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The Economics of Energy Storage in 14 Deregulated Power Markets
Assessed with Pumped Storage as the Model Investment.

by

Fatima Cristina Ramos de Azevedo Figueiredo



A thesis submitted to the Faculty of Graduate Studies and Research in
partial fulfillment of the requirements for the degree of Master of Science

Department of Mechanical Engineering

Edmonton, Alberta
Fall 2005



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This thesis is dedicated to: my husband, son and daughter who offered all the emotional support necessary for a woman that decides 17 years after graduation to come back to school to pursue further education; to my parents for their continuous encouragement and my supervisor for becoming my mentor throughout this journey.

ABSTRACT

Power can be time shifted from a period of low price to high price by energy storage, with an efficiency penalty; pumped storage is a common form of energy storage. Fourteen deregulated markets are ranked based on available revenue and potential return on investment; the incentive to store energy varies significantly between markets.

In addition, a model is developed to maximize the return on pumped storage investment by varying the generation capacity for a given reservoir. The amount of power stored (MWh) is set by the reservoir capacity; the rate of recovery of stored energy (MW) is set by the capacity of the pump/generator. Two examples from Alberta confirm that the size of pump/generator relative to reservoir that optimizes daily operating time and return on investment depends on each of: the deregulated power market (diurnal price pattern), the site within the power market (site specific interconnection charges), and the storage technology (energy efficiency).

ACKNOWLEDGEMENT

I want to express my gratitude to Dr. Peter Flynn for becoming my mentor for the last years. His leadership, dedication, patience and persistence allowed my growth in many fields of my life.

Thanks also to all that assisted me over the course of this project, in particular: David Morrow for sharing his ideas and experience, Ron Hankewich for his assistance, Dr. Edgar Cabral for providing his expertise to help with the development of the macros for the spreadsheets, Dr. Angela Kupper for providing valuable data inputs, sharing her expertise, and providing thoughtful discussions, and Professor Paulo Jose Ramos de Azevedo for providing valuable comments and encouragement.

My sincere appreciation to my husband and children; their support was crucial in order to achieve this degree. Thanks also to my parents for their continuous encouragement.

My thanks also to Epcor, an Alberta based integrated power company, and Canada's Natural Sciences and Engineering Research Council, who provided financial support for this research through a graduate student stipend.

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Chapter 1

1 Introduction

1.1 Organization of the Thesis

This thesis explores the incentive for pumped storage in deregulated power markets. Chapter 1 gives a background of energy storage, and sets pumped storage in the context of various methods for storing electrical energy. It also surveys the history of pumped storage and its implementation in both regulated and deregulated power markets. Chapter 2 then looks at the economic return for energy storage in 14 different deregulated power markets for which historical average power price patterns are available, and determines the highest possible return for an idealized case and highest possible investment per unit capacity for a pumped storage project in each market. As part of this analysis, pumped storage operating profiles (hours per day of economic generation and pumping) are developed for each market. Chapter 3 then looks in detail at two specific potential pumped storage projects in one market, Alberta, Canada, and utilizes historical average diurnal power price patterns to optimize the operating profile for each project. Optimal operating profiles are shown to depend on the efficiency of the specific energy storage technology, the diurnal power price pattern, and the site specific variable operating costs. Chapter 4 includes conclusions and identifies areas of possible future research. The appendices contain the supporting

calculations for the work in Chapters 2 and 3. The format of the thesis is paper based, i.e. Chapters 2 and 3 consist of work that has been prepared for publication. Each of the two chapters has been submitted for publication and is currently under review.

1.2 Energy Storage and Pumped Storage Plants

The possibility of storing electricity can assist power system planning and operation by increasing the supply of electricity or shifting demand on electricity supply assets from critical times to off-peak periods. Therefore, in general, energy storage can be used to balance fluctuations in the supply and demand for electricity.

An overview of energy storage applications is given by Price et al. (2000) in tables 1-1 and 1-2. Table 1-1 shows a classification of energy storage systems by technology type, power rating, and storage capacity or application. Table 1-2 shows a number of network applications in which an energy storage system can be used.

Energy storage technologies have widely differing operating and cost characteristics. Pumped storage is considered a mature energy storage technology. It is the most used of the existing storage systems and its main applications have been described as energy management, frequency control, and provision of reserve (Price et al., 2000).

Price et al. (2000) describe three possible network applications of storage systems. First, storage plants can be used in a distributive role by

being charged in off-peak hours, and then run as a generator during peak hours. The utilities can be charged using low cost off-peak electricity supplied at marginal cost from a base load plant. Secondly, storage plants can be used to provide ancillary services. According to O'Keeffe (2001) we can describe ancillary services as those services other than scheduled energy deliveries that are required to maintain system reliability and meet system operating criteria. They include spinning, non-spinning and replacement reserves; regulation (automatic generation control), voltage control, black start capability and other services; thirdly, storage plants can also be used to enhance services to consumers, e.g. an electrical supply of high power quality, with no interruptions, and the ability to choose when to absorb or transmit power with the distribution grid.

