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The American University in Cairo
School of Global Affairs and Public Policy
Public Policy and Administration Department

**Subsidies for Energy Efficiency and Alternative Energy
Adoption Programs:**

Case Study from Egypt Taxi Recycling Program

A Thesis Submitted to the Public Policy and Administration Department in partial fulfillment of
the requirements of the degree of Master of Arts

By

Omnia Ahmed M. Abdellatif

Supervised by

Jennifer Bremer, Ph.D.

Public Policy and Administration Associate Professor and Chair, AUC

Hamid E. Ali, Ph.D.

Assistant Professor of Public Policy and Administration, AUC

Salah El-Hagggar, PHD

Professor and Chair, Department of Mechanical Engineering, AUC

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Finally, I would also like to extend my warm thanks to my family and friends for their support, constant encouragement, and for helping me with the survey data collection and with the final touches of this thesis.

“I can no other answer make, but, thanks, and thanks.”

William Shakespeare

Abstract

- University:** The American University in Cairo
- Thesis Title:** Subsidies for Energy Efficiency and Alternative Energy Adoption Programs: Case Study from Egypt Taxi Recycling Program
- Student Name:** Omnia Ahmed Mohamed Abdellatif
- Advisors:** Jennifer Bremer, Ph.D.; Hamid Ali, Ph.D.; and Salah El-Hagggar, Ph.D.

This thesis was developed to call in question the conventional perception that energy subsidies, especially in the service sector, are necessarily barriers to the adoption of improved technology. It provides a case study for an innovative program that supported energy efficiency and the adoption of alternative energy in the transportation sector and relied in part on subsidy savings. The program-Egypt's Taxi Recycling Program-was not only successful in reaching the targeted population effectively, but also lifted some of the fuel subsidies burden off the government budget. Cost Benefit Analysis (CBA) and Soft System Methodology (SSM) were applied to analyze the distribution of benefits from the Taxi Recycling program. The CBA was applied to define the main costs and benefits drawn by the two key stakeholders- the Egyptian Government and taxi owners participating in the program. The SSM was applied to have more detailed understanding of the role and the power of the stakeholders involved; in order to evaluate the performance of the stakeholders.

The study findings indicated that the program has an overall positive impact on the different stakeholders involved. Since it was structured as a Public-Private-Partnership, the program offered significant opportunities to the private sector participating companies, either by stimulating vehicles sales and loan demands that would have not otherwise occurred, or by facilitating the communication channels among the different stakeholders involved.

The program encountered some challenges that directly and indirectly affected the stakeholders involved. The taxi owners, however, had been the most influenced by the program's challenges. The challenges included: the advertising firm being unable to fulfill its commitments; the maintenance services and maintenance costs; the waiting periods for getting the new cars; the quality of the cars that were sold; and the adoption of natural gas as an alternative fuel. Nonetheless, the program had overall positive social impacts.

Through applying CBA from the government perspective, we concluded that the benefits encountered from the program implementation far exceed the costs incurred by the government. Upon reaching the program target of changing around 40,000 old taxi vehicles operating in Greater Cairo Region, the program would save more than LE 380 million annually from the fuel subsidies assigned funds. As for the environmental impacts, the Taxi Recycling program has been divided into eleven separate projects called Certified Project Activities (CPAs); with an average of 4,576 recycled taxi vehicles per CPA. The preliminary assessment, based on CAPMAS's 2010 estimation of the costs associated with CO₂ emissions' negative environmental impacts, showed that the new vehicles would result in annual average environmental benefits of 2.080 million US dollars per each Taxi-Recycling-CPA. In addition, these saved emissions represent potential government revenue if the government was able to sell the reduced emissions under the Clean Development Mechanism.

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“There are powerful reasons to explore alternate transportation fuels, with urban air quality being the prime consideration. Public policy can be designed to support the adoption of an alternate fuel.”

(Flynn, 2002, p. 618)

Chapter One: Introduction

This thesis is developed to reexamine the overall perception that energy subsidies, especially in the service sector, necessarily impede the adoption of clean technologies. It provides a case study for an innovative program that supported energy efficiency and the adoption of alternative energy technology in the transportation sector in Egypt. The thesis starts by providing a brief background information on Egypt's transportation sector and on the program to be studied, Egypt's taxi recycling program.

Egypt's Transportation Sector:

Transportation in Egypt falls between the dilemma of urbanization from one hand and energy and environment from the other. Egypt is the most populous Arab country and the second-most populous African country (Background Note: Egypt, 2010). Between the year 1996 and 2006, the total population of Egypt increased from 59 million to 73 million, with an average annual growth rate of 2.04 percent (MOF, 2010), with most of the population concentrated in Greater Cairo Region (GCR). GCR has expanded to include five governorates. The northeastern part of GCR includes the Qalubia Governorate, the west bank is part of Giza and 6th of October Governorates, the eastern and southeastern parts are within Cairo and Helwan Governorates (MOF, 2010). Correspondingly, the transport demand is concentrated on a few transport roads starting from or ending in Greater Cairo.

GCR accommodates over 20 million motorized trips and 7 million non-motorized trips daily. Half of all motorized vehicles in Egypt operate in GCR, with an annual 4 percent increase. This is one of the fastest growing motorization rates in MENA, reaching more than 2.5 million by 2022. As a result, about two third of transport sector emissions is due to urban transport, especially in Cairo (Eiweida and Pinnoi, 2009).

The urban transport strategy for GCR has identified several urban transports, traffic management and environmental issues as the most serious challenges faced by GCR transport sector; including, serious traffic congestion; long travel time; high accident rate with more than 1000 deaths and 4000 injuries/year; underdeveloped public transport system; and air and noise pollution (Eiweida and Pinnoi, 2009). In 2009, it was estimated that the transport sector in Egypt has been responsible for more than 40 million metric tons of GHG emissions, most of which have been emitted by road based vehicles; 40 percent or 14 million tones of CO₂ may be attributed to the GCR (MoF, 2010).

Egypt's Taxis Recycling Program:

In Egypt, the Taxi Recycling Program was first initiated during 2007 by the Ministry of State for Environmental Affairs (MSEA). It started as a pilot project to replace 100 old taxis that were more than 35 years old and operating in Greater Cairo. These taxis were replaced with new vehicles operating on natural gas (EEAA, 2009). The project aimed “to improve the status of old taxis in Greater Cairo under the environmental framework to guarantee the safety limits of emissions exhausted from these vehicles in addition to cost reduction” (EEAA, 2009, p. 61).

The goals of the project, based on MSEA project proposal, included: reducing local air pollution that resulted from the high level of emissions from taxi vehicles that were more than 28 years old. In addition, it aimed at accomplishing economic gains through reducing gasoline consumption and thus gasoline subsidies. Since the new taxis would run on natural gas, the government would save some of the gasoline subsidies, due to the difference between the gasoline subsidies that the government is currently paying (LE 2.50 per liter equivalent to 0.45 US dollars per liter) and the natural gas subsidies (LE 0.15 per cubic meter equivalent to 0.027 US dollars). Moreover, it would help taxi drivers to purchase new cars that are more efficient,

up-to-date and comfortable. This would reduce the stress that resulted from the old taxis' frequent break downs and help reduce the maintenance and spare part costs. It also aimed to reduce the traffic congestion and to improve the overall image of Cairo; as the new taxi vehicles are more appealing to tourists and visitors (EEAA, 2006).

The project provided several incentives to encourage owners of old taxis to scrap and replace them with new vehicles that work with natural gas including: offering direct subsidies for each old vehicle to be replaced; sales and custom tax exemption for all new vehicles (up to 20% of the vehicles' price); and offering bank loans at an interest rate below the market value. In addition to the financial incentives, the project provided additional enticements for the participating vehicles, including; nationwide vehicle license instead of the regular governorate licenses offered. This would enable the taxi drivers to travel through different governorates with no need to issue travelling permits. In addition, they reinforced the application of the meter system by introducing a new metered rate structure that could be reliably used by the taxi drivers and taxis' customers.

In light of the success of the pilot project, a greater number of old taxis owners applied. According to an interview with one of the Egyptian Environmental Affairs Agency (EEAA) senior officials, at the beginning they were searching for 100 taxis to participate in the program. It was a challenging task to find 100 taxis. From 350 surveyed taxis, only 100 agreed to be part of the pilot project. However, because of the project's success, more taxi drivers approached the MSEA and EEAA to be part of the project.

In 2008, the first phase of the program was completed by replacing 1000 old taxi vehicles. The MSEA was not able to meet the financial demands of the growing program by itself; thus, the first phase was completed through collaboration between the MSEA and the Ministry of Finance

(MoF) (EEAA, 2009). Given to the program's success, it was expanded and management responsibility was shifted to the MoF (EEAA, 2009), given the need to develop and implement a complex financing scheme. A fund was created for the Taxi Recycling Program with an independent juridical personality and special balance sheet affiliated to the Ministry of Finance (EEAA, 2009).

In addition to the economic and environmental goals, the MoF had adopted the program to realize further goals, including: facilitating the transition required by taxi drivers under traffic law no. 121 of year 2008. The law dictates that all vehicles of mass transport that are 20 years old will not be granted license to operate. To prevent the conversion of these old taxis into private use vehicles, which is outside the jurisdiction of the law, the MoF has adopted the program with the intention of scrapping the older vehicles (MOF, 2010). In addition, it would allow Egypt to take advantage of the Clean Development Mechanism (CDM) funding. The CDM allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one ton of CO₂, which can be counted towards meeting Kyoto targets (CDM, 2006). More information about the CDM and Kyoto protocol is available at Appendix 1.

According to the MoF, the CDM funding will be used to support monitoring of GHG emissions reductions associated with the program implementation; development and preparation for a recycling facility that would safely and environmentally friendly dispose the surrendered vehicles. It would also support the subsidy that the MoF uses to encourage vehicle owners to surrender their old vehicles for managed scrapping and recycling (MoF, 2010). Moreover, the program has been planned to be extended to include other scrapping and recycling projects; that

would be expanded all over Egypt under the title “Egypt Vehicle Scrapping and Recycling program”.

The Taxi Recycling program has been structured as a Public-Private-Partnership (PPP), where the cost burden of the program, as expressed by the MoF, has been divided between the public sector and the private sector. Key parties have voluntarily signed a cooperative agreement to participate in the program. The private sector organizations that chose to participate in the program include: three commercial banks, five vehicle companies (which assemble locally), an advertising firm, and an insurance agency.

The public sector is represented primarily by the MoF; however, the agreement is also signed by the Ministry of Interior (Traffic Police), which has an important role in the program. According to the program protocol, the responsibilities of the Ministry of Interior include: allocation of a suitable area to turn in old vehicles and scrap them, preparing three areas to issue licenses for the new vehicles and renewing them, licensing the new vehicles to their owners as taxi vehicles. In addition, the Ministry of interior is obligated to take and manage all the necessary measures needed to make sure that the taxi owners will abide by the program protocol, including: making the license valid for three months in the first year and for 6 months starting from the second year, stating in the license a ban for the benefit of the bank which cannot be removed unless the bank approves, and taking all the necessary procedures to find the vehicles if notified by the bank or the auto dealer (MoF, 2010).

In addition, the Ministry of State for Environmental Affairs (MSEA) plays an important independent role in program oversight from an environmental perspective. Furthermore, the Egypt Environmental Affairs Authority (EEAA), affiliated to the MSEA, initiated the program and conducted the pilot project. Although implementation has largely passed to MoF, EEAA

retains a role as Egypt's Carbon Finance Designated National Authority (DNA), which is responsible for preparing a letter of Approval that indicates whether the program supports sustainable development in Egypt. (MoF, 2010, p. 24)

Owners of the new vehicles are considered to be the program implementers, since they are ultimately responsible for the ownership and operation of the new vehicles. However, the potential beneficiaries of this program include not only taxi drivers, but also, the private sector participants, the Egyptian government, and GCR commuters and all citizens (MOF, 2010), as well as tourists and other visitors to Egypt.

The international organizations, including the World Bank and the United Nations Framework Convention on Climate Change (UNFCCC), which support Carbon Finance projects, play an important part. Based on the MoF 2010, the international organizations would play vital roles in ensuring the program's long term success by ascertaining that the program's social and environmental objectives are met.

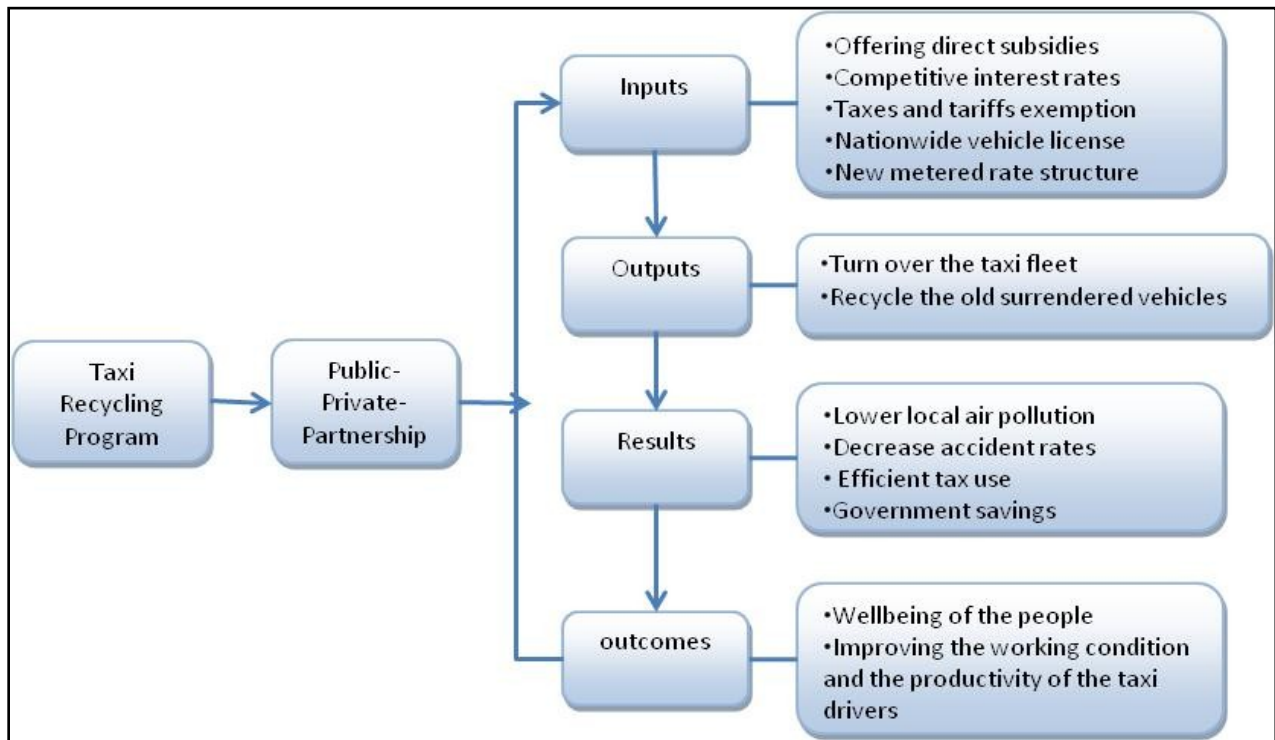
Although the program was operating successfully, the rapid growth of the program created some challenges. For example, the advertising company, one of the participating private sector companies, was not able to fulfill its commitment. The advertising company had been responsible for offering a fixed rate of LE 550 per month for a period of up to five years to the lending bank towards vehicle owner's debt service payments. Thus, the program was divided into three phases; phase 1 in which vehicle purchasers were entitled to the advertisement support and phase 2 and 3 that did not get the advertisement support.

In addition, some of the participating vehicle maintenance companies faced some challenges. It resulted either from the rapid growth of the program that may have created service demand that was not anticipated; or from the cultural differences with the taxi owners who were used to the

local mechanic shops' services system. Moreover, the natural gas adoption goal, which at the beginning was the main reason for adopting the program, has been displaced by the other goals of the program. Rather than the obligatory use of natural gas as an alternative fuel, it became optional for taxi drivers to choose between natural gas and gasoline . The government alleged that the current natural gas infrastructure would not be able to support the rapid increase in the demand that would be created by the obligatory use of natural gas. These challenges are discussed in more detail at a later point.

Nevertheless, the initiative is considered successful because it took into consideration the economic, environmental and social impact of the subsidy. Although new subsidies programs often represent an extra burden on the government budget, the Taxi Recycling program, is reported by the government to provide several economic benefits in both the short and long run. Conversion to natural gas and replacement of old, poorly-maintained, and inefficient cars were seen as a way to reduce the negative impacts of gasoline on the environment through reducing GHG emissions and local air pollution. The program targets the taxi drivers who are generally from lower and middle income groups. By assisting these groups in the more modest economic quartiles, the program is fulfilling its social purpose, targeting the subsidy to a low-income population.

Figure 1: Preliminary Conceptual Model



Research Questions:

This research paper will provide a case study of this innovative program, and define and evaluate the program's impact on the different stakeholders involved.

The investigative questions include:

- How does the Taxi Recycling program affect/save government budgetary resources?
- How effective has the implementation of the program been:
 - In achieving the government's aims for adopting the program (natural gas program).
 - In removing barriers to the adoption of natural gas conversion program.
- How do the program's different stakeholders affect or are affected by the program implementation?
- What are the social and environmental impacts of the program? (preliminary assessment)

The thesis is divided into chapters. Chapter 2 provides more elaborate description of the problem and why it is worthy of study. Then, Chapter 3 presents arguments that have been discussed in the literature that may affect public decision making with regards to subsidies for energy efficiency and alternative energy adoption programs. Chapter 4 discusses the methodologies used; followed by a description of the data collected in Chapter 5. In Chapter 6 and 7 we analyze the data collected and provide study results in chapter 8; while chapter 9 provides the study implications on the public decision making process.

Chapter Two: Statement of the Problem

Economic development and environmental management are often assumed, by policy analysts, to be at odds with each other (Perkins, 2006). Governments usually justify subsidies in order to achieve different policy objectives, including: offsetting market imperfections, exploiting economies of scale, correcting market failures, and meeting various social and environmental policy considerations (UNEP and IEA, 2001).

One of the most important concerns about extensive government subsidies is that they may easily become counterproductive. In other words, the same aggregate social goals could be attained at a much lower level of government expenditures and a much lower cost (Clements et al., 1998). “Energy subsidies, in particular, are often used to alleviate energy poverty and promote economic development by enabling access to affordable energy service.” (IEA et al., 2010, p. 4)

Inefficient energy subsidies, however, have created a huge economic burden on the Egyptian governments’ budget. They have caused inefficient production processes and contributed to the slowing down of economic growth (Harik, 1992). Energy subsidies have provided no incentive for efficient consumption of energy; which resulted in more productivity losses. With regards to social impacts, energy subsidies were often not well targeted; thus, they often resulted in benefiting the rich more than the poor, or in benefiting the rich at the expense of the poor. In addition, it resulted in a wide range of negative environmental impacts, including: greenhouse gas emissions, local air pollution, water pollution, and depletion of non-renewable fossil-fuel stocks (Ellis, 2010).

Since the industrial revolution, the amount of carbon dioxide in the atmosphere has increased to 800 billion metric tons of carbon, its highest level in 400,000 years. Most of this carbon dioxide has come from the use of fossil fuels such as coal, oil, and natural gas. Fossil fuel consumption

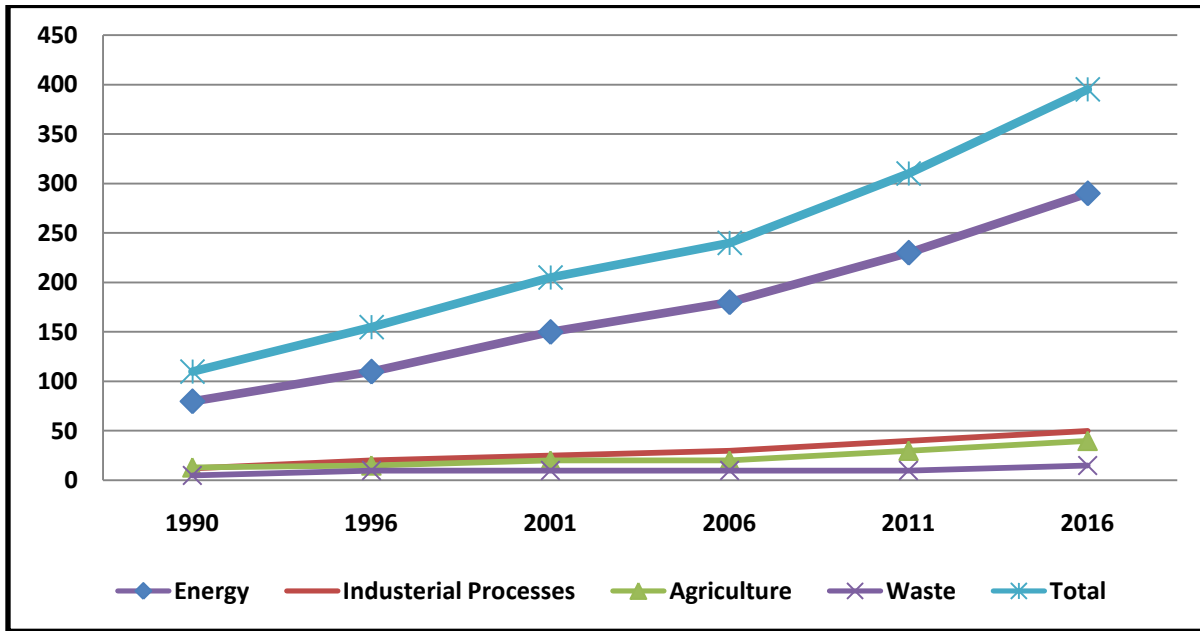
used has contributed to the warming of the earth as reflected in the increase of surface temperatures by more than 1 degree Fahrenheit over the past 30 years, the most rapid increase in the last 1000 years. Global snow cover has declined by 10% since the 1960s, and global sea levels have raised by one-third to two-thirds of a foot over the last century (Gruber, 2007).

