COST BENEFIT ANALYSIS OF THE PREPAYMENT SYSTEM IN ENEMALTA CORPORATION

By

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A DISSERTATION SUBMITTED
TO THE FACULTY OF ECONOMICS, MANAGEMENT AND
ACCOUNTANCY IN PARTIAL FULFILLMENT OF THE
REQUIREMENT FOR THE DEGREE OF BA(HONOURS)
ACCOUNTANCY

UNIVERSITY OF MALTA
APRIL 2000

"When things go wrong as they sometimes will
When the road you're trudging seems all uphill
When the funds are low and the debts are high
And you want to smile but you have to sigh
When care is pressing you down a bit
Rest if you want
But don't you quit"

Dedicated to all those close and dear who provided me with the strength and determination to carry on and not to quit.

Mum, Dad
Marica and
Brian

ACKNOWLEDGEMENTS

I would like to express my sincerest gratitude to all who helped me in my dissertation.

First and foremost I would like to thank my tutor Mr. Gordon Cordina M. Phil Lecturer at the Faculty of Economics, Management and Accounting, whose guidance, continuous assistance and constructive criticism was of crucial help throughout.

Secondly my gratitude extends to Mr. Tarcisio Mifsud MBA.(Henley), the Financial Controller of Enemalta who was instrumental in furnishing me with lots of useful information.

I am also very grateful to the following Ms. Josephine Vella Grech B. Elec. Eng. (Hons) Eng.II Gozo District, Dr. Manuel Borda B.A.(Hons) Eco., M.A.(Hons), Ph.D. Deputy Chairman at Enemalta Corporation and Mr. Silvio Decelis officer in charge at Statistics Office in Enemalta who spared me the time necessary during the process of this dissertation.

Moreover special thanks go to Ms. Maria Borg B.A. (Gen) who helped me along my work.

Sincerest Thanks go to my parents whose constant help and dedication throughout my upbringing were of utmost importance to me. Also thanks for their patience with me in all difficult moments. My gratitude extends to my brother Joseph, Michaela and their children Rebecca and Jennifer, to my brother Ruben, Victoria and their children Joel and Abigail and the youngest brother Mark Anthony.

Last but not least I am greatly indebted with Brian. There are no words that can express all the gratitude to him for the precious time he dedicated to help in the course of my dissertation. Thanks to Brian for his continuous support and encouragement he gave at all times.

ABSTRACT

COST BENEFIT ANALYSIS OF THE PREPAYMENT METER IN ENEMALTA CORPORATION

Production of electricity in Malta is catered wholly by Enemalta Corporation. It is now experiencing major challenges both nationally and by the European Union on its efficiency.

Enemalta should first of all be free of any political intervention in order to be efficient. Another objective for Enemalta must be that of taking responsibility of the electricity bill payment. Enemalta has to decrease electricity consumption during the day and increase it at night in order to have a more stable demand and avoid unnecessary capital investment.

Through the implementation of the prepayment meters Enemalta would be able to achieve all the objectives just mentioned. The scope of this dissertation has been to evaluate the implementation of these prepayment meters by Enemalta Corporation in domestic premises.

Finally a cost benefit analysis was carried out to verify the feasibility of such an investment and assumptions made stated. Any recommendations regarding this system and its implementation were forwarded and a number of issues to be considered were highlighted.

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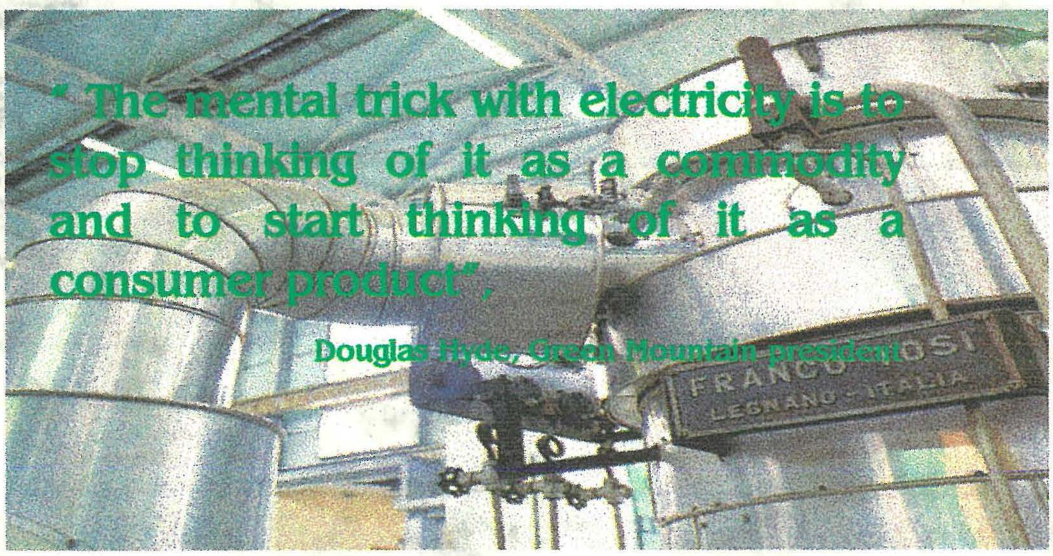
Chapter *one*

Introduction



1.1 WHAT IS ELECTRICITY

Electricity is the most versatile, widely used form of energy available. Since the 19th century, it has permitted and accompanied economic development everywhere. Unlike other energies, though, it cannot be stored, so electricity demand must be carefully monitored, just as its production. Companies, which generate, transmit, distribute, or trade in electricity, need accurate production and consumption measurements. These must be analysed on time to ensure that this energy resource is managed correctly, and to ensure that the power is always there when people want it, no matter what time of day or night.

Measurement is playing an increasingly important role in the efficient operation of thermal energy production and distribution systems. Equitable allocation and billing for actual consumption allow consumers to be charged for exactly what they use, encouraging personal responsibility for energy conservation. Accurate measurement of customers' consumption also provides industries providing electricity with all the information necessary to assess consumption, enabling them to make a true evaluation of services rendered to their customers.

1.2 THE EVOLUTION OF ENEMALTA CORPORATION

"In the nineteenth century, Malta found itself in the wake of the industrial revolution which was spreading over the continent of

> *Europe. The invention of the steam engine and the development of electricity supply, the latter being dependent on the former for motive power, heralded new horizons for the mechanisation and the attainment of a more comfortable life style."*[1]

The Council of Government through the secretary of State for Colonies in 1890 invited William Preece to Malta to conduct a feasibility study on technical and economic aspects of the introduction of electricity supply. With the result of this study in 1895 the first power station in Malta was built. Maltese people could enjoy electric light, which was replacing gas lamps. This made public streets safer during the night and houses became more comfortable. Electricity in Gozo was introduced in 1926 through a local power station at Victoria.

In Post War years the trend imposed an increasing demand for electricity. To meet demands three other power stations were constructed. Electricity supply in 1963 was the first Government Department to be changed in a Corporate under the name of Malta Electricity Board. In 1977 Enemalta Corporation was established.

At the present time Enemalta is employing about 2,000 workers and has two operating power stations, one in Delimara and the other in Marsa.

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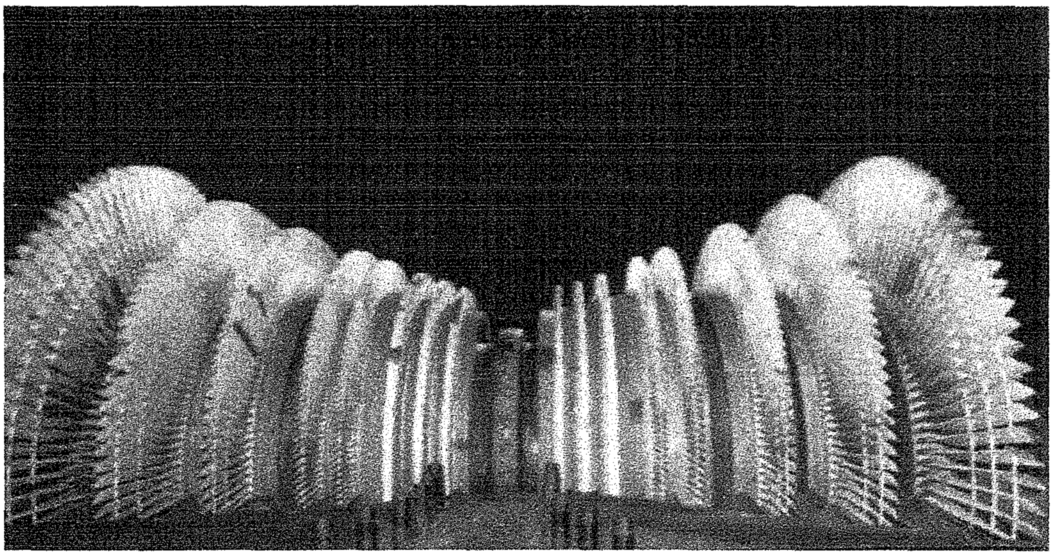
[1] Enemalta Corporation- Annual report & financial Statements 1995

Chapter *two*

Research and Methodology



2.1 SCOPE OF THIS STUDY

Enemalta has been criticised for operating inefficiently and at a loss. The major reasons for Enemalta's inefficiency are the policies adopted by the political parties. High amounts of thefts are not being investigated and are being treated as normal losses in order to keep the electorate undisturbed. Bills are not being sent as often as they should and Enemalta is the last party who receives the income while it is the first to pay for the capital investments. The scope of this study is thus to analyse whether the prepayment system would be helping in solving such problems.

In fact the prepayment system that is being proposed in this dissertation would be a first step to help Enemalta in getting its revenue first, even before energy is supplied. This would help a lot in the liquidity problems that Enemalta is facing. Funds available would be used to reduce loans and creditors and thus interest payments and gearing level would be lower.

2.2 OBJECTIVES OF THE STUDY

The objective of this dissertation will be to assess whether it would be beneficial for Enemalta to introduce the prepayment system in the Electricity section. This study will try to establish whether revenue or cost savings would cover the costs undertaken to implement such a project. This study would estimate such costs and revenues on a relevant cost approach. Revenue would include the reduction in theft, tampering and in long-term debtors.

2.3 FRAMEWORK OF DISSERTATION

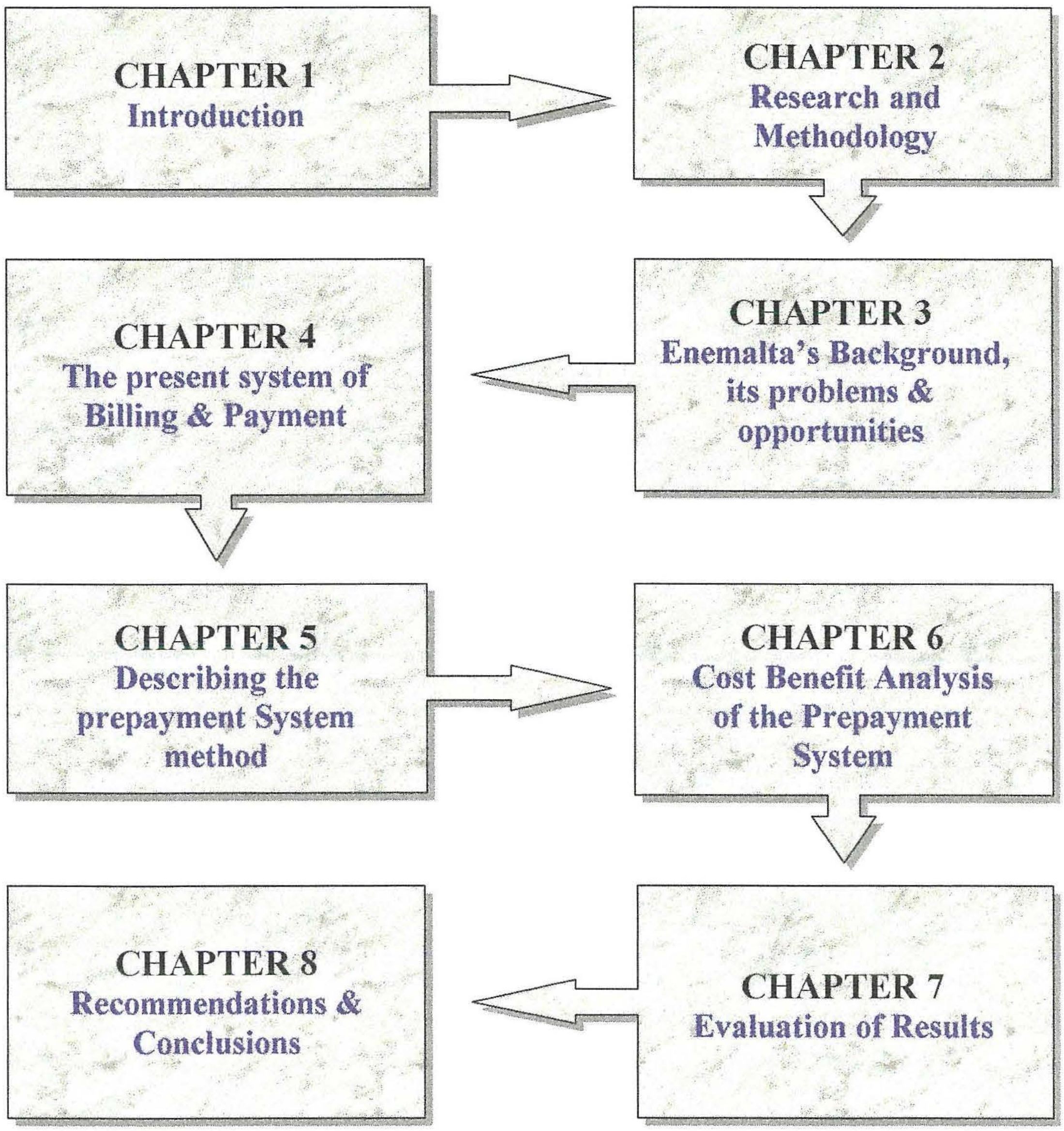
Chapter 1 gives a brief overview of how Enemalta Corporation was established in Malta. The next chapter of this dissertation introduces Enemalta's strength, weaknesses, opportunities and threats (SWOT analysis). In that section the liquidity problems that Enemalta is facing would also be highlighted. Then chapter 3 ends with the definition of why a prepayment method is needed in Malta. The following chapter outlines the present system of payment. This will give an overview of how the system works from the time when a client asks to get a new service until his first and subsequent bills are sent and paid.

Chapter 5 gives an idea of how the prepayment method of billing that is being proposed works. Further more, the benefits that Enemalta will gain from the installation of such meters will also be analysed.

Chapter 6 and 7 aim at fulfilling the purpose of this dissertation by scrutinizing the revenue and cost incurred in the implementation of the prepayment method by Enemalta Corporation. Such costs and revenue include the capital investment, the expected increase in revenue and expenditure, the tax computation and the cash flow movements due to the decrease in debtors. Computations in order to find the Net Present Value (NPV), Internal Rate of Return (IRR) and Payback of this project will also be carried out.

Chapter 8 presents the conclusions and recommendations proposed after study is completed.

Figure 2.1 Outline of Dissertation



2.4 METHODOLOGY

The preliminary work carried out on the dissertation involved discussions with Mr. Tarcisio Mifsud, the Financial Controller of Enemalta. He presented some valuable data and Mr. T. Mifsud said that he is in full agreement that Enemalta Corporation should adopt the prepayment method as soon as possible. Mr. T Mifsud agrees with this project because both political parties have always treated Enemalta and the payment of its bill as a part of their electoral propaganda.

With the introduction of the prepayment system this will be practically eliminated since bills will no longer have to be paid, instead a card will have to be bought in order to make the meter function and supply electricity to the customer. Through these informal interviews and discussions with Mr. T. Mifsud and others in the corporation, it was possible to identify any problems and opportunities that Enemalta has.

Contacts with Schlumberger Co Ltd. through Internet and mail made it possible to get some information about the prepayment meters. Some information about this company can be found in Appendix 1.

Regarding how the present system is operating, discussions were carried out with staff in the billing section of Water Services Corporation (WSC).

2.5 RESEARCH IN CONNECTION WITH CAPITAL EXPENDITURE

Mr. T. Mifsud has already contacted some companies from abroad offering the prepayment meters. The quotations of prepayment meters and vending points sent to Enemalta by Schlumberger Co limited shall be analysed. In the quotations sent by this company, one can understand how payments for capital expenditure will be made. From this we can make a cash flow analysis and a net present value assessment for this project.

Apart from cost of meters and vending machines which are the initial investment outflows, other costs and savings would be incurred. Costs have been identified through an analysis of financial statements of Enemalta and any other data available from the statistics of Enemalta.