As a mature storage system, pumped storage plays an important role in meeting peaking demand and maintaining stability in power system operations. Pumped storage represents almost 3% of generating capacity in the United States (Leonhard and Grobe, 2005). In Japan, it reaches 10% of generating facilities, and more projects are being developed (Hayes, 2002).

There are many factors that could influence the choice of electricity storage. For instance, the application and size needed, capital and operating costs, cycle life, efficiency and maturity/availability are all relevant factors that should be mentioned. Price & Nourai (2001) show in Figure 1-1 the range of storage technologies available. Pumped storage

is clearly recognized as an electricity storage system capable of meeting load-generation (i.e., energy management), providing high power (in the order of MW) and storing hours of energy.

Table 1-1. Classification of energy storage types (after Price et al., 2000)

Technology Type	Typical Power Rating	Typical Energy Rating	Applications	
Mechanical	Pumped Hydro Storage	100 - 2,000 MW	4 - 10h	Daily load leveling Frequency control and reserve
	Compressed Air Energy Storage (CAES)	100 - 300MW	6-20h	Peak shaving Power plant improvement Reserve
	Micro - CAES	10 - 50MW	1-4h	Peak shaving
	Flywheels	5KW - 1MW	15s - 15 min	Peak shaving Frequency control UPS/Power quality
Electrical	Superconducting magnetic storage	10KW - 1MW	5s - 5min	UPS/Power quality Transmission/distribution line stability Power quality
	Capacitors/ ultra capacitors	0.1KW- 100KW	1s - 1 min	Transmission line stability (FACTS devices)
Electrochemical	Batteries Lead acid	1KW - 50MW	1 min - 3 hours	Power quality Reliability Frequency control Reserve Black start UPS
	Advanced batteries e.g. VRLA, Na S, Li	KW - MW	minutes - hours	Various
	Flow batteries e.g. Zn Br, V/V, Na Br/S	100KW - 100 MW	1 hour - 20 hours	Power quality Reliability Reserve Peak shaving Energy management Integration of renewable

Table 1-2. Some applications of utility scale energy storage (Price et al., 2000)

Generation Duties	Ancillary Services	Transmission and Distribution
Energy management	Frequency response	Voltage control
Load leveling	Spinning reserve	Power quality
Peak generation	Standby reserve	System reliability
Ramping/loading following	Long term reserve	Incorporation of renewable
Increase generation utilization	Reactive power	Increase system utilization
Reduce total required generating capacity	Allow unbundling of services from the generator	Defer investments
	Reduce cost of ancillary services	

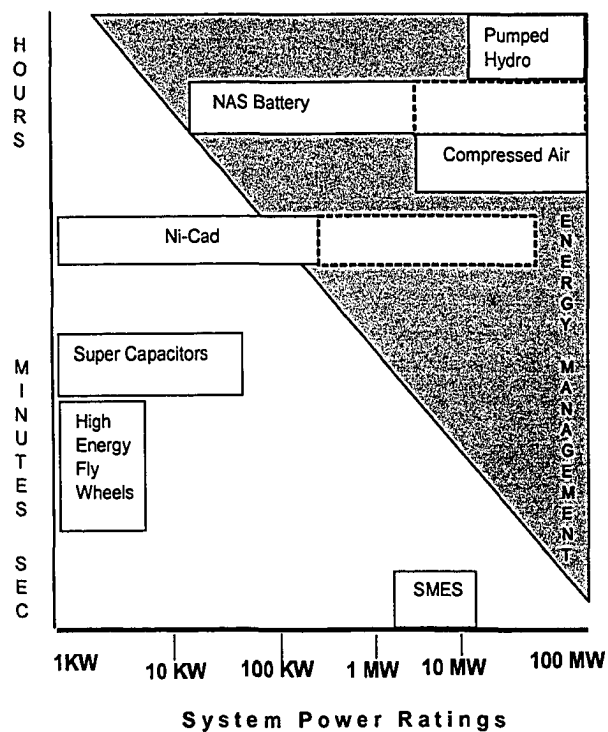


Figure 1-1. Range of some energy storage technologies available (after Price and Nourai, 2001).

1.3 Pumped Storage

1.3.1 The Concept

In this type of power plant, energy is stored by pumping water to a higher reservoir from a lower reservoir (see Figure 1-2). Water is pumped up at times of low power cost and then it is released through a generator at times of high demand and power price.

Pumped storage plants show the same useful characteristics as conventional hydroelectric plants; however, their design concepts are different (ASCE, 1989).

