Cairo Air Improvement Project

Lead Pollution Abatement Component

Lead Supply and Demand Study

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EXECUTIVE SUMMARY

The study for Supply and Demand Tracking and Protection System and Database aims at examining and analyzing the performance of industrial demand for lead, as well as, the supply of recyclable lead baring materials in Egypt. In this respect, the three parties involved in the lead industry, lead users, lead smelters and scrap batteries' collectors are investigated in order to provide Egypt's decision making and international donors with accurate information on the present and projected future demand and supply of lead ingots in Egypt.

The approach adopted is to collect information from both secondary and primary sources. Previous reports on the lead industry and lead consuming industries are reviewed, from which the key findings are derived and analyzed. Published and unpublished information issued by public statistical agents are also collected.

A market survey was conducted to collect primary data on the three parties involved in the lead market. A representative sample of these three parties were selected and interviewed. In this respect, three sets of questionnaires addressing each of the three parties were designed to include questions about market structure, market size, market shares, domestic production, factors affecting both demand and supply, and finally market mechanism and pricing system.

The collected data from secondary and primary sources were used to tackle two major issues; market overview and market outlook. The market overview involves a comprehensive analysis of the past and present performance of both demand and supply of lead.

Demand analysis reveals that lead is mainly used in eight industries (more than 90% of the quantity used of lead); batteries (both final product and intermediate product), pipes, pressure hose, crystal, electric cables, lead

oxides and paints. The market structure and key market parameters for basic lead user industries are summarized as follows:

Basic parameters of lead user Industries of Lead

Lead Users	**Market Structure**	**Major Players**	**Market Share**	**Quantity used of lead (2001)**	**Annual rate of Growth**
Batteries	Monopolistic Competitive market	1. Chloride 2. El-Nasr for Batteries	40% 29%	7560 (hard lead) 975 (grey oxide)	7.2%
Battery Components	Perfect Competitive market	Large Number of small firms		321 (hard lead)	-3.8%
Lead Pipes	Oligopoly market	1. Awadallah 2. El – Mahy 3. Hassan Mostafa	40% 20% 10%	15375 (hard lead)	-3.8%
Pressure Hose	Oligopoly Market	Narobeen	40%	68 (hard lead)	-13.2%
Crystal	Monopolistic Market	Crystal Asfour	100%	244 (Red oxide)	8.8%
Electric Cables	Duopoly Model	1. El-Sweedy Cable Co. 2. Arab Cable Co.	70% 28%	390 (hard lead)	22.2%
Lead Oxide	Dominant Firm Model	Awadallah	60%	4500 (soft lead)	-9.3% -12.7%
Paints	Monopolistic Competitive market	1. Pachin 2. Sipes	Both account for 35%	74 (red oxide)	4.1%

Total market size of lead industry is estimated at 35 thousand tons (2001), of which lead pipes industry is the major user of lead in Egypt (more than 46% of hard lead ingots), followed by the battery industry. These two industries use around 70% of the quantity used of lead ingots. Hard lead ingots is the major lead used in Egypt (88% of the total quantity used of lead), followed by soft lead ingots. Both red lead oxides and grey lead oxides are used in limited quantities.

The supply side is represented by the lead smelters. Investigation into lead smelting market in Egypt indicates that it follows the dominant firm model, where one major industry operator; Sayed Awadallah controls the market with a market share of approximately 65% of secondary smelted lead. Domination of the market was reinforced upon the withdrawal of General Metal Co. that used to compete with Awadallah in terms of quality (not quantity). The public sector company could not conform with new environmental laws and suffered from highly depreciated lines of production, which led to complete termination of smelting activities. Awadallah, as a dominant firm, is a market leader and price maker, while other firms are price takers. The second player in the market is Hassan Mostafa with 15% market share.

Price of lead ingots has shown an upward trend over the last five years, with an annual increase rate ranging from 7% -10% over that period. Supply of lead ingots was lagging behind demand.

The scrap battery market is an oligopoly market where few collectors dominate the scrap battery market. The major market supplier accounts for 50% of the total collected scrap batteries. He is the dominant firm and market leader, controlling the market prices. The rest of the market is divided between 4-5 suppliers each with a share ranging from 10%-15%. However, despite that imports of scrap batteries is forbidden by law, still the major supplier has access to imported batteries especially from Libya where batteries are available at a relatively cheaper price than Egypt. It is estimated that annual imports of scrap batteries from Libya are around 10 thousand tons.

The amount of locally collected scrap batteries decreased significantly from 90 thousand tons in 1997(average price of LE 450-550 per Ton) to around 31 thousand tons in 2001 at an average price of LE 850 per ton. Some smelters claim that in recent years there has been exports of scrap batteries (5-7 thousand tons).

Investigation into future prospects of demand and supply of lead ingots reveals that the domestic demand for lead ingots is expected to take a downward trend over the coming ten years, with an annual decline rate of 1%. It is expected to decrease from 34.8 thousand tons in 2002 to less than 32 thousand tons in 2012. This is inspite of the fact that demand for some major users of lead such as batteries is expected to increase. The basic reason for the expected drop in demand for lead is the general trend toward substituting lead pipes (the major user of lead) by PVC pipes. Demand for lead pipes is expected to drop from 15 thousand tons in 2002 to less than 9 thousand tons in 2012.

On the other hand due to the expected expansion in production capacities of lead ingots (Awadallah new plant in Abou Zaabal), domestic production of lead ingots is expected to increase significantly. This will put pressure on small smelters who do not comply with environmental regulations. Unless Awadallah will be able to export the excess production, many of the small smelters, who do not comply with environmental regulations, will be forced to withdraw from the market.

The study is finalized by recommending the following:

- **On the demand side,** efforts should be exerted to control the growth of demand for industrial lead. In this respect, four measures are recommended:

    - Encourage producers of batteries to import or manufacture lead components of the batteries internally.

- Undertake serious interventions through quality control procedures in order to increase the useful life of the battery so as to decrease the demand of replacement batteries.

- Enhance and speed the product substitution in pumping process through implementation of adequate training programs or incentives to plumbers and rigid specification to encourage the use of PVC pipes.

- Encourage and promote the lead user industries such as paints, pressure hoses and electric cables to minimize the use of lead, through improving their awareness of the new technology, which would save the use of lead. However, such industries would need some support through offering them subsidies during the transitional stage.

- **On the supply side,** it is a crucial matter to:

  - Enforce environmental regulations and encourage smelters to upgrade their industrial facilities and modify the existing plants. In this respect, a support should be given to Awadallah new plant to encourage him to produce at low cost with high quality, in that he will be able to export a good deal of his production of lead ingots.

  - Provide subsidies for environmental upgrading, in the form of soft loans, which would help a larger number of workshops to achieve the environmental transition. According to the conducted interviews with smelters, they

welcomed the transfer option, given the availability of infrastructure.

- **As far as scrap batteries market is concerned,** two major issues should be considered:

  - It is advised to ensure separation and sound disposal of plastic case. Battery dismantling and component separation should be done mechanically in a securely enclosed chamber in order to protect worker's health and drastically reduce environmental pollution.

  - Restrict importation and exportation of scrap batteries, taking into consideration both the environmental and the economic effect of importing and exporting such materials which are considered as hazard wastes by the Environment Affairs Agency. In this context, a close coordination should take place between the different relevant government entities (Environment Affairs, customs and Import and Exports Authorities) to enforce such prohibition. This implies enforcement of restriction through updating the legal and regulatory framework, to comply with the Basel agreement already signed by Egypt, through introducing a clear and concise general law emphasizing such restrictions.

The findings that emerged from the demand and supply study for lead imply that both the economic and the environmental recommendations complement each other and contribute significantly to the development of the lead market and to the restriction of its negative effect on the environment in the future. The economic recommendations include basically control and monitoring of the major industries using lead, up grading the collection and smelting facilities, and restriction of importation

and exportation of scrap batteries. The environmental recommendations include enforcement of environmental regulation in the smelting activity, restriction of importation and exportation of scrap batteries and ensuring upgrading of separation and dismantling of scrap batteries.

The consistency between the economic and environmental recommendations is reinforced by the fact that:

* The smelting activity is not labor intensive. Hence, the control in this industry will not have serious negative effect on employment.

* Supply of lead ingots is expected to exceed demand over the coming ten years, in that the excess supply should be restricted to comply with environmental regulations.

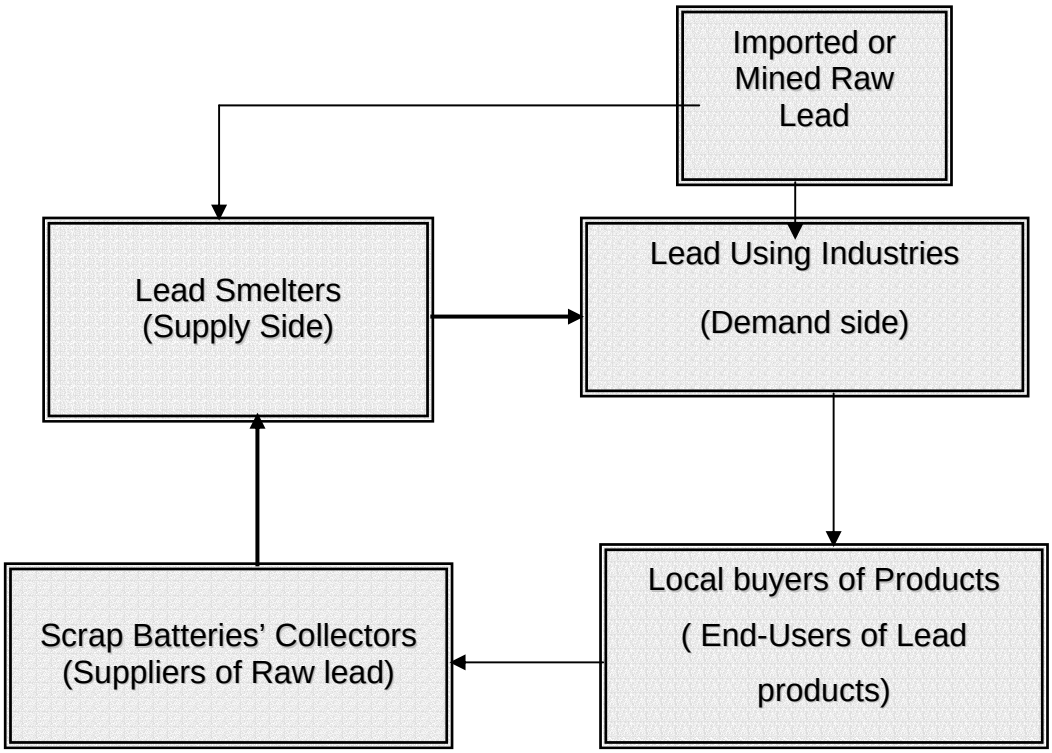
The bottom line is that the study ensures that the increase in the efficiency and the productivity of the lead industry is highly consistent with the application and enforcement of environmental measures and regulations. This finding supports the fact that enforcement of environmental regulation would have positive effect on the economy and would result in additional economic benefits in the long-run. However there could be some negative effects, in the short-run, such as additional cost, and unemployment.
This can be overcome through financial and social support for this industry during the interval or transitional period.

1.OBJECTIVE AND SCOPE OF WORK

1. OBJECTIVE AND SCOPE OF WORK

The study for Supply and Demand Tracking and Protection System and Database aims at providing Egypt's decision making and international donors with accurate information on the present and projected future demand for products produced by Egypt's secondary lead smelters, and of raw material availability for their products. This study is expected to enable decision-makers to design regulatory interventions targeting supply and demand mechanisms in support of the lead smelting industry. It will benefit potential investors, lenders, owners, operators and regulators of the lead smelting industry, as well as, lead consuming industries and the construction and building industry.

Four parties are involved in this market, lead users, lead smelters, scrap batteries' collectors and end-users. These parties are highly interrelated. This is explained by highlighting the cycle of lead market as illustrated thereunder:



Investigation into lead market cycle, with its four key players reveals that the three major products are:

- Lead outputs.
- Lead inputs.
- Recyclable lead to be smelted.

Lead outputs include the various lead products including batteries and batteries components, lead pipes, electric cables, pressure hoses, radiation sheeting, crystal and paints, as well as lead oxides.

Lead inputs imply the various types of lead that is produced by the smelting industry. They include hard lead ingots, soft lead ingots, grey lead oxides and red lead oxides. Lead inputs produced by lead smelters are used to produce the various lead outputs by the lead using industries.

Recyclable lead to be smelted refers to the raw lead extracted from scrap batteries, which represent the bulk of the raw materials used in the smelting industry. Recyclable lead is extracted from the collected scrap batteries and is used by lead smelters to produce lead inputs.

The report includes the following:

- The adopted approach and methodology in collecting and processing the information which is used to analyze both demand and supply of lead, in order to arrive at the key findings and conclusion which would help the decision makers to come-up with the proper solutions.

- Summary of the findings derived from previous, market and sectoral reports and studies on the lead consuming industries, the lead smelters and the scrap batteries' collectors.

- The approach adopted in conducting the market survey and a summary of the collected data and results from a representative sample of lead users, lead smelters and scrap batteries' collectors.

- Analysis of the industrial demand function for lead products (lead users) by major sector and by type including the production trend, market size and market shares, estimate of demand function and derived elasticities, and market mechanism.

- Analysis of the supply function of recyclable lead (lead smelters) including investigation into market structure and degree of competition, market size and market shares, market mechanism and pricing system, as well as key issues.

- Analysis of supply of recyclable lead (scrap batteries' collectors), including investigation into present collection systems, market structure, major players and market mechanism and pricing system.

- Projection of the industrial demand function for lead products by major sector and type over the coming ten year through specification and quantification of major variables affecting the demand for lead, considering the growth rates of these variables and the degree by which these factors affect demand for lead.

- Projection of the potential supply of recyclable lead over the coming ten years on the basis of the general trend of the expansion in production capacity, taking into consideration the current supply, the trend for the availability of raw materials (scrap batteries) and the expected future economic and environmental changes.

- Estimating and measuring the expected surplus or deficit through comparing the expected demand for secondary lead with the potential supply of recyclable lead over the coming ten years.

- A summary of major findings derived from analysis of past , current and projected demand-supply relationship for lead, as well, as suggesting the most relevant and appropriate recommendations inlight of the findings derived.

2. APPROACH AND METHODOLOGY

2. APPROACH AND METHODOLOGY

In order to provide Egypt decision-makers and international donors with accurate and detailed picture of the current and projected industrial demand for lead, and supply of recyclable lead bearing materials, a proper understanding of the market mechanism of the lead industry in Egypt is ensured through:

- Collecting accurate and reliable information on demand and supply of lead.
- Adopting the appropriate and relevant methods by which data are interpreted and analyzed.

2.1. Accuracy and reliability of the data

Two basic sources are used to collect the required information.

2.1.1. Secondary sources

They include:

- Review of the previous reports on the lead industry, as well as lead consuming industries. These include market and sectoral studies on various industries conducted by the consultant.

- Data issued by Ministry of Industry, EEAA, Investment Authority, Information centers and chambers of commerce, in addition to public statistical agents such as CAPMAS and Ministry of Planning.

Previous reports, which contain information on lead using industries, lead smelters and scrap batteries' collectors for the period 1996-1999 are reviewed. As for the last two years, further investigation into the market and

interviews with some users and smelters are made in order to update the information in the previous reports. Previous reports for the period 1996-1999 and further investigations in the period 2000-2001 are analyzed in order to investigate the performance of the three parties involved in the lead industry. Main reports reviewed are listed in Appendix 1.

(a) Lead using industries

Major industrial sectors that demand lead are lead pipes, batteries (components or whole batteries), pressure hoses, cables, paints, crystal and radiation sheets. The bulk for the demand for lead ingots produced by smelters is represented in lead pipes and batteries.

The table below illustrates the lead input required and the useful life per lead product:

TABLE 2.1
Kinds of Lead Input and Useful Life per Lead Product

Lead product	Kind of lead input	Useful life of product
Lead pipes	Hard lead ingots	40-50 years
Whole battery	Hard lead ingots Grey lead oxides	1.5 years
Battery components	Hard lead ingots	1.5 years
Electric cables	Hard lead ingots	10 years
Pressure hoses	Hard lead ingots	5 years
Crystal	Red lead oxides	Life time
Paints	Red lead oxides	5 years
Radiation sheathing	Hard lead ingots Grey lead oxides	2 years

Source: *Environmental Health Project "Activity Report", Dec.96, Lead Smelting in Egypt "Baseline study", Feb.96, Makary Consulting "market investigation",2002.*

The following should be noted:

1. Batteries high replacement rate (low useful life) contributes to being one of the bulk of demand for smelters' lead products.
2. Lead pipes are mostly produced by smelters who in this case are considered also the lead using industry.
3. Lead pipes can also be recycled , but it will result in low quality lead pipes.
4. The only sector that faces substitution is the lead pipes sector. PVC is the most popular substitute. Still, lead pipes are preferred in some cases by plumbers. This is reinforced by the long useful life of lead pipes, which did not encourage end-users enough to divert to PVC pipes with shorter useful life in the last period. However, it is expected that this trend will change in the future and more substitution towards reinforced PVC pipes will be effected.
5. It is estimated that a high income housing unit requires 100 kg of lead, while a low income housing unit requires around 45 kg of lead.
6. Crystal manufacturers use small quantities of lead. However, most of the quantities they use are primary mined lead.

7.The only two sectors that use red lead oxides are paints and crystal.

(b) Lead Smelters:

The information is classified as follows:

b.1. Overview on the lead industry in Egypt:

The lead industry involves two production processes:

1. **Secondary smelting**, which is basically the process of extracting lead from scrap batteries to produce lead ingots. It involves rotary furnaces at a temperature of 1450° C. It takes around 4 hours and involves high emission in the air.

2. **Lead Fabrication foundries**, which is basically the process of re-melting lead ingots at a temperature of 450° C to produce lead pipes. It involves a satisfactory emission of lead (lower than secondary smelting), except in the workplace.

Few other distinctions between secondary smelters and lead fabrication foundries is illustrated thereunder:

TABLE 2.2

Comparison between secondary smelters and lead fabrication foundaries

Characteristics	Secondary smelters	Lead fabrications
Space needed	Large space-ranges from 500 sqm. to 10,000 sqm. . If the factory installs an emission control equipment, at least 2,000 sqm. Will be needed.	Significantly smaller space is required.
Formality	Around 48-50% are licensed (formal).	80-90 % are licensed.
Geographical distribution	16% in industrial areas 31% in residential areas 6% in agriculture areas 6% in commercial areas 41% in remote areas	66% in residential areas 17% in commercial areas 17% in industrial areas

Source: *Lead smelters and lead foundaries in Egypt, Jun.99, Technical and economic study for small and medium lead smelters, Jan.99*

b.2. Market structure and dynamics of secondary smelters

Lead secondary smelting market produce lead ingots and/or oxides that are guided by the demand for lead products, mainly Lead pipes and lead acid batteries.

In the period from 1996-1999, production of lead ingots market by smelters is considered a dominant firm model controlled by a large company, Awadallah (private sector) controlling more than 65% total lead ingots production through 3 smelters. General Metals Co. (public sector) constitutes some 15%. Around 12 private small and medium smelters produce around 20% of total lead ingots.

Due to the strict enforcement of environment conditions during the last two years, the following changes took place:

1. Ten small and medium smelters opened or relocated to remote areas informally such as in Giza "Arab Abou Saed" area.
2. Awadallah Co. opened 2 large smelters in Giza "Arab Abou Saed" area.
3. Two smelters in Cairo closed down and 4 smelters diverted their activities to being foundaries.
4. General Metals co. stopped its smelting activity and intends to establish a new site that meets environment requirements.
5. Three smelters in qaliyoubia (Shubra El-Kheima) stopped their smelting activity of which one closed down.
6. Awadallah established a new up to date smelter in 10th of Ramadan City that meets all environment requirements. Also, he is establishing a new smelter in Abou Zaabal area complying with environment requirements.

Based on the above information, one would conclude that the market for lead ingots in the last 2 years is still a dominant market, controlled by one private large producer-Awadallah- who produces around 65-70% of total ingots in Egypt through 5 smelters. The remaining 30-35% of the market consists of around 15 private small and medium smelters scattered between Alexandria, Sharkiya, Giza, Qaliyoubia and Menia. General Metals Co. currently stopped its smelting activities. It is possible that it may establish a new up to date site in the future.

Previous reports also indicate that during the period 1996-1999, lead smelting was mainly concentrated in Greater Cairo due to the following reasons:

1. Few reported smelters are outside G. Cairo.
2. 50% of vehicles are in G. Cairo.
3. Major battery manufacturers are located in G. Cairo.(one of the major lead using industry)

However, due to the enforcement of environmental law in 1998, the distribution of lead smelters was changed as follows:

1. A number of smelters in G. Cairo were closed. (as illustrated above)
2. Some smelters were relocated to other governorates.
3. Some smelters relocated to remote areas such as in Giza "Arab Abou Saed" and worked informally.(12 smelters as illustrated above)

Although the environment restrictions were exerted equally on smelters and foundaries, however, foundaries by nature can more easily comply due to the lower level of emissions produced. Moreover, foundaries require smaller space and are in most cases located within residential areas and hence can not be easily identified. Accordingly, the following redistribution of smelters to foundaries occurred in the last 2 years:

- 2 smelters diverted to foundaries in Qaliyoubia.
- 4 smelters in Cairo converted into foundaries.
- Basically, at most 2 smelters operate in G. Cairo and Qaliyoubia and mostly informally.

b.3. Annual production capacity of secondary smelters

During the period 1996 - 1999, annual production of lead ingots ranged from 55,000 - 60,000 MT/year concentrated mainly in Qaliyoubia (Shubra El-Kheima).

In the last two years, annual production capacity ranged from 25,000 to 30,000 MT/year concentrated in G. Cairo mostly Giza "Arab Abou Saed" area.

Smelters are classified according to sizes into the following:

Small smelters producing less than	1,000 tons/year	-30%
Medium smelters producing between	1,000 to 4,000 tons/year	- 50%
Large smelters producing more than	8,000 tons/year	- 20%

However, the following should be noted:

1. Large smelters produce around 65-70% of total lead ingots production in Egypt.
2. Around 1/3 of lead ingots produced by secondary smelters is utilized by fabrications to produce lead products-mostly lead pipes. The remaining 2/3 is sold directly to lead using industries-mostly battery manufacturers.

b.4. Production process and prevailing technology

During the period from 1996 to 1999, production processes for all smelters were manual, traditional and rather inefficient, depending on rotary furnaces. Lead yield was around 50-70% of lead content in the scrap battery. It should be noted that all private smelters use the same technology in their operations.

Below are some characteristics of the typical production process used in Egypt in the period 1996-1999:

TABLE 2.3

Typical Production Process for smelters in Egypt

1996-1999

Function	**Characteristics**
Rotary furnaces	All are locally produced with capacity of 1-1.2 MT/hour.
Fuel used	Around 55% use Mozart, while 45% use solar. The last is preferable (more environment friendly).
Total amount of fuel used	Around 11,000 MT/Y of solar & around 4,000 MT/Y of mazot.
Emission control equipment	High concentrations of particulate matter and lead- only 2 factories installed wet scrubbers that had 20% efficiency.
Solid wastes	Slag (around 4,000MT/Y) and plastic cases of batteries.

Source: *Technical and economic study for small and medium lead smelters, Jan.99, Lead smelters and lead foundaries in Egypt, Jun.99*

In the last two years, there were some attempts to upgrade and relocate smelters to other areas. The most successful is Awadallah facility in 10th of Ramadan. This facility technology is up to date with a complete emission control equipment. It should be noted that Awadallah is establishing an even more environmental friendly fully automated facility in the new industrial area of Abou Zaabal. Also, General Metals co. may relocate and upgrade its facility. It is possible that this company will be privatized. The same applies with some medium smelters. As for small smelters, it is not feasible for them to upgrade their facilities. Hence, they are expected to close down or work informally.

b.5. Required Environment standards

The lead smelting contributes significantly to the pollution of Egypt, and specially Greater Cairo. Our investigation indicates that lead smelters use primitive and inefficient emission control equipment, with the exception of Awadallah facility in 10th of Ramadan. They do not meet the environment standards stressed by law no.4 of 1994 concerning the emission levels acceptable. This is in addition to the high health problems incurred by the workforce (around 600 to 800 employees).

The lead extraction stages (preparation, smelting and refining) produce most of the pollution from the smelting industry. In order to control pollution from the smelting industry, a number of procedures can be recommended of which:

1. Mechanical dismantling and component separation of batteries in a secure closed chamber.
2. Systematically separate the components of the battery.
3. Wet separation of lead oxides and sulfates.
4. Hydrometallurgical technologies instead of rotary furnace based technology.

One of the least pollutant processes is the bag house, which is adopted currently by Awadallah facility in 10th of Ramadan. Such a new technology , of smelting enables:

1. More efficient recovery of lead metal from lead bearing raw material.
2. Recovery of lead from dust trapped in the air pollution control system to be recycled.

In numbers, it can save at least 10,000 tons of scrap batteries and can recycle about 1,800 tons of dust. The cost of an environment friendly facility components can be classified as follows:

Smelter building	42%
Furnaces & refining	30%
Air pollution control	22%
Others	6%

Source: *Lead Smelting in Egypt "Baseline study", Feb.96*

In short, the solution for the current polluting technology of lead smelting in the short run is upgrading the facilities. In the long-run, the whole facilities must be removed to remote areas. In this respect, two sites were chosen by the government. However, the government dedicated the new industrial area of Abou Zaabal for smelting activity. Currently, only one facility is being established (Awadallah facility).

b.6. Availability of raw materials

Around 90-95% of lead used in smelting is extracted from dry lead acid batteries; the remaining 5-10% of lead is extracted from lead scrap materials. Supply of scrap batteries is around 45,000 to 60,000 tons/year based on the most likely useful life of batteries of one year and a half in Egypt. Base stock of scrap batteries needed in the smelting industry is around 5 months. It should be noted that further investigation into the market entailed a longer useful life for batteries (around 2.5 years).