2.6 RESEARCH RELATED TO CURRENT REVENUE AND EXPENDITURE

The present situation and liquidity problems at Enemalta are established by analysing through the last 3 years' Financial Statements. On the other hand, the figures after the system would have been implemented are found by going through several computations and assumptions, which will be mentioned as the study is being carried out.

Chapter *three*

Enemalta's background, its problems and opportunities

enemalta

Working harder for you

3.1 ENEMALTA'S DIVISIONS

Enemalta is a Government owned corporation that was established over 20 years ago. Enemalta has a monopoly on the provision of electricity services as well as on the importation and distribution of petroleum and gas products.

From these three divisions the heaviest responsibility of the corporation centres on that of electricity. The focus of this dissertation would be on this division. The petroleum division has the largest turnover and the functions of this section are to procure, store, distribute and sell petroleum products excluding lubricants. This division is also an important one for Enemalta. The least important of these divisions is that of gas. The main function of the gas section is the bottling of liquid petroleum gas in cylinders. Self-employed distributors who work on commission basis then carry out the distribution of gas. Enemalta's income arises from the sale of electricity, petroleum and gas and the total sales made by Enemalta are the highest made by any corporate entity on the Island.[1]

3.2 ENEMALTA'S OBJECTIVES

> *"As the principal energy provider for the nation, Enemalta has the responsibility of meeting the demands of ever growing economy in the most sustainable and efficient manner. As an enterprise that has the responsibility to meet the needs of each individual consumer, Enemalta must carry out its role with the satisfaction of*

[1] Interview with Mr. T. Mifsud financial controller of Enemalta Corporation

> *its customers as its primary aim. As a producer of energy, Enemalta has the duty to protect the environment for this and future generations. Enemalta Corporation seeks its goal through investment in technology and in human resources and through the commitment of all its employees towards excellence."*[2]

Enemalta Corporation's principal objectives have always been: -

a) exploiting to the fullest extent its resources and manpower and

b) an emphasis on customer care.

Enemalta's mission statement is:

> *"To meet the energy needs and expectations of the customer in a safe, efficient and profitable manner whilst safeguarding the environment."*[3]

Enemalta is the sole provider and regulator of energy; thus it carries a heavy responsibility. It must meet the constantly growing demand for energy through investment, both in the power station at Marsa and in the expansion of that in Delimara. This will cause high capital investments and expenses without which demand will not be met. This heavy financial burden must be borne in full consciousness of the fact that Enemalta Corporation operates under social as well as economic obligations. This large financial outflow brings about the problem of liquidity for the Corporation since not enough cash is being generated in order to pay for the investments required.

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[2] Enemalta Corporation Annual Report 1998
[3] Enemalta Corporation Annual Report 1999

3.3 A SWOT ANALYSIS FOR ENEMALTA

Strengths, weaknesses, opportunities and threats of Enemalta Corporation, which were considered throughout the study, are discussed below.

3.3.1 STRENGTHS

Enemalta's most important strength is that it has a monopoly status. When Malta joins the European Union (EU) Enemalta would be exempt from the policies regulating monopolies in the EU and will continue to operate as a monopoly but this exemption would only apply to the electricity section and not to the gas and petroleum sections. In fact during EU screening process regarding energy and the EU the following was suggested:

> *"Energy supply by a state owned monopoly is dissonant with the EU liberalisation of energy markets. A case can be made by Enemalta to retain electricity generation on the basis that it is in the public interest that the status quo is maintained here. Besides it is difficult to see local or even foreign entrepreneurs willing to invest the large capital expenditure required to set up a rival in a liberalised market. However, fuel and gas distribution could be liberalised."*[4]

Other strengths are that it has skilled personnel and its strategic geographical position on the island.

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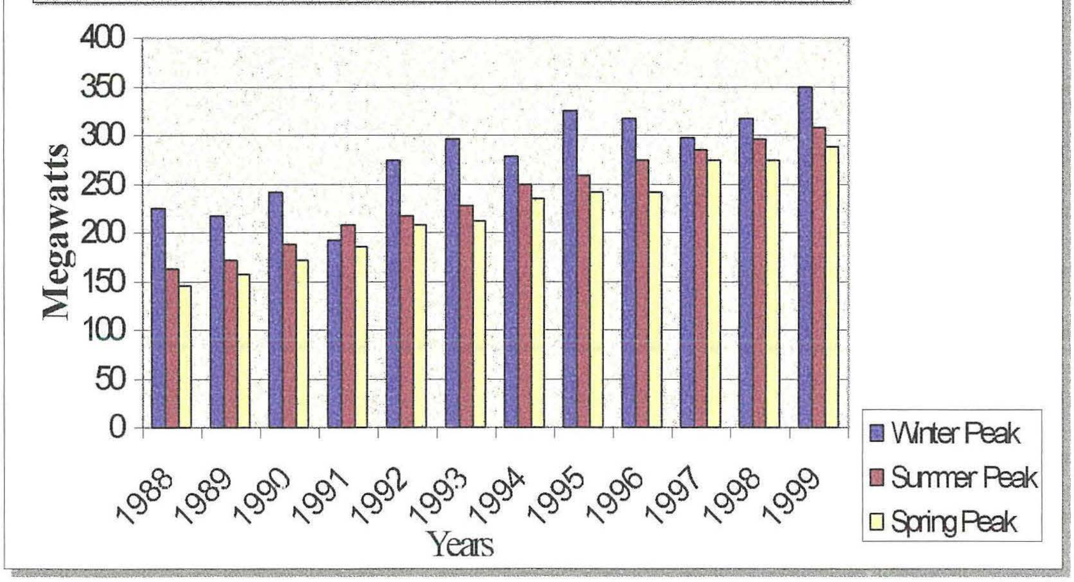
[4] Dr. Emmanuel Sinagra *"Malta, energy and the EU"* The Times November 10. 1999.

3.3.2 WEAKNESSES

On the other hand Enemalta also has certain weaknesses. One of the weaknesses is that since the electricity division is making a loss and the tariffs paid by the customers are subsidized, no energy saving efforts are being made by most energy users. This means that investment in solar energy is not yet being given the importance that it deserves. Another weakness Enemalta faces are the peak demand periods as shown in graph 3.1. Extra capital would have to be bought in order to meet this excess demand. When demand goes back to its normal status idle capacity would result.

Graph 3.1 Seasonal variations in demand



Source: Financial statements Enemalta Corporation 1999

This weakness may be solved by investing in capital up to a specific constant demand, then extra demand might be met by producing energy via a solar energy system (Appendix 2), wind turbine system (Appendix 3) or purchase energy from Sicily (Appendix 4).

When Mr. T. Mifsud was asked about investing in these systems he replied that these methods are not feasible since in these cases large capital outflows would also have to be made. In the case of wind turbines he said,

> *"Malta has wind in only 3 months out of 12 and the only place suitable to have the turbines in is Mellieha. Mellieha is the part of Malta which is still unspoiled and the wind turbines would ruin its environment."*[5]

Solar energy would not be available when you need it most, that is on cold days particularly if it is a cloudy. Beyond this system is expensive to be implemented by Enemalta. This shows that the only way to reduce capital investment is by either inducing customers to use energy during the low peak seasons when demand is lower or by encouraging them to use other sources of energy such as solar systems.

> *"The corporation will encourage the use of solar energy, particularly for heating, and will shortly issue a new policy to promote the use of alternative sources of energy. The corporation would also seek to bring about a more equitable distribution of demand between day and night. At present, consumption at night is far lower than during the day. The introduction of multi-tariff meters with lower rates for nighttime use would go a long way to encourage consumers to switch on appliances such as water*

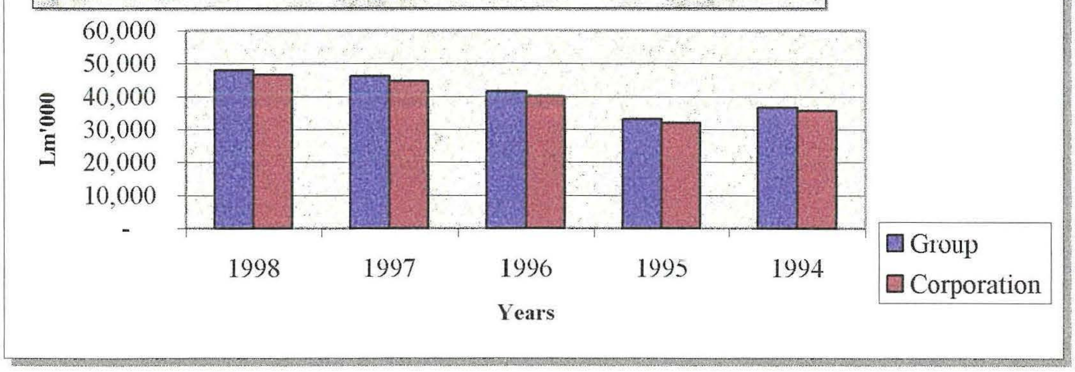
[5] Interview with Mr. T. Mifsud

heaters during the night. A more equitable distribution of demand would mean Enemalta would not have idle plants at night, saving the need to increase capacity to meet demand during the day." [6]

Another weakness is that Enemalta does not have a Finance Director in the Board of Directors (BOD). A Finance director would focus more on the financial problems that Enemalta is facing. He may provide Enemalta with ways as to how these problems may be solved. The BOD deals more with operational matters, particularly those relating to staff, rather than the establishment of policies. This may be due to the fact that they are appointed from year to year, and their appointment is more of a political nature rather than a true commercial one.[7]

High losses in the transmission and distribution bring about another weakness in the corporation. Another drawback that Enemalta has to face is the high percentage of debtors as shown in graph 3.2. This becomes more critical since WSC does the reading, billing and collection of revenue.

Graph 3.2 – Debtors' amounts



Source: Financial Statements Enemalta Corporation 1999

[6] Parliament *"Losses on oil purchase agreements running at $8 million"* The Times October 27, 1999

[7] Interview with Mr. T. Mifsud

3.3.3 OPPORTUNITIES

Enemalta also has several opportunities that it can make use of in order to be more efficient and effective. Such an opportunity is that of implementing the prepayment system of billing. This will help the Corporation to reduce both the debtors' and theft rates. Another opportunity is that of installing automatic meter readers at industrial and commercial premises.

3.3.4 THREATS

One of the threats for Enemalta is the very high exposure to currency and oil fluctuation. Enemalta makes its purchases in foreign currencies while its revenues are mainly in local currency. A high percentage of its purchases are obtained from abroad and this may result in a change in direct material prices and increase in the cost of sales. In order to curtail this exposure to both foreign exchange risk and fluctuations in oil prices, Enemalta may hedge against swings in the currencies and in oil prices.

Hedging has always been the best way to eliminate risk completely but this is an area where Enemalta does not have any power to intervene. Enemalta has to do what politicians suggest. In fact the two political parties are again in conflict about this criteria. Mr. Leo Brincat who was responsible for Enemalta during the

Labour administration agreed on a hedging contract for the price of oil. On the other face of the coin we have Profs. J. Bonnici the present minister for economic services who stated that he would not even consider hedging.

> *Profs. J Bonnici "said he was not prepared to gamble on long term hedging agreements lest prices went the other way and Enemalta would suffer big losses"*[8]

3.4 ENEMALTA'S LIQUIDITY PROBLEMS

From table 3.1 one can note that Enemalta has consistently increased the level of creditors falling due within one year, from Lm34,088,000 in 1994 to Lm109,764,000 in 1998. This also resulted in an increase in the interest expense of about Lm2,000,000 which is a considerable amount. Most of the interest expense is related to the electricity division due to the creditors for capital investment.

Apart from interest expenses losses incurred are higher because of the amount of bad debts, which is being increased every year since there are more defaulters of electricity bills.

[8] Parliament *"Enemalta rapped for poor customer service"* The Times October 27. 1999

Table 3.1 – Extracts from Enemalta's financial statements

The Group

Year	98	97	96	95	94
	Lm '000	Lm '000	Lm '000	Lm '000	Lm '000
Creditors falling due within one year	109,764	112,152	70,016	60,040	34,088
Creditors falling due after more than one year	44,427	47,995	70,189	53,857	54,382
Interest Expense	6,810	6,226	6,279	5,044	4,879
Profit or (Loss) after tax	6,002	(2,332)	(832)	1,619	12,178

Electricity Section

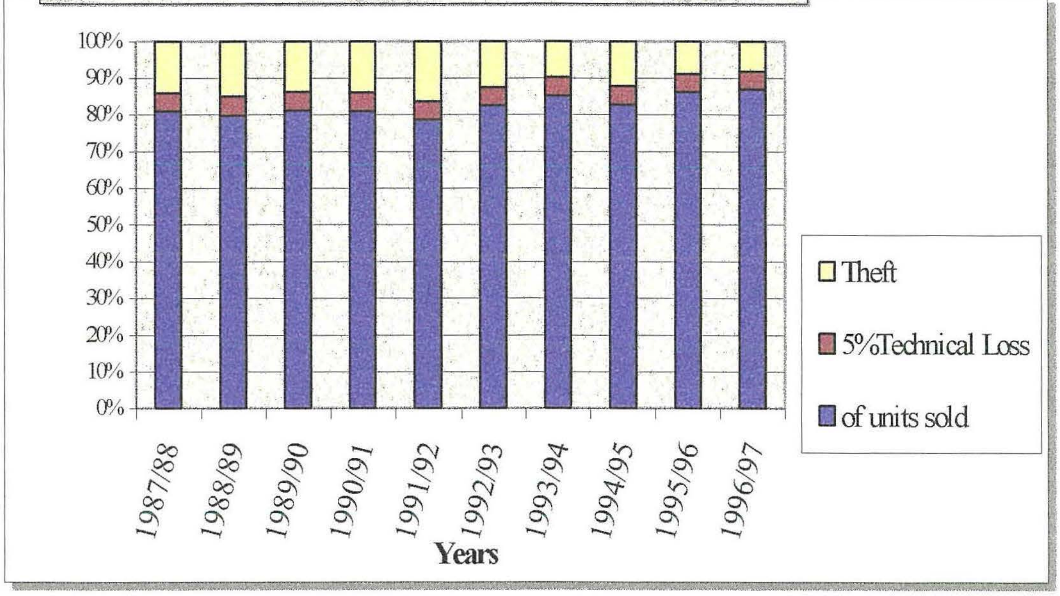
Interest Expense	6,715	6,136	6,201	4,993	4,858
Bad Debts	17	28	14	19	117
(Loss) after tax	(3,498)	(13,047)	(12,757)	(11,427)	(11)
Debtors	47,962	46,227	41,547	33,152	36,624
Provision for Doubtful Debts	3,871	3,492	3,346	3,116	2,846

If both interest expenses and bad debts are reduced by the electricity section the losses incurred would be much less and in 1998 the loss might change into a profit. This means that both debtors and creditors must be reduced to try to diminish these two costs as much as possible. One can also note from table 3.1, that interest paid by Enemalta is practically incurred by the electricity section. Eliminating debtors would help significantly to reduce such interests. With the implementation of the prepayment system to all customers domestic and commercial, Enemalta would be paid for the services provided immediately and could pay the creditors at a faster pace thus it would be saving high interest costs.

3.5 TECHNICAL AND NON TECHNICAL LOSSES IN ENEMALTA

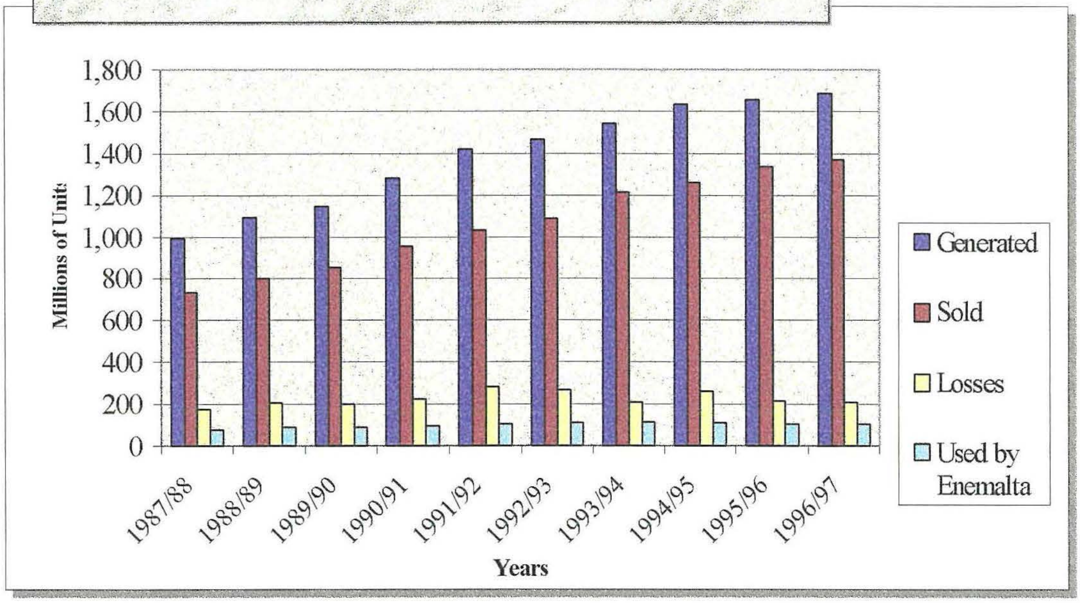
Enemalta has a substantial percentage of losses in transmission and distribution. These losses arise because of technical and non-technical losses. These are included in graphs 3.3 and 3.4. The data for these two graphs is found in Table 5.1A in Appendix 5. These graphs show the units generated and the units sold, used, lost and stolen compared with each other as a percentage.