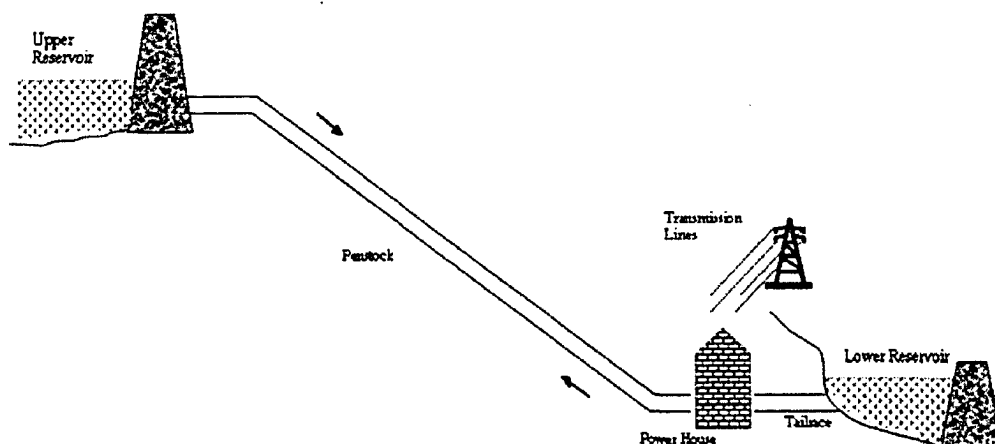


Figure 1-2. Typical layout of a pumped storage plant.

The question may arise, why not just build conventional hydro power plants since they can store energy, and release it when the supply grid needs it? Usually, hydro power plants are used when energy demand is greatest. They work very well for this purpose because of their capability to be started and stopped quickly. However, for this capability

they would usually require considerable water storage, and thus a large upper reservoir. Also, new hydro power plants face environmental challenges, largely due to their modifying a significant water course. In addition, they have no ability to absorb power from the grid that pumped storage plants do. This feature is vital to nuclear generation plants because they can change load only very slowly, and pumped storage plants can be used to absorb their output at night. The maintenance costs of certain types of coal fired power stations increase sharply if they are forced to significantly reduce load at night, and so they also benefit from storage plants attached to the grid. Even oil and gas-fired stations can be operated closer to their optimum efficiency (and thus reduced gaseous emissions) if the supply system includes pumped storage plants (Tanaka, 2001).

Due to losses in the pumping and turbine operations, pumped storage plants consume more energy than they can deliver. In modern designs usually about 1.25 KWh will be consumed in pumping mode to produce 1.0 KWh of energy.

Daily or weekly operating cycles are applied in pumped storage plants; the choice will depend on the utility's requirement. A daily cycle fills the reservoir every day. The weekly cycle will use the weekends to pump more of the volume of water needed to fill up the upper reservoir, recognizing that a large block of low cost energy for pumping is likely to be available on the weekends (ASCE, 1989).

1.3.2 Types of Pumped Storage

1.3.2.1 Pure or Recirculating Pumped Storage

We classify as pure or recirculating pumped storage systems those which do not have a significant surface water inflow (less than 5%). The upper lake is typically artificial; there is no or very low inflow in the upper reservoir, and usually, the makeup water is provided by inflow into the lower reservoir that makes good any evaporation and percolation losses. Thus, the same mass of water is moved up and down recurrently. Typical examples are: Vianden (Luxembourg), Ffestingiog (Britain) and Taum Sauk (Missouri, USA) (ASCE, 1989; ASCE, 1993; ASCE, 1996).

1.3.2.2 Mixed or Combined Pumped Storage

We classify as mixed or combined pumped storage systems those which have natural inflow in the upper reservoir allowing additional power generation. They contain the elements of a pure pumped storage plant combined with a conventional hydro plant. Thermalito (Oroville Complex, California) and Cruachan (Britain) can be cited as some examples of mixed pumped storage (ASCE, 1989).

1.3.2.3 Water Transfer Pumped Storage

Water transfer pumped storage plants are usually the mixed type; however, water is pumped from one reservoir into another hilltop upper reservoir, and then released to another lower reservoir created at a different location. For instance, we have the Reisach-Rabensleite project

on the Pfreimd River in Germany, which uses one upper basin and two power plants (ASCE, 1989).

1.3.2.4 Underground Pumped Storage

The concept of underground pumped hydro (UPH) is similar to conventional pumped hydro; the only difference is that the lower reservoir is excavated underground (ASCE, 1989).

According to Willett (1974), the principles of the concept of UPH were first explained in the late 1960's at the Moscow World Power Conference by Isaaksen, Milsson and Sjorstand. Since that time, the concept has been developed.

One possibility that can alleviate the cost of an underground reservoir, i.e. the volume of the excavation, is to increase the head in order to diminish the size of the reservoirs. As the power output (P) is proportional to the product of the flow rate (Q) and the hydraulic head (H), there is an inverse relationship between Q and H . Heads between 1,500 – 2,000 meters with multistage units were considered more economically desirable (ASCE, 1989). Another possibility that has been evaluated to minimize costs in UPH is to use underground abandoned mines as the lower reservoir. Two interesting UPH projects in the USA, the Summit Energy Storage Project in Ohio (1500MW) (Douglas, 1990) and the Mount Hope Hydro Project in New Jersey (2000MW) (Prendergast, 1991),

received licenses for construction in the early 1990's; however, due to changes in the US electricity market, they were postponed.

The Summit Project would use a former limestone mine 671m below ground as an 8,600,000 m³ storage chamber for the lower reservoir. However recent information about this project indicates that it is no longer under consideration and its site is being used for a fossil fuelled plant (Prendergast, 1991).