It should be noted that the breakdown of operating cost structure for a smelting facility is as follows:

Scrap batteries	75%
Fluxing and additive materials	10%
Fuel and electricity	5%
Others	10%

Source: *Lead Smelting in Egypt "Baseline study", Feb.96*

(c) Scrap batteries collectors

Through analyzing previous reports, four major issues are identified.

c.1. Battery collection sources:

The prevailing five methods of collecting scrap batteries are as follows:

1. Bids by public sector and government institutions.
2. Bids by the army.
3. Shops of vehicles repair.
4. Disposable and garbage collectors.
5. Importation.

Collection of scrap batteries, from these five sources, is 95% efficient.

It should be noted that the most significant sources are bids and garbage collectors. Indeed, one main dealer controls this last source. However, he provides 90% of the quantities to Awadallah facilities. On the other hand, importation is mainly from Libya. It is worthnoting that it is illegal to import scrap batteries, however, it is still considered a significant source. On the other hand , our investigation into the market indicated that scrap batteries are being exported currently capitalizing on the high world price for lead ingots. It should be noted that exportation is illegal.

c.2. Market structure

The scrap batteries market is considered an oligopoly market, in that it is controlled by few large collectors. This market provides the input for the secondary smelting industry. Hence, the demand for scrap batteries is a derived demand for an intermediate product, lead ingots produced by smelters. Two major factors influence the demand for scrap batteries, namely the useful life of batteries in Egypt (replacement rate) and the number of vehicles assembled in Egypt.

The useful life of batteries is around 1.5 years.The number of vehicles assembles are concentrated in G.Cairo and is estimated at 45,000 – 50,000 yearly. The growth rate for assembled cars is around 6-7% yearly.

c.3. Market size

Annual supply of scrap batteries ranges from around 45,000 to 60,000 tons. It is worthnoting that quantity demanded decreased significantly in the last two years. This is basically due to the recession experienced, and restrictions on the enforcement of the environment law , especially in G. Cairo.

c.4. Technical data

Below are some technical characteristics concerning scrap batteries:

- The bulk of scrap batteries are 12 volts batteries.
- A small automobile battery weights 11 kg., of which lead constitutes 9 kg. and plastic materials constitute 2 kg.
- A large automobile battery weights 15 kg, , of which lead constitutes 12 kg..
- The lead inside the scrap battery is classified as follows:60% lead oxide and lead sulfite and 40% lead metal grids and posts.
- Scrap batteries are purchased and sold in lots , by tons. Profit margin for collectors is estimated at around 50%.

2.1.2. Primary sources

A market survey was conducted to collect primary data on the three parties involved in the lead market, lead users, lead smelters and collectors of scrap batteries. Lead users are the potential buyers representing demand side. Secondary lead smelters represent the suppliers of recyclable lead, which constitutes the major part of supply side. Collectors of used batteries containing lead represent the key source of recyclable lead. A representative

sample of these three parties were selected and interviewed. In this respect, three sets of questionnaires addressing each of the three parties were designed to include questions concerning information on demand, supply, prices, collection system of scrap batteries, and recycling process of lead in Egypt. A copy of each questionnaire in both Arabic and English are attached in Appendix 2.

Stratified sampling technique was used in designing and selecting the relevant units within each strata. The significance of the sample size is tested by measuring coefficient of variation. In cases where coefficient of variation exceeds 10%, the number of cases are increased until the 10% coefficient of variation is reached.

Lead Users are stratified into 7 strata on the basis of types of products. Within each strata the key users are identified and interviewed. Total number of interviewed users are 38 factories.

The results of the **interviewed lead users** are summarized as follows:

- Production of lead products has shown declining trend during the period 1997-2001. This can be attributed to the enforcement of environmental regulations on one hand and due to lead substitution on the other hand (PVC pipes), during the last five years. This is reinforced by the slow down in the economy.

- Hard lead ingots is the major lead used by the lead using industries in Egypt (around 75% of the total quantities used of lead), followed by soft lead ingots. This is due to the fact that the major industries consuming hard lead ingots are the lead pipe industry and the battery industry (around 70% of total demand for lead). Both red lead oxide and Grey lead oxide are used in limited quantities.

- Smelters are the only source of secondary lead. Imports of lead ingots are insignificant.

- Cost of lead represents a high proportion in the cost of the product in the cases of batteries (whole and components), lead pipes and lead oxides.

- Price of lead has a greater effect on demand for the final product in the cases of batteries, lead pipes and lead oxides, as compared to other lead products. This is consistent with the fact that the proportion of lead cost in these products is high.

- The general trend of price increase during the last five years was rather low. This is a reflection of the low inflation rate that took place during the last few years.

- All products, except crystal and electric cables have a short useful life. This would reflect an active lead market with dynamic movement.

Lead smelters are stratified into two strata; large smelters complying with environment measures (one only) and smaller polluting smelters. 21 smelters and fabrications were randomly selected and interviewed. Most of them do not comply with environment measures.

The results of the **interviewed lead smelters** are summarized as follows:

- Smelters market is rather oligopoly market controlled by few large smelters. Awadallah co. is a market leader with more than 65% market share.

- Major users of recycled lead are battery companies, sanitary-ware companies, paints companies and engineering companies, as well as the smelters themselves.

- The majority of smelters believe that price of recycled lead will increase in the future, of which more than 50% expects that the price will increase at high rates.

- Demand for recycled lead is rather inelastic, in that price has limited effect.

- More than 80% of smelters face harassment from environment people, of which around 70% are willing to remove their facilities to remote areas.

- Most of smelters believe that imported lead will not formulate a threat on demand for recycled lead. This is simply because primary lead is used in a very limited scale.

- Lead pipes are the only lead product that would have substitutes (PVC). However, many smelters believe that PVC pipes are not a good substitute for lead pipes.

- The major sources of lead are scrap collectors and tenders.

- Lead ingots is the most expensive raw lead material used in the smelting industry. Scrap batteries are the cheapest.

- Only 50% of smelters expect that prices of raw lead will increase, of which 70% believe that price will increase at low rates.

- Demand for raw lead is inelastic with respect to price. It will turn to be elastic of price if increased by high percentage.

- Around 60% of the lead in a dry battery is recovered, (40% waste).

Three Collectors of scrap Batteries representing more than 80% of those involved in this business were identified and interviewed.

The results of the **interviewed scrap batteries' collectors** are summarized as follows:

- The major sources of scrap batteries are public sector companies and governmental departments. Both together represent more than 40% of the supply of scrap batteries. However, the weight of garbage collectors is increasing recently.

- Price of scrap batteries has shown low growth rate over the last five years. However, the expectations that price of scrap batteries will increase in the future at high rates. This is due to the current high world price and the expectation about higher inflation rate in the future.

- Demand for scrap batteries with respect to price is rather inelastic (insignificant price effect).

- Around 15-20% of the quantity supplied of scrap batteries is imported from Arab countries, basically from Libya. It is worth noting that import price of scrap batteries is less than the domestic price.

- All the interviewed battery collectors indicate that imports of scrap batteries are not expected to increase in the future due to environment restrictions. Some smelters claim that scrap batteries are now being exported. Export price exceeds domestic price.

- Supply of scrap batteries has shown declining rate during the last five years**.**

- The majority of collectors believe that there will be no change in the system of collection.

- Although the change in traded quantity during the last five years was declining, all collectors agree that demand for scrap batteries will increase at high rates.

The results of the market survey is attached in Appendix 3.

It should be noted that the collected data through the market survey is tested and verified through personal interviews with experts in the lead industry and the lead consuming industries as well as technical and market experts.

2.2. Adopted Methodology

The general idea of market studies concerning industries, such as lead industry where sizable informal sector prevails and dominate the market, is to identify the key market parameters which determine the present performance of both demand and supply and which would reflect the general trend of demand and supply in the future. Our main concern in this study is to tackle two major issues; market overview and market outlook.

2.2.1. Market overview

It implies a comprehensive analysis of the past and present performance of both demand and supply of lead. Our analysis is based on in-depth investigation of key market parameters. In this respect, industrial demand function of lead as a derived demand function is formulated to measure the degree by which the relevant independent variables could affect industrial demand for lead. This is applied to major consuming industries. An attempt is made to estimate:

- Price elasticity of demand; the degree by which price of lead affects the demand for it.
- Price elasticity of lead product; the degree by which price of lead product affects the demand for it.
- Cross elasticity of demand; the degree by which prices of substitutes affect the demand for lead.

On the other hand, supply of recyclable lead is analyzed to measure the factors which could affect supply of recyclable lead bearing materials. Both market mechanism and pricing system are analyzed.

The market overview includes also an investigation into the present collection system of scrap batteries in Egypt, including major sources of collection, quantities imported and exported of scrap batteries and the availability of scrap batteries.

2.2.2. Market outlook

It aims at projecting the expected demand for lead and potential supply of recyclable lead bearing materials over the coming ten years.

An attempt is made to project the expected demand for lead by major industries. In this respect, the independent variables which might influence demand for lead are specified and quantified. Their effect on demand for lead is measured, and incorporated in the relevant mathematical model in order to project the expected demand for lead over the coming ten years.

On the other hand, potential supply of recyclable lead bearing materials is forecasted on the basis of the general trend of the key parameters which would affect such a supply and the expected trend for availability of raw materials (scrap batteries), taking into consideration the expected future economic and environmental changes.

Comparison between demand for lead and supply of recyclable lead is made to measure the expected surplus or deficit of lead in the Egyptian market.

3.MARKET OVERVIEW

3. MARKET OVERVIEW

3.1. Approach

The approach adopted in testing the performance of the industrial demand for lead, and the supply of recyclable lead bearing materials is to conduct a comprehensive analysis and in-depth investigation of the factors which would affect both demand and supply of lead. In this respect, market structure for major lead consuming industries and lead smelters are identified and examined, in order to arrive at the prevailing market mechanisms and pricing system. The major players in the lead market are also investigated. Hence, the two market parameters, demand and supply are analyzed.

3.2. Demand analysis

3.2.1. Market structure of lead users

Our investigation into the market dynamics of lead in Egypt indicates that lead is mainly used in eight industries (more than 90% of the quantity used of lead); batteries (both final product and intermediate product), pipes, pressure hose, crystal, electric cables, lead oxides and paints. The market structure and key players for these industries are identified as follows:

Batteries market is monopolistic competitive market, where quite few firms operate in the market. Products in this market are well identified through brand names, in that products are similar but not identical. Each firm has some control on prices of its products capitalizing on its brand name, nevertheless prices do not differ significantly. The two major players in this market are Chloride with 40% market share, and El-Nasr for Batteries, a public sector company with around 29% market share. Total production of batteries in Egypt is around 750 thousand batteries (2001), of which more

than 60% of the production is located in Greater Cairo. Imports of batteries are within 160 thousand batteries per annum.

Batteries components market is highly competitive, where large number of small firms operate in this market. Each firm represents small proportion of the total market (less than 5%). Products of different firms are rather identical with insignificant differences in quality. All firms are price takers, with identical prices. No barriers exist in this market, and demand is rather elastic. Total production of batteries' components in Egypt is estimated at 300 tons, of which around 68% is processed in Greater Cairo.

Pressure hose market is an oligopoly market, with few companies operating in this market. Barriers in this market are rather economic barriers, which limit the opportunities for new entries. The major player in this market is Narobeen, a public sector company with a market share of 40%. Narobeen is a price maker, other firms are rather price takers. Total production of pressure hose is roughly estimated at 150 tons (2001). All firms are located in Greater Cairo. Imports represent around 20% of domestic production.

Crystal Asfour is the sole producer of crystal in Egypt, i.e. monopolistic market. In this respect, the company is price maker and has complete control on domestic production. New entries are restricted due to technical constraints. Crystal Asfour is a reputable company with potentiality for growth. Total production of crystal is around 840 tons (2001).

Electric Cables market in Egypt is based on a doupoly model, where two companies control the market, El-Sweedy Cable company with 70% market share, and Arab Cable Company with around 28%. Around 2% of the total production of electric cables is manufactured by small firms. The total production of electric cables in Egypt is 75 thousand tons, of which more than 90% of the production is manufactured in Greater Cairo. The two companies dominate the market with hidden agreement between them concerning prices

and market parameters. Imports of electric cables are within 10% - 15% of the total production.

Lead pipes market in Egypt is oligopoly market, controlled by three smelters, Awadallah, with a 40% market share, El-Mahy with 20% market share and Hassan Mostafa with 10% market share. Other smelters are small with around 30% market share. Awadallah is the price maker, while all other smelters are price takers. Entry to this market is rather restricted. Total production of lead pipes is estimated at some 15 thousand tons, of which more than 85% of the production is manufactured in Greater Cairo. PVC pipes compete with lead pipes, and are considered acceptable substitutes particularly by many large contractors.

Lead oxide market, both grey lead and red lead, is rather a dominant firm model, in that there exist one major firm that dominates the market. The dominant firm in this market is Awadallah with more than 60% market share. Awadallah is a market leader and price maker, other firms are small ones and price takers. Total production of grey lead oxide is around 4000 tons, while total production of red lead oxide is estimated at 320 tons (2001). Imports of lead oxides are insignificant, representing less than 5% of the domestic production.

Paints market is rather monopolistic competitive market, where products of different firms are similar but not identical. Each firm has its own brand name and is well identified in the market, in that consumers can distinguish the products from one another. However, none of the operating firms has a complete control on the market. This situation is reinforced in the recent years with the movement towards a free market system and supported by low barriers to entry. Paints industry is characterized by low cost of equipment, simple technology, accessibility to well-established channels of distribution, and availability of basic raw materials. On the other hand, paint is rather non-tradable good in that paint industry is naturally protected from imports.

Paints market in Egypt is highly competitive and is characterized by intense rivalry. This is due to new entries, elastic demand with respect to price, low brand awareness, shared channels of distribution, and insignificant differences in quality. More than 25 companies are involved in manufacturing paints and coating, with a total production value of 110 thousand tons. This is in addition to hand made paints and coating with production capacity of 70 thousand tons, processed by large number of very small firms. Ten companies control 90% of total supply in the market. Two companies (Pachin and Sipes) produce more than 35% of paints available in the market. Less than 10% of the quantity of the produced paints use lead.

3.2.2. Demand structure

3.2.2.1. Approach

The approach adopted in estimating demand for lead is to convert the quantity produced by lead using industries into quantity demanded for lead on the basis of the input-output ratios or technical coefficients. Input-Output ratio reflects the quantity of lead required to produce one unit of output. This approach is applied to the quantity produced by the major users during the last five years.

3.2.2.2. Production Volume of the Basic Users

Based on primary data collected from all major companies manufacturing the underlying products, and with the help of secondary data available and statistical agents such as CAPMAS and GOFI total production of the underlying products during the period 1997 – 2001 are roughly estimated at both G. Cairo level and national level as shown in the following table.

TABLE 3.1

Production Volume of Basic Users of lead in Egypt
1997-2001

		G. Cairo	Egypt
1	**Batteries**		
		Unit / year	**Unit / year**
	1997	321600	568000
	1998	334000	570000
	1999	377200	600000
	2000	402000	700000
	2001	414000	750000
	Annual Growth Rate	6.5%	7.2%
2	**Battery Components**		
		Ton / year	**Ton / year**
	1997	250	350
	1998	210	320
	1999	200	275
	2000	185	255
	2001	220	300
	Annual Growth Rate	-3.1%	-3.8%
3	**Pressure Hoses**		
		Ton / year	**Ton / year**
	1997	120	300
	1998	84	210
	1999	48	120
	2000	60	180
	2001	55	170
	Annual Growth Rate	-17.7%	-13.2%
4	**Crystal**		
		Ton / year	**Ton / year**
	1997	600	600
	1998	660	660
	1999	810	810
	2000	810	810
	2001	840	840
	Annual Growth Rate	8.8%	8.8%
5	**Cables**		
		Ton / year	**Ton / year**
	1997	35000	35000
	1998	65000	70000
	1999	65000	70000
	2000	70000	70000
	2001	78000	78000
	Annual Growth Rate	22.2%	22.2%
6	**Radiation sheaths**		
		Ton / year	**Ton / year**
	1997	1000	1500
	1998	500	900
	1999	750	1150
	2000	1400	1700
	2001	1500	1900
	Annual Growth Rate	10.7%	6.1%

7	**Lead Pipes**		
		Ton / year	**Ton / year**
	1997	15720	17520
	1998	12880	14480
	1999	14360	16060
	2000	13060	14760
	2001	13200	15000
	Annual Growth Rate	-4.3%	-3.8%
8	**Grey Lead Oxide**		
		Ton / year	**Ton / year**
	1997	4085	5900
	1998	3750	5400
	1999	3640	5000
	2000	2970	4100
	2001	3000	4000
	Annual Growth Rate	-7.4%	-9.3%
9	**Red Lead Oxide**		
		Ton / year	**Ton / year**
	1997	550	550
	1998	550	550
	1999	500	600
	2000	350	400
	2001	300	320
	Annual Growth Rate	-14.1%	-12.7%
10	**Paints**		
		Ton / year	**Ton / year**
	1997	440	970
	1998	460	1000
	1999	480	1050
	2000	500	1100
	2001	520	1140
	Annual Growth Rate	4.3%	4.1%
11	**Others** (work for others)		
		Ton / year	**Ton / year**
	1997	1400	1650
	1998	800	1000
	1999	900	1100
	2000	1010	1230
	2001	1110	1354
	Annual Growth Rate	-5.6%	-4.8%

Source 1: ***"Makary Consulting and interviews with major users", March, 2002.***

Source 2: ***CAPMAS and other official sources.***

The above table indicates the following:

- Production of batteries was growing at an annual rate of around 7% over the period 1997-2001, to reflect the general trend of substituting imported cars by locally assembled cars. It should be noted that the number of assembled cars was also increasing at 7% over the same period. Inspite of the high growth of produced batteries, production of batteries components has shown a drop over the same period. This is attributed to the fact that the major producer of batteries, Chloride, tended to manufacture batteries components internally, in that the components required for the manufactured batteries are not traded in the market.

- Production of electric cables has shown significant growth during the last five years to match with the large investment in infrastructure in Greater Cairo , and in the new urban areas as well as new touristic areas.

- Production of crystal increased at relatively high rates during the period 1997-2001. Crystal Asfour company succeeded to develop its local market and to attain large exports.

- Production of lead pipes has shown downward trend during the last five years. This is due to the substitution of PVC pipes for lead pipes. Still, the degree of substitution was not high enough resulting in a minor reduction in the demand for lead pipes (by around 4% per annum on the average).

- Production of lead oxide has shown significant drop due to the general trend of battery producers and paints industry towards importing lead oxide instead of locally produced oxides.

- Production of paints during the last five years was increasing at low rates as a result of the slow down in the economy, and the recession that took place in the construction sector.

- Production of pressure hoses dropped significantly due to the increase of imports to substitute local products. Narobeen company, the major producer, could not compete with imports with better quality and less prices.

3.2.2.3.Input-Output Ratios

Based on personal interviews with major users of lead and with experts in these industries, the lead required to produce one unit of output for the underlying ten products is measured. These ratios are measured for the four types of lead; hard lead ingots, soft lead ingots, red lead oxide and Grey lead oxide. The following table shows the corresponding input-output ratios.

TABLE 3.2

Input – Output Ratio for Lead

Industry / Lead Type	**Hard Lead**	**Soft Lead**	**Red Oxide**	**Grey Oxide**
Batteries	10.080			1.3
Components	1.070			
Pressure Hoses	0.400			
Electric Cables	0.005			
Radiation sheaths	1.025			
Crystal			0.290	
Pipes	1.025			
Paints			0.065	
Red Oxides	1.080			
Grey Oxides		1.125		

* ***Input – output ratio for batteries, crystal and paints exclude lead used in battery components, red oxides and grey oxides.***

Source: ***"Makary Consulting and interviews with major users", March, 2002.***

3.2.2.4. Quantity Demanded of Lead Ingots

Applying the relevant input-output ratios to quantity produced by the major users of lead, quantity demanded for lead in both G. Cairo and the whole country by type of lead for each user during the period 1997 - 2001 are estimated as shown in the following table.

TABLE 3.3

Quantity Demanded of Lead

by Users in Egypt

	User	Hard Lead Ingots	Soft Lead Ingots	Red Lead Oxides	Grey Lead Oxides
1	**Batteries Ton / year**				
	1997	5725			738
	1998	5746			741
	1999	6048			780
	2000	7056			910
	2001	7560			975
2	**Battery Components Ton / year**				
	1997	375			
	1998	342			
	1999	294			
	2000	273			
	2001	321			
3	**Pressure Hoses Ton / year**				
	1997	120			
	1998	84			
	1999	48			
	2000	72			
	2001	68			
4	**Crystal Ton / year**				
	1997			174	
	1998			191	
	1999			235	
	2000			235	
	2001			244	
5	**Cables Ton / year**				
	1997	175			
	1998	350			
	1999	350			
	2000	350			
	2001	390			

6	**Radiation sheaths**				
	Ton / year				
	1997	1538			
	1998	923			
	1999	1179			
	2000	1743			
	2001	1948			
7	**Lead Pipes Ton / year**				
	1997	17958			
	1998	14842			
	1999	16462			
	2000	15129			
	2001	15375			
8	**Grey Lead Oxide**				
	Ton / year				
	1997		6638		
	1998		6075		
	1999		5625		
	2000		4613		
	2001		4500		
9	**Red Lead Oxide**				
	Ton / year				
	1997	594			
	1998	594			
	1999	648			
	2000	432			
	2001	346			
10	**Paints Ton / year**				
	1997			63	
	1998			65	
	1999			68	
	2000			72	
	2001			74	

Source: ***Estimated by the consultant.***

Hence, the annual quantities demanded of lead during the period 1997-2001 are estimated by type of lead as follows:

TABLE 3.4
Total Quantities Demanded of Lead in Egypt

1997-2001

Year/ Type of lead	Hard Lead	Soft Lead	Red Oxide	Grey Oxide
1997	28074	6638	237	738
1998	24253	6075	256	741
1999	26530	5625	303	780
2000	26588	4613	306	910
2001	27568	4500	318	975

Source: ***Estimated by the consultant.***

Red oxide and grey oxide are converted into hard lead ingots and added to the soft lead ingots, in order to arrive at the total quantities demanded of lead ingots.

TABLE 3.5
Quantities Demanded of Lead

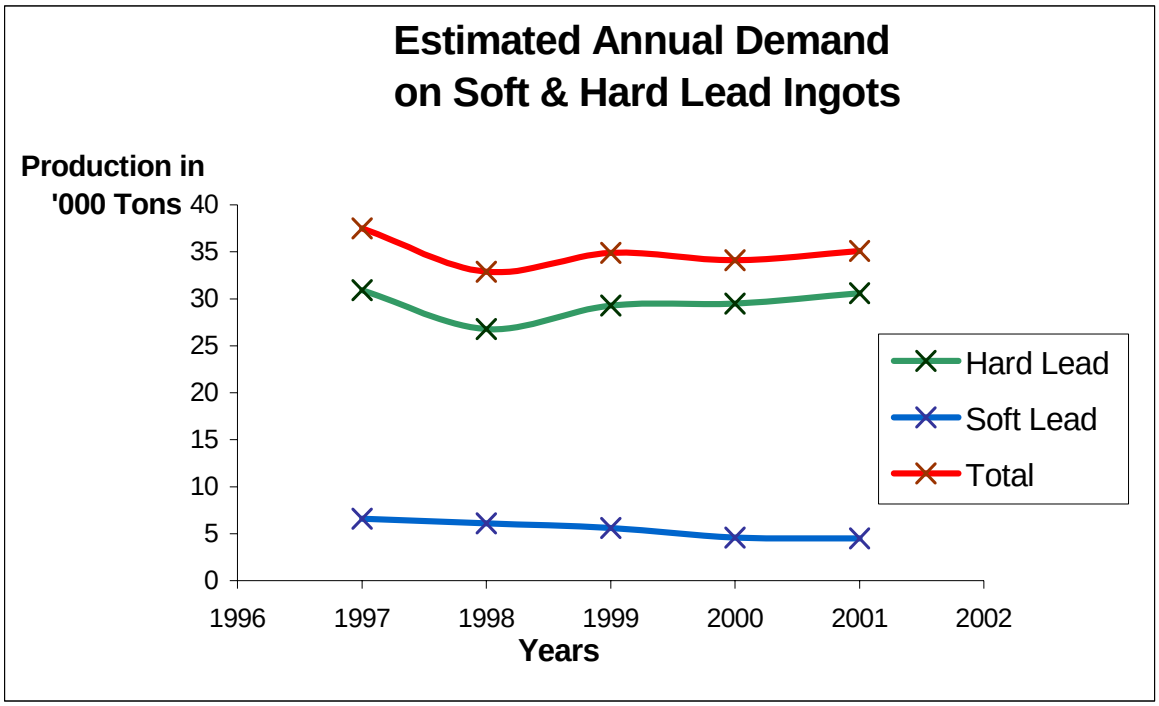
In terms of hard ingots and soft ingots

In Egypt ('000 tons)

Year/ Type of lead	Hard Lead	Soft Lead	Total
1997	30.9	6.6	37.5
1998	26.8	6.1	32.9
1999	29.3	5.6	34.9
2000	29.5	4.6	34.1
2001	30.6	4.5	35.1
Annual Growth rate	-0.2%	-10%	-1.7%

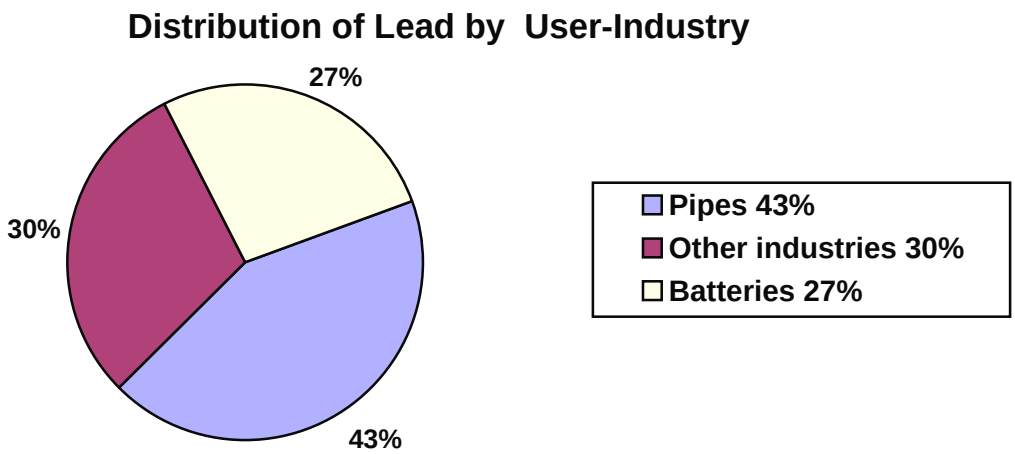
Source: ***Estimated by the consultant.***

The estimated demand for lead ingots is illustrated by the following graph:



The above tables reveal the following:

- Lead pipes industry is the major user of lead in Egypt (more than 43% of lead ingots), followed by the battery industry. These two industries use around 70% of the quantity used of lead ingots as shown in the following pie chart.



