Cairo Air Improvement Project

Compressed Natural Gas Component

Vehicle Emissions and Performance Testing Center Business Plan

Chemonics International, Inc.

USAID/Egypt Office of Environment
USAID Contract No. 263-C-00-97-00090-00

March 2004

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Acronyms and Abbreviations

ABC	Activity base costing
AETB	Association of Egyptian Travel Business
CAIP	Cairo Air Improvement Project
CBD	Central Business District
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
CRM	Chain-ratio method
CVS	Constant volume sample
GOE	Government of Egypt
HC	Hydrocarbons
HCMLT	Holding Company for Maritime and Transportation
HP	Horse Power
ML	Misr Lab
NMOG	Non-methane organic gas
NOx	Nitrogen Oxides
O&M	Operations & Maintenance
OJT	On-the-job-training
PLC	Product life cycle
PM	Particular Matter
SBU	Strategic Business Unit
SOP	Standard Operating Procedure
STP	Segmentation, targeting, and positioning
TSP	Total Suspended Particulates
USAID	United States Agency for International Development
VEPTC	Vehicle Emission and Performance Testing Center
VOC	Volatile Organic Compounds
ZAG	Zero Air Generator
4Ps	Product, Price, Place and Promotion

1. Background and Purpose

The Cairo Air Improvement Project (CAIP), funded by the United States Agency for International Development (USAID), and implemented through a partnership with the Government of Egypt (GOE), began in 1997. The goals of the project were to initiate and implement measures to reduce air pollutants that have the most serious impacts on human health in the Greater Cairo Area, especially suspended particulates and lead. One key component of CAIP was to reduce particulate emissions from diesel-fueled buses through expanded use of compressed natural gas (CNG) in the public municipal bus fleets and tuning up existing diesel-powered vehicles. Another project component was to institute an air quality monitoring and analysis program for Greater Cairo, to collect baseline data, and measure the results of implementing the GOE's interventions.

As part of the CNG component, CAIP procured the necessary equipment and provided technical assistance to establish heavy duty vehicle emissions testing and performance measurement capacity at the Misr Laboratory facility of Misr Petroleum, a company that operates under the umbrella of the Ministry of Petroleum.

Misr Petroleum is a large company in the petroleum sector. It holds 83 percent of the Egyptian market for aircraft fueling services, 33 percent of the market for bunker supplies in all Egyptian ports, and 38 percent of the market for gasoline distribution through 810 gas stations. Misr Petroleum is also a large scale manufacturer of chemical products including car care products, household detergents, thinners and solvents, textile auxiliaries, and agricultural insecticides. Finally, Misr Petroleum makes and markets lubricants for autos, industrial uses, and marine engines.

The Misr Research Laboratory primarily tests the performance of products manufactured and distributed by Misr Petroleum. These include more advanced types of fuel, lubricating oils, and other petroleum products required for industry, agriculture, and other service utilities. The specialized test laboratory was developed to analyze and evaluate the properties of petroleum products, determine their performance standards and their ability to meet the requirements of different equipment.

Under CAIP, state-of-the art equipment for a Vehicle Emissions and Performance Testing Center (VEPTC) was added to the facility (Misr Lab). The objectives of VEPTC are to measure vehicle emissions and performance for governmental and private sector fleets; quantify and compare reductions in emissions from vehicles powered by diesel,

gasoline, and alternative fuels; provide a center for vehicle emission standardization, certification, and training; and participate in Egypt's efforts to improve air quality.

Misr Petroleum has 6,000 employees, including 200 working at the Misr Lab. Nine of those are assigned to VEPTC.

Table 1 Key Steps in VEPTC Development

Milestone	Date Completed
Construction finalization	February 2000
Equipment procurement & arrival	May 2000
Equipment installation	September 2001
Staff training	September 2002
Facility Commissioning	September 2001
CNG & Diesel Bus comparison finalization	October 2003
Promotional activities initiation	October 2003
1st commercialization bus rolling in	December 2003

The objective of this business plan is to provide a roadmap for sustainable operation of VEPTC by Misr Petroleum. It provides a development strategy for VEPTC, defines the services that can be offered by the laboratory and determines the levels of cost recovery Misr Petroleum can expect from operating VEPTC.

2. Business Development Strategy

The business development strategy for VEPTC differs from a traditional business plan to take into account the constraints and realities that govern VEPTC. Acknowledging these constraints is key to developing a realistic and achievable plan.

Market Constraints

There are two key constraints to the development of VEPTC as a money-making entity or profit center:

- **On the demand side**, while some regulations exist requiring limited testing of emissions from heavy vehicles, there are currently none being enforced that compel manufacturers, or owners of heavy vehicles to use this service. In addition there is an absence of vehicle emission standards for comparison. This means that potential clients will have to be provided with incentives to use the services of VEPTC until regulations and enforcement are in place to compel them to do so.
- **On the supply side**, the laboratory's maximum capacity is to handle 90–100 vehicles per year. This limits the number of customers VEPTC can process and potential revenues.

In addition to these constraints, there are objective realities that make the traditional business plan approach not applicable in this case. These also have to be recognized to develop a credible plan.

- VEPTC was equipped using money from a USAID grant through CAIP. Therefore, Misr Petroleum does not have to recover significant capital investment costs to repay a bank loan, as they would have to in a traditional business plan approach.
- VEPTC has no competitors in Egypt or the region offering the same testing capabilities for heavy vehicles. The state-of-the-art equipment available at VEPTC is unique to this region and is only available at a handful of facilities worldwide. While limited emissions testing can be provided by other facilities in Egypt for passenger cars and other light duty vehicles, there are no competitors for the full range of emissions testing services provided by VEPTC. Therefore, the typical competitive analysis found in most business plans does not apply.
- The size of the potential market is limited to vehicles that can reasonably expect to be tested in Cairo, and by the testing capacity of the laboratory.

- In the absence of environmental or other regulations requiring heavy vehicle manufacturers and fleet owners to conduct full testing of their buses and trucks, there is little incentive to pay for these services. This places significant constraints on cost recovery and on the notion that VEPTC will be a profit center for Misr Petroleum. Thus, in this case, a traditional rate of return analysis to demonstrate profitability is not applicable.