The Mount Hope underground pumped storage project has an iron ore mine on the site, but, it is not deep enough to achieve the 762m planned for the project's lower reservoir. Thus, the construction of the lower reservoir and associated structures would be one of the most extensive underground excavations in the U.S. Initially, they planned to use an existing surface lake as the upper reservoir; however, the mines and the existing surface lake were disallowed by FERC in the early 90's, forcing a change to a newly constructed surface reservoir, about 30% larger. The latest information available about Mt. Hope was that around May of 2001 the developer was trying to solicit partners for purchasing the plant output as well as setting up engineering and equipment manufacturer contacts in an attempt to start building in August of 2002. To date, no further information confirming the beginning of the construction has been located (Ferreira, 2002).

1.3.3 History

The construction of the first pure pumped storage had its beginning in Switzerland in 1904. Most of the early developments of pumped storage were located in Western Europe, mainly in Germany, Switzerland, and Italy. In 1925, a plant began its operation in Germany. Around 1930, units in the USA and Japan started being commissioned (ASCE, 1989). These developments were justified by favorable economic opportunities which arose in energy marketing with regional systems served by many utilities. Energy trading benefited from the capability of storing for peak-load demand. Initially, these were seasonal storages, with later adoption of daily storage. Most of these units had separate pumps and turbines (Cox, 1974). Due to the innovation of single-runner reversible pump/turbines in the early 1940's, significant progress in pumped storage was made. This development began with a group of Brazilian installations that transformed an existing hydro installation at Cubatao to pumped storage use to benefit from the flows of the Rio Tiete. The Traicao and Pedreira pump stations were installed to lift water, on a seasonal basis, from the reservoir of the Eduardo de Souza Power Plant into the main storage of the Billings Reservoir. The river flow was reversed, and a quantity of it used over a head drop of about 2,100 feet from the plateau to the sea. Otherwise, only 800 feet would be used over a drop for power generation (ASCE, 1989). The Traicao and Pedreira pumping stations are two milestone plants in the reversible pumping turbine field (Cox, 1974).

In the early 1960's, daily reversing cycle hydro turbines were widely used around the world. However, the low cost of fuel and the continuing demand for electrical energy encouraged some countries with lack of hydro potential to introduce thermal power on a comparatively large scale.

With the advent of the energy crisis in 1973, followed by the increase in oil prices, the world's industrial countries started probing alternative sources of energy to avoid dependency on the traditionally dominant oil producing and exporting countries. Thus, the development of energy management to use energy more efficiently and the development of alternative power sources, such as the sun, wind, and water among others, evolved rapidly in industrial countries.

In 1979, the total installed generating capacity in pumped storage power stations within the European Community was estimated at approximately 10 GW. In 1980 in the United States pumped storage capacity was equal to approximately 20% of the hydraulic power stations capacity. In Japan, more pumped storage stations were developed, taking advantage of the pumped storage machinery technologies developed by Japanese manufacturers. By 1998 Japan achieved the largest pumped storage capacity in the world with 43 pumped storage plants and a total capacity of 24,968 MW compared to 38 pumped storage plants in the USA, with a total capacity of 19,722 MW (Yasuda, 2000).

Table 1-3 shows pumped storage development around the world with Japan, the United States and China ranking highest in pumped

storage capacity. Pumped storage continues its development around the world; on February 3, 2003, following a construction time of close to six years, Vattenfall Europe Generation (VE-G) put the first unit of a 1060 MW Goldisthal pumped storage power plant in Thuringia, Germany into commercial service; these units use a variable speed turbine that improves efficiency over a wider operating range. Two large pumped-storage plants are under construction in the Republic of Korea: Yangyang (1000 MW) and Cheongsong (600 MW) with commissioning expected for 2005 and 2006. In Japan, Kaore, a 1300 MW pumped storage plant is being developed and the first unit is expected to begin operating in 2007. Tokuyama (400 MW), another pumped storage facility in Japan, is also being developed and its initial operation is planned for 2008. In the Ukraine, two pumped storage projects are being built: Dniester (2268 MW - 7 units) with unit 1 scheduled to begin in 2005, and Tashlyk (906 MW - 6 x 151MW) with its first stage (2 units) already 85% ready.

Table 1-3 Major worldwide pumped storage development

Country	Number of pumped storage plants	Pumped Storage Capacity MW
Japan	43	24,967
USA	38	19,722
China *	7	8,373
Italy	21	7,386
Germany **	37	6,677
France	29	>5,845
Spain	25	5,841
UK	5	3,242
Austria	17	2,837
Switzerland	18	2,678

Table based on Water Power & Dam Construction Yearbook 1999 "The world's pumped storage plants".

* includes Guangzhou plant commissioned in 2000, 2,400 MW and Tienhuangping plant commissioned in 2001, 1,800 MW

**includes Goldisthal plant commissioned in 2003, 1,060 MW

1.4 Pumped Storage in Deregulated Markets

In regulated power markets pumped storage has been used as a load management mechanism; i.e. pumped storage offers a means to defer investment in primary power generation facilities, such as new thermal power plants. In deregulated power markets pumped storage plants pump water to an upper reservoir at times of low power cost and this potential energy is then released through a hydro-electric generator at times of high demand and power price.