- Hard lead ingots is the major lead used in Egypt (88% of the total quantity used of lead), followed by soft lead ingots. Both red lead oxides and grey lead oxides are used in limited quantities.

- Very few quantities of lead ingots are imported, in that the bulk of quantities used of lead ingots in Egypt is secondary, smelted locally. Hence, quantity used of lead would reflect the quantity produced. Nevertheless, there might be minor differences due to inventory.

3.2.3. Demand Variables and Consumption Pattern

3.2.3.1. Characteristics of Demand for Lead

Demand for lead is a derived demand; it is derived from the demand for products using lead. Hence, demand for lead is not only affected by factors determining the decision of the users of lead, but also would depend on factors affecting demand for the products which use lead.

In this respect, two sets of demand functions are estimated, intermediate demand functions for lead and demand functions for the products using lead.

3.2.3.2. Intermediate Demand Functions for Lead

The factors (independent variables) which might affect demand for lead are identified and their effects on demand for lead are measured. Our investigation into lead industry revealed that the key factors affecting demand for lead are price of lead, price of substitutes and demand for the products which use lead. The effect of these factors would depend on two parameters:

- The rates at which these variables change (i.e., rates of growth)

- The degree to which these variables would affect demand for lead (i.e., elasticities)

(One) Growth Rates

Based on the conducted market survey and previous studies made by the consultant, the past trend of prices of lead and quantity demanded of lead are estimated as follows:

TABLE 3.6
Annual Growth Rates of Independent Variables
1997-2001

Product	Type of Lead	Price of Lead	Price of Substitute	Demand for the Product
Batteries	Hard Lead Grey oxide	7% 10%	--	5.7%
Electric Cables	Hard Lead	7%	---	17%
Crystal	Red Oxide	13%	---	7%
Pressure Hose	Hard Lead	7%	---	-11%
Pipes	Hard Lead	7%	2%-3%	-3%
Paints	Red Oxide	13%	---	3.3%
Grey oxide	Soft Lead	7%	---	-10%

Source: ***Estimated by the consultant.***

(Two) Elasticities

An attempt is made to estimate price elasticity of demand for lead. Since it changes from one product (user) to another, it is measured for each product, taking into consideration the following factors:

- The availability of substitutes or the degree of substitution. The higher the degree of substitution, the higher the price elasticity of demand for lead.

- Cost of raw lead to the value of final products. The higher this cost, the higher the price elasticity of demand for lead

- The price elasticity of demand for the product (the user), the higher the degree of price elasticity of demand for the user of lead, the higher the price elasticity of demand for lead, in that the lead user can not pass the price increase to the end-user.

Applying these three factors to the demand for the products that use lead, price elasticities of demand for lead with respect to each product are roughly estimated as follows:

TABLE 3.7

Key Parameters in Demand Functions

For Lead Ingots

Product	**Degree of Substitution**	**Proportion of Cost of Lead**	**Price Elasticity of Demand for Product (lead user)**	**Estimated Price Elasticity of demand for lead**
Inputs used in batteries	Zero	60%	Low	Unity
Batteries as final product	Zero	15%	Low	Less than one (0.8)
Electric Cables	Low	0.5%	Low	Very low (0.4)
Crystal	Low	Negligible	High	Low (0.6)
Pressure Hose	Low	16%	Low	Less than one (0.5)
Lead Oxide	Low	43%	Rather high	Rather high (1.1)
Paints	Low	2.5%	Low	Very low (0.4)
Pipes	Relatively high	40%	Low	Rather high (1.2)

Source: ***Estimated by the consultant.***

Based on the past trend of prices of both lead ingots and the underlying products, and taking into consideration growth rates and price elasticities of demand for both lead ingots and the lead users, demand for lead by user is estimated as follows:

TABLE 3.8

Annual Growth Rate of Demand for Lead Ingots

By User

Product	Annual Growth Rate	Weight	Weighted Growth Rate
Batteries	5.1%	0.245	1.249
Batteries Components	-3.6%	0.009	-0.032
Electric Cables	21.8%	0.011	0.240
Crystal	6%	0.006	0.036
Pressure Hose	-14.1%	0.002	-0.028
Oxides	-10.5%	0.140	-1.470
Paints	7.9%	0.002	0.016
Pipes	-5.6%	0.440	-2.46
Others	5%	0.145	0.725
Weighted Average Growth Rate		**1.000**	**-1.724%**

Source: ***Estimated by the consultant.***

The above table reveals that demand for lead ingots has shown minor drop (i.e. by 1.7% annually). This is consistent with table 3.5, which shows that the quantity demanded of lead ingots decreased from 37.5 thousand tons in 1997 to around 35 thousand tons in 2001, with an annual drop 1.7% on average.

3.2.3.3. Demand Functions for Lead

Demand functions for the two major users of lead, batteries and pipes are formulated. These two products absorb around 70% of the demand for lead in Egypt. The two products are intermediate products, in that demand for these products is derived from the demand for the products that use batteries and lead pipes, i.e., cars and real estate units respectively.

(a) Demand function for batteries

Demand for batteries is derived from locally manufactured / assembled cars and replacement of batteries for existing cars. An attempt is made here to estimate the size of annual demand for batteries by source and by type of cars. The price effect is also tested.

The approach adopted in estimating demand for batteries for the purpose of replacement is to convert the total number of cars in the Egyptian market classified into passenger cars, microbuses & buses, and trucks into batteries on the basis of the existing number of cars and the expected useful life of batteries. The batteries used by newly assembled cars are estimated and therefore added to the replaced ones to arrive at the total market size.

Based on CAPMAS data, total number of cars in Egypt is estimated as follows:

TABLE 3.9

Total Number of Cars

2001

Type of Car	**Number '000**
Passenger Cars	1480
Buses & Mini Buses	52
Trucks	520
Total	**2052**

Source: ***CAPMAS, 2001.***

Based on the prevailing norms, expected useful life of the batteries for the underlying cars are as follows:

TABLE 3.10

Expected Life of Batteries

Type of Car	Expected life in years*
Passenger Cars	2.5
Buses & Mini Buses	1.5
Trucks	2

Source: ***Estimated by the consultant.***

* Expected life of batteries is based on actual rates rather than standard rates, taking into consideration the repairs of the batteries. These rates are derived from interviews with mechanics and car agents.

Demand for batteries for the purpose of replacement is therefore estimated in 2001 as follows:

TABLE 3.11

Estimated Demand for Batteries

For the Purpose of Replacement

2001

Type of Car	**'000 Batteries**
Passenger Cars	592
Buses & Mini Buses	35
Trucks	260
Total	**887**

Source: ***Estimated by the consultant.***

Batteries used by newly assembled cars are therefore added to the replaced batteries. They are estimated in 2001 as follows:

TABLE 3.12

Number of Batteries Used by Newly Assembled Cars

Type of Car	**'000 Batteries**
Passenger Cars	46
Buses & Mini Buses	3
Trucks	24
Total	**73**

Source: ***CAPMAS, 2001.***

Hence, total demand for batteries in 2001 is estimated as follows:

TABLE 3.13

Estimated Total Demand for Batteries

In 2001

Type of Car	**'000 Batteries**
Passenger Cars	638
Buses & Mini Buses	38
Trucks	284
Total	**960**

Source: ***Estimated by the consultant.***

Based on CAPMAS data, total imports of batteries in 2001 is estimated at 162 thousand batteries. Quantity bought of locally manufactured batteries in Egypt is therefore estimated at 798 thousand batteries. This number is consistent with the reported number of batteries manufactured in 2001,i.e. 750 thousand batteries. The difference between demand and production figures could be due to inventory or due to non-reported production of batteries by the informal sector.

The above investigation indicates that the two basic factors which determine demand for batteries, are the expected useful life of batteries and number of cars assembled in Egypt. Price has a limited effect on demand for batteries, i.e. inelastic demand. Batteries have no substitute and represent low

percentage of the running cost of the car. On the other hand, price variation in the market is insignificant. Price elasticity of demand for batteries is roughly estimated at 0.6, in that as price increases by 10%, demand for batteries decreases by 6%.

(b) Demand Function for Pipes

Our investigation into the market dynamics of pipes in Egypt indicates that pipes are used in six basic sectors; housing including second homes in touristic areas and suburb area, office buildings including governmental offices, commercial units including all activities, tourism focusing on hotels and resorts, industrial sector, and then finally the informal sector.

The approach adopted in estimating demand for pipes is to convert investment cost allocated for each sector into number of units on the basis of average cost per unit within each sector. The accuracy of this number is tested by comparing it with the additional units to be annually added as reported by CAPMAS. Total building areas added in 2001, is therefore estimated on the basis of average size per unit for each sector, and converted into quantity used of pipes on the basis of the required quantity of pipes in tons per building unit (input-output ratio).

Estimated Additional Units

The number of additional units in 2001 is estimated on the basis of investment cost per sector taking into consideration the average cost per unit within each sector as shown in the following table:

TABLE 3.14

Investment Cost and Annual Additional Building Units

2001

Sector	Investment Cost LE Million	Number of Additional Buildings
Housing Units	11,970	180,000
Second Homes	900	16,000
Office Buildings	910	20,000
Commercial Units	1,200	60,000
Tourism	1,500	10,000
Factories	1,890	3,000
Infrastructure	21,640	
Informal	2,700	90,000
Total	**42,710**	**379,000**

Source: ***Ministry of Housing, Utilities and Urban Development, Ministry of Finance, Ministry of Tourism and Ministry of Industry.***

Estimated Building Areas

Average size of building unit for each sector is based on the prevailing norms over the last few years. Total areas to be added annually by sector are therefore estimated as follows:

TABLE 3.15

Estimated Areas of Building Units Added

2001

Sector	No. Of Units '000 Units	Average Size Square Meter	No. Of Square Meter '000
Housing Units	180	95	17,100
Second Homes	16	80	1,280
Office Buildings	20	70	1,400
Commercial Units	60	40	2,400
Tourism (Rooms)	10	25	250
Factories	3	1400	4,200
Informal Sector	90	60	5,400
Total			**32,030**

Source: ***General Organization for Urban Planning***

Input-Output Ratios

The above sectors are classified into five groups: housing sector, business sector, tourism sector, industrial sector and informal sector. Input-output ratios for pipes are identified for each sector as follows:

TABLE 3.16

Required Pipes Per Building Unit

Sector	Pipes (Kg)
Housing Sector	50
Business Sector	30
Tourism Sector	25
Industrial Sector	600
Informal Sector	35

Source: ***Interviews with contractors and consultants.***

Quantity Demanded of Pipes

The quantity demanded of pipes in 2001 classified into sectors is therefore estimated by adding up new demand and demand for the purpose of replacement. Annual replacement of pipes is estimated at 4500 tons per annum:

TABLE 3.17
Quantity Demanded of Pipes
2001

Sector	Pipes ('000 Tons)	Percentage
Housing	9800	45%
Business	2400	11%
Tourism	250	1%
Industry	1800	8%
Informal Sector	3150	14%
Replacement	4500	21%
Total	**21900**	**100.0%**

Source: ***Estimated by the consultant.***

The above table reveals that total demand for all pipes in Egypt is roughly estimated at 21900 tons, of which around 70% are made of lead, giving a total quantity used of lead pipes of 15380 tons. This is very close to the estimated quantity of produced lead pipes (15375 tons). The difference between the two estimates is insignificant.

It appears that demand for lead pipes is highly effected by the availability of PVC pipes at high quality and competitive price. PVC pipes are now available at acceptable quality and at prices lower than the lead pipes' prices. Still, many plumbers and households insist on lead pipes, they believe that they are durable and cheaper in the long run. Nevertheless, many contractors and large projects use PVC pipes and refuse lead pipes. Prices in this context would be a key element reflecting high price elasticity of demand. This is consistent with our previous finding, i.e. demand for pipes is rather elastic with respect to price. This finding is confirmed by the fact that there is a general trend towards substitution of PVC pipes for lead pipes. Price elasticity of demand for lead pipes is roughly estimated at 1.1,i.e., as price increases by 10%, demand for pipes decreases by 11%.

3.3. Supply analysis

The bulk of used lead in Egypt is secondary smelted lead, representing more than 95% of the total quantity of lead used. Hence, the key players in the market are the smelters. On the other hand, supply of secondary smelted lead depends on the availability of scrap lead. The later is collected by collectors of scrap batteries. Hence, two parties determine the supply of lead in the Egyptian market; smelters and collectors of scrap batteries.

3.3.1.The Smelters

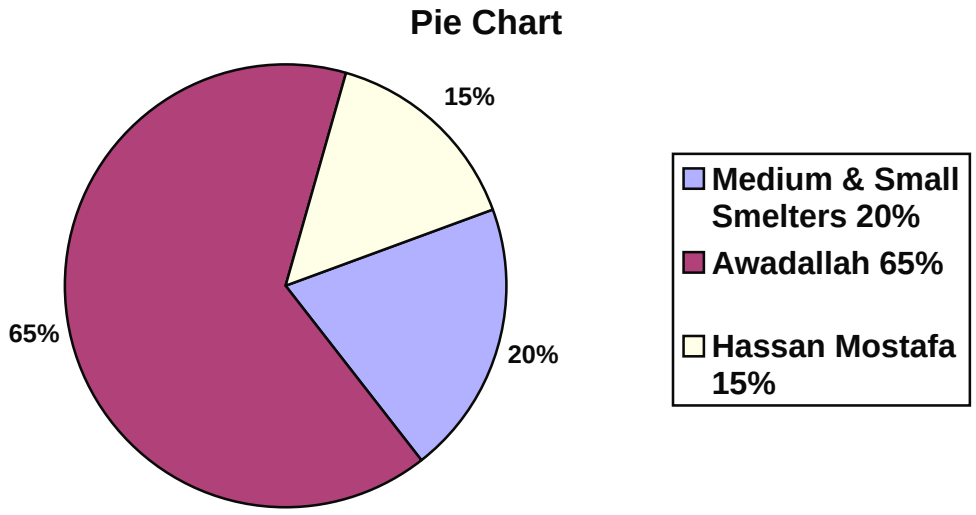
Three basic issues are considered in the analysis of the smelting industry as follows:

Market structure and competition
The general trend of smelting industry
Prices of lead smelting products

3.3.1.1.Market Structure and Competition

The market of smelted lead in Egypt follows the dominant firm model, where one major industry operator; Sayed Awadallah controls the market with a market share of approximately 65% of secondary smelted lead. Domination of the market was reinforced upon the withdrawal of General Metal Co. that used to compete with Awadallah in terms of quality (not quantity). The public sector Company could not conform with new environmental laws and suffered from highly depreciated lines of production, which led to complete termination of smelting activities. Awadallah, as a dominant firm, is a market leader and price maker, while other firms are price takers.

The distribution of production between major producers is shown by the following pie chart:



The characteristics of the market for lead smelting, as a special case of oligopoly market (dominant firm model) are identified as follows:

- Smelted lead products are not homogenous i.e.; outputs of different firms are close but not perfect substitutes. There exists some product differentiation through quality. This enables the dominant firm to be the price leader and to set a higher price for its products compared to the competitors but still not losing a significant part of

sales volume. Sayed Awadallah applies his own know how that enables him to meet the battery industry quality standards. Small operators in the industry are not capable of meeting these requirements. However, standards for lead piping are less rigid than those required by lead battery producers i.e., demand for lead pipes could be satisfied through small and medium size smelters.

- Existence of barriers to entry to the industry whether these barriers are natural (such as barriers related to economy of scale) or imposed by existing firms. The long duration of being involved in the smelting business is a manifestation of these barriers. In case of smelted lead industry, the main barrier is the overwhelming control of the major players in the market on the basic raw material (scrap batteries) and their capabilities to secure and store a raw material inventory exceeding two years as in Awadallah's case. Lately, the pressure exerted by environmental laws induced high barriers to entry. This situation of difficulty of entry to the market allows the dominant firm to maintain its remarkable profits in the long run.

Due to these characteristics, the lead smelting industry is a high return industry, but most sensitive to interruptions in production leading to high inventory of material inputs.

Total annual production of smelting industry is estimated at an average of 34 thousand MT of lead ingots and concentrated in G. Cairo, with around 75% contribution. However, production of lead ingots is classified as follows:

Hard Lead ingots	29.5 thousand MT
Soft Lead Ingots	4.5 thousand MT

The market shares of key players in the smelting industry are identified as follows:

TABLE 3.18

Market Shares of Key Players

Name	Market Share	No. of Operating Smelters/Foundry	Governorate
Sayed Awadallah	65%	5	Cairo Giza Sharkiya
Hassan Mostafa	15%	2	Alex. Borg El Arab
Medium & Small size Smelters	20%	20-25	The majority in Arab Abou Saed in Giza

Source: ***Makary Consulting "Makary survey and interviews with major smelters, March 2002.***

The above table reveals the following:

- The secondary lead smelting industry is dominated by one private sector company (Awadallah) which has five operating lead smelters, two located in Shoubra el Kheima, Two in Arab Abou Saed and the fifth in Tenth of Ramadan City (the latest being the only plant conforming with new environmental laws)

- The dominant firm and second major market player shown in the above table are both lead smelters and lead fabricators. However, Awadallah is the sole smelter that performs alloying. Customers for alloying are mainly battery factories. In order to insure the proper ingredients of alloying metals, it is only undertaken using pure lead ingots (99.98%).

Based on personal interview with Awadallah (the market leader), the following parameters are identified:

- Annual production of Awadallah amounts to 21-22 thousand tons. The product mix is as follows:

Ingots (soft & hard)	75%
Pipes	15%
Oxides	10%

- A new product is demanded by the company which is reinforced concrete base containing lead. Demand for this product resulted from the need to fulfil the rigid requirements /standards for anti-earthquake constructions.

- Major clients for the company are the following sectors:

Lead acid batteries	60-70%
Military Factories	10%
Lead Pipe	10%
Elevators and hospitals	5%
Others	5%

- Cost norms of the industry is estimated as follows:

80%	scrap batteries
7%	energy & fuel
5%	Additives
5%	depreciation
3%	Others (mainly labor & transportation)

However, upon relocation of one of Awadallah's plants in Tenth of Ramadan City and installation of a complete emission control system both energy consumption (using only solar at present) and transportation cost (of raw material, final product and labor) increased. Also the new technology entailed special oxygen cylinders, which rendered a higher production cost. Offsetting

this increase in cost, higher efficiency in retrieving lead from lead dust accumulated in filtration bags (emission control equipment) was achieved. Also cost of additives decreased.

3.3.1.2. The General Trend of Smelting Industry

- Lead smelting industry used to be a booming industry that witnessed its peak production at year 1997. Total production during that year was estimated at 38.5 thousand MT. In 1998, the industry experienced a sudden slow down upon enforcement of the Environmental Law in March 1998. Now with recession in the lead industry market, Sayed Awadallah (dominant firm and market leader) who used to base his annual production plan on 300 working days, has decreased his planned working days to 165-170 working days on average. The following table shows the total production of lead during the past five years.

TABLE 3.19

Estimated Annual Production of Lead Ingots

Year	**Annual Production '000 Tons**
1997	38.5
1998	33.0
1999	35.0
2000	34.0
2001	34.0

Source: ***Makary Consulting "Makary survey and interviews with major smelters, March 2002.***

In 1998, the industry experienced a sudden slow down from 38.5 thousand tons to around 33 thousand tons. This can be attributed to the below factors, which worked together to induce a drop in the production of lead ingots.

- The enforcement of the Environmental Law in March 1998 and the pressure of local authorities on the smelter owners to comply with it, has forced the majority of these smelters to relocate in remote areas in order to sustain their activities. More than 40% of the smelting activities were relocated in Arab Abou Saed in the vicinity of the brick factories. This stage of relocation from one place to another was reflected in the drop witnessed in 1998.

- The General Metals Co., the single Public sector company located in Tebbin, first reduced its annual production from 8000 MT to 3250 MT of lead ingots. Then due to the difficulties in adapting to new environmental laws, it completely terminated its smelting activities by the beginning of 2000.

- The significant reduction in demand for lead pipes due to the introduction of PVC pipes as a good and effective substitute for lead pipes. It should be noted that PVC pipes are locally produced in Egypt and are available in the market at a less expensive price than lead pipes per meter. The reduction in demand for lead pipes through product substitution i.e., PVC pipes is working as a factor that partially displaces lead from the piping market. At first, plumbers and contractors still favored lead pipes for their higher flexibility and to avoid problems faced with PVC pipes with regard to sealing junctions and fixtures. But with development and introduction of adequate training in the construction market, the demand for lead pipes is expected to decrease.

However, production of lead ingots increased again in 1999. This can be explained by two major factors:

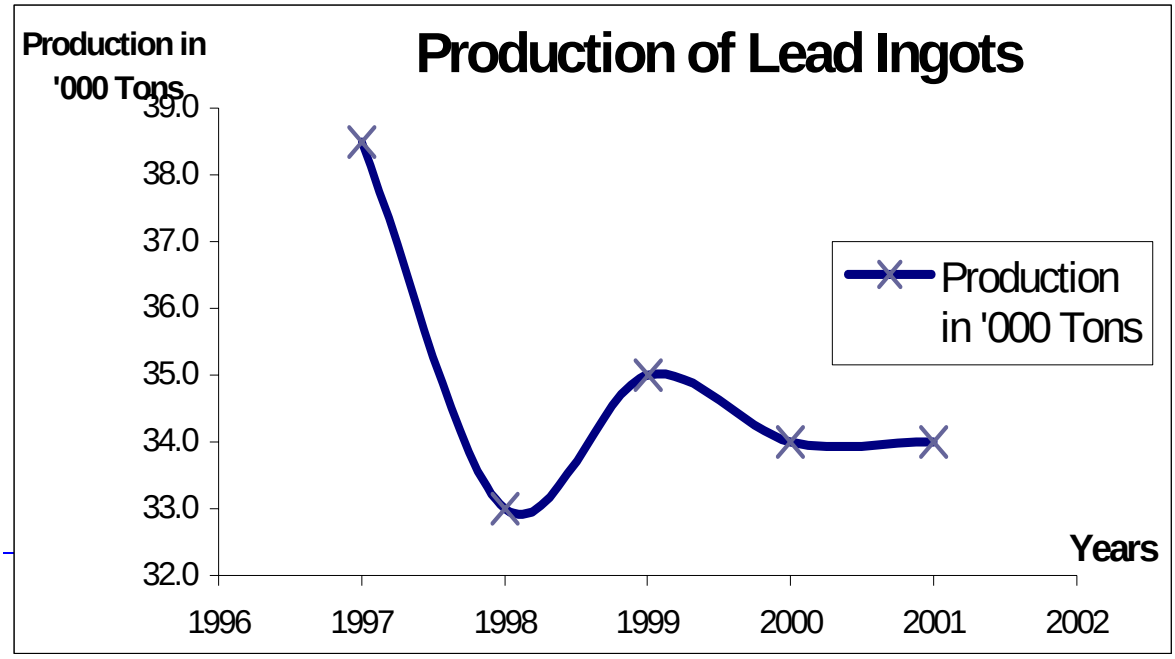
- As a result of the enforcement of the environmental law, smelters were forced to relocate their production facilities in new areas (Arab Abou Saad in Giza) with relatively larger spaces. Therefore, they were able to increase the number of furnaces resulting in larger production quantities.

- The car industry has shown expansion resulting in increasing demand for batteries.

The smelting industry showed a slight decrease in year 2000 that is attributed rigid implementation of laws prohibiting imports of scrap batteries that constrained the availability of the basic raw material for this industry. However, scarcity of raw material upon prohibiting importation was reinforced by the exportation of local scrap batteries to Asian countries. Some exporting agents (not involved in the smelting industry) tended to export the scrap batteries to benefit form the increase of world price. This resulted in shortage of scrap batteries in the Egyptian market which led to increase in price from LE600/ton to LE 850/ton at present. This in turn, constrained the Egyptian production of smelted lead products since the scrap battery represent around 80% of total cost of operation in this industry.

Since 2000, the smelting industry has stabilized at some 34 thousand tons. While demand for batteries was steadily growing, demand for both lead pipes and lead oxides have shown significant decrease offsetting the increase in demand for batteries. Such stagnation in the smelting industry during that period is strengthened by the economic recession that took place in Egypt during that period.

Hence, production of lead ingots during the last five years is illustrated by the following graph:



In conclusion, one would argue that the market size of lead ingots in Egypt is within the range of 34 thousand tons. This is consistent with the quantity demanded of lead ingots, as estimated through analysis of demand functions. The variation between demand and supply figures is insignificant. It reflects inventory of the basic raw material, i.e. scrap batteries.

3.3.1.3. Prices of Lead Smelting Products

The following table summarizes the prices of different products per ton of the smelting industry for the last five years.