The global warming effects would not only have negative impacts on the environment, but also on the economy. To illustrate, for the next century, it is projected that temperatures will increase by as much as 6 to 10 degrees Fahrenheit, a rate unprecedented in the last 10,000 years. A temperature rise of 6 degrees would lower global GDP in 2100 by over 10%, with India, Africa, and Western Europe seeing reductions of more than 15% (Gruber, 2007).

According to Eiwida and Pinnoi (2009), Egypt ranks the 11th among countries in the world showing fastest growing Greenhouse Gas Emissions (GHG). Egypt's emission contribution to the world has increased from 0.66 to 0.68 percent in one year- from 2006 to 2007 (CAPMAS, 2008). The share of energy emissions in Egypt, as shown in Figure 2, has increased from 31 percent to 42 percent in 2006, while the shares of other sectors have been decreasing. For the same period, the transport emissions increased from 18 to 21 percent.

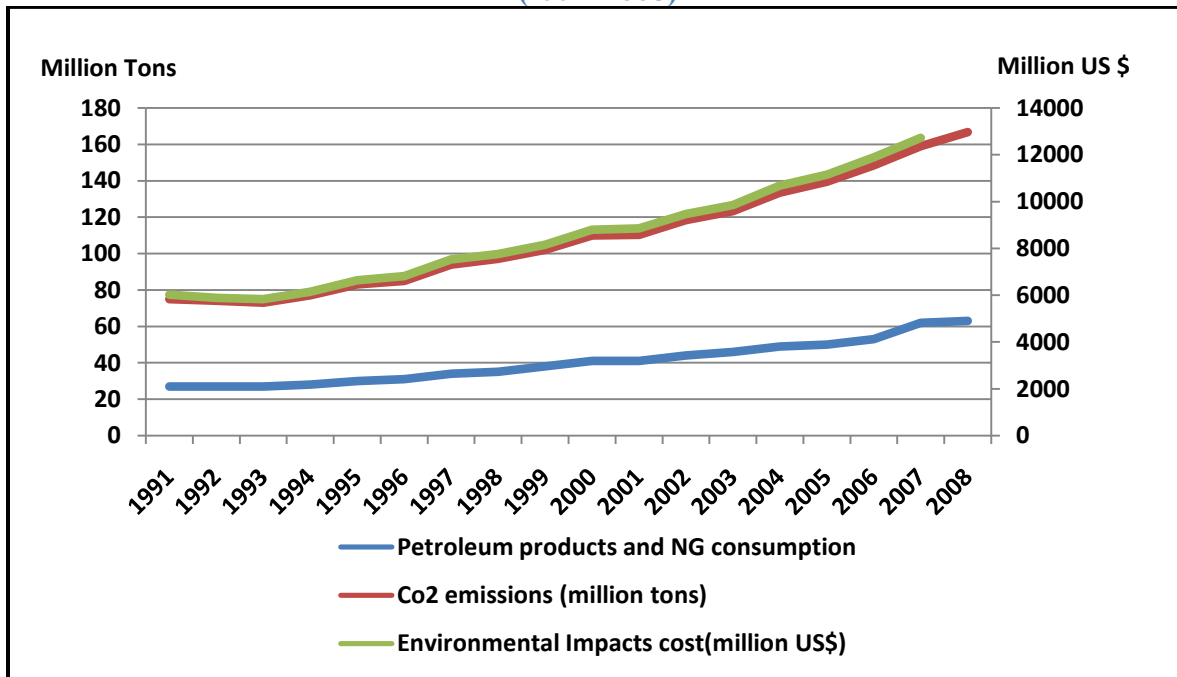
In 2010, The Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS) had estimated the costs of environmental impacts from CO₂ emissions- the main component of GHG- to be approximately 80 US dollars per ton of CO₂. As shown in Figure 3, since the early 1990s, the quantity and costs of CO₂ emissions due to fossil fuel consumption has increased by more than 50 percent. The environmental impacts costs increased to reach more than 12,000 million US dollars in 2007.

Figure 2: GHG Projections for All Sectors, Egypt (1990-2016)



Source: Egyptian Environmental Affairs Authority; (Eiweida and Pinnoi, 2009)

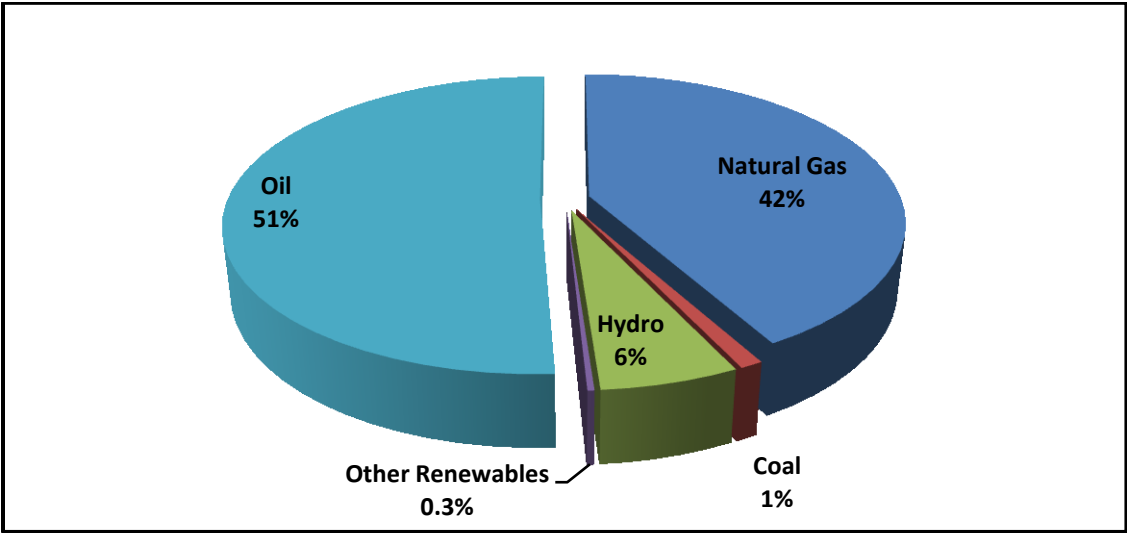
Figure 3: Quantity and Cost of CO₂ Emissions Due to Petroleum and NG Consumption (1991-2008)



Source: Egypt in Figures, CAPMAS, 2010

As a result of subsidizing energy products in Egypt for decades, investment in alternative energy sources and alternative energy technologies was undermined; either through increasing consumer demand for fossil fuels, or decreasing production costs for producers. In either case, fossil fuel subsidies have distorted the market and reduced investment in alternative energy sources or alternative energy technologies that are potentially more efficient and less environmentally harmful (Ellis, 2010). In Egypt, as shown in Figure 4, according to the U.S. Energy Information Administration (EIA), almost all of the energy consumption in 2007 was met by oil and natural gas with 51% and 42% respectively; while hydro power and other renewable energy sources combined percentages does not exceed 7%.

Figure 4: Total Energy Consumption in Egypt, by Type (2007)



Source: EIA International Energy Statistics; Country Analysis Briefs, Egypt (2010)

To overcome some of the negative impacts of fossil fuel subsidies, energy subsidies’ reform programs have been introduced and implemented worldwide, and the need for energy supply diversification has emerged. Governments have realized that adopting new productive technologies that also protect the environment and achieve social goals can reduce the conflict

between the need for economic growth and environmental degradation, leading to environmental improvements, and improved economic output and welfare (Perkins, 2006). In the short term, reform policies are likely to emphasize measures that do not require the introduction of radical changes to the current system of energy supply and use (Watt and Outhred, 2006). Thus, the importance and the advantages of the introduction and adoption of natural gas in the transportation sector has been recognized globally, with the implementations of several natural gas vehicles conversion programs that have resulted in reducing local air pollution, reducing the dependency of governments on oil and diversifying energy supply from oil through the promotion and adoption of natural gas. The next chapter presents arguments and discussions cited in the literature. It aims to provide a more detailed understanding of the different viewpoints that may affect the decision making process with regards to subsidies for energy efficiency and alternative energy adoption programs.

Chapter Three: Literature Review

The subsidies literature has included debates regarding the different types of subsidies allocations. The focus, however, in the review of the literature was on the discussions and arguments that may affect public decision making with regards to subsidies for energy efficiency and alternative energy adoption programs.

This literature review starts by briefly defining energy subsidies as a general topic. This is followed by a discussion of the impacts of subsidizing fossil fuel products' production and consumption for decades and the policy reforms suggested by various analysts. Then, we discuss the debates over subsidies allocation for renewable energy and alternative energy adoption programs. Next, we present arguments in favor of natural gas as an alternative energy source to be adopted in the transportation sector, and provide examples of natural gas conversion programs that have been adopted and implemented worldwide. Finally the stakeholders' level of adoption and impediments to the adoption to alternative technology will be discussed.

In general, a subsidy can be defined as “any government assistance that allows consumers to purchase goods and services at prices lower than those affected by a perfectly competitive private sector, or raises producers' incomes beyond those that would be earned without this intervention” (Clements et.al, 1998, p. 4).

According to a study done by the United Nations Environmental Program (UNEP) and the International Energy Agency (IEA), 2001, no consensus definition exists for determining what could be considered as subsidy. The narrowest and perhaps most commonly used definition, according to the study, is a “direct payment by a government to a producer or consumer,” while broader definitions attempt to take into consideration other types of government interventions that affect the market prices or costs either directly or indirectly (UNEP & IEA, 2001). Examples

included in the study were the definition set by a 1998 OECD study, which defined subsidy in general terms “as any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduce costs for consumers and producers” (UNEP & IEA, 2001, p. 5). Similarly, the IEA defined energy subsidies as “any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers” (UNEP & IEA, 2001, p. 5). In a joint report published by IEA, OPEC, OECD, and World Bank, subsidies were defined as “one of many policy instruments used by governments to attain economic, social and environmental objectives.”

Subsidies can take many forms, including direct government payments to producers or consumers; low-interest government loans; intentional reductions in tax liabilities; government equity participation; government provision of goods and services at subsidized prices; procurement subsidies; and regulatory subsidies (Clements et al., 1995).

Governments usually justify subsidies in order to achieve different policy objectives. In many developing countries and transition economies, governments often keep consumers’ prices below market levels for social welfare reasons. Energy subsidies, predominantly, are aimed to help redistribute income to poor people, and to help poor people afford modern forms of energy or to pacify the middle class (UNEP & IEA, 2001). The next part discusses the implications of over-subsidizing fossil fuel products and reform policies and measures suggested by various analysts.

3.1 Fossil Fuel Subsidies:

Fossil fuel subsidies have been criticized extensively for resulting in negative economic, social and environmental impacts. The literature of the fossil fuel subsidies has cited the global and domestic negative impacts of the subsidies. This section discusses such negative impacts in order to emphasize the importance of the topic and the magnitude of the negative impacts of fossil fuel subsidies.

3.1.1 Economic Impacts

According to Ellis (2010), unless the subsidy is successful in correcting a market failure, it will result, inevitably, in a loss in economic efficiency. In that case, the subsidy can only be justified if any gain in social welfare or environmental improvement is judged to exceed the economic cost. In the real world, energy subsidies often fail to meet their objectives.

The economic impacts of fossil-fuel subsidies include, but not limited to: increasing energy consumption and reducing incentives for energy efficiency; decreasing foreign exchange revenues from energy exports; creating a burden on the government budgets; undermining investment in alternative energy sources and alternative energy technologies, that are potentially more efficient or less environmentally harmful; finally, it may encourage energy-intensive production at the expense of labor (Ellis, 2010). Thus, inefficient, poorly implemented energy subsidies are economically costly to the taxpayers and may reduce the social welfare. (IEA et al., 2010)

3.1.2 Environmental Impacts

The environmental impacts of fossil fuel subsidies are complex and mixed. On the one hand, there are cases where subsidies have positive environmental impacts such as reducing pressure

on forests by reducing biomass fuel use (Ellis, 2010). However, regarding the overall impact, fossil-fuel subsidies encourage excessive fossil-fuel consumption and result in excessive investments in sectors that are intensive users of energy inputs (World Bank, 2005).

Fossil fuel subsidies can damage the environment through increased emissions of GHG and other air pollutant (IEA et al., 2010). Fossil-fuel consumption is a key contributor to global GHG emissions. It is estimated to contribute 97 per cent of all man-made CO₂ emissions in the OECD countries. In addition, fossil-fuel combustion produces pollutants including sulfur dioxide, nitrogen oxides and particulates, which are released into the atmosphere and can cause long- and short-term health impacts. Finally, it results in the depletion of non-renewable fossil-fuel stocks (Ellis, 2010).

3.1.3 Social Impacts

Subsidies on fossil fuels -especially those aiming at improving the welfare of the poor or disadvantaged- can often lead to the opposite outcome (UNEP & IEA, 2001, p. 10). It often results in benefiting the rich more than the poor who spend more money on energy and have greater access to energy than the poor (Ellis, 2010). Several studies that were reviewed by the Independent Evaluation Group (IEG) of the World Bank found that, in developing countries, the bottom 40% of the population in terms of income distribution received only 15-20% of the fuel subsidies (IEA et al., 2010). In addition, fossil fuel subsidies usually do not target types of energy that would be more beneficial to the poor. In Egypt, for example, the richest 20% of the population get 93% of the total gasoline subsidy while the poorest 40% get less than 1% of the total gasoline subsidy (World Bank, 2005).

Moreover, subsidies may favor larger capital-intensive projects, such as dams or power plants, at the expense of local labor-intensive means of providing energy services. Finally, it may divert

government money that could be more effectively directed to social programs such as healthcare, free education, food coupons or targeted cash transfers.

3.2 Fossil Fuel Subsidies Reform

Since energy subsidies have often failed to meet their goals of enhancing national and economic development; many analysts have suggested and justified subsidies reform. It was justified because there are many advantages for eliminating fossil fuel subsidies.

In a study conducted by the World Bank Group that assesses the recent experiences with fuel subsidies in developing countries, it was concluded that “fuel price subsidies help the poor, but at a large cost to society and to governments. Governments should look for opportunities to move away from fuel price subsidies as rapidly as possible and replace them with targeted assistance to the poor.” In Egypt, a study conducted by the World Bank justified the Egyptian petroleum subsidies reform process for the same three important rationales, negative economic, social and environmental impacts of the subsidies (World Bank, 2005).

Although reforming the energy subsidies holds a lot of advantages both for the governments and for individuals, the reforming process is not considered a smooth path. Petroleum products directly and indirectly affect individual life. “Energy affects the competitiveness of all other industries. It affects how people work, move and live” (Sherif and Elsobki, 2010, p. 117). Thus, the sudden removal of the subsidy may create a huge chaos that the government may not be able to confront.

3.2.1 Fuel Subsidies in Other Countries and Lessons Learned:

Global experiences for countries such as Jordan, Ghana and Indonesia suggest that reform doesn't have to be either sudden or comprehensive. For example, in Jordan, the government had

initiated a gradual reduction of petroleum product subsidies plan in 2005, culminating in full price liberalization in February 2008. In order to avoid the negative impacts that will result from the sudden removal of the subsidies, Jordan introduced a diverse array of measures including increasing the minimum wage; a one-time bonus was given to low-income government employees and pensioners; cash transfers were provided to other low-income households whose heads were nongovernmental workers or pensioners (Coady et al., 2010).

Ghana launched a program called Poverty and Social Impact Assessment (PSIA) for assessing fossil fuel impact in 2004. The program was guided by a steering committee of stakeholders from ministries, academia, and the national oil company. PSIA was completed in less than a year. Then, in 2005, the government announced the 50 percent increase in the fuel prices. On the other hand, Indonesia introduced a cash transfer scheme that targets more than 15.5 million low income households before doubling the domestic petroleum product prices in October 2005 (Bacon and Kojima, 2006). In addition, some budgetary savings from reducing subsidies were reallocated to existing education, health, and infrastructure programs that benefit low- and middle-income households (Coady et al., 2010).

In view of the fact that it takes time to put in place effective social safety nets, measures that diversify the energy supply and reduce the total dependency on fossil fuel are key parts in implementing fossil fuel subsidies reform. The next part discusses the debate over renewable energy and alternative energy adoption subsidies.

3.3 Debate over Renewable Energy and Alternative Energy Adoption Subsidies:

According to Watt and Outhred 2006, renewable sources provided the major portion of the energy used for production, transport, and the different needs till the 19th century. Then over the last century, industrialization has been made possible by the exploitation of fossil fuel resources.

Over the past two decades, however, there has been growing awareness of the environmental and ecosystem impacts associated with the use of fossil fuels, nuclear power, and large hydro systems. Public opinion about these impacts, combined with the development of newer and more efficient technologies is leading to the widespread re-examination of the possibility of reliance on alternative energy sources and renewable energy systems (Watt and Outhred, 2006).

While renewable energy seems desirable, the transition will not be straightforward. There are a number of reasons, including: strong vested interests in the energy system; the full costs of environmental impacts are not yet incorporated into energy prices; the lack of infrastructure for alternative fuels; market distortions, where economic systems are strongly linked to the availability of cheap fossil fuel. Finally, often the most critical, barriers to renewable at present is a general lack of awareness and information on what is available, where to source it, and how best to use it (Watt and Outhred, 2006). Thus, the political will and government support are the most critical factors behind the full incorporation of renewable energy sources into the energy markets.

Correspondingly, the same arguments apply for alternative energy adoption. Thus, it has been argued that “Government aid, not the market, is the real engine driving the boom in alternative energy” (Islam, 2009). Subsidies, tax credits and grants have assisted individuals and companies to purchase and install their own alternative energy generators. Subsidies and tax breaks provided incentives for consumers to adopt alternative energy products that are simply not market-based (Islam, 2009).

Strategies being employed around the world to accelerate their introduction include mandatory targets and supportive tariffs, tax incentives, capital cost subsidies, support for research, development and demonstration, facilitating customers’ choice of renewable options, education,

and information. Nevertheless, concerted efforts and strong political will are needed for a successful transition from central to distributed generation systems, from centralized to locally based decision making and from monopolistic to competitive energy supply services (Watt and Outhred, 2006).

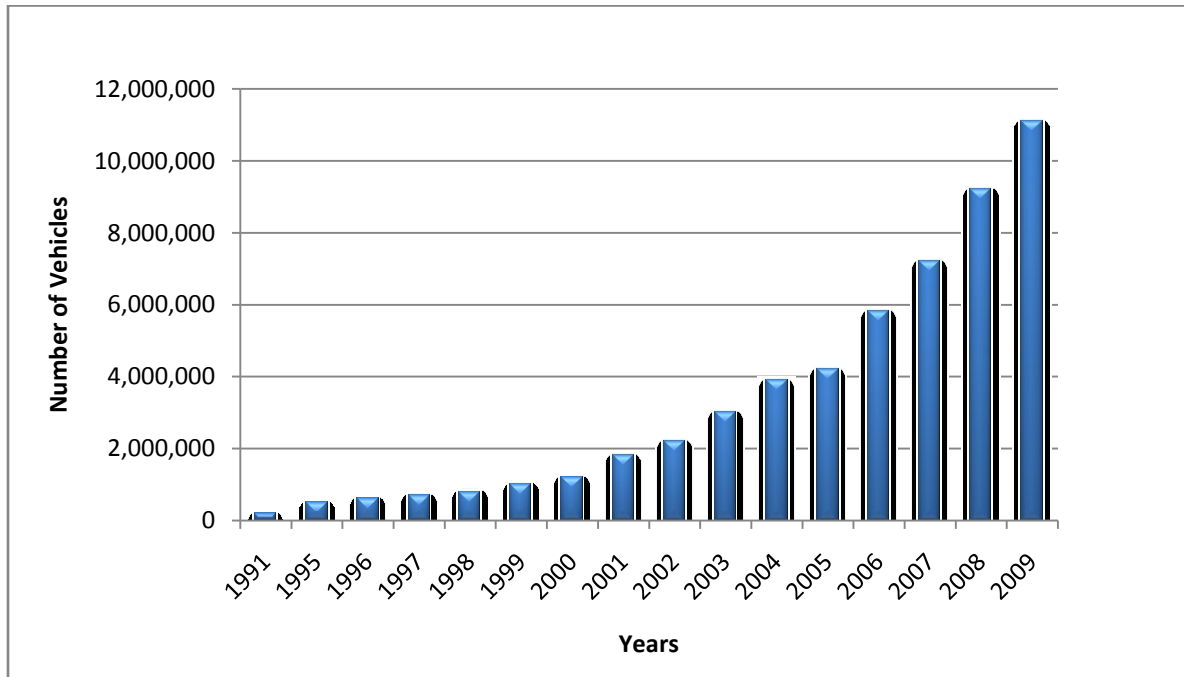
3.4 Importance of Natural Gas as One of the Best Solutions:

If fossil fuel subsidies have been heavily criticized, why should governments support natural gas? The answer to this question is that although greenhouse gas reduction strategies are becoming key policy drivers in the energy sector; renewable energy sources are not always the most cost effective options. In the short-term, GHG reduction policies adopted are likely to emphasize other measures that do not require the introduction of radical changes to the current system of energy supply and use (Watt and Outhred, 2006). For example, the impact of replacing the car stock with fuel efficient, cleaner and lighter vehicles represents an effective policy measures that can reduce the greenhouse gas emissions and improve the energy supply system (JCEE, 2008).

