LOAD SCHEDULING WITH COGENERATION AND REAL TIME PRICING

By

Dawid J Erasmus

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DISSERTATION SUMMARY

LOAD SCHEDULING WITH COGENERATION AND REAL TIME PRICING

The increase in energy costs, restructuring of electricity supply industry, quality of supply standards and environmental responsibility, initiated an investigation to utilize available carbon monoxide for cogeneration at an industrial site. A literature study indicated that most of the elements involved in establishing a cogeneration plant, were investigated individually, but had not been evaluated as a system with an indication of their relationships.

The main objective of this study was to create a methodology to evaluate the impact of load scheduling, cogeneration and electrical tariff structures on the energy cost of an industrial operation. A modelling methodology was developed to evaluate the requirements for each of the elements, which were identified as the following processes:

Plant and stockpiles
Gas and fuel
Power generation technology
Electricity tariffs
Financial evaluation

Each of the processes' input requirements were evaluated in terms of being sufficient in providing either useful information or a model from which information could be manipulated.

This methodology was then applied to a titanium slag producer with electric arc furnaces and excess carbon monoxide, which was burnt and treated as waste.

OPSOMMING VAN VERHANDELING

LOAD SCHEDULING WITH COGENERATION AND REAL TIME PRICING

Die verhoging van energie pryse, herstruktuering van elektrisiteitsvoorsieningsindustrie, standaarde vir elektrisiteitsvoorsiening en omgewingsbeheer het aanleiding gegee tot die ondersoek van die gebruik van beskikbare energie bronne vir kogenerasie by 'n industriële aanleg. 'n Literatuur studie het aangetoon dat die elemente betrokke by die daarstelling van 'n sodanige kogenerasie aanleg, individueel ondersoek was, maar nie as 'n eenheid of 'n sisteem, waarvan die onderlinge afhanklikheid ondersoek was nie.

Die hoofdoelwit van hierdie studie is gerig daarop om 'n metodiek te ontwikkel waarmee die invloed van lasskedulering, kogenerasie en elektrisiteitstariewe ondersoek kan word op die energie kostes van 'n industriële aanleg. 'n Model metodiek is ontwikkel om die vereistes van die elemente, wat as prosesse geidentifiseer is, te ondersoek:

Aanleg en storing
Gas en brandstof
Elektrisiteitsopwekkings tegnologie
Elektrisiteitstariewe
Finansiële ontleding

Elk van die prosesse se insetvereistes word ondersoek en uitspraak word gelewer oor die voorsiening van, of inligting, of 'n model, waarmee inligting verkry kan word.

Hierdie model word dan toegepas op 'n titanium dioksied produseerder met elektriese boogoonde en afval koolstof monoksied, wat verbrand word.

LIST OF ABBREVIATIONS

AC	Access Charge
AL	Additional Load
BC	Basic Charge
BFG	Blast Furnace Gas
CBL	Customer Baseline Load
CCG	Combined Cycle Generation
CHP	Combined Heat and power generation Plant
CO	Carbon Monoxide
COG	Coke Oven Gas
DSM	Demand Side Management
EDF	Electricité de France
ESI	Electricity Supply Industry
IPC	Integrated Pollution Control
IPP	Independent Power Producer
IRR	Internal Rate of Return
LCC	Life Cycle Costing
LD	Linz Donawitz
LDG	LD Furnace Gas
LHV	Low Heating Values
LNG	Liquified Natural Gas
MR	Monthly Rental
MRG	Methane Rich Gas
MWe	Mega Watt Electric
NER	National Electricity Regulator
NPV	Net Present Value
NP	New Profile
PGP	Power Generating Plant
RL	Reduced Load
RTP	Real Time Pricing

RTP_1	Real time price including the profit adder.
RTP_2	Real time price excluding the profit adder
HMC	heavy mineral concentrate
MSP	Mineral separation plant
DE&S	Duke Engineering and Services Africa, Inc.
RBM	Richards Bay Minerals
NP	New Profile

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CHAPTER 1

1.0 PROBLEM IDENTIFICATION AND BACKGROUND

1.1 Introduction

The objective of this chapter is to provide background information on aspects that motivated this study. Problem identification will then be motivated with information obtained from a literature search, which was studied during the research.

Energy efficiency awareness, environmental awareness and turmoil in the electricity supply industry were the driving forces to initiate this study on cogeneration options with real time pricing tariff optimisation, through which possible electricity cost increases can be countered. Conclusions of a global survey conducted [1], shows that the established electric utilities began to discover that power production by smaller cogenerators could be economically justified when compared with their own long term avoided cost of production of such increments of load. The philosophy has since spread to other countries, and "non-utility" generation is being promoted with the expectation and achievement to reduce electricity cost. The importance of cogeneration is confirmed in countries such as Colombia [2], Japan [3], Taiwan [4] and Canada [5]. The potential for cogeneration in South Africa has been investigated in 1993 and shows that a total of 1471 MW was possible [6], which can be broken down as 1290 MW for chemical and fuel processing, 60 MW for sugar and 121 MW for metal manufacturing.

1.2 Government policy options and electricity regulatory issues

The National Electricity Regulator (NER) as the controlling authority of the Electricity Supply Industry (ESI) in South Africa has the specific objective "to exercise control over

the electricity supply industry so as to ensure order in the generation and efficient supply of electricity." Thus the NER, established under the Electricity Act, has powers to regulate private generation whether for use internally in the industry concerned, or in the event of sale to the next consumer and in that case to monitor the charges. With the NER being a government controlled regulatory body, it provides the government with the opportunity to make certain policy decisions, which will be quantified next.

Firstly, the state of the country's economy is an important factor which will guide government to make policy decisions that may result in reinvestment in industry and renewed trading which in turn will impose a demand on electricity generating capacity. A capability of obtaining power plants in as short a time as possible would become a necessity and this could be accomplished by adopting a policy of encouraging small private generation or cogeneration. This cogeneration should be of sufficient capacity for own requirements with excess for resale to adjacent communities, which will be promoting the Independent Power Producer (IPP) concept. The IPP's are broadly classified as those sectors of industry where cogeneration was both technical and economically feasible for generating electricity for own use or for exporting or selling to other consumers.

The second reason for such a policy would be the result of government priorities to utilise capital funds for building programs of domestic housing and electrification, educational expansion projects and other social upliftment activities. The funding of these may compete with that for the construction of new power stations. If power station funding in particular and perhaps some of the other programs could be undertaken by the private sector, the funding by government would be considerably less.

The utility in South Africa, Eskom, is at present a juristic body established in terms of the Eskom Act (no 40 of 1987). It has no shareholders and is seen by many as a national asset. The Eskom Act also provides that Eskom does not pay income tax. With the promulgation of the new Eskom Amendment Bill that was approved by Parliament on 11 June 1998, the

Minister of Public Enterprises will take the necessary steps to make Eskom a company, with the State as the sole shareholder [7]. The privatisation of the ESI has been and still is a contentious issue and there could be pressure to retain statutory control of Eskom, for example simply on the grounds that the supply of power could be controlled, and cross-subsidisation to finance less profitable rural electrification, more easily applied. Electricity may also be more readily taxed in order to augment government monetary resources. Even if the ESI is privatised, the money required to subsidise rural electrification can be obtained from normal taxation sources, which are more widely spread over the economy, and private electricity generation can be taxed anyway. The advantage to government however is that the capital amounts required for the expansion of power generation must also be privately secured and that competition between generators and distributors of electricity should assist to keep the price of electricity to an optimum low.

At this stage the Electricity Supply Industry (ESI) is in the process of major change without clear indication on the expected outcome and this leads to uncertainty about the future electricity prices.

1.2.1 Environmental aspects

Information from the EDF (Electricité de France) in [8] clearly shows that coal is used to produce 40% of the world's electricity and the planet has sufficient reserves for the next 250 years [8]. Coal consumption is set to double between now and 2015 and this growth in consumption of coal for electricity generation will be subject to stringent international regulations to ensure environmental protection. On the question of the preservation of the environment, effective contributions to the reduction of pollutants such as SO_2 occurring in both the combustion of coal, or in ash, or from the effluent run-off from the dumps of discarded coal, would have widespread support, not only from those living in the coal producing areas, but also in adjacent territories which might be affected by acid rain. Providing incentives to install de-sulphurisation plants at coal or oil-fired power stations,

should be an effective means to promote control of this aspect, and direct subsidies or tax deductions in respect of the capital expenditure for the plant should be considered.

Creating a more environmentally sustainable future is one of the greatest issues facing us and there is a need for a national database, to be utilised for the storage and access of air quality data which has been collected throughout the country [9].

More importantly, the assurance of adequate quality control of data being generated by monitoring activities throughout the country is required. This will result in central planning and effective utilisation of resources and funds to support Integrated Pollution Control (IPC) objectives. If this is implemented it will put a lot of pressure on any organisation or company whose emission levels are not within regulatory standards.

These pressures as well as the incentives would encourage the use of fluidised-bed combustors for burning discarded coal or bunker fuel oil, thus achieving a desirable objective also of utilising this waste material and conserving more high grade energy resources. Likewise the use of hydraulic power plants will reduce the production of CO_2 into the atmosphere from equivalent coal burning plants.

The above aspects may also be interpreted that there is a need for environmental regulatory bodies to set more stringent objectives and that must be seen as a warning to others who do pollute the atmosphere with less aggressive emission levels, such as flaring and burning of furnace off-gas

1.2.2 Quality of Supply (QoS)

Worldwide, the financial cost implications of poor quality of electricity is being measured, quantified and analysed. Poor power quality impacts are always translatable, albeit with difficulty, into economic or financial terms. With the implementation of NRS048 as an industry standard in May 1997, the NER has decided that the initial compliance would be enforced with discretion but it would be necessary to concentrate on data collection [10]. This would assist with the establishment and refinement of the benchmarks set for the various quality supply parameters. The NRS048 specifies the compatibility level and assessment methods for quality parameters such as voltage and frequency regulation requirements, voltage pollution limits for harmonic distortion, flicker and voltage unbalance as well as specifications for supply interruptions and voltage dips.

By addressing only one aspect of quality of supply, Erasmus [11] has demonstrated that with the implementation of NRS048, the electricity supply network has not changed but new rules were implemented. He further demonstrated that, for the industry, electricity is an important operating requirement, which contributes to the economic growth of the country and that careful consideration should be given to the business case before NRS048 is implemented as a universal standard. Mitigation technologies and equipment exists but can be capital intensive without reaching unrealistic targets.

A utility generator normally generates perfect voltage waveforms with high supply reliability. Quality is adversely affected in the transmission and distribution process, which will result in consumers suffering loss of production, and equipment such as semiconductor fuses in variable speed drives, due to commutation failure caused by dips.
In South Africa, most of the power-generating stations are centralised inland where the coal resources are, with very large consumers at remote distances from the source. The transmission lines stretch over vast distances and different terrain forms, which also have an impact on the quality of supply. One possible solution would be to provide some generating capacity closer to the load to neutralise these effects. The typical utility coal

fired power station would be uneconomical due to the unavailability of the coal, which will have to be transported to site.

This then places the focus on the option discussed earlier, namely, the power production by smaller cogenerators or independent power producers such as chemical and fuel processing industry, sugar industry, wood, paper and pulp industry and metal manufacturing industry.

1.3 Problem identification

This study was also partly motivated base on specific requirements for investigating cogeneration for a industrial plant that produces titanium dioxide, with Carbon monoxide gas which is treated as waste. The threats of increase in cost of energy, uncertainties in the ESI with quality of supply issues were the main motivational factors for this study.
In view of the need to further investigate the cogeneration option for the metal industry in South Africa, it will be necessary to provide some information to demonstrate the unavailability of certain information. Anderson [6] has indicated that the total potential from cogeneration is nearly 1500 MW and is shown in Table 1.1

Table 1.1: Total cogeneration capacity in South Africa in 1993

Industrial sector	Installed generating plant (MW)	Potential additional plant (MW)	Possible surplus for export (MW)
Chemical & fuel	635	1290	485
Sugar	217	60	72
Wood, paper & pulp	279	Nil	12
Metal manufacturing	Nil	121	Nil
Total	1131	1471	569

This survey was published in 1993, with a subsequent change in the metal manufacturing in 1995. This was the installation of a 50 MW cogeneration plant at Samancor's Meyerton Works in Vanderbijlpark [12]. In a search for additional information on how this project was approached, it was found that very little information was published.

A survey on the non utility generators [6], in the United States of America, has revealed that cogeneration is more readily applied in certain industries which contribute about 70% of the total 32 880 MW between five major industry groups as illustrated in Table 1.2.

Table 1.2: Total cogeneration installed capacity per industry group in USA

Industrial sector	Installed capacity (%)
Chemical & allied products	22,8
Other unclassified	21,7
Forestry & wood products	21,3
Coal, oil and gas mining processes	10,0
Metal mining & manufacturing	8,1
Transportation & public utilities	7,0
Agriculture & food processing	3,3
Other manufacturing	2,7
Public administration	1,4
Educational services	1,7

In the United Kingdom and Western Europe cogeneration is better known in the form of combined heat and power where most of this generation is utilising natural gas and does have an 11,2 % contribution from iron and steel industries. If one considers the information available on cogeneration for metal mining and manufacturing, it is clear that it is not as prominent as for instance the chemical and fuel, forestry and wood and coal industry. Also, an additional factor, is the secrecy amongst and within the titanium oxide or slag producing companies within the metal industry market, who mainly process mineral sands, for which limited information is published regarding their operations and processes. This is confirmed by the literature search and first hand experience that they deemed that type of information as propriety which can have a negative influence on their position in the competitive market. From this evaluation and the need to investigate a cogeneration plant

on a titanium oxide producer, the opportunity was identified to provide building blocks on the methodology that should be followed when evaluating a cogeneration option for such an industry. The relationship and dependency of the various building blocks can then be evaluated as a system.

1.4 Main Objective

The main objective of this study is to create a methodology to evaluate the impact of load scheduling, cogeneration and real time pricing on the energy cost of a typical titanium mineral producer in the mineral sand industries.

1.5 Specific objectives

To be able to satisfy the main objective, the following specific objectives can be used as goals:

1.5.1 Develop a modelling methodology for a cogeneration feasibility study with the aid of building blocks and determine the relationship of the processes identified, as a system.

1.5.2 Plant operations and stockpiles methodology

1.5.3 Gas or fuel evaluation methodology.

1.5.4 Power plant evaluation methodology.

1.5.5 Electricity tariffs evaluation methodology.

1.5.6 Financial evaluation methodology

1.5.7 Verify methodologies and models with a case study.

1.6 Conclusions

From information obtained from literature and practical experience, the following can be concluded:

- Companies in the chemical, sugar, wood and pulp industrial sectors do make use of available resources for cogeneration.

- Most information available was conducted on operations that have steam available for cogeneration as well as on those with a combination of steam and natural gas. The iron and steel industry does make use of water for roof and wall cooling which is the start of the steam process, whilst electric arc furnaces have only recently adopted this method on a small scale.

- A clear distinction is made in the metal and steel industries between operations with electric furnaces which make use of blast furnaces, coke ovens, the Linz Donawitz (LD) process and electric arc furnaces. Process related information is more readily available on the first three types with more secrecy regarding the electric arc furnace.

- A world-wide investigation of competitors in the mineral sands industry, who provides titanium minerals, has revealed that none of them make use of the gas from their electric arc furnaces for cogeneration.

- Research which has been published, focuses on the individual components such as power plants and real time pricing optimisation techniques, without taking into

consideration the need for evaluating the combination thereof. No general methodology exists that will provide building blocks to evaluate the complete system.

- Investigation on power generation equipment has proved that the technology exists and has been implemented in cogeneration plants world-wide.

- Implementation of cogenerators has proved to be of a supportive nature for integral planning on electricity load planning in various countries.
- It is clear that there are various activities within the South African electricity supply industries that warrants an investigation into the utilisation of all possible energy resources for generation of electricity.

CHAPTER 2

2.0 MODELLING METHODOLOGY

2.1 Introduction

Energy efficiency is likely to be one of the performance measurement areas in most energy intensive operations due to the percentage contribution in operational cost. Cogeneration is only one of the aspects that can make a contribution towards improving energy efficiencies by making use of available energy resources that are treated as waste.

The purpose of this chapter is to represent a methodology that will provide a general problem solving methodology for handling the decision making process for the implementation of cogeneration with the components thereof. The objectives set in Chapter 1 to provide building blocks will be developed and evaluated individually. The relationship and the need to obtain information from the other building blocks will determine the structure of the building blocks as a system. The functional flow diagram will then be used to evaluate the implementation of cogeneration with real time pricing as a case study.

2.2 System requirements and evaluation

Evaluation refers to the examination and judgement of a system or an element of the system in terms of worth, quality, and degree of effectiveness. The purpose is to determine, through a combination of prediction, analysis and measurement, the true characteristics of the system and to ensure that it successfully fulfils its intended mission. For this study it will not be an interactive process, which will be repeated to obtain the best outcome, but merely a framework that can be used to improve in further studies.

The building block concept that will be used is illustrated in Figure 2.1 [13] [14] [15], and consists of only three components namely:

- Input. The inputs that can possibly influence the process.

- Process. That consists of operational activities that may have an influence on the process.

- Output. The outputs which are generated as a result of the operational activity within the process.

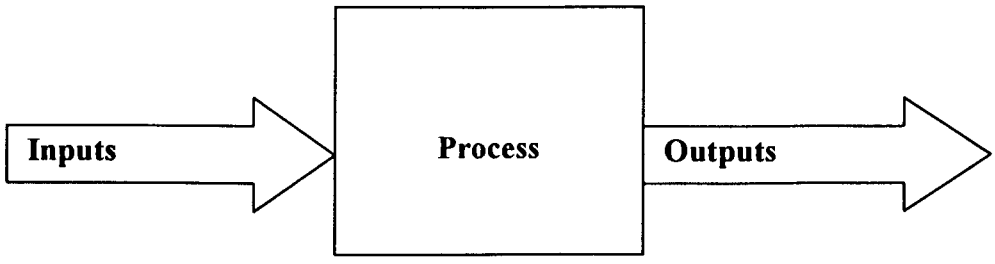

Figure 2.1: A building block

Processes identified here are as follows:

1. Plant operations & stockpiles

2. Evaluation of gas or fuel.

3. Evaluation of the power plant technologies.

4. Evaluation of tariff structures.

5. Evaluation of financial aspects.

Each of the processes will now be constructed on the building block principle with the identification of inputs and outputs.

2.2.1 Plant operations and stockpiles

In terms of the objectives set for establishing a cogeneration plant, one must determine the availability of energy resources that can be used for cogeneration within the plant operation. This process, with energy input and output parameters is illustrated in Figure 2.2. This process to determine the energy sources is site specific and will only be discussed and illustrated in the case study.

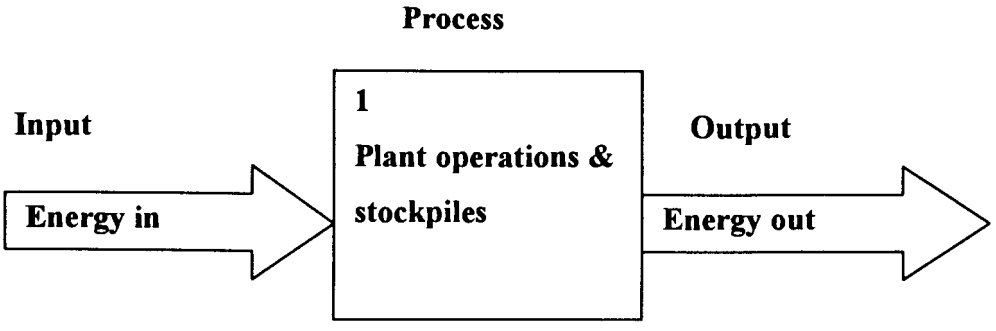

Figure 2.2: A building block for plant operations

2.2.2 Evaluation of gas or fuel.

This process is the methodology used to obtain sufficient information on the energy components of the gas or fuel available, to be able to make a decision to proceed to the next step. The building block shown in Figure 2.3, shows that the input requirements consist mainly of measurements, sampling and analyses, which is data accumulation. That will provide information on the quantities, composition and energy content, which are the output parameters which will influence the next step of the system.

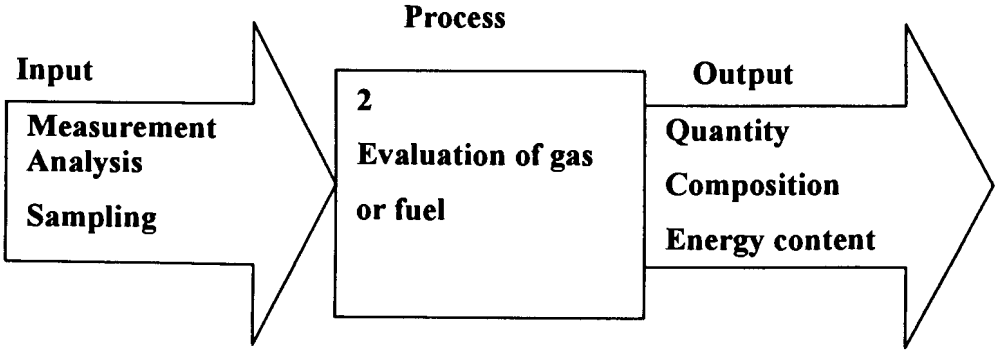

Figure 2.3: A building block for gas or fuel evaluation

2.2.3 Evaluation of power plant technologies

This is also to provide a methodology on how to obtain sufficient information on the availability of expertise and power plant technology. The dependency of this building block on the others will be demonstrated. From building block in Figure 2.4, information seems to be the primary requirement for the power plant selection, which can provide information to decide the concept of the technology application depending on energy type and quantities.

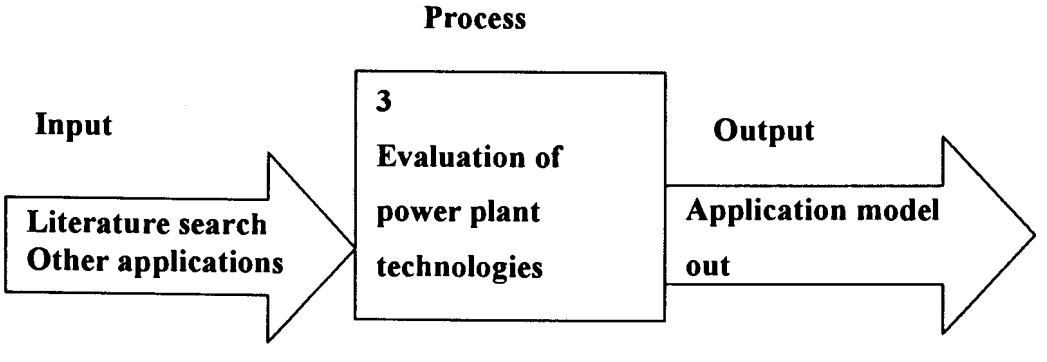

Figure 2.4: A building block for power plant technology evaluation

2.2.4 Evaluation of electrical tariffs structures.

This process will give a methodology on how to obtain tariff structure information and to show how it can influence your decision-making process. Again the input requirements as shown in Figure 2.5, to influence the evaluation process will be information and a good understanding of the tariffs available.

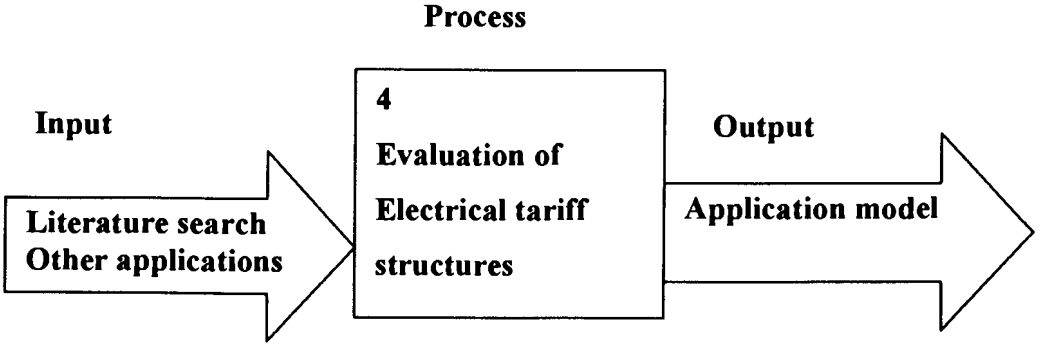

Figure 2.5: A building block for evaluation of tariff structures

2.2.5 Evaluation of financial aspects.

The financial evaluation process will show the methodology and models required to evaluate this aspect and to assist with the decision making process. The outcome of this process should give a clear indication on whether the cogeneration plant is feasible or not.

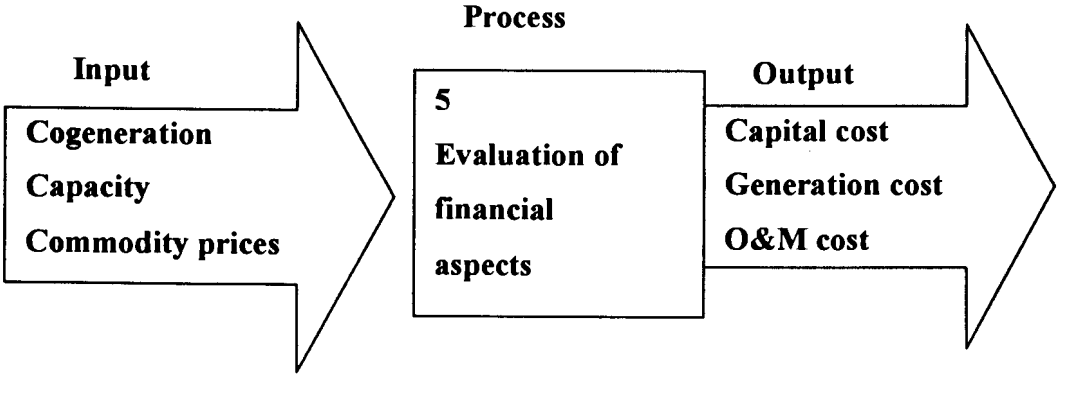

Figure 2.6: A building block for financial evaluation

2.3 Cogeneration as a system

The various components or elements as identified in this study will each be individually evaluated in terms of the building block methodology, with an evaluation of the outcome (outputs), to assist with the decision-making for the next step. The building blocks discussed in paragraph 2.2.1 to 2.2.5 have been identified by means of a number inside the block to identify the specific process. These processes can be evaluated in series or in parallel groups. This process dependency will ensure that sufficient information is available at the correct phase, to improve on the decision-making process on the success or failure of the cogeneration study. The relationship and the outcomes of each of the individual building blocks and is illustrated in Figure 2.7, where the question is represented by means of the trapezium shape with the question mark.