In the past decade the electricity industry, known as a regulated vertically integrated business with centralized planning and decision making, has been deregulated in many countries and power transactions between power generators and consumers have been liberalized.

In an effort to ensure a fair and open market, deregulated markets have usually started with a single mandated clearing pool through which

all wholesale electric power is sold, giving a single price for the commodity at any point in time (Li & Flynn, 2004a).

Deregulated power markets show a diurnal pattern of price change: power has a lower cost from around 10 P.M. to 6 A.M., than it does during the day, and power prices are frequently much higher at a time of peak usage. For example, in Alberta, there is a predictable increase in power price during the electricity “rush hour” of 5 P.M. to 8 P.M. Recent work at the University of Alberta has documented diurnal power price patterns in 14 different deregulated markets around the world (Li & Flynn, 2004a; 2004b; 2005a; 2005b). One finding of this research is that, in deregulated markets, there are significant differences in diurnal price patterns, including the magnitude of the maximum to minimum price ratio that is a key factor in creating an incentive for energy storage.

The opening of the electricity business to competition opens new markets and business opportunities for new entrants. In addition, emerging technologies for distributed generation, energy storage, controls, communications, and energy management provide the potential for customers to manage their energy use and processes on an integrated basis. Hence, the tendency of the electric power business is to be shaped by customers and how they choose to manage their energy bill. Customers’ need for integrated, cost effective, timely, and reliable solutions opens up significant investment and business opportunities for new products, services, and emerging technologies to make the electric

system more efficient, reliable, low cost, decentralized, and smart (Budhraj, 1999).

With the event of deregulation and liberalized use of transmission lines, the system reliability has drawn more attention. The need to maintain the frequency and voltage of the system within certain limits, as well as to prevent the propagation of a system fault when a serious fault occurs, has been recognized and some new market regulations are being placed to cope with this problem. Therefore, in a deregulated market an additional role for pumped storage is to become an ancillary service provider beyond a peak power generator (Tanaka, 2000). However, although pumped storage and conventional hydro are currently dominant ancillary service providers, there have been successive efforts to advance the technology to improve their ancillary services and to minimize costs to maintain their competitiveness against other generating sources. The ancillary services provided by pumped storage units are discussed below.

1.4.1 Describing Ancillary Services Provided by Pumped Storage Plants

1.4.1.1 Online Generation (instantaneous response)

The capability of pumped storage units to pick up load and reject load very quickly makes them very well suited to cope with load fluctuations in the power supply system, regulating its voltage and frequency. The cost of downtime associated with momentary outages and

voltage dips lasting less than one second is more than 12 billion U.S. dollars per year in the United States (O’Keeffe, 2002).

Using the automatic frequency control (AFC) and governor-free operation, pumped storage can perform well in a load following mode. Recently, adjustable speed generator-motors have been introduced to enable the frequency control even at pumping time (Yasuda and Tanaka, 2002). In addition, improving the stability of network voltage and frequency reduces the chance of network failures, and consequently increases the safety of nuclear plants.

1.4.1.2 Reserve Margin

The ability to operate from standstill to the full load within a few minutes and continue the full load over a period of hours with high reliability makes pumped storage facilities an ideal reserve margin to the network. In the ancillary service market, the following services are traded:

- **Spinning Reserve (10 s response)**

This ancillary service consists of providing power in 10 sec or less in the case of an unplanned outage. To supply this service, generators should spin in air at synchronous speed.

- **Non spinning reserve (3 min or less)**

The plants should have water in storage and a generator on standby to be able to provide power in 3 min or less.

- **Load Following or Ramping (50MW per min)**

Plants should be able to follow a load change at a rate of 50MW per minute.

- **Replacement Reserves**

In case of planned outages, facilities with enough reserve could schedule energy production in advance.

- **Electrical Storage**

A determined amount of water, which can be transformed to electricity, is kept stored for a client that can request it any time.

- **Black Start Capability**

By maintaining a certain amount of water in the upper reservoir, expressly reserved for this contingency, pumped storage facilities can start their plants and a connected system when no electricity is available on line. Thus, it can provide the initial power for line charging use in the recovery from a system blackout.

1.4.1.3 Oxides of Nitrogen (NO_x) Gases Credit

Giving credits for reduction of NO_x gases is currently under discussion in the legislatures throughout the US. The pumping operation of a pumped storage facility can help large coal thermal plants keep running in the middle of the night with higher efficiency, avoiding daily ramp up in the morning. This efficiency gain gives a fuel saving in thermal plants and, consequently a reduction of NO_x could be claimed (Louis, 2001).

1.5 Diurnal Power Price Patterns to Assess the Economics of Energy Storage in Deregulated Markets

Unlike other commodities, electricity can not be stored in significant quantities relative to daily or monthly consumption (Li & Flynn, 2004a), but it must be there when needed.