While natural gas is often used as the energy source for residential, commercial, and industrial processes, engines designed to run on gasoline or diesel can also be modified to operate on natural gas. Natural gas is considered the cleanest burning fossil fuel (Convert to Natural Gas, 2010); thus, fuel shifts to natural gas reduces the GHG emissions and improve the energy security by diversification (JCEE, 2008).

The importance of natural gas has been emerging globally as an efficient way to reduce the GHG emission in the transportation sector. As shown in Figure 5, according to the International Association for Natural Gas Vehicles (IANGV), 2010, the annual growth rate for natural gas vehicles have reached an average 20 percent growth rate per year since year 2000.

Figure 5: Natural Gas Vehicles Growth Worldwide 1991-2009

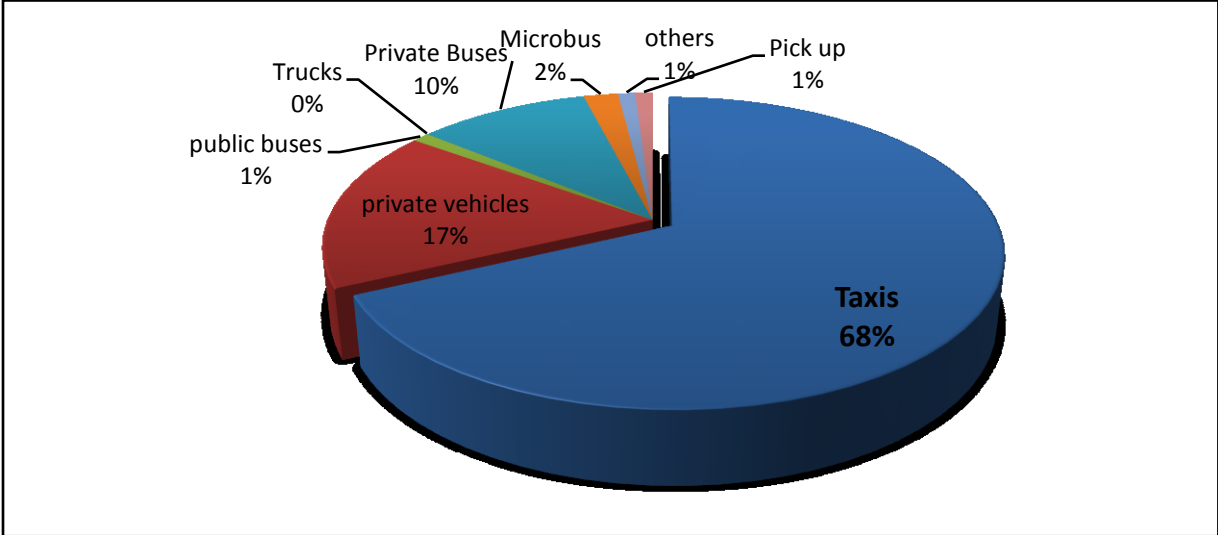


Source: International Association for Natural Gas Vehicles (IANGV), 2010

In Egypt, the decreases in oil production have been offset by the rapid development of the natural gas sector, for both domestic consumption and export. According to the U.S. Energy Information Administration (EIA), almost all of the energy consumption in 2007 was met by oil and natural gas, with 51% and 42% share for each respectively. Although, the oil's share of the energy mix is mostly in the transportation sector; natural gas has been gaining an increasing importance. The share of natural gas in the transportation sector is expected to grow with the development of compressed natural gas (CNG) infrastructure and vehicles conversion programs (EIA, 2010).

Since 2006, 131,930 vehicles had converted to work on natural gas, with an average of 1,275 vehicles per month. As presented in Figure 6, 68 percent of the total vehicle conversions were for taxi vehicles (El- Nil, 2010).

Figure 6: Natural Gas Vehicles Conversion in Egypt (2010)



Source: NG Report Summary on Natural Gas Conversion Status, 2010

While considering the environmental importance of natural gas – as a clean burning fuel, we must also consider the economic and social importance of adopting natural gas in the transport sector in Egypt. According to the Taxi Recycling Program proposal presented by the Ministry of State for Environmental Affairs (MSEA), the subsidies burden for gasoline and solar fuel - LE 2.50 per liter and LE 2.90 per liter respectively- could be reduced by the introduction and support for natural gas- for which the subsidies burden is only LE 0.15 per cubic meter. Furthermore, while the adoption of natural gas in the transport sector does not affect the continuing large subsidy to upper-middle and upper income car owners, it will at least redress the balance with respect to the negative social impacts of fossil fuel subsidies.

The expansion of natural gas in the transportation sector is one of the most efficient short-to-medium term strategies that could be adopted to alleviate the economic, social, and environmental burden of fossil fuel consumption subsidies. The next part discusses some of the

natural gas conversion programs that have been implemented worldwide and will assess their economic, social and environmental impacts.

3.5 Natural Gas Conversion Programs:

Clean air programs, those aimed at reducing local air pollution, have been put into place in many countries. These programs have targeted, in most cases, local emissions from vehicles and combustion of coal and biomass (Watt and Outhred, 2006). In the mid 1930s, the use of natural gas vehicles was first introduced in Italy as an alternative to gasoline-powered vehicles. In the 1940s, it began spreading to other countries. In the 1970s, after the energy crisis, in both developed and developing countries, governments have been promoting natural gas vehicles as a clean alternative to gasoline and diesel vehicles, and also to reduce dependence on foreign oil (Yeh, 2007).

According to Yeh (2007), the adoption of Alternative Fuel Vehicles has been regarded as one of the most important strategies to address the issues of energy dependence, air quality, and climate change. In the study, Yeh (2007) compared the adoption of natural gas in eight countries- Argentina, Brazil, China, India, Italy, New- Zealand, Pakistan, and the US- and found that the factors that motivate governments to promote the adoption of alternative fuel –natural gas- vehicles in the transportation sector include: the environmental benefits of reducing the air pollution; reducing the dependency on imported oil and the urgent need to diversify away from oil; and the availability of natural gas resources and existing pipeline and delivery infrastructure. All of the countries examined have offered financial incentive programs both to consumers and equipment suppliers. Incentives included: subsidies and tax breaks to reduce prices of natural gas specifically for transportation; rebates and loans to lower or eliminate consumers' vehicle conversion costs; exemptions from import duties and the lowering or elimination of import

tariffs on machinery, equipment, and kits; and exemption from sales taxes for the construction and operation of refueling stations.

In 1969, the natural gas vehicles started to appear in the US on a very small scale. In 1992, as a result of the Energy Policy Act (EPACT), the market share of natural gas vehicles had grown significantly. It had been primarily adopted by government light-duty fleets. In addition, natural gas had presented opportunities for taxis, especially in large cities with air pollution problems. Compressed natural gas taxis are in service in Atlanta, Las Vegas, Los Angeles, Toronto, and Washington, D.C. (Siuru, 2007). Taxis represent a great area of focus, because of their high annual mileage; some taxis rack up 50,000 to 100,000 miles annually. Thus, replacing one gasoline taxi with a natural gas one nets about the same emissions reduction and gasoline displacement as replacing 5-10 personal-use or conventional fleet cars driven an average of 10,000 miles per year (Siuru, 2007).

In New York, over 300 cabs have been converted to run on CNG, many of which travel 100,000 miles or more annually. The New York City Clean Fuel Taxi Program provides funds toward the purchase of new natural gas taxi cabs or the conversion of gasoline cabs to natural gas. Besides reduced exhaust emissions, CNG vehicles do not release fuel vapors while refueling or due to fuel heating during vehicle operation. In addition, operators generally say that CNG vehicles are better to the driver than gasoline vehicles; because they have lower maintenance costs, longer life expectancy, and lower fueling cost. Additionally, drivers who were often in their cabs for up to 12 hours at a time, prefer natural gas taxis because of their lower emissions (Siuru, 2007)

In Latin American countries, primarily Brazil and Argentina, governments have strongly promoted natural gas as a replacement for gasoline and diesel in order to reduce urban air pollution and increase energy independence (Yeh, 2007). In Brazil, for example, Rio Grande Gas

Company has commenced a long with the government, a new initiative to expand the sales in the natural gas vehicle sector. The program offered conversion incentives for new users and for already-converted users, including 10% discount on conversion, a bonus of 400 cubic meters of fuel, and fuel discounts (NGV, 2009). Another example is that of Peru's government, which sponsored "My Taxi" natural gas program. The program has led to savings of over \$414 million in costly diesel and liquefied petroleum gas imports reduction. The program was designed to help drivers convert their engines to natural gas as part of Peru's strategy to convert to low-cost natural gas; in order to reduce the current hydrocarbon deficit and the country's dependence on costly diesel and liquefied petroleum gas (Anniether, 2008).

In addition, several Asian countries, notably India, China, and Pakistan, had significant natural gas vehicles growth beginning in the late 1990s. The best-known success story, according to Yeh (2007), took place in India, where in response to a citizen lawsuit initiated in 1985 over poor air quality in Delhi, the Supreme Court issued a series of resolutions instructing the government to ensure that all public transportation, buses, taxis, and auto-rickshaws switch to clean alternative fuel.

In China, the primary reasons for moving to a larger NGV market are environmental concerns and energy security (Seisler, 2000). China's growing demand for imported gasoline was evidenced when it became the world's second-largest oil consumer after the US. The Chinese government has played a major role in promoting liquefied petroleum gas (LPG) and CNG fuels in public transit buses-through various R&D programs, direct investments, incentive programs, and targets.

Although natural gas conversion programs have been successfully adopted and implemented, they have faced some obstacles and impediments that jeopardized the continuous success of the

program. For example, in New York, Natural Gas Taxi program started in the late 90's with 300 taxis; however, by December 2004, it had less than 100 taxis. The main Barrier to the program success was the lack of proper infrastructure which limited the driver's access for Compressed Natural Gas (CNG) stations (Simon, 2004).

Other examples include New Zealand and Canada. New Zealand, for example, had a very successful natural gas vehicles market in the mid 1980s; that resulted from government incentives and targets for the adoption of natural gas vehicles. However, by 1985, policy and political changes promoted the government to cancel the favorable compressed natural gas loan conditions, and the market eventually disappeared (Yeh, 2007).

Flynn's study (2002) that focused on barriers to the growth in Natural Gas Vehicles (NGV) during the period 1984-1986 in Canada cited the main barriers to include: lack of infrastructure to support converted vehicles; lack of refueling facilities; failure of existing refueling stations to achieve profitability, which stalled further investment. Other problems included exaggerated claims for environmental and economic benefits, and poor design of the promotional programs.

On the other hand, the World Bank Energy Sector Management Assistance Program (ESMAP) cited the successful conversion in Argentina; where CNG vehicle program was launched in 1984. By then, there was an extensive network of natural gas pipelines reaching most cities. There were no subsidies offered by the government; instead, the incentive for fuel switching stemmed entirely from the high tax on gasoline. In December 1999, the fuel prices reached US \$1.04 per liter of premium gasoline, 0.50 per liter of diesel, and 0.33 per cubic meter of NG. At these prices, the payback period for those vehicle owners converting from gasoline to CNG could be a matter of months depending on the total number of kilometers traveled a year (ESMAP, 2001).

Thus, there is no one best strategy that could be adopted to ensure the successful implementation of NGV conversion programs; rather, strong political will, careful assessment of the stakeholders' involved, and detailed analysis of the market is a key to the successful adoption. The next part discusses the importance of the careful assessment and involvement of the stakeholders.

3.6 Stakeholders:

The literature has cited the importance of a constructive coordination between the different stakeholders in order to ensure the long-term success of alternative energy adoption programs. According to Byrne and Polonsky (2001), the success of energy efficiency and alternative energy programs does not rest only on the shoulders of consumers; rather, it relies on a network of stakeholder involvement. Since the programs always affect and are affected by different groups of stakeholders, it is important to note that, as in any stakeholder network, the behavior of each group is interrelated and they are interdependent to a large extent. Thus, the failure to include and fully consider each group in the development and implementation of the programs may inhibit its growth and expansion.

The different needs of the various stakeholders must be taken into consideration while setting different policies and measures. Successful policy interventions to promote alternative vehicles and fuels will require well-designed combinations of regulatory standards, information, incentives, and market creation. Any effective policy-intervention strategy must be designed to reduce the key barriers affecting each stakeholder group whose actions may determine the policy's success (Yeh, 2007).

There are a number of impediments to consumers' adoption of alternative fuel vehicles, including: regulatory barriers, resources availability, lack of infrastructure, and vehicle

characteristics. These impediments do not only affect the consumers, rather, they also impact other stakeholders, such as government, fuel producers and suppliers, competitors (producers of alternative products), and activist groups. The inter-relationships amongst all stakeholders are complex, as one group may initiate actions that serve as impediments for others. Thus, developing systems-based sustainable alternatives to traditional, environmentally-harmful automobiles requires the network of relationships between stakeholders and impediments to be considered. The most likely method of removing barriers or even transforming barriers into positive opportunities is to encourage the development of a network of exchanges; where effective communication within this network of exchanges is thus a prerequisite for long-term alternative fuel vehicles market success and improved environmental outcomes (Byrne and Polonsky, 2001).

3.7 Literature Conclusion:

To sum up, the adoption of alternative fuel vehicles has been recognized globally as one of the most effective strategies to address the issues of energy dependence, air quality and climate change. However, the successful adoption of the alternative fuel program requires strong government will in addition to a clear definition of the stakeholders involved, how each will benefit, and effective communication among the stakeholders' defined.

In case of an alternative energy adoption programs, subsidies and government incentives may or may not be considered as an economic burden, depending on the presence of subsidies or other incentives for the traditional technology. Rather, they may be viewed as an effective tool to reduce the negative economic, social, and environmental impacts of fossil fuel subsidies. The importance and the advantages of the introduction and adoption of natural gas in the transportation sector has been recognized globally, with the implementations of several natural

gas vehicles conversion programs that have resulted in reducing local air pollution, reducing the dependency of governments on oil and diversifying energy supply from oil through the promotion and adoption of natural gas. The next section discusses the methodology used in this study and assesses why this methodology was chosen and applied.

Chapter Four: Methodology

4.1 Basic Aim of the Research:

The research paper aimed to examine Egypt's Taxi Recycling Program, in order to call in question the overall perception that energy subsidies, especially in the service sector, are necessarily barriers to the adoption of improved technology. It provided a case study for an innovative subsidies program that was not only successful in reaching the targeted population effectively, but also lifted some of the fuel subsidies burden off the government budget. The research study defined and evaluated the impact of the program on the different stakeholders involved. The final outcome of this study is a formal and academic documentation of the costs involved and the benefits that can be drawn by the different stakeholders involved in alternative energy adoption programs. Thus, it could be used by the decision makers to enhance the policy making process.

To the extent that the results of the research showed that the planning of the program or its implementation was not as successful as predicted, or that the costs exceeded the benefits drawn from the program, the research aimed to define the areas of deficiency and the appropriate strategies and approaches for stakeholders' engagement. It provided a better understanding of the groups that should be encouraged to participate in different stages of the program; and it proposed ways to improve the policy making process with regard to the planning and implementation of alternative energy adoption subsidies programs.

4.2 Relevant Methodologies that were Found in the Literature

The literature provided several methodologies have been used to assess the usefulness and the impact of alternative energy adoption subsidies program. The cost-benefit analysis was the most

common methodology found to be used. For example, in a study that analyzed the natural gas vehicle program in Thailand, the economic aspect of Thailand natural gas vehicle conversion was investigated in terms of the cost of diesel oil that can be substituted for by natural gas in the case of pickup truck, non-fixed route truck and private truck vehicles. It was noted that two main technologies of diesel natural gas vehicle (NGV), i.e. dedicated retrofit and diesel dual fuel (DDF), were considered in this work. The study found that the dedicated retrofit needed higher investment costs than dual fuel, but can achieve higher diesel saving than dual fuel (Chouykerd et al., 2008).

The behavioral model based on the theory of reasoned action was used by Johns et al., 2009, in their study that evaluates the conversion of DuPage County's local government fleet from gasoline to bi-fuel, compressed natural gas and propane gas powered vehicles. The model was employed to explore factors that influence individuals' perceived and actual use of alternative fuels. Analysis was based on survey data collected from primary drivers of bi-fuel fleet vehicles at the forest preserve district of DuPage County, Illinois. The study findings showed that environmental attitudes do not have a significant effect on actual or perceived use; however, external variables such as fueling convenience, vehicle performance, and the extent of informal communication significantly affect the driver's likelihood of using alternative fuel. Yeh (2007) has compared the adoption of natural gas vehicles in eight countries, earlier defined in the literature review.

In addition, relatively new methodologies, such as Soft System Methodology (SSM), have been modified and implemented to assess and analyze alternative energy adoption programs. According to Neves et al., 2004, energy efficiency initiatives became more a public policy issue than a business issue, with a major focus on the environmental and social externalities that need

to be accounted for. This perception led to the need for a clear formulation of the problem in order to seek better solutions. The use of a problem structuring methodology then emerged as a valuable tool in this process.

Soft System Methodology (SSM) was developed by Chekland in the late 1960s at Lancaster University in the UK (Mingers and Taylor, 1992). It was used to explore the situation, identifying the stakeholders and their relations, and modeling the evaluation system to be used by an interested party (Neves et al., 2004). With regards to energy efficiency initiative, SSM has been used to gain insight into the problematic concept of the interest of the different stakeholders involved in the energy efficiency initiatives. SSM makes it possible to look at the whole context within which energy efficiency initiatives are undertaken, defining a system for providing decision support as to which initiatives are better and for whom, and to identify all possible implications of this decision.

The major outcomes of SSM are “the identification of all the agents in the market, promoting or affected by energy efficiency initiatives, their role in the process and the relations of power”. Thus, the ultimate goal of SSM is defined to be “the formulation of a more adequate decision model, which should give decision makers in different player entities a structured support for a more informed decision, regarding the implementation of energy efficiency initiatives” (Neves et al., 2004).

In this thesis, the SSM was applied on the Taxis’ Recycling program. SSM was chosen to create a general understanding of the role and the power of the stakeholders involved. It provided a tool for evaluating the performance of the stakeholders involved. In addition, it helped in restructuring the role of the different stakeholders involved based on the outcome of the model (Mingers & Taylor, 1992).

In order to enhance the findings, cost-benefit analysis methodology was used to assess the costs and benefits from the perspective of two key stakeholders: the government and the taxi drivers. This analysis helped provide quantitative evidence as to the gains or losses incurred by the government, the initiator of the program, and the taxi drivers, the targeted population of the program. It did not include the other stakeholders identified because of the time limitation and lack of data to support the research.

4.3 Data Collection:

The data collected included quantitative and qualitative descriptions of the different costs and benefits acquired by the government and the taxi owners. It provided an explanation for the role of every significant stakeholder and the level of communication and involvement in the program.

Primary data were collected through the distribution of a questionnaire to taxi drivers. The taxi owners' cost-benefit analysis was based largely on survey data collected from the taxi drivers. The survey questions were asked by the researchers while he/she was in the taxi. This method of collection was chosen to ensure a higher response rate and increased cooperation on the part of the taxi drivers. The method of distribution also was expected to be the most feasible, as there was no database for taxi drivers through which to distribute the questionnaire.

In addition, we conducted a series of interviews with government officials who were directly involved in the initiation, planning and implementation of the program and the stakeholders who influence or are influenced by the program. These interviews provided in depth analysis of the perception of the different stakeholders regarding their role in the program, the level of involvement, and their interests versus the power of the different stakeholders in influencing the program. As to secondary data, we went through reports, documents and information available

on the program from different sources including the EEAA, the Ministry of Finance, World Bank, and UNCFFF online databases.

Chapter Five: Description of Data Collected

The survey goal was to examine the main costs and benefits from the perspective of the taxi drivers under the Taxi Recycling Program. These data were used to evaluate the usefulness of the program from the taxi drivers' point of view, as they are the key targeted population. The survey gathered data pertaining to six data items, which include: reasons for joining the program; taxi drivers' fuel choice, natural gas or gasoline ; maintenance services and how the new cars' maintenance differs in cost and quality from that of the old cars; the taxi drivers' perception and comments on the financial incentives provided; the taxi customers' perception of the new white vehicles as perceived by taxi drivers; and how their income changed under the new program. In addition, some overall evaluations questions on the whole program were included in the survey, as well as some questions to collect basic demographic data.