From the output of each block, information and data obtained should be evaluated to enable one to make a decision on the next step. The question to be raised is simple in that one should evaluate the need to proceed to the next building block or not. There can only be two outcomes, namely yes or no. The approach in obtaining solutions for the five building blocks can be done individually or in groups, which will speed up the process, and that relationship will be investigated as part of this study.

2.4 Conclusion

The evolution of a design is illustrated by [14], and amplified in a process or system as shown in Figure 2.7. There are checks and balances in the form of reviews at each stage of the design progression and a feedback loop for corrective action. This preliminary design process in this chapter would assist in setting a framework that can be improved through an iterative approach for this cogeneration study.

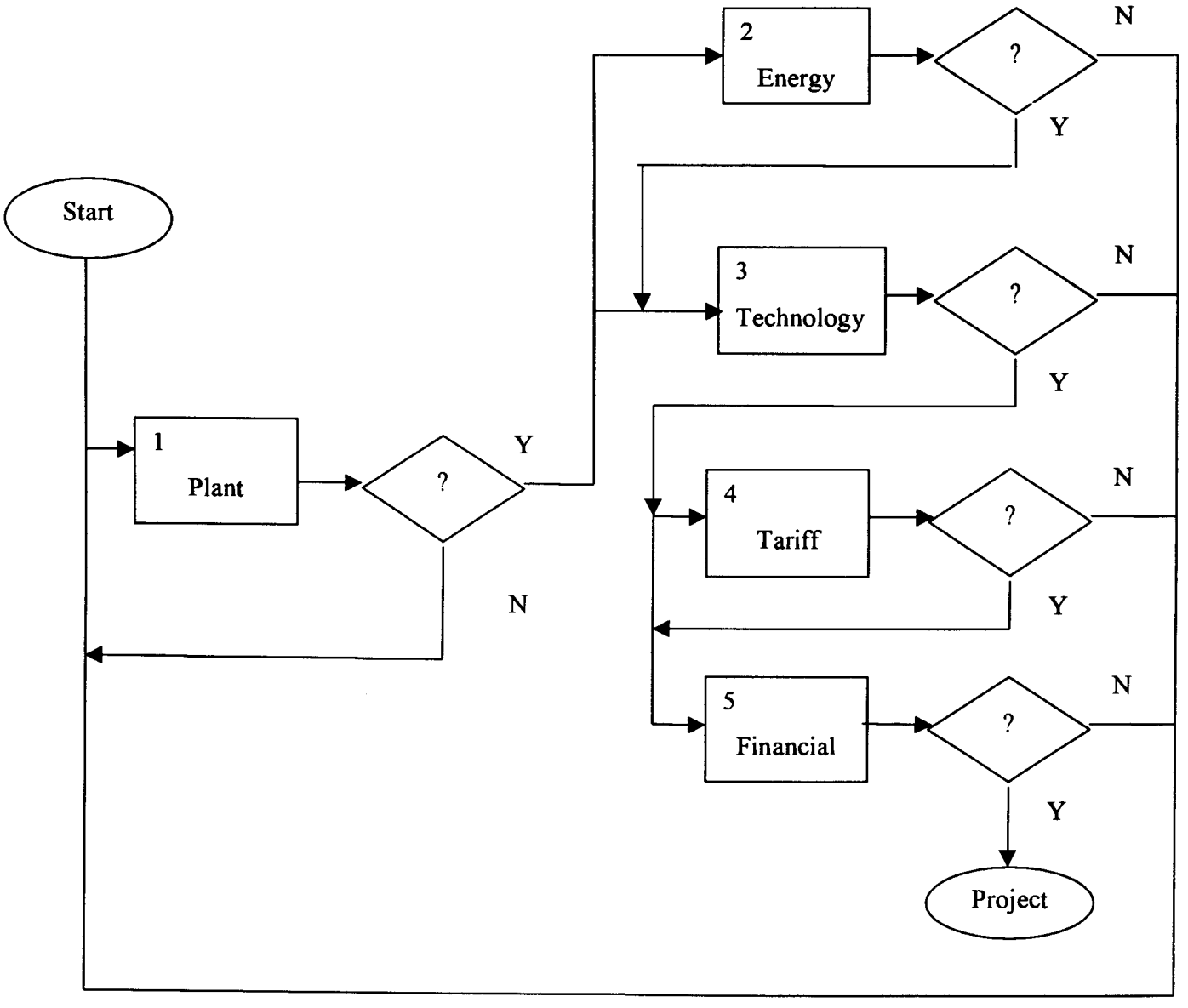

Figure 2.7: Design process for cogeneration as a system

CHAPTER 3

3.0 GAS OR FUEL

3.1 Introduction

The methodology as described in the previous chapter will now be confirmed, the input and output requirements will be evaluated and it will be verified whether it will be sufficient to make decisions.

One of the specific objectives was to identify how much gas will be available. The energy content of the gas is the more specific requirement as that will determine the electrical generating capacity of the CO gas. This is in fact very simple and can only be achieved through theoretical calculations or on-site measurements. It is always useful to verify theoretical or design values with actual measurement.

3.2 Gas composition and energy content

As identified by [6], the chemical and fuel processing industry is perhaps the major potential contributor to power generation in view of its requirements for both electric and steam for processing. A specific example is Sasol, which generates about half of its electrical power needs. The sugar industry uses its residue material as fuel, which is seasonal and available during cropping. In the wood, the paper and pulp industry obtain the raw material from the forests, which can be used as fuel but need to be supplemented with coal in most cases. The metal manufacturing industry has the potential for producing electrical power from various sources of gaseous material, which become available during the manufacturing of metal concentrates, pure metals or alloys. These sources of gas are from the manufacture of coke from coal or from the various types of furnaces.

The various metallurgical processes used for the different iron and metals will influence the gas composition. For instance the oxygen and fuel burners can be added as supplemental power sources with the primary aim to increase productivity.

Information on electric furnaces [16] has indicated that iron and steel industries' gases produced by the process have Low Heating Values (LHV) in the region of 800 kCal/Nm^3 (3300 kJ/Nm^3) for Blast furnace gas. Although these figures are quoted without giving any additional information, it is worth noting the availability of additional energy resources. One important aspect about the composition of recovery gases is that they have high impurity levels and must therefore be treated. This will have an impact on the power plant configuration and one will have to investigate the availability of natural gas as an additional energy source if required.

As an example to illustrate the typical composition of recovery gases, the BFG, COG, LDG with the exception of Electric arc furnace gas, which is not available due to secrecy aspects, is shown in Table 3.1

The gas composition can be obtained by taking various samples at different positions within the plant to be analysed by a reputable laboratory. The importance of detailed gas analyses is further supported by the fact that the detailed content of the gas needs to be known in order to determine to which extent the gas cleaning needs to be done.

Table 3.1: Example of the composition of furnace recovery gases.

Component	BFG % volume dry	COG % volume dry	LDG % volume dry
H_2	2,5	60,3	1,0
CO	22,8	5,0	69,2
N_2	53,5	4,5	14,9
CH_4	-	25,3	-
CO_2	21,2	1,3	14,6
C_nH2_n	-	3,6	0,3
LHV (kCal/ Nm^3)	780 ± 60	4500 ± 290	2030 ± 150

3.3 Gas quantities

Inspection of the design specifications and drawings is usually a good starting point for any plant, if available. This will provide some information on the use of the carbon monoxide as part of the process by other parts of the plant. It will also show the minimum and maximum values. The level of accuracy required would depend on whether the requirements will only be for evaluation or design purposes.

3.3.1 Flow measurements

The following technologies or measurement methodologies are available for gas measurement in a pipeline and should be carefully selected for the specific application [17]:

- Micromanometer (Pilot tube based system)
- Thermal mass flowmeter
- Annubar flowmeter
- Hot-wire anemometer
- Ultrasonic flowmeter

Experience in the field of measurement has indicated that the hot-wire anemometer and the ultrasonic type sensor are not the most reliable in this type of application and therefore only specifications for the others are shown as per Table 3.2.

Table 3.2: Gas measurement equipment specifications

Type	Velocity (m/s)	Pressures (Pa)	Temperature (° C)	Accuracy (%)	Other facility
Micromano meter (PVM100)	0 to 75	0 to 3500	-5 to 50	1	RS232
Thermal mass flowmeter (MT 91)	0,07 to 46	-	-18 to 60	2	4 - 20 mA
Annubar flowmeter	0 to 70	-	>200	1	4 – 20 mA

The major disadvantage of the micromanometer is that it has to be installed very precisely into the flow area in order to prevent erroneous measurements and is relatively cheap, which is an advantage. Thermal mass flowmeters have the facility to be coupled to a datalogger and are relatively expensive.

Annubar flowmeters need to be connected to a highly sensitive differential pressure transducer and are in the same price range as the thermal mass flowmeter. Although the micrometer is relatively cheaper, the installation requirements may be a disadvantage.

3.3.2 Useful information to collect

The CO gas flow rate based on furnace power can be expressed for various production conditions such as normal, average, peak and design values. There will seldom be a

minimum value as most production furnaces are capital intensive and will be operated at most economic productive levels.

Relationships between CO gas production and furnace load to be obtained from where the minimum and maximum consumption rates as part of process should be conducted to determine the quantities being flared.

3.3.3 Verification of theoretical values

For more accurate evaluation it may be necessary to verify the known theoretical quantities with the measurements taken by means of the field instrumentation and gas analyses.

The reason for this is to determine if there is a relationship between the furnace production and the other sections of the plant. If the whole process is not constant and provision is made for stockpiles, then the process flow will not be constant. The primary and secondary plant operations may therefore be flexible and vary their production output, which means a variation in CO gas consumption.

Actual measurements over a minimum of a two-week time period is recommended to obtain a reasonable level of confidence. Any deviations from normal production profiles should be investigated to determine the need for additional measurement.

It will also be advantageous to do the field measurements of the gas quantities, over the same period as the power and gas evaluations.

3.4 Verification of building block for gas or fuel

Information obtained from this practical approach should now be evaluated to determine whether it is sufficient to make any decisions and determine an outcome for the next step. Refer to Figure 3.1 for the discussion that follows.

The basic information, which will determine whether it will be viable to consider a cogeneration plant for any specific application is simply the quantity of CO gas available with energy content. It is not critical to obtain gas cleanliness information, as this can be recycled as part of an interactive process for further evaluation.

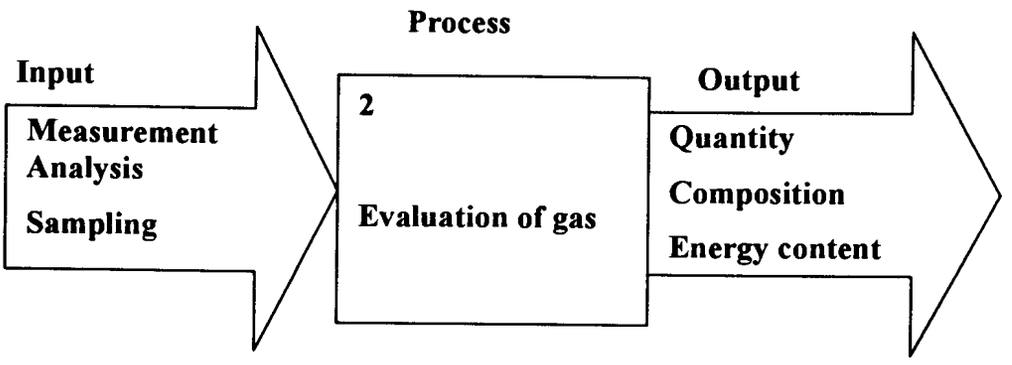

Figure 3.1: A building block for gas or fuel evaluation

Let's summarise the input and output requirements for this building block from the information gathered in the previous discussions:

Inputs

- Measurement of power levels and CO gas volumes.
- Take sufficient CO gas samples for composite laboratory analysis.
- Analyse the consistency of CO gas availability.

Outputs

- Quantity of CO gas available to determine generation capacity.

- Energy content of CO gas to calculate the electrical capacity.
- Composition of CO gas obtained from samples taken to assist with defining the cleaning requirements.

3.5 Conclusion

The availability and variability of the CO gas will have an impact on the power plant selection and if they were very stochastic by nature, an additional makeup fuel would be required.

The volumes of gas consumed by the operations are very constant with clearly defined step changes such as when parts of it are switched on or off. The evaluation to release all CO gas for electricity generation, and convert all the plant internal CO gas consumers to natural gas should be conducted. In some cases, where the infrastructure exists and the price of natural gas is relatively low, it may be feasible, otherwise it can be very expensive.

In furnace intensive operations the relationship between CO gas volumes produced is proportional to the plant electricity consumption. However, due to the erratic nature of the furnaces, stable gas consumption by the various plants, the excess CO availability is erratic with very high rates of change , which can be a constraint on any power generator turbine.

CHAPTER 4

4.0 POWER GENERATION PLANT

4.1 Introduction

Cogeneration installations worldwide may have in common the use of similar hardware, but most installations are unique for being optimised for its own specific plant or industry application. The type of power generation is dependent on the type of fuel available and this chapter will provide additional background information to confirm that there is in fact sufficient technology and expertise available for any specific application. The information obtained from the previous chapter should now be sufficient to develop the input and output requirements of the next building block and to determine its relationship to the other building blocks for further decision-making.

4.2 Power generating technology

In observing the power generating capacity of only the South Africa utilities, one can only conclude that the technology exist. Power plants, elsewhere in the world, of different types and sizes have been built with a product range from natural gas, oil fired, combined cycle coal-fired, nuclear, hydro and photovoltaic plants [18].

4.2.1 Preliminary evaluation

The first commercially combined cycle application was installed in 1949, which was a 3,5 MW General Electric gas turbine which was installed at Oklahoma Gas and Electric Company [19], which used the energy from its exhaust gas to heat feedwater for a 35 MW steam turbine. Since that initial installation, the technology has continuously evolved, and today combined cycle generation (CCG) are operating at ever-higher rates of efficiency and reliability. The prediction given by GE is that the CCG plants in service by the turn of the century will exceed the 20 GW mark.

R Gusso and M Pucci [16], made more specific reference to the iron and steel markets, where they indicated that these industries generally have thermoelectric power plants. Generating electricity and steam, which uses part of the gases produced by the process in the various forms such as Blast Furnace Gas (BFG), Coke Oven Gas (COG), LD Furnace gas (LDG) to fuel the boilers. The current trend is to completely or partially replace the traditional power plant with a combined cycle plant, which raises the efficiency from under 35 % to between 40 % and 50 %. This also achieves the objective of drastically reducing combustion emissions, making the new plant comply with pollution regulations.

In this application it is more economical to generate electricity by a combined cycle than a conventional steam cycle. Iron industry, by-product gas treatment and compressor cost do however mean higher investment cost than for a combined cycle of the same output burning natural gas. This consideration, plus the energy saving and emission control aspects, have supported various forms of incentives in many countries to construct combined cycles fuelled by iron industry gasses.

Combined heat and power generation plant's (CHP) main advantage is that it allows an improvement in fuel utilisation, which translates into a major fuel saving in comparison with separate heat and power generation, [20]. The better fuel utilisation comes from use of the steam's condensation heat, which is lost in a conventional power plant. The advantages of simultaneously generating electricity and heat or steam in a single plant have been recognised for a long time and both industry and electricity utilities have made use of cogeneration.
There are two ways of cogenerating heat and electricity, namely:

In the first, known as "topping cycle", the steam at the highest temperature level is used to generate electricity.

In the second, called "bottoming cycle", heat recovered from the high temperature process is used to generate electricity with a low efficiency from waste heat at a relatively low temperature.

Another article presented by R Gusso, [21] indicated that although the most common type of plant for electricity generation is the steam plant, there are a number of disadvantages. Limited flexibility of back pressure turbines, lower efficiency and the need to use cooling water for extraction and condensing turbines, as well as high installation cost and long construction periods. Many of these disadvantages have been eliminated with the introduction of plants using gas as fuel. If electric power alone is required, combined cycles with a gas turbine and condensing steam turbine represent an advanced instrument for generating high efficiency electric power.

Previous reference was made to the Samancor's Meyerton Works, [12], which are utilising waste gas from its manganese alloy furnaces to generate 50 MW of electricity. This has not only led to improved processing economics, but to better utilisation of natural resources and reduced atmospheric pollution. They have also illustrated that the project will reduce the requirement of the utility to burn approximately 200 000 tons/year less coal.

4.2.2 Cogeneration with gas turbines.

In Italy, by the end of 1981, cogeneration stations totalled over 5 GW, representing 13,4 % of the thermal generated electricity [22], with cogeneration on a smaller scale amounting to an installed power level of only a few dozen MW. Although the capacity is not clearly stated, [22] has given an overview of what type some of the cogeneration plants are and is summarised as follows:

- Stream turbines, both back pressure and extraction types which are mainly used in applications over a few MW.

- Gas turbines, which allow high temperature, heat recovery without affecting either output or power efficiency. Also used in applications for minimum power levels of a few MW.

- Internal combustion cycles (Diesel and Otto cycles) applied in applications of only a few MW.

- Electric power generating systems with heat recovery from industrial process exhaust with a load capacity of a few MW.

Gas turbines have certain advantages when used with cogeneration and can be running on various fuel types when changed over. Gas turbines also lend a good degree of flexibility to a cogeneration system in that they allow the electric power to thermal power ratio to be varied. For instance, a simple cycle or regenerative cycle turbine or supplementary-fired waste heat boiler can be selected. The ratio can vary according to the type of operation one wishes to adopt. For example, with a by-pass on the exhaust gas, power generation can be made independent from thermal power production. In addition, supplementary firing can greatly alter the quantity of heat transferred to the user.

4.2.3 Gas turbine fuels

Gas turbines can also run on coal gas and in some cases on refinery and coke-oven gas [22]. Gas oil is the most widely used fuel whilst natural gas is the preferred gas, based on the fact that it ensures safe machine operation and its purity, which does not cause deposits or fouling. The exhaust gas is relatively clean and will therefor not be an environmental risk.

The utilisation of the combustibility of off gas is dependent on three requirements: Pressure, calorific value and composition. Approximately 24-bar pressure is required and increases with lower calorific value, which means that a compressor would be required. The cost of a compressor is significant and the energy balance for energy required compressing the gas versus energy obtained on combustion in a turbine for electrical generation might be unfavourable due to low calorific values. Investigation on the quantity and composition is essential to determine what type of turbine should be considered.

If required, the availability of natural gas in the region should also be investigated to determine an already existing market in liquefied natural gas in the area. This is important because if the infrastructure does not exist; it can become a very expensive commodity. Sasol Gas has indicated that they are supplying Methane Rich Gas (MRG), which is a natural gas, to the local area, which was produced from Sasol Synthetic Fuels refinery in Secunda. They have indicated that they would consider business options to increase their supply at the time.

This natural gas is an ideal turbine fuel with a high calorific value. Utilisation of this gas throughout the plant will result in a reduced consumption, which will release all the CO gas for cogeneration purposes. This will also improve the gas reliability which will result in less interplant dependency with increased production capacity with increased storage facilities. From this information it is clear that the technology is available to utilise the available furnace waste gas with various options available. This study will not cover the selection of the best power plant type for this application. The objectives set here is to determine available quantities of CO gas and to analyse the gas content to confirm power plant selection.

4.3 Power generation plant

It should be noted that the essence for the investigation of cogeneration was dependent on the availability of CO gas, which was confirmed in the previous chapter. For the purpose of this investigation, a generalised layout will be proposed to show the relationship between the various components of the operating plant, which are namely: the utility, consumers and cogeneration.

The generalised layout is specific for a mineral sands operation but may be applicable for various other operations with small changes. It makes provision for steam, alternate generating capacity available on site or CCG and is shown in Figure 4.1. This layout shows the electricity to and from the utility busbars, from where it can be seen that the cogeneration electricity will be fed into the utility busbars. The main power, from the utility, consumed by the furnaces and the rest of the operations are respectively shown as Production load 1 and 2. The electricity generated by the gas turbine power plant (e1) is fed into the utility busbar. The electricity generated by the steam turbine power plant (e2) is also fed into the utility busbar. The excess CO gas not used is flared (e3) and burned into the atmosphere. This will make provision for simulating the use of either the gas turbine power plant or the steam power plant individually or as a combination to get the most from the CCG system.

The only variables, depending on the fuel combination, are:

- Electricity generation capacity from gas turbine power plant in MWe (e1)
- Electricity generation capacity from steam turbine power plant in MWe (e2)
- Output at flare stack in MWe if available (e3)

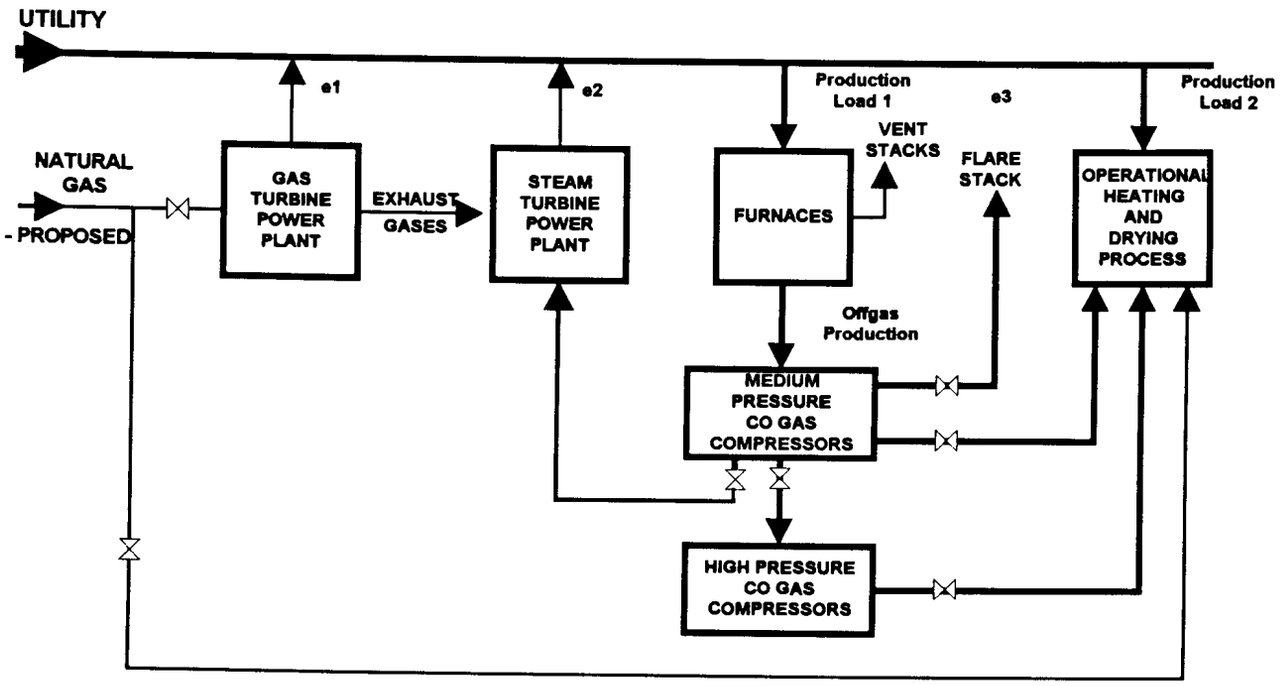

Figure 4.1: Process flow for proposed power plant

These variables are shown in Table 4.1, as an example, and note should be taken that the actual sizing of the options are dependent on factors such as the availability of fuel types, volumes, energy levels and the available technology.

Table 4.1: Generation options with variables quantified

Option	Type	Sasol Gas	Co-Gas	e1(MWe) Gas turbine	e2(MWe) Steam boiler	E3(MWe) Flare stack
20 MWe	Steam	X	✓	0	20	Waste
80 MWe	CCG	✓	X	42	38	Waste
100 MWe	CCG	✓	✓	42	58	Waste

4.4 Verification of building block for power plant

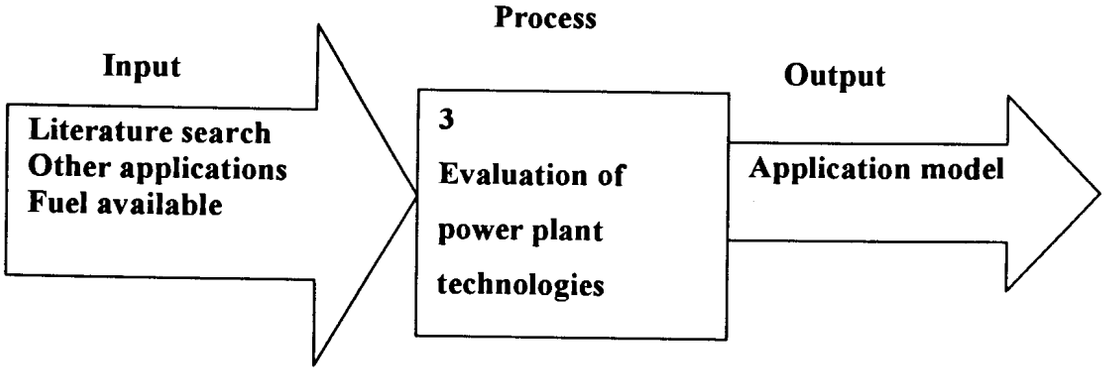

Figure 4.2: A building block for power plant technology evaluation

The literature search will provide some insight into the complexities of power generation options with the role played by the type fuel available. It will be necessary to modify the input requirements by adding the output of the previous decision block, which is the type of fuel available. The output as the application model will provide some flexibility in that various cogeneration options can then be evaluated. Availability of used equipment can be investigated and compared with the price of new equipment.

4.5 Conclusion

Where cogeneration plants are concerned, plant capacity is generally dictated by the local heat demand, and manufacturers have indicated that they can offer cost effective cogeneration plants, which will make maximum use of the primary energy source.