Graph 3.3 – Units generated, sold, and lost



Enemalta brought over some experts from the 'Electricity De France' (EDF) on April 1999 and from the study they conducted with the appropriate apparatus that they brought with them established that 5% of the whole turnover resulted in technical losses made by Enemalta.

Graph 3.4 – Classification of generated units



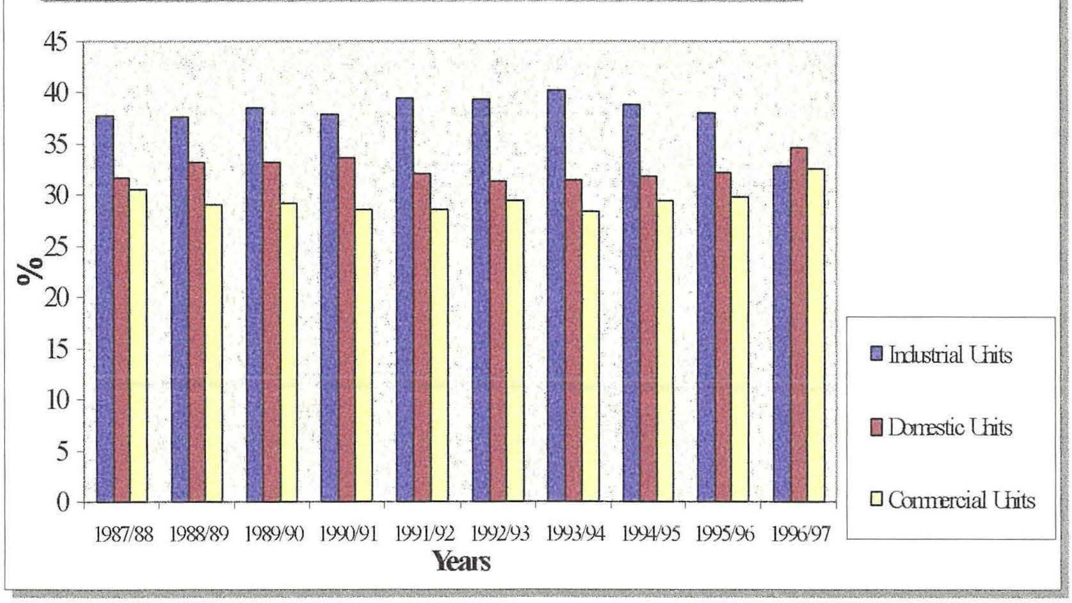
The amount of units received by the customers is 95% after deducting the normal loss, but Enemalta charges for units between 75% to 89% of total units generated as seen from Appendix 5. What are the other losses incurred which amount up to 20% (5% of the units produced represent Normal Loss) of the total amount of units produced? The remaining is the non-technical loss that is mainly caused by theft of electricity by the customers. Up to June 1999, ninety cases of theft of electricity were to be investigated by the police. 2322 reports of theft of electricity were made in the past 10 years[9].

[9] Minister Josef Bonnici handed this information to reply a parliamentary question by Dr. Adrian Vassallo

3.6 ENEMALTA'S CUSTOMERS

The types of clients that are served by Enemalta are the Government, Domestic, Commercial and Industrial. These are expressed as a percentage in graph 3.5. The highest proportion of theft of electricity is being recorded from the small customers. Such customers are the minor commercials which consist of small restaurants, retail outlets and other types of outlets which are normally family run or run by a sole trader. The other party that steals electricity in considerable amounts is the domestic section.

Graph 3.5 – Enemalta's customers



Enemalta has calculated that thefts of around Lm2.5 million to Lm3 million are being committed annually. This is quite an alarming amount.

3.6.1 GOVERNMENT AS A CLIENT FOR ENEMALTA

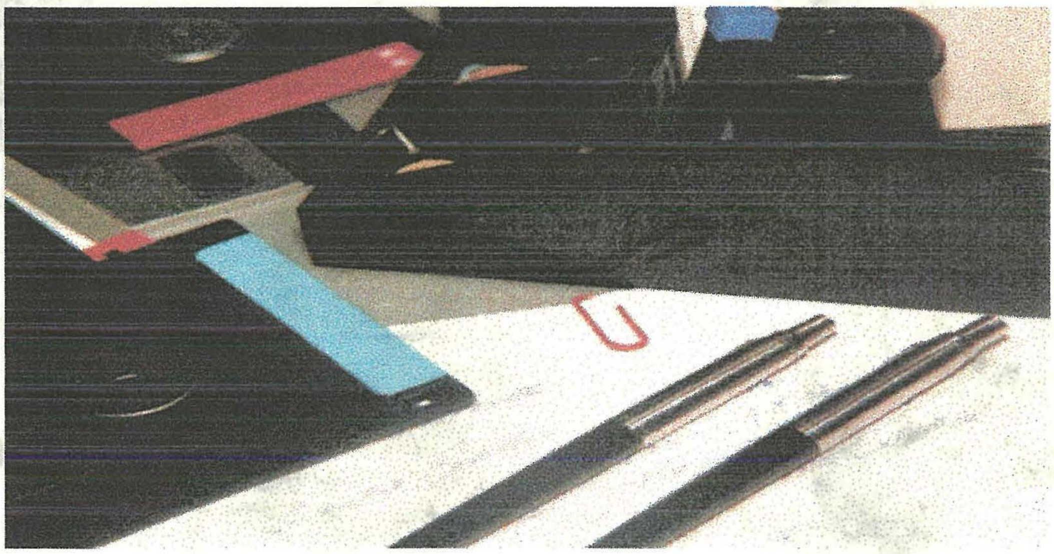
One of the clients is the government section, which uses around 7% of the total consumption, if one excludes the corporations. This amount is increased to 20% when the corporations are included. One of these corporations is the WSC, which uses 11% of the units of electricity generated by Enemalta. The remaining 80% may be able to steal electricity thus prepayment meters will be reducing the risk of energy being stolen. On the other hand, the Government can issue a policy of paying the electricity bills due by the Government departments on time. This policy will be reducing the part of debt due by the Governments section that has not been paid for a long time. While the remaining clients, which represent 80% of the total turnover may only pay earlier by means of a prepayment meter.

3.7 THE ANSWER TO ENEMALTA'S PROBLEMS

The solution which, is going to be proposed in this dissertation in order to reduce these problems, is the introduction of the prepayment system. This study about the feasibility of the Prepayment System is made in order to see what the effect would be when the rates of debts and thefts are reduced. The answer to improving the situation of Enemalta does not lie in the increase in rates. This will mean that further thefts will be made and further bad debts arising and the increase in revenue would be minimal. The first step to go through is to stop the customers from stealing energy and make them pay for the service they receive. When all this is done Enemalta would be much better off and its liquidity problems would begin to decrease because more cash would be generated and received earlier.

Chapter *four*

The present system of billing and payment



4.1 INTRODUCTION

Metering is an essential function among the utilities. Together with billing, it constitutes the basis of the supplier/customer relationship particularly in the domestic sector and is the foundation upon which a supplier's revenue is secured. The present meter is simple in design and over the years it has been used, it has demonstrated a proven level of accuracy. Each meter has a certification life of fifteen years after which it can be reconditioned. The meter is also cheap to maintain and for this reason it may be reluctantly replaced. However, as tariff structures are developed electronic meters will be the only means by which suppliers will be able to offer a wider range of tariff structures and a greater degree of flexibility.

All domestic and commercial premises still rely on mechanical meters to register their use of utility services. For electricity the magnetic Electro-mechanical wheel meter is used. These meters need to be periodically read and in Enemalta's case they are read by their agent's staff from the WSC. This is a costly and often inefficient process for Enemalta and inconvenient for the customer. Often estimates of meter readings are made as the meter reader could not gain access to the premises at the appointed time, and these estimates can prove inaccurate, providing one cause of delayed payment by customers. Further problems of the present system employed by Enemalta are tampering and late payment leading to high level of debtors.

Apart from the reasons mentioned, the need to change the type of meters comes not only from the need to reduce bad debts on Enemalta's side but also from the consumer's side. An increasing awareness of energy consumption and the cost savings can be made simply if there is greater knowledge about usage patterns and small adjustments in the usage thereof.

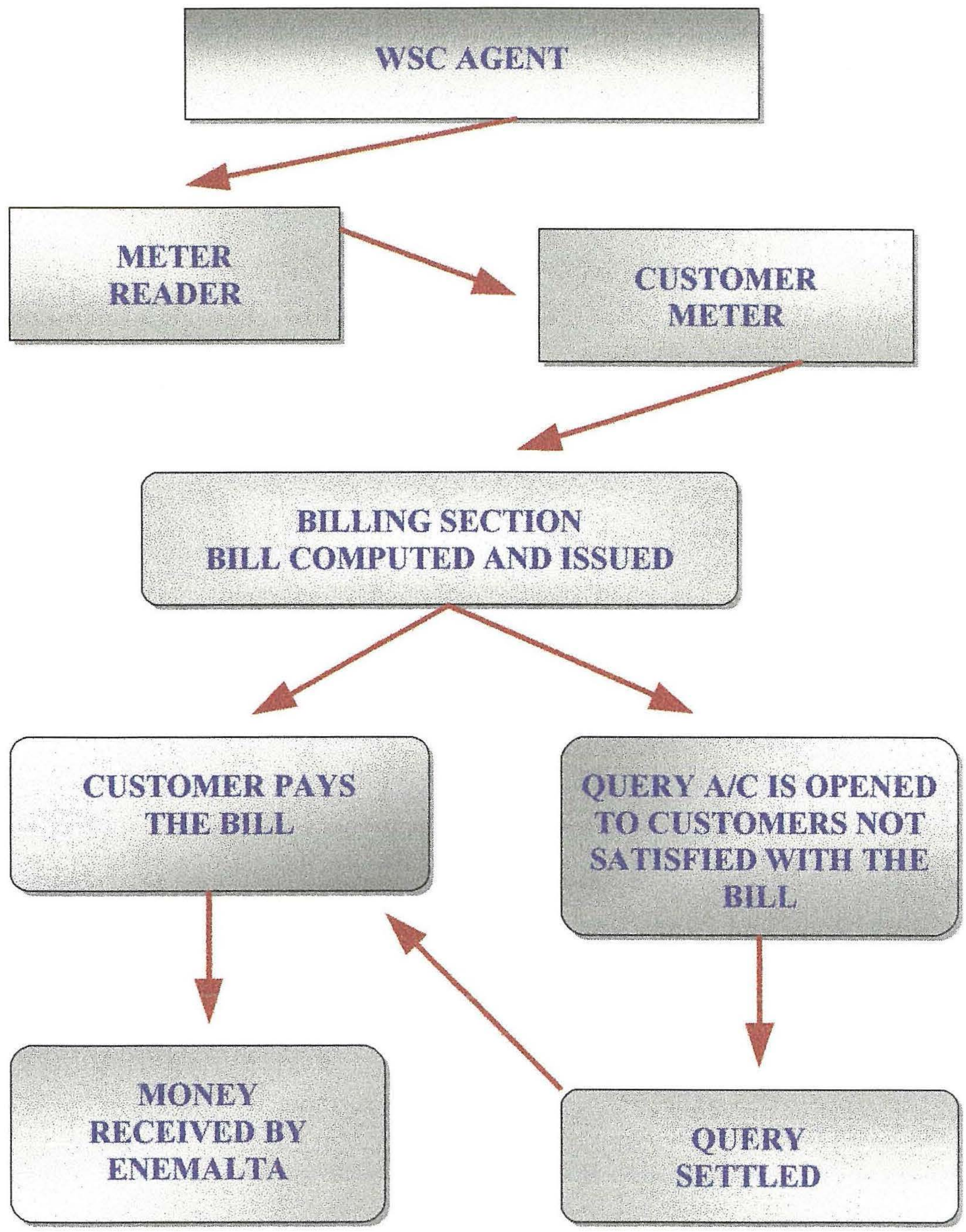
4.2 DATA HANDLING AND PROCESSING

Apart from being paid for the service provided, Enemalta must be involved in data handling. Data handling includes data collection and data aggregation activities. These are defined as meter reading and the various data processing tasks of validation readings, processing meter reading data for settlement and use of system bills, preparing invoices for customers and sending the bills.

With the present system data handling and processing is being done through an agent that is the WSC, that is being paid to do this task for Enemalta Corporation. The present system is not beneficial to Enemalta since the bills are left unpaid for a long time after they are sent.

Figure 4.1 illustrates the flow of information through the process of meter reading billing and payment by customers.

Figure 4.1 Flow of information at the present system



Enemalta only comes into play as the last actor and does not has any say along the whole process.

4.3 PROCEDURE NEEDED FOR A NEW CUSTOMER TO RECEIVE AN ELECTRICITY SERVICE WITH THE PRESENT SYSTEM

Apart from having less say on the processing of data, Enemalta also has to wait for a long time before the first payment is done by a first time client since WSC takes some time to put them on stream. Now the stages one has to go through on applying for the electricity service will be stated.

4.3.1 APPLYING FOR THE SERVICE

The customer has to apply to get a new service and once this service is extended, Enemalta issues a chit so that WSC can match with their water meter number and open an account. At this stage a problem will immediately arise, because the meter reader will normally take a minimum of six months and as much as one year before the first bill is issued to this customer. This procedure would distort sales figures. After the first reading is taken and thus a first bill is sent that customer will have been entered into the system.

4.3.2 TRANSFER OF INFORMATION TO WSC

After meter reading is complete the information is passed to the Data Capture Department at WSC. Here data is inputted in a computerised system from where the bills are issued. From the time when the meter has been read until the bill is issued another six to eight weeks would have passed. Enemalta nowadays has an online facility with WSC and thus can clear any queries arising.

4.3.3 COLLECTION OF PAYMENTS

Once the bills are sent to the customers these are then collected from customers by either paying at the WSC office, by a cheque sent by post or otherwise at the nearest bank branch to the customer. 85% of the bills collected are credited to Enemalta's account in the following days. The final balancing payment is normally received in the second week of the following month.

Enemalta's personnel suspect that WSC is passing all debts to Enemalta rather than distributing them properly between water and electricity sections. They think that WSC are first paying all water debts due then the remaining revenue is given to Enemalta as a part payment of the debts due for electricity. This is unfairly increasing debtors' burden on Enemalta's accounts.

4.3.4 PENDING BILLS

Whenever more than one bill is pending by a customer and has been so for a considerable time, a request of suspension is passed on to Enemalta by their agent. The customer has to be given a twenty-four hour notice of suspension before the actual suspension is made. If a customer has queried his bill, a file is opened and a ledger showing his billing and payment history is inserted. This would result in a loss of time to the detriment of both Enemalta and the client who will have to follow his query. Another fact which will help for the process to take more time is that the clients sometimes are not able to determine if their query involves the water or electricity side.

4.3.5 INFORMATION RECEIVED BY ENEMALTA REGARDING BILLS

Enemalta receives returns against each district. The returns will show the number of units billed and the respective amounts broken down under the categories of consumers which are domestic, industrial and Government. Other statements are also received mostly on a monthly basis regarding the debtors and the period for which they have not paid the bills.

4.3.6 ANALYSING THE PRESENT PROCEDURE

As one can note the procedure is a long and laborious one and Enemalta is the last party, which gets the income but is the first one to pay for the expenses in order to provide the services relating to electricity. The reason for this is that both political parties were unwilling to solve the cash flow problem which Enemalta continues to face. Both parties were against the issue of separating WSC from Enemalta accounts. This may have resulted from a perceived increased burden on the electorate since two separate meter readings, bill issue and payments would have to be made. This may only cease as the political class matures.