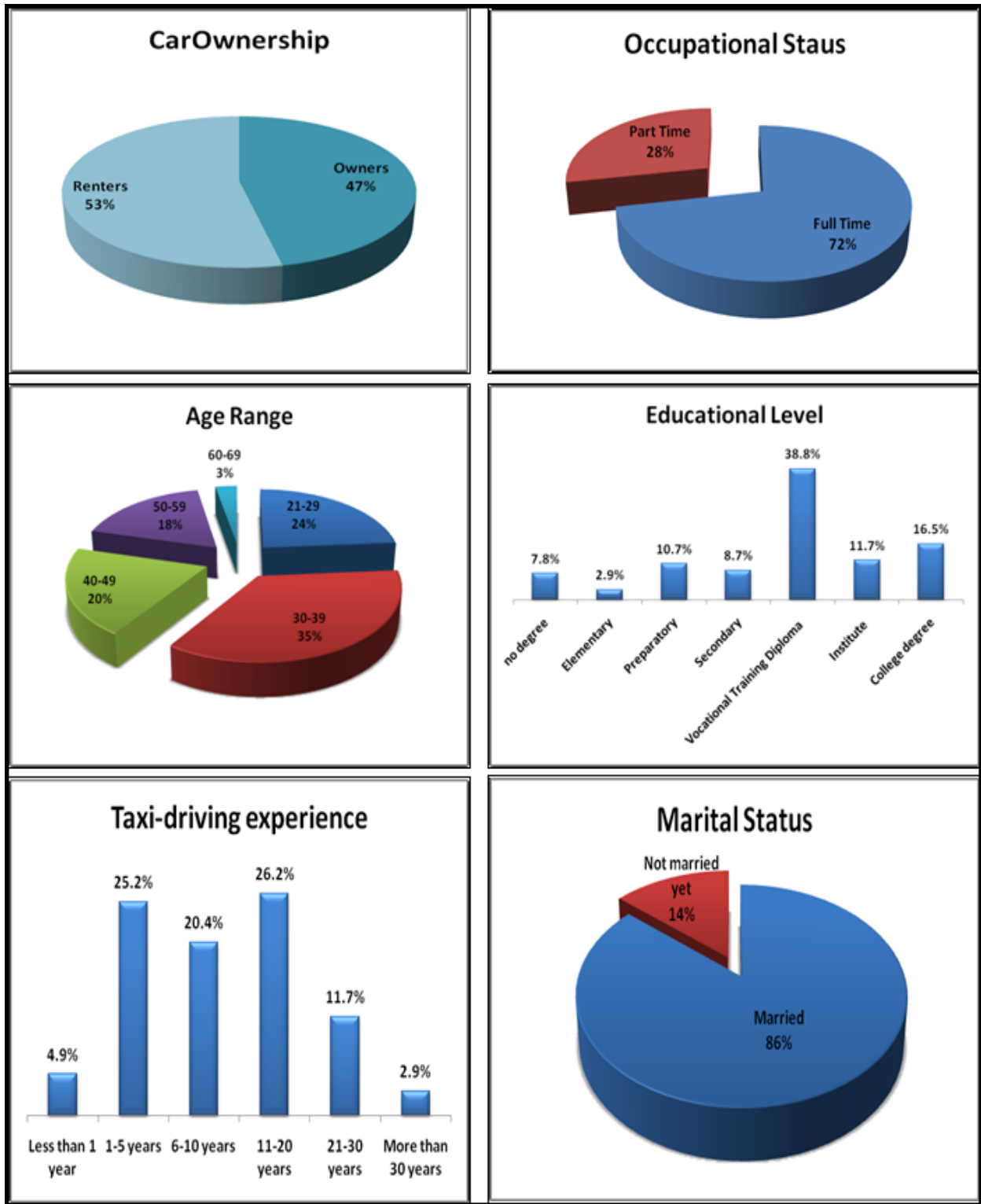
Regarding the sample, we were targeting white taxis, which are part of the Taxi Recycling Program. The sample was randomly selected, the researchers generally hailed a cab on the street and asked for a certain destination that would provide enough time to complete the surveys, which were conducted with drivers who accepted going to the destination and accepted participating in the survey.

An overall number of 111 interviews/surveys were conducted with white-taxi drivers who participated in the program; of those, 103 surveys were fit for use in the research sample. A pretesting of the survey was done on 4 taxi drivers who fit the parameters of interest, but no significant changes were made. Some minor changes were made to make the questions clearer for the taxi drivers to answer and for the researchers to ask. Four surveys were excluded. Two were more than 60% incomplete while the other two did not fit the parameters of interest as they had not been taxi drivers on black and white vehicles before they joined the program. They

joined the program, because they found it a reliable investment opportunity to buy a new white taxicab. They both used their savings to buy the car from a friend or from a dealer showroom. Thus, they are not directly involved in the different steps of the program. No comparison could be made between their experiences driving an old black-and-white cab versus what they are currently experiencing while having a new white cab under the program. Their interviews were influential on both the personal and professional level; they are used later in the analysis to define some of the social impacts of the program. However, their surveys are not applicable to the stated sample.

All surveys were done with male taxi drivers who drive a white taxi cab. They are either leasers or owners of the white taxi and used to drive black-and-white taxis (old taxis). As shown in Figure 7, the surveys ensured a diversified sample. It varied based on the ownership status of the taxi, occupational status of the taxi (part-time versus full-time taxi drivers) educational level, experience, age, and marital status.

Figure 7: Sampled Data Description



Limitations:

Surveying taxi drivers was a challenging task. Even with the help of the research assistants, collecting around 100 surveys took one month of fieldwork. Some challenges included: the surveys being time consuming; the lack of survey culture in Egypt; and training the research assistants who were going to interview/ survey taxi drivers while they are in the taxi.

Although the survey was planned to take around 15 minutes, it usually took over 25 minutes to finish the survey. Taxi drivers are used to talking. Interviewing skills were necessary to control the interview and get answers to the survey questions. In addition, traffic conditions made it even more time consuming. Since researchers were instructed to ask the taxi driver for a destination, and the taxi that accepted was then asked to participate in the survey, it would sometimes take up to 20 minutes to find a taxi willing to go to the mentioned destination. This reduced the efficiency of getting the surveys done.

The lack of a surveying culture in Egypt also posed a great challenge, since people are not accustomed to filling out surveys and cooperating in data collection processes. Some taxis were very reluctant in giving out any information, while others refused to answer some questions related to their income, program evaluation, and demographic questions. Finally, finding research assistants who have the necessary interviewing skills, time and are willing to participate in the research within the time limits of the research presented an additional challenge. Thus, all research assistants who participated were working on the surveys based on time convenience, for example, they would only take a taxi to and from their work. The next section analyzes the collected data using cost benefit analysis and the soft system methodology.

Chapter Six: Analysis of Data

The data collected through surveys were entered on an Excel file. The different answers were number-coded to facilitate the analysis. The data was analyzed using SPSS application. The different variables were described in terms of frequency and percentages. In addition, cross-tabulations were used to define the relations that might exist among different variables.

The Cost Benefit Analysis (CBA) and the Soft System Methodology (SSM) were applied on the Taxi Recycling program. The CBA is applied to define the main costs and benefits drawn by the two key stakeholders- Egyptian Government and taxi drivers participating in the program. The SSM is applied to have more detailed understanding of the role and the power of the stakeholders involved; in order to evaluate the performance of the stakeholders. Thus, we could recommend actions to improve the policy making process and the performance of the different stakeholders.

6.1 Cost-Benefit-Analysis (CBA)

The financial and the economic benefits and/or burdens of the program were analyzed from the standpoint of the taxi drivers and the government. Although the program's benefits extend to include major environmental and social benefits, this part will focus only on the economic and financial analysis. Later we discuss the environmental and social benefits in more detail.

6.1.1 Taxi Owners/Drivers CBA:

In Egypt, based on ownership status of the regular taxi on which the program is applied, there are three different categories for taxi drivers, which include:

- Owners of the taxi vehicle, who usually rent their cars to drivers in exchange for a previously agreed on amount of money.
- Owners-drivers who work full-time or part-time as taxi drivers on their own car.
- Taxi drivers who lease taxi vehicles and work on it either full-time or part-time.

The CBA is applied on the second category, white taxi vehicles owners who work on their taxis either full-time or part-time. The owners represented 47% of the whole sample. Only owners were taken into consideration in this part of the analysis, because they are the most influenced by the burden that may have resulted from the bank monthly installments and the maintenance costs that may have changed. Later, we discuss the main benefits and costs for new white taxi vehicles renters.

The analysis was based on the sample weighted average benefits and costs encountered by the taxi owners-drivers. The benefits include: income earned, advertisement support and the government subsidies offered in exchange for the old vehicles. The costs include: the vehicle monthly installments, the maintenance costs, the insurance costs, and the fuelling costs.

Although the program was operating successfully, the rapid growth of the program created some challenges. As explained earlier in the program background, the advertising company, one of the participating private sector companies that had been responsible for offering a fixed rate per month for a period of up to five years to the lending bank towards vehicle owner's debt service payments, was not able to fulfill its commitment. Thus, the program was divided into three phases; phase 1 that was entitled the advertisement support and phase 2 and 3 that did not get the advertisement support. In addition, the natural gas adoption goal, which at the beginning was the main reason for adopting the program, has been offset by the other goals of the program. Rather than the obligatory use of natural gas as an alternative fuel, it became optional for taxi drivers to choose between natural gas and gasoline. However, it must be mentioned that new vehicles are modified to work on both natural gas and gasoline. Taxi drivers do not depend on natural gas for long-distance travelled or between governorates, where they might not find any natural gas

fuelling stations. In addition, they usually use gasoline for the first 10,000 Kilometers travelled, as recommended by the vehicle companies.

Based on the CBA results, the taxi owners-drivers net monthly income was affected by two key variables, the advertisement support and the fuel type used. As shown in Table 1, the average annual car installments differed based on whether or not the taxi owners were entitled the advertisement support. In addition, the fueling costs varied significantly based on the fuel type used. The sample weighted average maintenance costs as well as the sample weighted average benefits incurred were calculated for all sampled taxi owners.

Table 1: Taxi Owners' Cost Benefit Analysis (CBA per Taxi Owner, 2010 year prices)

	Year 0 Gasoline	Year 1 Gasoline	Year 0 Natural Gas	Year 1 Natural Gas
Costs (LE)				
• Annual sample average car installments (without ad support)	14250	14250	14250	14250
• Annual sample average car installments (with ad support)	8250	8250	8250	8250
• Annual sample average maintenance services costs	2850	2850	2850	2850
• Sample average gasoline / natural gas costs per year	11609	11609	3450	3450
Benefits (LE)				
• Government subsidies payments	5000		5000	
• Sample average annual income	31750	31750	31750	31750
Annual income (without ad support)	8041	3041	16200	11200
Annual income (with ad support)	14041	9041	22200	17200

As per Table 1, year 0 is the year when the taxi drivers changed their old vehicles with the new white vehicle. In year 0, an additional LE 5000 is added as benefits for taxi drivers. This amount was originally received by the taxi drivers from the government as a compensation for their old cars. They received it in the form of a check that was then used as a down payment for their new cars at the bank. Thus, year 0 costs include the car installments, the maintenance costs and the fuelling costs; while benefits include the income earned and the payment received from the government in exchange for their old car. It should be noted that, from a strictly economic standpoint, the payment for the old car and the loss of the car should cancel out; but, because of the new law, the cars cannot be resold and, because of the large number of vehicles that would have to be scrapped, the scrap value would likely be low. This is why the government payments were calculated as benefits for the taxi owners.

Year 1, represents the regular year that the taxi drivers would have during their installments period, during the time they are paying the bank installments, which ranges from 5 to 7 years. In year 1, the costs incurred by the taxi drivers are: the car installments, the maintenance costs, and the fuel costs; while the benefit includes their monthly income. The depreciation cost was not added to simplify the calculations and because it is not generally taken into account by the owners. Even without adding the depreciation costs, the results show that taxi drivers' income earned varied based on the fuel type they are using and on whether or not they had the advertising company support. It would be expected that maintenance cost and possibly fuel cost would increase as the vehicles age, but it was not possible to obtain an estimate of this impact.

Thus, as shown in Table 2, taxi owners-drivers were grouped into four categories based on whether or not they were entitled the advertisement support and the fuel type used-natural gas or gasoline - in their new taxi-vehicles.

Table 2: Taxi Drivers Monthly Income Variation based on Advertisement Support and Fuel Type Used

Monthly Income Fuel Type	With Advertisement	Without Advertisement
Gasoline (Year 0)	1170 LE	670 LE
Gasoline (Year 1)	753 LE	253 LE
Natural Gas (Year 0)	1850 LE	1350 LE
Natural Gas (Year 1)	1433 LE	933 LE

Reference to Table 2, the lowest income earned is the case where taxi drivers do not have the advertising company support and are using gasoline, while the highest income is earned by taxi drivers who have the advertising support and are using natural gas. The income difference between taxi drivers who got the advertising company support and those who did not is LE 500 per month. The income difference that resulted from the different fuel types used natural gas versus gasoline is LE 680 more in case of natural gas. Thus, taxi drivers who are using natural gas and have the advertising company support receive the highest monthly income, averaging LE 1850 and LE 1433 in year 0 and year 1 respectively, the lowest average income is earned by taxi drivers who did not get the advertising support and are using gasoline, LE 670 and LE 253 in year 0 and year 1 respectively. Thus, the total difference between the taxi drivers monthly income based on these two variables is LE 1180 per month, equivalent to 215 US dollars per month.

The income was calculated assuming that the car owners will only get what they earn while driving their taxis; however, in most cases the taxi owners-drivers would rent the vehicle for an extra shift, i.e. if they work on the taxi for 8-10 hours, they will rent the car to another drivers to

work on it for an extra shift. The sample average rent, based on the taxi renters, is LE 74 per day; which would add an average of LE 2300 per month to the taxi owners sample average monthly income.

It must be noted that all the CBA figures were calculated in 2010 year prices; where 1 US dollar was equivalent to LE 5.6124, according to the CIA fact-book. In the same year, the GDP- per capita (PPP) was 6,200 US dollars in Egypt compared to 47,400 US dollars in the United States¹. The results show the huge impact that resulted from the advertising company support. In addition, it may motivate more taxi drivers to shift from the use of gasoline to natural gas; especially that the new cars must use gasoline octane 90 and 92, better quality than that the taxi drivers used to use on their old cars, octane 80. This raises the prices for gasoline for car drivers LE 0.75 per liter (90 octane costs LE 1.75 while 80 octane costs LE 1.00). This was confirmed by the results from the sampled data which showed that 36% of the taxi drivers use natural gas and 59% use gasoline in their old cars. On the contrary, 62% of the taxi drivers chose natural gas and 38% chose gasoline in their new cars.

Although the program may have indirectly supported the adoption of natural gas, there are several barriers that might hinder its adoption. The lack of proper natural gas infrastructure is one of the most important challenges facing the adoption. In addition, the affects of natural gas on vehicle performance is not clearly defined. Moreover, the space that the natural gas tank takes at the back of the vehicles. Finally, some surveyed drivers had questioned the safety level of having the natural gas tank at the back of the vehicles. These challenges are discussed in more details later in the Soft System Methodology analysis.

¹ Regarding the costs associated with CO₂ emissions' negative environmental impacts, we used the latest available figures from CAPMAS, reported in 2010; however, the report does not cite a date for the estimates.

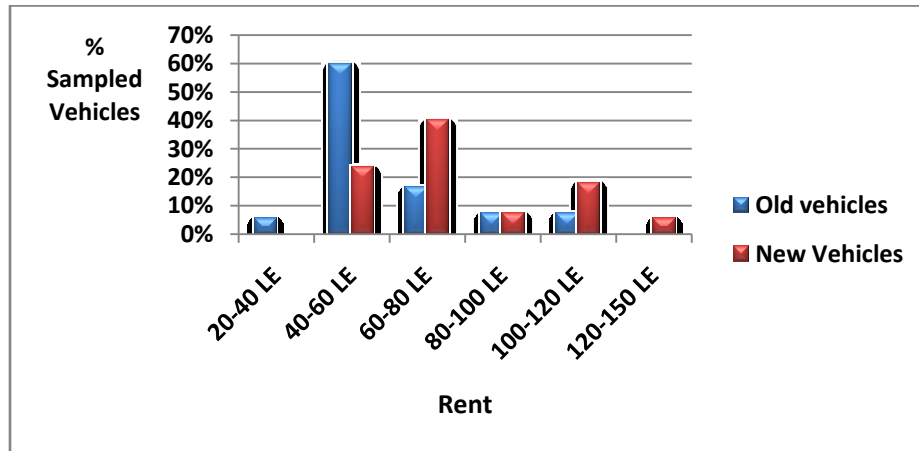
6.1.2 Taxi Renters/Drivers

The taxi renters are indirectly influenced by the economic costs and/or benefits of the program implementation. They are directly influenced by the social benefits of the program. This part provides preliminary assessment of the costs and benefits incurred by the taxi renters. It is important in order to have a broader understanding of the program's indirect economic impact on the taxi renters, one of the program beneficiaries.

The renters usually rent the taxi vehicles in exchange for a previously agreed on amount of money. 53 percent of the surveyed taxi drivers were taxi renters. The taxi renters were affected with the rent increase. In addition, they were affected with the fuel costs changes, especially in the case of gasoline. On the other hand, the main benefits include the positive social impact of the project including, the income increases that may have resulted from the increased productivity, and the improved working conditions.

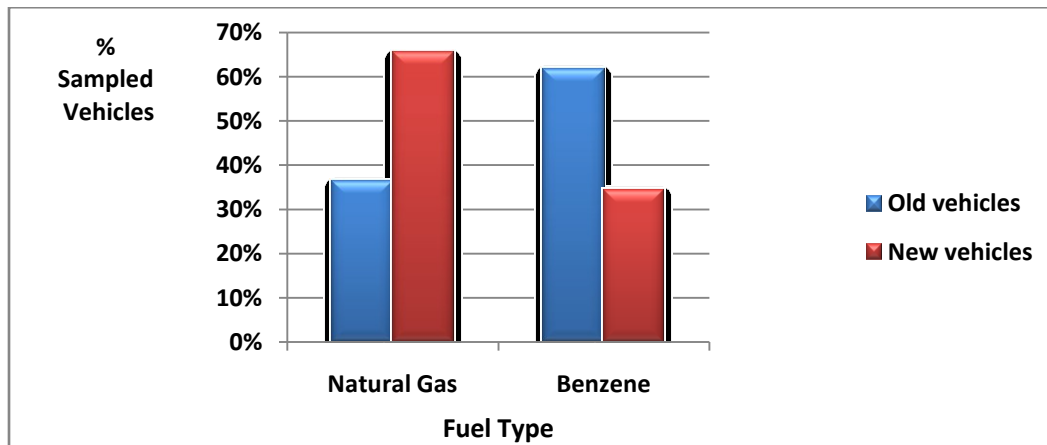
As shown in Figure 8, more than 60 percent of the taxi renters typically paid from LE 20 to LE 60 per shift for their old vehicles; while more than 60 percent of the taxi renters pay from LE 60 to LE 120 per shift for their new vehicles. The sample weighted average rent paid is LE 58 and LE 74 per shift for the old vehicle and the new vehicles respectively. The taxi shift average between 8 to 12 hours depending on the rent agreements with the taxi owners. The costs incurred by the renters include an average of LE 16 per shift, the difference between rent paid for new vehicles versus rent paid for old taxi vehicles.

Figure 8: Rent Differences (Old Vehicle vs. New Vehicles)



The second cost type incurred by the taxi renters is the fuel costs difference that may have resulted from the different fuel type used. As shown in the figure below, the natural gas use increased from 36 percent to 65 percent from the old to the new vehicles respectively.

Figure 9: Fuel Type Used (Old Vehicles vs. New Vehicles)



Regardless of the fuel type, the sample weighted average income earned for renters is LE 82 per day, equivalent to around 15 US dollars per day. The sample weighted average for income earned for taxi owners-drivers is LE 105 per day, equivalent to 20 US dollars per day.

The social benefits from the taxi renters' viewpoint are more influential than the economic and financial benefits. The program, as discussed later in the program preliminary social impact

assessment, had upgraded the working conditions of the taxi drivers, improved their productivity, and provided non-financial incentives including the nationwide license and the application of the meter system, that improved the taxi services provided. The social benefits are discussed in more details in later points. The next part, however, discusses the cost benefit analysis from the Egyptian government's perspective.

6.1.3 Egyptian Government CBA

The financial and economic analysis for the Taxi Recycling Program from the government perspective shows the economic and financial benefits and costs to the Egyptian government as a result of the program's implementation. The benefits included the subsidy savings that result either from the improved efficiency of the new vehicles fuel consumption; or from the difference in subsidies to gasoline versus natural gas. In addition, the benefits included the scrap value the government obtains from selling the old vehicles surrendered.