The information obtained with the conclusion of building blocks 1 to 3 would provide sufficient information to give a clear indication of the power plant configuration and whether it is a technically feasible option. The output of the building block on gas evaluation is an essential input element to narrow down on the power plant configuration.

The financial aspects will now become more relevant and one can start to investigate the flexibility of the operation and the optimisation of the real time pricing tariff .

CHAPTER 5

5.0 ELECTRICAL TARIFFS

5.1 Introduction

Financial aspects will now be of importance as to how the proposed cogeneration plant can be optimised to reduce electricity cost and to improve efficient utilisation of energy available. Knowing that the opportunity exists for possible cogeneration implementation, this chapter will investigate the RTP tariff whilst production targets must be maintained or improved. Also the basic principles of an excel model, developed as part of this investigation, will be discussed for use of the case study, with different production profiles (RTP adapted).

5.2 Scope and objectives of RTP tariff

RTP has been used successfully by utilities as a Demand Side Management (DSM) tool. Significant load shifting out of peak periods has been achieved for these utilities while customers have been able to profit from increased production at times of low prices. These international experiences have been repeated by the South African electricity market, where it has been clearly demonstrated that customers, who participate actively in the dynamics of the product:

(a) Use significantly more electricity during system unconstrained periods and
(b) Shift significant load out of peak periods, as signalled by the real time price.

Prices do not vary continuously as the name may suggest. For practical reasons, price levels are fixed for short discreet time periods, typically one hour. The day ahead posting of hourly prices for the next day has become the industry standard, since few customers are able to effectively respond with shorter notice.

RTP is a pricing methodology that exposes customers' consumption decisions to the short-term value and availability of electricity. This results in the desired DSM behaviour of RTP customers. Since the implementation of such a pilot project at a gold mine, Western Deep Levels has proven the benefits to both the utility and the consumer by shifting loads of up to 70MW and achieved a 2% reduction on the electricity bill, [23].

The objectives of the RTP product is to stimulate optimal customer behaviour through dynamic price signalling which includes:

a) Energy conservation when the system is constrained, as signalled by high prices.

b) Increased energy sales (and hence net contribution) when the system is unconstrained, as reflected by low prices.

b) Reduced system peaks and hence deferred generation capital expenditure.

d) Reduced operating cost resulting from not having to start up more expensive units to supply short peak loads.

e) Improved customer service, through lower overall average prices and more customer choice.

The philosophy of RTP is rooted in the principle of signalling to customers the dynamic real time value of electricity, which will dictate the customer behaviour. Due to being the only pilot tariff in South Africa, both the utility and the customer need to be protected. Revenue neutrality will be maintained with respect to the previous pricing structure, when the customer's load and load profile remains unchanged after conversion to RTP. Only through load shifting or demand side management will it be possible for the customer to

reduce the average cost of electricity. The requirement for revenue neutrality will be individualised at customer level, to prevent customers from being advantaged merely by changing to RTP.

The historic load profile of the customer, which is known as the Customer Baseline Load (CBL), is the fixed reference on which the calculation of fixed charges and revenue neutrality will be based at the time of conversion. The CBL is therefore, by definition, "the load profile that can reasonably be expected without behaviour modification (due to RTP)".

5.2.1 CBL calculation

The utility requirements are to use twelve-month continuous historical hourly data for calculating the CBL, except if agreed to by both utility and consumer.
The CBL rate is calculated for a 30-day month and a 31-day month. February is always treated as a 30-day month. The CBL charge is calculated using the following equation:

$$CBL_{charge} = \left(\frac{D_{rate}}{24 \cdot days \cdot Lf} + E_{rate} \right) \cdot (1 - V_{discount}) \cdot (1 + S_{surcharge}) \tag{5.1}$$

$$Lf = \frac{E}{MD \cdot 24 \cdot days} \tag{5.2}$$

Where:

CBL_{charge}	CBL charge c/kWh
D_{rate}	Demand rate in c/kVA
E_{rate}	Energy rate in c/kWh
E	Total energy consumed for the number of days
MD	Maximum Demand in kVA
Lf	Load factor for applicable month (30-day month or 31-day month)
$V_{discount}$	Voltage discount
$S_{surcharge}$	Transmission surcharge

The measured CBL shall be adjusted to reflect the shift in weekends and public holidays and known events that have caused the recorded profile to deviate from the normal, may be adjusted accordingly.

5.2.2 RTP bill calculation

This RTP option has a two-part structure, namely the Access charge and the RTP Load charge. The energy supplied at the CBL profile is priced at the customer's normal pervious tariff and becomes a commitment of the customer. The customer therefore commits to pay the utility for this amount of electricity, whether it is used or not. This mechanism guarantees the utility's revenue requirements and also protects the customer against exceptionally high prices.

The customer's actual energy consumption for every hour is measured and compared to the CBL. The difference between the CBL and the actual consumption, measured for every hour, is the RTP Load. If the actual load is greater than the CBL, the difference is the Additional Load (AL). If the CBL is greater than the actual load, the difference is the Reduced Load (RL). The AL is charged for at the RTP rate including the profit adder. The

RL is charged for at the RTP excluding the profit adder. The customer is effectively refunded at the RTP rate excluding the profit adder for the energy not consumed below the CBL.

The monthly bill for the two-part RTP option is calculated as follows:

$$\text{Bill} = \text{BC} + \text{MR} + \text{AC} + \text{AL} * \text{RTP}_1 - \text{RL} * \text{RTP}_2 \quad (5.3)$$

Where:

BC = The Basic Charge. The BC is taken as the same as for the previous tariff.

MR = Monthly Rental. The MR is taken as the same as for the previous tariff. Any capital expenditure to switch to RTP will be included in the MR.

AC = The Access Charge. This Access Charge is a commitment from the customer, Richards Bay Minerals, to purchase the electrical energy under the customer base load (CBL). The Access Charge is charged at the CBL rate.

AL = The Additional Load.

RL = The Reduced Load.

RTP_1 = Real-time Price including the profit adder.

RTP_2 = Real-time Price excluding the profit adder.

5.2.3 Night save tariff overview

The organisation that will be evaluated in the case study is on Nightsave tariff, it seems to be in order to give a brief description thereof. This tariff consists mainly of two components, maximum demand (kVA) and active energy charge (kWh). Maximum demand is only payable during on-peak time periods where active energy is charged for the total usage.

Weekdays consist of on-peak period from 06h00 to 22h00, during which time period the highest maximum demand will be recorded for payment at the end of the month. The rest of the week day including weekends and public holidays are considered as off-peak time periods where only the authorised connected load values as stipulated in the contract are the maximum demand limit.

5.3 Model for RTP tariff evaluation

This tariff evaluation model was developed as a tool, in a spreadsheet environment, to assist with the evaluation of the potential benefits through changing the load profile to optimise the RTP tariff. The following assumptions were made:

- No seasonal loads were considered due to the nature of the operation, which was also applicable for weekdays, where nightsave tariff was used.
- Monthly CBL profiles were calculated for weekday and weekend.
- CBL values for weekdays were calculated by using average hourly values for all weekdays.
- Weekends and holidays were treated the same as it was seen as "off-peak" periods.
- For this application only seven-month historic data was used, with utility's agreement.

The average weekday RTP rates were calculated for weekdays and weekends, from daily schedules provided from the utility. Only the weekend values are shown for demonstration purposes in Figure 5.1. The rates are sorted in an ascending order (random hours), which will be used to construct the new profile based on the history to obtain the same energy area.

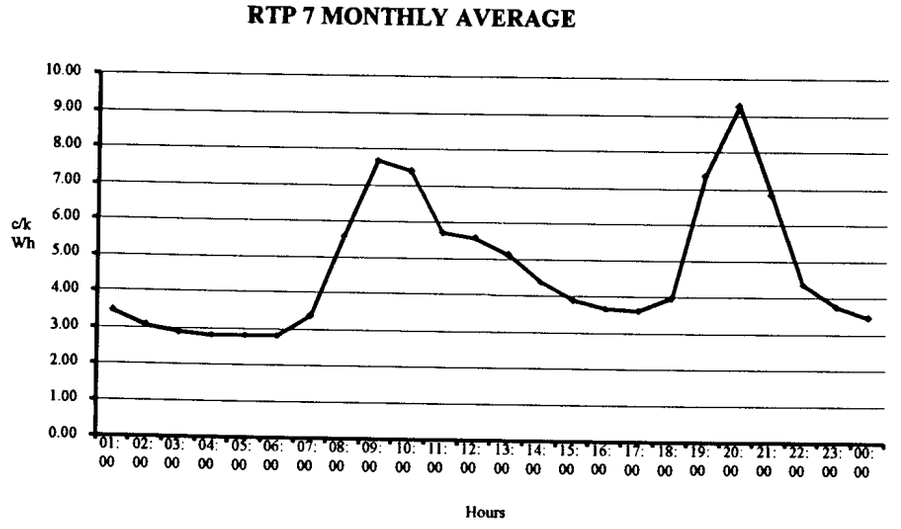

Figure 5.1: RTP tariff monthly average cost for electricity (Jan-Jul 99)

With the average RTP prices available, the new profile can now be constructed based on the previous operational data and profile. The new profile will then be constructed by placing the highest obtained load at the specific time of the lowest price for electricity. The new profile will then be fitted on the CBL graph and an example is shown in Figure 5.2.

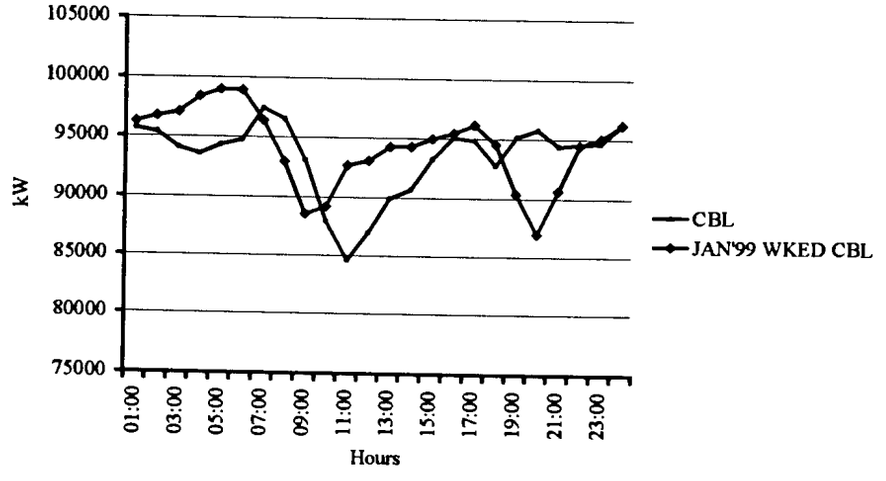

Figure 5.2: Weekend CBL with RTP profile for Jan 99

5.4 Verification of building block for tariff structures

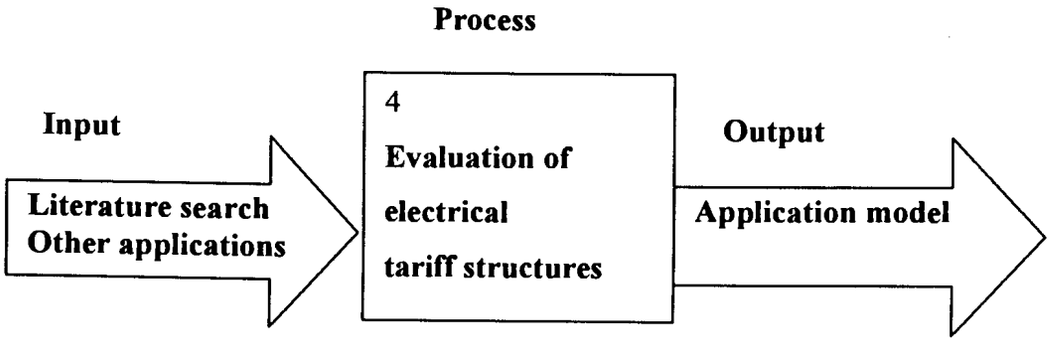

Figure 5.3: A building block for evaluation of tariff structures

The input requirement indicates that a close relationship with the utility may be an advantage. This will provide you firsthand information on the tariff structures available and perhaps pilot projects. Careful evaluation of the electricity load profiles should give some indication on the load flexibility to apply demand side management and utilise any additional capacity in low price periods. Using the same production kWh area should provide some confidence on the possible success during tariff changes.

5.5 Conclusion

The RTP objectives set by the utility provides both parties with potential benefits and savings. The tariff change might be restricted to specific utility conditions that should be clarified in advance to assist with realistic evaluations. Investigation of the CBL profile shows a large difference between on-peak and off-peak values, which indicates that flexibility exists to to apply DSM. The effect of this DSM should be evaluated in terms of production requirements. It is important to note the maximum RTP price on average was about 9c/kW, which now can be compared to the specific plant's average cost to give an indication of the expected change.

CHAPTER 6

6.0 FINANCIAL EVALUATION

6.1 Introduction

At this stage of the evaluation process, there should be a clear indication on whether a cogeneration plant is an option or not. This chapter will give some insight into the fundamentals of total economy for such an investment.

6.2 Profitability of a cogeneration plant

Producing energy with a cogeneration plant involves several cost groups such as initial investment, capital, fuel, operations and maintenance. Achieving the lowest total energy cost is therefore the sum of a correct investment in a reliable technology/supplier and the organisation of all operational activities in an optimum manner.

The Life Cycle Costing (LCC) method is normally used to determine the total economy of a system under development. LCC requires the identification of all potential costs, from plant concept to full operation. The true LCC is monitored throughout the lifetime of the system. More than 60% of such a product's LCC is generated during actual operation; many of an operator's daily decisions affect the true LCC. Therefore, the operations phase is the most important from a total economy point of view. LCC is not just a measurement and decision tool, but rather means a constantly improving the effectiveness of maintenance that should be built into the operational system.

Although capital cost represents the initial cost or investment for erecting and maintaining a cogeneration plant, the most important factor is fuel costs. Changing the fuel costs requires either changing the fuel type or improving fuel consumption.

The most common indicators used to compare mutually exclusive projects are simple payback, internal rate of return (IRR) and the net present value (NPV).
Net present value and present value (PV) have to be understood before IRR can be explained and the information is available in various financial textbooks of which [24] is only one. The present value of an investment is the value of all the investment's future payments or savings discounted to today's money. Discounting is done as follows:

$$\text{Discount factor} = 1/(1+r)^n \qquad (6.1)$$

Where r= The discount rate and
n= number of years starting at 1

The present value of savings generated by a project is calculated by adding each tear's discounted savings. Thus two factors are arbitrary in the present value calculation: the discount rate and the lifetime of the project. The present value calculation is defined as:

$$\text{Present value} = \text{savings for year } n/(1+r)^n + \ldots.. \qquad (6.2)$$

The NPV is simply the present value of savings minus the initial investment cost.

$$\text{NPV} = \text{present value} - \text{investment cost} \qquad (6.3)$$

The IRR is the discount rate (r in formula), that yields a zero net present value.

The basic rule is is that an investment is profitable if its NPV is larger than zero and the IRR should be higher than the interest rate for borrowing the money.

6.3 Commercial model for cogeneration feasibility

There are various commercial packages or systems available for feasibility analyses for power plant or cogeneration projects such as the "Feasibility Calculator" from a company by the name Wärtsilä [25], or the one that will be used in this study which was developed by a company Duke Engineering and Services Africa, Inc. (DE&S).

In order to model the CCG plant, it would be necessary, depending on the model, to make certain assumptions depending on the specific requirements on each case. All the parameters under the headings "Financial" and "Technical" are inputs with the output parameters under the heading "Outputs" For the purposes of this study, the model will be considered an additional aid and will not be discussed in any detail. The assumption is made that the outputs will be reliable based on results of previous evaluations for other operations, which are still in service. The input parameters can be modified based on the specific requirements. One of the important output parameters that will have a direct influence on the tariff evaluation will be the total cost for generation of energy (electricity).

In the previous chapter, the maximum value of the RTP cost was given as approximately 9 c/kWh, which is 45 % less than the 13,12 c/kWh of the cost to generate electricity with cogeneration. These costs should be compared with the specific plant average cost on the existing tariff structure. This would clearly show the potential with or without cogeneration. For instance, if the existing average cost is a value between 9 and 11 cents, it will indicate some potential for RTP but will be uneconomical to implement cogeneration.

Table 6.1: DE&S model for combined cycle power plant

Combined Power and Heat Model by DE&S

Financial			***Technical***		
Electricity Price	10.00	c/kWh	Availability	90	%
Gas Price	12.70	R/GJ	*Load Factors*		
Steam Price		R/ton	Electricity	100	%
Electricity Escalation	10.0	%/yr	Steam	100	%
Gas Escalation	10.0	%/yr	Gas Turbine Power	45.0	MWe
Repayment Term	15	Yrs	***Outputs***		
Depreciation Term	3	Yrs	IRR	-0.1	%
Interest Rate	16.50	%	NPV, 15%, 15 yrs	-68.3	R mill
Debt-Equity Ratio	-	%	Total Power	102.54	MWe
Management Fee	-	%	Gas Consumption	3,621,610	GJ/yr
Tax Relief	-		O&M Costs	5.5	R mill
Company Tax	35.0	%	Total Project Costs	113.3	R mill
Secondary Tax	12.5	%	Installed cost per kW	1,620	R/kW
O&M Costs: GT	0.50	c/kWh	O&M	1.01	c/kWh
O&M Costs: ST	0.50	c/kWh	Fuel Costs	8.34	c/kWh
Contingency Costs: GT	-	c/kWh	Interest Costs	3.77	c/kWh
Contingency Costs: ST	-	c/kWh	Contingency Cost	-	c/kWh
			Total Energy Costs	13.12	c/kWh

O&M = Operation and maintenance
IRR =Investment rate on return
GT = Generator turbine
NPV = Net present Value
ST = Steam turbine

6.4 Tariff evaluations with cogeneration.

The model discussed in Chapter 5, was improved to make provision for modelling the use of a cogeneration plant to influence the load profile. The actual generating capacity needed to be specified for specific hours over weekdays and weekend for the time period selected. The decision as to when to schedule the cogeneration is directly related to the price that electricity could be purchased from the utility. This means that if the price for buying from the utility is cheaper than the price to generate electricity, then the cogenerator will not be utilised. Outsourcing or selling is another option that can be considered if there is a demand.

6.5 Verification of building block for financial aspects

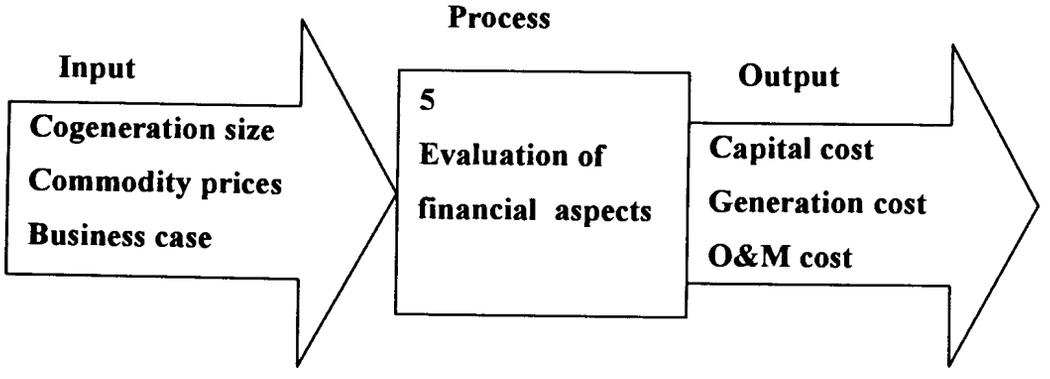

Figure 6.1: A building block for financial evaluation

From figure 6.1 it can be seen that the input requirements which will dictate the output parameters are clearly the cogeneration plant's generating capacity, with the commodities being the price of electricity and natural gas. The business case will be dependent on the financial status of the investor and his credibility. Money markets such as capital funding and interest rates will have an influence.

6.6 Conclusion

There are clearly a few important aspects that will influence the decision for the implementation of cogeneration. From the DE&S model one could see that the some of the input parameters should have an impact on the total energy cost for cogeneration and will be discussed next.

- Interest rate on the loan.
  The higher the interest rates the less attractive the project due to a higher generating cost.

- The existing price paid for electricity from the utility. If the electricity is cheaper to buy from the utility, then more expensive cogeneration is not a viable option.

- The price of the natural gas from the utility depends on quantities required and if distribution infrastructure exists.

- The actual type and power plant required will influence this commodity. The information in the literature search has indicated that steam turbine cogeneration capacities are relatively small. For energy intensive operations with high maximum demands, low cogeneration plant capacities may not look so viable and there might be the need to increase the cogeneration capacity. This can be achieved by selecting a CCG which is dual-fired with higher efficiencies.

- The aspects should therefore be properly analysed to obtain sufficient information to assist with the decision. Some of these aspects will be discussed with the evaluation of the business case.

- The output parameters clearly indicate that the decision pending the outcome is financially driven. This means that unless there are any potential benefits that will result in efficiency improvement with cost savings, this project is not likely to be implemented.

- From table 6.1 the IRR or NPV are both negative which indicate that the cogeneration option is not viable at all. The IRR should at least be more than the interest rate for borrowing the money.

CHAPTER 7

CASE STUDY

7.1 Introduction

This Chapter will consist of a case study, which will be conducted on a typical mineral sands business with electric arc furnaces as part of the operation. The cogeneration evaluation process will be used, whilst each of the building blocks defined, will be verified.

7.2 Overview of typical operation of mineral sands operation

Most of the world's titanium ore production starts from heavy mineral sands and a typical process is shown in Figure 7.1.

The dredging mining process mines the heavy mineral concentrate (HMC) which is transported to the mineral separation plant (MSP), where the HMC is separated into by-products, rutile and zircon, with ilmenite as roaster feedstock and some tailings that are returned to the dunes. The roaster treats the ilmenite, which is then fed to the smelter. Anthracite is bought in and will be treated in the char plant to change the chemical composition thereof. The ilmenite from the roaster and the treated anthracite are then fed into the smelter. The smelter output results in cast iron, which is transported to the iron injection plant for treatment and casting. The titanium dioxide (TiO_2), in coarse form is then transported to the slag plant for crushing, milling and screening. The pig iron and the slag are then ready for shipment to local and international customers.

The metallurgical process for removing iron from ilmenite is based on slag formation in which the iron is reduced by anthracite or coke to metal at 1200-1600 degree Celsius in an electric arc furnace, and then separated. Titanium free pig iron is produced together with

slag containing 70-80 % TiO_2 (depending on the ore used) that can be digested with sulphuric acid because they are in titanium and low in carbon. Raw materials of this type are produced in Canada by Quebec Iron and Titanium Corporation (QIT), in South Africa by Richards Bay Minerals (RBM) and to a smaller extent in Japan by Hokuetro Metal and Tinfos Titan and Iron in Norway and only recently Namakwa Sands South Africa. The raw materials for TiO_2 production include natural product such as ilmenite, leucoxenene and rutile [26].

7.3 Plant operations and stockpiles

The process is now evaluated by using the building block concept as illustrated in Chapter 2, of which the first step is to determine the energy inputs and outputs to and from the plant. Useful energy sources identified consist mainly of electricity, anthracite, gas and fuel for standby or emergency conditions. Although this is an energy intensive electricity type operation, carbine monoxide (CO) gas is produced as a furnace off-gas which is used by some of the primary and secondary operations with excess being flared (burnt) and treated as waste.