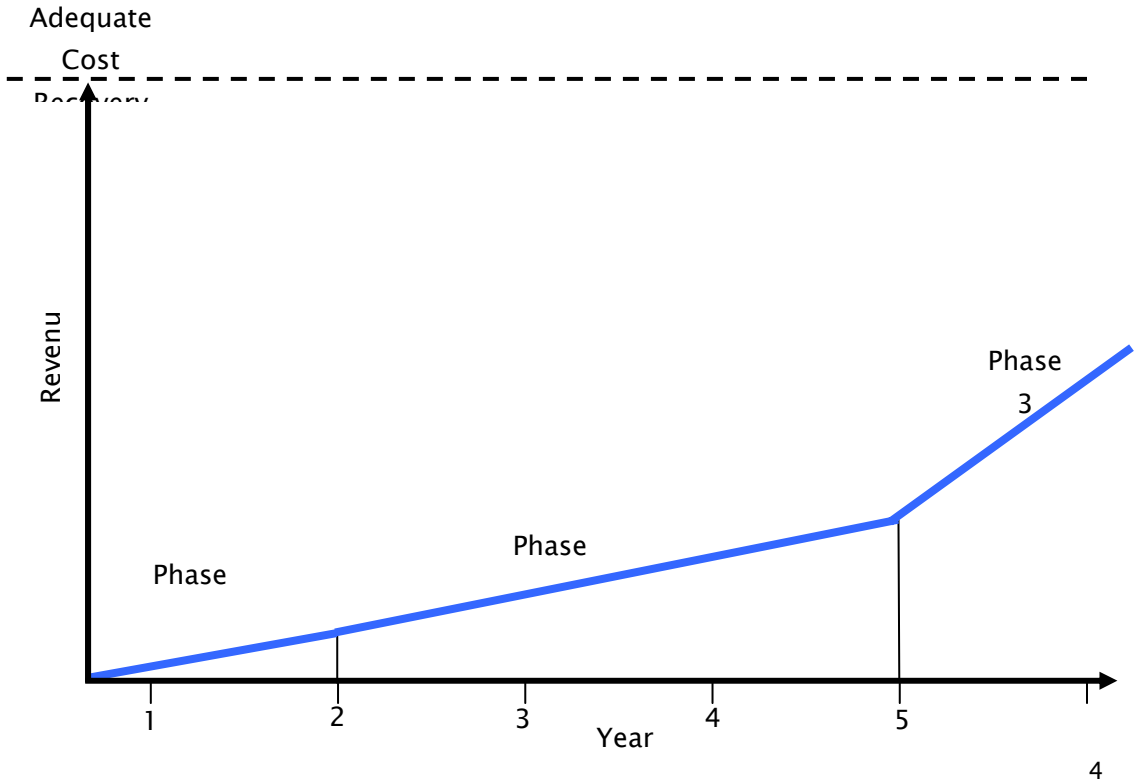
Strategy

Given the constraints identified above, the proposed strategy to make VEPTC sustainable would be implemented in three phases:

1. **Phase 1:** Develop a client base in years 1–2. In this phase, Misr Petroleum would implement a marketing plan to get customers in the door and generate traffic. In this phase, only a modest amount of cost recovery is expected.
2. **Phase 2:** Serve an established domestic market during years 3–5. In this phase, Misr Petroleum would work with an established local client base, charging a reasonable fee for its services.
3. **Phase 3:** Expand services and serve new domestic and international clients after year 5. In this phase, VEPTC would begin to serve both domestic and international clients and charge considerably higher fees for its services. Significant cost recovery would be realized and sustainability ensured.

Figure 1 summarizes the VEPTC business plan strategy. The eventual objective is to achieve adequate cost recovery to make the laboratory operations sustainable.

Figure 1 VEPTC Business Development Strategy



3. VEPTC Technical Capabilities

VEPTC's equipment measures emissions and vehicle performance through computer simulation of driving under various conditions. The laboratory uses state-of-the-art technology, including a heavy-duty chassis dynamometer.

The dynamometer simulates driving conditions for vehicles up to 20 tons, together with an exhaust Constant Volume Sampling (CVS) system, as well as collecting and measurement systems for particulate matters (PM) and gaseous emissions.

The constant Volume Sampling System and the dynamometer are integrated with a data acquisition and control system. The dynamometer is composed of two 160-cm diameter steel rollers mounted on one shaft and powered by a 380 kW direct current electric motor. The drive wheels of the vehicle are driven onto the rollers, where road conditions are simulated through a computer controlled driving cycle. The cycle could be a transient pattern of sequences of acceleration, deceleration, constant speed, and idle, depending on the type of function that needs to be assessed.

A principal purpose of these measurements is to quantify the reduction in emissions of diesel particulate matter and other pollutants resulting from the introduction of natural gas to power public transit buses or other pollution mitigation measures. Other purposes include improving the accuracy of the pollutant emission inventory for Cairo by measuring actual pollutant emissions from typical heavy-duty vehicles, and assessing the benefits of emission control measures such as emission standards for new vehicles and the introduction of an inspection and maintenance system.

Operating procedures for the emission test facility can be grouped as:

- Vehicle preparation and emission testing
- Gas analyzers and gas handling
- Particulate measurements
- Periodic checking, calibration, and preventive maintenance.

Vehicle Preparation and Emission Testing

To measure pollutant emissions from a given heavy-duty vehicle, the vehicle must first inspected at the laboratory to confirm that it can safely be tested. If necessary, coast-down tests are performed to establish the vehicle's frictional characteristics so that they

can be programmed into the dynamometer. The vehicle is then installed on the chassis dynamometer, preconditioned, and subjected to one or more emissions tests. Each emissions test consists of driving the vehicle through a defined driving cycle while measuring the gaseous and particulate emissions that result. When testing is completed, the vehicle is removed from the dynamometer and released. These procedures are defined in standard operating procedures (SOPs):

SOP-V01	Vehicle Reception and Inspection
SOP-V02	Vehicle installation on the Dynamometer
SOP-V03	Exhaust Emission Testing and Sample Collection
SOP-V04	Vehicle Removal and Release.

Gas Analyzers and Gas Handling

The measurement of gaseous emissions requires the use of specific gas mixtures to calibrate the span and zero values on the gas analyzers. These mixtures must be checked upon receipt against the master gas mixtures maintained at the laboratory. When a given cylinder is exhausted, it must be replaced with a fresh one. The zero air mixture is not supplied in cylinders, but continuously, by a zero air generator using a molecular sieve to purify atmospheric air. The purity of air from the zero air generator must be checked periodically (or in case of doubt) to ensure that the device is operating correctly. Finally, the response curves of the gas analyzers can change over time, and must be checked at monthly intervals. The corresponding SOPs are:

SOP-G01	Gas Naming Verification (upon cylinder receipt)
SOP-G02	Gas Cylinder Change (as needed)
SOP-G03	Zero Air Verification (monthly or as needed)
SOP-G04	Gas Analyzer Multipoint Calibration (monthly).

Particulate Filter Measurements

PM emissions are determined by collecting the PM on a pre-weighed filter, then weighing the filter again after the test. Typical filter loadings are expected to be in the range of 100-1,000 micrograms, or about the weight of a human hair. Thus, an extremely precise, microgram balance, which is housed in a temperature and humidity controlled room, is required, and extreme care is necessary in preconditioning, handling, and weighing the filters to ensure that the emission results are not compromised. These procedures are documented in the following SOPs:

SOP-F01	Microbalance Calibration
SOP-F02	Particulate Filter Handling and Weighing
SOP-F03	Master Balancer Calibration.

