Document (PAD) No. 60332-CN dated March 21, 2011
2. Project Agreement and Grant Agreement
3. Draft Borrower's Completion Report and Annexes dated February 2016
4. Aide Memoires and ISRs
5. Restructuring Paper, December 2014 and November 2015
6. Semi-annual Progress Status Reports from the Borrower