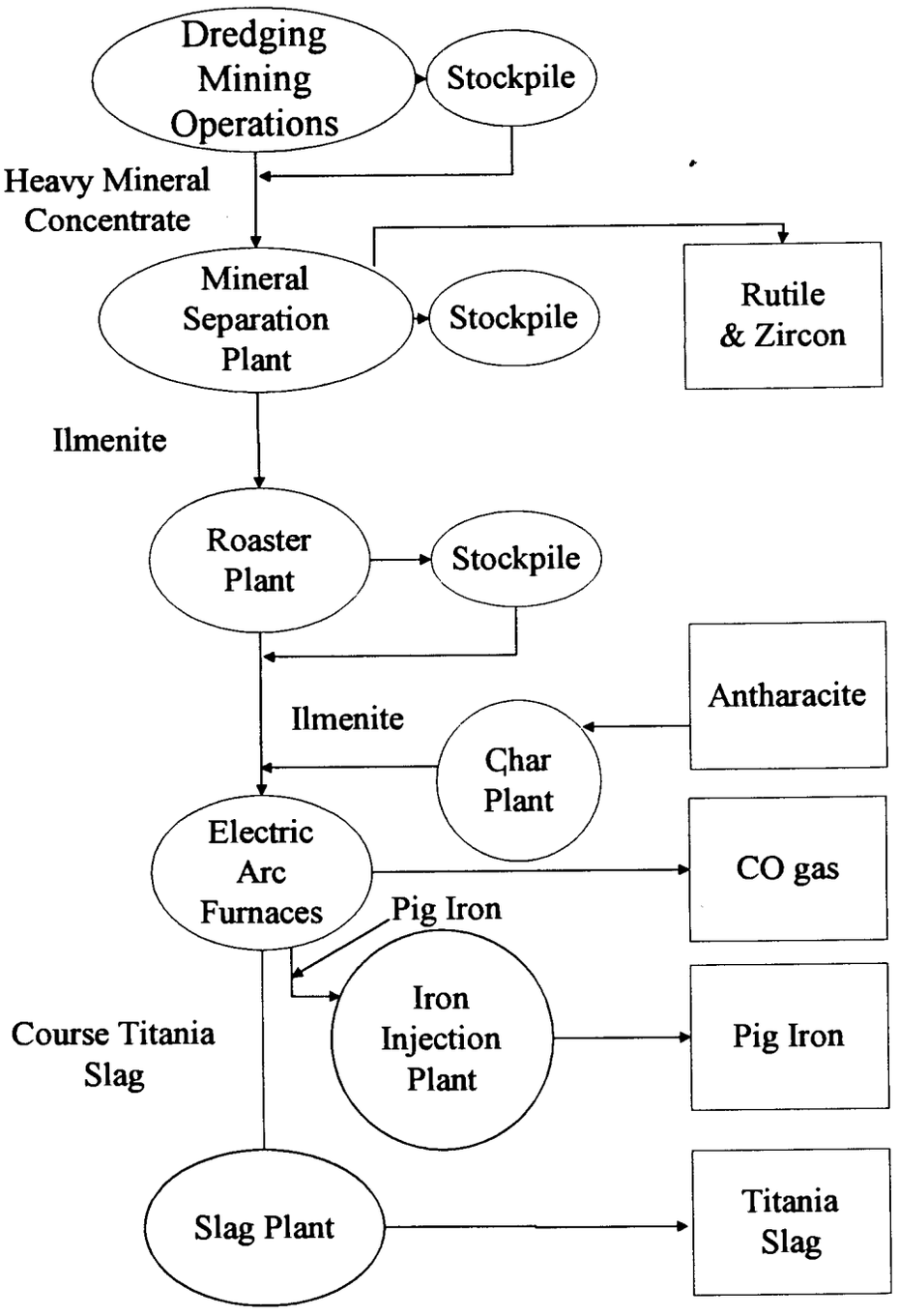

Figure 7.1: Typical minerals sands plant process flow diagram

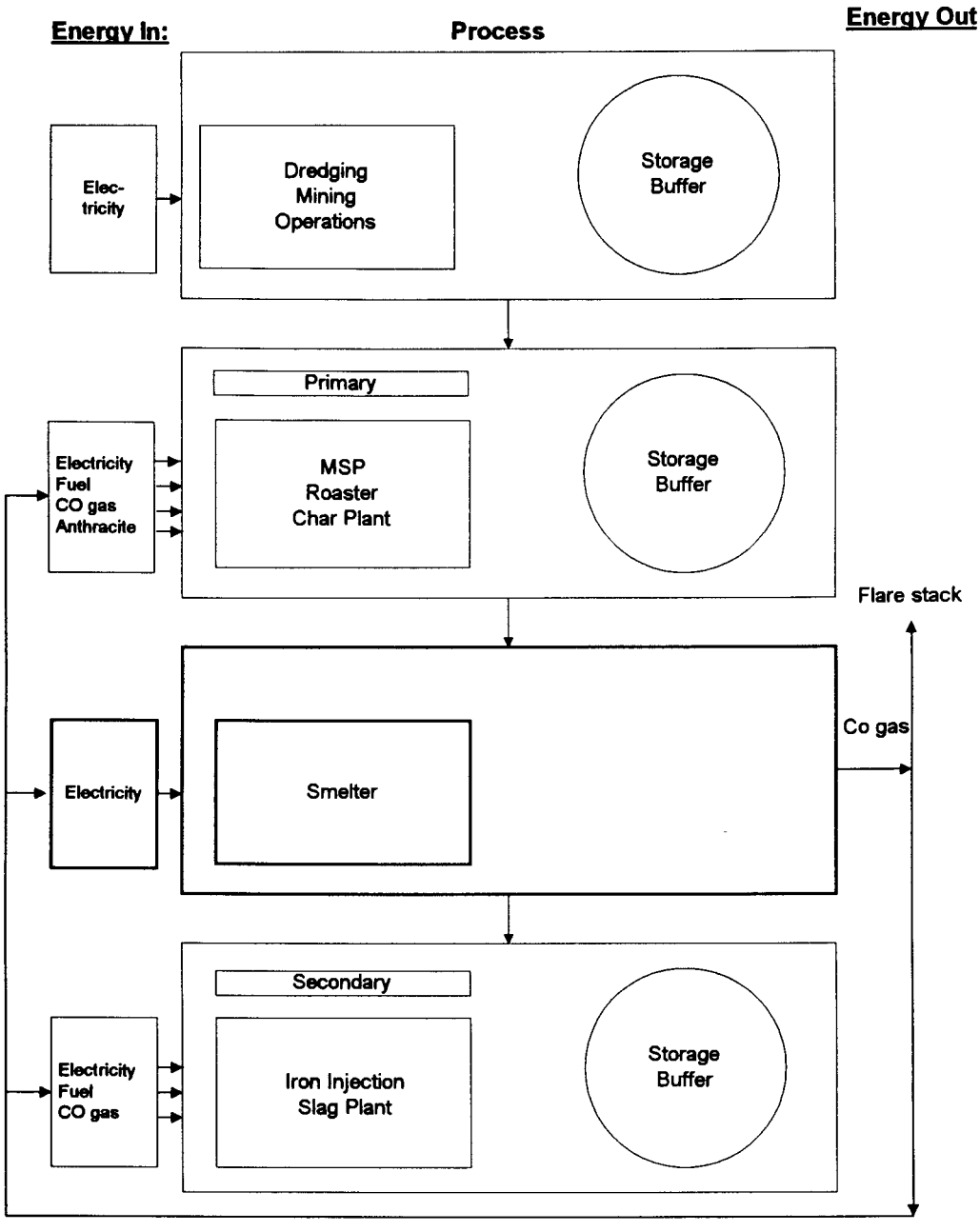

Figure 7.2: Energy flow diagram for typical mineral sands operation

The process is now evaluated in terms of the energy sources for the inputs and outputs and is structured in a simplistic form as useful energy. In the process and useful energy out as described in Figure 7.2, which is summarised in building block form as illustrated in Figure 7.3.

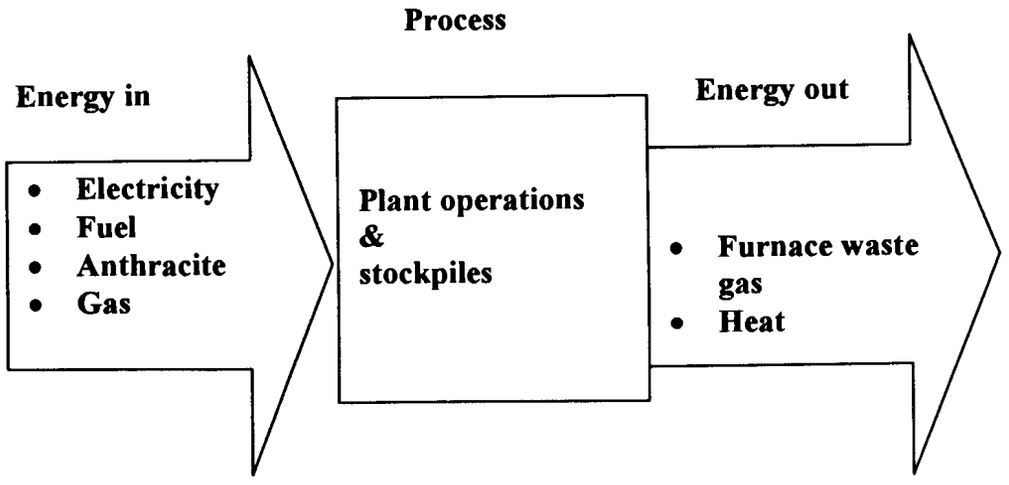

Figure 7.3: Energy input and output identification for a typical plant operation

7.3.1 Verification of building block for plant operations (case study)

It will be useful to have an intimate knowledge of the specific operation, being evaluated, as this will speed up the process and provide more comprehensive information. The following information on the energy input parameters are:

Electricity. Imported from the local utility with the electric arc furnaces as the main consumer that produces the outputs, namely heat and furnace waste gas (CO).

Anthracite. This is commercially obtained and when treated, it becomes part of the furnace feed stock, which contributes to the CO gas production levels.

Gas. Carbon monoxide (CO) gas produced by the furnaces. Some of the gas is distributed to other parts of the production for process heating and drying and the rest is burnt and treated as waste, which can be used for cogeneration.

Fuel. This is consumed in relatively small quantities of diesoline, which is mainly used for emergency or abnormal conditions.

Information on output parameters:

As previously mentioned, the CO gas is treated as waste and is burnt into the atmosphere, which is definitely energy wastage.

Due to the nature of the operation, excessive heat is generated but is maintained within the firewalls of the furnaces. This heat and possible uses will not be discussed here, but a recommendation will be made based on the potential.

7.4 Evaluation of gas or fuel

Furnace power levels and CO gas measurement results showed almost a 100% correlation with relative steady production conditions and are illustrated in Figure 7.4. The fact that the process heating and drying is independent of the furnace feedstock is due to sufficient stockpile capacity available for a relative long duration. This provides some flexibility that allows individual plants to vary the production profile (maintenance, breakdowns, etc). Plant design information provided information to determine the internal CO gas consumption for average and maximum conditions.

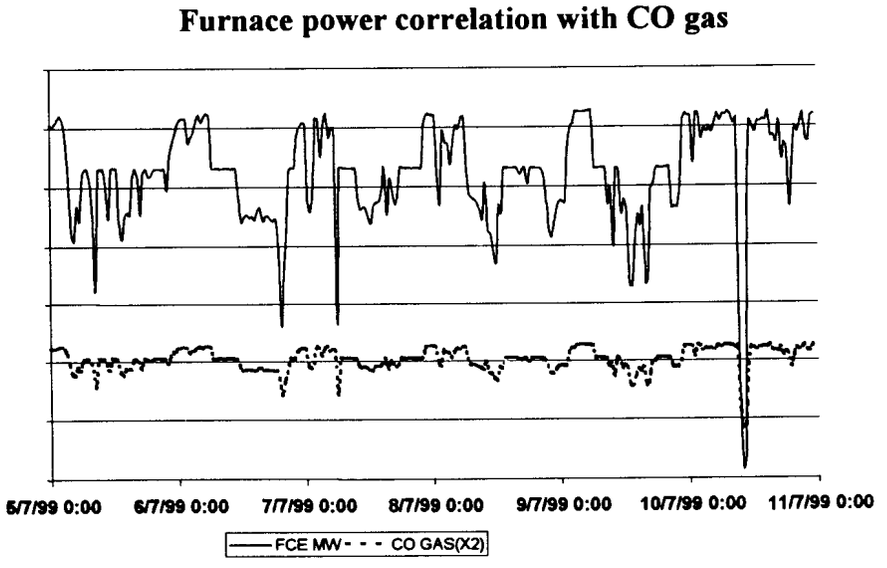

Figure 7.4: Furnace power (kW) correlation with CO gas production (Nm^3)

These values were used to simulate the minimum and maximum CO gas quantities, which will be flared, thus giving an indication of the flow pattern and are illustrated in Figure 7.5. Various Gas samples were taken for Composite analyses by a reputable laboratory which provided the gas content and energy levels as per the proposed layout as required by Table 3.1 in Chapter 3. This is sensitive information that will not be divulged here and an assumption from a text book will be made on the energy content as being 11.79 MJ/Nm^3 [27], for CO gas.

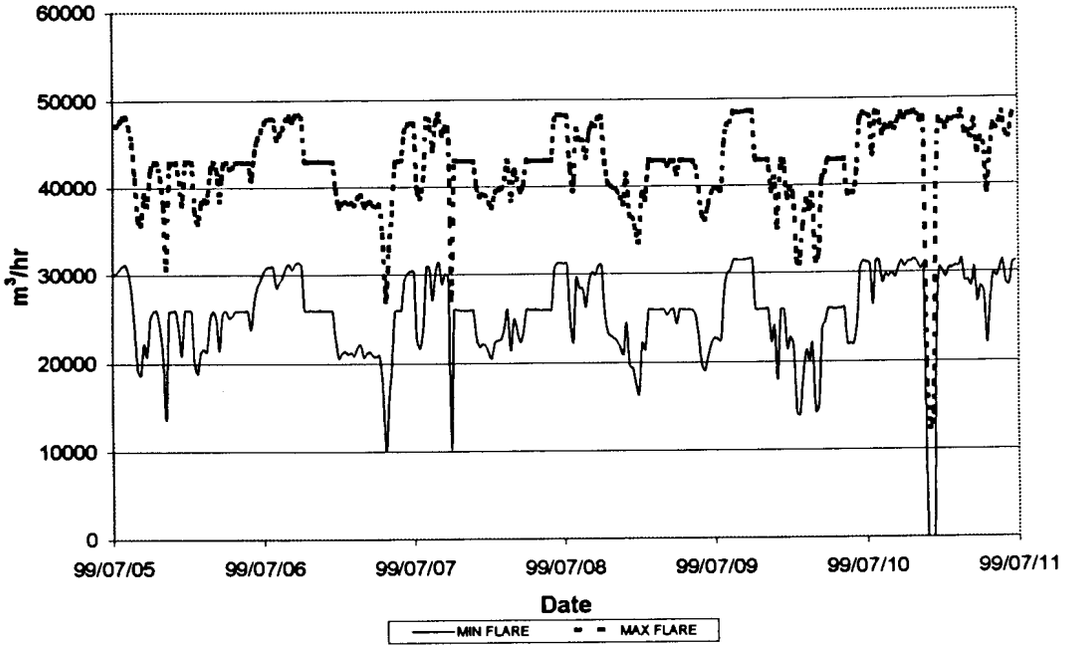

Figure 7.5: Minimum and maximum quantity CO gas wasted (flared)

7.4.1 Verification of building block for gas or fuel evaluation (case study)

The input parameters consisting of measurement analysis and sampling have provided the information required as an output and are therefore correctly identified.

Quantity.

On evaluation of Figure 7.5, one can see that the CO gas volumes vary between 0 and almost 50 000 Nm^3. For safe turbine operation it is clear that the minimum gas for safe turbine operation can be taken as 20 000 Nm^3.

Composition.

The information obtained and discussed in Chapters 1 and 3 have indicated that electric furnace waste gas is very dirty and should be treated by means of bag-houses and scrubbers.

Energy content.

The laboratory analyses would be able to provide this information, but being sensitive, an assumption has been made based on data obtained from a textbook being 11.79 MJ/Nm^3. [27].

7.5 Power generation technology

The information obtained from Figure 7.5 clearly shows that a maximum value of between 40 - 50 000 Nm^3/ hr can possibly be used for cogeneration. Indication then is that an additional make-up fuel would be required to smooth out the erratic profile to prevent damage to the turbine. Based on the assessment made to safely use the minimum value of 20 000 Nm^3/hr, the generating capacity can be calculated for the type of technology selected. For the next discussion and explanation of the power plant process flow model, Figure 4.1 from Chapter 4 is repeated here as Figure 7.6.

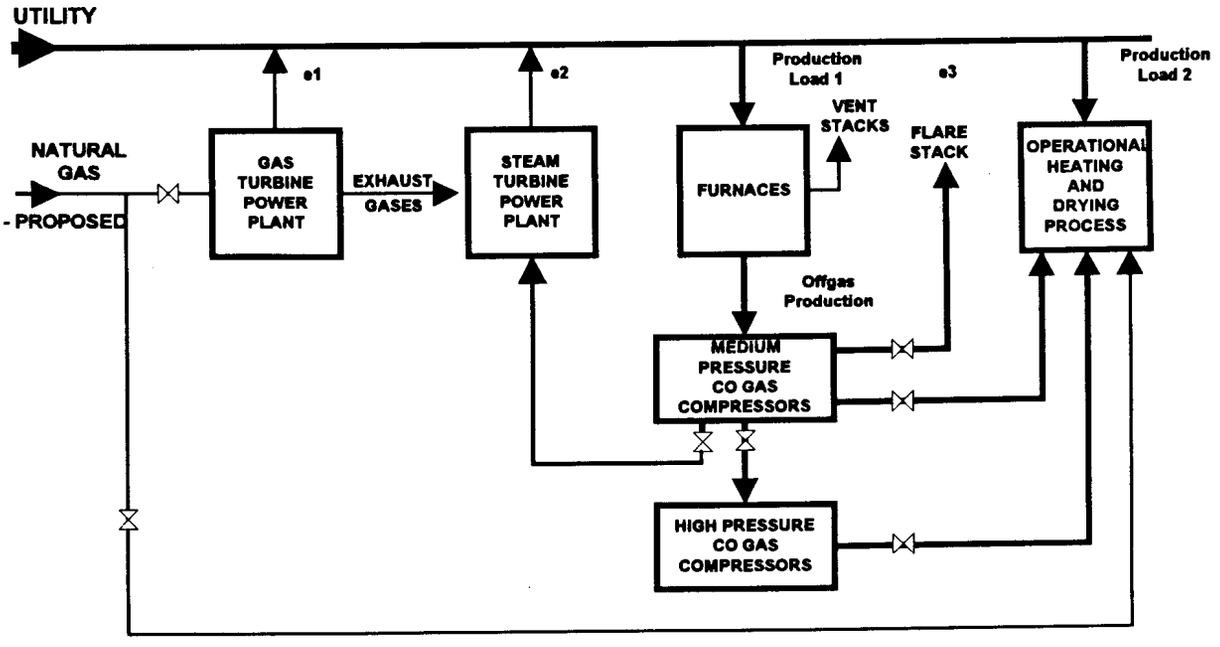

Figure 7.6: Process flow for proposed power plant

7.5.1 Gas boiler and steam turbine configuration

In this configuration the CO gas from the Flare stack is utilized as the main fuel source. Natural gas or oil will be used as a top-up and the gas is combusted in a gas-fired boiler. Steam is then raised and a steam turbine is driven, resulting in 21,55 MWe generating capacity. This is illustrated in Table 7.1, where the tick (✔) means CO gas will be used, with e2 equal to 21 MWe electrical generation into the utility busbar. With zero electricity generated with the CCG, which is indicated with the X.

Power generated = Volume of gas x CV x k x efficiency (7.1)

= 20 000 Nm^3/hr x 11,79 MJ/ Nm^3 x 0,277 MW x 0.33 pu

= 21,55 MWe

where k = Conversion factor of 277,8 kW equals to 1 GJ/h

MWe = Megawatt electrical

Nm^3 = Nominal cubical metre

Table 7.1: Generation option with variable quantities

Option	Type	Natural Gas	CO-Gas	e1 (MWe) Gas turbine	e2 (MWe) Steam boiler	e3 (MWe) Flare stack
21 MWe	Steam	X	✓	0	21	Waste
80 MWe	CCG	✓	X	45	35	Waste
100 MWe	CCG	✓	✓	45	55	Waste

7.5.2 Combined cycle generation (CCG)

For the 80 MWe option , the technology used is CCG, with natural gas as fuel (✔). Natural gas is used to drive a gas turbine with 45 MWe output at e1, whilst the exhaust gases from the gas turbine is put through a waste heat boiler, which in turn drives a steam turbine. In this configuration, nil CO gas is used for cogeneration (X), which will be burnt as waste and thus will not be energy efficient.

For the 100 MWe option, again the CCG technology. Natural gas is used(✔), in a gas turbine with a 45 MWe output at e1, whilst the exhaust gases from the gas turbine is put through a waste heat boiler, which is co-fired with the total CO gas(✔). Natural gas is used as top-up fuel in the waste heat boiler in order to ensure a constant power output from the steam turbine, which will be 55 MWe at e2. Any excess CO gas will then be burnt as waste.

7.5.3 Verification of building block for power plant technology evaluation (case study)

The input requirements for this process are high technical skills for selecting the correct plant configurations for the specific application to be investigated. It also requires a good understanding of the process to enable one to identify all the possible energy sources and to summarize the plant into the different elements as illustrated in Figure 2.6 in Chapter 2. The information obtained from the gas investigation is essential information to limit the

wide choice of options on the various power plant configurations. From a systems point of view, it is shown that the relationship between these two building blocks, namely gas evaluation prior to power plant evaluation is essential.

7.6 Tariff evaluation

Although the utility requires a 12-month historical database for CBL calculations, it was agreed between consumer and utility to use the seven-month history in this case. The motivation for this was clearly due to a more aggressive approach towards nightsave, with a considerable reduction in maximum demand during on-peak period.

As indicated in Chapter 5, the CBLs were calculated for weekdays and weekends separately. With the objective to use the same area under the historic load profile, the new profile is now constructed by allocating the highest load value to the cheapest hour for each month.

The new profile (NP) is then fitted on the CBL graph as illustrated in Figure 7.7. For this evaluation, with the assumptions made, only the difference in load, AL and RL is of importance and will be used to calculate the price difference.

The results, with the RTP prices applied to the AL and RL values are illustrated in Figure 7.8. The cost benefits are summarized in Table 7.2, with the detailed spreadsheets for each month's weekday and weekend, attached as Appendix A.

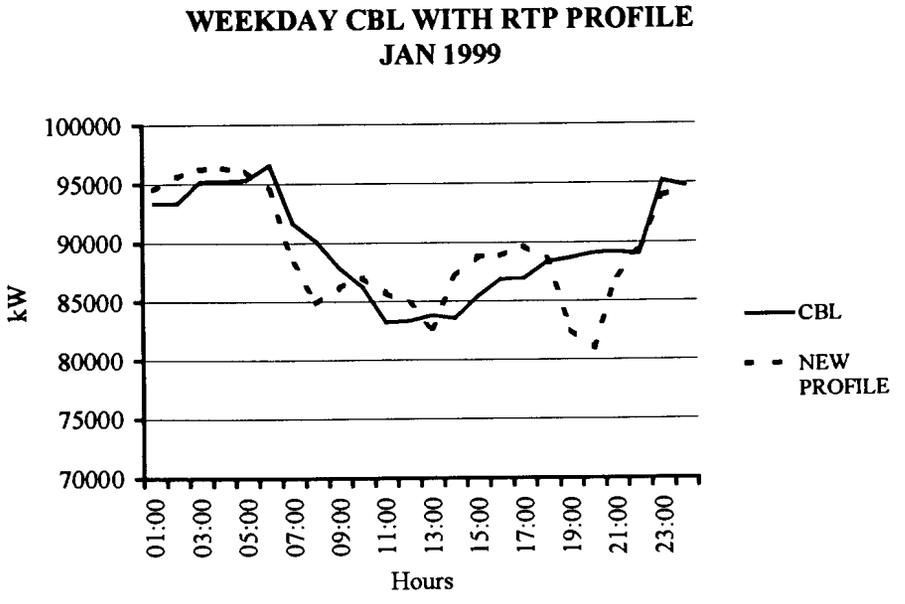

Figure 7.7: New Profile fitted on CBL to illustrate the AL and RL

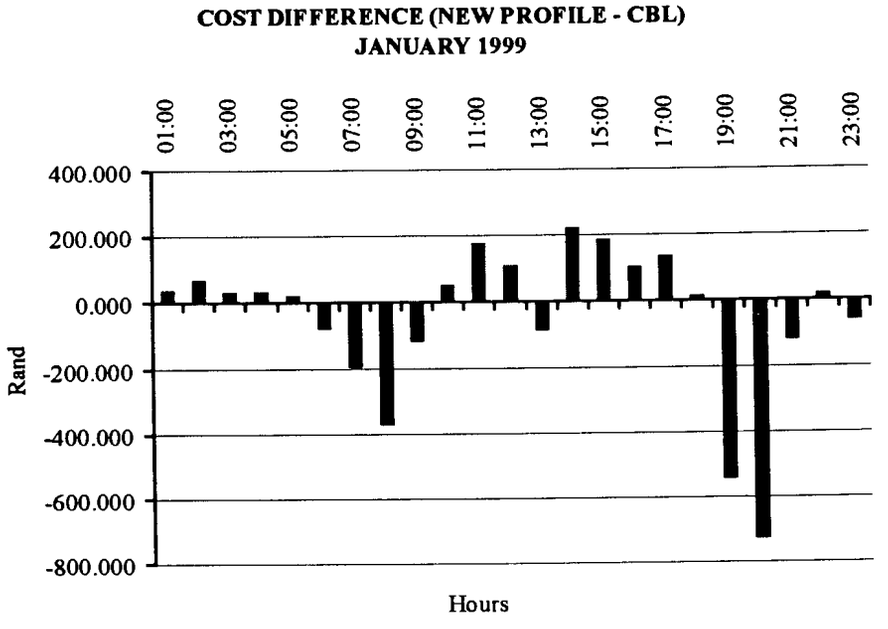

Figure 7.8: Graphical illustration on the cost difference between NP and CBL

Table 7.2: Cost difference between AL and RL, with no cogeneration

Monthly	Jan '99	Feb '99	Mar '99	Apr '99	May '99	Jun '99	Jul '99
Weekdays							
Number of days	21	20	23	19	21	21	22
Cost Difference (NP-CBL)(R*1000)	(1)	4	0	(3)	(2)	(1)	2
Additional cost/(saving)(R*1000)	(23)	79	1	(61)	(51)	(22)	33
Weekends							
Number of weekends	5	4	4	4	5	5	5
Cost difference (NP-CBL)(R)	10	4,6	(4,5)	(4,7)	(1,5)	(1,6)	4,5
Additional cost/(-saving)(R*1000)	0	19	(18)	(19)	(8)	(8)	23
Cost/(saving)(R*1000)	(23)	97	(17)	(80)	(58)	(30)	56
Total cost/saving(R*1000)	(55)	Sum of monthly values					
Annual cost/(saving)(R*1000)	(94,1)	Predicted annual cost					

7.6.1 Verification of electrical tariff evaluation building block

The summated cost values for the seven months of the year show a saving of R54, 913.07, which can be interpreted as R 7,844.72 saving per month which will then give a total predicted saving of R 94,136.69 per annum. This demonstrates then, with the capability to adapt to the RTP tariff, that there will be a potential saving if the same production outputs are maintained.

Inspecting the load profile in Figure 7.7, indicates that the plant does have the capability to adapt to the RTP. This is supported with the ± 16 MW difference between maximum and minimum values recorded, which is almost a 16 % variation.

7.7 Financial evaluation

From the three types of cogeneration plant options in the previous chapter, the 100 MW CCG provides the best flexibility to conduct financial evaluations with the DE&S model, for capital investment and the potential tariff evaluation with cogeneration. The 80 MW CCG plant does not adhere to the requirement of the initial condition set, which was to utilize the CO gas that is treated as waste, and is therefor disqualified and will not be discussed. The steam generation system has no flexibility to evaluate different scenarios and it was also identified as being inefficient and too expensive. For this case study, only the 100 MW CCG will be discussed.

7.7.1 DE&S model

From the discussions on the financial model illustrated in Chapter 6, it was identified that the existing price paid for electricity will play an important role in the decision-making process. With electricity that is cheaper to buy from the utility, cogeneration would not be a viable option.

The following assumptions made for this case study produced the information as illustrated as Table 7.3, which will be further discussed:

- Electricity is available from the utility at 12 c/kWh.
- The banker is so kind as to extend the repayment term from 15 to 20 years and the interest rate dropped as low as 8 %, due to an improved economy.
- The Panda gas fields have been explored and the natural gas is available at R6, 00 per GJ.