The costs included the government payment to the taxi drivers in order to surrender their old vehicles, LE 5000 per taxi vehicle (equivalent to 900 US dollars per taxi). In addition, it included the sales tax and tariff costs that the government forgave for participating taxi owners. Finally, it included administration and operating costs that were needed for the program implementation. It must be noted that it was not possible to do a complete analysis, due to lack of data; however, the partial analysis provides a conservative estimate of the net benefits.

The Cost Benefit Analysis (CBA) results showed that the successful implementation of the program created substantial benefits to the government, both short and long run. As shown in Table 3, using the fuel efficiency estimates provided by Eweida 2009, the new vehicles were found to be, on average, 29 percent more efficient in fuel consumption, whether the new vehicles

were using gasoline or natural gas. It must be noted that the distance that a taxi can drive on a liter of gasoline is roughly equivalent to that completed on a cubic meter of natural gas.

Table 3: Fuel Efficiency Estimates (Old vs. New Vehicles)

Old cars fuel/100 km (liters or m3)	13.20
New cars fuel/100 km (liters or m3)	9.40
Absolute savings in fuel consumption	3.80
Percentage savings in fuel consumption	0.29

In addition to accomplishing economic gains through reducing fuel consumption and thus fuel subsidies, the government would save some of the gasoline subsidies. Since the natural gas adoption had increased, according to the Egyptian Environmental Affairs Agency program proposal, the government would be saving the difference between the gasoline subsidies that the government is currently paying (LE 2.50 per liter equivalent to 0.45 US dollars per liter) and the natural gas subsidies (LE 0.15 per cubic meter equivalent to 0.027 US dollars).

Table 4: Subsidies Savings (Difference between Gasoline and Natural Gas Subsidies)

Subsidy on natural gas/m3 (LE)		0.15		
Subsidy on gasoline /Liter (LE)		2.50		
Subsidy cost for taxi vehicles /vehicle/year at 25 liter/day			Sample fuel type used percentage	Sample weighted average estimated annual subsidy per vehicle
Old Vehicles	Gasoline	26,408	0.64	17,472
	Natural gas	1,585	0.36	
New vehicles	Gasoline	18,750	0.38	7,823
	Natural gas	1,125	0.62	
Sample weighted average estimated total subsidies savings per taxi vehicle				9,649

Reference to Table 4, the estimated subsidies savings per vehicle was calculated using the fuel efficiency estimates provided by Eweida; where new vehicles were assumed to be 29% more efficient in fuel consumption than old vehicles. The sample weighted average subsidies savings per vehicle was calculated based on the sample data results for fuel type used in the old versus the new vehicles. Based on the sample data, the gasoline consumption decreased from 64% to 38% while the percentage of vehicles using natural gas use versus gasoline increased from 36% to 62% in the old versus the new vehicles respectively. This would result in more than LE 9,600 annual subsidies savings per taxi vehicle.

Other studies reached different estimates for savings per vehicle converted. In order to get more accurate results, the total weighted average subsidies savings from taxi fleet turn over was calculated based on the average of the subsidies savings calculated in this study and in two other studies; namely, the Egyptian Environmental Affairs Agency (EEAA) program proposal and Henfy’s 2009 study. Thus, as per Table 5, the LE 9,500 savings per vehicle converted represents the average of the subsidies savings calculated in the mentioned studies.

Table 5: Total Estimated Subsidies Savings (in LE)

	Year 0	Year 1	Year 2	Year 3
Vehicles converted per year	10,000	10,000	10,000	10,000
Fleet converted	10,000	20,000	30,000	40,000
Savings per vehicle (estimated)	9,500	9,500	9,500	9,500
Total weighted average subsidy saving from taxi fleet turnover	95,000,000	190,000,000	285,000,000	380,000,000

Thus, as shown in Table 5, the implementation of the Taxi Recycling Program through the replacement of 40,000 old taxi vehicles operating in Greater Cairo Region (GCR) would result in saving more than LE 380 million annually as a result of subsidies savings, equivalent to more

than 69 million US dollars annually². The results were consistent with the results provided by the Egyptian Environmental Affairs Agency (EEAA) original program proposal results and with Henfy's 2009 study results. It must be noted that these benefits did not take into consideration the costs incurred by the government, which will be discussed in later points.

In addition to the subsidies savings, the government would benefit from the scrap values it receives in exchange for selling the old surrendered vehicles to scrapping and recycling company to be safely and environmentally disposed. The government did not disclose the selling price of the surrendered vehicles to the scrapping company, it was considered confidential information. Thus, we used estimates provided by experienced scrap metal dealers. The estimated selling price provided was LE 5,000 per vehicle. It was confirmed that this price would allow for acceptable profit margin; since the scrapping and recycling process will result in tons of raw materials that are very utilizable, especially in large quantities.

On the other hand, the key costs incurred by the government were the LE 5000 incentive subsidies, tax and tariff on vehicles' parts exemption costs, and the administration costs. The CBA results confirmed that the government is benefiting from subsidies savings while having very few important costs. Firstly, the LE 5000 incentive subsidies would be balanced by the scrap values the government receives in exchange for selling the old surrendered vehicles.

Secondly, tax and tariff on vehicles' parts exemption costs does not constitute actual payments by the government. The estimated exemption costs for locally assembled vehicles from sales tax and export tariff average amount are 13,000 LE, equivalent to 2,400 US dollars per vehicle,

² It should be noted that in addition to the mentioned savings, the government also saved the interest that would have otherwise been needed to finance the subsidy. In current terms, for each million borrowed at the current 8.25% interest rate, interest charges would have been LE 779,285. However, because the government pays negative real interest rate - the difference between the inflation rate and the current interest rate - there would be negative savings on interest payments in real terms, somewhat reducing the total savings.

based on the vehicle price. However, it does not add any financial burden on the government budget. It only requires a regulatory change to allow tax and tariff exemption for participating vehicles (EEAA, 2009). In addition, it could not be accounted for as a reduced revenue that the government would otherwise collect. The program created the extra demand; otherwise, the car manufactures would not have any reason to import the taxi vehicles parts or sell these vehicles. In other words, the government would not have collected these amounts as revenue.

The final costs incurred by the government were the administration and operating costs of the program. The administration and operating costs of the program were not disclosed. Thus, estimates of the administration costs were made, for purposes of argument, based on the assumption that the government would need to hire 20 additional employees; and each employee would be paid LE 5000 per month. In addition, the operating costs were assumed to be 20 % of the total staff monthly salaries. The annual total administration and operations costs under these assumptions would reach LE 1.440 million. These costs represent only 0.5 percent of the government's subsidies savings after converting 30,000 vehicles (285 million LE). Thus, even with the assumed administration costs, the program benefits far exceeded its costs.

To sum up, the CBA results show that from the government viewpoint, the successful implementation of the program holds a lot of benefits in both the short and long run. In addition to the benefits mentioned, there are some additional benefits that were not quantified. More than 30,000 taxi vehicles that were assembled locally have been produced and sold during the past two years as taxi vehicles. These benefits include: the extra taxes acquired by the government as a result of the extra profit made by the private sector attributable to the program implementation. The program helped the local car manufacturers to pass the financial crisis while actually expanding production. The program was successful in stimulating the insurance market, the

advertising market, and in supporting the recycling industry in Egypt. These benefits are discussed in more details later in the Soft System Methodology analysis. The next part, however, discusses the preliminary environmental and social impacts of the program.

6.2 Social and Environmental Impacts Preliminary Assessment

In addition to the economic and financial benefits of the Taxi Recycling Program, it brings substantial social and environmental benefits. This part develops preliminary assessment of the social and environmental impacts of the program.

6.2.1 The Social Impacts

The cost benefit analysis was applied mainly on the owners-drivers of the new vehicles who were considered to be the program implementers. The social benefits, however, extend to include all three categories of taxi drivers, i.e. owners, owners-drivers, and taxi renters. The potential beneficiaries of this program include not only taxi drivers, but also the private sector participants, the Egyptian government, and Greater Cairo Region commuters and all citizens, as well as tourists and other visitors to Egypt.

The challenges faced by the program, particularly the inability to maintain the advertising payment component as the program grew, affected the taxi owners' average income earned. However, the program was able to attain some of the planned social goals. The program was successful in meeting the targeted population. As explained earlier in the data description, the surveyed taxi drivers were mostly from low and middle income groups. The majority of them had an average education level. The social impacts of the program include: improving the working condition for taxi drivers; reinforcing the application of the meter system by introducing a new metered rate structure; improving the productivity of the taxi drivers; upgrading the taxi services for taxi customers' visitors and tourists; and improving the traffic congestion.

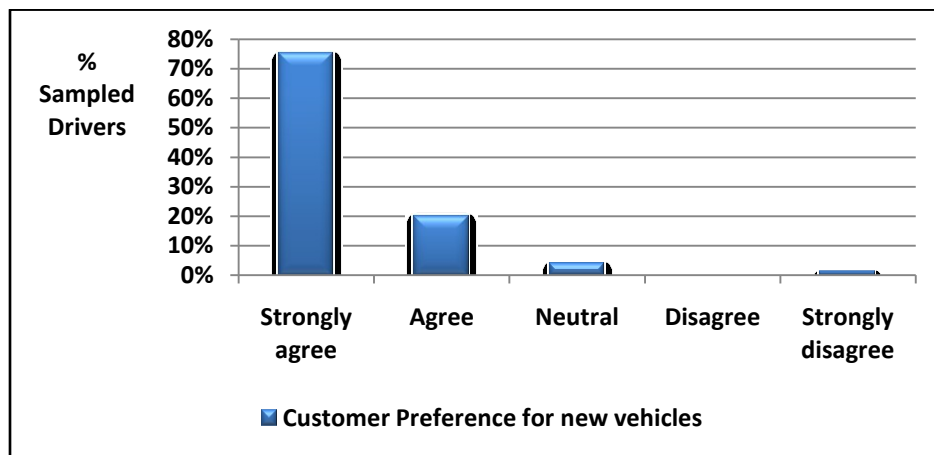
The program was successful in upgrading the working conditions of the drivers. The program facilitated having new clean and more comfortable cars. When taxi drivers were asked about what they liked the most about the program, most answers were about the improved working conditions. Nearly everyone has agreed that the new cars provided more comfortable working environment. This includes, but is not limited to, the power system, the air conditioner, the more comfortable seats, and the lower breakdown rates. In one case the driver mentioned that after having the new car, he started wearing better clothing, because he knew that he would not have to stop every now and then to check the car mechanics, a situation he was used to with the old vehicle. Another driver mentioned that he was used to going home so exhausted from the long hours of driving that he could barely feel his hands. The new vehicles, however, have a power system, an air conditioner and different facilities that make driving more comfortable.

In addition to the comfortable cars, drivers had commented on the non-financial incentives introduced by the program including the nationwide license and the new meter system. Introducing the nationwide license rather than the regular governorate license had improved the taxis' productivity. For example, the new license enables them to go directly to Alexandria or any governorate as might be requested by the customer; instead of issuing travelling permits on a case by case basis. The system is more efficient for the taxi drivers.

Nearly all the surveyed taxi drivers commented on the usefulness of the meter system. Some taxi drivers did not agree with the new metered rate structure and mentioned that they used to make more money without the new meter system; however, all of them agreed that the new meter system provided a clear and reliable system that could be used by both the taxi drivers and taxi customers. In one case the taxi driver mentioned that he used to force customers to pay the amount that he decides. He used to go through constant arguments with the taxi customers.

Although he believes that he is making less money now, he still likes the clear and fair system. Because of the new meter system, he does not have to worry about how much each and every customer would pay based on his personal perception; they all have to pay by the meter system. 62 percent of taxi drivers stated that they did not face any problems with customers to pay with the new meter. The rest mentioned that they faced some problems especially at the beginning of the program, when the customers were not familiar yet with the meter system. On the other hand, the taxi customers accepted and respected paying by the meter. From each 10 customers, 52 percent of taxi drivers mentioned that no one would refuse to pay by the meter. 43 percent of taxi drivers stated that only one or two customers would refuse to pay by the new meter system, especially at the beginning of the program. Overall, as shown in the figure below, 75 percent of the surveyed taxi drivers strongly agreed that taxi customers preferred the new white taxis over the old black-and-white taxi.

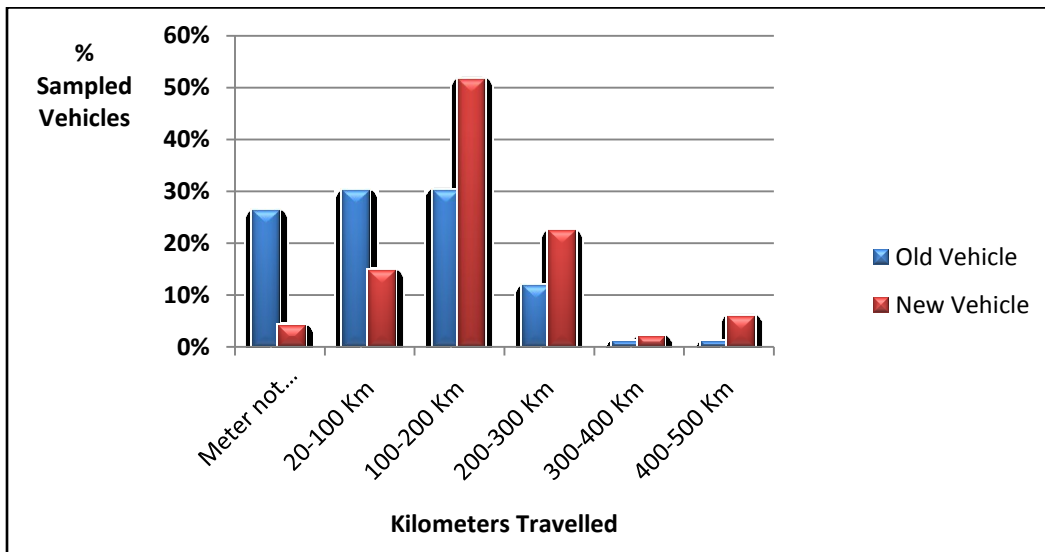
Figure 10: Taxi Drivers’ Perceived Customers’ Preference for the New Vehicles



Besides improving the working conditions, replacing the old vehicles with new more efficient vehicles enhanced the efficiency and the productivity of the taxi drivers. According to the sampled taxi drivers, the average kilometers travelled per shift varied significantly between the old vehicles and the new vehicles. Reference to Figure 11, more than 50 percent of the taxi

drivers either did not know the kilometers derived per the taxi shift on their old vehicles, because the meter was not working, or they used to drive less than 100 kilometers. On the contrary, more than 70 percent of the sampled taxi drivers mentioned that they travel from 100 to 300 kilometers per shift on their new vehicles. The sampled average kilometers travelled per taxi shift were 100 Km for the old taxis and 174 Km for the new taxis.

Figure 11: Kilometers Travelled per Shift (Old Vehicles vs. New Vehicles)



Moreover, some citizens found it a reliable investment opportunity to buy a new white taxicab. Two interviews, that were not included in the sample, were for citizens who joined the program, because they found it a reliable investment opportunity. They both used their savings to buy the car from a friend or from a dealer showroom. They both stated that the application of the new meter system in addition to the clean comfortable cars encouraged them to join the program. Although, no comparison could be made between their experiences driving an old black and white cab versus what they are currently experiencing while having a new white cab under the program, their decision to join the program stresses the indirect positive social impacts of a well designed and implemented subsidies system.

Adding to the same point, some surveyed taxi drivers used to have a relatively new black-and-white taxi vehicle. They sold it and bought an old black-and-white taxi vehicle in order to change it under the program. This emphasizes the positive competition impact created by the program in the taxi market. In one case, the taxi owner was complaining about how hard it was to fulfill the extra commitments of the monthly bank allowance and maintenance costs. When he was asked why he changed his old car under the program, even if he was not required to do so under the law; he stated that he had to upgrade his taxi or he would lose the competition. He mentioned that with the introduction of the new white taxi vehicles, more customers are looking for a clean comfortable car with a valid meter system. Even if the program encountered some challenges, from his viewpoint, it holds a lot of potential.

Furthermore, the program upgraded the taxi services for taxi customers', visitors, and tourists. In addition to introducing new clean and comfortable vehicles with a valid meter system, the program influenced the taxi drivers' behavior. As mentioned earlier, the taxi drivers dress better and do not argue over the amounts to be paid. Additionally, the taxi owners make different choices as to who would rent their new taxi vehicles. They choose drivers who are more reliable, in order to avoid accidents and fines.

On top of the mentioned impacts, the program had additional positive impact on the traffic congestion. As explained earlier, the Greater Cairo Region (GCR) transportation sector had been facing serious challenges; including, serious traffic congestion; long travel time; high accident rates with more than 1000 deaths and 4000 injuries per year; underdeveloped public transport system; and air and noise pollution (Eiweida and Pinnoi, 2009). In 2009, according to the Ministry of Interior, the replacement of 18.5% of the old taxi vehicles operating in GCR resulted in 4% reduction in traffic offence citation among Greater Cairo Region taxis affected by law 121,

and 6.5% reduction in the number of accidents involving GCR taxis affected by law 121 during the same period. In addition, it resulted in major positive environmental impacts discussed in more details in the next part.

6.2.1 The Environmental Impacts

The program was originally adopted to reduce the local air pollution. The goals of the program, based on the Ministry of State for Environmental Affairs program proposal, included: reducing local air pollution that resulted from the high level of emissions from taxi vehicles that were more than 28 years old. These taxis were originally planned to be replaced with new vehicles operating on natural gas. In addition to the stated environmental goal, the Ministry of Finance adopted and expanded the program to facilitate the transition required by taxi owners under traffic law no. 121 of year 2008; and to prevent the conversion of these old taxis into private use vehicles, outside the jurisdiction of the law. The Ministry of Finance had adopted the program with the intention of scrapping the older vehicles (MOF, 2010). Thus, the program's environmental impact could be divided into two goals. The first goal is reducing the high level of emissions resulting from the old vehicles. The second goal is the safe and environmentally friendly disposal of the surrendered old vehicles.

The program reveals promising results with regards to the achievement of the first goal. So far the program had been able to replace more than 30,000 old taxi vehicles with new more efficient vehicles. Although the natural gas adoption had been voluntary, the program created financial incentives for taxi owners to use natural gas. In addition, regardless of the fuel type used, the new vehicles are more efficient with respect to fuel consumption. As per Table 6, even after 10 years of operation, the new vehicles are estimated to be more fuel efficient when compared to the old vehicles.

Table 6: Projected Fuel Efficiency (Old Vehicle vs. New Vehicles)

Fuel efficiency	Old Vehicle	New vehicles		
		Year 0	Year 5	Year 10
Fuel Type				
Motor Gasoline (Liter/100Km)	12.87	9.39	9.58	10.07
Compressed Natural Gas (CNG) (m3/ 100Km)	12.23	8.34	8.51	8.94

Source: MoF, 2010 (Annex 3: Emissions reduction calculation methodology)

In addition to the lower fuel consumption levels, changing the old vehicles resulted in lower pollution emissions. This is not only due to the lower fuel consumption of the new vehicles, but also because of the improved technology. The Taxi Recycling program has been divided into eleven separate projects called Certified Project Activities (CPAs); with an average of 4,576 recycled taxi vehicles per CPA. According to Eiweida 2009, each Greater Cairo Region taxi CPA is estimated to have an average CO₂ emission reduction per year between 17,000 and 35,000 tons of CO₂ over a ten-year period, with an average annual estimated reduction of 26,000 tons of CO₂ per taxi CPA. This represents an average annual estimated reduction of 5.68 tons of CO₂ per taxi vehicle. These reduced emissions would result in lowering the environmental impacts costs of CO₂. In 2010, the Central Agency for Public Mobilization and Statistics (CAPMAS) in Egypt, had estimated the cost of environmental impacts from CO₂ emissions to be approximately 80 US dollars per ton of CO₂. Thus, the new vehicles would result in annual average environmental benefits of 2.080 million US dollars per taxi CPA. In addition, these saved emissions represent potential government revenue if the government was able to sell the reduced emissions under the Clean Development Mechanism.

In order to have a more comprehensive understanding of the environmental impact of the program, we applied Gurber's 2007 explanation of the market for pollution reduction with multiple firms on the Taxi Recycling Program. The old taxi vehicles were considered the first player in the market while the new taxi vehicles were considered to be the second player that was introduced to the taxi market in Greater Cairo Region.