According to Ku (2000), the inflexibility of generation plants¹, transmission congestion², and unresponsiveness³ of demand are the factors that lead to power price volatility. Li & Flynn (2004a; 2004b; 2005a; 2005b) has examined diurnal power price patterns of 14 deregulated power markets. The study shows that in deregulated markets there are significant differences in diurnal price patterns, and also comments on the consistent monotonic diurnal price pattern on weekdays shown in the North American markets, while all other markets show either a morning and evening price peak, or choppy multiple peaks.

There is considerable hour to hour price variation in deregulated markets, and in particular where bids for all power are taken on an hour ahead basis there is a high degree of short term uncertainty in price. However, long term historical price patterns can provide a basis for an initial economic assessment of any kind of energy storage. In this study, the historical diurnal power price patterns for the 14 deregulated power markets, found by Li and Flynn (2004a) were utilized to assess the economics of energy storage. Each deregulated power market has a characteristic average pattern which can be used to predict both the

¹ In general hydro and pumped storages can shift on and off quickly following the load while thermal plants are more efficient if stay on line instead of shifting on and off according to demand.

² Delivery of power is influenced by transmission capacity constraints and requirements for grid stability.

³ When you need power the most, that's when everyone else also needs it. In extreme conditions when demand is hard to meet, the few providers of power can act like monopolists, asking any price they want.

number of hours per day that an energy storage generation is economic and the expected revenue from the energy storage unit. Hence, an optimum operating strategy based on historical price patterns can be developed utilizing a pumped storage unit as a model. Limitations in this approach are discussed throughout this study.

A theoretical pumped storage project, in which all factors align to minimize net capital cost, is also analyzed in this study in order to determine the maximum possible pre-tax return on investment for the 14 deregulated markets and the largest amount of investment per unit of power output that can be justified in each market to earn a return on capital of 10%. In addition, two real business cases located in Alberta are assessed in a detailed level; Kneehills, a medium head site using a natural prairie coulee as a reservoir by building an earthen dam, and Grande Cache, a high head mountainous site that would have the potential to use existing mining pits as reservoirs.

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Chapter 2

2 The Economics of Energy Storage in 14 Deregulated Power Markets

2.1 Introduction

Any storage of electrical power requires an investment in capital and incurs the cost of inefficiency, i.e. the ratio of power recovered to power consumed. Pumped storage, in which water is pumped from lower to a higher water source and then later flowed from the higher source to the lower to produce electricity, is one means of time shifting, or storing, electrical power. It requires an investment in capital for reservoirs, penstocks, one or more pump/turbo-generators, and associated switching and transformer equipment to allow access to transmission. It consumes more power than it returns, due to inefficiencies in pumping and generation. Power purchase is the most significant operating cost, with maintenance and other operating costs being relatively minor.

Pumped storage has been applied in regulated power markets (see, for example, (Anonymous, 2000; Wicker, 2004; ASCE, 1975; Hayes, 2002)) to better utilize existing generation capacity and postpone more costly investment in generation; the justification is a reduction in the overall regulated price of power compared to the alternative of investment in new primary generation. In deregulated markets, the sale of electrical energy and/or ancillary services from pumped storage can be evaluated

based on each individual project: given a forecast diurnal power and ancillary service price, does the revenue from the sale of power or services less the cost of purchased power cover the capital recovery and other operating costs?

In this study, we utilize historical power price data from 14 deregulated markets to assess the incentive to implement pumped storage for electrical energy; power price patterns in these markets have been analyzed by Li and Flynn (2004a; 2004b; 2005a; 2005b). Each market has a unique average diurnal power price profile that in turn leads to a unique price spread for pumped storage; each market will also have its own maximum profitable operating duration, i.e. the number of hours in which the revenue from the sale of power is higher than the purchase cost of power required to pump the water into the reservoir; this value is also dependent on the operating efficiency of pumped storage. We assess the net income potential from energy sale from pumped storage for each market, and rank the markets in terms of the incentive to invest in pumped energy storage. We illustrate an optimal operating profile in detail based on historical price patterns for one of the markets. In addition, we analyze the adequacy of return on investment for pumped storage by two different methods. First, we define a theoretical minimum level of investment in which all factors align to minimize net capital cost and calculate the expected maximum pre-tax return on investment for the 14 markets studied. Second, we determine the largest amount of investment per unit

of power output that can be justified in each market to earn a pre-tax return on capital of 10%.

Deb (2000) illustrated a bidding strategy for both energy and ancillary services sales in a day ahead market for which all prices are known. Lu et al. (2004) developed an optimal strategy for pumped storage, including both the sale of electrical energy and ancillary services, for the New York ISO based on historical prices. We focus on the sale of electrical energy and do not include ancillary services in our comparison of the 14 deregulated markets because data on the price of ancillary services is not readily available, while price data for hourly or half hourly electrical energy is. In addition, the specific provisions for purchase of ancillary services vary widely between markets and are often different than those for the purchase of energy (for example, purchase of ancillary services on a day ahead basis in markets where energy is purchase on an hour ahead basis). We note, however, that any party implementing pumped storage would have the potential to increase their revenue in certain periods by selling ancillary services instead of energy.