Although simple payback is the most common method of comparison, the major disadvantage is that it does not take into account the savings after the payback period. On the other hand, the present value of the savings generated by a project is calculated by adding each year's discounted savings. The NPV is then simply the present value of savings minus the investment cost, which looks very good at more than R 170 million over 15 year period.

This high NPV is obtained due to the large difference in electricity price from the utility (13 c/kWh) and the relative cheap cost for generating (5,98 c/kWh). Another contributor is the low gas price. Remember that the steam generation portion is 55 % of total electricity generated, which make this portion of electricity generation, very cheap.

The IRR, which is the discount rate that yields a zero NPV, is 40,6 %, which is exceptionally good. This rate is a lot higher than the interest rate at which this money will be borrowed. Also some companies will consider investing at IRR rates as low as 15 %. Thus to put this in other financial terms means that this is relatively cheap money to borrow for such an investment.

Table 7.3: DE&S CCP financial model for case study

Combined Power and Heat Model by DE&S

Financial			***Technical***		
Electricity Price	13.00	c/kWh	Availability	90	%
Gas Price	4.39	R/GJ	*Load Factors*		
Steam Price		R/ton	Electricity	100	%
Electricity Escalation	10.0	%/yr.	Steam	100	%
Gas Escalation	10.0	%/yr.	Gas Turbine Power	45.0	MWe
Repayment Term	20	yr.	***Outputs***		
Depreciation Term	3	yr.	IRR, BIAT	40.6	%
Interest Rate	8.00	%	NPV, 15%, 15 yr.	170.5	R mill
Debt-Equity Ratio	-	%	Total Power	102.54	MWe
Management Fee	-	%	Gas Consumption	3,621,610	GJ/yr.
Tax Relief	-		O&M Costs	5.5	R mill
Company Tax	35.0	%	Total Project Costs	113.3	R mill
Secondary Tax	12.5	%	Installed cost per kW	1,620	R/kW
O&M Costs: GT	0.50	c/kWh	O&M	1.01	c/kWh
O&M Costs: ST	0.50	c/kWh	Fuel Costs	2.88	c/kWh
Contingency Costs: GT	-	c/kWh	Interest Costs	2.09	c/kWh
Contingency Costs: ST	-	c/kWh	Contingency Cost	-	c/kWh
			Total Energy Costs	5.98	c/kWh

7.7.2 Tariff evaluations (case study)

Inspection of the monthly RTP average prices, for both weekdays and weekends show that there is plenty opportunity to run this 100 MW cogeneration plant. The scheduling of the cogeneration plant is illustrated in Figure 7.9, where the new profile is plotted with the CBL (January 99 weekday as an example). Due to operational constraints on the utilization of the cogenerator plant, it is recommended to perform two separate case studies for demonstration purposes.

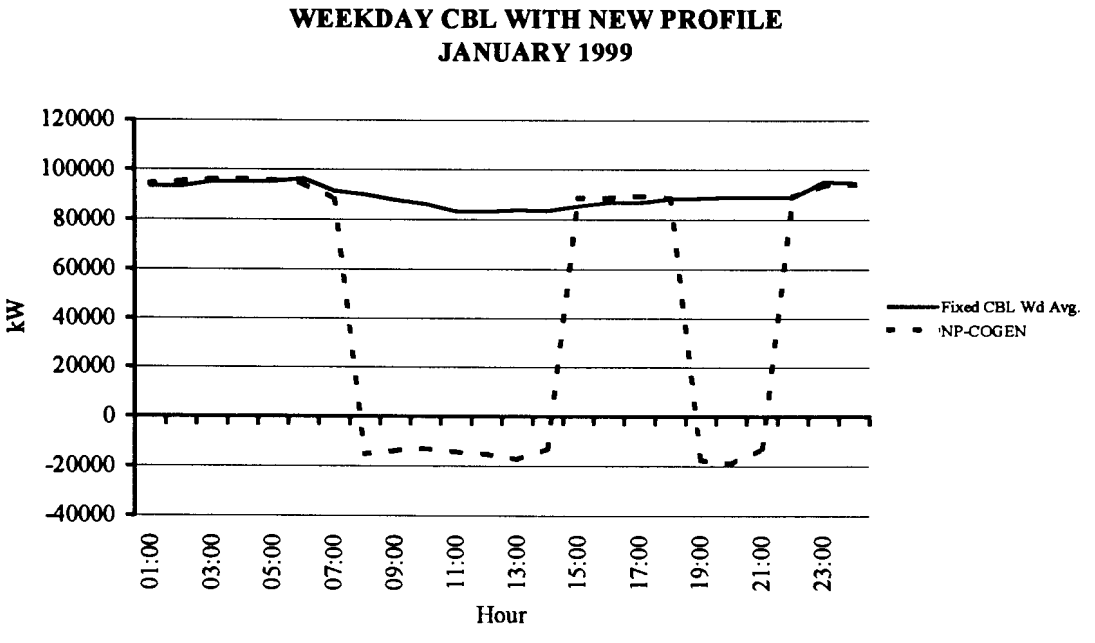

Figure 7.9: New profile fitted with CBL, with cogeneration (Case 1)

7.7.3 Tariff evaluation (Case 1)

This is the more theoretical approach, where cogeneration will be operational at all hours where RTP price is 6 c/kWh and more. From Figure 7.9, it can clearly be seen that electricity will be exported during their operational period.

The cost benefits are summarized in Table 7.4 with the detailed spreadsheets for the monthly weekday and weekends attached as Appendix B. This evaluation supports the DE&S results with a clear indication that this will be a good business proposition.

Table 7.4: Cost difference between AL and RL, with cogeneration. (Case 1)

Monthly	Jan '99	Feb '99	Mar '99	Apr '99	May'99	Jun '99	Jul '99
Weekdays							
Number of days	21	20	23	19	21	21	22
Cost Difference (NP-CBL) (R*1000)	(73)	(68)	(72)	(75)	(75)	(73)	(71)
Additional cost/(saving) (R*1000)	(1,539)	(1,365)	(1,659)	(1,432)	(1,566)	(1,537)	(1,554)
Weekends							
Number of weekends	5	4	4	4	5	5	5
Cost difference (NP-CBL)(R)							
Additional cost/ (-saving)(R*1000)	(192.86)	(135,83)	(172,49)	(173,04)	(200,54)	(201,12)	(170,08)
Cost/(saving)(R*1000)	(1,731)	(1,501)	(1,831)	(1,605)	(1,767)	(1,738)	(1,724)
Total cost/saving(R*1000)	(11.897)	Sum of monthly values					
Annual cost/(saving)(R*1000)	(20,396)	Predicted annual cost					

7.7.4 Tariff evaluation (Case 2)

From an operational point of view, the preference would be to run continuously over a set period, with the limitation that RTP should not be more than 10 % less than cogeneration price and it should run for a minimum period of 4 hours. This limitation is overcome with the scheduling of the cogeneration as illustrated in Figure 7.10. The cost benefits are summarised in Table 7.5, with the detailed spreadsheets attached as Appendix C.

Comparing the two cases with each other, it seems that the more practical approach (Case 2), result in additional savings, which is, from a machine maintenance perspective advantageous for the machinery and equipment.

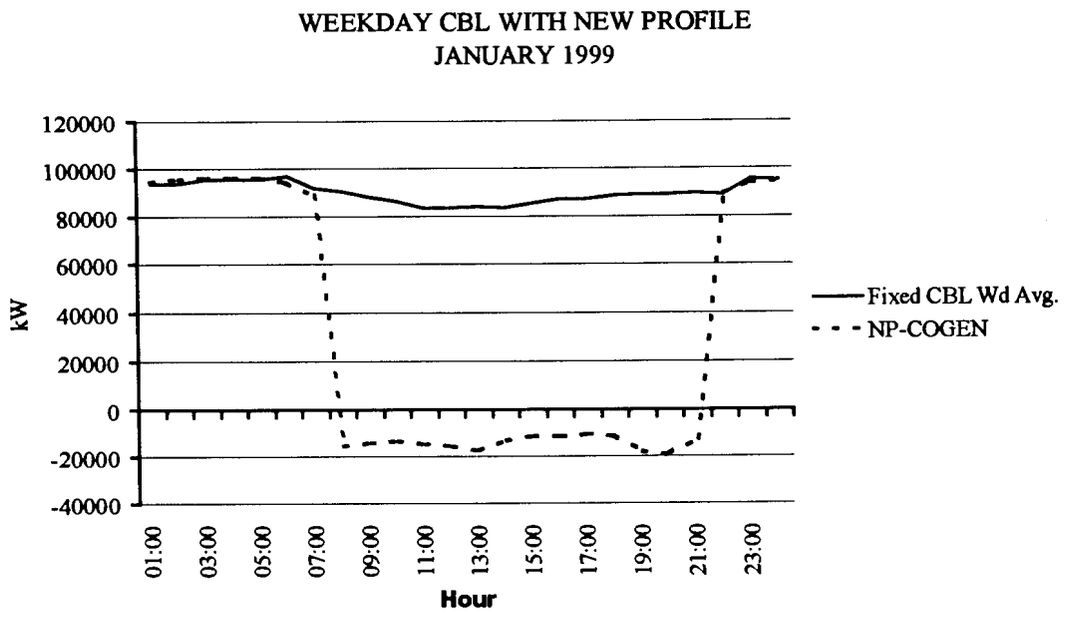

Figure 7.10: New profile fitted with CBL, with cogeneration (Case 2)

Table 7.5: Cost difference between AL and RL, with cogeneration.(Case 2)

Monthly	Jan '99	Feb '99	Mar '99	Apr '99	May'99	Jun '99	Jul '99
Weekdays							
Number of days	21	20	23	19	21	21	22
Cost Difference (NP-CBL) (R*1000)	(95)	(90)	(94)	(97)	(96)	(95)	(92)
Additional cost/(saving) (R*1000)	(1,988)	(1,793)	(2,151)	(1,839)	(2,015)	(1,986)	(2,025)
Weekends							
Number of weekends	5	4	4	4	5	5	5
Cost difference (NP-CBL)(R)							
Additional cost/ (-saving)(R*1000)	(131,99)	(100,61)	(123,80)	(124,35)	(139,67)	(140,26)	(109,21)
Cost/(saving)(R*1000)	(2,120)	(1,893)	(2,275)	(1,963)	(2,155)	(2,127)	(2,134)
Total cost/saving(R*1000)	(14,666)	Sum of monthly values					
Annual cost/(saving)(R*1000)	(25,143)	Predicted annual cost					

7.8 Verification of financial aspects building block

The inputs are market driven, which cannot be influenced by the specific plant and the immediate environment. This means that the cogeneration capacity is dependent on the plant infrastructure and the availability of fuel, which cannot easily be changed without capital expenditure to maintain at least the same output. The commodity prices are dependent on the economic climate and also cannot be changed by the operation. This then indicates that it will be necessary to clearly define a business case, which can then be evaluated, based on the outcome. Typically the business case can be approved with an IRR of 30 % or more. This DR&S financial calculator provides sufficient information to assist the feasibility of such a capital-intensive project. One of the more important output parameters of this process is in fact the generation cost of electricity, dependent on the plant size specified by the customer. This information then needs additional manipulation to determine how this is going to be used with DSM for energy efficiency improvement. The outcome of this building block should be sufficient in providing information to make conceptual decisions.

The second part of the financial evaluation is in fact the results of the spreadsheets developed for this study. The outcome is referring to the difference in cost and not actual values, which means a saving or additional cost. The flexibility to re-schedule the cogeneration facility is very useful and the optimum solution can be obtained.
This provides one the tool to test various options without any expenses and provides information on the proposed load profile for he specific organization.

7.9 Verification of building blocks as a system

The impact of the process as a system can have major financial and technical implications that need to be discussed. The processes identified for a cogeneration system can each be investigated individually and at random, but will confuse the issue.
This will have certain disadvantages in that it is possible to obtain a lot of data, information, technical parameters, etc, which may not be relevant to the specific

cogeneration option being investigated. The design process confirms that the first and most important process is in fact the plant, which should be evaluated in terms of the opportunities that exist for cogeneration use. The energy source (gas & fuel), should then be evaluated to determine the type of fuel available to make it easier to select the technology for the application.

The information obtained from this two processes can then indicate the size and capability of the cogeneartion plant, which will now be evaluated in terms of utilisation to manipulate the tariffs. Again it is possible to obtain information on the tariff structures, but it will be difficult to quantify without understanding the availability and energy contentwhich will influence the cost directly.

This design process for cogeneration as a system provides a tool to guide one through the steps required before making hasty decisions, which can be expensive if it is the wrong decision.

CHAPTER 8

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

In this chapter conclusions will be made to review to what extent the objectives set were achieved. Recommendations will then be made on the possible use of this methodology process for operations other than mineral sand businesses.

8.2 Conclusions on main objective

The main objective set was to create a methodology to evaluate the impact of load scheduling, cogeneration and RTP on the energy cost of a typical titanium mineral producer in the mineral sands industry. This objective was achieved by providing a model in a spreadsheet environment, which converted the historical load profile to a new load profile with definite cost saving potential, without applying any load scheduling. The conversion of the historical energy area to a new load profile with the same energy area, without any load scheduling is already a positive conclusion, which indicates future potential with the use of load scheduling. The spreadsheet environment developed for this study, shows that it is relatively easy to investigate various scenarios without incurring any cost, which is an advantage.

The difference between the maximum and minimum load values indicates that flexibility exists to reschedule some load to obtain greater cost saving advantages.

The results obtained whilst cogenerating electricity during the higher priced periods of the RTP, have showed that it can be very economical if external factors such as gas, electricity price and interest rates on borrowing money are more favorable towards the

potential investor into cogeneration. Not only will the plant generate electricity for its own needs but it will also be able to export.

With the addition of a cogeneration into the system, the load scheduling principles are now enhanced. The cheaper electricity can now be imported from the utility whilst the cogenerator will supply, when the utility price exceeds the cogeneration price to generate electricity. This shows very high monetary values, which means lots of potential cost savings.

8.3 Conclusions on specific objectives

8.3.1 Conclusion on the development of a modelling methodology.

The application of cogeneration in any industrial application is dependent on various aspects, which were identified as processes in this study. For these processes, not all the input and output parameters were measured and quantified. The focus was more on whether sufficient information was obtained to proceed to the next process, or not.

The relationship of the building blocks was shown to be dependent on the availability of information. This assisted with the decision-making process and some alternatives could be eliminated without further investigation. This then confirms that the relationship between the processes can be flexible, but they will influence each other. This is confirmed to be a reliable system, which can be modified by adding or reducing building blocks depending on the specific case study being evaluated. The work done in establishing a methodology, provides guidance for the prospective cogenerator who wants to invest such an installation

8.3.2 Conclusions on plant operations and stockpiles evaluation methodology.

Intimate knowledge and a good understanding of operational processes will be a definite advantage with the confirmation of the energy resources. One should distinguish between the cost components and the application for the different energy resources available to keep focused on the objectives set for the specific application. In this study, CO gas was identified as a useful energy component which was burnt and treated as waste, whilst there are a few other potential aspects, such as using the heat generated by the furnaces, that needs further investigation for other applications. The process described here for a titanium mineral process should be useful for evaluating any other industrial plant because the process is energy focussed and most industrial plants use relatively the same energy sources such as electricity, gas, fuel, and steam.

8.3.3 Conclusions on gas or fuel evaluation methodology.

The basic techniques identified here consist of theoretical calculations for which the results are confirmed by means of field measurements. Again the focus here was gas, but the technique should apply for any other type of energy source. The type of equipment used for the field measurement should be reliable, accurate and suitable for the application. The information obtained in this study was sufficient to confirm the quantity and volumes available for cogeneration use.

8.3.4 Conclusion on power plant evaluation methodology.

This building block was strongly influenced by the outcome of the gas or fuel investigation. Information disclosed in this section is very general and it excludes most of the technical aspects for the implementation of a cogeneration plant. Technical support and experience in the field of electricity generation are required, which can be of assistance with the decision-making process but can also have a financial impact on the selection of power plant equipment.

8.3.5 Conclusions on electricity tariff evaluation methodology.

Again, a good understanding of the available tariffs from the utility is required. The RTP tariff used in this study was not an official tariff and only selected pilot plants were approved. The methodology applied in this study is reliable, but only relevant to electricity consumers who have no seasonal load profiles, with flexibility to adjust load. For such loads, the individual days will have to be profiled for further evaluation.

The utility's requirement for changing tariffs is that it will be revenue neutral and supports the methodology of only investigating the AL and RL. The assumption made to ignore the profit adder in the RL component, proved to be acceptable, as it will have very little impact on the outcome of this case study. The profit adder should be incorporated where the difference between AL and RL is only marginal.

8.3.6 Conclusions on financial evaluation methodology.

Commercial software packages are available and they make provision for inputs or assumptions to suit the specific conditions and requirements. It is therefore necessary to understand the basic operation of the system to enhance the level of confidence in the results.

The results, without the assumptions, have indicated that the cost of cogeneration is more expensive than the purchasing of electricity from the utility, which makes the project not at all feasible. The program is flexible to allow "what ifs", to predict possible changes. This 'what if" allows one to influence possible future scenarios and predict an outcome. This is a very useful tool to have for financial evaluations on power generation plant feasibility.

Equipped with information on the technology, capacity, capital cost, generating cost of electricity and the business case, the influence thereof can be evaluated on the area of concern. In this case, the optimisation of RTP was successfully investigated by enhancing the load scheduling process with the availability of a cogeneration capacity.

8.4 Recommendations

The simple process of measuring the outcome of each of the building blocks can be further developed into an iterative process to improve the technique. The furnaces are operating at very high temperatures and an investigation should be initiated to determine the possible use of the heat energy. The software tools provided, used and recommended in this study should be evaluated and tested for information available on actual installations to increase the level of understanding and confidence.

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JANUARY 99 WEEKDAY

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg		NP-NO COGEN	NP-COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.755	94518.160	94518.160	01:00	1150.404	37.63
03:00	2.955	02:00	3.081	02:00			02:00	93353.807	95594.642	95594.642	02:00	2240.835	69.05
05:00	3.016	03:00	2.955	03:00			03:00	95198.321	96238.765	96238.765	03:00	1040.444	30.75
02:00	3.081	04:00	2.918	04:00			04:00	95223.349	96344.649	96344.649	04:00	1121.300	32.71
01:00	3.271	05:00	3.016	05:00			05:00	95324.829	96084.352	96084.352	05:00	759.524	22.91
06:00	3.767	06:00	3.767	06:00			06:00	96555.758	94496.101	94496.101	06:00	-2059.658	(77.59)
00:00	4.029	07:00	5.818	07:00			07:00	91631.479	88257.802	88257.802	07:00	-3373.677	(196.29)
23:00	4.652	08:00	7.115	08:00			08:00	90126.108	84913.650	84913.650	08:00	-5212.458	(370.88)
17:00	5.030	09:00	6.846	09:00			09:00	87912.010	86232.781	86232.781	09:00	-1679.228	(114.97)
22:00	5.195	10:00	6.584	10:00			10:00	86297.053	87101.908	87101.908	10:00	804.855	52.99
16:00	5.243	11:00	7.113	11:00			11:00	83283.152	85756.306	85756.306	11:00	2473.154	175.91
15:00	5.514	12:00	7.198	12:00			12:00	83381.360	84913.650	84913.650	12:00	1532.290	110.30
18:00	5.608	13:00	7.260	13:00			13:00	83844.655	82690.099	82690.099	13:00	-1154.557	(83.82)
07:00	5.818	14:00	6.226	14:00			14:00	83597.289	87137.202	87137.202	14:00	3539.913	220.38
21:00	6.096	15:00	5.514	15:00			15:00	85449.384	88857.808	88857.808	15:00	3408.424	187.94
14:00	6.226	16:00	5.243	16:00			16:00	86925.287	88893.103	88893.103	16:00	1967.816	103.18
10:00	6.584	17:00	5.030	17:00			17:00	87001.202	89678.405	89678.405	17:00	2677.203	134.67
09:00	6.846	18:00	5.608	18:00			18:00	88394.045	88654.865	88654.865	18:00	260.820	14.63
11:00	7.113	19:00	8.745	19:00			19:00	88725.467	82531.273	82531.273	19:00	-6194.195	(541.68)
08:00	7.115	20:00	8.978	20:00			20:00	89142.414	81018.023	81018.023	20:00	-8124.391	(729.45)
12:00	7.198	21:00	6.096	21:00			21:00	89198.740	87225.439	87225.439	21:00	-1973.301	(120.29)
13:00	7.260	22:00	5.195	22:00			22:00	89056.438	89431.343	89431.343	22:00	374.905	19.48
19:00	8.745	23:00	4.652	23:00			23:00	95205.075	93935.801	93935.801	23:00	-1269.273	(59.05)
20:00	8.978	00:00	4.029	00:00			00:00	94787.968	94288.746	94288.746	00:00	-499.223	(20.11)

Additional cost/(saving) (1,101.58)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APPENDIX A

FEBRUARY 99 WEEKDAY

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP-NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	97769.664	97769.664	01:00	4401.908	144.01
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	99137.324	99137.324	02:00	5783.517	178.21
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	100412.337	100412.337	03:00	5214.016	154.10
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	101449.113	101449.113	04:00	6225.764	181.64
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	99357.915	99357.915	05:00	4033.086	121.64
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	94787.280	94787.280	06:00	-1768.479	(66.62)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	91200.478	91200.478	07:00	-431.000	(25.08)
23:00	4.652	08:00	7.115	08:00			08:00	90126.10782	89713.699	89713.699	08:00	-412.409	(29.34)
17:00	5.030	09:00	6.846	09:00			09:00	87912.00971	90401.941	90401.941	09:00	2489.932	170.47
22:00	5.195	10:00	6.584	10:00			10:00	86297.05337	90724.004	90724.004	10:00	4426.950	291.48
16:00	5.243	11:00	7.113	11:00			11:00	83283.15218	89837.230	89837.230	11:00	6554.078	466.18
15:00	5.514	12:00	7.198	12:00			12:00	83381.36037	89400.461	89400.461	12:00	6019.100	433.28
18:00	5.608	13:00	7.260	13:00			13:00	83844.6552	88593.099	88593.099	13:00	4748.444	344.73
07:00	5.818	14:00	6.226	14:00			14:00	83597.2894	91138.713	91138.713	14:00	7541.423	469.50
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	91743.131	91743.131	15:00	6293.748	347.05
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	92215.195	92215.195	16:00	5289.908	277.36
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	92369.608	92369.608	17:00	5368.406	270.05
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	91344.598	91344.598	18:00	2950.553	165.46
11:00	7.113	19:00	8.745	19:00			19:00	88725.46746	88072.506	88072.506	19:00	-652.962	(57.10)
08:00	7.115	20:00	8.978	20:00			20:00	89142.41355	88063.682	88063.682	20:00	-1078.731	(96.85)
12:00	7.198	21:00	6.096	21:00			21:00	89198.74003	91160.772	91160.772	21:00	1962.032	119.61
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	92356.373	92356.373	22:00	3299.935	171.44
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	93701.976	93701.976	23:00	-1503.099	(69.92)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	93891.683	93891.683	00:00	-896.286	(36.11)

Additional cost/(saving) 3,925.19

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MARCH 99 WEEKDAY

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	96084.352	96084.352	01:00	2716.597	88.87
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	96344.649	96344.649	02:00	2990.842	92.16
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	95594.642	95594.642	03:00	396.321	11.71
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	94518.160	94518.160	04:00	-705.189	(20.57)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	96238.765	96238.765	05:00	913.937	27.56
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	94496.101	94496.101	06:00	-2059.658	(77.59)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	87137.202	87137.202	07:00	-4494.277	(261.50)
23:00	4.652	08:00	7.115	08:00			08:00	90126.10782	81018.023	81018.023	08:00	-9108.085	(648.06)
17:00	5.030	09:00	6.846	09:00			09:00	87912.00971	88654.865	88654.865	09:00	742.855	50.86
22:00	5.195	10:00	6.584	10:00			10:00	86297.05337	89678.405	89678.405	10:00	3381.352	222.64
16:00	5.243	11:00	7.113	11:00			11:00	83283.15218	82531.273	82531.273	11:00	-751.879	(53.48)
15:00	5.514	12:00	7.198	12:00			12:00	83381.36037	87225.439	87225.439	12:00	3844.078	276.71
18:00	5.608	13:00	7.260	13:00			13:00	83844.6552	89431.343	89431.343	13:00	5586.688	405.59
07:00	5.818	14:00	6.226	14:00			14:00	83597.2894	88893.103	88893.103	14:00	5295.813	329.70
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	84913.650	84913.650	15:00	-535.734	(29.54)
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	85756.306	85756.306	16:00	-1168.981	(61.29)
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	86232.781	86232.781	17:00	-768.421	(38.65)
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	82690.099	82690.099	18:00	-5703.947	(319.86)
11:00	7.113	19:00	8.745	19:00			19:00	88725.46746	93935.801	93935.801	19:00	5210.334	455.64
08:00	7.115	20:00	8.978	20:00			20:00	89142.41355	94288.746	94288.746	20:00	5146.332	462.06
12:00	7.198	21:00	6.096	21:00			21:00	89198.74003	88857.808	88857.808	21:00	-340.932	(20.78)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	87101.908	87101.908	22:00	-1954.530	(101.54)
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	84913.650	84913.650	23:00	-10291.425	(478.75)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	88257.802	88257.802	00:00	-6530.166	(263.08)