Figure 12: CO₂ Pollution Reduction Market (Taxi Recycling Program)

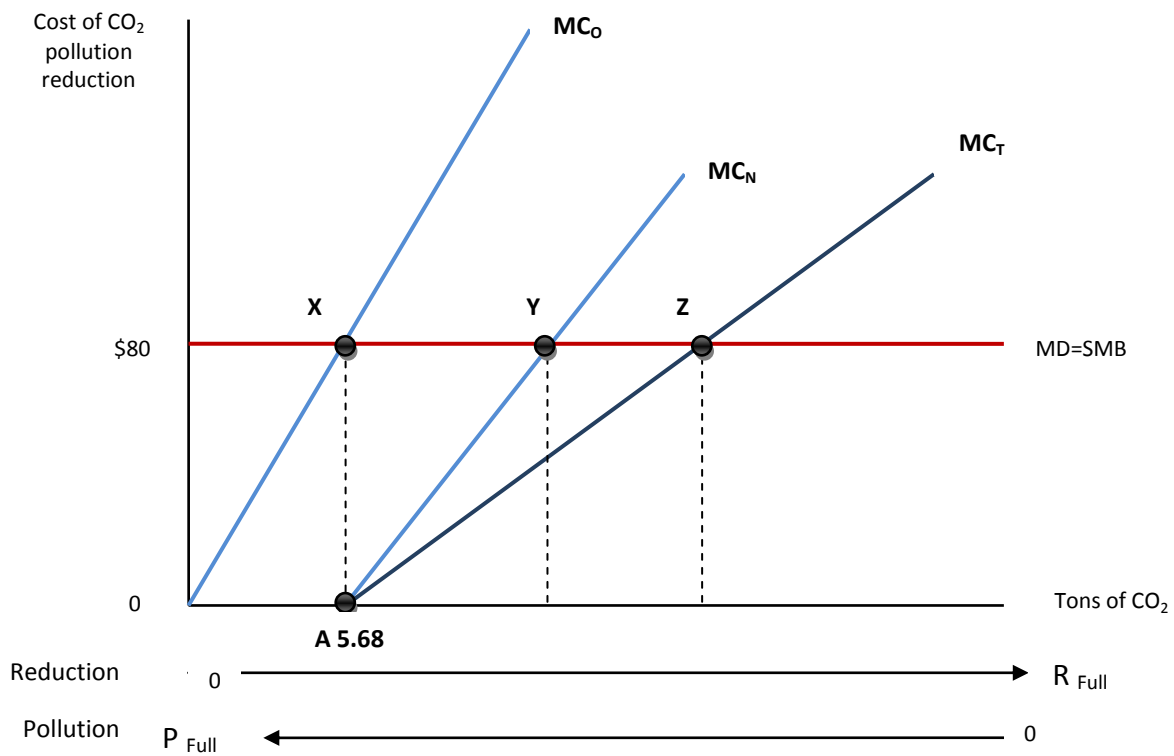


Figure 12 summarizes the market for pollution reduction in the case of the Taxi Recycling Program. Only CO₂ is included, although it is not the only component of the vehicles' emissions. CO₂ is used as an indicator for the pollution reduction market, since carbon dioxide is the principal GHG (Emissions Trading, 1998) and is the most actively traded.

As per the above Figure, the marginal cost for old taxi vehicles (MC_O) represents the vehicles' owners' private marginal cost of reducing pollution resulting from their vehicles emission. The MC_O curve slopes upwards, because of the diminishing marginal productivity of this input. The first units of pollution are cheap to reduce: just tighten a few screws or put in a cheap filter. Additional units of reduction become more expensive, until it is incredibly expensive to be completely pollution-free, or even to reach the minimum level of pollution that taxi vehicle could reach. In other words, the old vehicle owners would have to incur more costs and make more changes to their cars in order to reach lower pollution levels. The introduction of the new taxi vehicles is considered to be a new technology that is now available to reduce the vehicles' emissions. For the new vehicles, emissions reduction is cheaper at any level of reduction, since it involves the implementation of newer technology.

At every level of pollution reduction, the marginal cost for new taxi vehicles (MC_N) is lower than the marginal cost for old taxi vehicles (MC_O). As explained earlier in the cost benefit analysis, regardless of the fuel type used by taxi drivers, the new vehicles are 29% more efficient in fuel consumption. The total marginal cost of reduction in the market (MC_T) is the sum of the MC_O and MC_N . For any total reduction in the pollution, this curve indicates the cost of that reduction if it is distributed most efficiently across the two types of vehicles; i.e. upgrading the performance of the old black-and-white taxi vehicles and the introduction and monitoring of the new white vehicles.

Point A presents the total marginal costs per the reduction of 5.68 tons of CO_2 – the average estimated annual CO_2 reduction achieved by replacing each old vehicle with a new one. At this point, the total marginal cost is zero since the new vehicles can reach this reduction level with no additional costs, i.e. the new vehicles do not need any modifications to reach this reduction level.

The marginal damage (MD) curve represents the marginal damage that is averted by additional pollution reduction. The marginal damage in the figure below was estimated to be 80 US dollars per ton of CO₂ reduced. The social marginal benefits (SMB) of pollution reduction are equal to the MD, since the marginal damage averted by the additional pollution reduction represents the social gains of the pollution reduction. Thus, the social efficient level of pollution and pollution reduction (SMB) is the intersection of the MC_T with the marginal damage curve (MD) at point Z.

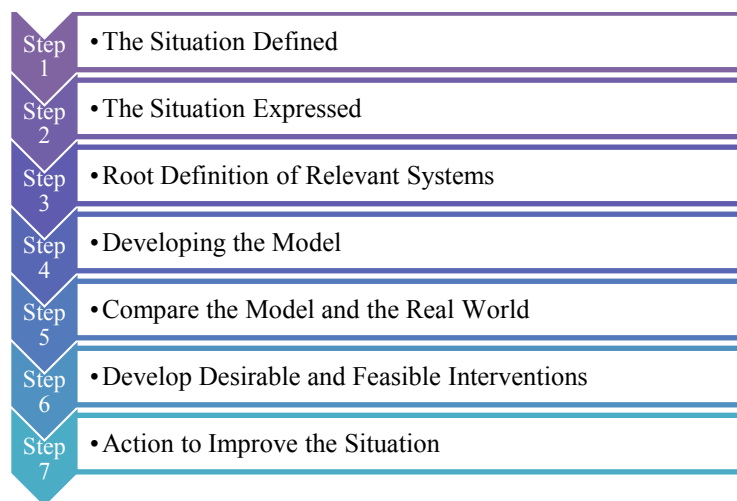
The second environmental goal was to scrap and recycle the surrendered old vehicles in a safe and environmentally friendly way. The Ministry of Finance had contracted with recycling company through bidding. In July 2010, the scrapping and recycling process started. According to an interview with an official from the Ministry of Finance, the company is committed to the safe and environmentally friendly disposal of the surrendered cars under the monitoring and supervision of the Ministry. At this point of the program, it is still early to define the environmental reliability of the scrapping company. However, since the Ministry of Finance is applying for CDM support, some documents on the scrapping and recycling process might be disclosed later.

To sum up, the financial and the economic benefits and burdens of the program were analyzed from the standpoint of the taxi drivers and the government. Since the program's benefits extend to include major environmental and social benefits, this part included preliminary assessment of the social and environmental impacts of the program. The next section applies the soft system methodology to the Taxi Recycling Program to examine the rationale for participation by different stakeholders.

Chapter Seven: Soft System Methodology (SSM)

The SSM is used to identify the stakeholders and their relationships, and to model the evaluation system to be used by the interested party (Neves et al., 2004). Following the typology explained by Williams (2005), this analysis employs the seven steps that were originally developed by Checkland in the late 1960's. As the table below shows, it starts by defining the Taxi Recycling Program. Then, it provides more details on the program with regard to the different relations that exist among the program's stakeholders. Step three moves beyond the concrete world into the conceptual framework of the program through identifying the root definitions of the relevant systems. Step four involves developing the conceptual model; followed by a comparison between the conceptual model and the real world. The sixth step is to develop desirable and feasible interventions. The seventh, and the last step, includes the recommended actions for the program improvement (Williams, 2005).

Table 7: Soft System Methodology Steps



Source: (Williams, 2005)

Step 1: The Situation Defined

The SSM was applied here to analyze Egypt's Taxi Recycling Program. It examined the rationale for participation by different stakeholders; and defined the role played by the different stakeholders involved in the program. The SSM analysis was applied to the program's current phase; where all major changes have occurred (as explained earlier; see Taxi Recycling Program background above).

Step 2: The Situation Expressed

The Taxi Recycling Program as part of Egypt's Vehicle Scrapping and Recycling program has provided several financial incentives for taxi owners to replace their old taxi vehicles with new vehicles that are more efficient in fuel consumption and emits less pollution. As explained earlier, the program has been structured as a Public-Private-Partnership (PPP) where the cost burden of the program has been divided among the public sector and the private sector. The public sector is represented primarily by the MoF; however, the agreement is also signed by the Ministry of Interior (Traffic Police), which has an important role in the program. The private sector organizations that chose to participate in the program include: three commercial banks, five vehicle companies (which assemble locally), an advertising firm, and an insurance agency. In addition, the Ministry of Environment and the Egypt Environmental Affairs Authority (EEAA) affiliated to the Ministry of Environment play an important independent role in program oversight from an environmental perspective.

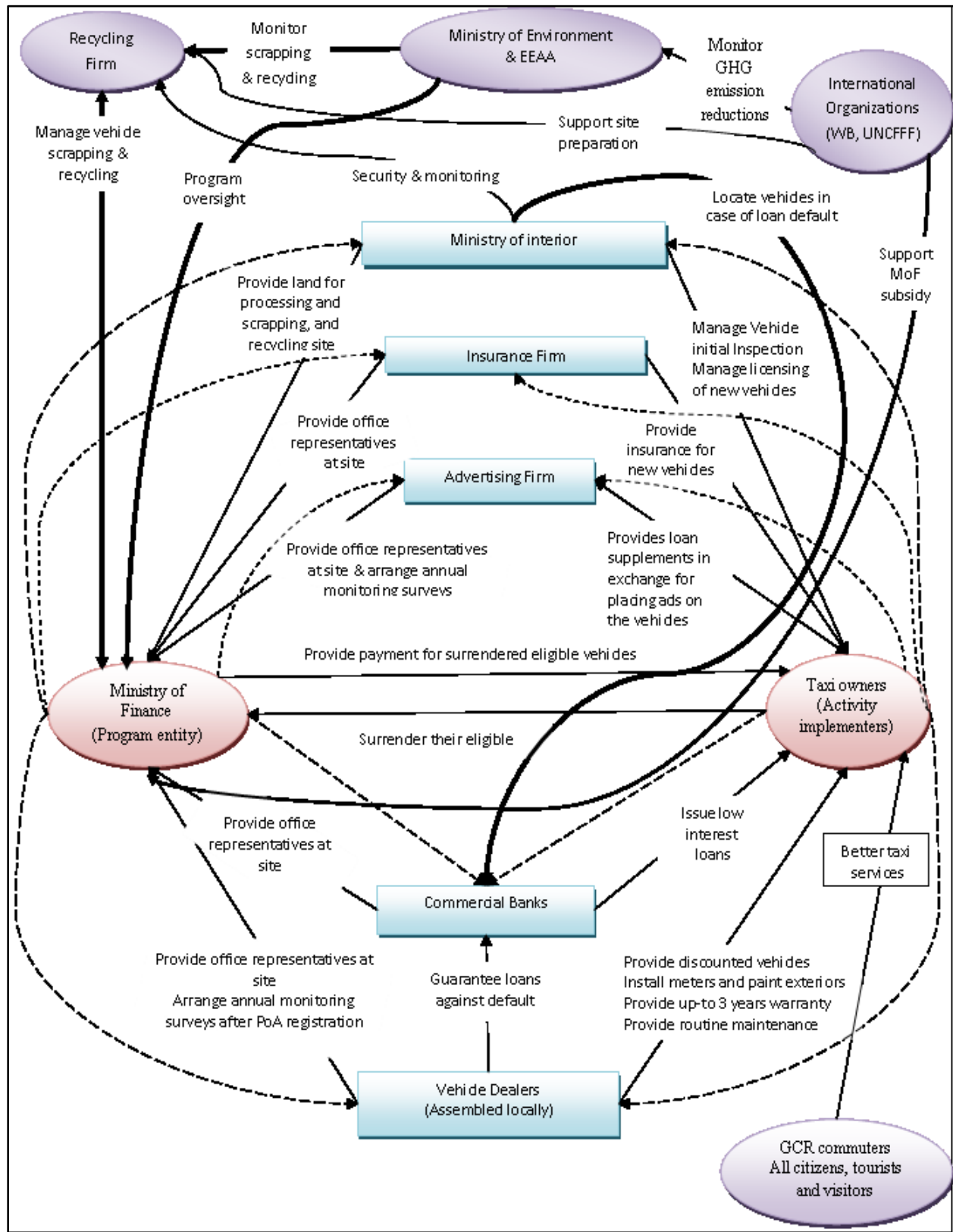
Furthermore, international organizations, including the World Bank and the United Nations Framework Convention on Climate Change (UNFCCC), that support the Carbon Finance project have the potential to play a vital role, as expressed by the Ministry of Finance, in ensuring the

program's long term success by ascertaining that the program's social and environmental objectives are met.

The program has been applied in Greater Cairo Region (GCR). Owners of the new vehicles are considered to be the program implementers. However, the potential beneficiaries of this program include not only taxi drivers, but also, the private sector participants, the Egyptian Government, and GCR commuters and all citizens (MOF, 2010), as well as tourists and other visitors to Egypt.

In order to have a clearer definition of the different relations that exist among the program's stakeholders, the rich picture format is used. As presented in Figure 13, the rich picture provides comprehensive explanation of the relationships among the different stakeholders involved in the program.

Figure 13: Rich Picture of Egypt's Taxi Recycling Program



As per Figure 13, the stakeholders' relationships overlap each other. In other words, in order for the taxi owners to change their vehicle while fulfilling the requirements of the program, different stakeholders must maintain active communication channels. The dotted lines, in the figure, represent the counter responsibilities of the taxi owners and the Ministry of Finance. To illustrate, in addition to the responsibilities included in the figure, the Ministry of Finance is responsible for overseeing the program activities, paying vehicle sales taxes on behalf of the owners, exempting customs on imported vehicle components, guaranteeing the loans against default in selected cases, placing program advertising in local and national media, managing comments and complains for participants (taxi owners), and maintaining registered project database.

On the other hand, the taxi owners are required to approach one of the participating banks and submit an application for a bank loan. The owner, then, visits one of the participating vehicle dealers at the processing and storage site and submits the preliminary loan approval letter from the bank. The owners are required to submit their old vehicles to the processing site for inspection and scrapping. Up on approval, the MoF issues a subsidy check. In addition, they used to get an approval letter indicating their participation in the advertising program, before canceling the advertisement support. Afterwards, owners deposit the subsidy check in the bank, and return to the vehicle dealer where they submit the needed documents and receive the new vehicle. Finally, owners license their new vehicles and go to the advertising agency to have ads applied on the vehicle. In order to facilitate the process, the stakeholders must keep an active communication system amongst each other. The next step defines value bases that are possible to draw out of the rich picture by which to evaluate the program.

Step 3: Root Definitions and CATWOE analysis

Step three moves out of the “real” world and to the world of systems. This is the stage out of which everything else grows. It is the unique and most challenging part of the SSM. The first part is to define the different perspectives that are possible to draw out of the rich picture. Each perspective provides a separate value base by which to evaluate the program. The second and final part of this step is to apply Customers, Actors, Transformation, Weltanschauung (i.e. why this transformation is relevant), Owners, and Environment analysis (CATWOE analysis) on the different perspectives of systems defined. Based on the transformation that actually happened applying CATWOE ensures a structured and rigorous model development process.

3.1 Possible different perspectives to evaluate the Taxi Recycling Program:

1. Facilitating the transition required by traffic law 121 by providing reliable financial incentives that encourage and assist the taxi drivers to meet the regulation while ensuring the implementation of the law’s intended impact on safety, air quality, and GHG mitigation.
2. Reduce the local air pollution and GHG emissions in Greater Cairo Region by supporting the transition to new taxi vehicles that are more efficient with regards to fuel consumption and pollution emissions.
3. Contributing to the global efforts to decrease global warming through reducing local GHG emissions in GCR, and trading these reduced emissions under the CDM.
4. Activating the local car manufacturing market by supporting locally assembled cars’ production and sales.
5. Upgrading the taxi services for visitors and tourists by providing better looking, more comfortable and cleaner taxicabs with valid meter system.

6. Enhancing the taxi drivers' working conditions through facilitating the transition to new vehicles that are more comfortable, cleaner and easier to maintain, and implementing a reliable meter system.
7. Reinforcing the application of the meter system by introducing a new metered rate structure that could be reliably used by the taxi drivers and taxis' customers.
8. Improving the traffic congestion by ensuring better taxi vehicles performance on roads.
9. Supporting the recycling industry in Egypt by supporting the clean and environmentally friendly disposal of the old vehicles surrendered.
10. Reducing energy subsidy expenditures on fossil fuel through adopting natural gas as an alternative clean fuel instead of the total dependency on gasoline ; and reducing the subsidy burden on the public purse and the Egyptian taxpayers. In addition to supporting the transition to new cars that are more efficient in fuel consumption.
11. Speeding the adoption of natural gas as an alternative fuel.

3.2 Applying CATWOE

This part applies CATWOE analysis on the different perspectives of the system defined. Based on Williams's (2005) explanation, it is important that everything flow from the transformation. Thus, we will construct it in different order starting with the Transformation, then Weltanschauung, followed by defining Customers, Actors, Owners, and Environment.

Table 8: Applying CATWOE on Taxi Recycling Program

Perspective systems	Transformation	Weltanschauung (i.e. why this transformation is relevant)	Customers	Actors	Owners	Environment
Facilitating the transition required by traffic law 121	<p>More than 30000 taxi vehicles have been exchanged.</p> <p>55% of the surveyed sample has indicated that they changed their cars in order to meet the regulation set by law 121.</p>	<p>It is a proof of success that taxi drivers have been applying for the program.</p> <p>In the context of a weak regulatory enforcement environment and limited support for the law, no reasonable means would exist to ensure that vehicles affected by the law are fully taken out of service; thus, no means to ensure that the law is having any material effect on improving traffic conditions, air quality or GHG</p>	<p>-Taxi owners</p> <p>-Ministry of interior (traffic police)</p>	<p>-MoF</p> <p>-Ministry of interior</p> <p>- Banks</p> <p>-Vehicle dealers</p>	<p>-MoF</p> <p>-Taxi owners</p>	<p>-Advertising agency</p> <p>-Media</p>
Reduce the local air pollution and GHG emissions in GCR.	By supporting the transition from the old vehicles to new vehicles that are more efficient with regards to fuel consumption and emits less pollution.	For each GCR taxi replaced, it is estimated to have removed between 17000 and 35000 tons CO ₂ emissions each year over ten years period (Ewieida, 2009).	<p>-GCR community</p> <p>-International Organizations</p> <p>-MoF</p>	<p>-MoF</p> <p>-UNFCCC</p>	<p>-UNFCCC</p> <p>-MoF</p>	-Taxi owners
Contributing to the global efforts to decrease global warming	Taking active role in the Kyoto protocol by introducing less carbon-intensive technology and applying for CDM funding under the UNFCCC procedure	Being part of the Global efforts to reduce global warming by playing active role through upgrading technology and selling the reduced emissions	<p>-MoF</p> <p>-MSEA</p> <p>-EEAA</p> <p>-GCR community</p> <p>-Taxi owners</p>	<p>-UNFCCC</p> <p>-MoF</p>	-MoF	<p>-UNFCCC support</p> <p>-Other countries participating in Kyoto protocol</p>
Activating the local car	More than 30000 vehicles that are	This helped the local car manufacturers to pass the	Local car	MoF	Taxi	-After sale services