2.2 Power Price Data

Table 2-1 summarizes the average of hourly or half hourly price data that were analyzed by Li and Flynn for 14 different markets (all cost figures in this study are expressed in 2004 US\$). Table 2-2 shows the range of time over which the original power price data was averaged. Average prices in the local currency were converted to a single currency,

US\$, at the exchange rates as of October 7th, 2004 (Oanda.com, 2004), shown in Table 2-3. Note that deregulated markets differ in the method by which the predominant power price is set; in some markets it is based on an hour or half hour ahead bid, while in others it is based on a binding day ahead bid, with a small hourly market for adjustments in day ahead bid volumes. Price data in this study is the predominant price, i.e. the price at which most of the power in the given market is sold. Data cleaning, dealing with missing or duplicate data points, was a minor issue, typically affecting less than 0.5% of data points and hence not a significant source of error (Li and Flynn, 2004a). Fig. 2-1 illustrates a sample average diurnal price pattern for weekdays and weekends in one market in this study. Weekday and weekend price patterns for all markets in this study can be found in (Li and Flynn, 2004a).

Diurnal price patterns in deregulated power markets are created by a number of factors, including the generation mix and the market design and operation. Generation mix, for example the blend of hydro, nuclear, coal and gas fired power, will lead to significant shifts in the marginal bid price of power as demand changes. Market design, e.g. binding day ahead vs. hour by hour bidding, influences volatility. Finally, there is evidence that the exercise of market power is related to the effectiveness of market surveillance mechanisms in each market. All of these factors help to create a unique daily pattern of average power prices that is different for each deregulated power market.

Table 2-1. Average diurnal power price converted to a common currency (USD/MWh)