TABLE 3.20

Prices of Lead Smelted Products in LE/ton

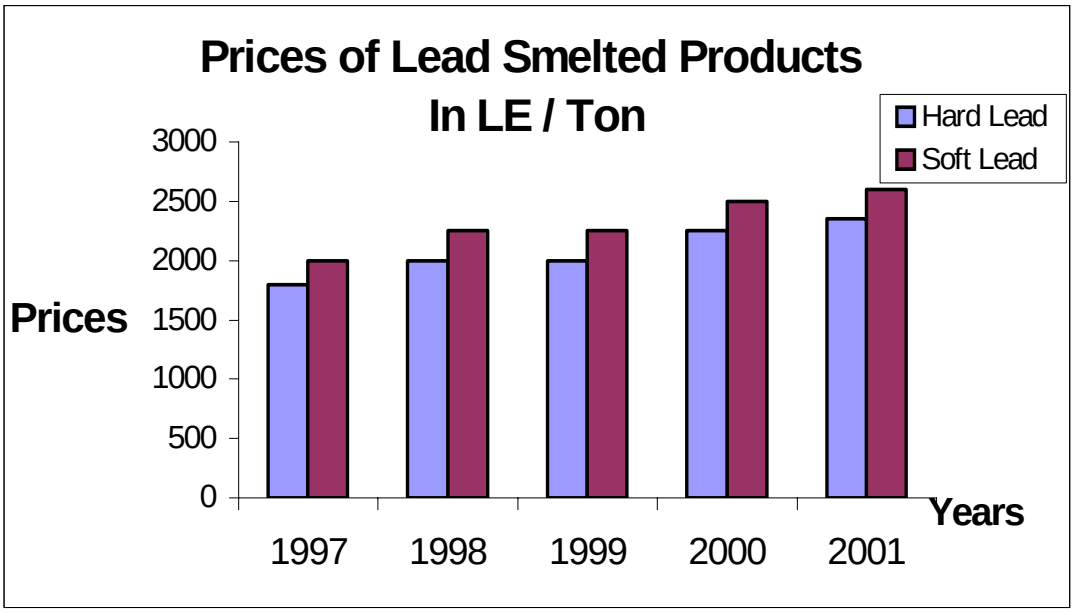
Year	Hard Ingots	Soft Ingots	Lead Pipes	Red Oxide	Grey Oxide
1997	1800	2000	3000	3500-4500	2250
1998	2000	2250	3250	5000-6000	2500
1999	2000	2250	2750	6000-6500	3000
2000	2250	2500	3000	6500	3250
2001	2350	2600	3200	6500	3250
Annual increase of prices	**7%**	**7%**	**2%**	**13%**	**10%**

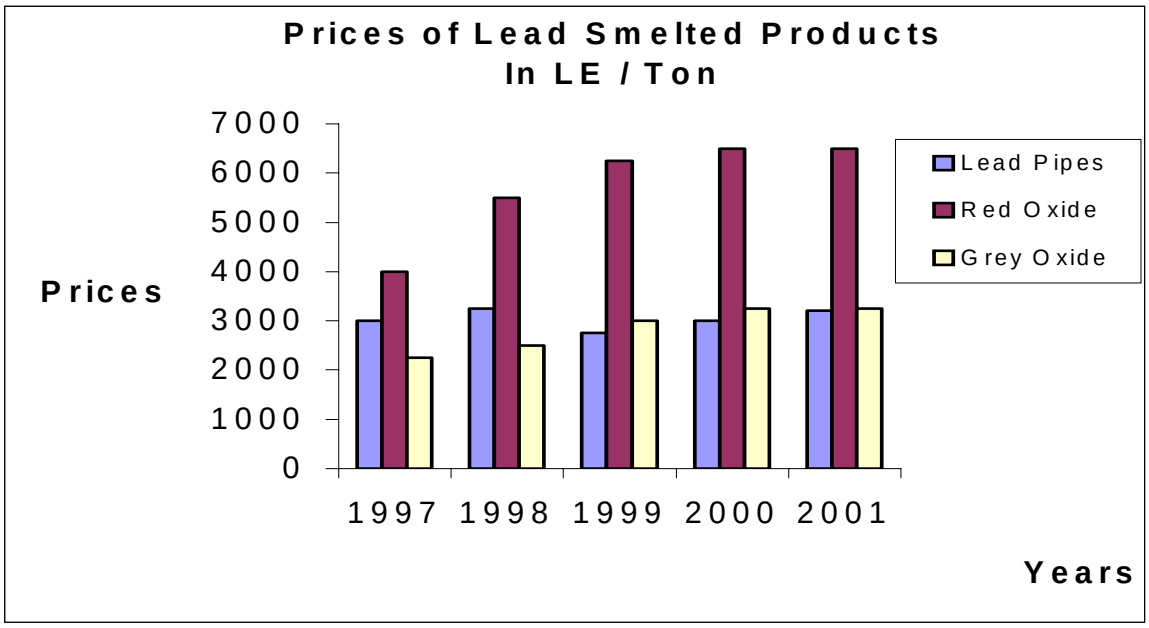
Source: ***Makary Consulting "Makary survey and interviews with major smelters, March 2002.***

It should be noted that the current world price of lead ingots is USD 450

(equivalent to LE 2,092.5).

The general trend of prices is shown as follows:





3.3.2. Collectors of Scrap Batteries

The lead smelting industry is a self-recycling industry in that the markets in which lead products are sold are also the sources of raw material for lead smelting. However, three basic features govern the recycling process as follows:

1. Because of the different life spans of lead products, these products do not contribute equally to the recyclable stream. Lead sheets and lead pipes have a useful life of 30-40 years, while lead acid batteries currently have an average life of 2-2.5 years in Egypt. Hence, batteries is by far the major contributor to the recyclable flow of lead meanwhile pipes constitute a small proportion of lead scrap for recycle.

2. Not all lead recycling involves lead smelting. Actually, scrap lead pipes and sheets do not normally go through the smelting stage. They are re-melted and extruded into new pipes or rolled into new sheets. Given the impurities in scrap pipes, the rudimentary process reflects negatively on the product quality.

3. Imported scrap batteries are banded and enforced by the Egyptian Environment Affairs Agency. Exports are also legally prohibited.

Based on the above factors, raw materials for this industry entails investigation of the battery collection process in Egypt, and price of scrap batteries.

3.3.2.1. Scrap Battery Collection System in Egypt

The scrap battery market is an oligopoly market where few firms dominate the scrap battery market. Major suppliers are supported by an elaborate network of battery collection that follows a hierarchy of street peddlers buying the

discarded battery to large dealers selling the acid drained batteries to those major suppliers who sells to smelters. Those intermediate collectors are paid on monthly basis by major suppliers to secure their shares of quantity supplied. The high rate of collection can be visually supported by the fact that no discarded batteries are seen in dumpsites or waste . In addition to their dependence on garbage collectors, major suppliers resort to bids announced by Army forces, public sector companies and governmental agencies for securing around 30-40% of their quantities supplied to smelters. The supply of used batteries varies from one season to another in an unstable market. Raw materials are delivered at smelter gate and their cost include cost of transportation.

The major market supplier accounts for 50% of the total collected scrap batteries. He is the dominant firm and market leader, controlling the market prices. The rest of the market is divided between 4-5 suppliers each with a share ranging from 10%-15%. However, despite that imports of scrap batteries is forbidden by law, still the major supplier has access to imported batteries especially from Libya where batteries are available at a relatively cheaper price than Egypt. It is estimated that annual imports of scrap batteries from Libya are around 10 thousand tons. The following table summarizes the quantity collected of scrap batteries during the last five years. It should be noted that these quantities exclude imports and exports of scrap batteries.

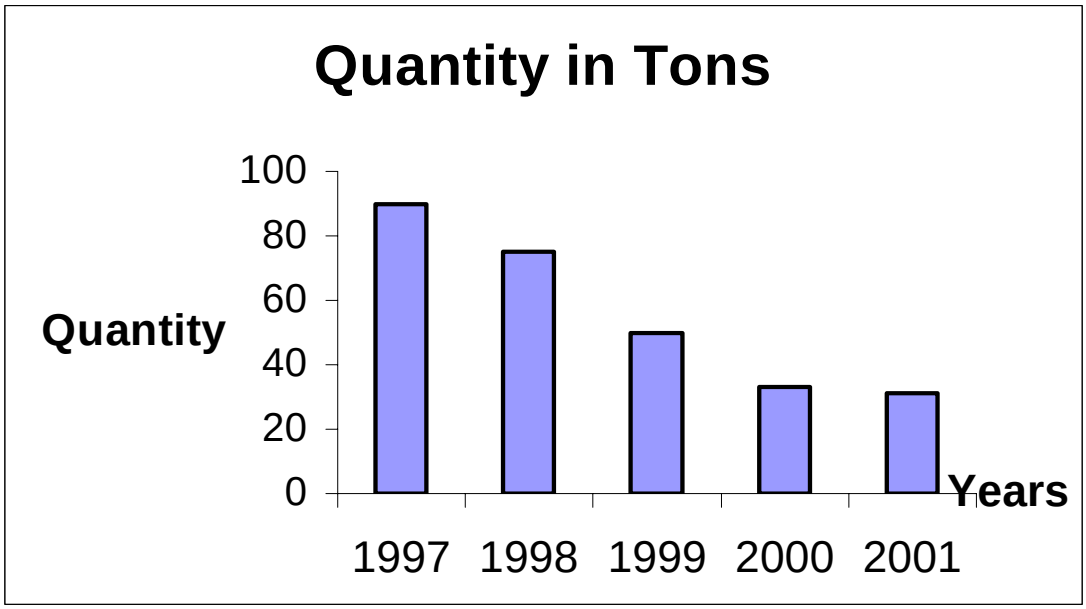
TABLE 3.21

Estimated Amount of Locally Collected Scrap Batteries

Year	**Collect Scrap Batteries ('000 tons)**
1997	90
1998	75
1999	50
2000	33
2001	31

<u>Source:</u> Makary Consulting "Makary survey and interviews with major smelters, March 2002.

Quantities of collected scrap batteries is illustrated by the following bar chart:



It is evident that the quantity collected of scrap batteries has been decreasing during the last five years. It dropped from 90 thousand tons in 1997 to 30 thousand tons in 2001. This significant drop can be attributed to the following three factors:

- In years 1997 and 1998, smelters used to keep high levels of inventory of scrap batteries, reaching 24 months. In later years, the inventory level dropped to six months.
- Demand for lead in general has shown a downward trend.
- During the last two years, a number of scrap battery collectors and traders exported large quantities capitalizing on the upward movement of the world price of lead. More than 15 thousand tons of scrap batteries were exported in the last two years.

It should be noted that Awadallah has resorted to establishing his own smelting facilities in Libya to overcome the problem of shortage of raw material inside and capitalize on a cheaper market of scrap batteries in Libya. Produced Lead ingots are then transferred to his plants in Egypt.

3.3.2.2 Prices of Scrap Batteries

The scrap battery market has witnessed an increasing price trend for the last five years. As mentioned before, a significant increase in scrap batteries prices was witnessed during last year (from LE 650/ton to exceed LE 850/ton). To overcome this problem, major players in the smelted industry market keep an inventory equivalent to 2 years of raw material (scrap batteries) needed. This in turns raises their working capital requirements, and would induce higher prices for lead. Generally speaking, any increase in raw material cost is easily transferred to price of final product, if demand for the product is inelastic.

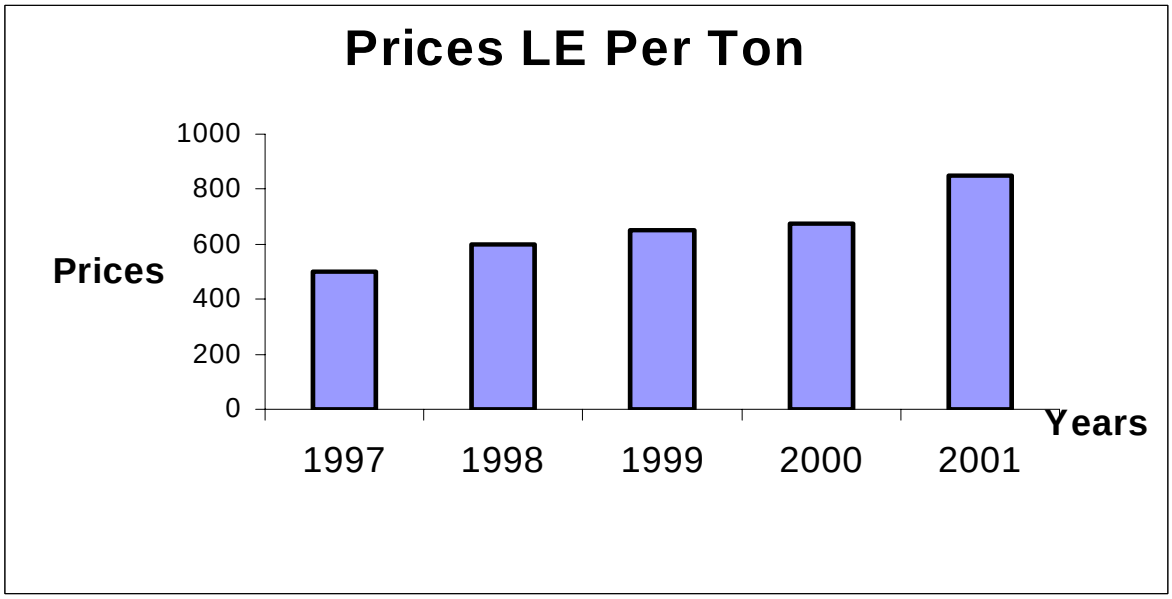
The following table summarizes the average sales price of collected scrap batteries.

TABLE 3.22

Average Sales Price of Scrap Batteries

Year	Average price per Ton (LE)
1997	450-550
1998	600
1999	650
2000	650-700
2001	850

Note: ***Scrap batteries are purchased by scrap collectors at an average of LE 300 – LE 400 per ton.***



It should be noted that the price of raw material vary according to its lead content. While battery grids are procured at LE 1400 /ton - LE1600/ton, drained batteries were quoted at prices ranging from LE 700 to LE 900 /ton, with mode of LE 850/ton (in 2001). In a smelter only using scrap batteries to produce refined lead ingots, and based on the 50% output stated by operators, the per ton of refined lead cost is approximately LE 1700.

3.3.2.3.Techniques used in processing batteries for lead recovery

Used batteries are broken using hammer-mills, saws, shears, or some combination of all above. The batteries may be punctured to allow the acid to drain before they are broken. The broken batteries are usually conveyed to a separator, which separates the battery plates from the cases. Following the battery breaking, the plates are sent to raw materials storage and the cases are sent for crushing to reduce size. Based upon our interviews with smelters, some of them do the above seperation procedures and then sell the plastic case for recyling in plastic industry. The discarded plastics is sold at a maximum of LE 70 per ton (for recycling) but the price is much less if sold as a feul. Others feed the furnance with the whole battery. This results in air pollution problems caused by using the entire battery in the smelting process. In addition, metal recovery is reduced since more non-metallic materials are charged to the furnace.

Then the raw material is loaded on small barrows to be manually charged in the smelting furnace. The furnace charge materials consist of the lead-bearing materials, lead-bearing slag, flue dust, dross, fluxing agents and coke. The smelting process is usually performed in blast, rotary furnaces which is the most common type of smelting furnace in Egypt.

It should be noted that some secondary smelters offer a “ tolling service” where a customer delivers scrap lead to the smelter and receives the recovered lead, paying only for the service of having the lead processed and cast into ingots. This is common among the small smelters.

4. MARKET OUTLOOK

4. MARKET OUTLOOK

4.1. Approach

Demand for lead is projected over ten years period to be compared with the potential domestic supply of lead ingots in order to test the significance of the expected local market gap of lead. Demand projection is based on the expected growth of the users of lead, taking into consideration the general trend of the market parameters. This includes projection of the expected growth rates of demand variables, i.e. prices, and estimate of elasticities, i.e. the degree by which prices effect demand. The potential supply is estimated on the basis of future development of lead industry in Egypt taking into consideration the market structure and the enforcement of environmental regulations. Demand and supply of lead are projected on an annual basis.

4.2. Demand Projection

4.2.1. Demand Variables

Demand for lead is a derived demand in that it is derived from the demand for the products which use lead, i.e. an intermediate demand function. Hence, demand for the basic users of lead, product by product, is projected to be converted into lead on the basis of the prevailing input – output ratios to estimate the expected demand for lead. However, the growth of demand for lead users is a necessary but not sufficient condition to secure demand for lead. Price ratios would play significant role in determining demand for lead. This includes two price ratios, input – output price ratio, i.e. price of lead versus price of substitute, (PVC), and input – input ratio, i.e. price of lead versus the price of the user of lead. Hence, four basic independent variables in the demand function of lead are identified:

- Demand for the product that use lead.
- Price of lead
- Price of substitute (if it is applicable)
- Price of the product that use lead.

One would expect that the price of lead has a negative effect on demand for lead, while price of lead user and price of lead substitute would have a positive effect. In the case of, growing industries (user of lead) demand for the products (users) would have positive effect on demand for lead. If demand for the industry is declining, the demand for the users would have negative effect. Hence, the general trend of demand for lead would depend on the weight of the positive effects against the weight of the negative effects.

The above approach is applied to each product (lead user) to estimate the expected demand for lead by product, and therefore to arrive at the total demand for lead ingots classified into types of lead.

The effect of the above independent variables would depend on two parameters:

- The rates at which these variables change (i.e. rate of growth)
- The degree to which these variables would affect demand for lead (i.e. elasticities)

4.2.2. Growth Rates

An attempt is made here to estimate the expected growth rates of the underlying independent variables over the period 2003-2012. Based on our analysis of the future growth of the Egyptian economy, taking into consideration the economic reform policy and expected changes in macro parameters such as GOP, inflation rate, foreign exchange rate and investment, the whole projection period is divided into three periods:

- The period from 2003-2005, where the economy will grow at slow rate compared with the last five years. Both investment and GOP are expected to grow at an annual rate ranging from 4% - 4.5% giving a growth rate of per capita income within 2% - 2.5% range. Inflation rate will be maintained at a low rate (4% - 5%), while the Egyptian pound will be depreciated by an annual rate ranging from 2.5% - 3%. Based on these assumptions one would expect that the annual increase of price of lead will drop from 7% - 8% (over the last five years), to 6%. Annual growth rates of the prices and demand of the users of lead are therefore projected as follows:

TABLE 4.1
Expected Annual Growth Rates
Of the Independent Variables
2003-2005

User - industry	Annual growth rate of Price	Annual growth rate Of Demand
Batteries	5%	5%
Batteries Components	5%	-4%
Electric Cables	8%	8%
Crystal	7%	5%
Pressure Hose	4%	-7%
Pipes *	6%	-4%
Paints	4%	3%
Grey Lead Oxide	3%	-3%
Red Lead Oxide	3%	-3%
Others	3%	3%

* Pipes is the only lead user that have substitute for lead, i.e. PVC. Price of PVC used in pipes is expected to increase by 4%.

- The period from 2006-2009, over which the Egyptian economy will recover from the slow down that took place during the last two years, and maintain stable and sustainable growth with a growth rate similar to the growth rates prevailed during the period 1997- 2000, i.e. GDP growth of 5.5% - 6%. Investment will also increase to match with the growth of GDP, while both inflation and depreciation of Egyptian pound will be controlled within 3% - 3.5%. Hence, one would expect that price of lead will increase at less rate (5%). Demand for the underlying products (lead users) will increase at higher rates and prices of the products will increase at lower rates as follows:

TABLE 4.2
Expected Annual Growth Rates
Of the Independent Variables
2006-2009

User	**Price of the product**	**Demand for the product**
Batteries	4%	5.5%
Batteries Components	4%	-3%
Electric Cables	6%	10%
Crystal	5%	6%
Pressure Hose	3%	-4%
Pipes	4%	-6%
Paints	3%	4%
Grey Lead Oxide	2%	-4%
Red Lead Oxide	2%	-4%
Others	2%	4%

∗ Price of PVC materials is expected to increase at lower rate (2%) than the price of lead.

- During the period from 2010– 2012, the Egyptian economy will reach maturity with steady growth. GDP will grow at 5%, and annual inflation rate and depreciation of Egyptian pound will remain at 2.5% - 3%, reflecting the following growth rates of the underlying variables:

TABLE 4.3
Expected Annual Growth Rates
Of the Independent Variables
2010-2012

User -Industry	Annual growth rate of price	Annual growth rate of demand
Batteries	3%	4.5%
Batteries Components	3%	-2%
Electric Cables	5%	7%
Crystal	4%	5%
Pressure Hose	2%	-3%
Pipes*	3%	-5%
Paints	2%	3%
Grey Lead Oxide	2%	-2%
Red Lead Oxide	2%	-2%
Others	2%	3%

∗ Price of lead is expected to increase at higher rates than inflation rate i.e., 4% (inelastic demand), while the price of PVC used in pipes is expected to increase at low rate (1%).

4.2.3. Elasticities of Demand

An attempt is made to estimate the effect of three prices on demand, price of lead (price elasticity of demand for lead) price of the product (price elasticity of demand for the product that use lead), and then price of lead substitute (cross elasticity of demand).

(One) Price elasticity of demand for lead

It reflects the relative change of demand for lead due to the relative change of price of lead, i.e., the degree by which price of lead effects demand for lead. It would depend on three factors:

- The availability of substitutes or the degree of substitution. The higher the degree of substitution, the higher the price elasticity of demand for lead.

- The cost of raw lead as a percentage of the value of final products. The higher this percentage, the higher the price elasticity of demand for lead

- The price elasticity of demand for the product (the user), the higher the degree of price elasticity of demand for the user of lead, the higher the price elasticity of demand for lead, in that the lead user can not pass the price increase to the end-user.

Since these factors differ from one product to another, price elasticity of demand for lead is measured for each product as follows:

TABLE 4.4

The Estimated Price Elasticity of demand

For Lead

	Price elasticity of lead
Batteries	0.8
Batteries Components	1.0
Electric Cables	0.4
Crystal	0.6
Pressure Hose	0.5
Pipes	1.2
Paints	0.4
Grey Lead Oxide	1.1
Red Lead Oxide	1.1
Others	0.8

Source: ***Estimated by the consultant.***

(Two) Price elasticity of demand for the lead users

It reveals the relative change of the demand for the product due to the relative change of the price of the product, i.e. the degree by which the price of the product effects demand for such a product. It would depend on three factors:

- The degree of necessity, the higher the degree of necessity the lower the price elasticity of demand. In this respect one would expect that demand for all users of lead, except crystal, is rather inelastic.
- The degree of substitution, the higher the degree of substitution, the higher the price elasticity of demand. All the underlying products do not have substitute with low price elasticity of demand.
- The proportion of income (or cost) to be spent on the product. Values of all products or cost except batteries and lead oxide represent a small proportion of either income or cost.

Based on the above factors, price elasticities of demand for the underlying products are roughly estimated as shown in the following table:

TABLE 4.5

The Estimated Price Elasticities of demand

For the Products (lead users)

	Price elasticity of the Product
Batteries	0.7
Batteries Components	0.6
Electric Cables	0.5
Crystal	1.3
Pressure Hose	0.7
Pipes	0.8
Paints	0.7
Grey Lead Oxide	1.2
Red Lead Oxide	1.2
Others	0.7

Source: ***Estimated by the consultant.***

(Three) Cross elasticity of demand

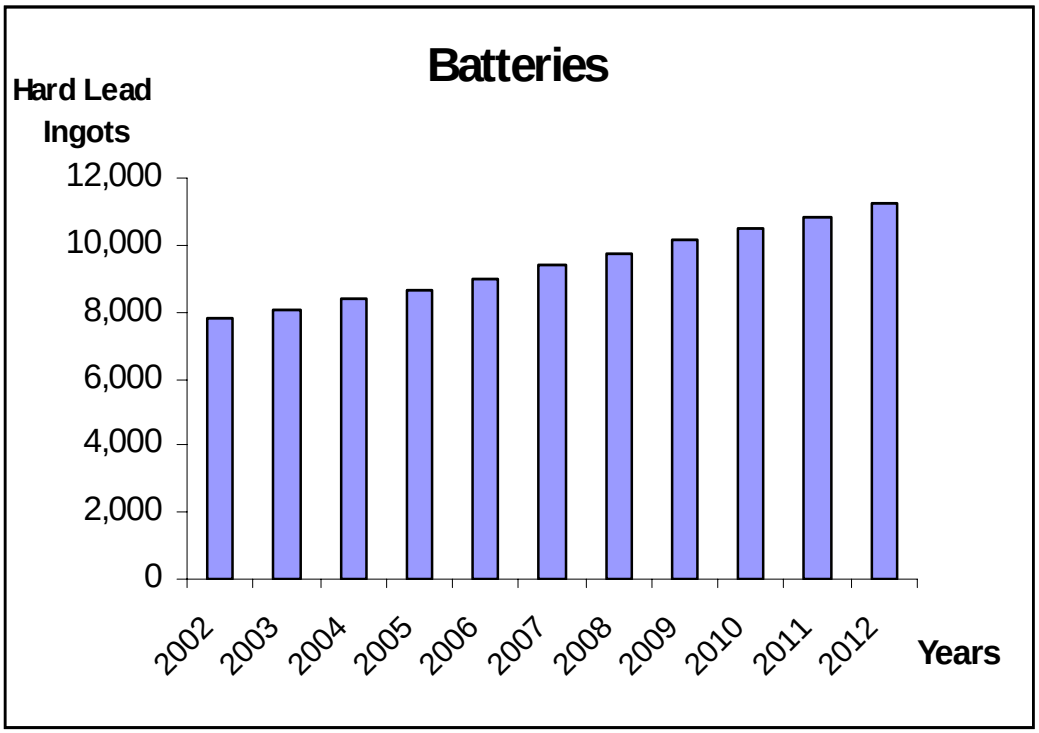
It shows the relevant change of demand for lead due to the relative change of price of lead substitute, i.e. the degree by which price of lead substitute would affect demand for lead (Cross elasticity of demand). As far as lead is concerned, cross elasticity of demand applies only in the case of pipes, where PVC is a good and acceptable substitute for lead. In this respect it is expected to be rather high. It is roughly estimated at 1.2, i.e. as price of substitute of lead increases by 10%, demand for lead will increase by 12%.