Additional cost/(saving) 836.22

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APRIL 99 WEEKDAY

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	90989.641	90989.641	01:00	-2378.115	(77.80)
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	91022.149	91022.149	02:00	-2331.658	(71.85)
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	92085.627	92085.627	03:00	-3112.694	(91.99)
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	92800.806	92800.806	04:00	-2422.543	(70.68)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	91073.233	91073.233	05:00	-4251.596	(128.23)
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	90724.932	90724.932	06:00	-5830.826	(219.65)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	86029.838	86029.838	07:00	-5601.641	(325.93)
23:00	4.652	08:00	7.115	08:00			08:00	90126.10782	84474.096	84474.096	08:00	-5652.012	(402.16)
17:00	5.030	09:00	6.846	09:00			09:00	87912.00971	84919.920	84919.920	09:00	-2992.090	(204.85)
22:00	5.195	10:00	6.584	10:00			10:00	86297.05337	85277.509	85277.509	10:00	-1019.545	(67.13)
16:00	5.243	11:00	7.113	11:00			11:00	83283.15218	84557.687	84557.687	11:00	1274.535	90.66
15:00	5.514	12:00	7.198	12:00			12:00	83381.36037	83656.749	83656.749	12:00	275.388	19.82
18:00	5.608	13:00	7.260	13:00			13:00	83844.6552	83373.464	83373.464	13:00	-471.191	(34.21)
07:00	5.818	14:00	6.226	14:00			14:00	83597.2894	85639.741	85639.741	14:00	2042.452	127.16
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	86684.643	86684.643	15:00	1235.260	68.11
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	86981.860	86981.860	16:00	56.573	2.97
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	89192.409	89192.409	17:00	2191.207	110.23
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	86368.851	86368.851	18:00	-2025.194	(113.57)
11:00	7.113	19:00	8.745	19:00			19:00	88725.46746	83294.517	83294.517	19:00	-5430.951	(474.93)
08:00	7.115	20:00	8.978	20:00			20:00	89142.41355	80930.715	80930.715	20:00	-8211.699	(737.28)
12:00	7.198	21:00	6.096	21:00			21:00	89198.74003	85867.298	85867.298	21:00	-3331.442	(203.09)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	88579.400	88579.400	22:00	-477.038	(24.78)
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	90362.699	90362.699	23:00	-4842.376	(225.26)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	90711.000	90711.000	00:00	-4076.968	(164.25)

Additional cost/(saving) (3,218.69)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MAY 99 WEEKDAY

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	91130.730	91130.730	01:00	-2237.025	(73.18)
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	91454.263	91454.263	02:00	-1899.544	(58.53)
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	92483.685	92483.685	03:00	-2714.636	(80.23)
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	94903.878	94903.878	04:00	-319.471	(9.32)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	92420.660	92420.660	05:00	-2904.169	(87.59)
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	90744.172	90744.172	06:00	-5811.587	(218.92)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	86399.589	86399.589	07:00	-5231.889	(304.41)
23:00	4.652	08:00	7.115	08:00			08:00	90126.10782	85122.266	85122.266	08:00	-5003.842	(356.04)
17:00	5.030	09:00	6.846	09:00			09:00	87912.00971	85685.297	85685.297	09:00	-2226.713	(152.45)
22:00	5.195	10:00	6.584	10:00			10:00	86297.05337	86034.040	86034.040	10:00	-263.014	(17.32)
16:00	5.243	11:00	7.113	11:00			11:00	83283.15218	85592.859	85592.859	11:00	2309.707	164.29
15:00	5.514	12:00	7.198	12:00			12:00	83381.36037	83597.040	83597.040	12:00	215.680	15.53
18:00	5.608	13:00	7.260	13:00			13:00	83844.6552	83576.031	83576.031	13:00	-268.624	(19.50)
07:00	5.818	14:00	6.226	14:00			14:00	83597.2894	86046.645	86046.645	14:00	2449.355	152.49
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	88727.344	88727.344	15:00	3277.961	180.75
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	89218.946	89218.946	16:00	2293.659	120.26
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	89823.994	89823.994	17:00	2822.792	142.00
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	87899.605	87899.605	18:00	-494.440	(27.73)
11:00	7.113	19:00	8.745	19:00			19:00	88725.46746	82660.056	82660.056	19:00	-6065.411	(530.42)
08:00	7.115	20:00	8.978	20:00			20:00	89142.41355	81710.466	81710.466	20:00	-7431.947	(667.27)
12:00	7.198	21:00	6.096	21:00			21:00	89198.74003	86050.847	86050.847	21:00	-3147.893	(191.90)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	89223.148	89223.148	22:00	166.710	8.66
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	90042.484	90042.484	23:00	-5162.591	(240.16)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	90735.768	90735.768	00:00	-4052.200	(163.25)

Additional cost/(saving) (2,414.25)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JUNE 99 WEEKDAY

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	96223.219	96223.219	01:00	2855.464	93.41
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	96517.339	96517.339	02:00	3163.532	97.48
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	97340.878	97340.878	03:00	2142.556	63.32
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	97870.295	97870.295	04:00	2646.946	77.23
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	96891.293	96891.293	05:00	1566.465	47.25
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	95576.154	95576.154	06:00	-979.605	(36.90)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	88887.010	88887.010	07:00	-2744.469	(159.68)
23:00	4.652	08:00	7.115	08:00			08:00	90126.10782	85744.121	85744.121	08:00	-4381.987	(311.79)
17:00	5.030	09:00	6.846	09:00			09:00	87912.00971	86378.581	86378.581	09:00	-1533.428	(104.98)
22:00	5.195	10:00	6.584	10:00			10:00	86297.05337	87454.223	87454.223	10:00	1157.170	76.19
16:00	5.243	11:00	7.113	11:00			11:00	83283.15218	85886.979	85886.979	11:00	2603.827	185.21
15:00	5.514	12:00	7.198	12:00			12:00	83381.36037	82752.494	82752.494	12:00	-628.867	(45.27)
18:00	5.608	13:00	7.260	13:00			13:00	83844.6552	82012.991	82012.991	13:00	-1831.665	(132.98)
07:00	5.818	14:00	6.226	14:00			14:00	83597.2894	87853.386	87853.386	14:00	4256.097	264.97
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	90008.870	90008.870	15:00	4559.486	251.42
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	90298.789	90298.789	16:00	3373.502	176.88
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	91655.945	91655.945	17:00	4654.743	234.15
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	89655.925	89655.925	18:00	1261.880	70.76
11:00	7.113	19:00	8.745	19:00			19:00	88725.46746	79302.879	79302.879	19:00	-9422.589	(824.00)
08:00	7.115	20:00	8.978	20:00			20:00	89142.41355	76996.133	76996.133	20:00	-12146.281	(1,090.55)
12:00	7.198	21:00	6.096	21:00			21:00	89198.74003	88714.739	88714.739	21:00	-484.001	(29.51)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	90353.411	90353.411	22:00	1296.973	67.38
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	94622.362	94622.362	23:00	-582.712	(27.11)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	95403.883	95403.883	00:00	615.915	24.81

Additional cost/(saving) (1,032.31)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JULY 99 WEEKDAY

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP- NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	97941.724	97941.724	01:00	4573.968	149.63
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	98762.321	98762.321	02:00	5408.513	166.66
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	99578.506	99578.506	03:00	4380.184	129.45
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	100531.457	100531.457	04:00	5308.108	154.87
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	99366.738	99366.738	05:00	4041.910	121.91
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	96900.537	96900.537	06:00	344.778	12.99
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	89943.113	89943.113	07:00	-1688.365	(98.24)
23:00	4.652	08:00	7.115	08:00			08:00	90126.10782	86290.135	86290.135	08:00	-3835.973	(272.94)
17:00	5.030	09:00	6.846	09:00			09:00	87912.00971	87834.268	87834.268	09:00	-77.742	(5.32)
22:00	5.195	10:00	6.584	10:00			10:00	86297.05337	88593.099	88593.099	10:00	2296.046	151.18
16:00	5.243	11:00	7.113	11:00			11:00	83283.15218	86409.254	86409.254	11:00	3126.101	222.36
15:00	5.514	12:00	7.198	12:00			12:00	83381.36037	85310.713	85310.713	12:00	1929.353	138.88
18:00	5.608	13:00	7.260	13:00			13:00	83844.6552	84790.119	84790.119	13:00	945.464	68.64
07:00	5.818	14:00	6.226	14:00			14:00	83597.2894	88875.455	88875.455	14:00	5278.166	328.60
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	91116.654	91116.654	15:00	5667.271	312.50
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	91518.130	91518.130	16:00	4592.843	240.81
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	92096.076	92096.076	17:00	5094.874	256.29
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	90273.999	90273.999	18:00	1879.954	105.42
11:00	7.113	19:00	8.745	19:00			19:00	88725.46746	84459.234	84459.234	19:00	-4266.234	(373.08)
08:00	7.115	20:00	8.978	20:00			20:00	89142.41355	84004.818	84004.818	20:00	-5137.596	(461.28)
12:00	7.198	21:00	6.096	21:00			21:00	89198.74003	89272.518	89272.518	21:00	73.778	4.50
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	91954.898	91954.898	22:00	2898.460	150.58
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	94518.160	94518.160	23:00	-686.914	(31.95)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	95982.881	95982.881	00:00	1194.913	48.14

Additional cost/(saving) 1,520.60

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JANUARY 99 WEEKEND

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	96291.708	96291.708	01:00	594.638	20.56
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	96732.888	96732.888	02:00	1321.769	40.59
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97112.304	97112.304	03:00	2978.742	86.01
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	98400.552	98400.552	04:00	4778.431	134.19
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99027.029	99027.029	05:00	4650.232	130.39
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	98947.616	98947.616	06:00	4153.917	116.56
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	96432.885	96432.885	07:00	-1043.381	(35.16)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	92965.203	92965.203	08:00	-3584.352	(200.43)
17:00	3.604	09:00	7.687	09:00			09:00	93132.85173	88579.865	88579.865	09:00	-4552.987	(350.00)
16:00	3.664	10:00	7.410	10:00			10:00	87950.49732	89206.341	89206.341	10:00	1255.844	93.06
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	92735.788	92735.788	11:00	8122.860	464.63
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	93124.029	93124.029	12:00	6136.664	343.04
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	94306.393	94306.393	13:00	4364.049	223.61
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	94350.511	94350.511	14:00	3660.728	160.37
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	95003.459	95003.459	15:00	1696.003	65.95
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	95506.405	95506.405	16:00	411.115	15.06
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	96150.529	96150.529	17:00	1265.560	45.61
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	94588.748	94588.748	18:00	1801.138	71.46
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	90397.529	90397.529	19:00	-4792.066	(352.68)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	87000.437	87000.437	20:00	-8796.541	(816.13)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	90679.885	90679.885	21:00	-3767.873	(258.00)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	94500.512	94500.512	22:00	-73.997	(3.21)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	95091.695	95091.695	23:00	408.174	15.31
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	96238.766	96238.766	00:00	-8.730	(0.30)

Additional cost/(saving) 10.50

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

FEBRUARY 99 WEEKEND

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	100423.367	100423.367	01:00	4726.297	163.44
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	101107.198	101107.198	02:00	5696.078	174.91
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	101371.907	101371.907	03:00	7238.345	209.00
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	103004.276	103004.276	04:00	9382.155	263.48
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	104272.671	104272.671	05:00	9895.874	277.47
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	103026.335	103026.335	06:00	8232.636	231.01
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	100941.754	100941.754	07:00	3465.488	116.76
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	96816.713	96816.713	08:00	267.159	14.94
17:00	3.604	09:00	7.687	09:00			09:00	93132.85173	92945.349	92945.349	09:00	-187.503	(14.41)
16:00	3.664	10:00	7.410	10:00			10:00	87950.49732	94809.340	94809.340	10:00	6858.842	508.26
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	96011.558	96011.558	11:00	11398.630	652.01
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	97048.333	97048.333	12:00	10060.968	562.41
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	97224.805	97224.805	13:00	7282.462	373.15
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	97489.513	97489.513	14:00	6799.730	297.88
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	98283.639	98283.639	15:00	4976.182	193.50
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	99154.972	99154.972	16:00	4059.683	148.76
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	99916.009	99916.009	17:00	5031.039	181.31
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	97665.986	97665.986	18:00	4878.376	193.56
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	95471.110	95471.110	19:00	281.515	20.72
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	90937.976	90937.976	20:00	-4859.002	(450.81)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	95702.731	95702.731	21:00	1254.973	85.93
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	97610.838	97610.838	22:00	3036.329	131.74
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	98768.938	98768.938	23:00	4085.417	153.20
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	100202.776	100202.776	00:00	3955.280	136.88

Additional cost/(saving) 4,625.10

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MARCH 99 WEEKEND

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	91930.635	91930.635	01:00	-3766.435	(130.25)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	93794.623	93794.623	02:00	-1616.496	(49.64)
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	94158.598	94158.598	03:00	25.036	0.72
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	95548.318	95548.318	04:00	1926.196	54.09
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	97026.274	97026.274	05:00	2649.477	74.29
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	95559.347	95559.347	06:00	765.648	21.48
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	92040.929	92040.929	07:00	-5435.338	(183.14)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	89018.839	89018.839	08:00	-7530.716	(421.11)
17:00	3.604	09:00	7.687	09:00			09:00	93132.85173	84827.620	84827.620	09:00	-8305.231	(638.44)
16:00	3.664	10:00	7.410	10:00			10:00	87950.49732	85312.918	85312.918	10:00	-2637.579	(195.45)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	87882.798	87882.798	11:00	3269.870	187.04
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	89548.256	89548.256	12:00	2560.892	143.15
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	89945.319	89945.319	13:00	2.976	0.15
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	90320.342	90320.342	14:00	-369.440	(16.18)
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	90739.455	90739.455	15:00	-2568.002	(99.86)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	91147.538	91147.538	16:00	-3947.752	(144.66)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	91445.334	91445.334	17:00	-3439.636	(123.96)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	90706.357	90706.357	18:00	-2081.253	(82.58)
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	85412.202	85412.202	19:00	-9777.393	(719.57)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	82654.804	82654.804	20:00	-13142.174	(1,219.31)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	86669.573	86669.573	21:00	-7778.185	(532.60)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	90629.166	90629.166	22:00	-3945.343	(171.18)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	91092.390	91092.390	23:00	-3591.131	(134.67)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	91632.836	91632.836	00:00	-4614.660	(159.70)

Additional cost/(saving) (4,541.37)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APRIL 99 WEEKEND

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	92625.494	92625.494	01:00	-3071.576	(106.22)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	93971.095	93971.095	02:00	-1440.024	(44.22)
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	94180.657	94180.657	03:00	47.095	1.36
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	94754.192	94754.192	04:00	1132.070	31.79
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	94831.399	94831.399	05:00	454.601	12.75
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	94820.369	94820.369	06:00	26.670	0.75
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	93298.295	93298.295	07:00	-4177.972	(140.77)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	88412.218	88412.218	08:00	-8137.336	(455.03)
17:00	3.604	09:00	7.687	09:00			09:00	93132.85173	85820.277	85820.277	09:00	-7312.575	(562.13)
16:00	3.664	10:00	7.410	10:00			10:00	87950.49732	86879.111	86879.111	10:00	-1071.386	(79.39)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	88202.656	88202.656	11:00	3589.728	205.33
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	88599.717	88599.717	12:00	1612.353	90.13
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	88676.924	88676.924	13:00	-1265.420	(64.84)
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	88687.953	88687.953	14:00	-2001.830	(87.70)
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	88985.750	88985.750	15:00	-4321.706	(168.05)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	90640.179	90640.179	16:00	-4455.110	(163.25)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	90662.238	90662.238	17:00	-4222.732	(152.18)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	88952.662	88952.662	18:00	-3834.948	(152.16)
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	87066.615	87066.615	19:00	-8122.980	(597.82)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	82368.036	82368.036	20:00	-13428.942	(1,245.92)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	88169.566	88169.566	21:00	-6278.191	(429.89)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	88941.632	88941.632	22:00	-5632.878	(244.40)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	89448.990	89448.990	23:00	-5234.531	(196.29)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	92482.110	92482.110	00:00	-3765.386	(130.31)

Additional cost/(saving) (4,678.46)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MAY 99 WEEKEND

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	95013.887	95013.887	01:00	-683.183	(23.63)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	96842.782	96842.782	02:00	1431.662	43.96
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97404.286	97404.286	03:00	3270.724	94.44
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	98615.528	98615.528	04:00	4993.406	140.23
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99963.135	99963.135	05:00	5586.338	156.63
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	99610.190	99610.190	06:00	4816.491	135.15
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	95029.930	95029.930	07:00	-2446.337	(82.43)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	89984.424	89984.424	08:00	-6565.131	(367.12)
17:00	3.604	09:00	7.687	09:00			09:00	93132.85173	87642.154	87642.154	09:00	-5490.698	(422.08)
16:00	3.664	10:00	7.410	10:00			10:00	87950.49732	88941.632	88941.632	10:00	991.135	73.45
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	89872.123	89872.123	11:00	5259.195	300.83
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	90569.992	90569.992	12:00	3582.627	200.27
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	91420.268	91420.268	13:00	1477.924	75.73
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	91757.169	91757.169	14:00	1067.386	46.76
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	93184.991	93184.991	15:00	-122.466	(4.76)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	93914.945	93914.945	16:00	-1180.345	(43.25)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	94003.182	94003.182	17:00	-881.788	(31.78)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	92559.316	92559.316	18:00	-228.294	(9.06)
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	89190.298	89190.298	19:00	-5999.297	(441.52)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	86928.243	86928.243	20:00	-8868.735	(822.83)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	89350.727	89350.727	21:00	-5097.030	(349.01)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	92479.101	92479.101	22:00	-2095.408	(90.92)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	93345.421	93345.421	23:00	-1338.100	(50.18)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	94693.028	94693.028	00:00	-1554.468	(53.80)

Additional cost/(saving) (1,524.91)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JUNE 99 WEEKEND

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	95129.195	95129.195	01:00	-567.875	(19.64)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	95989.497	95989.497	02:00	578.378	17.76
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97103.480	97103.480	03:00	2969.918	85.75
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	97489.513	97489.513	04:00	3867.392	108.61
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99507.917	99507.917	05:00	5131.119	143.87
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	97809.370	97809.370	06:00	3015.670	84.62
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	95757.879	95757.879	07:00	-1718.388	(57.90)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	91037.242	91037.242	08:00	-5512.312	(308.24)
17:00	3.604	09:00	7.687	09:00			09:00	93132.85173	87607.060	87607.060	09:00	-5525.791	(424.78)
16:00	3.664	10:00	7.410	10:00			10:00	87950.49732	88125.449	88125.449	10:00	174.951	12.96
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	91015.183	91015.183	11:00	6402.255	366.21
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	91621.807	91621.807	12:00	4634.443	259.07
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	91831.367	91831.367	13:00	1889.024	96.79
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	92018.870	92018.870	14:00	1329.087	58.23
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	93187.999	93187.999	15:00	-119.458	(4.65)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	94026.243	94026.243	16:00	-1069.047	(39.17)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	94919.635	94919.635	17:00	34.665	1.25
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	92824.025	92824.025	18:00	36.415	1.44
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	88290.890	88290.890	19:00	-6898.705	(507.71)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	85158.505	85158.505	20:00	-10638.473	(987.02)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	89382.814	89382.814	21:00	-5064.944	(346.81)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	92658.582	92658.582	22:00	-1915.928	(83.13)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	93199.029	93199.029	23:00	-1484.492	(55.67)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	94985.812	94985.812	00:00	-1261.684	(43.66)

Additional cost/(saving) (1,641.83)

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APPENDIX A

JULY 99 WEEKEND

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN	NP - CBL		NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	101235.874	101235.874	01:00	5538.804	191.54
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	101579.016	101579.016	02:00	6167.896	189.39
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	101579.016	101579.016	03:00	7445.454	214.98
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	101588.820	101588.820	04:00	7966.699	223.73
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	102079.021	102079.021	05:00	7702.224	215.96
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	101667.252	101667.252	06:00	6873.553	192.87
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	101480.975	101480.975	07:00	4004.709	134.93
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	97716.232	97716.232	08:00	1166.678	65.24
17:00	3.604	09:00	7.687	09:00			09:00	93132.85173	91216.166	91216.166	09:00	-1916.686	(147.34)
16:00	3.664	10:00	7.410	10:00			10:00	87950.49732	91392.655	91392.655	10:00	3442.157	255.07
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	97716.231	97716.231	11:00	13103.303	749.52
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	98324.081	98324.081	12:00	11336.717	633.72
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	99324.090	99324.090	13:00	9381.747	480.72
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	99412.327	99412.327	14:00	8722.544	382.12
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	99667.232	99667.232	15:00	6359.775	247.30
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	100039.784	100039.784	16:00	4944.494	181.18
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	100873.127	100873.127	17:00	5988.157	215.81
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	99657.428	99657.428	18:00	6869.818	272.57
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	96569.161	96569.161	19:00	1379.566	101.53
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	85500.433	85500.433	20:00	-10296.545	(955.30)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	96627.985	96627.985	21:00	2180.228	149.29
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	99520.171	99520.171	22:00	4945.661	214.58
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	99726.056	99726.056	23:00	5042.535	189.09
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	101108.423	101108.423	00:00	4860.927	168.23
Additional cost/(saving)													4,566.74

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JANUARY 99 WEEKDAY - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP-NO COGEN	NP-COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.755	94518.160	94518.160	01:00	1150.404	37.63
03:00	2.955	02:00	3.081	02:00			02:00	93353.807	95594.642	95594.642	02:00	2240.835	69.05
05:00	3.016	03:00	2.955	03:00			03:00	95198.321	96238.765	96238.765	03:00	1040.444	30.75
02:00	3.081	04:00	2.918	04:00			04:00	95223.349	96344.649	96344.649	04:00	1121.300	32.71
01:00	3.271	05:00	3.016	05:00			05:00	95324.829	96084.352	96084.352	05:00	759.524	22.91
06:00	3.767	06:00	3.767	06:00			06:00	96555.758	94496.101	94496.101	06:00	-2059.658	(77.59)
00:00	4.029	07:00	5.818	07:00			07:00	91631.479	88257.802	88257.802	07:00	-3373.677	(196.29)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.108	84913.650	-15086.350	08:00	-105212.458	(7,486.15)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.010	86232.781	-13767.219	09:00	-101679.228	(6,961.29)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.053	87101.908	-12898.092	10:00	-99195.145	(6,531.25)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.152	85756.306	-14243.694	11:00	-97526.846	(6,936.97)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.360	84913.650	-15086.350	12:00	-98467.710	(7,088.16)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.655	82690.099	-17309.901	13:00	-101154.557	(7,343.73)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.289	87137.202	-12862.798	14:00	-96460.087	(6,005.25)
21:00	6.096	15:00	5.514	15:00			15:00	85449.384	88857.808	88857.808	15:00	3408.424	187.94
14:00	6.226	16:00	5.243	16:00			16:00	86925.287	88893.103	88893.103	16:00	1967.816	103.18
10:00	6.584	17:00	5.030	17:00			17:00	87001.202	89678.405	89678.405	17:00	2677.203	134.67
09:00	6.846	18:00	5.608	18:00			18:00	88394.045	88654.865	88654.865	18:00	260.820	14.63
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.467	82531.273	-17468.727	19:00	-106194.195	(9,286.65)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.414	81018.023	-18981.978	20:00	-108124.391	(9,707.91)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.740	87225.439	-12774.561	21:00	-101973.301	(6,216.39)
13:00	7.260	22:00	5.195	22:00			22:00	89056.438	89431.343	89431.343	22:00	374.905	19.48
19:00	8.745	23:00	4.652	23:00			23:00	95205.075	93935.801	93935.801	23:00	-1269.273	(59.05)
20:00	8.978	00:00	4.029	00:00			00:00	94787.968	94288.746	94288.746	00:00	-499.223	(20.11)

Additional cost/(saving) **(73,263.83)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

FEBRUARY 99 - CASE1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP-NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	97769.664	97769.664	01:00	4401.908	144.01
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	99137.324	99137.324	02:00	5783.517	178.21
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	100412.337	100412.337	03:00	5214.016	154.10
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	101449.113	101449.113	04:00	6225.764	181.64
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	99357.915	99357.915	05:00	4033.086	121.64
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	94787.280	94787.280	06:00	-1768.479	(66.62)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	91200.478	91200.478	07:00	-431.000	(25.08)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	89713.699	-10286.301	08:00	-100412.409	(7,144.61)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	90401.941	-9598.059	09:00	-97510.068	(6,675.86)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	90724.004	-9275.996	10:00	-95573.050	(6,292.76)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	89837.230	-10162.770	11:00	-93445.922	(6,646.70)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	89400.461	-10599.539	12:00	-93980.900	(6,765.18)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	88593.099	-11406.901	13:00	-95251.556	(6,915.18)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	91138.713	-8861.287	14:00	-92458.577	(5,756.13)
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	91743.131	91743.131	15:00	6293.748	347.05
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	92215.195	92215.195	16:00	5289.908	277.36
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	92369.608	92369.608	17:00	5368.406	270.05
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	91344.598	91344.598	18:00	2950.553	165.46
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	88072.506	-11927.494	19:00	-100652.962	(8,802.07)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	88063.682	-11936.318	20:00	-101078.731	(9,075.32)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	91160.772	-8839.228	21:00	-98037.968	(5,976.49)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	92356.373	92356.373	22:00	3299.935	171.44
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	93701.976	93701.976	23:00	-1503.099	(69.92)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	93891.683	93891.683	00:00	-896.286	(36.11)

Additional cost/(saving) **(68,237.07)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MARCH 99 WEEKDAY - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	96084.352	96084.352	01:00	2716.597	88.87
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	96344.649	96344.649	02:00	2990.842	92.16
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	95594.642	95594.642	03:00	396.321	11.71
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	94518.160	94518.160	04:00	-705.189	(20.57)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	96238.765	96238.765	05:00	913.937	27.56
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	94496.101	94496.101	06:00	-2059.658	(77.59)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	87137.202	87137.202	07:00	-4494.277	(261.50)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	81018.023	-18981.978	08:00	-109108.085	(7,763.33)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	88654.865	-11345.135	09:00	-99257.145	(6,795.47)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	89678.405	-10321.595	10:00	-96618.648	(6,361.61)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	82531.273	-17468.727	11:00	-100751.879	(7,166.36)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	87225.439	-12774.561	12:00	-96155.922	(6,921.75)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	89431.343	-10568.657	13:00	-94413.312	(6,854.32)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	88893.103	-11106.898	14:00	-94704.187	(5,895.93)
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	84913.650	84913.650	15:00	-535.734	(29.54)
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	85756.306	85756.306	16:00	-1168.981	(61.29)
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	86232.781	86232.781	17:00	-768.421	(38.65)
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	82690.099	82690.099	18:00	-5703.947	(319.86)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	93935.801	-6064.199	19:00	-94789.666	(8,289.33)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	94288.746	-5711.254	20:00	-94853.668	(8,516.40)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	88857.808	-11142.192	21:00	-100340.932	(6,116.88)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	87101.908	87101.908	22:00	-1954.530	(101.54)
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	84913.650	84913.650	23:00	-10291.425	(478.75)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	88257.802	88257.802	00:00	-6530.166	(263.08)