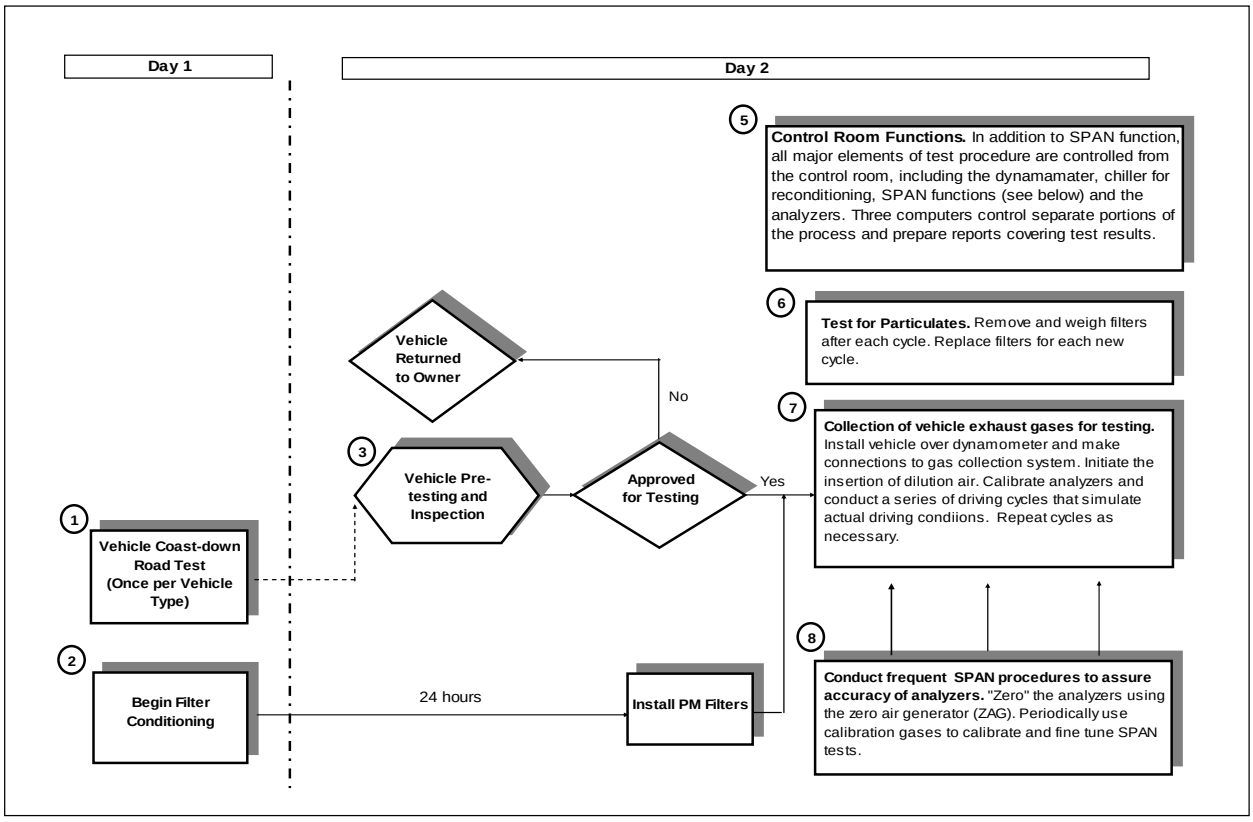
Periodic Checking, Calibration, and Preventive Maintenance

Numerous checks and calibration procedures are needed to ensure the validity of the emissions data. These include periodic calibration of the constant volume sampling system, particulate sampling system, and chassis dynamometer, as well as daily checks.

SOP-C-01	Critical Flow Venturi Flow Check (every 6 months)
SOP-C-02	CVS Propane Recovery Check (monthly)
SOP-C-03	Dynamometer Calibration (monthly)
SOP-C-04	PM Filter Flowmeter Calibration (every 6 months)
SOP-C-05	Daily Startup and End-of-Day Procedures.

The emissions testing process involves the use of sophisticated equipment and highly sensitive instrumentation. VEPTC staff have been thoroughly trained in the operation, calibration, servicing, and maintenance of all components of the system. The system is designed to test for carbon monoxide (CO), carbon dioxide CO_2, hydrocarbons (HC), and nitrogen oxides (NOx). The fifth test parameter is particulate matter (PM). The process is shown graphically in figure 2.

Figure 2 Emissions Testing Process



VEPTC should develop its own specifications or methodology for comparing the vehicle emission results with recognized standards. That would enable customers to better understand the data provided by the tests.

In addition to emissions testing, VEPTC and Misr Lab could offer these additional services:

1. Engine Testing

   Misr Lab has several engine dynamometers for measuring engine performance and characteristics such as:

   - Engine maximum horsepower (HP)
   - Engine fuel consumption
   - Engine torque
   - Engine bedding in.

2. Chassis Dynamometer Testing

   The chassis dynamometer available at VEPTC is designed for heavy-duty vehicles and is capable of measuring up to 600 H.P. The dynamometer can measure:

   - Fuel consumption
   - Horsepower
   - Torque, and torque rise percentage
   - Traction or brake horsepower
   - Maximum gradient
   - Acceleration
   - Power train efficiency.

3. Brake System Testing

   This system is for heavy-duty vehicles, and is capable of independently measuring the braking efficiency of each wheel.

4. Fuel and Oil Analysis

   Misr Lab is well recognized for its experience and reputation for fuel and oil analysis. The lab is well equipped with advanced technology to assure measurements results.

5. Training

   Misr Lab can offer intensive training programs on many technical subjects, the lab staff are professionals in their respective fields, and can offer classes and on-the-job (OJT) training programs.

The potential benefits of these vehicle performance tests include:

- Ensuring engine reliability
- Ensuring engine durability

- Minimizing engine repair costs
- Reducing engine fuel consumption
- Minimizing engine down time
- Minimizing engine maintenance
- Maximizing vehicle revenue
- Minimizing repair time
- Minimizing changes in vehicle parts
- Reducing accidents risks
- Maximizing vehicle operational time
- Upgrading vehicle safety
- Improving company service quality reputation.

These benefits save time and money and should be valued by potential customers. Highlighting the performance enhancement features of VEPTC, in addition to the emissions testing programs would be a strong element of the marketing strategy.

4. Staffing and Management

The VEPTC staff is comprised of Misr Petroleum employees. Staff members were trained through the CAIP project and are highly qualified. The engineers and technicians understand how the equipment functions and are well trained to use it in addition to maintain it and troubleshooting. Figure 3 shows VEPTC's organizational structure and table 2 presents a summary of VEPTC staff and associated costs.