4.2.4. Projection of the Expected Demand for Lead

The projected growth rates of the demand variables are applied to the estimated elasticities and injected in a Macro Growth Model, in order to arrive at the expected demand for lead, by product over the period 2003 – 2012. Total demand for lead is therefore projected on annual basis and classified into various types of lead. The following tables and charts illustrate the projected demand for Lead by product over the coming ten years.(All quantities of lead are given in tons)

TABLE 4.6
Projected Demand for Lead Ingots
Used by Batteries

Years	Batteries	
	Hard Lead Ingots	Grey Lead Oxide
2002	7,821	1,009
2003	8,092	1,044
2004	8,372	1,080
2005	8,661	1,117
2006	9,018	1,163
2007	9,389	1,211
2008	9,775	1,261
2009	10,178	1,313
2010	10,512	1,356
2011	10,857	1,400
2012	11,213	1,446


Batteries
Hard Lead Ingots
12,000
10,000
8,000
6,000
4,000
2,000
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Years

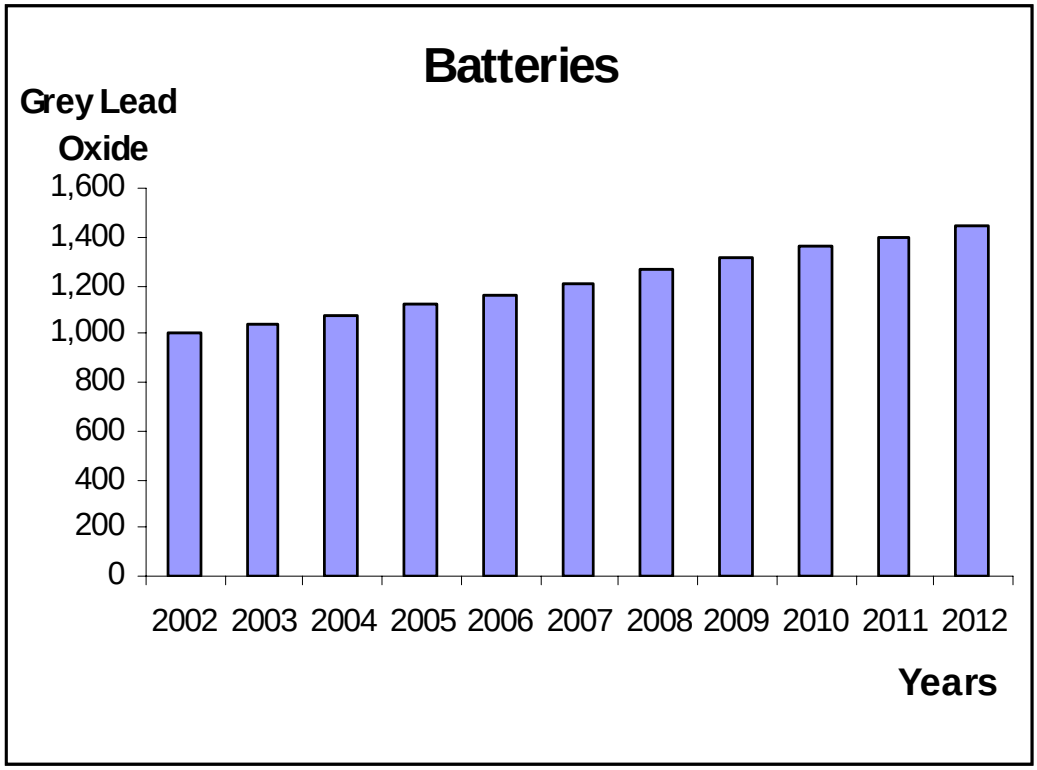

Batteries
Grey Lead Oxide
1,600
1,400
1,200
1,000
800
600
400
200
0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Years

TABLE 4.7

Projected Demand for Lead Ingots

Used by Batteries Components

Years	Batteries Components
2002	298
2003	277
2004	258
2005	240
2006	226
2007	213
2008	201
2009	190
2010	182
2011	174
2012	167

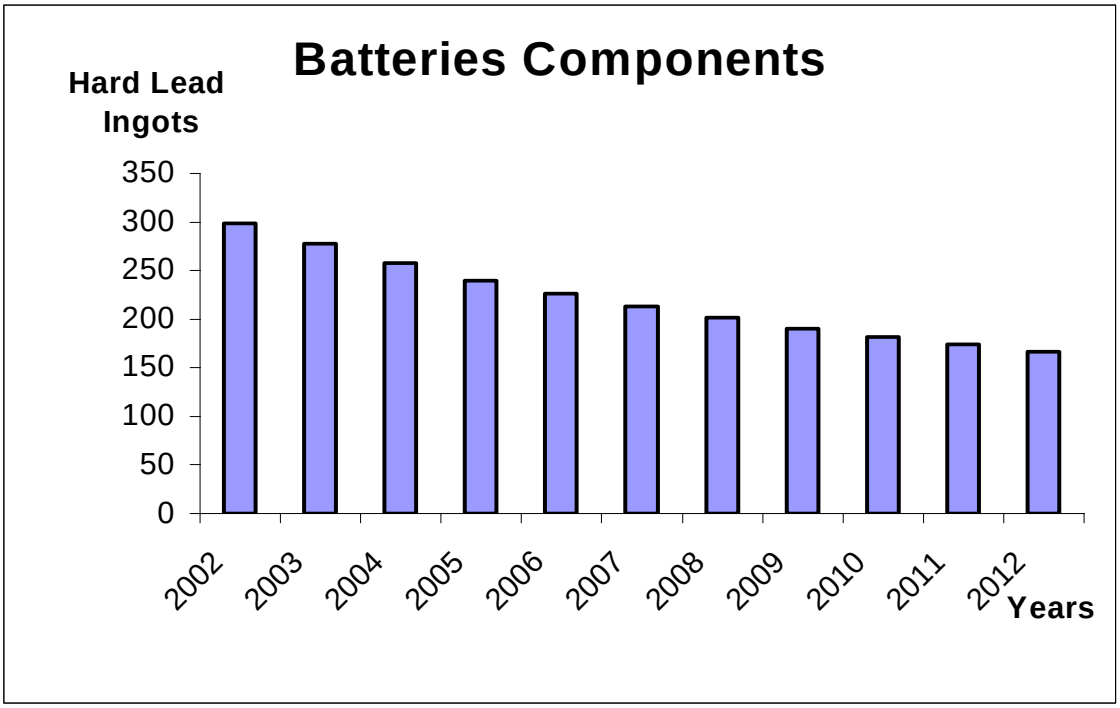


TABLE 4.8

Projected Demand for Lead Ingots

Used by Electric Cables

Years	Electric cables
2002	428
2003	469
2004	514
2005	563
2006	625
2007	694
2008	771
2009	856
2010	924
2011	997
2012	1,076

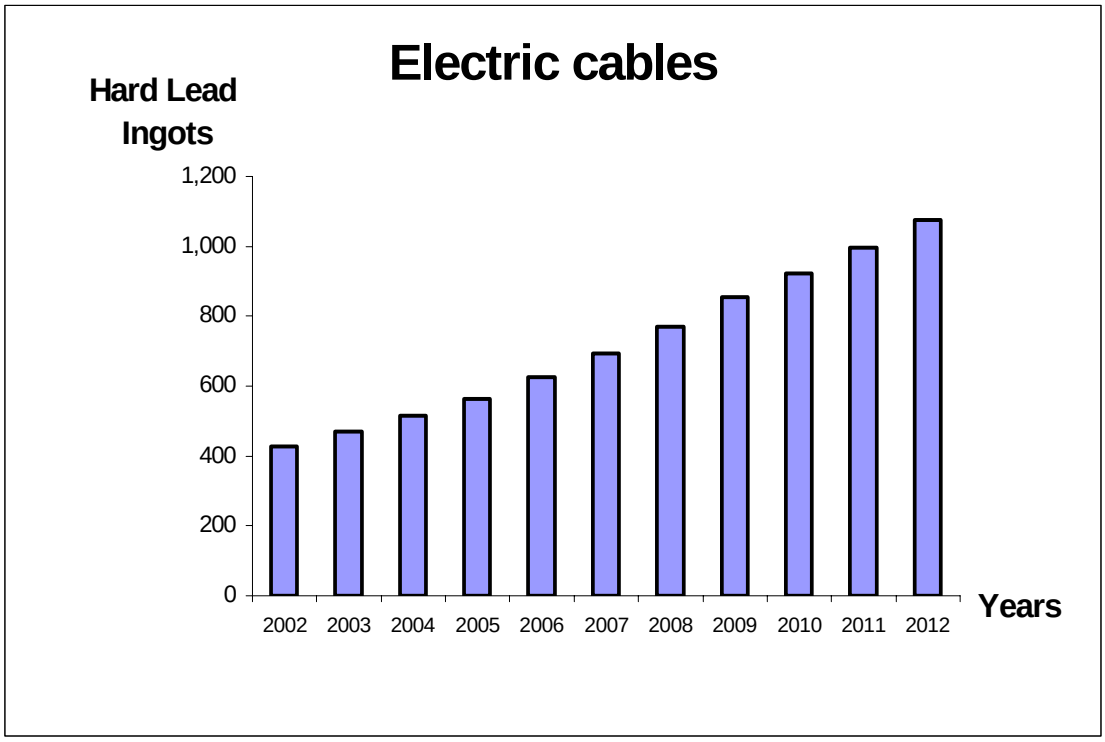


TABLE 4.9

Projected Demand for Lead Ingots

Used by Crystal

Years	Crystal
2002	269
2003	298
2004	329
2005	363
2006	397
2007	435
2008	476
2009	522
2010	562
2011	606
2012	654

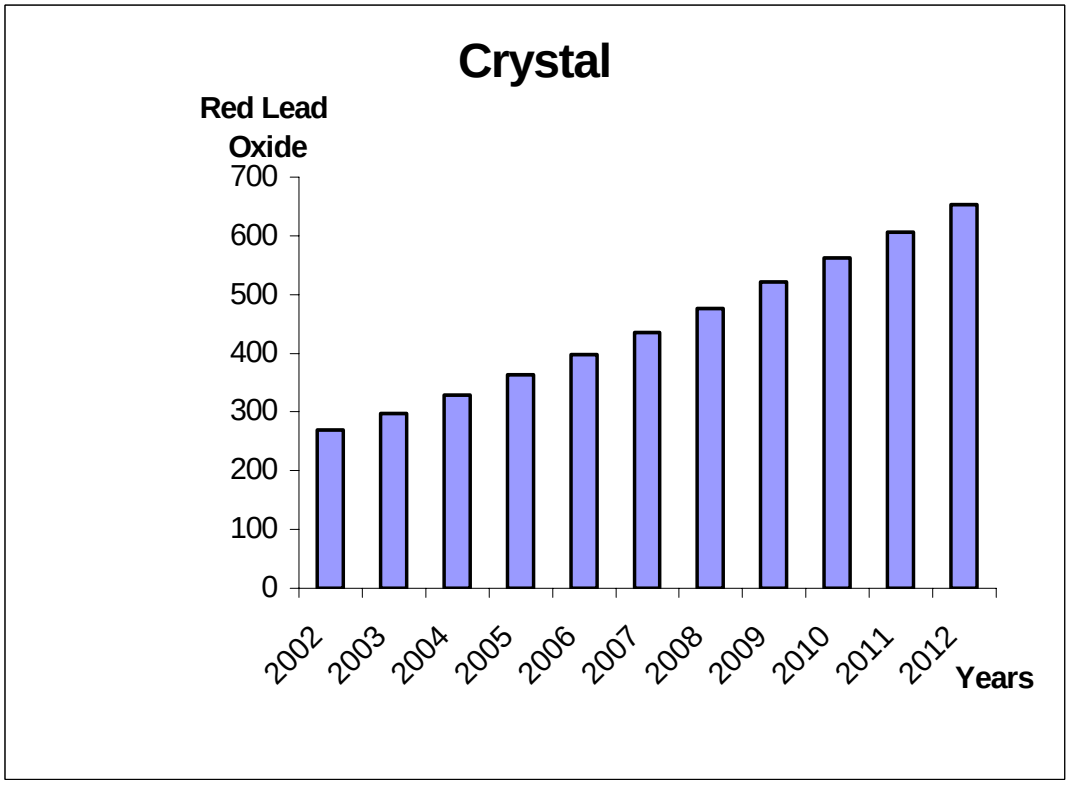


TABLE 4.10

Projected Demand for Lead Ingots

Used by Pressure Hose

Years	Pressure Hose
2002	63
2003	58
2004	54
2005	50
2006	48
2007	46
2008	44
2009	42
2010	40
2011	39
2012	38

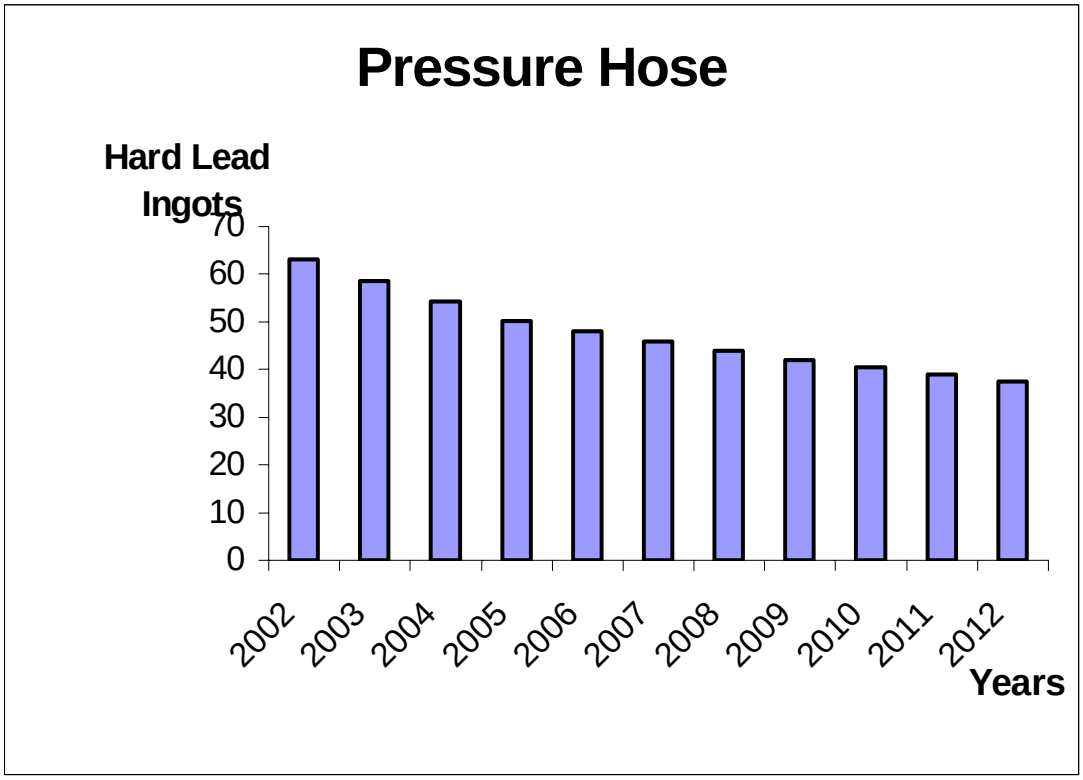


TABLE 4.11

Projected Demand for Lead Ingots

Used by Lead Pipes

Years	Pipes
2002	15,044
2003	14,720
2004	14,403
2005	14,092
2006	13,159
2007	12,287
2008	11,473
2009	10,713
2010	10,041
2011	9,410
2012	8,820

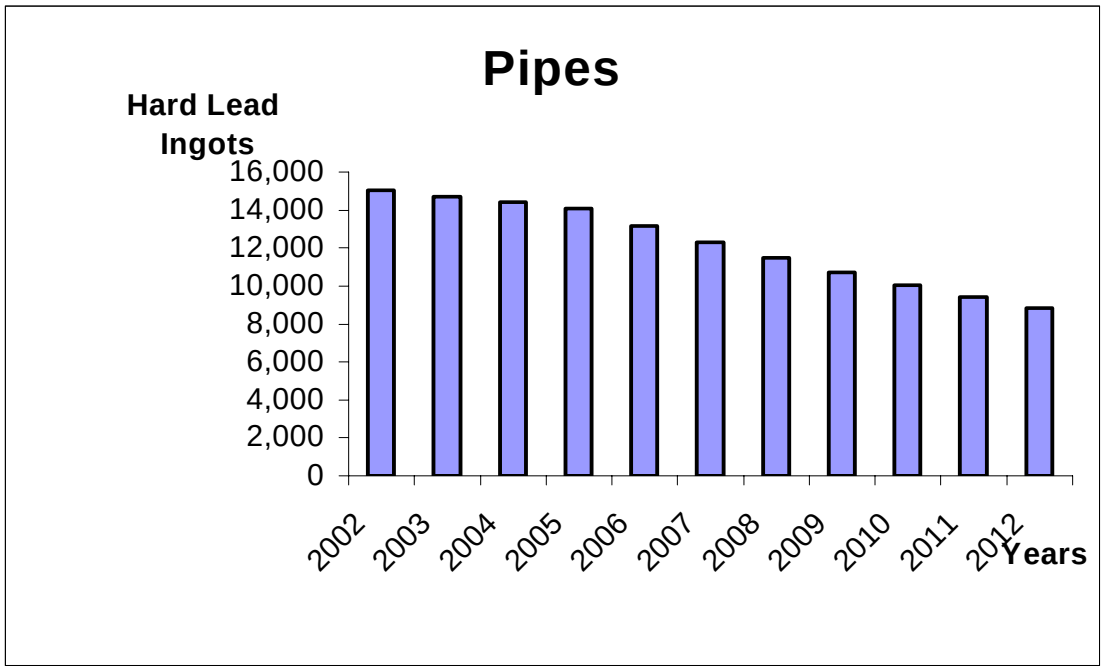


TABLE 4.12

Projected Demand for Lead Ingots

Used by Paints

Years	Paints
2002	76
2003	79
2004	82
2005	84
2006	88
2007	91
2008	95
2009	99
2010	102
2011	105
2012	107

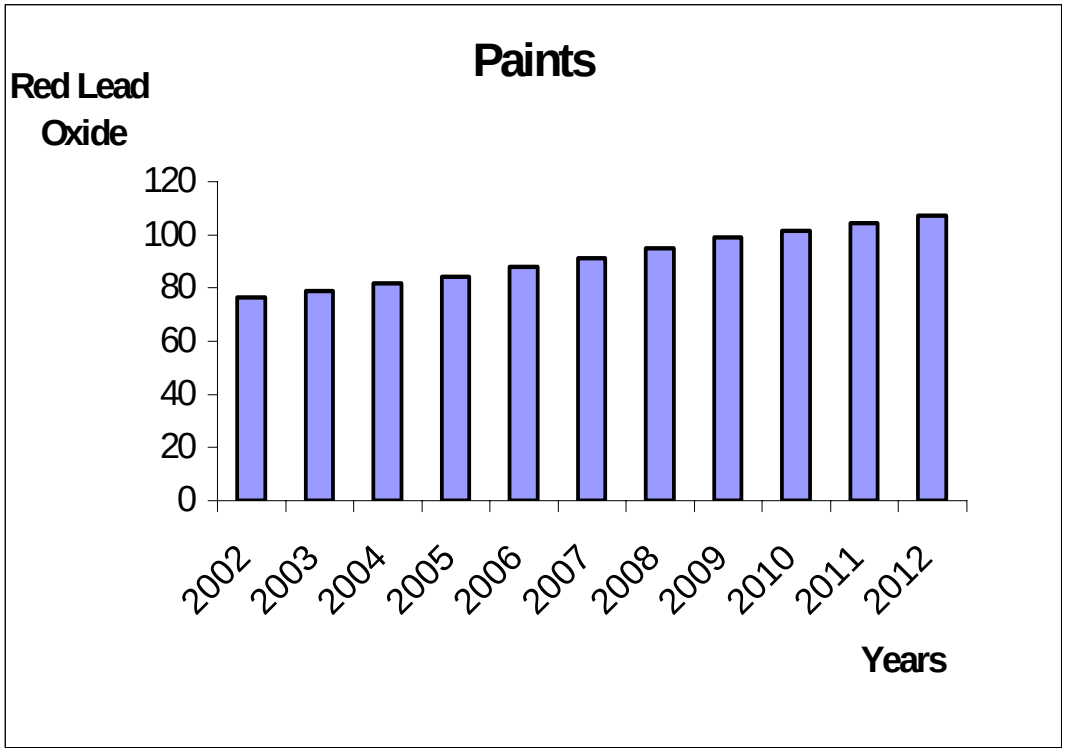


TABLE 4.13

Projected Demand for Lead Ingots

Used by Grey Lead Oxide

Years	Grey Lead Oxide
2002	4,224
2003	3,964
2004	3,721
2005	3,492
2006	3,244
2007	3,014
2008	2,800
2009	2,601
2010	2,495
2011	2,394
2012	2,297

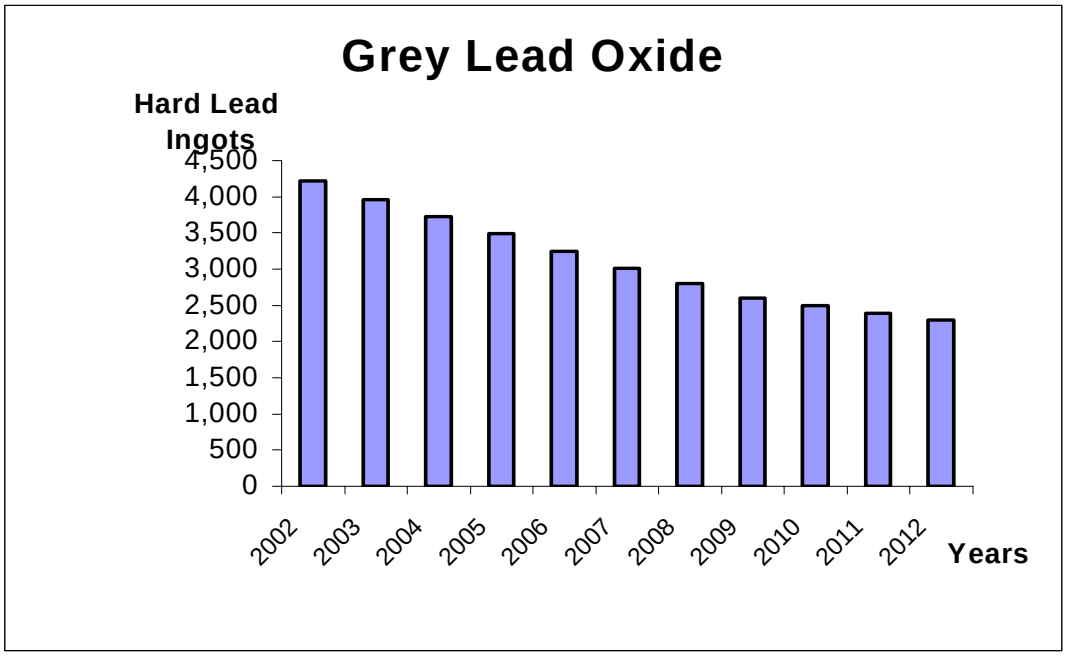


TABLE 4.14

Projected Demand for Lead Ingots

Used by Red Lead Oxide

Years	Red Lead Oxide
2002	325
2003	305
2004	286
2005	269
2006	249
2007	232
2008	215
2009	200
2010	192
2011	184
2012	177

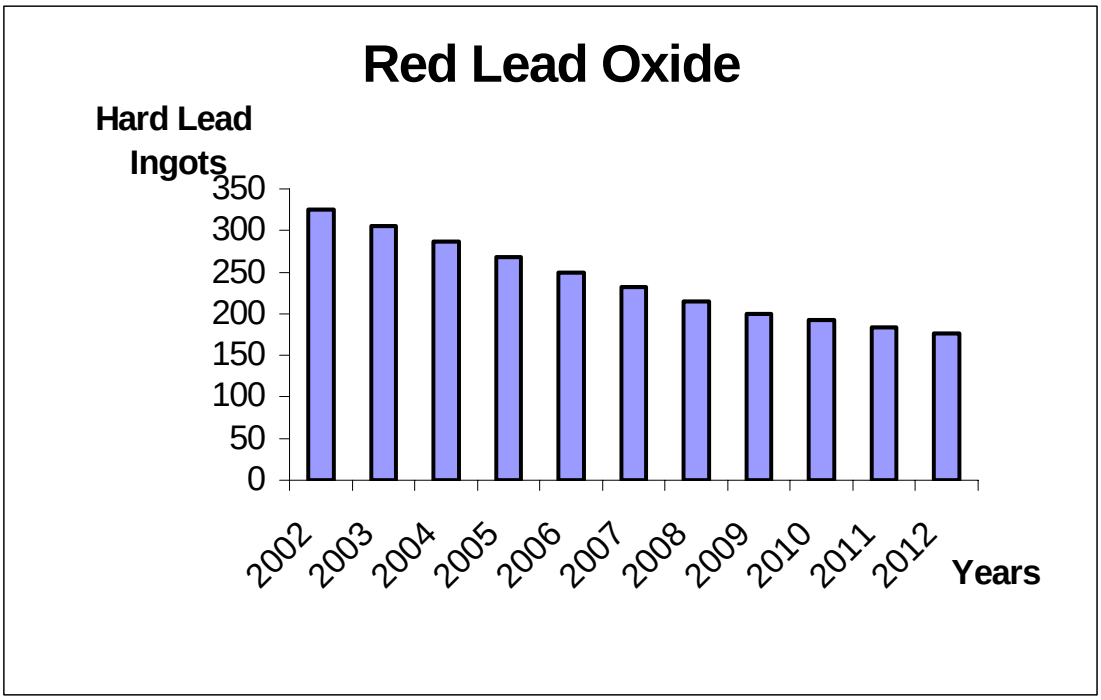


TABLE 4.15

Projected Demand for Lead Ingots

Used by Other Industries including Radiation Sheets

Years	Others
2002	5,179
2003	5,185
2004	5,191
2005	5,197
2006	5,261
2007	5,326
2008	5,392
2009	5,459
2010	5,519
2011	5,580
2012	5,641