4.4 PROPOSED CHANGES TO THE PRESENT SYSTEM AND RESULTING BENEFITS

The changes, which should be made to the present system and the benefits arising there from, are the following. Enemalta should start the immediate opening of an account and thus there will be no need to wait one year before the first payment is made. Payments will be made as soon as the service is introduced, in fact prepayment meters will make this possible. Also multi tariffs may be available with the proposed system. This service is not offered presently to consumers. The implementation of the new system will eliminate the need to send estimated bills to customers who are not present when the meter reader goes to take the actual reading. This will reduce the hassle for the client since he will no longer have to make a query, and for Enemalta since it does not have to calculate estimates any longer.

Another benefit to customers is that they can save money by having knowledge of the usage pattern. For Enemalta data, handling would be much easier since all transactions would be recorded in the meter system. This system may also be very beneficial to those who rent flats since their clients would have to pay for electricity.

The present procedure is now definitely not any longer valid and no longer a practical one. After studying the benefits of the prepayment method, the current system is seen as inadequate and thus must be changed. It is assumed that since 1963[1] the clients have changed their habits and this is another reason in itself why the system should be changed.

[1] When the present system began to operate.

Chapter *five*

Describing the prepayment system method

" The technology is advancing exponentially and it will only accelerate."

Don D. Jordan, chairman and CEO, Houston Industries

5.1 INTRODUCTION

The pre-payment system is a metering system for the electricity supply that utilizes a 'pay as you go concept'.

There are two main types of Revenue Collection Systems:

One-way communication where the end-user pays and receives a disposable token (magnetic card) which transfers credit to the prepayment device and is then thrown away. Two-way communication where the end-user is provided with a personalised, re-usable token[1] to transfer credit to the prepayment device. Meter reading data is returned to the utility each time that credit is purchased, with additional transaction data covering debt status and tariff updates.

Revenue Collection Systems are useful for utilities that need to improve customer services, increase cash flow, reduce bad debt losses, or to eliminate difficult-to-access meters. A reduction in billing costs is also a benefit to the utility by removing the need for periodic meter reading and billing accounts.

Revenue Collection Systems guarantee income for the utility by collecting payment before consumption by using a token for data exchange. With Revenue Collection Systems the end-user is provided with a personal "account" which is held in the prepayment device. Credit is added to the prepayment device using the

[1] The token may be in the form of a key or smart card.

smart card via a vending machine, which will be situated in all towns and villages. Once the user inserts the smart card in his domestic electricity meter he is given credit for consuming electricity. If the credit in the account reaches zero, supply is disconnected but before an emergency credit is allowed by the system until payment is made.

5.2 TRANSFER OF DATA FROM CUSTOMER TO ENEMALTA AND VICE VERSA WITH THE USE OF THE SMART CARD

The smart card has potential benefits, for both consumers and Enemalta itself. The smart card incorporates a microprocessor and memory storage capacity, embedded in a plastic card such as those used in credit cards. This means that the most important aspect of such a pre-payment system is the flow of data between the utility and the customer. This may occur even if the contact is made just through a vending system. The transfer of data from customer meter to vending occurs each time that the customer's token is presented for crediting. The data taken would consist of the meter readings, the date, tariff, credit status and cumulative total credit. After this data transfer, the vending will give the new credit, new tariff and may take special actions where necessary.

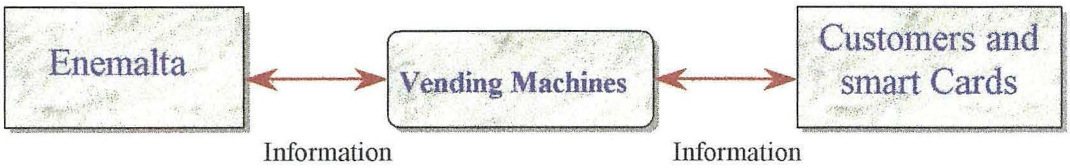
Transfer of data also occurs between vending and the central office. The central office equipment initialises this data transfer automatically. Data transferred at this stage are meter reading, transaction, special action reports, alarm status and end of period totals. Data transferred from central office to vending would include special actions to be taken, new tariffs, remote token authorization and validation of terminals.

One can note that meter readings taken by the customer smart card are a complete record of all consumption. The readings are timed and dated whenever they are inserted in the meter, and to protect meter memory readings are not taken unless a token card is inserted. The cards used are formatted so that one card can only be used with a single meter.

The key idea behind the smart card system is that whilst there will be no permanent physical link between Enemalta's customer information systems and the customer's premises, the smart card is used as a means of transferring information between the two parties. The information in the flow is payment and usage details, security/anti-tampering details and fault reports. Security is therefore built into the system and cross- checked automatically to prevent tampering.

The prepayment system offers a two-way communication of information, and it eliminates the need of any agents. Enemalta would be gaining access to information of the consumption at any time. When comparing the system in figure 5.1 below with that presented in figure 4.1, one can simply conclude that the former system is less complicated and more beneficial then the system currently adopted.

Figure 5.1 flow of information through prepayment system



5.3 WHAT ARE THE CONTRIBUTIONS OF THIS SYSTEM AND AT WHICH COST?

This pre-payment system will be offering a fully electronic system for the marketing of electricity and the payments of debts. This system caters for the need of modern society and can handle the changes occurring in the habits of customers. Through the automatic vending equipment a 24-hour service is available. Via this system a customer can charge their cards at any point in time, allowing high flexibility in purchasing patterns.

What makes the prepayment system so beneficial is that for the first time the customer can see electricity as a product. With the conventional metering system and in particular where the customer is familiar with the use of electricity the customer had begun to believe that electricity is a right and that the bill which he gets at the end of each period is an infringement of this right. Another benefit of the pre-payment system is that the customer may no longer be suspicious of the accuracy of the meter reading. This suspicion may have been aroused due to the fact that most of the customers do not know how the account was derived.

With the implementation of pre-payment metering in the domestic and commercial section, electricity can for the first time be purchased like any other product and service. The purchase may be done when desired, at a place of convenience and for the amount of money affordable. This system allows the consumer to budget his consumption. It also displays the remaining credit, and the consumption rate. With these facilities this system helps the customer to become more 'energy conscious'. When implementing this system Enemalta will be reducing the queries on the bills and bad debts considerably. While customers will be paying for the service given on time, Enemalta may take advantage of paying its own debts earlier thus saving high financing costs.

The pre-payment system will involve an extensive initial capital investment to change the meters, to get vending points and to change the Information System (IS). The current IS used by Enemalta may not be compatible with this new system. In 1998 a cost amounting to Lm566,000[2] was paid to WSC for their services of meter reading and billing, this cost would be spared.

[2] Enemalta Corporation Annual report 1999

5.4 HOW IS CREDIT GIVEN TO SMART CARD

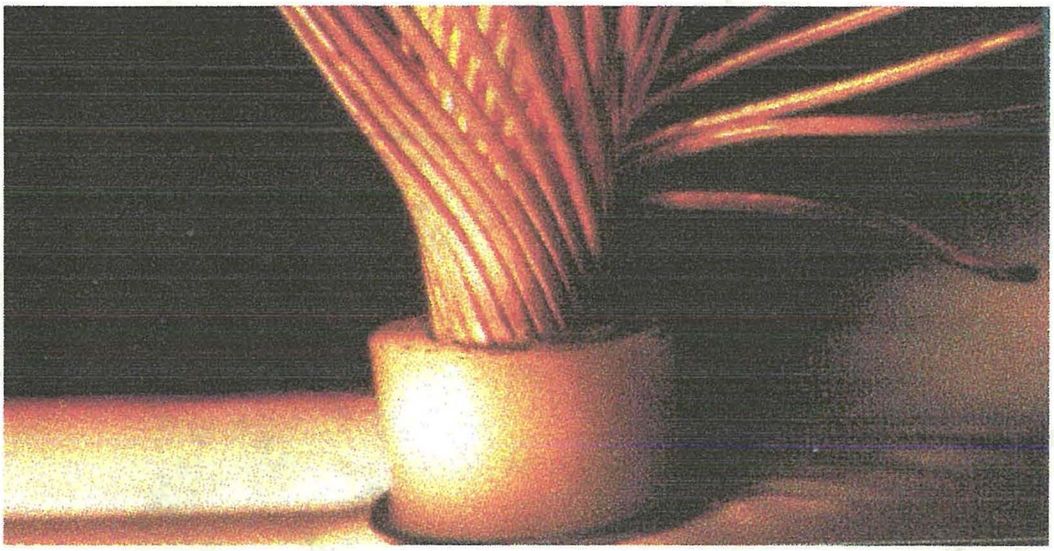
In order to give credit to the smart card, vending machines will have to be installed (at least one for every village). These will be put in commercial premises such as banks and stores. The meters will be programmed before installation for both tariff and energy credit amounts together with an initial credit to enable customers to use electricity. The recovery of this initial credit is programmed for the collection along with any other previous debt that the customer might have pending to Enemalta. This debt is to be collected weekly with the use of a recovery rate agreed between the customer and Enemalta. Once debt is settled the weekly debt collection rate reverts to nil and the customer will have to pay only for the consumption. The meters will also have a push button for an emergency credit facility so that the customer will not run out of electricity if he has not been able to purchase the energy source through the card. Also electricity will not be switched off during the night if the credit is not available.

5.5 COUNTRIES WHICH ARE CURRENTLY USING THIS SYSTEM

The current utilities using this system are London Electricity, Southern Electric, SWEB, Northern, South Eastern, Eastern Electricity in UK, Electricity de France, the Power co (New Zealand), Eszale (Hungary), Electrical (Belgium), ESB Irish Republic, PUB (Singapore) and a large number of utilities in South Africa. Surely the well-known names of these utilities confirm the reliability of this system.

Chapter *six*

Cost benefit analysis of the prepayment system method



6.1 INTRODUCTION TO COST BENEFIT ANALYSIS

Cost benefit analysis (CBA) was introduced by the Flood Control Act (1936) in USA. This legislation set out the social cost and benefits of flood control. Following this, CBA was also introduced in the context of welfare economics in the 1950's and 1960's in Europe and US.

6.2 DEFINITION OF CBA

CBA is a guide and aid in decision making although using this model may not fulfil the desire of the decision-maker for certitude and simplicity. Its aim is to help the decision maker in assessing the pros and cons of a policy or a project where the expected gains and losses are looked at also from the point of view of society's preferences. CBA is defined as:

> *"An estimation and evaluation of net benefits associated with alternatives for achieving defined public goals"*[1]

CBA is also an elaborate way of accounting for both positive and negative externalities. This appraisal technique attempts to take into account all the costs and benefits that result from a project that is being considered to be performed. The CBA also defines costs and benefits in much wider terms than the terms that

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[1] Sassone Peter G., Schaffer William A. **Cost benefit analysis a handbook.** Academic press USA (1978)

would be included by traditional accounting measures. A more detailed analysis of factors that will be involved in the project and included in the study is obtained by a CBA rather than with the traditional accounting investment appraisal. CBA also makes a study of all social costs and benefits involved not just the private costs and benefits as in the case of the traditional accounting methods.

6.2.1 BENEFITS OF CBA

The most important benefit of CBA is to overcome some of the problems of resource allocation created by the market mechanism. This is an investment appraisal technique whose fundamental rule is that of analysing and measuring the costs and benefits of capital projects or programmes to the whole community not only to the capitalists. In fact CBA compares between both private and social costs and benefits.

6.2.1.1 PRIVATE COSTS

Private cost is the cost one must bear in order to achieve a desired object. Paying a sum of money in order to buy a car is a classical example of a private cost. This cost is an internal one since the firm or household who incurs this cost must account for it clearly.

6.2.1.2 SOCIAL COSTS

Social cost is the total of private cost together with any other cost due to externalities caused by this action. In the example mentioned above, the cost of air pollution caused by the car is borne by others who did not buy the car. To arrive at the social cost a value is attributed to the external factors (ex. Air pollution and loud sound) and added to the private cost of the project under consideration. Social costs are not internalised by the individual or firm since such costs are not accounted for clearly and directly.

6.3 WEAKNESSES AND BENEFITS OF A CBA

The problem which lies in this technique is that all issues need to be expressed in a common classification so that an approximation of the aggregate price has to be calculated and this approximation must be as accurate as possible. This requisite is not always satisfied since the total price will include all costs and benefits that are both internal and external to the organisation. What shall be measured and how a monetary value is attributed is the most difficult and subjective part of the CBA. Externalities, which are included in the analysis, rely on standard decision and value judgements. The mathematical calculations made in order to carry out such estimations may undermine the values which are inputted in the analysis thus the help for decision making with CBA would be less than with the aid obtained from decisions already taken.

> *"This is the same as J. S. Mill had identified in utilitarianism: not all pains and pleasures are equal. Putting a price on the various components of a scheme is not as straightforward as the model suggests. We may have a fundamental disagreement about the values that are being applied to the project, such as decisions which involve amenities and natural beauty."*[2]

Projects that are being carried out for the first time have to be appraised by these methods since there are no available decisions to help with the project appraisal. The prepayment meter system in Enemalta is a first time issue and there are no previous decisions which could give an answer without going through a CBA.

CBA has been used with varying levels of success by governments all over the world. Its attractiveness as assistance in decision making is evident. CBA provides an apparently neutral technique for identifying goals, their effect and their costs and benefits. CBA provides the users with a comparable objective standard, which can serve to help in the formulation and choice from alternatives and options.

CBA will sometimes stimulate conflict and arouse opposition. Using it but provides a framework for public decision making to more responsible decisions. The decision made in this case will affect the community as a whole and the decider is entrusted to act on behalf of the community.

[2] Wayne Parsons **Public Policy: an introduction to the theory and practice of policy analysis,** Cambridge University Press P 400 (1996).

6.4 THE STAGES OF CBA

The process of carrying a CBA starts by valuing both social and private costs and benefits incurred in the useful life of the project under consideration. After that all costs and revenues are estimated the project may be analysed further by the use of either a discounting, a non-discounting appraisal technique or by using them both. Such techniques comprise the Payback (non-discounting), NPV and the IRR (both discounting). The latter two methods discount costs and benefits occurring in the future to compare them with present costs and benefits. These three methods would be those used in the dissertation after all costs have been identified. The following section would be giving a brief explanation of these three methods of appraisal, their advantages and disadvantages.

6.5 PAYBACK

Payback measures the length of time a project requires to recover the original cash outlay. This is commonly used in industry where cash in hand is a very important tool. In order to calculate the payback period one must consider cash receipts and not accounting profit. Non cash items such as depreciation are not taken into account.

Payback is easy to calculate and understand and it concentrates on cash flows. This is also accepted because it goes for those investments that pay you back the earliest and because the further away the estimated cash flows are the less accurate they will tend to be. However, the time value of money and the cash flows received after the payback period are completely ignored.

The time value of money is an important principle for the analysis of a project and it suggests that the value of money depends on when the cash flow occurs. The same amount of money is worth more today than in a year's time because of:

Risk: until money is received, there is a risk that the offer will collapse.

Inflation: value of money in terms of purchasing power tends to decline in periods of inflation.

Personal consumption preference: when one prefers to consume today rather than tomorrow.

As all other goods and services money has a price, it can be lent and thus earns an interest or it can be invested and one receives income in the form of a dividend or increase in market prices. This means that cash has an opportunity cost and it must be used efficiently.

6.6 NPV

The difference between the amount invested and the present value of future cash flows is called the NPV. The result can be either positive thus it would be worthwhile to invest or negative which means that one would end up worse off if he invests. NPV calculates a project's profit by comparing cash payments to cash receipts at the same point in time on a cash basis. This comparison may be done through the discounting of expected future cash flows back to the present with a discount rate representing the cost of living adjustment risk, cost of capital and inflation for the specific firm. The net future cash receipts are then deducted from the present value of the cash payments and the resulting figure would be either a positive NPV or a negative one.

NPV takes into account all the cash flows made in the life of the investment and the time value of money.

6.7 IRR

IRR is the discount rate that equates the present value of the expected cash outflows with the present value of the expected cash inflows. IRR is then used to compare it with the cut-off rate established by the firm in order to see which projects should be undertaken and which not. If IRR is lower than the cut-off rate, the project would be rejected since it would be generating less revenue than expected by the firm.