Figure 3 VEPTC Organizational Structure

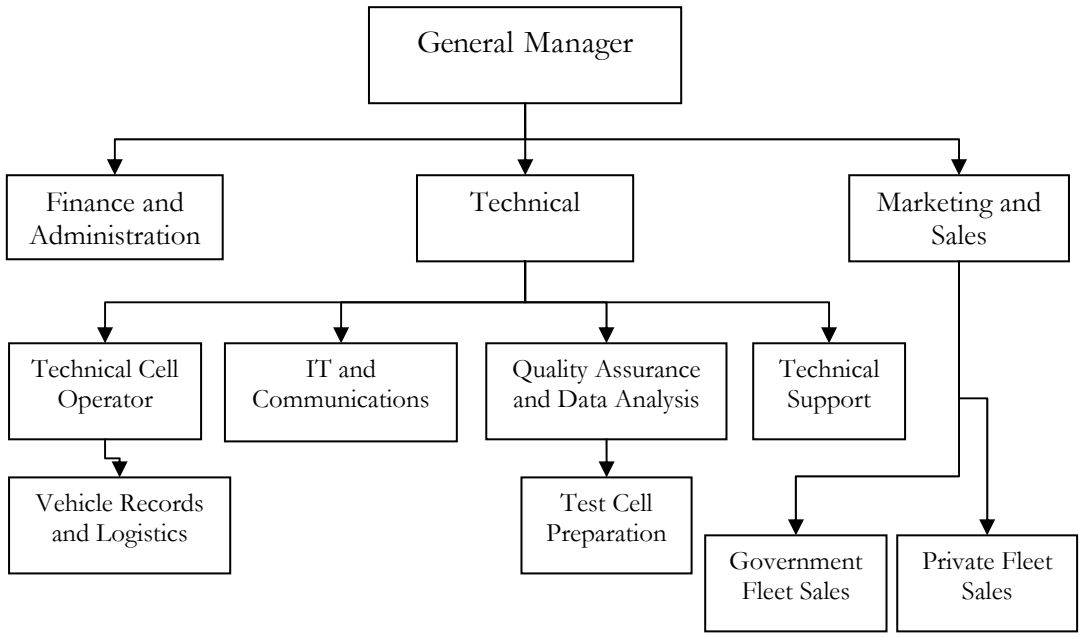


Table 2 VEPTC Staff Summary

Staffing (% of time applicable to part-time staff)	Overall Staff Compensation		
	Complement	Monthly LE	Annual LE
General Manager (20%)	1	1,200	14,400
Accountant (MISR Petroleum - 35%)	1	1,750	21,000
Technical Manager	1	3,200	38,400
Marketing Manager	1	3,200	38,400
Sales Persons	2	1,500	36,000
Sales Commissions		500	12,000
Engineer/Test Operator	1	2,000	24,000
Engineer/Support	1	2,000	24,000
Technician/Test Operator	2	1,500	36,000
Technician/Support	2	1,500	36,000
Clerical (20%)	1	150	1,800
Totals	13	18,500	282,000

Source: Misr Petroleum

Operating Parameters and Costs

The requirements for operating VEPTC are important because they directly affect operating costs. While the equipment was provided through a USAID grant, the costs of operating VEPTC will have to be borne by Misr Petroleum. Thus, the cost recovery parameters will be a function of operating costs. Operating steps, staffing, and resources required to complete a vehicle test are summarized in table 3.

Table 3 VEPTC Facilities, Test Procedures, and Resources

Step	Procedures/Facilities Employed	Resources		
		Staffing (Persons)	Inputs (Units)	Time (Min.)
1	Coast-down Road Test (one test per bus type)			
	Procedures involve driving bus to a section of roadway selected for its flat grade, light traffic, and ability to restrict the use of a considerable length one lane entirely to the conduct of the test. The bus is accelerated to a specified speed (e.g. 100 km/hr), then the transmission is placed in neutral and allowed to coast until it comes to rest. The test measures the vehicle's performance against road resistance in terms of the time required to reach declining levels of speed.	2	Fuel	480

Step	Procedures/Facilities Employed	Resources		
		Staffing	Inputs	Time
		(Persons)	(Units)	(Min.)
2–4	Filter Conditioning (Day 1–Day 2) and Filter Installation (Day 2)			
	Filters used to measure particulates must be pre-conditioned in a temperature and humidity controlled clean room for a period of 24 hours prior to installation on Day 2.. Filters are weighed prior to and after emissions tests using a highly sensitive scale Test may be repeated 5–10 times.	1	2–3 filters/ test	60
3	Pre-testing and Preparation (all buses)			
	Before entering test facility, all buses are inspected visually for leaks of transmission or brake fluids, tire wear/damage, steering and starter performance. An exhaust opacity test is also made. Refueling is done if required.	3	n/a	15
5	Control Room Functions			
	In addition to performing the SPAN operating described in Step 8 below, operators control the other major testing procedures from the control room, including the dynamometer, using three computers, each having specific functions. Two analyzers are used to test for various parameters. The gas stream is divided into two parts, the first part going directly to an analyzer dedicated to testing for NOx and HC. The second part of the gas stream passes through the "chiller" that prepares the gas for testing for CO and CO_2. The gas is reconditioned in terms of humidity, temperature, and flow rate before being sent to large plastic bags. The reconditioned gases are then sent from the bags to the second analyzer. The computers' software analyzes the test results and produces detailed reports covering all test parameters. The supervisor reviews the computer generated test reports and determines whether or not re-testing is required based on an evaluation of the data. If the data is deemed satisfactory, the supervisor then prepares the final report, including a synthesis of the findings and any recommendations arising from the assessment of test results.	See Step 8	See Step 8	See Step 8

Step	Procedures/Facilities Employed	Resources		
		Staffing	Inputs	Time
		(Persons)	(Units)	(Min.)
6	Tests for Particulates			
	Filters used for particulate testing have been prepared as described in Step 2. Filters are changed and weighed in the clean (balance) room under carefully controlled temperature and humidity conditions. Six filters are required for each cycle in the test.	1	18 filters	30
7	Collection of Exhaust Gases			
	The vehicle is moved into the test facility and positioned so that the rear wheels are centered on the dynamometer drums. The vehicle is then tied down with chains connected to fixed docking piers to prevent movement during the test. A gas collection tube is then fixed in place to connect the vehicle's exhaust pipe to the gas collection system. "Dilution air" is added to the exhaust stream. Dilution air is taken from the atmosphere, filtered and then processed so that it is of comparable temperature and pressure when inserted into the gas collection system. These steps require about 30-45 minutes. Before initiation of the test, the emissions analyzers are calibrated using test gases of known composition to assure accurate measurements are made during the test. The test simulates actual driving conditions as the vehicle is "driven" through pre-determined cycles. The test begins with a demonstration cycle (approximately 20 minutes) that is used to confirm the analyzers are working properly. The actual test cycles are repeated 2–3 times using standardized routines known as "CBD2" (12 minutes) and "Braunchwig" (30 minutes). At the end of the test procedure, the vehicle is unchained and removed from the test facility.	2	Fuel and electricity	114

Step	Procedures/Facilities Employed	Resources		
		Staffing	Inputs	Time
		(Persons)	(Units)	(Min.)
8	Verification of Analyzer Accuracy			
	During conduct of the driving cycles on the dynamometer, a series of "SPAN" procedures are conducted using test gases of known composition to maintain the accuracy of the analyzers. SPAN procedures are controlled from the control room and conducted at the beginning of each day, then before, during, and after each test. For a 2-phase test, SPAN procedures are performed three times during the test and for a single phase test, SPAN procedures are conducted twice. In addition, the gas room contains a "zero air generator" (ZAG) which compresses, dries, and cleans air to be used in "zeroing" the analyzers. In addition to the SPAN gases and the ZAG, the gas room contains test gases to be used on a monthly basis for calibration and fine-tuning of the SPAN procedures. These functions are performed under the direction of operators located in the control room.	2	Test gases	120

As the table shows, besides the time of the technical staff, filters and gases are essential inputs in conducting emissions tests. These materials have to be available at all times and constitute key elements of operating costs.