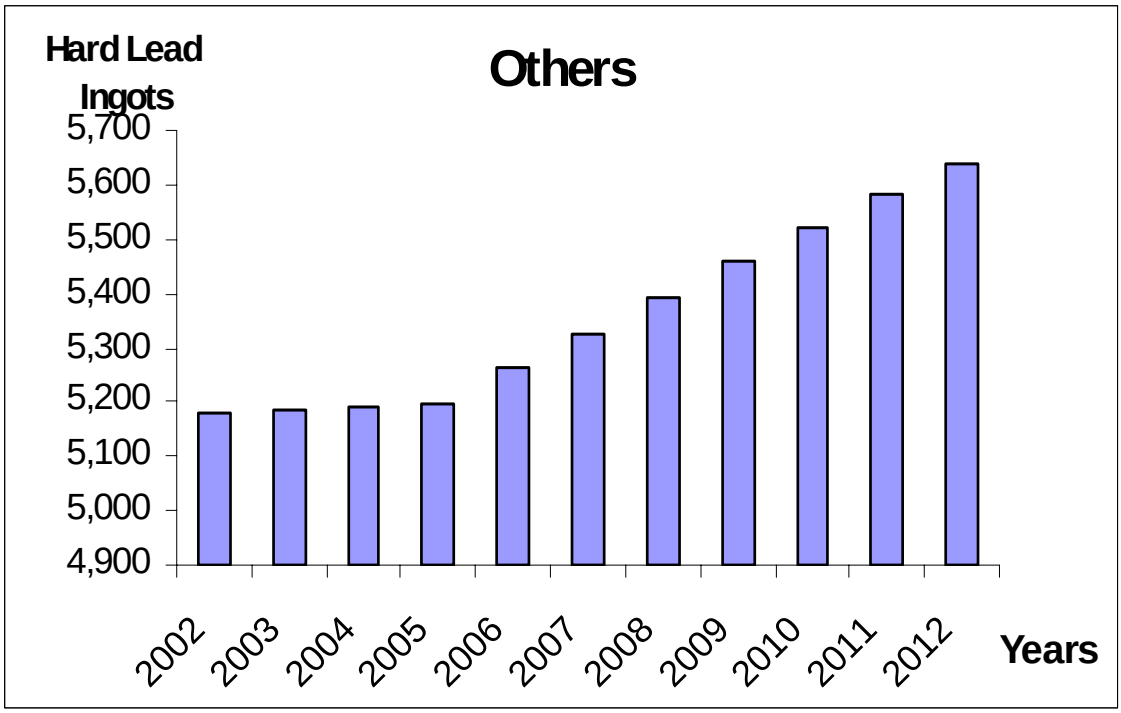


TABLE 4.16

Projected Total Demand for Hard Lead Ingots

2002-2012

Years	Total Hard Lead Ingots
2002	30,591
2003	30,608
2004	30,654
2005	30,728
2006	30,332
2007	30,028
2008	29,814
2009	29,687
2010	29,550
2011	29,479
2012	29,471

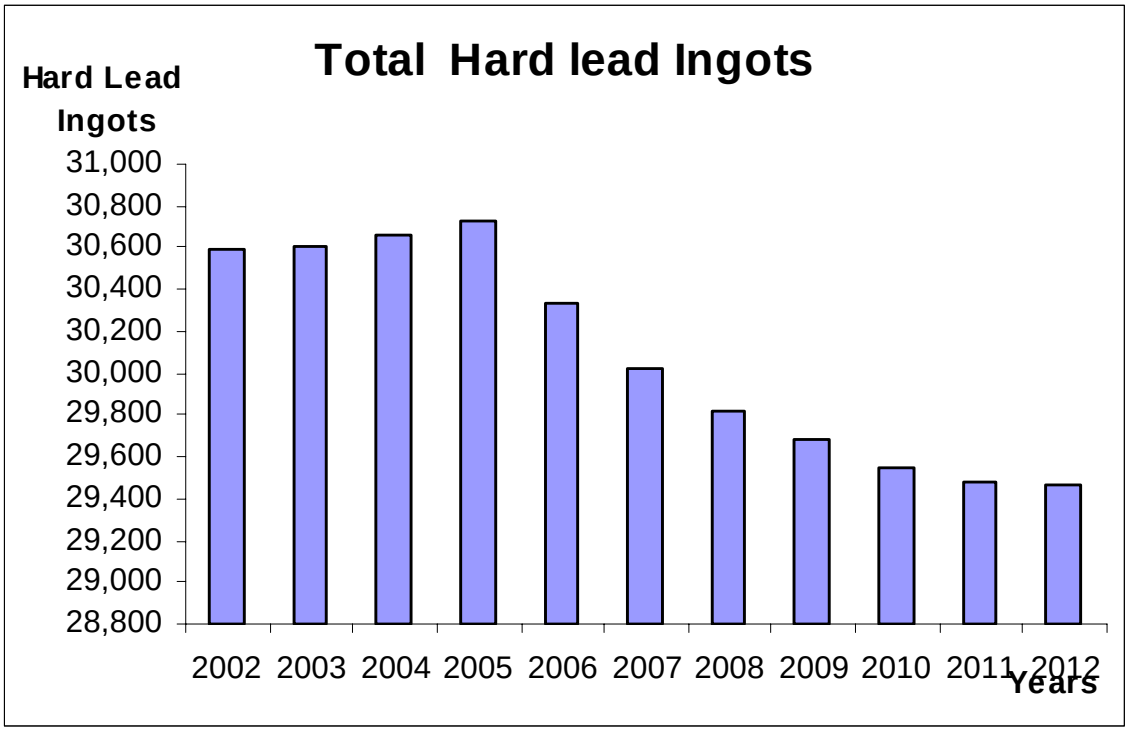
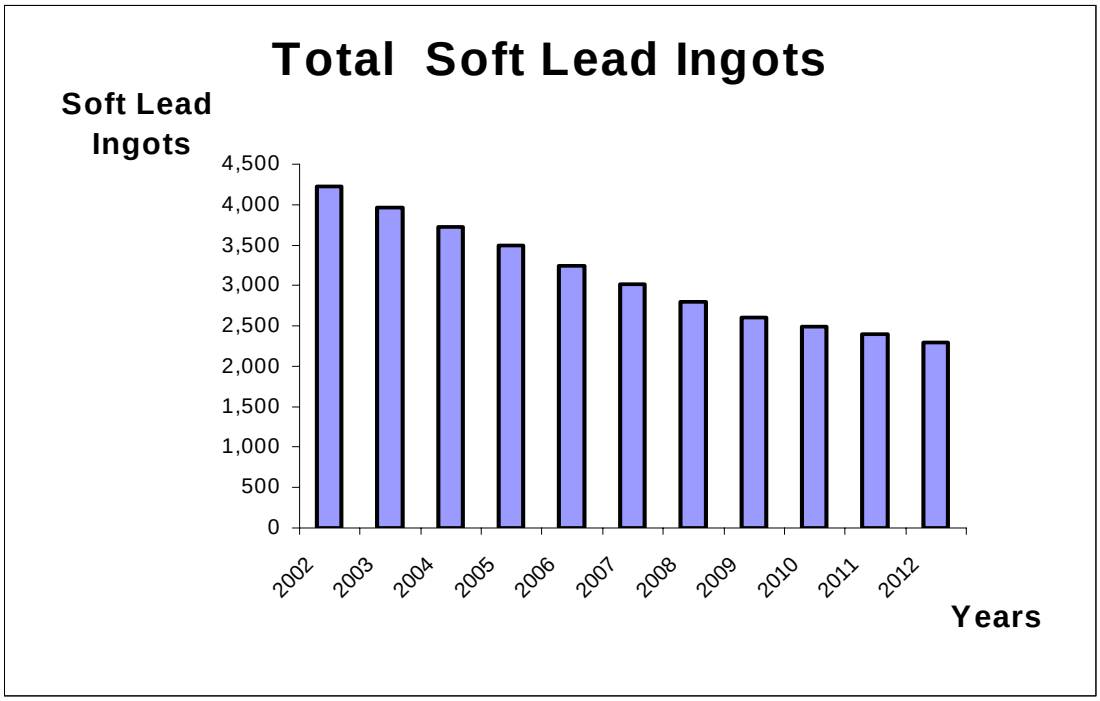


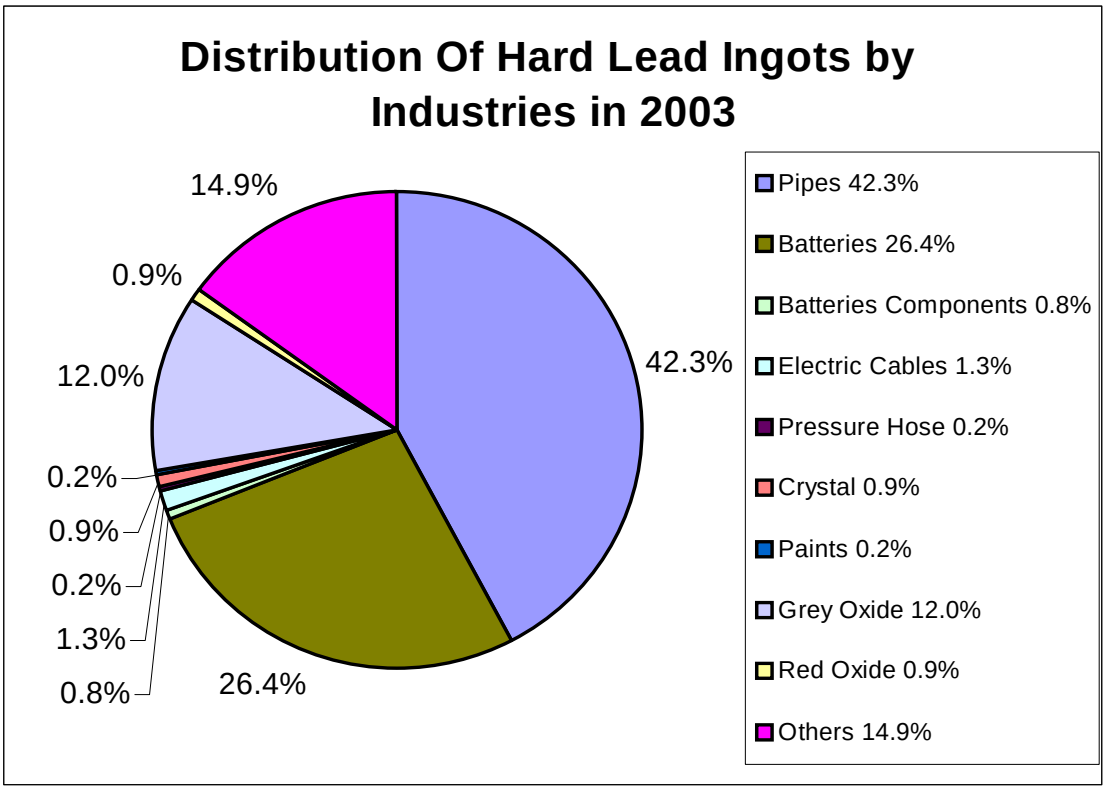
TABLE 4.17

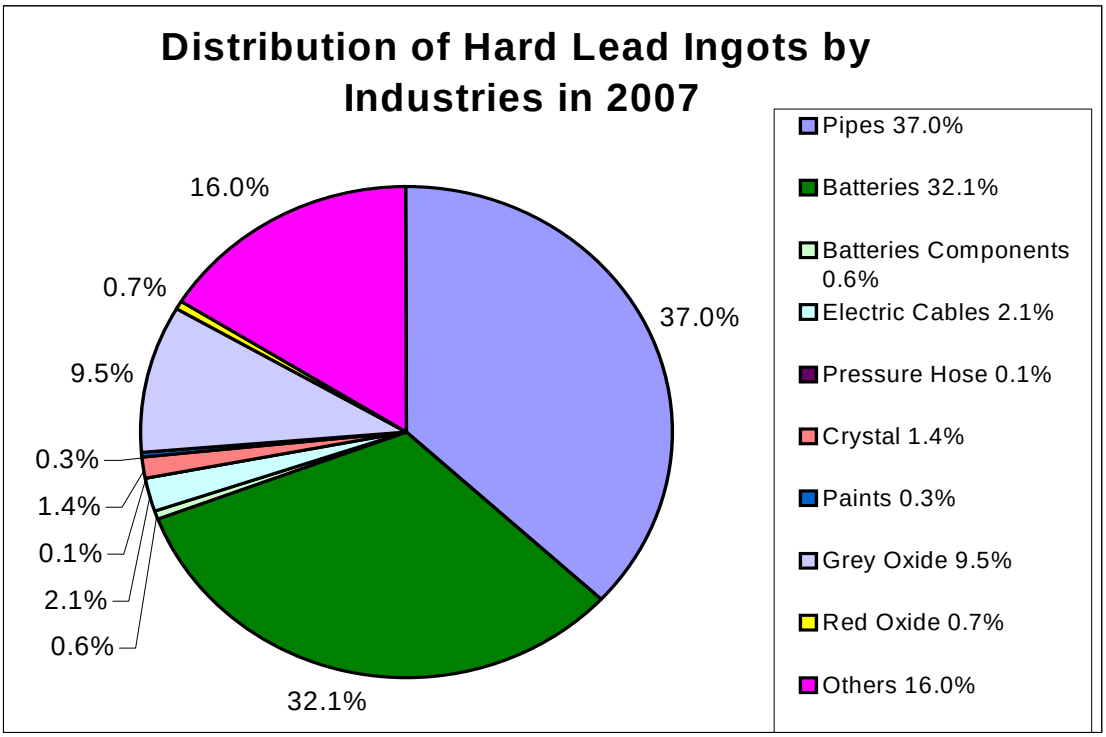
Projected Total Demand for Soft Lead Ingots

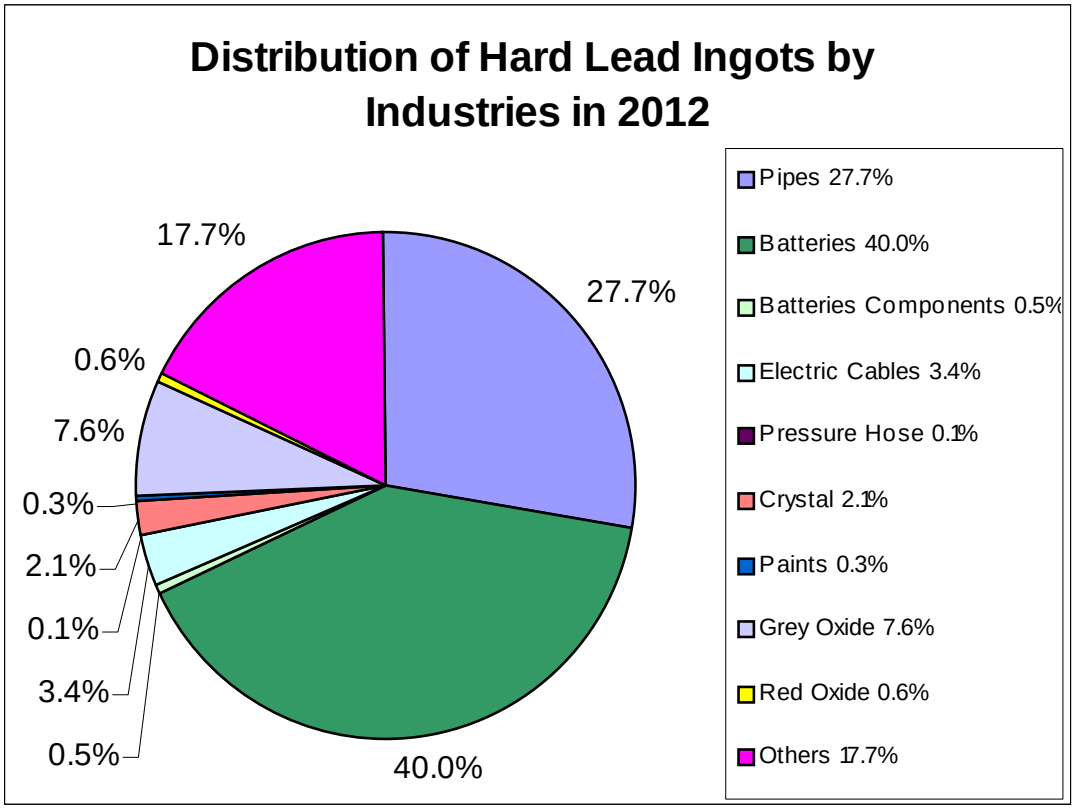
2002-2012

Years	Total Soft Lead Ingots
2002	4,224
2003	3,964
2004	3,721
2005	3,492
2006	3,244
2007	3,014
2008	2,800
2009	2,601
2010	2,495
2011	2,394
2012	2,297




Distribution Of Hard Lead Ingots by Industries in 2003
14.9%
0.9%
12.0%
0.2%
0.9%
0.2%
1.3%
0.8%
26.4%
42.3%
Pipes 42.3%
Batteries 26.4%
Batteries Components 0.8%
Electric Cables 1.3%
Pressure Hose 0.2%
Crystal 0.9%
Paints 0.2%
Grey Oxide 12.0%
Red Oxide 0.9%
Others 14.9%


Distribution of Hard Lead Ingots by Industries in 2007
16.0%
0.7%
9.5%
0.3%
1.4%
0.1%
2.1%
0.6%
32.1%
37.0%
Pipes 37.0%
Batteries 32.1%
Batteries Components 0.6%
Electric Cables 2.1%
Pressure Hose 0.1%
Crystal 1.4%
Paints 0.3%
Grey Oxide 9.5%
Red Oxide 0.7%
Others 16.0%



The results of demand projection reveal that demand for lead is expected to have downward trend over the coming ten years. It is expected to decrease from 34.8 thousand tons in 2002 to 33 thousand tons in 2007 and then to 31.8 thousand tons in 2012, with an annual decline rate of 1 % on the average over the whole period. This can be attributed to the following reasons:

(One) Demand for lead pipes, the major user of lead, with 45% share, is expected to decline significantly, due to the general trend towards substituting lead pipes by PVC pipes. Demand for lead pipes is expected to drop from 15 thousand tons in 2002 to less than 9 thousand tons in 2012, with an annual decline rate of 5%. As a result, the contribution of lead pipes to the total demand for lead will drop from around 45% in 2002 to less than 29% in 2012. This is evident by the following facts:

- The expansion in using PVC pipes as a substitute to lead pipes in sewage systems. Lead pipes were mainly used for inside the dwelling drainage, especially in-wall and under flooring, while iron pipes are used for water supply fixtures. When PVC pipes were first introduced in the Egyptian market, many plumbers and households resisted the application of PVC pipes but with the progress witnessed in this new technology many problems were solved such as :

  - Ducts and enclosures for PVC pipes were taken into account at the design stage in large contracting projects.
  - Problems faced with PVC pipes in sealing junctions and fixtures were solved by the introduction of better silence and ready -made joints suitable for direct use by plumbers.
  - Experience gained in the construction sector by plumbers enabling them to use this new technology.

However, it is expected that PVC pipes will totally displace lead pipes in sewage system in ten years time (excluding sewage of industrial and chemical factories). This trend is reinforced by the fact that a new specification item was introduced in contracting sector in new residential areas and tourism sector, where sewage water is subject to treatment for re-use in irrigation. PVC pipes were specified as the only eligible for sewage system to avoid problem of treatment of water containing lead residual.

(Two) Reduction in the production (smelting) of batteries components, and lead oxide due to the general trend of the batteries companies to manufacture some of lead parts internally in batteries factories, and importing other parts. This is excepted to result in reduction in soft lead ingots from 4.2 thousand tons in 2002 to 2.3 thousand tons in 2012, with an annual decline rate of 6%.

(Three) The drop in local production of pressure hoses, due to the increasing competition of the imported pressure hoses. Narobeen, the major producer of pressure hoses in Egypt is loosing competitiveness and market share.

Still inspite of such reduction in demand for lead in general, demand by quite few users of lead, which do not have substitute for lead such as batteries, electric cables, paints and crystal is expected to increase in the future.

4.3. Supply estimate

4.3.1. Supply variables

An attempt is made to estimate the potential domestic supply of lead ingots in Egypt during the period 2002-2012, on the basis of the factors which would determine the future supply. Our investigation into lead market reveals that three basic factors determine the general trend of future supply of lead ingots as presented below.

(a) Expansion in the smelting production capacities

The major source of capacities expansion is the new smelting plant of Awadallah in Abou – Zaabal Industrial area. The plant is currently in the trial phase and is expected to operate within few months. The technical capacity of the new plant is 24 tons / day for the first phase, which is expected to be doubled after the addition of a second production line in 3 years time. The utilized capacity of the factory is expected to increase gradually as follows:

TABLE 4.18

Expected Capacity Utilization

Of the new Smelting Plant of Awadallah Abou Zaabal

Years	First Line	Second Line
Year 2003	60%	
Year 2004	75%	
Year 2005	90%	
Year 2006	90%	50%
Year 2007	90%	70%
Year 2008 and onwards	90%	90%

(b) Enforcement of environmental regulations

A critical issue that will determine the supply of lead in the future is the future status of smelters working in Arab Abou Saed. Those smelters were located in Arab Abou Saed upon enforcement of the environmental law in March 1998 where they resumed their production activities. However, up to present and despite the harassment they face from environmental intervention, they are still running their business. Based on our investigation, two scenarios are expected.

* Continuation of their production activities in the present location or even through re-allocation in a new distant area.

* Rigid application of environmental laws and taking actual actions against them which would lead to the compliance of a minority of them with the laws and withdrawal of the majority of these small smelters.

(c) Availability of raw materials

The availability of scrap batteries in the future will depend on the following factors:

* Supply of scrap batteries is not expected to represent a constrain on supply and production of lead products given the growth manifested in the Egyptian vehicle fleet.

* Exports and imports of scrap batteries is carried in very limited amount and not expected to prevail in the future with rigid monitoring of the basal convention.

* Up to present very few imports exist of lead ingots due to the fact that importation of ingots would render prices of locally produced lead products very high and not competitive with their imported counterparts. However, exports of ingots might take place in the future by Awadallah.

* It should be also mentioned that the major industry operator "Sayed Awadallah" capitalizes on the lower price and availability of scrap batteries in Libya where he established a smelting facility to provide him with ingots, which confirms that the non-availability of scrap batteries is less likely to constrain his production capabilities.

4.3.2. Projection of potential supply

Based on the general trend of the factors affecting future supply, and taking into consideration the present production of lead ingots, potential supply is projected over the period 2002-2012. Potential supply is the expected domestic production of lead ingots, if there will be enough demand to absorb such supply.

TABLE 4.19
Estimated Potential Domestic Supply
Of Lead Ingots
2002-2012
in Thousand Tons

Year	Awadallah new plant	Awadallah existing plants	Other smelters	Total
2002	___	22	12	34.0
2003	4.3	21	12	37.3
2004	5.4	20	12	37.4
2005	6.5	19	12	37.5
2006	10.1	18	12	40.1
2007	11.5	18	12	41.5
2008	13.0	17	12	42.0
2009	13.0	17	12	42.0
2010	13.0	17	12	42.0
2011	13.0	17	12	42.0
2012	13.0	17	12	42.0

On the assumption that there will be no new entries of small smelters, domestic production of lead inputs could reach 42 thousand tons, provided there will be enough demand to absorb supply.

4.4. Projection of the market gap or surplus

The projected demand is compared with the potential supply to arrive at the expected surplus or deficit in lead market in Egypt over the period 2002-2012.

TABLE 4.20
Projected Surplus or Deficit in Lead Market in Egypt
2002-2012
In Thousand Tons

Year	Potential Supply	Projected Demand	Surplus/(Deficit)
2002	34.0	34.8	(0.8)
2003	37.3	34.6	2.7
2004	37.4	34.4	3.0
2005	37.5	34.2	3.3
2006	40.1	33.5	6.6
2007	41.5	33.0	8.5
2008	42.0	32.6	9.4
2009	42.0	32.3	9.7
2010	42.0	32.1	9.9
2011	42.0	31.9	10.1
2012	42.0	31.8	10.2

Analysis of future potential supply and expected demand indicates that supply is expected to exceed demand, due to the significant expansion of production capacities of lead ingots, i.e., Awadallah new plant. This surplus is potential and rather theoretical surplus, as smelters are expected to adjust domestic supply to match with demand, either through reducing domestic production, or through increasing exports. However, due to such a surplus, real price of lead will drop, but since demand for lead is inelastic, it is not expected that demand

will increase at high rates. Hence, adjustment will be made through reducing domestic supply. In this respect, one of the following scenarios might take place:

- Awadallah as a market leader (Dominant Firm Model) will be able to dominate the market and offer better quality products at competitive price. In this case, small followers are obliged to withdraw from the market due to losses incurred especially if Awadallah's efforts to fully dominate the market is supported by the Ministry of Environment since the new plant complies with the new environmental laws and regulations.
- Small smelters will be able to maintain their prices at low level and hence will be able to attract quite a few users of lead, particularly the small ones. In this respect, they will be able to violate the environmental regulations. Then, Awadallah will be forced to operate at low capacity utilization.
- Awadallah will take the initiative and adopt a new strategy targeting exportation of lead ingots to other countries and thus maintaining domestic supply at a level matching with domestic demand.

We believe that the most likely scenario is a combination of the above three scenarios as follows:

- Quite a few small smelters with out of date technology will get out of the market.
- Awadallah will not be able to utilize all the available capacity. It is expected that he will reach around 70-75% capacity utilization of the new plant.
- Awadallah will be able to export a portion of his production (around 15-20%). The percentage of exportation would depend on the ratio between domestic price and world price of lead.