IRR is found through a trial and error process by choosing two rates for discounting that result in a positive and a negative NPV. This formula must then be applied:

$$\textbf{IRR} = \textbf{Lower Rate from NPV's calculated} + \left[\frac{\textbf{NPV of lower rate}}{\textbf{Total difference between 2 NPV's}}\right] \times \textbf{difference between the two discounting rates}$$

IRR also accounts for time value of money and is easy for people to understand as it is expressed in a percentage form. However, giving a return as a percentage may sometimes be misleading because 50% on an investment of Lm100 would not give the same income as 40% on an investment of Lm1,000. The percentage result on its own may be misleading for the right decision to be made so it is better to find the NPV as well.

6.8 COST BENEFIT ANALYSIS OF THE PREPAYMENT SYSTEMS IN ENEMALTA CORPORATION

In order to achieve the scope of this dissertation costs and revenues incurred to implement this system had to be identified. The process of the cost benefit analysis involved the classification of three areas.

6.8.1 INITIAL INVESTMENT

This involves the cost of purchasing and installing meters and vending machines. It was decided that for efficiency the meters are to be installed by sub-contractors. This would reduce cost of training personnel and buying tools required.

Vending machines will be installed in accessible places all over Malta. To be more efficient some machines would be operating automatically on a 24-hour basis. Total cash that will be initially paid would involve the cost of this equipment, of meters and the marketing campaign. The latter will be used to help customers with the use of the meters and the vending machines. Advertising must also ensure the customers about the accuracy of the system and benefits offered.

6.8.2 OTHER COSTS

Items included under this title are vending points maintenance and sales commission. No meter maintenance cost was provided for, as it was assumed that the present meters and prepayment meters would involve the same maintenance cost. Further it was assumed that the same maintenance staff would be trained to do this task and to install any future new meters for new customers when sub contractors are no longer involved. As the vending machines will be situated in commercial premises will be offered a commission in order to provide the service to Enemalta's customers.

6.8.3 COSTS SAVED

The most obvious cost that is going to be saved is the charges imposed by WSC every year for the billing. Bad debt is another cost that would be eliminated when the system is fully operating. Since payments are made more often cost of capital on liabilities would be reduced. Another saving for Enemalta is the reduction of theft since non-technical losses would be detected. The figures used in the cost benefit analyses have been taken from the financial statements and where necessary an average has been calculated over five years.

Any social benefits that could not be translated in monetary terms are further discussed in Chapter 7. These benefits would be over and above those mentioned in the cost benefit calculations.

6.8.4 WORK CARRIED OUT

After costs and benefits have been identified a cash flow analysis was made to study when cash movements had to be made. Two scenarios were taken in consideration; the first scenario involves the implementation of meters in two years, while in the second scenario these are installed in five years.

Another assumption taken is that the meters have an estimated life span of ten years. A discount factor of 15%, which is being used for this study, is equal to that used by Enemalta when appraising its projects.

Once cash analysis is finalised the NPV, IRR and Payback could be calculated. Following this one finds the results of the work carried out.

Table 6.1 Cost Benefit Analysis Computation - Option 1

Notes	Description	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	*Total*
	Capital Investment												
1	Prepayment meters	3,213,161	3,213,161										**6,426,322**
2	Cost of contractors required to install meters	1,000,000	1,000,000										**2,000,000**
	Investment required to install p/payment meters	4,213,161	4,213,161										**8,426,322**
	Vending Points												
3	Regular vending machines	44,984											**44,984**
4	24-hour stand alone vending machines	192,790											**192,790**
	Total investment including vending machines	4,450,935	4,213,161										**8,664,096**
5	Marketing Campaign	200,000	150,000	50,000									**400,000**
	Total investment for successful implementation	4,650,935	4,363,161	50,000									**9,064,096**
	Other costs												
6	Vending points maintenance		7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	**70,000**
7	Sales commission		270,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	**5,130,000**
	Total costs incurred	4,650,935	4,640,161	597,000	547,000	547,000	547,000	547,000	547,000	547,000	547,000	547,000	**14,264,096**
	Costs saved												
8	Billing charges by WSC			(566,000)	(582,980)	(600,469)	(618,483)	(637,038)	(656,149)	(675,834)	(696,109)	(716,992)	**(5,750,054)**
9	Bad debts			(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	**(180,000)**
10	Cost of Capital on Enemalta's liabilities saved			(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	**(29,619,000)**
11	Theft			(2,138,453)	(2,138,452)	(2,138,453)	(2,138,453)	(2,138,452)	(2,138,453)	(2,138,452)	(2,138,452)	(2,138,452)	**(19,246,072)**
	Savings made in the implementation of meters			(6,015,453)	(6,032,432)	(6,049,922)	(6,067,936)	(6,086,490)	(6,105,602)	(6,125,286)	(6,145,561)	(6,166,444)	**(54,795,126)**
12	Tax at 35% saved or incurred	(784,429)	(922,576)	992,283	1,031,452	1,051,706	1,070,715	1,088,627	1,105,580	1,121,695	1,137,085	1,184,460	**8,076,598**
	Result of Cash benefit analysis for this project	3,866,506	3,717,585	(4,426,169)	(4,453,981)	(4,451,215)	(4,450,221)	(4,450,863)	(4,453,022)	(4,456,591)	(4,461,476)	(4,434,985)	**(32,454,432)**
13	Discount Factor 15%	1	0.86957	0.75614	0.65752	0.57175	0.49718	0.43233	0.37594	0.32690	0.28426	0.24718	
	Net Present Value	3,866,506	3,232,700	(3,346,804)	(2,928,581)	(2,544,982)	(2,212,561)	(1,924,242)	(1,674,069)	(1,456,859)	(1,268,219)	(1,096,239)	**(11,353,351)**
		3,866,506	3,717,585	(4,426,169)	(4,453,981)	(4,451,215)	(4,450,221)	(4,450,863)	(4,453,022)	(4,456,591)	(4,461,476)	(4,434,985)	**(32,454,432)**
	Discount Factor 40%	1	0.71429	0.51020	0.36443	0.26031	0.18593	0.13281	0.09486	0.06776	0.04840	0.03457	
		3,866,506	2,655,434	(2,258,232)	(1,623,164)	(1,158,696)	(827,430)	(591,119)	(422,414)	(301,979)	(215,935)	(153,317)	**(1,030,345)**
		3,866,506	3,717,585	(4,426,169)	(4,453,981)	(4,451,215)	(4,450,221)	(4,450,863)	(4,453,022)	(4,456,591)	(4,461,476)	(4,434,985)	**(32,454,432)**
	Discount Factor 50%	1	0.66667	0.44444	0.29630	0.19753	0.13169	0.08779	0.05853	0.03902	0.02601	0.01734	
		3,866,506	2,478,390	(1,967,186)	(1,319,698)	(879,252)	(586,037)	(390,748)	(260,625)	(173,889)	(116,053)	(76,909)	**574,497**
14 a	*IRR %age*	46.42											

Table 6.2 Cost Benefit Analysis Computation - Option 2

Notes	Description	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	*Total*
	Capital Investment												
1	Prepayment meters	1,285,264	1,285,264	1,285,264	1,285,264	1,285,264							**6,426,322**
2	Cost of contractors required to install meters	400,000	400,000	400,000	400,000	400,000							**2,000,000**
	Investment required to install p/payment meters	1,685,264	1,685,264	1,685,264	1,685,264	1,685,264							**8,426,322**
	Vending Points												
3	Regular vending machines	44,984											**44,984**
4	24-hour stand alone vending machines	192,790											**192,790**
	Total investment including vending machines	1,923,038	1,685,264	1,685,264	1,685,264	1,685,264							**8,664,096**
5	Marketing Campaign	200,000	150,000	100,000	50,000								**500,000**
	Total investment for successful implementation	2,123,038	1,835,264	1,785,264	1,735,264	1,685,264							**9,164,096**
	Other costs												
6	Vending points maintenance		7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	**70,000**
7	Sales commission		108,000	216,000	324,000	507,000	540,000	540,000	540,000	540,000	540,000	540,000	**4,395,000**
	Total costs incurred	2,123,038	1,950,264	2,008,264	2,066,264	2,199,264	547,000	547,000	547,000	547,000	547,000	547,000	**13,629,096**
	Costs saved												
8	Billing charges by WSC						(618,483)	(637,037)	(656,149)	(675,833)	(696,108)	(716,991)	**(4,000,601)**
9	Bad debts						(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	**(120,000)**
10	Cost of Capital on Enemalta's liabilities saved						(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	(3,291,000)	**(19,746,000)**
11	Theft						(2,138,452)	(2,138,453)	(2,138,452)	(2,138,453)	(2,138,452)	(2,138,453)	**(12,830,715)**
	Savings made in the implementation of meters						(6,067,935)	(6,086,490)	(6,105,601)	(6,125,286)	(6,145,560)	(6,166,444)	**(36,697,316)**
12	Tax at 35% saved or incurred	(372,000)	(406,214)	(453,976)	(499,014)	(567,847)	1,050,802	1,070,706	1,089,451	1,107,179	1,124,021	1,154,402	**4,297,511**
	Result of Cash benefit analysis for this project	1,751,039	1,544,051	1,554,289	1,567,251	1,631,417	(4,470,133)	(4,468,784)	(4,469,150)	(4,471,106)	(4,474,540)	(4,465,041)	**(18,770,708)**
13	Discount Factor 15%	1	0.86957	0.75614	0.65752	0.57175	0.49718	0.43233	0.37594	0.32690	0.28426	0.24718	
	Net Present Value	1,751,039	1,342,660	1,175,260	1,030,499	932,763	(2,222,461)	(1,931,989)	(1,680,132)	(1,461,605)	(1,271,933)	(1,103,669)	**(3,439,568)**
		1,751,039	1,544,051	1,554,289	1,567,251	1,631,417	(4,470,133)	(4,468,784)	(4,469,150)	(4,471,106)	(4,474,540)	(4,465,041)	**(18,770,708)**
	Discount Factor 25%	1	0.80000	0.64000	0.51200	0.40960	0.32768	0.26214	0.20972	0.16777	0.13422	0.10737	
		1,751,039	1,235,241	994,745	802,432	668,228	(1,464,773)	(1,171,447)	(937,270)	(750,118)	(600,573)	(479,411)	**48,093**
14 b	*IRR %age*	24.86											

6.9 NOTES AND ASSUMPTIONS TAKEN IN THE COURSE OF THE COST BENEFIT ANALYSIS OF THE PREPAYMENT METERS

1. The two different options to be studied are:-

   Option 1 – 200,000 meters are installed in two consecutive years i.e. 100,000 meters per year.

   Option 2 – 200,000 meters are installed in 5 consecutive years i.e. 40,000 meters per year.

   In each case the cost of the meters is taken as GBP50 and taking the currency rate of 1.5561 (Appendix 6). The estimated useful life of the prepayment meters is considered to be 10 years. The cost benefit analysis is being carried out on a ten-year period.

2. To meet the targets in note 1 above, Mr. T. Mifsud suggested that contractors will have to be employed. Cost for contractors is estimated to be Lm10 per meter.

3. 70 vending machines would have to be bought and installed all during the first year for the use by the customers. These cost GBP1,000 and currency used is the same as above.

4. Also ten 24-hours stand-alone vending machines would have to be bought in the first year. Their cost is GBP30,000 using the same currency as above. All prices of the prepayment meters and vending machines have been taken from a quotation list given to Enemalta by Schlumberger Co Ltd.

5. Marketing campaign would be required for the public to help them in the use of this system and making it easier for them to accept it.

6. Cost to maintain the vending points is Lm100 per machine per year. Maintenance would be carried out by the staff currently employed in the dis/reconnection section as these would not be needed since defaulters would no longer exist. Cost of meter maintenance is assumed to be unchanged thus no further costs or savings are implied to occur over and above the present system.

7. Sales commission to be paid is 3% on the collections. In this study it is being assumed that 90% of sales would be collected from the vending machines put at commercial premises. However the options are different thus costs in first years would be different for the options stated in 1 above.

Option 1 – Sales made by vending machines are estimated to be Lm10million on the 1st year and Lm20million on the following years when the meters are fully installed.

Option 2 – in this case sales would be Lm4million in the 1st year and increase with this amount on the 2nd to 5th year when all 200,000 meters would be installed.

8. Savings on current expenses charged by WSC are Lm566,000 as stated in the financial statements of 1999 year ending 30th September 1998. This amount has been increased by 3% every year since quite all times WSC charged higher rates from year to year as shown in table 6.3 below. It was assumed that WSC would charge 3% more than the previous years in the following years.

Table 6.3 – Billing costs charged to Enemalta by WSC

Year	**1994**	**1995**	**1996**	**1997**	**1998**
WSC billing costs In Lm'000's	394	554	518	548	566
%age change		+40.6%	-6.5%	+5.75%	+3.3%

Source: Enemalta Corporation Financial Statements

9. Bad debts from 1995 to 1998 were Lm19,000, Lm14,000, Lm28,000 and Lm17,000[3] respectively. The average is Lm20,000 per year.

10. Cost of capital on liabilities was calculated on the assumption of 8% cost of Enemalta's debts and liabilities. Table 6.4 below gives an average of total debtors and bad debts for the years 1994 to 1998.

[3] Enemalta Corporation financial statements 1995-1998

Table 6.4 – Debtors and bad debts average for the years 1994 – 1998

Year	**1998**	**1997**	**1996**	**1995**	**1994**
Debtors (Lm'000's)	47,962	46,227	41,547	33,152	36,624
Bad Debts (Lm'000's)	17	28	14	19	117
Totals (Lm'000's)	**47,979**	**46,255**	**41,561**	**33,171**	**36,741**

Source: Enemalta Corporation Financial Statements

Total debtors and bad debts for 5 years are Lm205,707,000 (adding the totals for 5 years). Average debtors and bad debts thus is Lm205,707,000/5= Lm41,141,000. Cost of interests saved assuming that receipts of these amounts were used to pay debts would have been Lm41,141,000 X 8% = Lm3,291,000.

11. Average units of electricity stolen from the electricity division in Enemalta in the years between 1993 and 1997 were 152,746,582 as calculated in table 6.5. Their cost using the lowest i.e. 2 cents per unit is Lm3,054,932. This rate was for the fact of being prudent. This cost could have been larger if the rates applied were from higher blocks.

Table 6.5 – Calculation of stolen units

Year	Units Generated	Total losses	Technical loss 5% of units generated	Theft (Total losses less technical loss)
1993	1,463,741,800	265,495,311	73,187,090	192,308,221
1994	1,541,641,300	211,132,386	77,082,065	134,050,321
1995	1,632,559,000	262,588,656	81,627,950	180,960,706
1996	1,657,514,000	215,135,481	82,875,700	132,259,781
1997	1,685,931,000	208,450,533	84,296,550	124,153,983
		Total		**763,733,012**
		Average Theft	Total/5years	152,746,602
		Rate 2 cents/unit		Lm3,054,932

Source: Appendix 5

Rates applicable by Enemalta are listed below.

Domestic rates

- 1st block consists of the first 150 and meter consumption charge for Lm3 per quarter

- 2nd block depends on the number of persons in the household.

1 person	200.0 units at 2 c/unit
2 persons	262.5 units at 2c/unit
3 persons	344.0 units at 2c/unit
4 persons	450.0 units at 2c/unit
5 persons or more	587.5 units at 2c/unit

- 3rd block

1 person	1,600-150-200.0=1,250.0 units at 4c/unit
2 persons	1,600-150-262.5=1,187.5 units at 4c/unit
3 persons	1,600-150-344.0=1,106.0 units at 4c/unit
4 persons	1,600-150-450.0=1,000.0 units at 4c/unit
5 persons or more	1,600-150-587.5=862.5 units at 4c/unit

Consumption above 1600 units is charged at 4.5cents per unit.

Commercial rates

Meter and consumption charge on the first 50 units is Lm6. Over 50 units at 3.7c per unit for this entire sector except for licensed hotels and guesthouses with the N.T.O.M. which charge for over 50 units is 3.6c per unit.

This shows that the 2c per unit could even be 4.5c per unit and the theft cost could even be doubled. It was assumed in this study that 70% of theft would be totally eliminated. 70% was taken in order to be prudent since it was assured that prepayment meters are high deterrents of theft. Thus theft is reduced by Lm3,054,932 X70% = Lm2,138,452.