In order to get a realistic picture of cost recovery requirements, it is important to categorize the types of costs that need to be recovered in the different phases of the business plan strategy. In Phase 1, the costs of the inputs required for conducting emissions tests (i.e., filters, test gases, electricity, and fuel) need to be recovered. In Phase 2, input costs and other operating costs (e.g., labor, marketing) will be recovered. Finally, in Phase 3 all operating costs plus depreciation costs will be recovered. The financial analysis is shown in detail in chapter 7.

5. Potential Market for Services

The ability of Misr Petroleum to generate income for VEPTC will be determined by the market for VEPTC services. There are a handful of emissions testing facilities worldwide that can offer services similar to VEPTC, as summarized in table 4. This list is not exhaustive, and there are other facilities that provide some capability for vehicle emissions testing, particularly for light vehicles.

Table 4 Heavy-duty Vehicle Emissions Testing Facilities Worldwide

Facility	Location	Type
Millbrook Proving Ground	Bedford, England	Private
AVL MTC	Haninge, Sweden	Private
Environment Canada	Ottawa, Canada	Government
West Virginia University	Morgantown, WV, USA	University
CaTTS	Richmond, CA, USA	Private
Southwest Research Institute	San Antonio, TX, USA	Private
NREL	Golden, CO, USA	Government
Pollution Control Department Laboratory	Bangkok, Thailand	Government

These facilities provide services such as:

- Engine diagnostics and consulting
- Certification and regulation compliance
- Emissions research
- Development and validation of emission control systems
- Investigation and evaluation of environmental impacts
- Advanced analysis of regulated and unregulated emissions, including real-time particle size characterization
- Environmental characterization
- Multi-dynamometer analysis.

The clients served by these laboratories include government agencies, owners of private fleets, manufacturers of buses and trucks, manufacturers of engines and parts, research institutions, international donor organizations, and industrial trade associations.

While it is difficult to obtain reliable data on the pricing of emissions testing vehicles from other laboratories, table 5 summarizes some pricing.

Table 5 Prices at Emissions Testing Laboratories

Laboratory	Price per Test	Comment
West Virginia University	$20,000	Price per vehicle for 12 vehicles
CaTTs	$1,400	Per test
	$2,500	For coast-down, setup, and reporting
MTC	$1,722	Per test
	$1,722	For management, setup, and reporting
Environment Canada	$700	Per test, price only used to cover operating costs

There is a wide range of prices charged for these tests. Environment Canada, which is a government entity, uses the tests primarily to set policy and predict future emission levels. West Virginia University charges high rates to private manufacturers of heavy duty vehicle engines and alternative fuels that want to demonstrate the benefits of their product. For the other two facilities (CaTTs and MTC), their prices are fairly similar for a full test ($3,900 and $3,500, respectively).

Potential Market

In Egypt, the initial market for VEPTC services includes companies operating buses and trucks in the Greater Cairo Area. These companies can be separated into the following categories: transit bus companies, tourist bus companies, and trucking/hauling companies. In addition, VEPTC can provide services to government companies (for policy-setting purposes) and to research institutions for research purposes. One of these might be the Holding Company for Maritime and Land Transportation (HCMLT), which presently has a fleet of appropriate size, and is growing.

Table 6 summarizes the bus and truck companies of HCMLT that are targeted as the near-term potential clients of VEPTC.

Table 6 Summary of Egyptian Bus and Truck Companies

Company Name	Address	No. of Vehicles

Company Name	Address	No. of Vehicles
Bus Companies		
East Delta Company	4 Taryan St., Nasr City, Cairo	818
Upper Egypt Bus Company	4 Youssed Abbas St., Nasr City, Cairo	685
Delta Bus Company	1343 Corniche el-Nil St., El-Sahel, Shoubra, Cairo	413
West Delta Bus Company	Victor Emanuel, Samouha, Alexandria	370
Total Buses		**2,286**
Truck Companies		
Nile Transportation Company	4 Markez Tadreb el-Moderabeen El-Ameeriya, Cairo	351
Road Transportation	Mehmoudeya Canal, El-Nozha, Alexandria	302
Heavy Transportation	16A Kablat St., Matareya, Cairo	267
Transportation Work	4 El-Sawah St., El-Ameeriya, Cairo	334
Direct Transportation	Gesr el-Suez St., Cairo	377
Total Trucks		**1,631**
Grand Total		**3,917**

These are the largest transportation companies and account for a major portion of the heavy vehicles in the country. There are many more heavy vehicles and companies that own small fleets of vehicles. However it is unlikely that these companies will be clients of VEPTC.

Other potential clients for VEPTC are tour operators with their own buses. This segment constitutes a significant pool of potential clients. The Association of Egyptian Travel Business on the Internet (AETBI) lists 52 Egyptian tour operators. There are probably quite a few others and a significant number of buses. In addition to tour operators, government agencies and research institutions are also potential clients of VEPTC. They too have buses and trucks and can benefit from the laboratory's services.

Potential clients would be influenced by future governmental policies and international actions, such as:

- Adoption of emission standards for new heavy-duty vehicles and/or engines would require domestic manufacturers and importers to certify engines for local sales.
- Requirements for advanced, "clean" vehicles used in sensitive applications to be tested to establish eligibility.

- Adoption of vehicle emission standards by other developing countries, especially in the Middle East, could lead manufacturers in those countries to use VEPTC's service.
- The U.S and Europe will eventually adopt transient emission test cycles for non-road equipment, so that the steady-state emission testing capability will be of less use.

The important feature of the Egyptian market for VEPTC services is that the number of heavy vehicles that can benefit from the use of the facility (at least 5,000) is far greater than the number that can be tested at the facility (100-150 per year). Therefore, the challenge for VEPTC is to create demand for its services.

6. Marketing Plan

With the recognition that the market for the services of VEPTC is currently limited, it is imperative that Misr Petroleum engages in an active marketing campaign to generate traffic at the facility. This plan comprises the analysis of the market-mix 4P's (Product, Price, Place, and Promotion) and entails market segmentation, targeting, and positioning (STP). This plan is directly related to the near-term objective of developing a client base and is based on providing incentives and developing communication tools targeted at potential users of the lab. The cost of services need to relate to the product life cycle (PLC) and enable Misr Labs to recover some operating costs.

General Promotional Tools

VEPTC must do more than offer good service, price it attractively, and make it accessible. VEPTC must inform prospective customers and potential stakeholders about the service benefits. To do this VEPTC must skillfully use targeted public awareness tools, including:

- Advertising
- Newspapers
- Pamphlets and brochures
- Appropriate magazines
- Directories
- Internet.