Additional cost/(saving) **(72,113.45)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APRIL 99 WEEKDAY - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	90989.641	90989.641	01:00	-2378.115	(77.80)
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	91022.149	91022.149	02:00	-2331.658	(71.85)
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	92085.627	92085.627	03:00	-3112.694	(91.99)
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	92800.806	92800.806	04:00	-2422.543	(70.68)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	91073.233	91073.233	05:00	-4251.596	(128.23)
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	90724.932	90724.932	06:00	-5830.826	(219.65)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	86029.838	86029.838	07:00	-5601.641	(325.93)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	84474.096	-15525.904	08:00	-105652.012	(7,517.42)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	84919.920	-15080.080	09:00	-102992.090	(7,051.17)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	85277.509	-14722.491	10:00	-101019.545	(6,651.37)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	84557.687	-15442.313	11:00	-98725.465	(7,022.23)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	83656.749	-16343.251	12:00	-99724.612	(7,178.64)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	83373.464	-16626.536	13:00	-100471.191	(7,294.12)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	85639.741	-14360.259	14:00	-97957.548	(6,098.47)
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	86684.643	86684.643	15:00	1235.260	68.11
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	86981.860	86981.860	16:00	56.573	2.97
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	89192.409	89192.409	17:00	2191.207	110.23
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	86368.851	86368.851	18:00	-2025.194	(113.57)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	83294.517	-16705.483	19:00	-105430.951	(9,219.90)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	80930.715	-19069.285	20:00	-108211.699	(9,715.75)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	85867.298	-14132.702	21:00	-103331.442	(6,299.19)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	88579.400	88579.400	22:00	-477.038	(24.78)
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	90362.699	90362.699	23:00	-4842.376	(225.26)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	90711.000	90711.000	00:00	-4076.968	(164.25)

Additional cost/(saving) **(75,380.94)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MAY 99 WEEKDAY - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	91130.730	01:00	-2237.025	(73.18)
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	91454.263	02:00	-1899.544	(58.53)
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	92483.685	03:00	-2714.636	(80.23)
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	94903.878	04:00	-319.471	(9.32)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	92420.660	05:00	-2904.169	(87.59)
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	90744.172	06:00	-5811.587	(218.92)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	86399.589	07:00	-5231.889	(304.41)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	85122.266	08:00	-105003.842	(7,471.30)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	85685.297	09:00	-102226.713	(6,998.77)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	86034.040	10:00	-100263.014	(6,601.56)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	85592.859	11:00	-97690.293	(6,948.60)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	83597.040	12:00	-99784.320	(7,182.94)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	83576.031	13:00	-100268.624	(7,279.42)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	86046.645	14:00	-97550.645	(6,073.14)
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	88727.344	15:00	3277.961	180.75
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	89218.946	16:00	2293.659	120.26
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	89823.994	17:00	2822.792	142.00
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	87899.605	18:00	-494.440	(27.73)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	82660.056	19:00	-106065.411	(9,275.39)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	81710.466	20:00	-107431.947	(9,645.74)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	86050.847	21:00	-103147.893	(6,288.00)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	89223.148	22:00	166.710	8.66
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	90042.484	23:00	-5162.591	(240.16)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	90735.768	00:00	-4052.200	(163.25)

Additional cost/(saving) **(74,576.51)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JUNE 99 WEEKDAY - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	96223.219	96223.219	01:00	2855.464	93.41
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	96517.339	96517.339	02:00	3163.532	97.48
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	97340.878	97340.878	03:00	2142.556	63.32
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	97870.295	97870.295	04:00	2646.946	77.23
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	96891.293	96891.293	05:00	1566.465	47.25
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	95576.154	95576.154	06:00	-979.605	(36.90)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	88887.010	88887.010	07:00	-2744.469	(159.68)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	85744.121	-14255.879	08:00	-104381.987	(7,427.06)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	86378.581	-13621.419	09:00	-101533.428	(6,951.31)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	87454.223	-12545.777	10:00	-98842.830	(6,508.05)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	85886.979	-14113.021	11:00	-97396.173	(6,927.68)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	82752.494	-17247.506	12:00	-100628.867	(7,243.73)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	82012.991	-17987.009	13:00	-101831.665	(7,392.89)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	87853.386	-12146.614	14:00	-95743.903	(5,960.66)
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	90008.870	90008.870	15:00	4559.486	251.42
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	90298.789	90298.789	16:00	3373.502	176.88
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	91655.945	91655.945	17:00	4654.743	234.15
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	89655.925	89655.925	18:00	1261.880	70.76
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	79302.879	-20697.121	19:00	-109422.589	(9,568.97)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	76996.133	-23003.867	20:00	-112146.281	(10,069.01)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	88714.739	-11285.261	21:00	-100484.001	(6,125.61)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	90353.411	90353.411	22:00	1296.973	67.38
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	94622.362	94622.362	23:00	-582.712	(27.11)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	95403.883	95403.883	00:00	615.915	24.81

Additional cost/(saving) **(73,194.56)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JULY 99 WEEKDAY - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP- NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	97941.724	97941.724	01:00	4573.968	149.63
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	98762.321	98762.321	02:00	5408.513	166.66
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	99578.506	99578.506	03:00	4380.184	129.45
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	100531.457	100531.457	04:00	5308.108	154.87
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	99366.738	99366.738	05:00	4041.910	121.91
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	96900.537	96900.537	06:00	344.778	12.99
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	89943.113	89943.113	07:00	-1688.365	(98.24)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	86290.135	-13709.865	08:00	-103835.973	(7,388.21)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	87834.268	-12165.732	09:00	-100077.742	(6,851.65)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	88593.099	-11406.901	10:00	-97703.954	(6,433.06)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	86409.254	-13590.746	11:00	-96873.899	(6,890.53)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	85310.713	-14689.287	12:00	-98070.647	(7,059.58)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	84790.119	-15209.881	13:00	-99054.536	(7,191.27)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	88875.455	-11124.545	14:00	-94721.834	(5,897.03)
21:00	6.096	15:00	5.514	15:00			15:00	85449.38364	91116.654	91116.654	15:00	5667.271	312.50
14:00	6.226	16:00	5.243	16:00			16:00	86925.28697	91518.130	91518.130	16:00	4592.843	240.81
10:00	6.584	17:00	5.030	17:00			17:00	87001.20196	92096.076	92096.076	17:00	5094.874	256.29
09:00	6.846	18:00	5.608	18:00			18:00	88394.04504	90273.999	90273.999	18:00	1879.954	105.42
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	84459.234	-15540.766	19:00	-104266.234	(9,118.05)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	84004.818	-15995.183	20:00	-105137.596	(9,439.74)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	89272.518	-10727.482	21:00	-99926.222	(6,091.60)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	91954.898	91954.898	22:00	2898.460	150.58
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	94518.160	94518.160	23:00	-686.914	(31.95)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	95982.881	95982.881	00:00	1194.913	48.14

Additional cost/(saving) **(70,641.65)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JANUARY 99 WEEKEND - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	96291.708	96291.708	01:00	594.638	20.56
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	96732.888	96732.888	02:00	1321.769	40.59
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97112.304	97112.304	03:00	2978.742	86.01
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	98400.552	98400.552	04:00	4778.431	134.19
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99027.029	99027.029	05:00	4650.232	130.39
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	98947.616	98947.616	06:00	4153.917	116.56
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	96432.885	96432.885	07:00	-1043.381	(35.16)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	92965.203	92965.203	08:00	-3584.352	(200.43)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	88579.865	-11420.135	09:00	-104552.987	(8,037.22)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	89206.341	-10793.659	10:00	-98744.156	(7,317.21)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	92735.788	92735.788	11:00	8122.860	464.63
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	93124.029	93124.029	12:00	6136.664	343.04
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	94306.393	94306.393	13:00	4364.049	223.61
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	94350.511	94350.511	14:00	3660.728	160.37
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	95003.459	95003.459	15:00	1696.003	65.95
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	95506.405	95506.405	16:00	411.115	15.06
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	96150.529	96150.529	17:00	1265.560	45.61
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	94588.748	94588.748	18:00	1801.138	71.46
11:00	5.720	19:00	7.360	19:00	*6.000*	*100000.00*	19:00	95189.59516	90397.529	-9602.471	19:00	-104792.066	(7,712.24)
21:00	6.847	20:00	9.278	20:00	*6.000*	*100000.00*	20:00	95796.97789	87000.437	-12999.563	20:00	-108796.541	(10,094.00)
19:00	7.360	21:00	6.847	21:00	*6.000*	*100000.00*	21:00	94447.75762	90679.885	-9320.115	21:00	-103767.873	(7,105.31)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	94500.512	94500.512	22:00	-73.997	(3.21)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	95091.695	95091.695	23:00	408.174	15.31
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	96238.766	96238.766	00:00	-8.730	(0.30)

Additional cost/(saving) **(38,571.75)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

FEBRUARY 99 WEEKEND - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	100423.367	100423.367	01:00	4726.297	163.44
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	101107.198	101107.198	02:00	5696.078	174.91
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	101371.907	101371.907	03:00	7238.345	209.00
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	103004.276	103004.276	04:00	9382.155	263.48
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	104272.671	104272.671	05:00	9895.874	277.47
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	103026.335	103026.335	06:00	8232.636	231.01
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	100941.754	100941.754	07:00	3465.488	116.76
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	96816.713	96816.713	08:00	267.159	14.94
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	92945.349	-7054.651	09:00	-100187.503	(7,701.64)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	94809.340	-5190.660	10:00	-93141.158	(6,902.02)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	96011.558	96011.558	11:00	11398.630	652.01
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	97048.333	97048.333	12:00	10060.968	562.41
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	97224.805	97224.805	13:00	7282.462	373.15
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	97489.513	97489.513	14:00	6799.730	297.88
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	98283.639	98283.639	15:00	4976.182	193.50
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	99154.972	99154.972	16:00	4059.683	148.76
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	99916.009	99916.009	17:00	5031.039	181.31
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	97665.986	97665.986	18:00	4878.376	193.56
11:00	5.720	19:00	7.360	19:00	*6.000*	*100000.00*	19:00	95189.59516	95471.110	-4528.890	19:00	-99718.485	(7,338.85)
21:00	6.847	20:00	9.278	20:00	*6.000*	*100000.00*	20:00	95796.97789	90937.976	-9062.024	20:00	-104859.002	(9,728.68)
19:00	7.360	21:00	6.847	21:00	*6.000*	*100000.00*	21:00	94447.75762	95702.731	-4297.269	21:00	-98745.027	(6,761.38)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	97610.838	97610.838	22:00	3036.329	131.74
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	98768.938	98768.938	23:00	4085.417	153.20
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	100202.776	100202.776	00:00	3955.280	136.88

Additional cost/(saving) **(33,957.16)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MARCH 99 WEEKEND - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	91930.635	91930.635	01:00	-3766.435	(130.25)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	93794.623	93794.623	02:00	-1616.496	(49.64)
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	94158.598	94158.598	03:00	25.036	0.72
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	95548.318	95548.318	04:00	1926.196	54.09
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	97026.274	97026.274	05:00	2649.477	74.29
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	95559.347	95559.347	06:00	765.648	21.48
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	92040.929	92040.929	07:00	-5435.338	(183.14)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	89018.839	89018.839	08:00	-7530.716	(421.11)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	84827.620	-15172.380	09:00	-108305.231	(8,325.67)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	85312.918	-14687.082	10:00	-102637.579	(7,605.73)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	87882.798	87882.798	11:00	3269.870	187.04
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	89548.256	89548.256	12:00	2560.892	143.15
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	89945.319	89945.319	13:00	2.976	0.15
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	90320.342	90320.342	14:00	-369.440	(16.18)
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	90739.455	90739.455	15:00	-2568.002	(99.86)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	91147.538	91147.538	16:00	-3947.752	(144.66)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	91445.334	91445.334	17:00	-3439.636	(123.96)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	90706.357	90706.357	18:00	-2081.253	(82.58)
11:00	5.720	19:00	7.360	19:00	*6.000*	*100000.00*	19:00	95189.59516	85412.202	-14587.798	19:00	-109777.393	(8,079.14)
21:00	6.847	20:00	9.278	20:00	*6.000*	*100000.00*	20:00	95796.97789	82654.804	-17345.196	20:00	-113142.174	(10,497.18)
19:00	7.360	21:00	6.847	21:00	*6.000*	*100000.00*	21:00	94447.75762	86669.573	-13330.427	21:00	-107778.185	(7,379.91)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	90629.166	90629.166	22:00	-3945.343	(171.18)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	91092.390	91092.390	23:00	-3591.131	(134.67)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	91632.836	91632.836	00:00	-4614.660	(159.70)

Additional cost/(saving) **(43,123.62)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APRIL 99 WEEKEND - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	92625.494	92625.494	01:00	-3071.576	(106.22)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	93971.095	93971.095	02:00	-1440.024	(44.22)
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	94180.657	94180.657	03:00	47.095	1.36
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	94754.192	94754.192	04:00	1132.070	31.79
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	94831.399	94831.399	05:00	454.601	12.75
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	94820.369	94820.369	06:00	26.670	0.75
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	93298.295	93298.295	07:00	-4177.972	(140.77)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	88412.218	88412.218	08:00	-8137.336	(455.03)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	85820.277	-14179.723	09:00	-107312.575	(8,249.36)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	86879.111	-13120.889	10:00	-101071.386	(7,489.67)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	88202.656	88202.656	11:00	3589.728	205.33
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	88599.717	88599.717	12:00	1612.353	90.13
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	88676.924	88676.924	13:00	-1265.420	(64.84)
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	88687.953	88687.953	14:00	-2001.830	(87.70)
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	88985.750	88985.750	15:00	-4321.706	(168.05)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	90640.179	90640.179	16:00	-4455.110	(163.25)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	90662.238	90662.238	17:00	-4222.732	(152.18)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	88952.662	88952.662	18:00	-3834.948	(152.16)
11:00	5.720	19:00	7.360	19:00	*6.000*	*100000.00*	19:00	95189.59516	87066.615	-12933.385	19:00	-108122.980	(7,957.39)
21:00	6.847	20:00	9.278	20:00	*6.000*	*100000.00*	20:00	95796.97789	82368.036	-17631.964	20:00	-113428.942	(10,523.79)
19:00	7.360	21:00	6.847	21:00	*6.000*	*100000.00*	21:00	94447.75762	88169.566	-11830.434	21:00	-106278.191	(7,277.20)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	88941.632	88941.632	22:00	-5632.878	(244.40)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	89448.990	89448.990	23:00	-5234.531	(196.29)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	92482.110	92482.110	00:00	-3765.386	(130.31)

Additional cost/(saving) **(43,260.71)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MAY 99 WEEKEND - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	95013.887	95013.887	01:00	-683.183	(23.63)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	96842.782	96842.782	02:00	1431.662	43.96
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97404.286	97404.286	03:00	3270.724	94.44
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	98615.528	98615.528	04:00	4993.406	140.23
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99963.135	99963.135	05:00	5586.338	156.63
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	99610.190	99610.190	06:00	4816.491	135.15
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	95029.930	95029.930	07:00	-2446.337	(82.43)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	89984.424	89984.424	08:00	-6565.131	(367.12)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	87642.154	-12357.846	09:00	-105490.698	(8,109.31)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	88941.632	-11058.368	10:00	-99008.865	(7,336.83)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	89872.123	89872.123	11:00	5259.195	300.83
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	90569.992	90569.992	12:00	3582.627	200.27
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	91420.268	91420.268	13:00	1477.924	75.73
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	91757.169	91757.169	14:00	1067.386	46.76
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	93184.991	93184.991	15:00	-122.466	(4.76)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	93914.945	93914.945	16:00	-1180.345	(43.25)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	94003.182	94003.182	17:00	-881.788	(31.78)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	92559.316	92559.316	18:00	-228.294	(9.06)
11:00	5.720	19:00	7.360	19:00	*6.000*	*100000.00*	19:00	95189.59516	89190.298	-10809.702	19:00	-105999.297	(7,801.09)
21:00	6.847	20:00	9.278	20:00	*6.000*	*100000.00*	20:00	95796.97789	86928.243	-13071.757	20:00	-108868.735	(10,100.70)
19:00	7.360	21:00	6.847	21:00	*6.000*	*100000.00*	21:00	94447.75762	89350.727	-10649.273	21:00	-105097.030	(7,196.33)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	92479.101	92479.101	22:00	-2095.408	(90.92)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	93345.421	93345.421	23:00	-1338.100	(50.18)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	94693.028	94693.028	00:00	-1554.468	(53.80)

Additional cost/(saving) **(40,107.16)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JUNE 99 WEEKEND - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	95129.195	95129.195	01:00	-567.875	(19.64)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	95989.497	95989.497	02:00	578.378	17.76
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97103.480	97103.480	03:00	2969.918	85.75
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	97489.513	97489.513	04:00	3867.392	108.61
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99507.917	99507.917	05:00	5131.119	143.87
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	97809.370	97809.370	06:00	3015.670	84.62
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	95757.879	95757.879	07:00	-1718.388	(57.90)
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	91037.242	91037.242	08:00	-5512.312	(308.24)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	87607.060	-12392.940	09:00	-105525.791	(8,112.01)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	88125.449	-11874.551	10:00	-99825.049	(7,397.31)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	91015.183	91015.183	11:00	6402.255	366.21
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	91621.807	91621.807	12:00	4634.443	259.07
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	91831.367	91831.367	13:00	1889.024	96.79
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	92018.870	92018.870	14:00	1329.087	58.23
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	93187.999	93187.999	15:00	-119.458	(4.65)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	94026.243	94026.243	16:00	-1069.047	(39.17)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	94919.635	94919.635	17:00	34.665	1.25
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	92824.025	92824.025	18:00	36.415	1.44
11:00	5.720	19:00	7.360	19:00	*6.000*	*100000.00*	19:00	95189.59516	88290.890	-11709.110	19:00	-106898.705	(7,867.28)
21:00	6.847	20:00	9.278	20:00	*6.000*	*100000.00*	20:00	95796.97789	85158.505	-14841.495	20:00	-110638.473	(10,264.89)
19:00	7.360	21:00	6.847	21:00	*6.000*	*100000.00*	21:00	94447.75762	89382.814	-10617.186	21:00	-105064.944	(7,194.13)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	92658.582	92658.582	22:00	-1915.928	(83.13)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	93199.029	93199.029	23:00	-1484.492	(55.67)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	94985.812	94985.812	00:00	-1261.684	(43.66)

Additional cost/(saving) **(40,224.08)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JULY 99 WEEKEND - CASE 1

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	101235.874	01:00	5538.804	191.54
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	101579.016	02:00	6167.896	189.39
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	101579.016	03:00	7445.454	214.98
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	101588.820	04:00	7966.699	223.73
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	102079.021	05:00	7702.224	215.96
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	101667.252	06:00	6873.553	192.87
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	101480.975	07:00	4004.709	134.93
00:00	3.461	08:00	5.592	08:00			08:00	96549.55438	97716.232	08:00	1166.678	65.24
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	91216.166	09:00	-101916.686	(7,834.57)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	91392.655	10:00	-96557.843	(7,155.20)
23:00	3.750	11:00	5.720	11:00			11:00	84612.9281	97716.231	11:00	13103.303	749.52
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	98324.081	12:00	11336.717	633.72
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	99324.090	13:00	9381.747	480.72
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	99412.327	14:00	8722.544	382.12
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	99667.232	15:00	6359.775	247.30
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	100039.784	16:00	4944.494	181.18
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	100873.127	17:00	5988.157	215.81
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	99657.428	18:00	6869.818	272.57
11:00	5.720	19:00	7.360	19:00	*6.000*	*100000.00*	19:00	95189.59516	96569.161	19:00	-98620.434	(7,258.04)
21:00	6.847	20:00	9.278	20:00	*6.000*	*100000.00*	20:00	95796.97789	85500.433	20:00	-110296.545	(10,233.17)
19:00	7.360	21:00	6.847	21:00	*6.000*	*100000.00*	21:00	94447.75762	96627.985	21:00	-97819.772	(6,698.03)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	99520.171	22:00	4945.661	214.58
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	99726.056	23:00	5042.535	189.09
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	101108.423	00:00	4860.927	168.23

Additional cost/(saving) **(34,015.51)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JANUARY 99 WEEKDAY - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg		NP-NO COGEN	NP-COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.755	94518.160	94518.160	01:00	1150.404	37.63
03:00	2.955	02:00	3.081	02:00			02:00	93353.807	95594.642	95594.642	02:00	2240.835	69.05
05:00	3.016	03:00	2.955	03:00			03:00	95198.321	96238.765	96238.765	03:00	1040.444	30.75
02:00	3.081	04:00	2.918	04:00			04:00	95223.349	96344.649	96344.649	04:00	1121.300	32.71
01:00	3.271	05:00	3.016	05:00			05:00	95324.829	96084.352	96084.352	05:00	759.524	22.91
06:00	3.767	06:00	3.767	06:00			06:00	96555.758	94496.101	94496.101	06:00	-2059.658	(77.59)
00:00	4.029	07:00	5.818	07:00			07:00	91631.479	88257.802	88257.802	07:00	-3373.677	(196.29)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.108	84913.650	-15086.350	08:00	-105212.458	(7,486.15)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.010	86232.781	-13767.219	09:00	-101679.228	(6,961.29)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.053	87101.908	-12898.092	10:00	-99195.145	(6,531.25)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.152	85756.306	-14243.694	11:00	-97526.846	(6,936.97)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.360	84913.650	-15086.350	12:00	-98467.710	(7,088.16)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.655	82690.099	-17309.901	13:00	-101154.557	(7,343.73)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.289	87137.202	-12862.798	14:00	-96460.087	(6,005.25)
21:00	6.096	15:00	5.514	15:00	*6.000*	*100000.00*	15:00	85449.384	88857.808	-11142.192	15:00	-96591.576	(5,326.18)
14:00	6.226	16:00	5.243	16:00	*6.000*	*100000.00*	16:00	86925.287	88893.103	-11106.898	16:00	-98032.184	(5,140.02)
10:00	6.584	17:00	5.030	17:00	*6.000*	*100000.00*	17:00	87001.202	89678.405	-10321.595	17:00	-97322.797	(4,895.73)
09:00	6.846	18:00	5.608	18:00	*6.000*	*100000.00*	18:00	88394.045	88654.865	-11345.135	18:00	-99739.180	(5,593.12)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.467	82531.273	-17468.727	19:00	-106194.195	(9,286.65)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.414	81018.023	-18981.978	20:00	-108124.391	(9,707.91)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.740	87225.439	-12774.561	21:00	-101973.301	(6,216.39)
13:00	7.260	22:00	5.195	22:00			22:00	89056.438	89431.343	89431.343	22:00	374.905	19.48
19:00	8.745	23:00	4.652	23:00			23:00	95205.075	93935.801	93935.801	23:00	-1269.273	(59.05)
20:00	8.978	00:00	4.029	00:00			00:00	94787.968	94288.746	94288.746	00:00	-499.223	(20.11)

Additional cost/(saving) **(94,659.30)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

FEBRUARY 99 - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP-NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	97769.664	97769.664	01:00	4401.908	144.01
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	99137.324	99137.324	02:00	5783.517	178.21
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	100412.337	100412.337	03:00	5214.016	154.10
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	101449.113	101449.113	04:00	6225.764	181.64
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	99357.915	99357.915	05:00	4033.086	121.64
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	94787.280	94787.280	06:00	-1768.479	(66.62)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	91200.478	91200.478	07:00	-431.000	(25.08)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	89713.699	-10286.301	08:00	-100412.409	(7,144.61)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	90401.941	-9598.059	09:00	-97510.068	(6,675.86)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	90724.004	-9275.996	10:00	-95573.050	(6,292.76)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	89837.230	-10162.770	11:00	-93445.922	(6,646.70)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	89400.461	-10599.539	12:00	-93980.900	(6,765.18)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	88593.099	-11406.901	13:00	-95251.556	(6,915.18)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	91138.713	-8861.287	14:00	-92458.577	(5,756.13)
21:00	6.096	15:00	5.514	15:00	*6.000*	*100000.00*	15:00	85449.38364	91743.131	-8256.869	15:00	-93706.252	(5,167.08)
14:00	6.226	16:00	5.243	16:00	*6.000*	*100000.00*	16:00	86925.28697	92215.195	-7784.805	16:00	-94710.092	(4,965.84)
10:00	6.584	17:00	5.030	17:00	*6.000*	*100000.00*	17:00	87001.20196	92369.608	-7630.392	17:00	-94631.594	(4,760.35)
09:00	6.846	18:00	5.608	18:00	*6.000*	*100000.00*	18:00	88394.04504	91344.598	-8655.402	18:00	-97049.447	(5,442.28)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	88072.506	-11927.494	19:00	-100652.962	(8,802.07)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	88063.682	-11936.318	20:00	-101078.731	(9,075.32)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	91160.772	-8839.228	21:00	-98037.968	(5,976.49)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	92356.373	92356.373	22:00	3299.935	171.44
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	93701.976	93701.976	23:00	-1503.099	(69.92)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	93891.683	93891.683	00:00	-896.286	(36.11)

Additional cost/(saving) **(89,632.53)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MARCH 99 WEEKDAY - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	96084.352	96084.352	01:00	2716.597	88.87
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	96344.649	96344.649	02:00	2990.842	92.16
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	95594.642	95594.642	03:00	396.321	11.71
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	94518.160	94518.160	04:00	-705.189	(20.57)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	96238.765	96238.765	05:00	913.937	27.56
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	94496.101	94496.101	06:00	-2059.658	(77.59)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	87137.202	87137.202	07:00	-4494.277	(261.50)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	81018.023	-18981.978	08:00	-109108.085	(7,763.33)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	88654.865	-11345.135	09:00	-99257.145	(6,795.47)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	89678.405	-10321.595	10:00	-96618.648	(6,361.61)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	82531.273	-17468.727	11:00	-100751.879	(7,166.36)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	87225.439	-12774.561	12:00	-96155.922	(6,921.75)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	89431.343	-10568.657	13:00	-94413.312	(6,854.32)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	88893.103	-11106.898	14:00	-94704.187	(5,895.93)
21:00	6.096	15:00	5.514	15:00	*6.000*	*100000.00*	15:00	85449.38364	84913.650	-15086.350	15:00	-100535.734	(5,543.66)
14:00	6.226	16:00	5.243	16:00	*6.000*	*100000.00*	16:00	86925.28697	85756.306	-14243.694	16:00	-101168.981	(5,304.49)
10:00	6.584	17:00	5.030	17:00	*6.000*	*100000.00*	17:00	87001.20196	86232.781	-13767.219	17:00	-100768.421	(5,069.05)
09:00	6.846	18:00	5.608	18:00	*6.000*	*100000.00*	18:00	88394.04504	82690.099	-17309.901	18:00	-105703.947	(5,927.61)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	93935.801	-6064.199	19:00	-94789.666	(8,289.33)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	94288.746	-5711.254	20:00	-94853.668	(8,516.40)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	88857.808	-11142.192	21:00	-100340.932	(6,116.88)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	87101.908	87101.908	22:00	-1954.530	(101.54)
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	84913.650	84913.650	23:00	-10291.425	(478.75)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	88257.802	88257.802	00:00	-6530.166	(263.08)