Note 12

Table 6.6 Tax Computation - Option 1

Notes	Details	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total
	Option 1												
12a	Capital Allowances	1,041,224.86	1,208,931.78	444,904.83	399,975.49	359,593.94	323,298.54	290,674.68	261,349.96	234,989.87	211,293.93	96,821.23	**4,873,059.12**
	Cost of contractors to install meters	1,000,000.00	1,000,000.00										**2,000,000.00**
	Marketing Campaign	200,000.00	150,000.00	50,000.00									**400,000.00**
	Vending points maintenance		7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	**70,000.00**
	Sales commission		270,000.00	540,000.00	540,000.00	540,000.00	540,000.00	540,000.00	540,000.00	540,000.00	540,000.00	540,000.00	**5,130,000.00**
	Total increase in expenses	**2,241,224.86**	**2,635,931.78**	**1,041,904.83**	**946,975.49**	**906,593.94**	**870,298.54**	**837,674.68**	**808,349.96**	**781,989.87**	**758,293.93**	**643,821.23**	**12,473,059.12**
	Billing charges by WSC			(566,000.00)	(582,980.00)	(600,469.40)	(618,483.48)	(637,037.99)	(656,149.13)	(675,833.60)	(696,108.61)	(716,991.87)	**(5,750,054.07)**
	Bad debts			(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	**(180,000.00)**
	Cost of capital on Enemalta's liabilities saved			(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	**(29,619,000.00)**
	Total savings in costs			**(3,877,000.00)**	**(3,893,980.00)**	**(3,911,469.40)**	**(3,929,483.48)**	**(3,948,037.99)**	**(3,967,149.13)**	**(3,986,833.60)**	**(4,007,108.61)**	**(4,027,991.87)**	**(35,549,054.07)**
	Total change in profit	**2,241,224.86**	**2,635,931.78**	**(2,835,095.17)**	**(2,947,004.51)**	**(3,004,875.46)**	**(3,059,184.94)**	**(3,110,363.30)**	**(3,158,799.16)**	**(3,204,843.73)**	**(3,248,814.68)**	**(3,384,170.63)**	**(23,075,994.95)**
	Tax at 35%	**784,428.70**	**922,576.12**	**(992,283.31)**	**(1,031,451.58)**	**(1,051,706.41)**	**(1,070,714.73)**	**(1,088,627.16)**	**(1,105,579.71)**	**(1,121,695.30)**	**(1,137,085.14)**	**(1,184,459.72)**	**(8,076,598.23)**

Note 12

Table 6.7 Tax Computation - Option 2

Notes	Details	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total
	Option 2												
12b	Capital Allowances	462,855.86	495,610.02	574,073.91	644,754.10	708,421.13	380,190.13	341,877.11	307,432.15	276,463.84	248,620.50	182,698.62	**4,622,997.36**
	Cost of contractors to install meters	400,000.00	400,000.00	400,000.00	400,000.00	400,000.00							**2,000,000.00**
	Marketing Campaign	200,000.00	150,000.00	100,000.00	50,000.00								**500,000.00**
	Vending points maintenance		7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	7,000.00	**70,000.00**
	Sales commission		108,000.00	216,000.00	324,000.00	507,000.00	540,000.00	540,000.00	540,000.00	540,000.00	540,000.00	540,000.00	**4,395,000.00**
	Total increase in expenses	**1,062,855.86**	**1,160,610.02**	**1,297,073.91**	**1,425,754.10**	**1,622,421.13**	**927,190.13**	**888,877.11**	**854,432.15**	**823,463.84**	**795,620.50**	**729,698.62**	**11,587,997.36**
	Billing charges by WSC						(618,482.94)	(637,037.43)	(656,148.55)	(675,833.01)	(696,108.00)	(716,991.24)	**(4,000,601.16)**
	Bad debts						(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	(20,000.00)	**(120,000.00)**
	Cost of capital on Enemalta's liabilities saved						(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	(3,291,000.00)	**(19,746,000.00)**
	Total savings in costs						**(3,929,482.94)**	**(3,948,037.43)**	**(3,967,148.55)**	**(3,986,833.01)**	**(4,007,108.00)**	**(4,027,991.24)**	**(23,866,601.16)**
	Total change in profit	**1,062,855.86**	**1,160,610.02**	**1,297,073.91**	**1,425,754.10**	**1,622,421.13**	**(3,002,292.81)**	**(3,059,160.32)**	**(3,112,716.40)**	**(3,163,369.17)**	**(3,211,487.50)**	**(3,298,292.62)**	**(12,278,603.80)**
	Tax at 35%	**371,999.55**	**406,213.51**	**453,975.87**	**499,013.94**	**567,847.40**	**(1,050,802.48)**	**(1,070,706.11)**	**(1,089,450.74)**	**(1,107,179.21)**	**(1,124,020.63)**	**(1,154,402.42)**	**(4,297,511.33)**

Note 12a

Table 6.8 Capital Allowances - option 1

Details	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total
Option 1												
Prepayment meters												
Initial allowance 20%	642,632.22	642,632.22										1,285,264.44
Wear and tear allowance 10% for meters bought in Yr 0	321,316.11	224,921.28	202,429.15	182,186.23	163,967.61	147,570.85	132,813.77	119,532.39	107,579.15	96,821.23		1,699,137.77
Wear and tear allowance 10% for meters bought in Yr 1		321,316.11	224,921.28	202,429.15	182,186.23	163,967.61	147,570.85	132,813.77	119,532.39	107,579.15	96,821.23	1,699,137.77
Vending machines												
Initail allowances 20%	47,554.78											47,554.78
Wear and tear allowance 12.5%	29,721.74	20,062.17	17,554.40	15,360.10	13,440.09	11,760.08	10,290.07	9,003.81	7,878.33	6,893.54		141,964.34
Total capital allowances for option 1	**1,041,224.86**	**1,208,931.78**	**444,904.83**	**399,975.49**	**359,593.94**	**323,298.54**	**290,674.68**	**261,349.96**	**234,989.87**	**211,293.93**	**96,821.23**	**4,873,059.12**

Note 12b

Table 6.9 Capital Allowances - option 2

Details	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total
Option 2												
Prepayment meters												
Initial allowance 20%	257,052.89	257,052.89	257,052.89	257,052.89	257,052.89							**1,285,264.44**
Wear and tear allowance 10% for meters bought in Yr 0	128,526.44	89,968.51	80,971.66	72,874.49	65,587.04	59,028.34	53,125.51	47,812.96	43,031.66	38,728.49		**679,655.11**
Wear and tear allowance 10% for meters bought in Yr 1		128,526.44	89,968.51	80,971.66	72,874.49	65,587.04	59,028.34	53,125.51	47,812.96	43,031.66	38,728.49	**679,655.11**
Wear and tear allowance 10% for meters bought in Yr 2			128,526.44	89,968.51	80,971.66	72,874.49	65,587.04	59,028.34	53,125.51	47,812.96	43,031.66	**640,926.62**
Wear and tear allowance 10% for meters bought in Yr 3				128,526.44	89,968.51	80,971.66	72,874.49	65,587.04	59,028.34	53,125.51	47,812.96	**597,894.96**
Wear and tear allowance 10% for meters bought in Yr 4					128,526.44	89,968.51	80,971.66	72,874.49	65,587.04	59,028.34	53,125.51	**550,082.00**
Vending machines												
Initail allowances 20%	47,554.78											**47,554.78**
Wear and tear allowance 12.5%	29,721.74	20,062.17	17,554.40	15,360.10	13,440.09	11,760.08	10,290.07	9,003.81	7,878.33	6,893.54		**141,964.34**
Total capital allowances for option 2	**462,855.86**	**495,610.02**	**574,073.91**	**644,754.10**	**708,421.13**	**380,190.13**	**341,877.11**	**307,432.15**	**276,463.84**	**248,620.50**	**182,698.62**	4,622,997.36

13. Enemalta discounts the projects which are being considered to be implemented with 15% discount rate. This rate considers risk cost of capital, inflation and cost of living adjustments (COLA). In this study the same discount rate is being applied for the prepayment meters.

14. The formula used in order to find the internal rate of return in both options is the following.

$$\text{IRR} = \text{Lower Rate from NPV's calculated} + \left[\frac{\text{NPV of lower rate}}{\text{Total difference between 2 NPV's}}\right] \times \text{difference between the two discounting rates}$$

14a Option 1

$$\text{IRR} = 40\% + \left[\frac{801{,}303}{801{,}303 + 259{,}548}\right] \times 10 \qquad = 47.55\%$$

14b Option 2

$$\text{IRR} = 15\% + \left[\frac{3{,}241{,}408}{3{,}241{,}408 + 226{,}118}\right] \times 10 \qquad = 24.35\%$$

6.10 PREPAYMENT METERS PAYBACK CALCULATIONS

This is used in order to see when would the investment yield back to Enemalta what was invested in the initial years.

6.10.1 OPTION 1

Table 6.10 Outlays and Savings – Option 1

	Year 0	Year 1	Year 2	Year 3	Total
Outlay Lm	4,650,935	4,363,161	50,000		**9,064,096**
Savings Lm	784,429	922,576	5,023,169	5,000,980	**11,731,154**

Up till year 2 the amount of the investment which is received is Lm6,730,174 thus some savings from year 3 is needed.

Lm9,064,096 – Lm6,730,174 = Lm2,333,922

(Lm2,333,922/Lm6,730,174) x 12 = 4.2 months or

(Lm2,333,922/Lm6,730,174) x 365 = 127 days

The project is paid back in the 4th month of year 2 to be more accurate on day 127 of year 2. On that day Enemalta would have recovered all cash outflows.

6.10.2 OPTION 2

Table 6.11 Outlays and Savings – Option 2

	Total outlay (Lm)	Total savings (Lm)
Year 0	2,123,038	372,000
Year 1	1,835,264	406,214
Year 2	1,785,264	453,976
Year 3	1,735,264	499,014
Year 4	1,685,264	567,847
Year 5		5,017,132
Year 6		5,015,784
Total	**9,164,094**	**12,331,967**

Up to year 5 the amount of the investment which will be received is Lm7,316,183 thus some savings from year 6 is needed.

Lm9,164,094 – Lm7,316,183 = Lm1,847,911

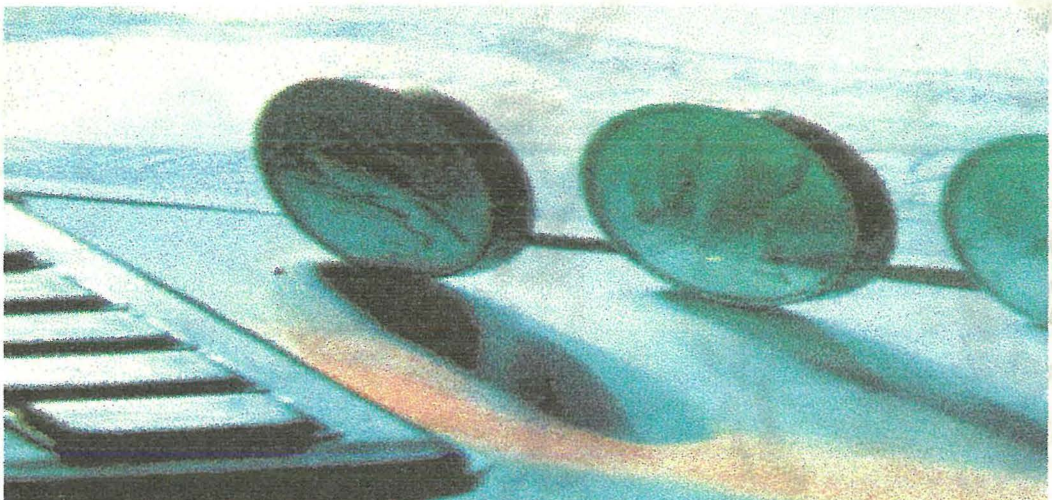
(Lm1,847,911/Lm5,015,784) x 12 = 4.4 months or

(Lm1,847,911/Lm5,015,784) x 365 = 134 days.

The project will be paid back in the 4th month of year 6 or after 134 days have elapsed from year 6.

Chapter *seven*

Evaluation of results



7.1 EVALUATION OF OPTION 1 RESULTS

The cost benefit analysis carried out in the previous chapter shows that Enemalta would benefit if the prepayment meters were implemented.

If the first option is chosen meters are implemented in two years. This option leaves a NPV of Lm11,353,351. This amount represents cash flow which may be used by Enemalta after allowing for all costs required to implement the system, cost of capital, inflation and other costs.

The IRR for this option is 46.42%; this gives the rate of return that would be generated to Enemalta when the system is in operation. This is a very good percentage and it means that Enemalta would be loosing money if it does not invest in these prepayment meters. Enemalta will not have other prospective investments that generate such a high level of return.

Payback for this option is achieved in the 4th month of year 2. An early payback is an advantage since cash used would be repaid to Enemalta and reused in any other project or payments of any liabilities.

The project that is being proposed is not sensitive to neither price nor currency fluctuations. This may be concluded from the results obtained in calculating the net present value that is large enough to cater for any changes in costs.

7.2 EVALUATION OF OPTION 2 RESULTS

In the case of this option NPV is Lm3,439,568 while IRR is 24.86%. Both results are lower than those achieved in option 1 this means that if meters are installed in 2 years Enemalta's benefits would be higher since savings would begin at an earlier stage. However, one must consider that meters installed in the 2nd to 4th year would still have to generate income to Enemalta since their useful life has not been fully utilised.

The payback for this option is the 4th month of year 6 that is later than the time taken for the first option. Also one has to state that Enemalta would be paying for the meters at lower amounts every year since payment for initial investment would be made over 5 years.

7.3 PAYMENT OF ARREARS: A FURTHER BENEFIT

Further to costs saved mentioned in the cost benefit analysis carried out in chapter 6 another benefit would be the collection of arrears from debtors. Collection of arrears would be made easier since crediting the customer's smart card with a stipulated amount would pay the bills due. The cumulative debtors of Lm47,962,000 in 1998 would all have to be paid automatically by using this method. It is being assumed in this study that a period of 5 years would be given to all defaulting customers to settle all their bills due. Thus the sum of Lm9,592,400 per year would have to be received by Enemalta in part payment of the bills due. Mr. T. Mifsud said that the debtors in the financial statements were all due to the electricity section since petroleum and gas section were paid as the invoices were given.

7.4 FURTHER BENEFITS FOR THE PREPAYMENT SYSTEM

The prepayment system would be generating a positive NPV and a very good IRR for both options. Apart from the positive results achieved this system would generate further benefits to Enemalta, its customers and last but not least to the environment. These benefits have not been included in the cost benefit analysis carried out in chapter 6 because they are difficult to quantify in monetary terms. However, these benefits are over and above the positive results obtained.

7.4.1 ENEMALTA

Enemalta would get direct data processing through vending points thus there will be no need for any employees to input data. The manual accounting system for the electricity section would thus be eliminated. This reduces the possibility of losses occurring due to mistakes or collusion arising from human intervention in the manual system.

This system can also offer considerable tariff flexibility and it would reduce the problem of peak demand and idle capacity. Another benefit is that after the implementation of this system electricity will be seen as a product and not any longer as a right which the customer has. If the electricity section of Enemalta begins to generate profits workers would be more motivated since there would no longer exist the thought that they are being of burden to Enemalta.

7.4.2 CUSTOMERS

Not only would Enemalta be getting benefits from this system but also the customers would gain. The first benefit is that customers can monitor and budget their consumption. This is made possible since the meter displays the remaining credit and consumption rate. Whenever credit is low the meter gives an audible signal thus customers are ensured that they are not left without any credit and no disconnection is required. However, if credit finishes during the night the service would not be interrupted as the customer is given emergency credit.

The customer will be freed from the thought of receiving a high bill. This is a flexible payment tool and electricity is paid as it is consumed. Any past pending bills would not have to be paid as a lump sum but divided in installations payable during an agreed time period. The amounts agreed would be deducted from the credit that the customer has as often as the meter is programmed until the pending bill is settled.

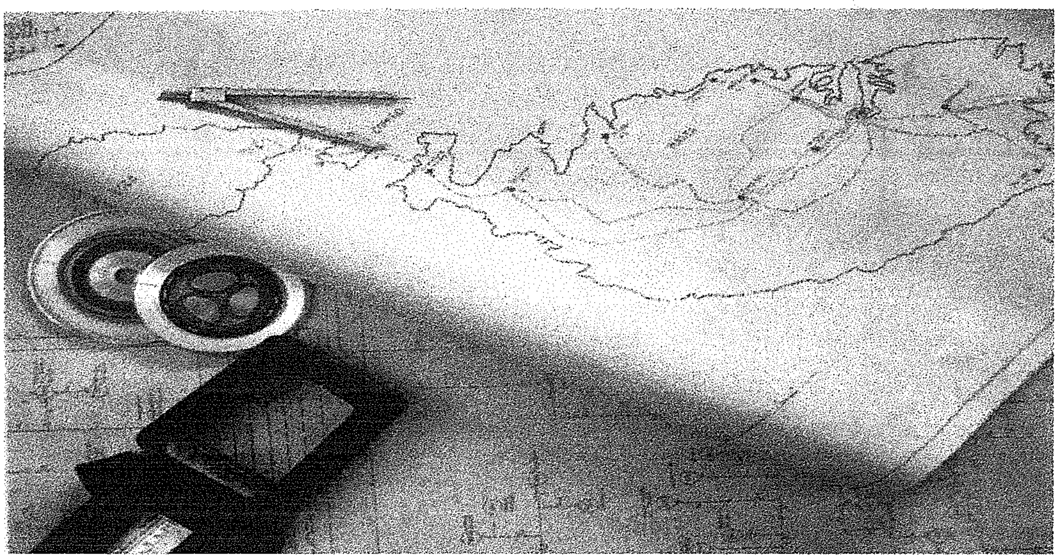
Short let apartment owners would benefit from this system since electricity consumption would not be paid by the owners but by whoever is consuming electricity. Another benefit for the customers is that they do not have to stay at home waiting for the meter reader.