Hence, one would conclude that the demand is the determining parameter of the market size of lead ingots in Egypt.

5. FINDINGS AND RECOMMENDATIONS

5. FINDINGS AND RECOMMENDATIONS

5.1. Findings

Our investigation into the lead market in Egypt reveals the following:

- Lead is mainly used in eight industries. Basic parameters of lead-user industries is summarized in the following table:

Lead Users	Market Structure	Major Players	Market Share	Quantity used of lead (2001)	Annual rate of Growth
Batteries	Monopolistic Competitive market	1. Chloride 2. El-Nasr for Batteries	40% 29%	7560 (hard lead) 975 (grey oxide)	7.2%
Battery Components	Perfect Competitive market	Large Number of small firms		321 (hard lead)	-3.8%
Lead Pipes	Oligopoly market	1. Awadallah 2. El – Mahy 3. Hassan Mostafa	40% 20% 10%	15375 (hard lead)	-3.8%
Pressure Hose	Oligopoly Market	Narobeen	40%	68 (hard lead)	-13.2%
Crystal	Monopolistic Market	Crystal Asfour	100%	244 (Red oxide)	8.8%
Electric Cables	Duopoly Model	1. El-Sweedy Cable Co. 2. Arab Cable Co.	70% 28%	390 (hard lead)	22.2%
Lead Oxide	Dominant Firm Model	Awadallah	60%	4500 (soft lead)	-9.3% -12.7%
Paints	Monopolistic Competitive market	1. Pachin 2. Sipes	Both account for 35%	74 (red oxide)	4.1%

- The market of smelted lead in Egypt follows the dominant firm model, where one major industry operator; Sayed Awadallah controls the market with a market share of approximately 65% of secondary smelted lead. Domination of the market was reinforced upon the withdrawal of General Metal Co. that used to compete with Awadallah in terms of quality (not quantity). The public Sector company could not conform with new environmental laws and suffered from highly depreciated lines of production, which led to complete termination of smelting activities. Awadallah, as a dominant firm, is a market leader and price maker, while other firms are price takers. The second player in the market is Hassan Mostafa with 15% market share.

- Price of lead ingots has shown an upward trend over the last five years, with an annual increase rate ranging from 7% -10% over that period. Supply of lead ingots was lagging behind demand.

- The scrap battery market is an oligopoly market where few collectors dominate the scrap battery market. The major market supplier accounts for 50% of the total collected scrap batteries. He is the dominant firm and market leader, controlling the market prices. The rest of the market is divided between 4-5 suppliers each with a share ranging from 10%-15%. However, despite that imports of scrap batteries is forbidden by law, still the major supplier has access to imported batteries especially from Libya where batteries are available at a relatively cheaper price than Egypt. It is estimated that annual imports of scrap batteries from Libya are around 10 thousand tons.

- The amount of locally collected scrap batteries decreased significantly from 90 thousand tons in 1997(average price of LE 450-550 per Ton) to around 31 thousand tons in 2001 at an average price of LE 850 per ton. Some smelters claim that in recent years there has been exports of scrap batteries (5-7 thousand tons).

- Investigation into future prospects of demand and supply of lead ingots reveals that the domestic demand for lead ingots is expected to take a downward trend over the coming ten years, with an annual decline rate of 1%. It is expected to decrease from 34.8 thousand tons in 2002 to less than 32 thousand tons in 2012. This is inspired of the fact that demand for some major users of lead such as batteries are expected to increase. The basic reason for the expected drop in demand for lead is the general trend toward substituting lead pipes (the major user of lead) by PVC pipes. Demand for lead pipes is expected to drop from 15 thousand tons in 2002 to less than 9 thousand tons in 2012.

- Due to the expected expansion in production capacities of lead ingots (Awadallah new plant in Abou Zaabal), domestic production of lead ingots is expected to increase significantly. This will put pressure on small smelters who do not comply with environmental regulations. Unless Awadallah will be able to export the excess production, many of the small smelters, who do not comply with environmental regulations, will be forced to withdraw from the market.

5.2. Recommendations

The key finding of the study is that the potential supply is expected to exceed the future demand for lead. This finding strongly supports the enforcement of environmental regulations, in that excess supply is not needed, and violation of the environmental conditions is not justified by the economic benefits.

Based on the findings of the study, the following recommendations are suggested.

- **On the demand side,** efforts should be exerted to control the growth of demand for industrial lead. In this respect, four measures are recommended:

- Encourage producers of batteries to import or manufacture lead components of the batteries internally.

- Undertake serious interventions through quality control procedures in order to increase the useful life of the battery so as to decrease the demand of replacement batteries.

- Enhance and speed the product substitution in pumping process through implementation of adequate training programs or incentives to plumbers and rigid specification to encourage the use of PVC pipes.

- Encourage and promote the lead user industries such as paints, pressure hoses and electric cables to minimize the use of lead, through improving their awareness of the new technology, which would save the use of lead. However, such industries would need some support through offering them subsidies during the transitional stage.

- **On the supply side,** it is a crucial matter to:

  - Enforce environmental regulations and encourage smelters to upgrade their industrial facilities and modify the existing plants. In this respect, a support should be given to Awadallah new plant to encourage him to produce at low cost with high quality, in that he will be able to export a good deal of his production of lead ingots.

  - Provide subsidies for environmental upgrading, in the form of soft loans, which would help a larger number of workshops to achieve the environmental transition.

According to the conducted interviews with smelters, they welcomed the transfer option, given the availability of infrastructure.

- **As far as scrap batteries market is concerned,** two major issues should be considered:

  - It is advised to ensure separation and sound disposal of plastic case. Battery dismantling and component separation should be done mechanically in a securely enclosed chamber in order to protect worker's health and drastically reduce environmental pollution.

  - Restrict importation and exportation of scrap batteries, taking into consideration both the environmental and the economic effect of importing and exporting such materials which are considered as hazard wastes by the Environment Affairs Agency. In this context, a close coordination should take place between the different relevant government entities (Environment Affairs, customs and Import and Exports Authorities) to enforce such prohibition. This implies enforcement of restriction through updating the legal and regulatory framework, to comply with the Basel agreement already signed by Egypt, through introducing a clear and concise general law emphasizing such restrictions.

The findings that emerged from the demand and supply study for lead imply that both the economic and the environmental recommendations complement each other and contribute significantly to the development of the lead market and to the restriction of its negative effect on the environment in the future. The economic recommendations include basically control and monitoring of the major industries using lead, up

grading the collection and smelting facilities, and restriction of importation and exportation of scrap batteries. The environmental recommendations include enforcement of environmental regulation in the smelting activity, restriction of importation and exportation of scrap batteries and ensuring upgrading of separation and dismantling of scrap batteries.

The consistency between the economic and environmental recommendations is reinforced by the fact that:

* The smelting activity is not labor intensive. Hence, the control in this industry will not have serious negative effect on employment.

* Supply of lead ingots is expected to exceed demand over the coming ten years, in that the excess supply should be restricted to comply with environmental regulations.

The bottom line is that the study ensures that the increase in the efficiency and the productivity of the lead industry is highly consistent with the application and enforcement of environmental measures and regulations. This finding supports the fact that enforcement of environmental regulation would have positive effect on the economy and would result in additional economic benefits in the long-run. However there could be some negative effects, in the short-run, such as additional cost, and unemployment.
This can be overcome through financial and social support for this industry during the interval or transitional period.

APPENDIX 1

APPENDIX 1

REFERENCES

Main reports reviewed are as follows:

- Lead Smelting in Egypt " Baseline study" Private lead smelters in Greater Cairo, CAIP, February 96.

- Environmental Health Project " Activity report no.31" Institutional assessment for lead exposure abatement and reduction in Cairo, CAIP, December 1996.

- Assessment of Financial Feasibility Awadallah smelter relocation plan, lead smelter action plan, Lead Abatement, CAIP, December 1998.

- Technical and Economic study for Small and Medium Lead Smelters, Lead Abatement, CAIP, January 1999.

- Lead Smelters and Lead Foundaries in Egypt, Lead Pollution Abatement, CAIP, June 1999.

- Economic study and Funding Means for Development and Relocation of Smelters, CAIP, October 1999 (in Arabic).

- Data issued by Ministry of Industry, Ministry of Planning and information centers on lead using industries, 2000 and 2001.

- Statistical information from CAPMAS, 1996 to 2001.

- Interviews with major smelters and major lead using companies.

APPENDIX 2

Questionnaire
For users

1- For how long have you been involved in this business?
(state by years)

2- What are the types of products that you produce and annual production volume for the last five years?

Quantities in tons or units

Year	Product A:....	Product B:.....	Product C:....	**Product D:....**
1997				
1998				
1999				
2000				
2001				

3-What is the type and quantity of lead used in your production? What is the input-output ratio for 1 kg of lead used in the production?

Type of product	Type of lead used	**Quantity of lead used**
- Product A:.....		
- Product B:.....		
- Product C:.....		
-Product D:.....		

4-From where is the lead brought for the different types of products?

Type of product	Source of lead
1: ----------	
2:----------	
3:----------	
4:----------	

5-At what prices is lead purchased by type?

Type of product	Price of lead (L.E / kg)
1: ----------	
2:----------	
3:----------	
4:----------	

6-What is the percentage of lead cost to the total cost of the product?

Type of lead / Product	Product A:.....	Product B:.....	Product C:.....	Product D:.....
1:----------				
2:----------				
3:----------				
4:----------				

7- Do you think the price of the product will be affected by the change of price of lead?

Yes **No**

If yes by what degree?

- **High rate.** - **Low rate.**
- **Same rate.** - **No impact.**

8- What is the degree by which the price of lead affects the demand on lead products?

-In case prices of lead increase by 10%.

-In case prices of lead increase by 25%.

-In case prices of lead increase by 50%.

9- Is there any substitution to lead to be used in lead products?

Yes **No**

If yes, what are the substitutes to lead?

And what is their cost as compared to lead?

Higher **Lower** **same**

What are their advantages & disadvantages?

Do you expect such substitution in the future?

Yes **No**

If yes , why?

10-What are the sales prices of your products?

Type of product	Sales prices (L.E / kg)
- Product A:.....	
- Product B:.....	
- Product C:.....	
-Product D:.....	

11-What do you think is the price trend for your products ?

	Past (Last five years)	Future (coming ten years)
- No change.		
- Downward trend.		
- Upward trend with decreasing returns.		
- Upward trend with increasing returns.		

12-What is the useful life of the different products produced?

Type of product	Useful life in years
- Product A:.....	
- Product B:.....	
- Product C:.....	
-Product D:.....	

Thank you for your cooperation

Name of factory: ----------.
Address: ----------.
Telephone: ----------.
Contact person: ----------.
Name of interviewer: ----------.

Questionnaire For Smelters

1-What are the products that you produce & their quantities in the last five years?

	Quantities (Tons or units)				
Year	Soft lead ingots	Hard lead ingots	Lead oxides	Lead pipes	**Others specify**
1997					
1998					
1999					
2000					
2001					

2-For how long have you been involved in this business? (state by years).

3-Who are your target customers by product? Classify target customers by nature of business , sectors & locations.

Type of product	Target Customer		
	Type of business	Location	**sector**
- Soft lead ingots.			
- Hard lead ingots.			
- Lead oxides.			
- Lead pipes.			
- Others			

4-What is the sales price for your products?

Type of product	Sales price in L.E
- Soft lead ingots.	
- Hard lead ingots.	
- Lead oxides.	
- Lead pipes.	
- Others.	

5- Do you expect sales prices to change in the coming period?

Yes **No**

If yes, what do you expect?

Large increase **Small increase** **Decrease** **Same**

Why? Specify Reasons.

6- What is the degree by which sales prices impact quantities sold?

-In case sales prices increased by 10%,

-In case sales prices increased by 25%,

-In case sales prices increased by 50%,

7- Describe your production process?

Production process					
Battery breaking	Extraction of lead	Charging capacity in tons	Addition in charging fluxing agents	**Fuel used in burning**	**Refining furnaces**
• Manual • Automated • Semi automated	• Local rotary furnace. • Imported rotary furnace • Other		• Yes • No	• **Mazot** • **Solar** • **Oil**	• **Yes** • **No**

Production process					
Emission Control Equipment	Solid wastes	No. of employees	Space for smelter building (in m2)	**Space for furnaces & refining (in m2)**	**Space for air pollution control (in m2)**
• Wet scrubbers • Bag house • No equipment • others	• Plastic of batteries. • Slag. • Others				

8-Do you need bigger space?

9-Do you face any harassment from environment people?

Yes **No**

If yes, are you willing to relocate to other remote places to evade the harassment?

10-Can you specify major smelters in the market by names, quantities Sold & location?

Smelters	Quantities Sold in tons or units	Location

11- how influential is primary lead or imported lead ingots as a threat on the demand for your products?

Large impact **small impact** **No impact**

Why? Specify reasons.

12- Is there any substitution to lead in the products that you produce?

Yes No

If yes, what are these products?

What is the impact of such substitution on the demand for your products?

Large impact **Small impact** **No impact**

Why? State the reasons.

Do you expect such substitution in the coming period?

Yes **No**

13-What are the sources of raw materials by the type ?

Type of raw materials	**Source of raw materials**
- Scrap batteries. - Lead scrap materials. - Cable sheating solder. - Others.	

14-What are the prices of the type of raw materials by type and location?

Type of products	**Price (L.E / Kg)**
- Scrap batteries. - Lead scrap materials. - Cable sheating solder. - Others.	

15- Do you expect any change in the price of raw materials in the coming period?

Yes **No**

If yes, you expect?

Large increase **Small increase** **Decrease** **Same**

Why? Specify Reasons.

16-What is the degree by which price of raw materials impact quantities sold?

-In case price of raw materials increased by 10%

-In case price of raw materials increased by 25%

-In case price of raw materials increased by 50%

17-What is the percentage of lead recovered from a dry battery (In kg or %)?

Weight of battery	Amount of lead recovered
12 kg	
15 kg	
Others	

18-What is the percentage of lead wasted during production?

19-What is the base stock required for different materials by type?

Type of raw material	Base stock
- Scrap batteries.	
- Lead scrap materials.	
- Cable sheating solder.	
- Others	

The base stock can be stated by period or in terms of quantity by tons.

Thank you for your cooperation

Name of smelter: ----------.
Area: ----------.
Address: ----------.
Telephone: ----------.
Contact person: ----------.
Name of interviewer: ----------.

Questionnaire For scrap batteries collectors

1- For how long have you been involved in this business?
(State in years)

2- Are you knowledgeable about the different sources of scrap batteries in Egypt by location?

3- What are your sources of scrap batteries?

4- What are the prices of scrap batteries?

5-What is the price trend for scrap batteries?

	Past (Last five years)	**Future (Coming ten years)**
- No change.		
- Downward trend.		
- Upward trend with decreasing returns.		
- Upward trend with increasing returns.		

6-What is the degree by which the prices of scrap batteries affect the demand for selling the batteries?

In case of a price increase of 10%

In case of a price increase of 25%

In case of a price increase of 50%

7-Do you import scrap batteries?

Yes **No**

If no. Who are the main importers?

If yes, what are the quantities that you import , their prices and their sources?

Quantities In tons or units	Prices	Sources

8- Do you expect a change in the trend for quantities imported of scrap batteries?

Large increase **Small increase** **Decrease** **No change**

Why?

9-What is the annual quantity of scrap batteries purchased by you in the last five years?

Quantity in tons or units

Quantity /Year	1997	1998	1999	2000	2001

10-What was the growth rate for quantities of scrap batteries in the last five years?

11-What is the useful life of batteries in Egypt?

12-What is the prevailing collection system of scrap batteries?

13-Do you know the names of the main collectors? How many & Quantities collected by each? And what is your market share?

Collectors	Quantity in tons or units

Your market share? (To be specified).

14-Do you expect any changes in the collection system in the future?

Yes **No**

Why?

15-Who are the main purchasers of scrap batteries classified by location and sector?

Purchasers	Location	Sector

16-What are the quantities of scrap batteries that you sold in 2001?

17-What is the trend for the change in these quantities?

Past (Last five years) **Future (Coming ten years)**

- No change.
- Downward trend.
- Upward trend with decreasing returns.
- Upward trend with increasing returns.

18-what are the sales prices of scrap batteries in 2001?

19-What is the trend for the change in these prices?

	Past (Last five years)	**Future (Coming ten years)**
- No change.		
- Downward trend.		
- Upward trend with decreasing returns.		
- Upward trend with increasing returns.		

20-What is the degree by which sales price change affect the demand for scrap batteries?

- If sales price increase by 10%

- If sales price increase by 25%

- If sales price increase by 50%

Thank you for your cooperation

Name of factory: ----------.
Address: ----------.
Telephone: ----------.
Contact person: ----------.
Name of interviewer: ----------.

استمارة
الشركات المستخدمة للرصاص

١- منذ متى وشركتكم تزاول هذا النشاط؟
(تذكر المدة بالسنوات)

٢-ماهي المنتجات التي تنتجونها وكمياتها خلال الخمس سنوات السابقة ؟

الكميات (طن أو وحدة)

السنة	المنتج أ:.....	المنتج ب:	المنتج ج:.....	المنتج د:.....
١٩٩٧				
١٩٩٨				
١٩٩٩				
٢٠٠٠				
٢٠٠١				

٣-ما هي معدلات استخدام الرصاص لكل وحدة من المنتج النهائي؟

(يحدد نوع الرصاص)

نوع الرصاص/ المنتج	(أ)...	(ب)	(ج).....	(د).....
١-				
٢-				
٣-				
٤-				

أو تحدد إجمالي الكميات من الرصاص.

٤-من أين تحصلون على الرصاص بأنواعه المختلفة؟

نوع الرصاص	المصدر
١-.....	.....
٢-.....	.....
٣-.....	.....
٤-.....	.....

٥-ما هي أسعار الرصاص الذي تشترونه وفقاً لأنواعه ومصدر الشراء؟

نوع الرصاص	السعر (جنيه / كيلوجرام)
١-	.....
٢-	.....
٣-	.....
٤-	.....
٥-	.....

٦- ما هي قيمة تكلفة الرصاص إلى إجمالي تكلفة المنتج؟ (نسبة مئوية)

نوع الرصاص/نوع المنتج	منتج أ...	منتج ب.....	منتج.ج	منتج.د

٧- هل سعر المنتج يتأثر بسعر الرصاص؟

نعم لا

- إذا كانت الإجابة نعم ، ما هي درجة تأثير سعر الرصاص على سعر المنتج؟

- نسبة أعلى. - نسبة أقل.

- نفس النسبة. - ليس له تأثير.

٨- ما هو تأثير سعر الرصاص على معدلات استخدامه؟

(معدل انخفاض الطلب)

- في حالة ارتفاع السعر بـــ ١٠ %.
- في حالة ارتفاع السعر بـــ ٢٥%.
- في حالة ارتفاع السعر بـــ ٥٠%.

٩- هل توجد بدائل للرصاص كمستخدم في المنتجات التي تنتجونها؟

نعم لا

- إذا كانت الإجابة نعم ما هي ؟

(تذكر)

- و ما هي تكلفتها بالقياس إلى الرصاص؟

-أعـــــــلى.

-أقـــــــل.

-نفس التكلفة.

- ما هي مزاياها أو عيوبها ؟ (تذكر).

- هل تتوقعون أن يكون الاتجاه نحو استخدام بدائل الرصاص في المستقبل؟

نعم لا

لماذا ؟

١٠-ما هي أسعار منتجاتكم ؟ (تذكر)

المنتج	السعر (جنيه / كجم
- منتج أ:.....	
- منتج ب:	
- منتج ج:	
- منتج د:	

١١- ما هو الاتجاه العام لتطور أسعار منتجاتكم؟

الماضي (للخمس سنوات السابقة) المستقبل (العشر سنوات القادمة)

- عدم تغير السعر.
- اتجاه تنازلي.
- اتجاه تصاعدي معدلات منخفضة.
- اتجاه تصاعدي معدلات مرتفعة.

١٢- ما هو العمر الافتراضي لهذه المنتجات؟

المنتج	العمر الافتراضي
- منتج أ:.....	
- منتج ب:	
- منتج ج:	
- منتج د:	

نشكركم على تعاونكم

اسم المصنع: _____.

العنوان: _____.

رقم التليفون: _____.

ضابط الاتصال: _____.

اسم الباحث: _____.

استمارة
مسابك الرصاص

١- ما هي المنتجات التي تنتجونها وكمياتها خلال الخمس سنوات السابقة؟

العام	قوالب رصاص طري	قوالب رصاص صلب	أكسيد رصاص	مواسير رصاص	أخرى (تذكر)
١٩٩٧					
١٩٩٨					
١٩٩٩					
٢٠٠٠					
٢٠٠١					

٢-منذ متى وشركتكم تزاول هذا النشاط ؟
(تذكر المدة بالسنوات)

٣-من هم عملائكم ؟ يحدد لكل نوع رصاص أو منتج ويحدد نوع القطاع ومواقع هؤلاء العملاء

نوع الرصاص أو المنتج	العملاء	
	الموقع	نوع القطاع
- قوالب رصاص طري. - قوالب رصاص صلب. - أكسيد رصاص. - مواسير رصاص. - أخرى.		

٤-ما هي أسعار بيع منتجاتكم وفقاً لانواعها؟

نوع الرصاص أو المنتج	سعر البيع بالجنيه
- قوالب رصاص طري.	
- قوالب رصاص صلب.	
- أكسيد رصاص.	
- مواسير رصاص.	
- أخرى.	

٥- هل تتوقعون أي تغيرات في أسعار البيع في الفترة القادمة ؟

نعم لا

إذا كانت الإجابة نعم ، ماذا تتوقعون ؟

زيادة كبيرة زيادة محدودة انخفاض نفس الأسعار

لماذا ؟ (تذكر الأسباب)

٦-ما هو تأثير سعر البيع على معدلات البيع ؟

(معدل أنماط الطلب)

- في حالة ارتفاع سعر البيع بـــ ١٠% .

- في حالة ارتفاع سعر البيع بـــ ٢٥% .

- في حالة ارتفاع سعر البيع بـــ ٥٠% .

٧-ما نوع خطوط الإنتاج الذي تستخدمونها؟

خط الإنتاج					
كسر بطاريات	صهر الرصاص	طاقة الشحن بالطن	إضافة عوامل مساعدة	الوقود المستعمل	أفران تكر
• **يدوي** • **أتوماتيكي** • **نصف-أوتوماتيكي**	• **فرن دوار محلي** • **فرن دوار مستورد** • **أخرى**		• نعم • لا	• مازوت • سولار • زيت	• نعم • لا

خط الإنتاج					
أجهزة تحكم في الانبعاثات	المخلفات الصلبة	عدد العاملين	المساحة لمبنى المسبك (متر مربع)	المساحة للأفران والتكرير (متر مربع)	المساحة لأجهز التحكم في تلوث الهواء (متر مربع)
• **فلتر برشاشات مائية** • **فلتر الأكياس** • **لا يوجد أجهزة** • **أخرى**	• البلاستيك • الخبث • أخرى			• البلاستيك • الخبث • أخرى	

٨-هل تحتاجون مساحة أكبر لمصنعكم ؟

نعم **لا**

٩- هل تواجهون أي مشكلات بخصوص تنفيذ اشتراطات البيئة؟

نعم **لا**

- إذا كانت الإجابة نعم ، هل أنتم مستعدون لنقل مصنعكم إلى أماكن متطرفة؟

نعم **لا**

١٠-ما هي مسابك الرصاص الرئيسية الموجودة في السوق المصري؟

يحدد أسمائهم ، كميات بيعهم ومواقعهم

المسابك	كميات البيع (بالطن أو الوحدة)	الموقع

١١- ما هو تأثير الرصاص الأولي أو المسابك المستوردة على هيكل الطلب لمنتجاتكم؟

تأثير كبير تأثير ضعيف لا تأثير

لماذا ؟ (تذكر الأسباب)

١٢- هل توجد بدائل للرصاص في المنتجات التي تصنعونها:

نعم لا

إذا كانت الإجابة نعم ، فما هي ؟ (تذكر)

ما هو تأثيرها على نمط الطلب على منتجاتكم ؟

تأثير كبير تأثير ضعيف لا تأثير

لماذا ؟ (تذكر الأسباب)

هل تتوقعون الاتجاه نحو استخدام بدائل الرصاص في المستقبل ؟

نعم لا

١٣-من أين تحصلون على المواد الأولية وفقاً لأنواعها المختلفة ؟

نوع المواد الأولية	مصدر الشراء
- بطاريات مستهلكة. - خردة رصاص. - أغطية كابلات الكهرباء. - أخرى.	

١٤-ما هي أسعار المواد الأولية التي تشترونها وفقا لأنواعها ومصادر الشراء ؟

نوع المواد الأولية	السعر (جنيه / كيلوجرام)
- بطاريات مستهلكة. - خردة رصاص. - أغطية كابلات الكهرباء. - أخرى.	

١٥-هل تتوقعون أي تغيرات في أسعار المواد الأولية في الفترة القادمة ؟

نعم لا

إذا كانت الإجابة نعم ، ماذا تتوقعون ؟

زيادة كبيرة زيادة محدودة انخفاض نفس الأسعار

لماذا ؟ (تذكر الأسباب)

١٦-ما هو تأثير سعر المواد الأولية على معدلات البيع ؟

- في حالة ارتفاع سعر المواد الاولية بـــ ١٠% .
-
- في حالة ارتفاع سعر المواد الأولية بـــ ٢٥% .
- في حالة ارتفاع سعر المواد الأولية بـــ ٥٠% .

١٧-ما هي نسبة الاستفادة من الرصاص الموجود في البطاريات المستهلكة ؟
(يحدد بالكيلوجرام أو بالنسبة)

وزن البطاريات	نسبة الرصاص المستفاد منها
١٢ كجم	
١٥ كجم	
أخرى	

١٨-ما هي نسبة الرصاص المهدرة في الصناعة ؟

١٩-ما هي فترة التخزين المثلى للمواد الأولية وفقاً لأنواعها المختلفة ؟

نوع المواد الأولية	فترة التخزين
- بطاريات مستهلكة. - خردة رصاص. - أغطية كابلات الكهرباء. - أخرى.	