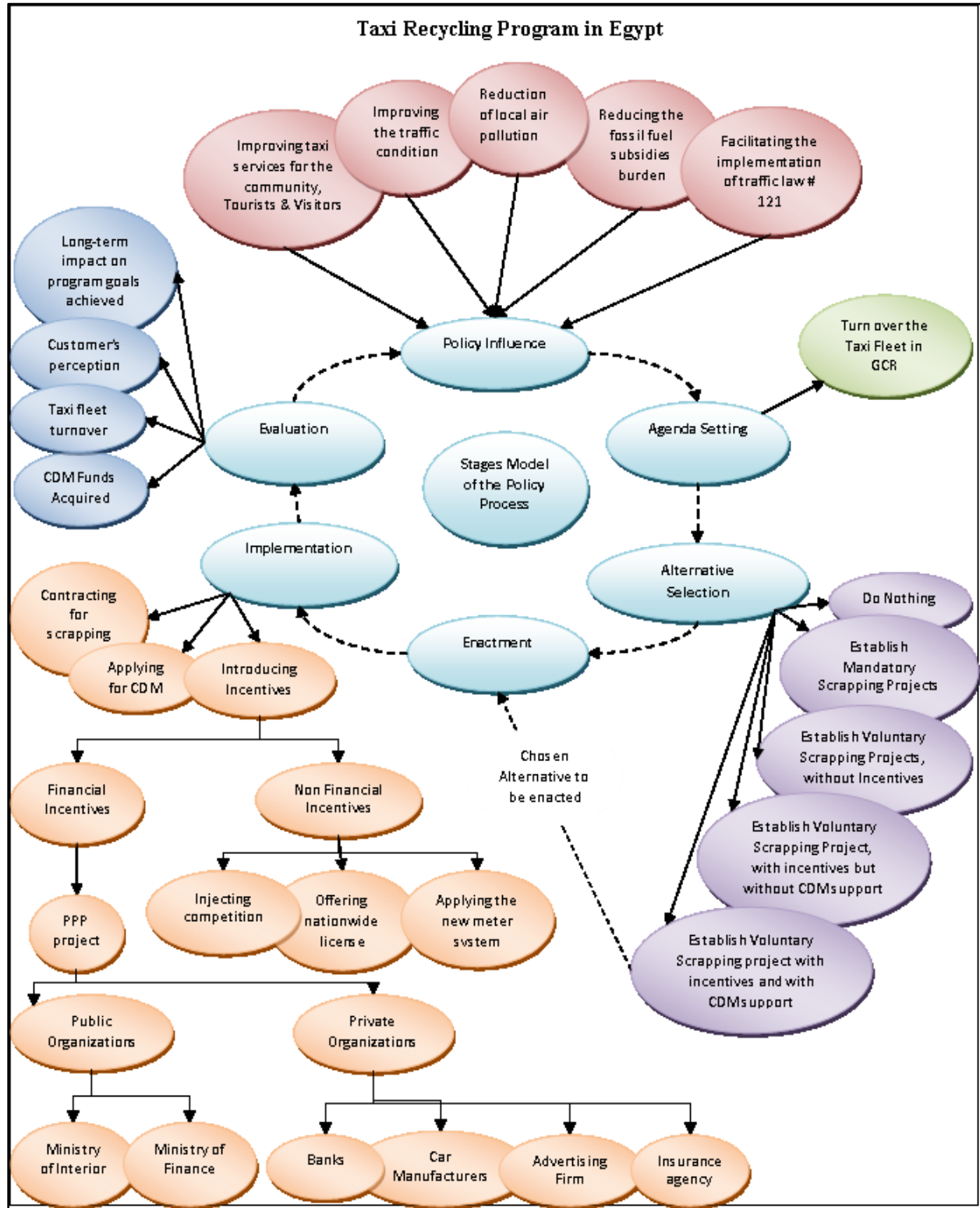
Perspective systems	Transformation	Weltanschauung (i.e. why this transformation is relevant)	Customers	Actors	Owners	Environment
manufacturing market	assembled locally have been produced and sold during past two years as taxi vehicles	financial crisis while having an expanded production	manufacturers		owners	availability - Car models and prices
Upgrading the taxi services for visitors and tourists	Changing the old and deteriorated cars with new taxis that are clean and comfortable with a valid meter system applied.	It improves the status of GCR taxis, since visitors and tourists have been complaining of the bad conditions of taxis' available	-Taxi drivers - Tourists and visitors -GCR community	-MoF	-MoF -Taxi owners	- Taxi drivers' behavior -Transportation status in GCR
Enhancing the taxi drivers working conditions	Changing over 30000 taxi vehicles in GCR with new cars that are more comfortable, cleaner and easier to maintain. Providing financial incentives to facilitate the change. New taxis have nationwide-license instead of governorates license.	It is relevant, because without the government support, these owners would probably not have thought of changing their taxis in such large numbers	Taxi drivers	MoF	Taxi owners	Traffic Police Private sector participating companies
Reinforcing the application of the meter system	The new meter system is installed in all the new taxi vehicles.	It is relevant because it provides clear, fair and civilized payment system.	-Customers -Taxi drivers	-MoF	-MoF -Traffic Police	MoF:
Improving the traffic congestion	Replacing more than 50% of GCR old taxis with new taxi vehicles that perform better on roads.	In 2009, the replacement of 18.5% of the old taxi vehicles operating in GCR resulted in 5% reduction in traffic offence citation among GCR taxis affected by law 121, and 6.5% reduction in the number	-GCR residents and commuters -Traffic police -taxi drivers	MoF	-MoF -Taxi owners	-Traffic police -Road conditions -Drivers'

Perspective systems	Transformation	Weltanschauung (i.e. why this transformation is relevant)	Customers	Actors	Owners	Environment
		of accidents involving GCR taxis affected by law 121 during the same period.				behavior
Supporting the recycling industry in Egypt.	Recruiting recycling firm that will safely and environmentally dispose the old surrendered vehicles	This activity is relatively new in Egypt as a formal sector. It may support and upgrade the recycling industry in Egypt.	-Scrapping companies -MoF	-MoF	-MoF -Ministry of Interior	-Negative externalities that may result from the scrapping activities
Reducing energy subsidy expenditures on fossil fuel and speeding the adoption of natural gas as an alternative fuel	In general, according to MSEA, more than 40% of those applied requested NG vehicles. According to the surveyed sample, 62% are using natural gas in their new cars compared to only 36% who used to use natural gas in their old cars.	It was successful in avoiding the dependency on gasoline . More taxis prefer natural gas as a cheaper fuel. It speeded natural gas adoption, a situation that the Egyptian government was striving to achieve since the 1990s.	-Egyptian Society -MoF -Ministry of Petroleum	-Ministry of Petroleum	-Taxi owners	-Ministry of Petroleum - Natural gas companies

Step 4: Developing the Model

In order to develop a comprehensive conceptual model for the whole program, the Stages Model of the Policy Process is applied to the Taxi Recycling Program. There are many different models to explain the policy process, but it is one of the most common approaches to the study of policy-making. The model helps building an understanding of the policy making process, since it separates policy-making into its component steps, or stages, and analyses each in turn (Metagora, 2004). The goal is to have a better understanding and to follow the policy making process, with regards to the recycling program.

Figure 14: Conceptual Model for the Taxi Recycling Program



Step 5: Compare the Model to the Real World

Step three and four have provided clearer understanding of how the program was planned to be implemented. It includes all the actions that the different stakeholders should perform. In the real world, however, not all the plans have worked as desired.

Establishing voluntary scrapping program with incentives and with CDM support represents a great potential. During the past two years, the program has been growing in a way that exceeded the expectations. It showed great success as it started as a pilot project and expanded to a comprehensive program that will be further expanded to include several projects that aims to upgrade the transportation fleet all over Egypt.

The stakeholders' roles were identified clearly. However, the rapid growth of the program created some challenges that had to be handled by the different stakeholders. The challenges include: the advertising firm being unable to fulfill its commitments; the maintenance services and maintenance costs; the waiting periods for getting the new cars; the quality of the cars that were sold; and the adoption of natural gas as an alternative fuel. This part discusses these challenges and defines why they did not behave as planned. What differed in the implementation phase that hindered their successful performance? While in Step 6 we define the alternative actions that could take place, and in step 7 actions to improve the situation will be recommended.

5.1 Advertising Firm:

The advertising company had originally signed for paying part of the installments in exchange for placing advertisements on the new vehicles. However, it was not able to meet the rapid growth of the program. Thus, the program was divided into 3 phases; the 1st phase with the advertisement support, and second and third phase with no advertisement support. From the sampled taxi owners, 54% got the advertisement support. This resulted in a major frustration for

taxi owners who did not have the advertisement support, especially for those who surrendered their old cars on the understanding that the program included the mentioned subsidy. This information influenced the car model they chose and their fuel choice. In one case, the driver mentioned that his old car was fine and he was not obligated to change it under the new law. However, he saw that the program represents a good opportunity to have a newer car especially that more people preferred the new cabs that were cleaner and have air conditioning. He applied for the program and based on the information he had then, he bought a Speranza car model. Then, he was later informed that based on his application date, he is considered a phase 2 and he is no longer entitled an advertising support. He was left with a new installment that is LE 500 more and that he could not afford. Now, he has to work extra hours, he pays more for maintenance and spare part costs than he used to pay for his old car which he would maintain himself or through regular mechanics, and he lost quality time that he used to spend with his family.

For this category specifically, i.e., those who applied and surrendered their cars believing that there will be entitlement to an advertisement support but were not eligible for the subsidy, the program was not appealing. For those who came later and before applying knew that there will not be any extra ad subsidies, but, in spite of this information, surrendered their cars, the interaction between information and decision making was more fair.

Such challenge jeopardizes the transparency and reliability of the program. Already some taxi drivers went on strikes and riots to ask for their right for the ad subsidy. On the long run, it may affect the success of the other planned CDM projects.

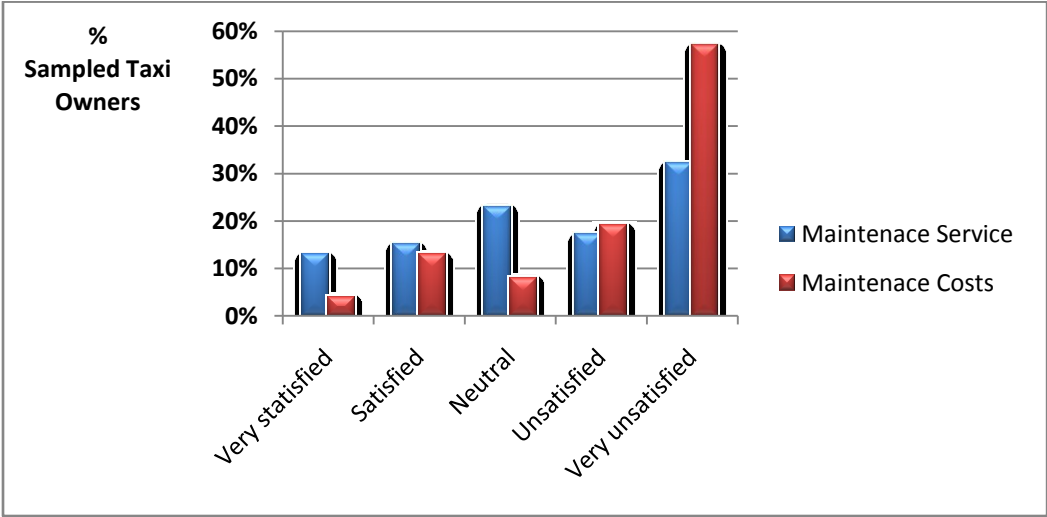
The Ministry of Finance (MoF) has tried to bid for additional advertising firms but with no success. The only action that was taken was the MoF accepting other advertising firms to support

the firm with regards to taxi owners who have already signed the advertising contract. In addition, some of the program’s stakeholders were assigned some taxis for placing their advertisement. However, no further advertising contracts was extended to new taxi owners. This created huge chaos and confusion among the taxi owners.

5.2 The Maintenance Services and Maintenance Costs:

The second challenge that resulted from the rapid growth of the program was the car maintenance costs and services. The car maintenance service centers were not prepared to serve the many customers that resulted from the program implementation. Most surveyed taxi owners had complained either from the maintenance services, the maintenance costs, or both. As shown in the figure below, more than 50% of the taxi owners were very unsatisfied with the maintenance costs; while more than 30% of them were very unsatisfied with the maintenance services offered.

Figure 15: Taxi Owners Maintenance Evaluation



When asked about the maintenance prices 69% of taxi owners strongly agreed that the maintenance services were very expensive at the maintenance services companies. Although the new vehicles have lower breakdown rates, the taxi owners would pay more on maintenance than

what they were used to pay on their old cars that had more breakdowns. The surveyed taxi owners mentioned that even regular maintenance like oil and filters changes and general inspection costs more for the new vehicles. That was not only due to the more expensive maintenance services costs, but also because of the more expensive supplies used for new cars. One taxi owner stated that the old car oil change used to cost LE 35, equivalent to 7 US dollars; while now he have to use better quality oil that costs around LE 100, equivalent to 18 US dollars, nearly triple the old costs. This applies also to spare-part costs, tires and filters used.

In addition, the taxi owners used to maintain their old cars at the regular local mechanic shops. With the new vehicles, however, they have to use the maintenance service centers in order not to lose the car warranty. The local mechanic shops' services were not as expensive as the vehicle maintenance companies; especially that most of them operate in the informal sector. Additionally, surveyed drivers mentioned that the maintenance services are time consuming. The mechanic shops used to provide their services as convenient to the taxi owners. They used to maintain the vehicle either after the working shifts or on their days off. However, vehicle maintenance companies works for regular hours. In most cases, these hours conflict with the drivers' working hours. Thus, they often lose the day's revenue. One taxi driver mentioned that the maintenance service centers were not prepared for that many taxi drivers. Thus, although they are working at their full capacity, the services are time consuming.

Moreover, the local mechanics were very creative with fixing the problems encountered by the vehicles. They used to fix the vehicles' problems at the minimum costs. However, the maintenance service companies, according to some surveyed taxi drivers, do not fix the problem; rather they replace the parts that are causing the problems. Thus, the companies' services were perceived as being costly and unnecessary from the drivers' viewpoint.

Furthermore, the owners often did some of the maintenance themselves, or at least they were knowledgeable about their old cars. They used to stay with the mechanic and observe what was being fixed. Now however, they have to report the problem and leave their cars and wait outside the maintenance area until the car maintenance is done. Thus, they frequently questioned what was done with their cars. Finally, some taxi owners have been complaining about how they were treated by the service companies' employees. While private car owners, in most cases, are assigned a special waiting area including a cafeteria, most taxi drivers had to get a number and wait outside usually in the sun and with no assigned parking places.

Thus, the maintenance services companies face two key challenges: the inability to meet the rapid demand increase created by the growth of the program and the cultural challenges presented by the taxi owners being used to the local mechanic shops' services system.

5.3 The Car Manufacturing Companies:

In addition to the maintenance challenge, the rapid growth of the program has created an additional challenge to the car manufacturers. The first and most important challenge is the lengthened waiting period for taxi owners after surrendering their old vehicle until they receive their new one. Although the car manufacturers were working full capacity, they were unable to meet the demands of the car owners within reasonable time limits. At the beginning of the program, the taxi owners did not have to wait to receive their new cars. One surveyed taxi owner mentioned that he surrendered his old car on Thursday and received his new taxi vehicle on Sunday. On the contrary, another surveyed taxi owner from the second phase complained about having to wait for three months after surrendering his old car and before receiving the new car.

The second challenge faced by the car manufacturers is the taxi vehicle quality. They complained about the taxi vehicles being not as good as that of regular cars sold at the dealers' showroom. In addition, some cars did not include all the accessories, such as air bags.

5.4 The Adoption of Natural Gas as an Alternative Fuel:

The natural gas adoption goal, which at the beginning was the main reason for adopting the program has been offset by the other goals of the program. Rather than the obligatory use of natural gas as an alternative fuel, it became optional for taxi drivers to choose between natural gas and gasoline. The government alleged that the current natural gas infrastructure would not be able to support the rapid increase in the demand that would be created by the obligatory use of natural gas. These claims were not supported by the official interviewed from one of the leading natural gas companies in the Egyptian market. In the interview, the official confirmed that some of the natural gas stations were not working their full capacity. Additionally, the Ministry of Finance could have approached the Ministry of Petroleum and the natural gas companies to upgrade the natural gas infrastructure, if it was willing to fully support the adoption. Moreover, the original program plan presented by the Ministry of State for Environmental Affairs had included recommendations to coordinate with the Ministry of Petroleum to upgrade the natural gas infrastructure needed to face the predicted increase of natural gas demand as a result of the program implementation. The recommendations included building 10 new natural gas fueling stations annually in Greater Cairo Region to address the increased demand (EEAA, 2009).

However, even if the program was not directly supporting the adoption of natural gas, it created economic and financial motives for taxi owners to use natural gas. As explained earlier in the cost benefit analysis, the monthly income of taxi drivers would be significantly affected by the fuel type used, since natural gas is far cheaper than gasoline . These results were confirmed by

the actual increase of the use of natural gas among the sampled drivers from 36 percent to 62 percent in the old and new vehicles respectively. Almost all of them had chosen natural gas because it was cheaper; even if they were very reluctant about the negative effects of natural gas on their car. Some had acknowledged the fact that natural gas is better for the environment as it results in less emission when compared to gasoline ; however, the economic and financial savings were their prime reason for choosing natural gas.

The program had indirectly supported the adoption of natural gas; however, there are several barriers that might hinder the adoption. The lack of proper natural gas infrastructure is one of the most important challenges facing the adoption. The surveyed taxi drivers generally questioned natural gas availability, especially over the long run. Since the new cars are modified to work on both natural gas and gasoline, taxi drivers do not depend on natural gas for long-distance travel or between governorates, where natural gas fuelling stations may not even exist.

Moreover, the effects of natural gas on vehicle performance are not clearly defined. Most surveyed taxi drivers, even those who chose natural gas over gasoline, had agreed that gasoline is better for the vehicle engine and the vehicle performance. Nearly all of them used natural gas only because it is cheaper. Furthermore, the space that the natural gas tank takes at the back of the vehicles leaves little or no space for customer luggage. Finally, some surveyed drivers had questioned the safety level of having the natural gas tank, especially in summer when the temperature reaches 40 degrees Celsius or more.

All the challenges encountered by the program directly influence the taxi owners. Thus, the challenges' effects on the taxi owners should not be underestimated. When the surveyed taxi drivers were asked about what they would change about the program, the most common answers included maintenance costs and services, the bank installments paid by the 2nd and 3rd

phases as a result of the lack of advertisement support, and some commented on the waiting periods and the car spare-parts and car qualities offered. Their answers showed that the owners are fully aware of the challenges faced by the program. All these challenges and barriers must be addressed in order for the program to reach its full potential. Based on the challenges presented and the previous analysis, the next step defines some possible and feasible interventions.

Step 6: Develop Desirable and Feasible Interventions:

According to Williams (2005), this step explores the possible interventions. Based on the previous analysis, two alternative interventions are available in this stage of the program. The first alternative is to take no action and go with the original plan. Since the program involves the voluntary participation of the taxi owners, then, it might be perceived as an offer that the taxi owners can accept or reject. The program had already achieved most of the originally proposed goals and was considered successful. Thus, the government could respond to the challenges on a case by case basis while taking no major corrective action.

The second alternative presented is for the government to step up to the challenges. This alternative includes assessing the program and making the needed modifications. It involves developing a comprehensive evaluation plan and adopting corrective measures. It incorporates all the stakeholders involved; who must be consulted on how they would further enhance the services offered. Based on the alternative presented, the next and final step discusses some recommended actions to improve the program.

Step 7: Action to Improve the Program (Program Recommendations)

This is where the methodology comes full cycle, and maybe starts a new cycle. This step discusses the recommended actions for the program to better reach its goals. It defines some measures that could be adopted by the government to confront the program's challenges.

If the government decided to adopt the second alternative presented in step six, it would require cooperation between the government and the program stakeholders including taxi owners. The proposed recommendations include: using part of the fuel subsidies savings to upgrade the natural gas infrastructure; introducing mitigating actions that target taxi owners who did not get the advertisement subsidy; improving the maintenance services offered; and keeping an open communication channels with the taxi drivers.

As explained earlier, government representatives stated that the current natural gas infrastructure would not be able to support the rapid increase in the demand that would be created by the obligatory use of natural gas. Hence, the first and most important recommendation is using some of the subsidies savings to upgrade the natural gas infrastructure. Although the natural gas use is voluntary, the program had speeded up natural gas adoption. Based on an interview with an official working in one of the leading natural gas companies in the Egyptian market; some taxi owners who did not initially chose natural gas had come to install the natural gas in their cars after realizing the major economic benefits they would attain. Thus, in the future, if the natural gas infrastructure is not upgraded to match the increased demands it will present great challenges. In addition, there would be a net benefit back to the government, as they would realize more subsidy savings as a result of the expanded use of natural gas.

This recommendation is feasible and attainable. The original program plan presented by the Ministry of State for Environmental Affairs had included recommendations to coordinate with the Ministry of Petroleum to upgrade the natural gas infrastructure needed to face the predicted increase of natural gas demand as a result of the program implementation, including building 10 natural gas stations per year for the next three years using the saved funds. According to the natural gas company official, the cost of building new natural gas fueling stations averages between LE 7 and LE 18 million, depending on the capacity and other technical aspects of the station. He confirmed his company is capable of building 10 natural gas fueling stations per year if there is market demand. In addition, government cooperation would facilitate and speed up the process and procedures.

The second action recommended is to take corrective measures to support the taxi owners who did not receive the advertisement subsidy. The current advertising subsidy accumulates to reach LE 6000 per year. The government could direct some of the gasoline subsidy savings towards the taxi owners who did not receive the advertisement support. For those who applied and surrendered their cars believing that there will be entitlement to an advertisement support but were not eligible for the subsidy, the program was not appealing. This recommendation is important to rebuild the trust with the government and to enhance the transparency and reliability of the program. The mitigating subsidies could cover 50 percent of the original advertisement subsidies amount. If this recommendation were to be implemented and based on how many cars are included, the supporting subsidies would amount to 32 percent of the annual projected fuel subsidies savings per vehicle for the next 5 years.

The third recommendation is for the maintenance service companies to improve the maintenance services offered. The government should communicate the taxi drivers' complaints to the

maintenance services companies. Some measures that could be implemented include: extended working hours for taxi drivers; assigning maintenance centers for the taxi vehicles; or assigning special working days only for taxi drivers. In addition, the maintenance companies should market its services to taxi drivers through special offers and sales discounts. They should understand the cultural barrier while working with the drivers.

The question is why should this recommendation would be attractive for the service companies?