Sales Promotion Tools

- Free sample tests
- Premium service (oil change free or at low cost)
- Rebates
- Participation in conventions, trade shows, and international conferences
- Calls for participation in workshops
- Demonstration tests.

Public Relations

- Keeping press agencies informed
- Building and maintaining relationships with legislators and government officials
- Networking with donor agencies and NGOs
- Communicating with universities and academic institutes
- Building linkages with oil companies, especially with Shell Egypt, to assist in marketing this service locally and abroad.

Personal Selling

- Sales presentations and offers
- Sales meeting
- Incentive programs
- Participation in fairs and trade shows.

Special Incentive Program

- Present engraved certificates to companies that have their vehicles tested stating that this company conducted emission tests at Misr Petroleum and is recognized for its social responsibility and protection of the environment. The presentation should take place at a formal event, with press invited.
- Offer trips to international vehicle trade shows for two people from participating companies.
- Offer a discount of 0.5–1.5 percent on all products sold to participating companies during the period covered by the test, usually 1 year.
- When the number of vehicles to be tested from any one company exceeds 30, offer a 15 percent discount for services rendered by VEPTC.

Such incentive schemes can be scaled back as the facility builds its reputation, but at this stage of the product life cycle, its strongly recommended to begin with an aggressive incentive scheme.

Pricing

Pricing of services will be an important element in the market-mix that will determine the volume of traffic at the lab. Misr Petroleum needs to strike a balance between the need to generate demand and the necessity to recover some operating costs. Phase 1 is a time when demand needs to be generated. Introductory prices and differentiated prices would be appropriate. It would be reasonable to raise prices in Phase 2, when a solid

client base has been established. In Phase 3, the facility would have established credibility locally, and a marketing plan for international customers could begin, with a separate price scale.

A willingness to pay analysis was conducted with bus operators to determine how much they would agree to pay to test buses at VEPTC. The bus company representatives, after visiting the lab facilities and being exposed to the capabilities of VEPTC, expressed their willingness to pay up to L.E.1,000 per test (approximately US$165). This amount is far below the average rate charged for similar tests elsewhere ($1,500–$2,500) per test. The bus companies should be able to pay far more for advanced emissions testing that can enhance the performance of their vehicle, especially if they realize savings as a result of the test. The appendix contains more on prices, and table 7 shows proposed pricing for the services.

Table 7 Pricing Proposal for VEPTC Services (L.E. per test)

Phase	Transport Buses	Government/Universities	Tourist Buses	Foreign
Phase 1 (years 1–2)	1,000	300	1,000	—
Phase 2 (years 3–5)	3,800	500	3,800	—
Phase 3 (after year 5)	5,000	1,000	5,000	50,000

7. Financial Analysis

The financial analysis for VEPTC is based on costs that need to be recovered by Misr Petroleum in Phases 1, 2, and 3 of the business plan; the projected number of vehicles to be tested at the facility; and the prices for VEPTC services.

Overall Costs

In a traditional cost recovery analysis, the costs to be recovered include capital and operations and maintenance (O&M) costs. In the case of VEPTC, the financial analysis departs somewhat from a traditional analysis because much of the capital costs incurred in building VEPTC were from a USAID grant through CAIP, and some of the operating costs (e.g., staffing) would be incurred by Misr Petroleum anyway, whether or not VEPTC were operating. Therefore, in this financial analysis, it is important to separate the costs that are additional to Misr Petroleum as a result of operating VEPTC from those costs that Misr Petroleum would incur anyway from its operation of the Misr Lab facility.

Capital Costs

The assets of VEPTC are comprised of the land and building that it occupies plus the equipment and instrumentation used in the test procedures. The GOE and MISR Petroleum provided the land, civil works, and mechanical/electrical infrastructure, and USAID provided the equipment and instrumentation used in emissions testing. Estimates for the value of the land occupied by the lab were not available at the time of preparation of the business plan, but it can be assumed to be a substantial amount. All other assets are estimated at a total book value of approximately L.E.12 million as of June 30, 2003.

The assumed economic life for each asset category, which serves as the basis for the estimated depreciation rates, is estimated in line with economic life factors typically used in research facilities. VEPTC, however, is one of only a small number of facilities engaged in emissions testing for heavy vehicles and information on depreciation rates in comparable laboratories is not available. It should be noted that the Ministry of Finance may stipulate the rates of depreciation to be used at such time as the lab

initiates operations in its new role as a Strategic Business Unit (SBU). In the interim, the assumed economic lives of the various asset categories will serve as reasonable guess.

Estimated asset values and depreciation rates for VEPTC are shown in table 8.

Table 8 VEPTC Estimated Fixed Assets and Depreciation (in L.E.)

Item	Estimated Book Value 30/6/03	Assumed Total Economic Life- Yrs	Annual Depreciation LE
Land	(Not Available)		0
Buildings - civil works	1,764,974	30	58,832
Buildings - mechanical/electrical	247,802	15	16,520
Operational Equipment	6,628,363	12	552,364
Instrumentation/Electronic Controls	3,319,737	8	414,967
Office equipment & furniture (est.)	15,000	10	1,500
Training (to be amortized)	103,320	5	20,664
Totals	12,079,196		1,064,847
Composite depreciation rate		8.82%	

Source: Misr Labs and CAIP

As indicated, annual depreciation is estimated to be in excess of L.E.1 million. The composite depreciation rate of 8.82 percent is considered high, but is attributable to the high proportion of assets in the equipment and instrumentation/electronic controls categories, which are assumed to have relatively short economic lives. Another factor to be aware of is obsolescence, especially in a field such as emissions testing, where the equipment, instrumentation and controls are subject to becoming obsolete before fully depreciating due to the rapid advances in the technology.

The magnitude of estimated depreciation is such that it may exceed the level of attainable cost recovery. For this reason, the "full cost recovery" scenario in Phase 3 (presented later) seeks to recover only 50 percent of depreciation expense.

VEPTC is not expected to expand its infrastructure or to add significant amounts of equipment within the planning horizon. Capital expenditures are expected to be required however, for renewal/replacement of equipment or for its upgrading.

Operating Costs

There are different types of operating costs. Some are inherent to the Misr facility where VEPTC is located and would be incurred by Misr Petroleum even if VEPTC were not operating. Labor costs fall in that category. Other costs are exclusively related to the operation of VEPTC. It will be less important for Misr Petroleum to recover costs in the first cost category than in the second.

Table 9 shows the operating costs components VEPTC will need to recover and categorizes those costs based on the operating phases.