7.4.3 ENVIRONMENT

Customers would become more conscious of energy consumption. This will induce them to reduce consumption wherever possible. There would be less pollution and less energy consumed because wasteful consumption is eliminated. Furthermore customers would invest in solar and other energy producing systems which are more environmental friendly.

Chapter eight

Recommendations and Conclusions



8.1 RECOMMENDATIONS

The cost benefit analysis carried out in this study shows that it would be appropriate if Enemalta implements prepayment meters in all household premises.

However, it may be recommended to Enemalta that they should as well implement automatic meter readers (AMR) at heavy consumers' premises. This is suggested because prepayment meters would not be effectively used in the industrial sector. Heavy consumption accounts for up to 60% of total electricity production. This meter will help Enemalta to get paid by this section of customers, while prepayment meters would cater for other customers. Appendix 7 gives some information about different types of AMR's and a brief description of how they work.

Another suggestion made to Enemalta is to make government departments pay for their electricity consumption on time. Another cost that should not be borne by Enemalta is the street lighting which totals to Lm1,000,000[1] per year. This service rendered should be paid for by the government and should not be accounted for by Enemalta adding to its losses.

Furthermore it may also be recommended that household meter visits are made once or twice yearly to detect any problems arising. Enemalta's employees may

[1] Enemalta Corporation Financial Statements 1999

carry out these visits. Although this meter detects tampering, one must still be careful to prevent customers from finding ways of stealing units.

It may be recommended that vending machines be kept at the local council offices. There are 67 offices over Malta and Gozo and most of them have been contacted and the officers in charge have agreed to this idea of implementing a vending machine at these premises. This would be convenient for the customers as these premises are kept open during working hours and are situated in accessible areas. Apart from this, commission would be paid to local councils and may be used for the improvement of the town or village.

Another suggestion would be that when the system is fully implemented, Enemalta should buy and instal further vending machines on request by customers or local councils for the convenience of the clients. This study proposed the purchase of 70 vending machines. Since there are 67 local council offices across the Islands two vending machines would be installed in B'kara, Qormi and Mosta instead of one. These are the most populated areas in Malta. Figure 8.1 gives an overview of where both standard and automatic vending machines should be situated.

Enemalta would need to consider ways of advertising and which media would be the most effective. Training is an important issue and clients must be shown how easy the operation of the prepayment meters is. This will help to reduce clients' resistance to change.

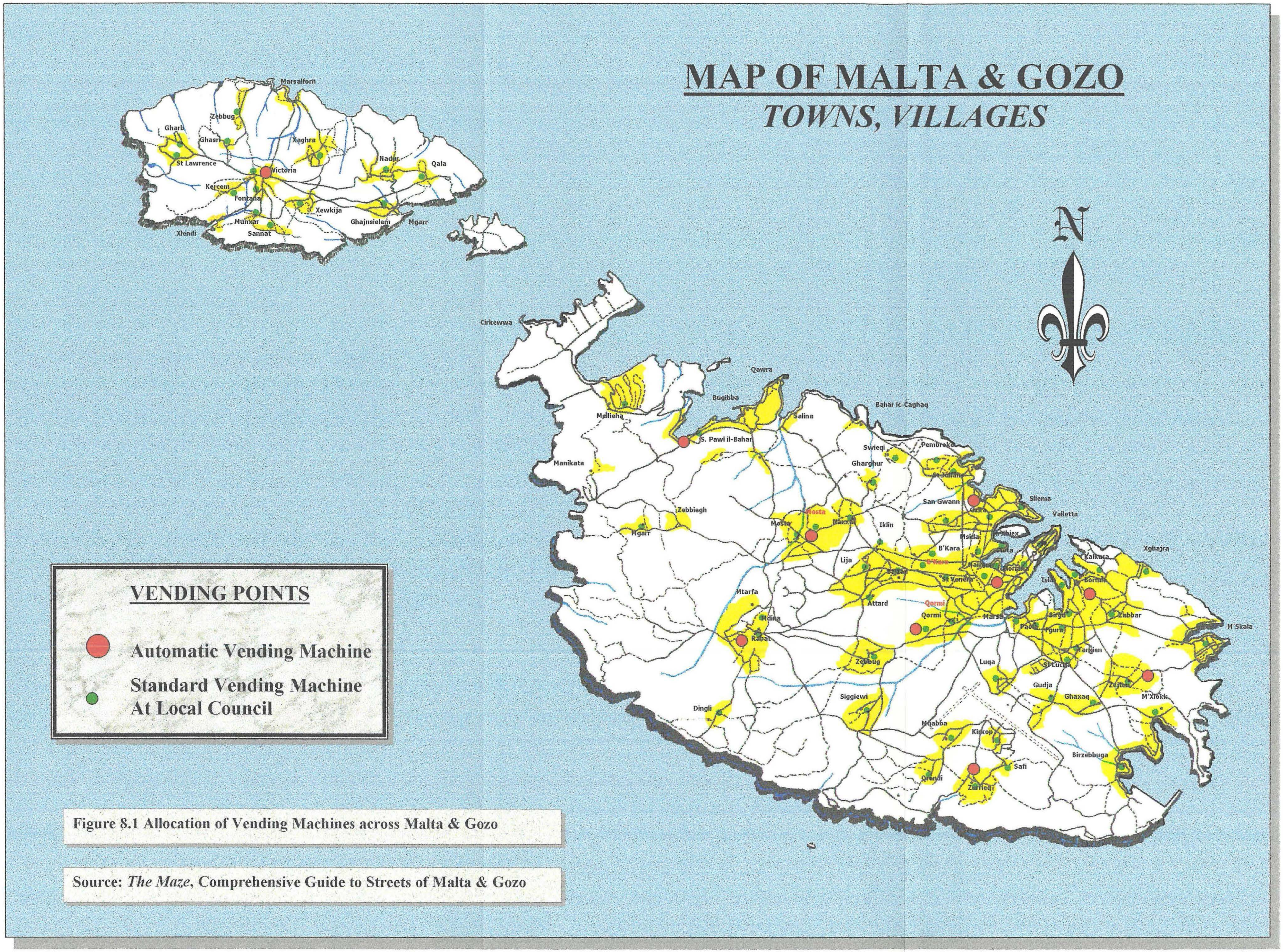


Figure 8.1 Allocation of Vending Machines across Malta & Gozo

Source: *The Maze*, Comprehensive Guide to Streets of Malta & Gozo

8.2 FOREIGN SURVEYS

A customer survey carried out in New Zealand after 12 months from the installation of the prepayment meters showed an overwhelming support for this system.

In this survey 99% of the customers were satisfied with paying for electricity in advance. 98% said they would recommend the system to friends or family. When asked what they liked about having the pre-payment system, 46% of responses related to budgeting. A further 30% related to the advantage of no electricity account and 13% to monitoring of usage and reduction of consumption[2].

In the research carried out in the United Kingdom these results were confirmed. 91% of customers said that this is a good way of paying for electricity. 88% of customers found the system easy to use and 87% said that they would recommend the system to their friends[3].

8.3 CONCLUSION

As mentioned in the course of this dissertation the main problems faced by Enemalta Corporation are high debts, non-technical losses and high annual capital expenditure. With the implementation of this project Enemalta would be able to

[2] Beale Chris and Martin Ian, Prepayment Metering a New Zealand experience.
[3] Metering and billing in the UK utilities, Market line International Ltd. (1998)

tackle these difficulties. Prepayment meters are the only method that allows Enemalta to collect its money before the service is provided. By going ahead with this project Enemalta will be adopting new payment methodologies with which both Enemalta and its customers would benefit.

Information gathered via a two-way communications interface can be used to facilitate customer profiling. In turn, this data can be used to segment the market. For example, the usage profile of a young professional will differ dramatically from that of a retired couple. With detailed consumption information, service packages could be designed which focus on the needs of the individual consumer. In addition, Enemalta would be in a better position to target certain customers with value-added products or related services.

After analysing the results one might ask why Enemalta Corporation has not implemented this system yet. One must consider whether this is a political problem brought about by the intrusion of both parties or a resistance to change by the Board of Directors (BOD) because of lack of information. If the former problem is the cause one would have to wait for both political parties to mature in order to have an Enemalta that is efficiently operated. If the problem is the latter one, then top management has the duty to inform the BOD of all benefits accruing to Enemalta should it use such system. A last point to make is the pressure that EU would be making over Enemalta to be more competitive and efficient. This was already highlighted in the EU screening process where it was stated that in Malta there are no specific laws or policy regarding energy efficiency.

Appendices

APPENDIX 1

SCHLUMBERGER CO. LTD

SCHLUMBERGER CO. LTD.

Managing vast quantities of energy and resource data is increasingly a key element for utilities wishing to reduce costs, increase efficiency, and market energy-related services. Schlumberger Resource Management Services (RMS) uses its in-depth knowledge of energy and resource markets to identify areas where a utility can integrate all of its systems to better serve its customers. Schlumberger RMS is a solution provider to electricity, gas and water resource industry clients worldwide, helping them to manage resources and enhance transactions. The RMS group delivers innovative solutions through strategic consulting services combined with smart measurement products, systems and services. Schlumberger's approach is centred on creating and sharing value with their customers.

Schlumberger's vision is to be the leader in providing solutions to the resource industry by understanding customer needs. Their mission is to provide solutions to resource industries and help in the management of resources, enhance transactions and strengthen relationships. The goal that Schlumberger tries to achieve is to do the right things right the first time, every time. This is the essence of Schlumberger RMS quality, driven by another goal that is absolute customer satisfaction.

For this reason, Schlumberger RMS, like all of Schlumberger, has embarked on a Total Quality Management (TQM) journey involving everyone in the organisation. The Schlumberger RMS TQM philosophy is consistent with and empowers its principles of action. Schlumberger RMS is customer-focused, solutions-oriented, value-driven and efficiency-centred.

Schlumberger offers a variety of services. These services focus on three main areas: -

- **Residential**

  From traditional neighbourhood developments to high-rise apartments, Schlumberger RMS offers proven electromechanical and solid-state solutions for both single-point and multi-tenant applications. These metering options can provide mass memory, time-of-use, remote communications, and programmable intelligence.

- **Commercial and industrial**

  Schlumberger RMS offers the industry's most complete range of products and services destined for commercial and industrial users. These metering options provide per-phase data, loss compensation, and two-way communication that uses analogue to digital technology and a SiteScan diagnostic system.

- **Transmission and industrial**

Whether monitoring feeder/loader imbalances or smoothing excessive peaks over time, Schlumberger RMS products reduce generation, distribution and maintenance costs while taking system planning beyond crisis management. These metering options deliver comprehensive meter information to utility computers through fibre optics, modem or cellular-based communications networks for perpetual, real-time system evaluation.

More than 200 million electricity, natural gas, water and heat meters with the Schlumberger name on them are installed around the world. Schlumberger RMS is the world's largest provider of specialised products, systems and services which measure, communicate and process data for the energy resource and water industries. However Schlumberger offers more services to other industries such as telecommunication, banking, and health transport. These services are offered to industries throughout the whole world as seen in Table A1.1 below. The Schlumberger smart card growth in the past few years has outpaced that of the industry. Despite smart card technology reaching certain maturity, the company notes that stakes for success are getting much higher and require suppliers to invest heavily in research and development.

Table A1.1 : World smart card consumption and forecast 1999-2000

Regions	**Millions**	**% Share of Total**	**Millions**	**% Share of Total**
Europe Middle East Africa	707	50%	850	48%
Asia Pacific	364	26%	485	28%
Latin America	294	21%	350	20%
North America	35	3%	65	4%
Total	**1,400**	**100%**	**1750**	**100%**

Source: Schlumberger

Schlumberger is the leading provider of smart card-based solutions worldwide. Drawing on 20 years' experience in pioneering smart card innovations, Schlumberger is continuing to evolve the next generation of smart cards, parking terminals, ticketing machines, payphones, banking terminals, servers, software, applications and systems integration that will play a key role in the 21st century's digital age.

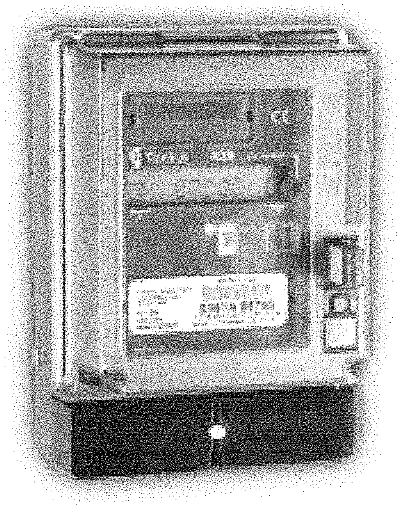


Figure A1.1 Schlumberger's prepayment meter

APPENDIX 2

SOLAR ENERGY

SOLAR ENERGY

Solar electricity is the electricity generated directly from sunlight using solar or photovoltaic cells. The word photovoltaic refers to an electric voltage caused by light. Solar cells were first developed to power satellites for space programmes. Most solar cells are made from a form of silicon, a hard material that is either dark blue or red in appearance. As sunlight shines on the surface of the silicon cells, electricity is generated by a process known as the photoelectric effect. Individual solar cells can be compared to batteries, used in torches and radios in that they produce only a low-voltage direct current. Each silicon solar cell produces about 0.4V. So just as several batteries are needed to radios to build up voltage, solar cells are connected together in series to produce a higher voltage, which is more useful. These modules are called solar panels. Since we use 240V A.C (Alternating Current) these solar modules must be connected in series to add up the voltage till 240V is obtained. Or, even higher value if a high wattage power system is required. This would be useful to supply a small village or to add this solar network to the distribution centre such as a power station. Since the voltage produced of these modules is D.C. (Direct Current) and our system is A.C. a converter is needed. To complete the system, rechargeable batteries are needed to store electricity for later use at night or during cloudy periods.

Although solar energy may be both plentiful and clean, it is certainly not cheap, because the equipment required to generate electricity, converting it and storing it in a useful form are not free. Solar energy is not usually available at a predicted constant rate, due to the weather conditions and the intensity of sunshine. Significant investment is required to produce electricity with these solar modules. The formidable barriers for a successful implementation of solar energy are not scientific or technological, but rather economic and institutional. Though the scientific aspect of solar energy utilization has been solved to a good degree, the most serious problem whether solar energy will be commercially viable, as a practical component of our energy needs is still unanswered.

APPENDIX 3

WIND GENERATION

WIND GENERATION

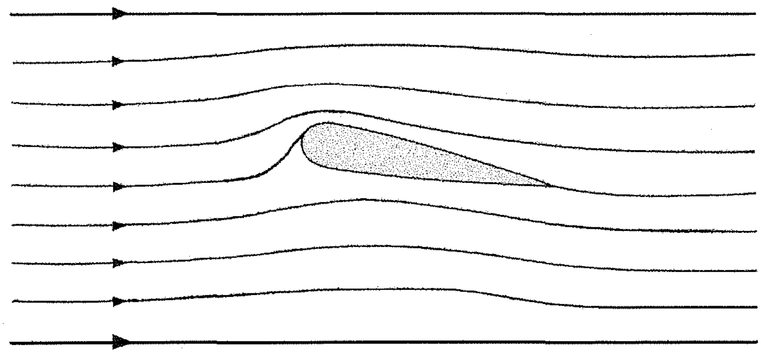
The wind generator consists of a rotor or blades, which are mounted on an axle. When the rotor rotates, it transmits a twisting force or torque[1] to a generator; as a result the generator rotates and generates electricity.