Additional cost/(saving) **(93,508.91)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APRIL 99 WEEKDAY - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	90989.641	90989.641	01:00	-2378.115	(77.80)
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	91022.149	91022.149	02:00	-2331.658	(71.85)
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	92085.627	92085.627	03:00	-3112.694	(91.99)
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	92800.806	92800.806	04:00	-2422.543	(70.68)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	91073.233	91073.233	05:00	-4251.596	(128.23)
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	90724.932	90724.932	06:00	-5830.826	(219.65)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	86029.838	86029.838	07:00	-5601.641	(325.93)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	84474.096	-15525.904	08:00	-105652.012	(7,517.42)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	84919.920	-15080.080	09:00	-102992.090	(7,051.17)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	85277.509	-14722.491	10:00	-101019.545	(6,651.37)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	84557.687	-15442.313	11:00	-98725.465	(7,022.23)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	83656.749	-16343.251	12:00	-99724.612	(7,178.64)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	83373.464	-16626.536	13:00	-100471.191	(7,294.12)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	85639.741	-14360.259	14:00	-97957.548	(6,098.47)
21:00	6.096	15:00	5.514	15:00	*6.000*	*100000.00*	15:00	85449.38364	86684.643	-13315.357	15:00	-98764.740	(5,446.01)
14:00	6.226	16:00	5.243	16:00	*6.000*	*100000.00*	16:00	86925.28697	86981.860	-13018.140	16:00	-99943.427	(5,240.23)
10:00	6.584	17:00	5.030	17:00	*6.000*	*100000.00*	17:00	87001.20196	89192.409	-10807.591	17:00	-97808.793	(4,920.17)
09:00	6.846	18:00	5.608	18:00	*6.000*	*100000.00*	18:00	88394.04504	86368.851	-13631.149	18:00	-102025.194	(5,721.31)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	83294.517	-16705.483	19:00	-105430.951	(9,219.90)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	80930.715	-19069.285	20:00	-108211.699	(9,715.75)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	85867.298	-14132.702	21:00	-103331.442	(6,299.19)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	88579.400	88579.400	22:00	-477.038	(24.78)
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	90362.699	90362.699	23:00	-4842.376	(225.26)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	90711.000	90711.000	00:00	-4076.968	(164.25)

Additional cost/(saving) **(96,776.41)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MAY 99 WEEKDAY - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	91130.730	91130.730	01:00	-2237.025	(73.18)
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	91454.263	91454.263	02:00	-1899.544	(58.53)
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	92483.685	92483.685	03:00	-2714.636	(80.23)
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	94903.878	94903.878	04:00	-319.471	(9.32)
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	92420.660	92420.660	05:00	-2904.169	(87.59)
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	90744.172	90744.172	06:00	-5811.587	(218.92)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	86399.589	86399.589	07:00	-5231.889	(304.41)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	85122.266	-14877.734	08:00	-105003.842	(7,471.30)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	85685.297	-14314.703	09:00	-102226.713	(6,998.77)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	86034.040	-13965.960	10:00	-100263.014	(6,601.56)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	85592.859	-14407.141	11:00	-97690.293	(6,948.60)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	83597.040	-16402.960	12:00	-99784.320	(7,182.94)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	83576.031	-16423.969	13:00	-100268.624	(7,279.42)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	86046.645	-13953.355	14:00	-97550.645	(6,073.14)
21:00	6.096	15:00	5.514	15:00	*6.000*	*100000.00*	15:00	85449.38364	88727.344	-11272.656	15:00	-96722.039	(5,333.37)
14:00	6.226	16:00	5.243	16:00	*6.000*	*100000.00*	16:00	86925.28697	89218.946	-10781.054	16:00	-97706.341	(5,122.94)
10:00	6.584	17:00	5.030	17:00	*6.000*	*100000.00*	17:00	87001.20196	89823.994	-10176.006	17:00	-97177.208	(4,888.40)
09:00	6.846	18:00	5.608	18:00	*6.000*	*100000.00*	18:00	88394.04504	87899.605	-12100.395	18:00	-100494.440	(5,635.47)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	82660.056	-17339.944	19:00	-106065.411	(9,275.39)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	81710.466	-18289.534	20:00	-107431.947	(9,645.74)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	86050.847	-13949.153	21:00	-103147.893	(6,288.00)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	89223.148	89223.148	22:00	166.710	8.66
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	90042.484	90042.484	23:00	-5162.591	(240.16)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	90735.768	90735.768	00:00	-4052.200	(163.25)

Additional cost/(saving) **(95,971.97)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JUNE 99 WEEKDAY - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	96223.219	96223.219	01:00	2855.464	93.41
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	96517.339	96517.339	02:00	3163.532	97.48
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	97340.878	97340.878	03:00	2142.556	63.32
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	97870.295	97870.295	04:00	2646.946	77.23
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	96891.293	96891.293	05:00	1566.465	47.25
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	95576.154	95576.154	06:00	-979.605	(36.90)
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	88887.010	88887.010	07:00	-2744.469	(159.68)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	85744.121	-14255.879	08:00	-104381.987	(7,427.06)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	86378.581	-13621.419	09:00	-101533.428	(6,951.31)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	87454.223	-12545.777	10:00	-98842.830	(6,508.05)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	85886.979	-14113.021	11:00	-97396.173	(6,927.68)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	82752.494	-17247.506	12:00	-100628.867	(7,243.73)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	82012.991	-17987.009	13:00	-101831.665	(7,392.89)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	87853.386	-12146.614	14:00	-95743.903	(5,960.66)
21:00	6.096	15:00	5.514	15:00	*6.000*	*100000.00*	15:00	85449.38364	90008.870	-9991.130	15:00	-95440.514	(5,262.71)
14:00	6.226	16:00	5.243	16:00	*6.000*	*100000.00*	16:00	86925.28697	90298.789	-9701.211	16:00	-96626.498	(5,066.32)
10:00	6.584	17:00	5.030	17:00	*6.000*	*100000.00*	17:00	87001.20196	91655.945	-8344.055	17:00	-95345.257	(4,796.25)
09:00	6.846	18:00	5.608	18:00	*6.000*	*100000.00*	18:00	88394.04504	89655.925	-10344.075	18:00	-98738.120	(5,536.98)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	79302.879	-20697.121	19:00	-109422.589	(9,568.97)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	76996.133	-23003.867	20:00	-112146.281	(10,069.01)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	88714.739	-11285.261	21:00	-100484.001	(6,125.61)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	90353.411	90353.411	22:00	1296.973	67.38
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	94622.362	94622.362	23:00	-582.712	(27.11)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	95403.883	95403.883	00:00	615.915	24.81

Additional cost/(saving) **(94,590.03)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JULY 99 WEEKDAY - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP- NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
04:00	2.918	01:00	3.271	01:00			01:00	93367.75547	97941.724	97941.724	01:00	4573.968	149.63
03:00	2.955	02:00	3.081	02:00			02:00	93353.80734	98762.321	98762.321	02:00	5408.513	166.66
05:00	3.016	03:00	2.955	03:00			03:00	95198.32147	99578.506	99578.506	03:00	4380.184	129.45
02:00	3.081	04:00	2.918	04:00			04:00	95223.34898	100531.457	100531.457	04:00	5308.108	154.87
01:00	3.271	05:00	3.016	05:00			05:00	95324.82858	99366.738	99366.738	05:00	4041.910	121.91
06:00	3.767	06:00	3.767	06:00			06:00	96555.75848	96900.537	96900.537	06:00	344.778	12.99
00:00	4.029	07:00	5.818	07:00			07:00	91631.47876	89943.113	89943.113	07:00	-1688.365	(98.24)
23:00	4.652	08:00	7.115	08:00	*6.000*	*100000.00*	08:00	90126.10782	86290.135	-13709.865	08:00	-103835.973	(7,388.21)
17:00	5.030	09:00	6.846	09:00	*6.000*	*100000.00*	09:00	87912.00971	87834.268	-12165.732	09:00	-100077.742	(6,851.65)
22:00	5.195	10:00	6.584	10:00	*6.000*	*100000.00*	10:00	86297.05337	88593.099	-11406.901	10:00	-97703.954	(6,433.06)
16:00	5.243	11:00	7.113	11:00	*6.000*	*100000.00*	11:00	83283.15218	86409.254	-13590.746	11:00	-96873.899	(6,890.53)
15:00	5.514	12:00	7.198	12:00	*6.000*	*100000.00*	12:00	83381.36037	85310.713	-14689.287	12:00	-98070.647	(7,059.58)
18:00	5.608	13:00	7.260	13:00	*6.000*	*100000.00*	13:00	83844.6552	84790.119	-15209.881	13:00	-99054.536	(7,191.27)
07:00	5.818	14:00	6.226	14:00	*6.000*	*100000.00*	14:00	83597.2894	88875.455	-11124.545	14:00	-94721.834	(5,897.03)
21:00	6.096	15:00	5.514	15:00	*6.000*	*100000.00*	15:00	85449.38364	91116.654	-8883.346	15:00	-94332.729	(5,201.62)
14:00	6.226	16:00	5.243	16:00	*6.000*	*100000.00*	16:00	86925.28697	91518.130	-8481.870	16:00	-95407.157	(5,002.39)
10:00	6.584	17:00	5.030	17:00	*6.000*	*100000.00*	17:00	87001.20196	92096.076	-7903.924	17:00	-94905.126	(4,774.11)
09:00	6.846	18:00	5.608	18:00	*6.000*	*100000.00*	18:00	88394.04504	90273.999	-9726.001	18:00	-98120.046	(5,502.32)
11:00	7.113	19:00	8.745	19:00	*6.000*	*100000.00*	19:00	88725.46746	84459.234	-15540.766	19:00	-104266.234	(9,118.05)
08:00	7.115	20:00	8.978	20:00	*6.000*	*100000.00*	20:00	89142.41355	84004.818	-15995.183	20:00	-105137.596	(9,439.74)
12:00	7.198	21:00	6.096	21:00	*6.000*	*100000.00*	21:00	89198.74003	89272.518	-10727.482	21:00	-99926.222	(6,091.60)
13:00	7.260	22:00	5.195	22:00			22:00	89056.43802	91954.898	91954.898	22:00	2898.460	150.58
19:00	8.745	23:00	4.652	23:00			23:00	95205.07482	94518.160	94518.160	23:00	-686.914	(31.95)
20:00	8.978	00:00	4.029	00:00			00:00	94787.96834	95982.881	95982.881	00:00	1194.913	48.14

Additional cost/(saving) **(92,037.12)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JANUARY 99 WEEKEND - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	96291.708	96291.708	01:00	594.638	20.56
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	96732.888	96732.888	02:00	1321.769	40.59
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97112.304	97112.304	03:00	2978.742	86.01
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	98400.552	98400.552	04:00	4778.431	134.19
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99027.029	99027.029	05:00	4650.232	130.39
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	98947.616	98947.616	06:00	4153.917	116.56
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	96432.885	96432.885	07:00	-1043.381	(35.16)
00:00	3.461	08:00	5.592	08:00	*6.000*	*100000.00*	08:00	96549.55438	92965.203	-7034.797	08:00	-103584.352	(5,792.34)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	88579.865	-11420.135	09:00	-104552.987	(8,037.22)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	89206.341	-10793.659	10:00	-98744.156	(7,317.21)
23:00	3.750	11:00	5.720	11:00	*6.000*	*100000.00*	11:00	84612.9281	92735.788	-7264.212	11:00	-91877.140	(5,255.42)
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	93124.029	93124.029	12:00	6136.664	343.04
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	94306.393	94306.393	13:00	4364.049	223.61
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	94350.511	94350.511	14:00	3660.728	160.37
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	95003.459	95003.459	15:00	1696.003	65.95
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	95506.405	95506.405	16:00	411.115	15.06
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	96150.529	96150.529	17:00	1265.560	45.61
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	94588.748	94588.748	18:00	1801.138	71.46
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	90397.529	90397.529	19:00	-4792.066	(352.68)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	87000.437	87000.437	20:00	-8796.541	(816.13)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	90679.885	90679.885	21:00	-3767.873	(258.00)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	94500.512	94500.512	22:00	-73.997	(3.21)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	95091.695	95091.695	23:00	408.174	15.31
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	96238.766	96238.766	00:00	-8.730	(0.30)

Additional cost/(saving) **(26,398.96)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

FEBRUARY 99 WEEKEND - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	100423.367	100423.367	01:00	4726.297	163.44
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	101107.198	101107.198	02:00	5696.078	174.91
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	101371.907	101371.907	03:00	7238.345	209.00
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	103004.276	103004.276	04:00	9382.155	263.48
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	104272.671	104272.671	05:00	9895.874	277.47
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	103026.335	103026.335	06:00	8232.636	231.01
01:00	3.458	07:00	3.369	07:00	*6.000*	*100000.00*	07:00	97476.26645	100941.754	941.754	07:00	-96534.512	(3,252.60)
00:00	3.461	08:00	5.592	08:00	*6.000*	*100000.00*	08:00	96549.55438	96816.713	-3183.287	08:00	-99732.841	(5,576.97)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	92945.349	-7054.651	09:00	-100187.503	(7,701.64)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	94809.340	-5190.660	10:00	-93141.158	(6,902.02)
23:00	3.750	11:00	5.720	11:00	*6.000*	*100000.00*	11:00	84612.9281	96011.558	-3988.442	11:00	-88601.370	(5,068.04)
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	97048.333	97048.333	12:00	10060.968	562.41
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	97224.805	97224.805	13:00	7282.462	373.15
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	97489.513	97489.513	14:00	6799.730	297.88
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	98283.639	98283.639	15:00	4976.182	193.50
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	99154.972	99154.972	16:00	4059.683	148.76
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	99916.009	99916.009	17:00	5031.039	181.31
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	97665.986	97665.986	18:00	4878.376	193.56
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	95471.110	95471.110	19:00	281.515	20.72
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	90937.976	90937.976	20:00	-4859.002	(450.81)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	95702.731	95702.731	21:00	1254.973	85.93
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	97610.838	97610.838	22:00	3036.329	131.74
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	98768.938	98768.938	23:00	4085.417	153.20
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	100202.776	100202.776	00:00	3955.280	136.88

Additional cost/(saving) **(25,153.72)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MARCH 99 WEEKEND - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	91930.635	91930.635	01:00	-3766.435	(130.25)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	93794.623	93794.623	02:00	-1616.496	(49.64)
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	94158.598	94158.598	03:00	25.036	0.72
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	95548.318	95548.318	04:00	1926.196	54.09
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	97026.274	97026.274	05:00	2649.477	74.29
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	95559.347	95559.347	06:00	765.648	21.48
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	92040.929	92040.929	07:00	-5435.338	(183.14)
00:00	3.461	08:00	5.592	08:00	*6.000*	*100000.00*	08:00	96549.55438	89018.839	-10981.161	08:00	-107530.716	(6,013.02)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	84827.620	-15172.380	09:00	-108305.231	(8,325.67)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	85312.918	-14687.082	10:00	-102637.579	(7,605.73)
23:00	3.750	11:00	5.720	11:00	*6.000*	*100000.00*	11:00	84612.9281	87882.798	-12117.202	11:00	-96730.130	(5,533.01)
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	89548.256	89548.256	12:00	2560.892	143.15
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	89945.319	89945.319	13:00	2.976	0.15
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	90320.342	90320.342	14:00	-369.440	(16.18)
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	90739.455	90739.455	15:00	-2568.002	(99.86)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	91147.538	91147.538	16:00	-3947.752	(144.66)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	91445.334	91445.334	17:00	-3439.636	(123.96)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	90706.357	90706.357	18:00	-2081.253	(82.58)
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	85412.202	85412.202	19:00	-9777.393	(719.57)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	82654.804	82654.804	20:00	-13142.174	(1,219.31)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	86669.573	86669.573	21:00	-7778.185	(532.60)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	90629.166	90629.166	22:00	-3945.343	(171.18)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	91092.390	91092.390	23:00	-3591.131	(134.67)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	91632.836	91632.836	00:00	-4614.660	(159.70)

Additional cost/(saving) **(30,950.82)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

APRIL 99 WEEKEND - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	92625.494	92625.494	01:00	-3071.576	(106.22)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	93971.095	93971.095	02:00	-1440.024	(44.22)
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	94180.657	94180.657	03:00	47.095	1.36
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	94754.192	94754.192	04:00	1132.070	31.79
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	94831.399	94831.399	05:00	454.601	12.75
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	94820.369	94820.369	06:00	26.670	0.75
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	93298.295	93298.295	07:00	-4177.972	(140.77)
00:00	3.461	08:00	5.592	08:00	*6.000*	*100000.00*	08:00	96549.55438	88412.218	-11587.782	08:00	-108137.336	(6,046.94)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	85820.277	-14179.723	09:00	-107312.575	(8,249.36)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	86879.111	-13120.889	10:00	-101071.386	(7,489.67)
23:00	3.750	11:00	5.720	11:00	*6.000*	*100000.00*	11:00	84612.9281	88202.656	-11797.344	11:00	-96410.272	(5,514.71)
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	88599.717	88599.717	12:00	1612.353	90.13
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	88676.924	88676.924	13:00	-1265.420	(64.84)
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	88687.953	88687.953	14:00	-2001.830	(87.70)
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	88985.750	88985.750	15:00	-4321.706	(168.05)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	90640.179	90640.179	16:00	-4455.110	(163.25)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	90662.238	90662.238	17:00	-4222.732	(152.18)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	88952.662	88952.662	18:00	-3834.948	(152.16)
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	87066.615	87066.615	19:00	-8122.980	(597.82)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	82368.036	82368.036	20:00	-13428.942	(1,245.92)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	88169.566	88169.566	21:00	-6278.191	(429.89)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	88941.632	88941.632	22:00	-5632.878	(244.40)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	89448.990	89448.990	23:00	-5234.531	(196.29)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	92482.110	92482.110	00:00	-3765.386	(130.31)

Additional cost/(saving) **(31,087.92)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

MAY 99 WEEKEND - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	95013.887	95013.887	01:00	-683.183	(23.63)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	96842.782	96842.782	02:00	1431.662	43.96
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97404.286	97404.286	03:00	3270.724	94.44
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	98615.528	98615.528	04:00	4993.406	140.23
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99963.135	99963.135	05:00	5586.338	156.63
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	99610.190	99610.190	06:00	4816.491	135.15
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	95029.930	95029.930	07:00	-2446.337	(82.43)
00:00	3.461	08:00	5.592	08:00	*6.000*	*100000.00*	08:00	96549.55438	89984.424	-10015.576	08:00	-106565.131	(5,959.02)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	87642.154	-12357.846	09:00	-105490.698	(8,109.31)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	88941.632	-11058.368	10:00	-99008.865	(7,336.83)
23:00	3.750	11:00	5.720	11:00	*6.000*	*100000.00*	11:00	84612.9281	89872.123	-10127.877	11:00	-94740.805	(5,419.22)
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	90569.992	90569.992	12:00	3582.627	200.27
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	91420.268	91420.268	13:00	1477.924	75.73
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	91757.169	91757.169	14:00	1067.386	46.76
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	93184.991	93184.991	15:00	-122.466	(4.76)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	93914.945	93914.945	16:00	-1180.345	(43.25)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	94003.182	94003.182	17:00	-881.788	(31.78)
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	92559.316	92559.316	18:00	-228.294	(9.06)
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	89190.298	89190.298	19:00	-5999.297	(441.52)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	86928.243	86928.243	20:00	-8868.735	(822.83)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	89350.727	89350.727	21:00	-5097.030	(349.01)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	92479.101	92479.101	22:00	-2095.408	(90.92)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	93345.421	93345.421	23:00	-1338.100	(50.18)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	94693.028	94693.028	00:00	-1554.468	(53.80)

Additional cost/(saving) **(27,934.37)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JUNE 99 WEEKEND - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.	NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	95129.195	95129.195	01:00	-567.875	(19.64)
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	95989.497	95989.497	02:00	578.378	17.76
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	97103.480	97103.480	03:00	2969.918	85.75
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	97489.513	97489.513	04:00	3867.392	108.61
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	99507.917	99507.917	05:00	5131.119	143.87
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	97809.370	97809.370	06:00	3015.670	84.62
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	95757.879	95757.879	07:00	-1718.388	(57.90)
00:00	3.461	08:00	5.592	08:00	*6.000*	*100000.00*	08:00	96549.55438	91037.242	-8962.758	08:00	-105512.312	(5,900.15)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	87607.060	-12392.940	09:00	-105525.791	(8,112.01)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	88125.449	-11874.551	10:00	-99825.049	(7,397.31)
23:00	3.750	11:00	5.720	11:00	*6.000*	*100000.00*	11:00	84612.9281	91015.183	-8984.817	11:00	-93597.745	(5,353.84)
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	91621.807	91621.807	12:00	4634.443	259.07
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	91831.367	91831.367	13:00	1889.024	96.79
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	92018.870	92018.870	14:00	1329.087	58.23
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	93187.999	93187.999	15:00	-119.458	(4.65)
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	94026.243	94026.243	16:00	-1069.047	(39.17)
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	94919.635	94919.635	17:00	34.665	1.25
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	92824.025	92824.025	18:00	36.415	1.44
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	88290.890	88290.890	19:00	-6898.705	(507.71)
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	85158.505	85158.505	20:00	-10638.473	(987.02)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	89382.814	89382.814	21:00	-5064.944	(346.81)
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	92658.582	92658.582	22:00	-1915.928	(83.13)
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	93199.029	93199.029	23:00	-1484.492	(55.67)
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	94985.812	94985.812	00:00	-1261.684	(43.66)

Additional cost/(saving) **(28,051.28)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

JULY 99 WEEKEND - CASE 2

RTP 6 MONTH AVG. COST				Cogen			Fixed CBL Wd Avg.		NP - NO COGEN	NP WITH COGEN		NP - CBL	NP - CBL
TIME	c/kWh	TIME	c/kWh	TIME	c/kWh	kW	TIME	kW	kW	kW	TIME	kW Diff	Cost Diff (R)
05:00	2.804	01:00	3.458	01:00			01:00	95697.06993	101235.874	101235.874	01:00	5538.804	191.54
06:00	2.806	02:00	3.071	02:00			02:00	95411.11935	101579.016	101579.016	02:00	6167.896	189.39
04:00	2.808	03:00	2.887	03:00			03:00	94133.5621	101579.016	101579.016	03:00	7445.454	214.98
03:00	2.887	04:00	2.808	04:00			04:00	93622.12151	101588.820	101588.820	04:00	7966.699	223.73
02:00	3.071	05:00	2.804	05:00			05:00	94376.79709	102079.021	102079.021	05:00	7702.224	215.96
07:00	3.369	06:00	2.806	06:00			06:00	94793.69941	101667.252	101667.252	06:00	6873.553	192.87
01:00	3.458	07:00	3.369	07:00			07:00	97476.26645	101480.975	101480.975	07:00	4004.709	134.93
00:00	3.461	08:00	5.592	08:00	*6.000*	*100000.00*	08:00	96549.55438	97716.232	-2283.768	08:00	-98833.322	(5,526.67)
17:00	3.604	09:00	7.687	09:00	*6.000*	*100000.00*	09:00	93132.85173	91216.166	-8783.834	09:00	-101916.686	(7,834.57)
16:00	3.664	10:00	7.410	10:00	*6.000*	*100000.00*	10:00	87950.49732	91392.655	-8607.345	10:00	-96557.843	(7,155.20)
23:00	3.750	11:00	5.720	11:00	*6.000*	*100000.00*	11:00	84612.9281	97716.231	-2283.769	11:00	-86896.697	(4,970.53)
15:00	3.888	12:00	5.590	12:00			12:00	86987.36448	98324.081	98324.081	12:00	11336.717	633.72
18:00	3.968	13:00	5.124	13:00			13:00	89942.34326	99324.090	99324.090	13:00	9381.747	480.72
22:00	4.339	14:00	4.381	14:00			14:00	90689.78292	99412.327	99412.327	14:00	8722.544	382.12
14:00	4.381	15:00	3.888	15:00			15:00	93307.45657	99667.232	99667.232	15:00	6359.775	247.30
13:00	5.124	16:00	3.664	16:00			16:00	95095.28981	100039.784	100039.784	16:00	4944.494	181.18
12:00	5.590	17:00	3.604	17:00			17:00	94884.96991	100873.127	100873.127	17:00	5988.157	215.81
08:00	5.592	18:00	3.968	18:00			18:00	92787.60993	99657.428	99657.428	18:00	6869.818	272.57
11:00	5.720	19:00	7.360	19:00			19:00	95189.59516	96569.161	96569.161	19:00	1379.566	101.53
21:00	6.847	20:00	9.278	20:00			20:00	95796.97789	85500.433	85500.433	20:00	-10296.545	(955.30)
19:00	7.360	21:00	6.847	21:00			21:00	94447.75762	96627.985	96627.985	21:00	2180.228	149.29
10:00	7.410	22:00	4.339	22:00			22:00	94574.50961	99520.171	99520.171	22:00	4945.661	214.58
09:00	7.687	23:00	3.750	23:00			23:00	94683.52095	99726.056	99726.056	23:00	5042.535	189.09
20:00	9.278	00:00	3.461	00:00			00:00	96247.4958	101108.423	101108.423	00:00	4860.927	168.23

Additional cost/(saving) **(21,842.72)**

NP = New Profile
RTP = Real Time Pricing
WD = Weekday
AVG = Average
COGEN = Cogeneration
CBL = Customer Base Load
DIFF = Difference

LIST OF TABLES

LIST OF FIGURES