Table 9 VEPTC Annual Projected Operating Costs

Cost Category	Cost per Year (L.E.)	Percent
Phase 1		
Calibration and test gases	73,200	3.4
Filter replacements for operating equipment	324,000	15.0
PM filters	27,726	1.3
Power and water	16,061	0.7
Equipment service and calibration	60,000	2.8
Subtotal	**500,987**	**23.3**
Phase 2		
Staff	282,000	13.1
Insurance	10,000	0.5
Travel and transportation	64,080	3.0
Misr Lab's overhead	147,178	6.8
Sales and promotion events	57,600	2.7
Supplies and other	26,666	1.2
Subtotal	**587,524**	**27.3**
Phase 3		
Depreciation	1,064,487	49.5
TOTAL	**2,153,358**	**100.0**

Source: Misr Labs and CAIP

It is not anticipated that Misr Petroleum would have to recover all these costs.

In Phase 1, only 25 percent of the costs of the filter replacements will have to be recovered because CAIP is purchasing replacement filters and gases for VEPTC which will cover the remaining 75 percent of needs during phase 1.

In Phase 2, 25 percent of staffing costs and 25 percent of Misr Lab's overhead costs will have to be recovered because Misr Petroleum staff assigned to VEPTC will be employed by Misr Lab in any event, and overhead costs are shared with other elements of the Misr Lab facility.

In Phase 3, all the operating costs are recovered, in addition to 50 percent of depreciation costs.

The total costs to be recovered in each phase of the business plan are summarized in tables 10, 11, and 12:

Table 10 Phase 1 Costs to be Recovered (2 Years)

Cost Category	Cost/Year	Percent to be Recovered	Cost to be Recovered in Phase1
Calibration and test gases	73,200	25	18,250
Filter replacement in operating equipment	324,000	25	81,000
PM filters	27,726	25	6,932
Power and water	16,061	100	2 × 16,061 = 32,122
Equipment servicing and calibration	60,000	100	2 × 60,000 = 120,000
Total Phase 1			**258,304**

Table 11 Phase 2 Costs to be Recovered (3 Years)

Cost Category	Cost/Year	Percent to be Recovered	Cost to be Recovered in Phase1
Calibration and test gases	73,200	100	73,200
Filter replacement in operating equipment	324,000	100	162,000
PM filters	27,726	100	27,726
Power and water	16,061	100	16,061
Equipment servicing and calibration	60,000	100	60,000
Staff	282,000	25	70,500
Insurance	10,000	100	10,000
Travel & transportation	64,080	100	64,080
Misr overhead	147,178	25	36,794
Sales and promotion events	57,600	100	57,600
Supplies & other	26,666	100	26,666
Total			**766,627**
Total Phase 2			**2,299,881**

Table 12 Phase 3 Costs to be Recovered

Cost Category	Cost/Year	Percent to be Recovered	Cost to be Recovered in Phase1
Calibration and test gases	73,200	100	73,200

Cost Category	Cost/Year	Percent to be Recovered	Cost to be Recovered in Phase1
Filter replacement in operating equipment	324,000	100	162,000
PM filters	27,726	100	27,726
Power and water	16,061	100	16,061
Equipment servicing and calibration	60,000	100	60,000
Staff	282,000	100	282,000
Insurance	10,000	100	10,000
Travel & transportation	64,080	100	64,080
Misr overhead	147,178	100	147,178
Sales and promotion events	57,600	100	57,600
Supplies & other	26,666	100	26,666
Depreciation	1,064,487	50	532,423
Total			**1,620,934**

Misr Petroleum can adjust the percent of costs in each category it expects to recover. As these adjustments are made, the total amount to be recovered each year will vary.

Expected Revenues and Cost Recovery Analysis

Expected revenues are based on the number of customers expected each year, the type of customer, and the price charged to each customer. Table 13 summarizes expected revenues in each Phase.

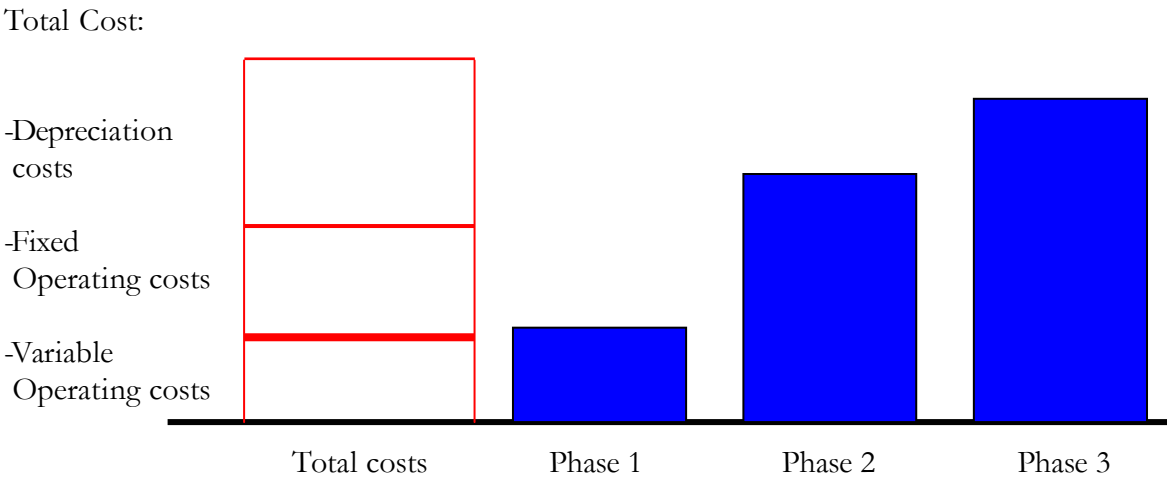
Table 13 Expected Revenues from VEPTC operations

Category	Phase 1			Phase 2			Phase 3		
	#	Price	Revenues	#	Price	Revenues	#	Price	Revenues
Transport Buses	250	1,000	250,000	400	3,800	1,520,000	400	5,000	2,000,000
University & Government	5	300	1500	10	500	5,000	10	1000	10,000
Tour Operators	50	1000	50000	150	3,800	570,000	100	5,000	500,000
Foreign	0	--	0	0	--	0	10	50,000	500,000
Total	305		**301,500**	100		**2,095,000**	100		**3,010,000**

We assume that approximately 150 vehicles will be tested each year. Each test will take between one and two days, so that VEPTC would be operating more than 200 days per year, which is very close to its maximum capacity. To the extent that fewer vehicles are tested, revenues will be lower. However, some elements of the variable costs will also be lower (e.g., test gases, filters, and power).

A summary of the cost recovery analysis is given in figure 4. It demonstrates that expected revenues would be sufficient to cover costs to be recovered in each phase.

Figure 4 Cost Recovery Analysis Summary



Misr Petroleum will not need not to subsidize the laboratory in Phase 1 or even in Phase 2 since the capital costs were financed through a USAID grant. The goal for Misr Petroleum will be to recover both fixed and variable operating costs by Phase 2. A portion of depreciation costs can also be recovered. This will be feasible if foreign buses and trucks can be tested at the facility at international prices.

In Phase 3, although total revenue would be less than total cost due to depreciation, this gap will not be associated with any actual cash outflow. Misr Petroleum would still not need to subsidize the lab, allowing the lab to stand alone as an independent SBU.