إذا لم يمكن تحديد فترة التخزين ، يمكن تحديد الكمية بالطن.

نشكركم على تعاونكم

اســـم المسبك: _____.

المســـــاحة: _____.

العنـــــوان: _____.

رقم التـــليفون: _____.

ضابط الاتصال: _____.

اسم البـــاحث: _____.

استمارة
جامعي البطاريات المستهلكة

١- منذ متى وشركتكم تزاول هذا النشاط؟
(تذكر المدة بالسنوات)

٢-ما هي المصادر المختلفة للحصول على البطاريات المستهلكة في مصر ؟

٣-من أين تحصلون انتم على البطاريات المستهلكة ؟

٤-ما هو أسعار البطاريات المستهلكة ؟

٥- **ما هو الاتجاه العام لتطور أسعار البطاريات المستهلكة ؟**

المستقبل	الماضي
(العشر سنوات القادمة)	(الخمس سنوات السابقة)

- عدم تغير السعر.
- اتجاه تنازلي.
- اتجاه تصاعدي بمعدلات منخفضة.
- اتجاه تصاعدي بمعدلات مرتفعة.

٦-**ما هو تأثير سعر** شراء البطاريات المستهلكة على الطلب على بيع البطاريات ؟

- في حالة ارتفاع سعر بـــ ١٠% .

- في حالة ارتفاع سعر البيع بـــ ٢٥% .

- في حالة ارتفاع سعر البيع بـــ ٥٠% .

٧-هل تستوردون بطاريات مستهلكة؟

نعم **لا**

إذا كانت الإجابة لا ، فمن هم المستوردين الرئيسيين ؟

إذا كانت الإجابة نعم ، فما هي الكميات التي تستوردونها وأسعارها ومصادرها؟

الكميات (بالطن أو الوحدة)	الأسعار	المصادر

٨-هل تتوقعون تغير في الاتجاه العام لكميات استيراد البطاريات المستهلكة؟

زيادة كبيرة زيادة محدودة انخفاض نفس المعدل

لماذا في رأيكم ؟

٩-ما هي كميات البطاريات المستهلكة التي قمتم بشرائها خلال الخمس سنوات السابقة؟

(الكمية بالطن أو الوحدة)

السنة/الكمية	١٩٩٧	١٩٩٨	١٩٩٩	٢٠٠٠	٢٠٠١

١٠- ما هو معدل نمو كميات البطاريات المستهلكة في الخمس سنوات السابقة؟

١١-ما هو العمر الافتراضي للبطاريات في مصر ؟

١٢- ما هو نظام تجميع البطاريات المستهلكة السائد في مصر حاليا ؟

١٣- ما هي الكميات التي تجمع من جامعي البطاريات الرئيسيين في مصر ؟
وما هو نصيبكم في السوق من البطاريات المستهلكة سنويا ؟

المجمع	الكمية بالطن أو الوحدة

نصيبكم من السوق ؟ (يحدد)

١٤-هل تتوقعون أي تغير في النظام الحالي لتجميع البطاريات المستهلكة ؟

نعم لا

لماذا في رأيكم ؟

١٥-من هم المشترين الرئيسيين للبطاريات المستهلكة مقسمين وفقاً لمواقعهم ونوع نشاطهم ؟

المشترين	مواقعهم	نوع نشاطهم

١٦-ما هي الكميات التي يعتمونها من البطاريات المستهلكة في ٢٠٠١ ؟

١٧-ما هو الاتجاه العام لتطور هذه الكميات ؟

الماضي (للخمس سنوات السابقة) — المستقبل (العشر سنوات القادمة)

- عدم تغير السعر.
- اتجاه تنازلي.
- اتجاه تصاعدي بمعدلات منخفضة.
- اتجاه تصاعدي بمعدلات مرتفعة.

١٨-ما هي أسعار بيع البطاريات المستهلكة في ٢٠٠١ ؟

١٩-ما هو الاتجاه العام لتطور أسعار بيع البطاريات المستهلكة ؟

الماضي	المستقبل
(للخمس سنوات السابقة)	(العشر سنوات القادمة)

- عدم تغير السعر.
- اتجاه تنازلي.
- اتجاه تصاعدي بمعدلات منخفضة.
- اتجاه تصاعدي بمعدلات مرتفعة.

٢٠-ما هو تأثير تغير سعر البيع على قدرتكم على الطلب على البطاريات المستهلكة ؟

- في حالة ارتفاع سعر البيع بـــ ١٠% .

- في حالة ارتفاع سعر البيع بـــ ٢٥% .

- في حالة ارتفاع سعر البيع بـــ ٥٠% .

نشكركم على تعاونكم

اســـم المصنع: _____.

العنـــــــوان: _____.

رقم التـــليفون: _____.

ضابط الاتصال: _____.

اسم البـــاحث: _____.

APPENDIX 3

APPENDIX 3

1. Questionnaire for Lead Users[1]

The questionnaire for lead users includes 14 questions concerning the following.

- Duration in business.
- General trend of annual production over the last five years.
- Annual quantity consumed of raw lead.
- Input-output ratios.
- Source of lead inputs.
- Average price of raw lead.
- Percentage of cost of raw lead to final product value.
- The price effect of lead.
- Availability of lead substitutes.
- Prices of final lead products.
- Price trend during the last five years.
- Expected price trends for the next two years.
- Expected life of the product.

The following are the results of the market survey:

[1] Lead pipes are considered in lead smelters questionnaire as almost all lead pipes producers are the lead smelters.

Questionnaire

For users

1. **Duration in business in years**

Type of Product	Less than 10 Years	10-20 Years	More than 20 Years	Total
Batteries				
- Components	19.7%	30.3%	50%	100%
- Final product	—	—	100%	100%
Electric Cables	—	—	100%	100%
Crystal	—	—	100%	100%
Pressure Hoses	—	—	100%	100%
Lead Oxides	33.3%	—	66.7%	100%
Pipes	—	22.2%	77.8%	100%
Paints	100%	—	—	100%

Comment: *The majority of lead users are well established* ***with long*** *duration in business (more than ten years).*

2. **Production Volume for Last Five Years By Type of Product (In Tons)**

Type of Product	Unit	1997	1998	1999	2000	2001	Annual Growth Rate
Batteries							
- Input	Ton	227.4	192.8	178.9	159.3	164.7	(7.8%)
- Blocks	Units	206	229	205.5	98.8	195.2	(1.4%)
-Final product	(000) Units	322	334	377	414	402	5.7%
Electric Cables	Ton	30000	25700	24560	24190	20200	(9.4%)
Crystal	Ton	50	55	67.5	67.5	70	8.8%
Pressure Hoses	Ton	120	84	48	60	60	(16%)
Lead Oxides	Ton	7580	5083	3773	3862	4554	(12%)

Pipes	Ton	17320	13480	8460	11560	13600	(6%)
Paints	Ton	—	—	—	5	25	—

- *Comment: Production of lead products has shown declining trend during the period 1997-2001. This can be attributed to the enforcement of environmental regulations on one hand and due to lead substitution on the other hand (PVC pipes), during the last five years. This is reinforced by the slow down in the economy.*

3. Annual Consumption of Raw Lead According to type used and Product

Type of Production	Hard Lead Ingots	Soft Lead Ingots	Red Lead Oxide	Grey Lead Oxide	Total
Batteries					
- Components	180.6	37	—	—	217.6
- Final product	550	3629	—	30	4209
Electric Cables	96.0	—	—	—	96
Crystal	—	—	20.25	—	20.25
Pressure Hoses	24	—	—	—	24
Lead Oxides	—	62	—	—	62
Pipes	—		—	—	—
Paints	—	23	—	—	23
Total	**850.06**	**3751**	**20.25**	**30**	**4651.31**

Comment: Hard lead ingots is the major lead used by the lead using industries in Egypt (around 75% of the total quantities used of lead), followed by soft lead ingots. This is due to the fact that the major industries consuming hard lead ingots are the lead pipe industry and the battery industry (around 70% of total demand for lead). Both red lead oxide and Grey lead oxide are used in limited quantities.

4. Input – Output Ratio (Percentage)

Type of Production	Unit	Hard Lead Ingots	Soft Lead Ingots	Red Lead Oxide	Grey Lead Oxide
Batteries					
- Components	Ton	1.07	—	—	—
- Final product	(000) Units	10.08	—	—	1.3
Electric Cables	Ton	0.005	—	—	—
Crystal	Ton		—	0.29	
Pressure Hoses	Ton	0.4	—	—	—
Red Lead Oxides	Ton	1.08	—	—	—
Grey Lead Oxides	Ton	—	1.125	—	—
Pipes	Ton	1.025	—	—	—
Radiation Sheets	Ton	1.025	—	—	—
Paints	Ton	—	—	0.065	—

Comment: *Input –output ratios reflect the quantity of lead required (in tons) to produce one unit of output. It is obvious that batteries production require the largest amount of lead.*

5. Source of Lead Inputs by type used

Type of lead Input	Lead Smelters	Imported	Others
Hard Lead Ingots	100%	—	—
Soft Lead Ingots	100%	—	—
Red Lead Oxide	100%	—	—
Grey Lead Oxide	100%	—	—

Comment: *Smelters are the only source of lead.* ***Imports are*** *insignificant.*

6. Average Price of Raw Lead by Type

Type of lead Input	Price LE / KG
Hard Lead Ingots	2.36
Soft Lead Ingots	2.57
Red Lead Oxide	6.00
Grey Lead Oxide	3.00

Comment: *Red lead oxide is the most expensive type of lead.* ***Hard lead*** *ingots are slightly cheaper than soft lead ingots.*

7. Cost of Raw Lead to Final Product

Type of Product	Percentage
Batteries	
- Components	57%
- Final product	15%
Electric Cables	0.5%
Crystal	0%
Pressure Hoses	16%
Lead Oxides	43%
Paints	2.5%

Comment: *Cost of lead represents a high proportion* ***in the cost of the*** *product in the cases of batteries, batteries' components* ***and lead oxides.*** *It is worthnoting that this is also true for lead pipes.*

8. Degree of Response of Final Product to Price

Type of Production	Higher Rate	Same Rate	Lower Rate	Total
Batteries				
- Components	95%	5%	—	100%
- Final product	75%	25%	—	100%
Electric Cables	—	—	100%	100%
Crystal	—	—	—	0%
Pressure Hoses	—	—	100%	100%
Lead Oxides	100%	—	—	100%
Paints	—	—	100%	100%

Comment: Price of lead has a significant effect on demand for the final product in the cases of batteries and lead oxides. This is consistent with the fact that the proportion of lead cost in these products is high.

9. Availability of Lead Alternatives

All sample cases responded that there are no alternatives to lead inputs in their products and it is not expected to find alternatives in the near future. It should be noted that the only industry that is facing substitution is the lead pipes industry.

10. Price of Product According to Type

Type of Production	Units	Price in LE
Batteries		
- Input	Kg	4
- Blocks	Unit	2.5
- Final product	Unit	172.5
Electric Cables	Meter	200
Crystal *	—	—
Pressure Hoses **	Kg	7
Lead Oxides	Kg	3.96
Pipes	Kg	3.19
Paints	Kg	8

- (*) Price of crystal differs greatly according to shape and size
- (**) Price Variations exist according to diameter and quality

11. Price trend of products during Last five Years

Type of Production	No Price Change	Declining Trend	Increasing with Decreasing Returns	Increasing with Increasing returns	Total
Batteries					
- Input	—	3.7%	92.6%	3.7%	100%
- Blocks	—	—	100%	—	100%
- Final product	—	—	75.0%	25.0%	100%
Electric Cables	—	—	100%	—	100%
Crystal	—	—	100%	—	100%
Pressure Hoses	—	—	100%	—	100%
Lead Oxides	—	—	100%	—	100%
Paints	—	—	100%	—	100%

Comment: The general trend of price increase during the last five years was rather low. This is a reflection of the low inflation rate that took place during the last few years.

12. Expected Price Trend for Next Ten Years

Type of Production	No Price Change	Declining Trend	Increasing with Decreasing Returns	Increasing with Increasing returns
Batteries	—	—		
- Input	—	—	60.7%	37%
- Blocks	—	—	100%	—
- Final product	—	—	—	100%
Electric Cables	—	—	100%	—
Crystal	—	—	100%	—
Pressure Hoses	—	—	100%	—
Lead Oxides	—	—	—	100%
Paints	—	—	—	100%

Comment: It is expected that prices of the final products will keep increasing but at low rates.

13. Expected Life Time of Product

Type of Production	AVG Life Time Years
Batteries	
- Input	1.6
- Blocks	2
- Final Product	1.1*
Electric Cables	10
Crystal	Life time
Pressure Hoses	5
Lead Oxides	3.5
Paints	5

- (*) We believe that the life time of batteries is underestimated.

<u>Comment:</u> All products, except crystal and electric cables have a short useful life. This would reflect an active lead market with dynamic movement.

2. Questionnaire for Smelters

Twenty-one smelters represent more than 90% of smelters in Greater Cairo were interviewed. The designed questionnaire included the following questions.

- The quantities of recycled lead
- Target consumers
- Sales price and their trends
- Price effect on recycled lead
- Production process of recycled lead
- Environmental measures and their effect on lead recycling
- Lead substitutes and lead imports
- Sources and prices of raw lead
- Price effect on demand for raw lead
- Lead recovered from dry batteries

Questionnaire For Smelters

1-Products produced by smelters & their quantities in the last five years

Quantities (Tons)

Year	Soft lead Ingots	Hard lead ingots	Lead oxides	Lead pipes	Lead Sheets
1997	24900	27580	7500	17320	2000
1998	19250	28980	5000	13480	1000
1999	10850	37920	3700	8460	1500
2000	2700	18910	3800	11560	2800
2001	3800	17810	4500	13150	3200

Comment: *Recycled lead has shown declining rates over the last five years*

2-Duration of being involved in this business

Duration in business is within 15 years.

3-Target customers by product

Type of product	Target Customer
- Soft lead ingots	Companies manufacturing batteries & oxides Other smelters
- Hard lead ingots	Pipe producing companies Battery producing companies Crystal producing companies Other smelters
- Lead oxides	Factories
- Lead pipes	Sanitary-ware companies
- Other Lead Products (Sheets)	Engineering/contracting sector for use in hospitals & x-ray sections

Comment: Major users of recycled lead are battery companies, sanitary-ware companies, paints companies and engineering companies.

4-Sales price for products

Type of product	Sales price in L.E / Ton
- Soft lead ingots	2793
- Hard lead ingots	2564
- Grey Lead oxides	3160
- Lead pipes	3194

Comment: Lead oxides are the most expensive lead, while hard lead ingots are the cheapest.

5-Expectations of sales prices to change in the coming period

Yes	No
85.7%	14.3%

If yes, degree of expectations

Large increase	Small increase	Decrease	Same
55.6%	44.4%		

Comment : The majority of smelters believe that price of recycled lead will increase in the future, of which more than 50% expect *that the price will increase at high rates.*

Reasons

- Number of smelters is decreasing due to restrictions of environmental laws.
- Demand is expected to increase on products using lead especially pipes.

- Smelters are being moved to remote areas, hence an increase in cost of transportation is expected to take place.

6-Degree by which sales prices impact quantities sold

-In case sales prices increased by 10%, Effect	No
-In case sales prices increased by 25%, Effect	Slight
-In case sales prices increased by 50%,	Products using lead as inputs will increase in price

Comment: Demand for recycled lead is rather inelastic, in that price has limited effect.

7-Description of production process

Battery breaking	Extraction of lead	Charging capacity in tons
Manual (94%) Automated (---) Semi automated (6%)	• Local rotary furnace (81%) • imported rotary furnace (---) • Other (19%)	AVG = 4.43
Addition in charging fluxing agents	**Fuel used in burning**	**Refining furnaces**
• Yes (86%) • No (14%)	• Mazot (4.8%) • Solar (28.6%) • Kerosene (9.5%) • Mazot & Solar (57.1%)	• Yes (38%) • No (62%)

Emission Control Equipment	Solid wastes	No. of employees
• Wet scrubbers (29%) • Bag house • No equipment (71%) • others	• Plastic & Slag (67%) • Slag. (19%) • Others (14%)	AVG = 29.43
Space for smelter building (in m2)	Space for furnaces & refining (in m2)	Space for air pollution control (in m2)
AVG = 23.71	AVG = 23.71	AVG = 13.33

8-Need for bigger space

Yes	No
38%	62%

Comment : *Most smelters do not need a larger space.*

9-Facing any harassment from environment people

Yes	No
81%	19%

If yes, willingness to relocate to other remote places to evade the harassment

Yes	No
71%	29%

Comment: More than 80% of smelters face harassment from environment people, of which around 70% are willing to remove their facilities to remote areas.

10-Major smelters in the market by names, quantities sold & location

Smelters	Quantities Sold in tons or units	Location
Awadallah	18000	Shoubra El Kheima
El Mahy	6000	Tenth of Ramaden
Ahmed Osman/Abd El Hamid Ossman		Shoubra El Kheima
Mostafa Hassan		Arab Abou Saed Alexandria

Comment : Awadallah is the market leader with 65% market share.

11- Influence of primary lead or imported lead ingots ingots as a threat on the demand for your products

Large impact	small impact	No impact
	29%	71%

Comment : Most of smelters believe that imported lead will not formulate a threat on demand for recycled lead. This is simply because primary lead is used in a very limited scale.

12- Substitution to lead in their products

Yes	No
33%	67%

Products that can substitute lead as inputs are mainly PVC pipes.

13. Impact of such substitution on the demand for smelter's

products

Large impact	Small impact	No impact
	10%	90%

Expectation of such substitution in the coming period

Yes	No
	100%

Comment : Lead pipes are the only lead product that would have substitutes (PVC). However, most of the smelters believe that PVC pipes are not a good substitute for lead pipes.

14- Sources of raw materials by the type

Source of raw materials
Battery/Scrap collectors
Tenders
Other smelters for hard lead ingots

Comment: The major sources of lead are scrap collectors and tenders.

15-Average prices of raw materials by type

Type of products	Price (L.E / Kg)
- Scrap batteries,	0.62
- Lead scrap materials,	0.77
- Cable sheeting solder,	0.72
- Hard Lead Ingots	2.23

Comment : Hard lead ingots is the most expensive raw lead material. Scrap batteries are the cheapest.

16- Expectations of change in the price of raw materials in the coming period

Yes	No
52%	48%

Degree of Change

Large increase	Small increase	Decrease	Same
20%	70%	10%	

Comment: Only 50% of smelters expect that prices of raw lead will increase, of which 70% believe that price will increase at low rates.

17-Degree by which price of raw materials impact quantities sold

-In case price of raw materials increased by 10%	No Effect
-In case price of raw materials increased by 25%	Limited decrease
-In case price of raw materials increased by 50%	Great decrease

Comment: Demand for raw lead is inelastic with respect to price. It will turn to be elastic of price if increased by high percentage.

18-Percentage of lead recovered from a dry battery

Weight of battery	Amount of lead recovered
12 kg	60%
15 kg	63%
60 kg	64%

19-The percentage of lead wasted during production is 40%

Comment: Around 60% of the lead in a dry battery is recovered, (40% waste).

20-Base stock required for different materials by type

Duration	Period
- Long Period	72%
- Very Long Period	28%

3. Questionnaire of Scrap Battery Collectors

Three collectors of scrap batteries controlling 80% of the supply of scrap batteries in Greater Cairo were personally interviewed. The questionnaire included the following questions:

- Duration of business
- Sources of scrap batteries
- Prices of scrap batteries and their trends
- Price effect
- Importation of scrap batteries in terms of quantities and prices
- The general trend of the quantity supplied of scrap batteries in the past and the expectable future
- The useful life of batteries
- Market size and market shares
- Major buyers of scrap batteries

Scrap batteries collectors

1-Average duration of being involved in this business is 26.7 years

It seems that all collectors have long duration in business of collecting scrap batteries.

2-Different sources of scrap batteries in Egypt

Source	Percentage
Public Sector Companies	22%
Governmental Departments	22%
Garbage Collectors	14%
Scrap Collectors	14%
Spare Parts / Car Repair Shops	14%
Battery Factories	7%
Army Forces Tenders	7%
Total	**100%**

Comment: *The major sources of scrap batteries are public sector companies and governmental departments. Both together represent more than 40% of the supply of scrap batteries.*

3-Sources from which the collector gets scrap batteries

Source	Percentage
Scrap Tenders by Public and Governmental Sector	33.3%
Scrap / Garbage Collectors	33.3%
Import and Tenders	33.3%
Total	**100%**

Comment: *The interviewed collectors rely equally on tenders and garbage collectors.*

4- Price trend for scrap batteries

	Past (Last five years)	Future (Coming ten years)
- No change		
- Downward trend	33%	
- Upward trend with decreasing returns	67%	33%
- Upward trend with increasing return		67%

Comment: Price of scrap batteries has shown low growth rate over the last five years. However, the expectations that price of scrap batteries will increase in the future at high rates. This is due to the current high world price and the expectation about higher inflation rate in the future.

6-What is the degree by which the prices of scrap batteries affect the demand for selling the batteries?

In case of a price increase of 10%	No Change
In case of a price increase of 25%	Slight Decrease in demand
In case of a price increase of 50%	Slight Decrease in demand

Comment: Demand for scrap batteries with respect to price is rather inelastic (insignificant price effect).

7-Importing scrap batteries

Yes	No
33%	67%

If yes, what are the quantities that you import, their prices and their sources?

Quantities In tons or units	Prices	Sources
10000 Tons	LE 350 /ton	Arab Countries

Comment: *Collectors indicated that around one-third of the quantity supplied of scrap batteries is imported from Arab countries, basically from Libya. However, it is expected that the quantity imported represent around 15-20% of the total quantity supplied of scrap batteries. It is worth noting that import price of scrap batteries is less than the domestic price.*

8- Expected change in the trend for quantities imported of scrap batteries

Large increase	Small increase	Decrease	No change
	100%		

Why?

Comment: *All the interviewed battery collectors indicate that imports of scrap batteries are not expected to increase in the future due to environment restrictions. Some smelters claim that scrap batteries are being exported nowadays. Export price exceeds domestic price.*

9-Total annual quantity of scrap batteries purchased during the last five years

Quantity in tons or units

Year	Quantity in Tons
1997	71500
1998	61000
1999	40000
2000	25500
2001	25000

Comment: *Supply of scrap batteries has shown declining rate during the last five years.*

10-Growth rate for quantities of scrap batteries in the last five years

Declining rate.

11-The Useful life of batteries in Egypt

One year and half.

This is consistent with the data collected from the battery producers, however, we believe that it is underestimated.

12-The prevailing collection system of scrap batteries

System	Percentage
Tenders of Public/ governmental Sector	50%
Garbage & Scrap Collectors	50%

Comment: *The two major sources of scrap batteries are public tenders and garbage. They have equal weights.*

13- Market Share

The market share of the three interviewed collectors is 80%. They represent the major players in the market.

14-Expectation of any changes in the collection system in the future

Yes	No
33%	67%

Reason for change

A national wide system will be organized by the suppliers

Comment: *The majority of collectors believe that there will be no change in the system of collection.*

15-Main purchasers of scrap batteries classified by location and sector

Purchasers	Location	Sector
Awadallah	Shoubra El-Kheima	Smelting, Purifying and Synthesis of lead
Hassan Mostafa	Borg el Arab	
El Mahy	Shoubra El Kheima	

Comment: *Awadallah is the major buyer of scrap batteries in Egypt. (more than 60% of the market). Hassan Mostafa and El Mahy also buy large quantities.*

16-Trend for the change in these quantities

	Past (Last five years)	Future (Coming ten years)
- No change		
- Downward trend	100%	
- Upward trend with decreasing returns		
- Upward trend with increasing returns		100%

Comment: *Although the change in traded quantity during the last five years was declining, all collectors agree that demand for scrap batteries will increase at high rates.*

17-Sales prices of scrap batteries in 2001

Ranging from LE 500 - LE600 per Ton. It should be noted that lately the price of scrap batteries has been increasing at high rates.

APPENDIX 4

APPENDIX 4

Main smelters in Greater Cairo

Giza

No.	Owner name	Production tons/year	
		Ingots	Lead products
1-	Adel Ismail Saudy	450	0
2-	Abdel-Hameed Osman	1800	0
3-	Abdel-Kader Abdel-Hameed Osman	500	0
4-	Samir Abo-Sekera	300	0
5-	Mohamed abo-Sekera	300	0
6-	Mosaad Abo-Sekera-Saad Temraz	250	0
7-	Arafa Bakhit –Nabil El-Mahy	360	0
8-	Mahmoud abdel Kader – Shams	300	0
9-	Aly M. Hussein El-Mahy	250	0
10-	Nabeeh abdel – Hameed	1400	0
11-	Sayed Awadallah (1)	6000	0
12-	Sayed Awadallah (2)	6000	0
	Total	**17910**	**0**

Qaliyoubia

No.	Owner name	Production tons/year	
		Ingots	Lead products
1-	Sayed Awadallah (1)	2000	4000
2-	Sayed Awadallah (2)	0	5500
3-	Emad Saudy	900	0
4-	M. Abdel-Kereem El-Mahy	0	3500
5-	Sayed Awadallah (3)	0	0
	Total	**2900**	**1300**

Cairo

No.	Owner name	Production tons/year	
		Ingots	Lead products
1-	Nabeeh Abdel-Hameed	0	900
2-	Ahmed M. Ahmed Aly	0	560
3-	Aly M. hussein El-Mahy	0	500
4-	Abdallah El-Farouk Aly Hussein	0	500
5-	Nagy Nabeeh abdel-Hameed	0	0
6-	Ibraheem Nabeeh Abdel-Hameed	0	0
	Total	**0**	**2460**