The answer was based on the program protocol signed by the Ministry of finance and by participating public and private organizations, including the car manufacturing and maintenance companies. Based on the protocol, the auto dealers- car manufacturing and maintenance companies- were responsible for selling the new vehicles to the owners of the old vehicles bearing all legal obligations in this regard, including delivering the new vehicles within five days at most from the date of the letter from the bank to the auto dealer. In addition, the protocol stated that the new taxi vehicles would be given priority in the service centers and the auto dealer should inform the bank in case that the vehicle owner did not abide by the regular maintenance (MoF, 2010). Thus, the Ministry of Finance must communicate the taxi drivers' complaints to the car manufacturing and maintenance companies. In addition, it must monitor and evaluate the companies' performance against the stated obligations in the protocol. Moreover, necessary measures should be taken in order to enhance the performance of the companies.

In order for the government to be able to communicate the taxi complaints, regular contact with the taxi owners should be maintained. A valid and updated database should be available so that taxi drivers could be regularly surveyed for their perceptions of the program. The Ministry of Finance had already assigned a special hot line for complaints; however, the main barrier is the lack of trust in the government. Most drivers do not see it as an active communication tool. Thus,

the transparency of the program should be enhanced through taking the needed corrective measures to respond to the drivers' complaints. In addition, the role of the media is very important in supporting the transparency of such programs. Officials should use different media channels to communicate the program's challenges and potential.

The final recommendation is the constant monitoring and evaluation of the program. For example, the meter system was indicated as a key success factor of the program by many taxi drivers; however, some taxi drivers have stated that the metered rate structure could be altered. Thus, the Ministry of Finance should cooperate with the Customers' Protection Agency in order to advertise the current metered rate and track down any misuse. In addition, the meter system must be frequently reevaluated. The current metered rate structure should be updated constantly to meet the changing financial needs of the taxi drivers and the changing economic conditions. If the government fails to update the meter system, we will face the same problem as with the old black-and-white taxis; where the old meter system is totally ignored. Additionally, the Ministry of Finance must monitor the loan default cases. It should define the reasons that hindered the taxi owners from fulfilling their loan commitment.

This program is intended to be expanded to other types of mass transportations and to taxis all over Egypt; thus, regular assessment and analysis would help discover any challenges and threats that might be encountered by the program. In addition, it might disclose some opportunities from which the program and the expanded projects could benefit.

Chapter Eight: Study Findings

This research paper aimed to provide a case study of an innovative subsidy program that supports energy efficiency and the adoption of alternative energy sources; and to define and evaluate the program's impact on the different stakeholders involved. This part explains the study findings reached using Cost Benefit Analysis (CBA) and Soft System Methodology (SSM) to answer the main research and investigative questions of this thesis.

The program has an overall positive impact on the different stakeholders involved. Since it was structured as a Public-Private-Partnership, the program offered significant opportunities to the private sector participating companies, either by stimulating vehicles sales and loan demands that would have not otherwise occurs, or by facilitating the communication channels among the different stakeholders involved.

The program encountered some challenges that directly and indirectly affected the stakeholders involved. The taxi owners, however, have been the most influenced by the program's challenges. The challenges included: the advertising firm being unable to fulfill its commitments; the maintenance services and maintenance costs; the waiting periods for getting the new cars; the quality of the cars that were sold; and the adoption of natural gas as an alternative fuel. Nonetheless, the program had overall positive social impacts. The program was successful in meeting the targeted population. It resulted in improving the working condition for taxi drivers. The program supported the application of new meter system by introducing a new metered rate structure. It provided the taxi drivers with a nationwide license instead of the governorate limited licenses they used to have. Based on information provided by the drivers, the program appears to have resulted in an actual improvement in their productivity. Moreover, the social benefits

extend to upgrading the taxi services for taxi customers' visitors and tourists; and improving the traffic congestion.

The main investigative question was how the Taxi Recycling Program affected the government budgetary resources. Through applying CBA from the government perspective, we concluded that the benefits encountered from the program implementation far exceeded the costs incurred by the government. Upon reaching the program target of changing around 40,000 old taxi vehicles operating in Greater Cairo Region, the program would be able to save the government more than LE 380 million annually from the fuel subsidies assigned funds.

Other investigative questions were to assess the effectiveness of the program with regards to: achieving the government's aims for adopting natural gas as an alternative fuel and removing barriers to the adoption of natural gas conversion programs. These questions were made based on the original program proposal submitted by the Ministry of State for Environmental Affairs and the Egyptian Environmental Affairs Agency. The main goal of the program was to support natural gas adoption in order to achieve economic, environmental, and social gains. As explained earlier, later on, the project was expanded and management responsibility was shifted to the Ministry of Finance. The natural gas adoption goal had been offset by the other goals of the program. Rather than the obligatory use of natural gas as an alternative fuel, it became optional for taxi drivers to choose between natural gas and gasoline . Thus, these investigative questions were answered with respect to the program's impact on the natural gas voluntary adoption; and the barriers that might have hindered the adoption process.

The program created economic and financial motive for taxi owners to use natural gas. According to the cost benefit analysis results, the sample average monthly income of taxi owners would be significantly affected by the fuel type used. The results showed that the sample average

monthly income of the taxi owners is LE 680 more in case of using natural gas, equivalent to 124 US dollars per month. The results were confirmed by the actual increase of the use of natural gas among the sampled taxi drivers from 36 percent to 62 percent in the old versus the new vehicles respectively. On the other hand, the program analysis revealed several barriers that might have hindered the full adoption of natural gas. The lack of proper natural gas infrastructure was one of the most important challenges facing adoption. In addition, the affects of natural gas on vehicle performance were not clearly defined. Most surveyed taxi drivers had mentioned that they used natural gas because it was cheaper; even if they were very reluctant about the natural gas negative effect on their vehicles. Moreover, the space that the natural gas tank takes at the back of the vehicles leaves little or no space for customer luggage. Finally, some surveyed drivers had questioned the safety level of having the natural gas tank, especially in summer when the temperature reaches 40 degrees Celsius or more.

As for the environmental impacts, the Taxi Recycling program has been divided into eleven separate projects called Certified Project Activities (CPAs); with an average of 4,576 recycled taxi vehicles per CPA. The preliminary assessment showed that the new vehicles would result in annual average environmental benefits of 2.080 million US dollars per taxi CPA. In addition, these saved emissions represent potential government revenue if the government was able to sell the reduced emissions under the Clean Development Mechanism.

The application of Gurber's 2007 explanation of the market for pollution reduction with multiple firms on the Taxi Recycling Program showed that at every level of pollution reduction, the marginal cost for new taxi vehicles is lower than the marginal cost for old taxi vehicles. In other words, the old vehicle owners would have to incur more costs and make more changes to their

cars in order to reach lower pollution level. While for the new vehicles, emissions reduction is cheaper at any level of reduction, since it involve the implementation of newer technology.

The second environmental goal was to scrap and recycle the old vehicles in a safe and environmentally friendly way. The Ministry of Finance has contracted with recycling company through bidding; which is committed to safely and environmentally friendly disposal of the surrendered cars under the monitoring and supervision of the Ministry.

Finally, based on the analysis, some recommendations were made in order to upgrade the performance of the different stakeholders' involved. The proposed recommendations included: using part of the fuel subsidies savings to upgrade the natural gas infrastructure; introducing mitigating actions that target taxi owners who did not get the advertisement subsidy; improving the maintenance services offered; and keeping an open communication channels with the taxi drivers.

Chapter Nine: Study Implications

The findings of this study refute the perception that energy subsidies, especially in the service sector, necessarily block the adoption of clean technologies. The study provided a case study of an innovative subsidies program that supported energy efficiency and the adoption of alternative energy technology in the transportation sector.

Public policy should support the adoption of alternative fuel. In addition to the environmental benefits, alternative energy adoption programs provide an opportunity to redirect part of the subsidy to improving technology. In these conditions there is a strong need for implementing energy efficiency programs that target lower carbon emission.

While taxis usually serve higher income sectors in Egypt, this program is intended to be expanded to other types of mass transportations and to taxis all over Egypt; thus, the implication of the program goes beyond enhancing the current situation to the taxi drivers to improving the planning and implementation of the new projects.

More mitigating measures should be taken to support the fuel subsidies reform process. These measures must take into consideration the affected income group. Any measure that attempts to gradually remove fuel subsidies and increase their prices should be carefully studied, because it would be affecting a socially venerable income level group as well as higher-income groups. In addition, it must be taken into consideration that Egypt is experiencing an unstable political arena. Egypt is already facing poverty, lack of proper education and health systems, high unemployment rates, and inadequate salary schemes. Since taxi drivers and taxi owners belong to the most vulnerable income groups, their satisfaction and efficient cooperation must be maintained. Their demands and complaints should not be ignored. Already there have been some

strikes and demonstrations regarding the inadequacy of the monthly installments especially with the withdrawal of advertisement support.

To sum up, the program is facing some challenges that were defined earlier in the analysis. These challenges, if neglected, would jeopardize the program's transparency and reliability. In addition, it might affect the successful implementation of the extended projects.

The program has many social and environmental benefits. These benefits would stand as a good excuse for government support; however, in this case the government is not even carrying the financial burden of the program. The program has achieved financial and economic success that provide additional support for the social and environmental benefits to be realized.

Later studies could develop more in depth analysis of the environmental benefits and costs associated with pollution reduction subsidies; and more in-depth analysis of the social impacts of the subsidies programs in the short and the long run.

Summary and Conclusion

This thesis was developed to call in question the overall perception that energy subsidies, especially in the service sector, necessarily hinder adoption of improved technology. It provided a case study for an innovative subsidies program that supported energy efficiency and the adoption of alternative energy technology. The program was not only successful in reaching the targeted population effectively, but also lifted some of the fuel subsidies burden off the government budget.

The subsidies literature has included debates regarding the different types of subsidies allocations. The study's literature review focused on the discussions and arguments that may affect public decision making with regards to subsidies for energy efficiency and alternative energy adoption programs, the impacts of subsidizing fossil fuel products' production and consumption over long periods and the policy reforms suggested by various analysts, as well as summarizing the debates over subsidies allocation for renewable energy and alternative energy adoption programs, arguments in favor of natural gas as an alternative transport energy source, examples of natural gas conversion programs implemented worldwide, and impediments to broader adoption of alternative technology.

Application of the soft system methodology provided a tool for evaluating the performance of the stakeholders involved, and clarifying their roles. A preliminary cost-benefit analysis further assessed the costs and benefits from the perspective of two key stakeholders: the government and the taxi drivers, quantifying the gains or losses incurred by both parties and permitting a preliminary assessment of the social and environmental impacts of the program.

Primary data collected from 111 taxi drivers participating in the program through a questionnaire and from interviews with government officials and other stakeholders involved in the program

provided further insights into the operation of the program, particularly its costs, benefits, and implementation challenges.

The study found that the program has overall positive economic, social and environmental impacts on the different stakeholders involved. The findings of this study refuted the perception that energy subsidies, especially in the service sector, are necessarily barriers to technology adoption. Future studies could develop more in depth analysis of the environmental benefits and costs associated subsidies as mechanisms to achieve pollution reduction and develop more in-depth analysis of the short and long-term economic and social impacts of alternative energy adoption subsidies programs.

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Appendix 1: Background Information

Kyoto Protocol

In 1988, International conferences to address the problem of global warming began. The peak of the activity was a 1997 meeting in Kyoto, Japan which was attended by over 170 nations (Gruber, 2007). The Kyoto Protocol was adopted on 11 December 1997 and entered into force on 16 February 2005. It represented an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). While the Convention encouraged industrialized countries to stabilize GHG emissions, the Protocol committed them to do so through establishing binding targets for 37 industrialized countries and the European community for reducing GHG emissions to an average of 5% against 1990 levels over the five-year period, 2008-2012 (Kyoto Protocol, 1998).

The Protocol places a heavier burden on developed nations under the principle of “common but differentiated responsibilities”; since developed countries, as a result of more than 150 years of industrial activity, are principally responsible for the current high levels of GHG emissions in the atmosphere. Under the protocol, countries must meet their targets primarily through national measures. It offers them, however, an additional means of meeting their targets by way of three market-based mechanisms: the Emission Trading Mechanism, Joint implementation Mechanism (JI), and Clean Development Mechanism (CDM).

Emissions Trading Mechanism: also known as “the carbon market” allows countries that have emission units to spare to sell this excess capacity to countries that are over their targets. Since

carbon dioxide is the principal GHG, emission trading is simply referred to as trading in carbon. Thus, carbon is now tracked and traded like any other commodity in the form of emissions reductions or removals (Emissions Trading, 1998).

Joint Implementation Mechanism (JI): allows a country with an emission reduction or limitation commitment under the Kyoto Protocol to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party- defined in the protocol, each equivalent to one ton of CO₂, which can be counted towards meeting its Kyoto target. It offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer (Joint Implementation (JI), 1998)

The Clean Development Mechanism (CDM): allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one ton of CO₂, which can be counted towards meeting Kyoto targets.

The mechanism is the first global, environmental investment and credit scheme of its kind. It stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets (CDM, 2006).

A CDM project must provide emission reductions that are additional to what would otherwise have occurred. The projects must qualify through a rigorous and public registration and issuance process. Approval is given by the Designated National Authorities. It is overseen by the CDM Executive Board, answerable ultimately to the countries that have ratified the Kyoto Protocol.

Since 2006, the mechanism has registered more than 1,650 projects and is anticipated to produce CERs amounting to more than 2.9 billion tones of CO₂ equivalent in the first commitment period of the Kyoto Protocol, 2008–2012 (CDM, 2006).

Appendix 2: Survey Questionnaire Manual

Survey for examining the main costs and benefits to taxi drivers under the “Taxi Recycling Program” Program

Introduction:

You are invited to participate in a research study. Taking part in this research is entirely voluntary. The purpose of this study is to examine the effectiveness of the Taxi Recycling Program subsidies program.

If you choose to take part in this study, you will complete a survey that will not take more than 15 minutes to answer. You may refuse to answer any of the questions and you may stop your participation in this study at any time.

We do not request your name or any identifying information in the survey. If the results of this research study are reported in journals or at meeting, data will only be shared in an aggregate form.

The Institutional Review Board at the American University in Cairo has already reviewed and approved the current survey.

To ensure anonymity, your signature is not required on this document. Your willingness to participate in this research study is implied if you proceed with completing the survey.

Survey Questions:

Q: Car Model

Q: Ownership status:

- Own the car
- Working on it

Q: Occupational Status:

- Full time taxi driver
- Part time taxi driver

Q: For part time taxi driver, what is the other job?

-

Q: Did you change your old car under this program to meet the regulations of traffic law 121?

- Yes
- No

Q: Did you change your old car under this program because the car was too old; you were looking forward to change it (not required by regulation)?

- Yes
- No

Q: When did you get your new car?

Q: Average working hours per day on the old car?

- 2-4 hours/day
- 5-7 hours/day
- 8-10 hours/day
- 11 or more hours/day

Q: Average working hours per day on the new car (white cab)?

- 2-4 hours/day
- 5-7 hours/day
- 8-10 hours/day
- 11 or more hours/day

Q: Average Km derived per day- old car?

Q: Average Km derived per day- new white cab?

Q: How much rent did you used to pay for old car per day (renters)?

- 20-40 LE/ day
- 40-60 LE/ day
- 60-80 LE/ day
- 80-100 LE/day
- 100-120 LE/ day
- More than 120 LE/ day
 - specify

Q: How much rent do you pay for the new car (renters)?

- 20-40 LE/ day
- 40-60 LE/ day
- 60-80 LE/ day
- 80-100 LE/day

- 100-120 LE/ day
- More than 120 LE/ day
 - specify
 - Fuel choice:

Q: Fuel type- Old cab:

- Natural gas
- Gasoline
- Natural gas/ gasoline
- Diesel

Q: Fuel type- new white cab:

- Natural gas
- Gasoline
- Natural gas/ gasoline
- Diesel

Q: why did you choose this fuel? (Mark all what apply for your case)

- More economic (cheaper)
- Better for the car
- Is readily available in all stations (you do not have to wait for long time)
- Recommended by the program (I did not choose it)
- Recommended by the car owner (in case of renters)
- Better for the environment (lower emissions)
- Other..... (specify)

Q: on an average day, for the new taxi, how much do you pay for fuel?

- 10-15 LE/day
- 15-20 LE/ day
- 20-40 LE/day
- 40-60 LE/day
- More than 60 LE/day..... Specify

Q: Is the new car more fuel efficient, i.e. does it burn less fuel? Why?

- Yes.....
- No.....

Q: Would you prefer natural gas use- under this program- to be optional/ mandatory? (Why?)

- Optional.....
- Mandatory.....

Maintenance:

Q: Do you agree that new vehicles are more prone to breakdowns?

- Agree
- Disagree

Q: on an average week, how many times did your old car break down?

- 0 times/ week
- 1-3 times/ week
- 4-6 times/week
- 7-9 times/week
- 10 or more times /week

Q: on an average week, how many times does your new car break down?

- 0 times/ week
- 1-3 times/ week
- 4-6 times/week
- 7-9 times/week
- 10 or more times /week

Q: Are the new cars easier to maintain, with regards to oil, filters changes, and other maintenance services?

- Yes.....
- No.....

Q: Do you agree that, some of the maintenance services, such as the oil, filters changes, and other maintenance services, are expensive?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Q: What are the available alternatives?

- Car station
- Mechanic
- Do it myself
- Maintenance company

Q: Over an average month, how much money did you used to pay on maintaining your old car, including oil changes, filters changes, and other maintenance services?

- Less than 100
- 100-300 LE
- 301-600 LE
- 601-900 LE
- 901-1500 LE
- 1501-2000 LE

Q: Over an average month, now, how much money do you pay on maintaining your new car, including oil changes, filters changes, and other maintenance services?

- Less than 100
- 100-300 LE
- 301-600 LE
- 601-900 LE
- 901-1500 LE
- 1501-2000 LE

Q: How satisfied are you with the following:

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
Q: I am satisfied with the maintenance costs					
Q: overall, I am satisfied with the maintenance service offered					

Financial incentives:

Q: Did you get a discount on the new car price?

- Yes
- No

Q: Did you get advantage of the competitive interest rates offered by banks?

- Yes
- No

Q: Did you get advantage of the subsidies paid by the government (10,000 to 15,000 LE)?

- Yes
- No

Q: Did you take advantage of the advertisement company offer?

- Yes
- No

Q: what's your comment on the subsidies and the financial incentives offered by the government?

.....
Q: How much is the bank installment per month?

- Less than 500 LE/ month
- 500- 1000 LE / month
- 1000- 1500 LE / month
- 1500- 2000 LE / month
- 2000- 3000 LE / month

Q: How long will you pay your bank installments?

Q: on an average month, have you ever been late on a payment?

- Yes..... (Why?)
- No.....

Q: on an average month, how long it takes to collect the bank payments?

- Within the first 10 days of the month
- Within the first 10 days of the month
- Within the month/ 30 days

Customers' perception and income earned:

Q: Do you face difficulty asking customers to pay by the new meter?

- Yes
- No

Q: on average, from each 10 customers, how many would refuse to pay by the meter?

- No one
- 1- 2 customers
- 3-5 customers
- 6-8 customers
- 9- 10 customers

Q: from your experience, do you agree that customers prefer the new cars' services, such as cleanness, quietness, air conditions (if available).....?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Q: Did your daily average income increased after changing your car?

- Yes, it increased
- No, it did not change
- No, it decreased.....why?

Program evaluation:

How satisfied are you of the following?

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
Q: I am satisfied with the car models offered					
Q: I am satisfied with the financial incentives					
Q: I am satisfied more with dealing with customers under the new program (applying meter)					
Q: I am satisfied with the banking services					
Q: I am satisfied with the maintenance services					

Q: Based on your experience, would you recommend the program for other fellow drivers?

- Definitely would
- Probably would
- Don't know (may be/ may be not)
- Probably would not
- Definitely would not

Q: what, if any, did you like the most about the new program?

.....

Q: If you can change one thing about this program, what would it be?

.....

Q: Overall, Rank the program from 1 to 10 (with 10 the best while one is the worst) based on your experience?

Demographic questions:

Introduction to demographic questions:

To put your answers in context, we would like to gather some personal information from you. Your answers will be held in the strictest confidence.

Q: How long have you been driving taxi?

.....

Q: How old are you?

- 21-30

- 30-40
- 40-50
- 50-60
- 60 or more

Q: How many days do you drive per an average week?

- 1-2 days per week
- 3-4 days per week
- 5-6 days per week
- All week

Q: On an average day, how many hours do you drive your taxi?

- 4-6 hours per day
- 7-10 hours per day
- 11-15 hours per day
- 16 hours or more per day

Q: on an average day, what is your approximate income?

- Under 30 LE
- 30-60
- 60-100
- 100-150
- 150-200
- More than 200 LE per day

Q: Highest level of education completed:

- Elementary
- Preparatory
- High school (secondary)
- Diploma (vocational training)
- Institute
- College degree (university degree)
- More, other: specify

Q20: Marital status

- Married
- Divorced
- Widow
- Never married

Q21: How many family members do you sponsor?

- 0 – 3
- 4 – 6
- 7 – 9
- 10 or more

Q: Do you sponsor family members other than your wife and kids?

- Yes.....
- No.....