Energy taken from the air is ultimately converted in electric power. The principle of the wind turbine is rather simple. Once the way it works is understood, one can come to a conclusion that they are in fact flying machines. The thin blades or airfoils of the rotor are shaped like the wings (or perhaps the propellers) of aircrafts and for very similar reasons. With the aid of figure A3.1 below we learn that the airflow above the airfoil moves faster than the air below it. The crowding-up of steam lines tells us this. Hence, the air pressure on the upper side is less than below because a small vacuum is produced which, finally results in an upward force. This is what keeps the aircraft airborne. Naturally if the airfoil is vertical, as in the case of the wind turbine, rather than horizontal as in the case of the wings of the aircraft, the force is not upwards but sideways. So the blades rotate.

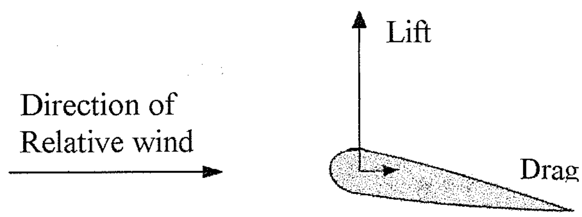
[1] A force causing rotation.

Figure A3.1 Airflow around an airfoil

Flow around airfoil



Forces on an airfoil



There are still problems, which have to be overcome before this turbine works in the most efficient way. Three of which are:

1. The turbine must match the winds.
2. The power must match demand.
3. The voltage generated must match our equipment (or the rest of the system, for large-scale generation).

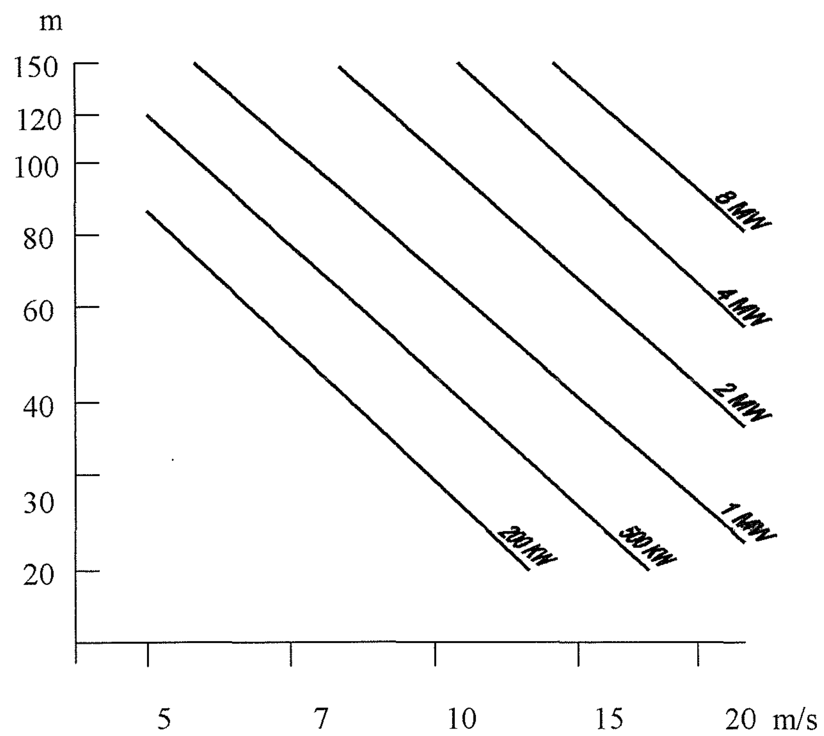
The first problem is that these wind generators must be designed for a particular range of wind speeds and a particular site. The second problem is that these generators do not have a constant output, due to the fact that the wind periods are not constant all year round. The last problem adds another limitation. Electric power is generated by rotating a coil inside a magnet (or vice versa). Now the speed or rotation determines the frequency of the alternating voltage; the number of cycles per second, or hertz. All our present mains operated equipment such as household appliances and industrial plant and machinery are designed for 50Hz supply. The efficiency curve for a wind turbine peaks at a certain tip-speed ratio, which means a different best turbine speed for each wind speed. So there is another compromise to be made. Either the turbine runs at a fixed speed, in which case it cannot always be at its wind's peak efficiency or it runs at the most efficient speed for the wind that's blowing. In the latter case we have to face the cost, complexity and losses of the electrical equipment needed to convert the frequency. This problem can be overcome by building complex wind turbines with a variable pitch of the airfoil which means that the blades of the generator twist to match the wind. Another problem is that these machines are not so robust to handle the strong winds and so they require continuous maintenance.

ENVIRONMENTAL EFFECTS.

Like the sunlight from which it derives its power, the wind is not a very concentrated energy source. Figure A3.2 below shows the rotor diameter needed in various winds to produce a specified electric power.

To take one example a turbine situated at a site, which could rely on a 30-mph or 13m/s wind for an appreciable fraction of the year, an output of 2MW would need a 60-meter rotor over a 100-meter or higher tower. Since one of these turbines is not enough, an array of these turbines must be connected together at a distance of ten rotor diameters. Another problem regarding these turbines is the noise generated by them. The problem's consequences of this problem are multiplied due to the fact that Malta lacks urban areas large enough to accommodate these networks without disturbing the inhabited neighbourhood.

Figure A3.2 Wind speed, rotor diameter and power



APPENDIX 4

BUYING ELECTRICITY FROM SICILY

BUYING ELECTRICITY FROM SICILY.

Italy uses the same type of electrical supply as Malta. In theory it would be very beneficial for Enemalta to import electricity from Sicily to accommodate peak demands. This importation of electricity would be made possible via the use of submarine cables. In practice though this would entail a large initial investment outlay because of the long distance between the two islands.

Mr. Mifsud argued that Enemalta would be better off if it invested in capital to produce electricity itself, rather than going through this investment to import electricity.

APPENDIX 5

UNITS GENERATED BY ENEMALTA

APPENDIX 5

Table A5.1 Units Generated by Enemalta

					Units Sold Under Different Categories								
Year	*Gerenated*	*Losses*	*Used*	*Sold*	*Industrial % of Sold Units*		*Domestic % of Sold Units*		*Commercial % of Sold Units*		*Distillers*	*%*	*% unit sold*
1964/65	132,086,440	13,835,631	8,932,043	109,639,119	50,857,446	*46.39*	32,182,082	*29.35*	26,599,591	*24.26*			*88.79*
1965/66	148,210,930	14,526,370	8,831,940	124,881,920	59,169,330	*47.38*	37,122,022	*29.73*	28,590,568	*22.89*			*89.58*
1966/67	175,350,030	23,883,703	12,470,990	139,108,787	65,554,922	*47.12*	42,933,509	*30.86*	30,620,356	*22.01*			*85.35*
1967/68	199,048,470	27,496,014	15,009,390	156,546,466	68,380,501	*43.68*	50,753,398	*32.42*	37,412,587	*23.90*			*85.06*
1968/69	220,251,390	29,055,436	15,846,290	173,007,154	72,175,598	*41.72*	59,348,374	*34.30*	41,483,182	*23.98*			*85.62*
1969/70	258,636,230	47,695,058	20,002,734	191,060,612	78,457,683	*41.06*	75,364,376	*39.45*	37,238,553	*19.49*			*81.18*
1970/71	284,702,830	49,468,134	21,895,885	213,338,811	78,872,528	*36.97*	86,945,015	*40.75*	47,521,268	*22.28*			*81.18*
1971/72	309,999,550	47,685,327	16,363,102	245,951,121	83,166,849	*33.81*	101,682,136	*41.34*	53,668,136	*21.82*	7,434,000	*3.02*	*83.76*
1972/73	334,362,300	32,409,173	24,480,400	277,472,727	98,920,505	*35.65*	111,150,110	*40.06*	58,665,362	*21.14*	8,736,750	*3.15*	*89.54*
1973/74	347,093,500	52,266,763	24,044,500	270,782,237	94,779,086	*35.00*	110,116,396	*40.67*	58,119,765	*21.46*	7,966,990	*2.94*	*83.82*
1974/75	310,273,550	44,711,960	20,070,060	245,491,530	96,319,929	*39.24*	76,835,769	*31.30*	68,967,178	*28.09*	4,329,230	*1.76*	*84.59*
1975/76	351,170,000	43,292,845	23,165,340	281,711,815	93,626,326	*33.23*	96,117,851	*34.12*	86,967,178	*30.87*	5,000,460	*1.78*	*85.89*
1976/77	386,919,600	60,769,307	25,489,550	300,660,743	96,768,200	*32.19*	106,042,615	*35.27*	91,433,128	*30.41*	6,416,800	*2.13*	*83.19*
1977/78	432,468,880	64,757,673	29,045,770	338,665,437	114,957,977	*33.94*	114,019,705	*33.67*	101,944,545	*30.10*	7,743,210	*2.29*	*83.95*
1978/79	469,613,400	62,198,936	32,343,790	375,070,674	127,517,781	*34.00*	126,537,116	*33.74*	113,100,807	*30.15*	7,914,970	*2.11*	*85.78*
1979/80	509,822,710	94,022,456	31,583,470	384,216,784	129,182,997	*33.62*	122,711,339	*31.94*	124,401,864	*32.38*	7,920,584	*2.06*	*80.34*
1980/81	534,180,893	103,001,983	30,948,213	400,230,697	118,005,399	*29.48*	138,655,864	*34.64*	136,390,727	*34.08*	7,178,707	*1.79*	*79.53*
1981/82	588,559,220	131,405,331	35,313,670	421,840,219	136,634,944	*32.39*	135,647,215	*32.16*	142,036,020	*33.67*	7,522,040	*1.78*	*76.25*
1982/83	652,168,420	113,386,285	42,420,640	496,361,495	176,802,661	*35.62*	163,653,313	*32.97*	148,302,004	*29.88*	7,603,517	*1.53*	*81.40*
1983/84	715,471,390	120,243,626	38,599,737	551,093,414	187,122,771	*33.95*	198,269,366	*35.98*	165,701,277	*30.07*	*		*82.09*
1984/85	766,890,240	134,984,543	48,342,800	577,914,677	197,812,346	*34.23*	200,260,149	*34.65*	179,842,182	*31.12*	*		*81.07*
1985/86	826,230,480	167,279,344	45,198,500	606,902,846	205,618,516	*33.88*	202,813,246	*33.42*	198,471,084	*32.70*	*		*78.39*
1986/87	933,409,450	212,533,449	64,010,530	653,332,241	241,547,252	*36.97*	210,074,793	*32.15*	201,710,196	*30.87*	*		*75.45*
1987/88	992,497,180	174,798,686	78,462,670	735,130,764	277,301,215	*37.72*	233,033,375	*31.70*	224,796,174	*30.58*	*		*80.79*
1988/89	1,095,024,210	202,999,503	88,881,200	803,143,507	302,892,199	*37.71*	267,103,549	*33.26*	233,147,759	*29.03*	*		*79.82*
1989/90	1,143,572,580	198,277,381	92,304,520	852,990,679	328,890,848	*38.56*	275,782,119	*32.33*	248,317,712	*29.11*	*		*81.14*
1990/91	1,278,502,610	225,592,646	98,106,600	954,803,364	361,478,664	*37.86*	320,864,711	*33.61*	272,459,989	*28.54*	*		*80.89*
1991/92	1,418,656,100	281,542,042	104,775,300	1,032,338,758	406,461,939	*39.37*	331,292,230	*32.09*	294,584,589	*28.54*	*		*78.57*
1992/93	1,463,741,800	265,495,311	111,945,700	1,086,300,789	426,567,432	*39.27*	340,574,884	*31.35*	319,158,473	*29.38*	*		*82.36*
1993/94	1,541,641,300	211,132,286	115,720,000	1,214,788,914	488,265,811	*40.19*	381,595,611	*31.42*	344,927,492	*28.39*	*		*85.19*
1994/95	1,632,559,000	262,588,656	110,853,100	1,259,117,244	488,961,995	*38.83*	399,853,539	*31.76*	370,301,710	*29.41*	*		*82.74*
1995/96	1,657,514,000	215,135,481	103,553,300	1,338,825,219	509,875,851	*38.08*	430,413,121	*32.15*	398,536,247	*29.77*	*		*86.16*
1996/97	1,685,931,000	208,450,533	105,144,000	1,372,336,467	450,319,464	*32.81*	474,579,528	*34.58*	447,437,475	*32.61*	*		*86.81*

Number of Consumers

Industrial	**996**
Commercial	**42,602**
Domestic	**163,558**
	207,156

** - Shown with Consumption in Stations*

Source: Enemalta Corporation Statistics

APPENDIX 6

CURRENCY RATES

Table A6.1 Currency Rates

1998	
January	1.5428
February	1.5396
March	1.5210
April	1.5163
May	1.5607
June	1.5443
July	1.5444
August	1.5571
September	1.5641
October	1.5882
November	1.5896
December	1.5887
Total	**18.6568**

Average for the year 1998 **1.5547**

1999	
January	1.5958
February	1.5814
March	1.5619
April	1.5556
May	1.5462
June	1.5408
July	1.5547
August	1.5507
September	1.5294
Total	**14.0165**

Average for the year 1999 until September **1.5574**

Average currency rate for 1998 and 1999 used in the cost benefit analysis **1.5561**

Source: Central Bank of Malta, Quarterly review, December 1999

APPENDIX 7

AUTOMATIC METER READER

FUTURE METER TECHNOLOGY

Competition is getting tougher and customers - especially commercial and industrial customers - are becoming more demanding because they have identified power consumption as a cost factor that can be reduced or better controlled. Detailed recording of power consumption showing customer consumption patterns is essential for Enemalta in order to meet this challenge. As a result it should make certain new demands on its future meter investments.

AUTOMATIC METER READING

Automatic meter reading (AMR) is the remote collection of consumption data from customers' utility meters over telecommunications, radio, power-line and other links. This utility is mainly beneficial for heavy consumers.

There are essentially three technologies which are used, radio frequency, telecommunications or power-line connections. These technologies are discussed below.

Radio Frequency

With this technology, the metering unit is fitted with transmitters which are operable over short or long ranges. The signal is usually emitted constantly and can be picked up and decoded by a receiver which can be hand held or vehicle mounted. The range is dependent on the equipment used.

Telecom connections

One means of passing data between two remote sites is to use telecommunications links. This system requires the utility to call up a meter over a telephone line, were the first type of telephone AMR systems to be deployed. The technology is mature and costs are stable. However, in many cases, the additional costs of a dedicated telephone line cannot be justified. A technology has been developed which prevents the telephones in a property from ringing when the utility initiates a read and this has led to the increasing popularity of this type of AMR.

Data from individual meters at the customer's premises is passed to an interface unit on site, these meters need not be within the same building as data can be passed from remote sites by networking links. The data from all the meters is then polled from the interface unit by Enemalta via conventional telephone lines. Within Enemalta, the data can be passed into the IT system for analysis and as a data input to other IT systems.

Drawbacks to this type of AMR system are relatively insignificant and limited to line cost issues and the need for Enemalta to maintain up to date telephone number records of their clients.

Dial inbound systems work by causing the meter automatically to call Enemalta at periodic intervals. Problems of busy lines are alleviated and the only drawback to such systems is Enemalta's reliance on the customers own telephone line to provide the connection between the two parties.

Power Line Carrier (PLC)

An alternative to remote metering via telephone lines or radio frequency is provided by the use of electricity power cables. Enemalta already has a cable connection to every one of the premises they supply, and through a new technological development they are able to remotely read meters via this link.

Recent advances have been made in this technology with the announcement by Nortel and Norweb Communications that they have developed a technology that will allow data transfer across existing power cables at speeds of over 1 Mbit/s. The development has been targeted for providing internet access via electricity companies' distribution networks. However, if the technology enables such high band width data transfer, there is certainly the provision for transmitting metering data in the same way.

It still remains to be seen how much data can be transferred reliably in this way. If the technology is as robust as Nortel and Norweb Communications claim, then there is the scope for electricity companies operating the system to be able to read the meters of other utility companies, such as those in the water industry, via the same technology. Electricity companies would then be able to cover some of their costs by offering such services to other companies.

Applications and benefits

Automatic meter reading devices can now be fitted over the face of existing electricity without physically interfering with Enemalta's meter or service connections. The reading device is connected to a radio transmitter, telephone, or cable TV communication system. This allows the utility company to realise some of the benefits of AMR whilst minimising the capital expenditure.

Competition has required utility companies to dramatically transform their operations. This meter allows two-way communication connections to each customer thus it would enable improved service at lower cost in two ways. First, the communications capability can diagnose problems, clear troubles, and eliminate expensive field visits. The result from the customer's point of view is fast, responsive, trouble-free service. From Enemalta's standpoint, operating costs are substantially reduced. Second, two-way communication enables load management and real-time pricing programmes. Load shedding and real-time pricing reduce costs by shaving energy consumption peaks, thus reducing the need for expensive plant capacity additions and enabling value-pricing strategies.

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