8. Detailed Plan and Timing

The objectives of this business plan are to

- Bring customers into the lab in the near term
- Establish a reliable local client base in the medium term
- Diversify the client base and expand services in the longer term.

Tasks

The tasks that should be undertaken by Misr Petroleum to reach the objectives of this business plan are not exhaustive and need to be vetted with all the partners involved. They would need to be approved by Misr Petroleum and could be refined and adjusted, based on the reaction of potential clients and government entities.

Phase 1

The Phase 1 tasks are related to developing a local client base:

- Set up a VEPTC marketing group at Misr Petroleum
- Identify potential clients (transport bus companies, tour operators, universities, government agencies)
- Create a document clearly explaining the test protocol (what it does, what the results are, what the results mean for vehicle performance and air pollution)
- Identify incentives Misr Petroleum can provide prospective new clients (e.g., discounts on Misr Petroleum products, free engine checks, recommendations for engine retrofitting, discounts at selected garages, or green label and environmental certification)
- Identify other products that can be provided by VEPTC besides full emissions testing (e.g., regular emissions testing and installation of new equipment)
- Establish a pricing strategy for VEPTC services
- Organize a seminar, including a laboratory visit, to showcase to potential clients VEPTC's state-of-the-art capabilities
- Develop pass/fail emission standards for heavy vehicles to be tested at the lab
- Develop marketing materials (brochures, posters, radio spots, and a Misr Petroleum magazine)

- Create a lab video (5–10 minutes) showing the uses and benefits of the lab
- Make agreements with garages to retrofit vehicles failing the emissions test
- Make agreements with tour operators to provide buses tested at the facility with "green" labels
- Create a system for monitoring vehicles that have been tested at the lab and for follow-up on the performance of the vehicles
- Develop joint programs with universities for training students at the lab
- Develop a VEPTC website
- Begin the process to get the laboratory internationally accredited.

Phase 2

The activities in Phase 2 are related to maintaining an established client base and preparing VEPTC for expanding its reach.

- Carry out a survey on customer satisfaction
- Monitor the performance of vehicles that were tested in Phase 1
- Prepare a report on vehicle performance and lab activities in Phase 1
- Review the pricing of services and adjust prices accordingly
- Organize a seminar to show the results of the performance evaluation
- Complete the laboratory accreditation process
- Refine marketing and communication tools to include real data from Phase 1
- Publish findings from data collected on Phase 1 activities
- Participate in conventions, trade shows, and related international conferences
- Communicate with other labs worldwide
- Identify potential foreign clients
- Prepare a marketing strategy for attracting foreign clients
- Develop marketing tools and communications support for attracting foreign clients
- Organize an international conference, to be held in Cairo, on heavy vehicle emissions and include a VEPTC visit for conference attendees
- Refine the VEPTC website.

Phase 3

In Phase 3, VEPTC would be fully functioning and seeks to expand its client base to include international clients.

- Negotiate deals with foreign clients
- Review data on VEPTC activities, costs, revenues, and demand for services
- Review prices and adjust them based on cost-recovery criteria

- Set up procedures, with relevant government agencies, to allow for the testing of foreign vehicles at VEPTC
- Continue to monitor VEPTC activities
- Update the website as appropriate
- Update marketing and communication materials, as appropriate.

Timing

The following GANTT chart that shows the timing of the tasks to be undertaken by VEPTC and Misr Petroleum in each phase of the business plan.

Task	Phase 1								Phase 2												Phase 3							
	2004				2005				2006				2007				2008				2009				2010			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Set up VEPTC marketing group																												
Identify potential clients																												
Create document on test protocol																												
Identify incentives to provide to clients																												
Identify products to be offered by VEPTC																												
Establish a pricing strategy for VEPTC																												
Organize a seminar to showcase VEPTC																												
Develop emissions standards																												
Develop marketing materials																												
Create a lab video																												
Make deals with garages for vehicle retrofitting																												
Make deals with tour operators for "green labels"																												
Create a vehicle monitoring system																												
Develop a joint training program with Universities																												
Develop a VEPTC web site																												
Begin international accreditation process																												
Prepare a survey of customer satisfaction																												
Monitor the performance of vehicles tested in Phase 1																												
Prepare a report on lab activities in Phase 1																												
Review the pricing of services and asjust prices																												
Organize a seminar to show results & performance																												
Complete the laboratory accreditation process																												
Refine marketing and communication tools																												
Identify potential foreign clients																												
Prepare a marketing strategy for foreign clients																												
Develop marketing tools and communications support																												
Organize an international conference on VEPTC																												
Refine the VEPTC web site																												
Negotiate deals with foreign clients																												
Review data on VEPTC activities																												
Review prices and adjust																												
Set up procedures for testing foreign vehicles																												
Monitor VEPTC activities																												
Update marketing and communications materials																												

9. Conclusion

This business plan presents a road map for Misr Petroleum to use to make VEPTC operational with reasonable opportunities to recover costs. The proposed phased approach recognizes that a fully operational laboratory that provides services to a wide variety of clients is a real challenge that will not happen overnight. However, by following the steps outlined, VEPTC will be well positioned in a few years to take full advantage of its market opportunities. In addition, the facility will be valuable for research institutions and for government agencies engaged in policymaking.

The plan is not cast in stone. The tasks suggested could be adapted and changed over time. Similarly, adjustments will be made in light of real experience and information about costs, number of customers, and prices. Initially, a quarterly review of VEPTC activities, operating costs, and revenues will be helpful to adjust elements of the plan appropriately.

Appendix: Price Ceiling

The price ceiling, which is the maximum amount the customer is willing to pay, was estimated by using estimated data about buses and trucks, emphasizing the most tangible benefit—fuel savings—perceived by owners and managers of that equipment. Other benefits such as improved vehicle performance and air quality improvement were estimated.

The method—the chain-ratio method (CRM)—involves multiplying base numbers by several percentages, then making an estimate of the price ceiling by this calculation:

Price Ceiling = Average Revenue per Bus/Truck ×
Average percent of revenue spent on operating costs ×
Average percent of operating cost spent on fuel ×
Average percent of fuel saving due to the emission test control, or
L.E.270,000 per year × 30% × 28% × 15% = L.E.3,402 per year.
(Data gathered from questionnaire)

Other benefits could allow for 5–10 percent increases.

This estimate gives the following range:

Minimum rationale = L.E.3,402 × 1.05 = L.E.3,572 @ = L.E.3,500
Maximum acceptable = L.E.3,402 × 1.10 = L.E.3,742 = L.E.3,800

Another direct—and conservative—method of calculation, is made using the following assumptions:

1. That the average bus/truck travels about 2 km/liter
2. That the average distant covered is 300km/day
3. This represents 150 liters/day
4. Which gives 45,000 liters/year
5. Assuming a maximum of 5 percent improvement in fuel use, this will save 2,250 liters/year
6. Which yields LE.1,012/year
7. With a mark-up to cover all intangible benefits of 10 percent
8. Then the ceiling price would be L.E.1,115

As customers appreciate the value of the testing, this will support future price increases.