Hour	Canada, Alberta		2 USA: Northern California		USA, P.M.		4 USA: New England		Germany, Leipzig Exchange		7 Britain		8 Spain		9 Scandinavia		10 Australia, South		11 Australia, New S.		12 Australia: Queensland		13 Australia: Victoria		14 N Zealand:		
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	
0:00	51.26	52.79	57.22	45.24	18.00	16.57	30.12	30.40	11.59	9.97	25.19	25.70	45.06	43.81	19.67	19.30	33.90	24.59	21.07	18.34	30.61	24.07	23.69	16.19	19.15	23.96	
0:30	43.77	48.45	51.00	49.69	15.73	15.99	28.20	26.14	10.17	9.55	21.98	22.72	39.53	43.88	18.21	18.69	34.32	28.29	21.85	16.90	30.01	16.92	20.25	16.79	24.12	25.36	
1:00	41.19	41.95	48.75	45.20	14.86	14.61	26.66	24.35	8.97	8.28	25.17	26.92	32.89	38.02	16.74	18.49	37.71	30.28	19.16	16.64	15.87	16.40	22.64	18.85	26.07	28.41	
2:00	39.63	42.78	43.85	41.98	13.90	13.69	24.80	24.12	8.33	7.98	26.06	29.73	32.89	38.02	16.74	18.49	29.30	29.30	18.61	16.66	14.18	14.02	18.63	16.66	23.05	25.19	
3:00	39.76	41.89	43.92	40.85	13.63	12.93	24.99	24.73	8.07	7.17	26.95	27.57	30.38	32.48	16.00	16.22	24.27	23.16	17.41	16.27	13.50	12.97	18.64	16.60	23.47	24.84	
4:00	38.71	40.61	45.81	40.77	14.13	13.07	27.24	27.60	8.37	6.97	25.66	26.61	29.26	30.20	16.42	17.89	17.19	14.72	13.28	12.08	12.53	12.38	12.17	13.97	12.84	20.61	22.89
5:00	42.69	40.30	53.08	41.69	16.66	13.75	31.10	33.22	9.39	9.81	22.89	21.10	28.54	28.80	18.57	17.78	13.70	11.42	12.83	10.73	12.55	11.83	11.32	9.43	17.69	17.60	
6:00	64.44	42.00	56.06	39.60	24.64	14.01	34.52	41.06	11.87	6.42	21.31	21.10	28.62	27.86	19.18	17.84	16.98	10.92	15.72	10.96	13.67	12.22	14.32	9.32	18.05	16.62	
7:00	76.05	46.22	61.43	42.45	28.21	14.94	36.99	45.97	16.24	7.42	30.63	22.14	32.34	27.81	20.45	18.03	27.70	12.74	22.80	12.51	12.98	23.71	10.81	21.99	18.08	18.08	
8:00	63.02	57.44	63.73	47.99	28.48	20.45	39.89	46.27	16.58	9.38	41.28	23.28	48.11	28.50	22.12	18.37	31.31	15.02	19.61	14.29	13.39	20.28	12.19	29.59	19.94	19.94	
9:00	98.85	65.10	67.84	52.28	28.76	23.39	41.58	47.66	19.61	11.21	48.72	27.15	49.11	28.50	23.34	18.66	40.88	21.46	25.87	19.12	13.38	23.48	14.19	36.68	21.19	21.19	
10:00	110.04	72.69	71.33	55.49	33.66	24.55	42.85	49.65	21.34	12.95	53.36	34.23	52.04	32.59	23.00	19.44	38.86	23.66	26.30	22.21	16.25	26.64	20.08	39.42	25.54	25.54	
11:00	114.37	74.87	73.90	57.55	35.61	23.96	44.25	59.12	28.98	14.66	48.54	38.42	54.57	38.64	22.76	19.74	37.95	30.78	24.85	21.34	16.25	29.23	20.03	37.59	28.32	28.32	
12:00	115.07	76.76	76.08	58.47	36.85	23.23	43.05	75.00	21.12	12.98	55.12	38.06	55.79	41.21	22.41	19.61	40.81	31.98	25.04	20.43	14.08	31.08	26.05	36.01	30.11	30.11	
13:00	114.15	75.72	79.47	59.90	43.11	22.85	41.22	74.96	19.89	11.23	45.04	34.49	55.94	41.12	21.02	19.64	45.76	39.21	28.48	20.45	14.47	30.44	26.07	34.49	31.01	31.01	
14:00	118.47	71.63	81.31	58.55	43.66	22.33	40.60	72.18	17.87	10.03	42.03	28.63	48.65	37.98	21.60	19.32	69.75	27.69	30.27	17.77	11.77	32.13	17.79	33.81	29.30	29.30	
15:00	119.03	72.21	81.53	58.38	43.28	22.18	40.63	67.60	16.49	9.61	39.29	23.98	50.32	35.89	21.49	19.34	76.84	28.53	28.65	17.58	14.68	37.41	17.64	33.79	27.73	27.73	
16:00	130.76	81.76	82.28	61.66	43.13	25.81	43.19	50.10	17.23	9.63	45.22	23.63	51.80	34.61	21.49	18.68	69.02	23.23	29.44	17.59	14.73	46.68	17.54	31.26	26.56	26.56	
17:00	151.28	95.61	81.95	72.76	45.33	29.71	48.08	56.17	20.41	11.78	44.35	28.83	53.93	35.10	21.70	19.94	63.22	25.49	28.16	18.98	16.64	31.88	29.98	31.08	24.82	24.82	
18:00	195.59	89.41	79.71	71.70	36.90	28.40	44.79	55.90	20.22	12.71	53.00	39.03	56.47	39.63	21.62	20.10	45.66	34.34	30.80	27.16	16.20	40.14	32.98	24.99	34.79	34.79	
19:00	107.43	77.22	76.82	70.59	33.03	28.03	42.62	48.43	17.21	12.64	42.15	40.31	57.29	42.52	21.24	20.01	43.52	42.07	24.89	20.97	19.35	45.06	28.03	26.82	37.98	37.98	
20:00	110.66	74.99	75.16	71.06	34.68	27.85	40.43	43.33	15.02	11.62	49.05	37.99	56.01	46.74	20.82	19.80	39.80	20.89	21.73	22.09	18.50	46.50	24.36	26.15	34.67	34.67	
21:00	108.43	80.41	65.61	57.54	30.01	24.89	35.00	36.99	13.34	11.31	44.46	34.13	55.30	50.66	20.83	19.02	36.71	19.97	20.27	19.97	17.70	42.18	23.65	17.34	30.00	30.00	
22:00	76.62	65.02	61.46	56.00	22.03	19.86	31.62	31.98	12.62	11.93	45.19	34.39	50.74	48.48	20.42	19.73	35.71	17.10	17.35	17.10	12.16	22.14	22.14	16.27	32.98	28.69	
23:00																											
23:30																											

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Table 2-2. Time span of power price data – Li & Flynn (2004a; 2004b).

Market	Frequency	Duration	% of data cleaned
1. Canada: Alberta	Hourly	96/01/01-01/12/31	0.02
2. USA: Northern California	Hourly	98/04/01-01/01/31	0.80
3. USA: PJM	Hourly	97/04/01-01/12/31	0.73
4. USA: New England	Hourly	99/05/01-01/12/31	0.87
5. Germany: Leipzig Exchange	Hourly	00/06/16-01/12/31	1.07
6. Netherlands	Hourly	99/05/26-01/12/31	0.01
7. Britain	Half hourly	96/01/01-97/12/31, 98/03/01-01/2/28	0.34
8. Spain	Hourly	98/01/01-01/12/31	0.08
9. Scandinavia	Hourly	92/05/04-01/12/31	0.03
10. Australia: South Australia	Half hourly	98/12/13-01/12/31	0.01
11. Australia: New South Wales	Half hourly	98/12/13-01/12/31	0.03
12. Australia: Queensland	Half hourly	98/12/13-01/12/31	0.04
13. Australia: Victoria	Half hourly	98/12/13-01/12/31	0.04
14. New Zealand: Benmore	Half hourly	96/11/01-01/12/31	0.04

Table 2-3. Exchange rates at October 7th, 2004 (Oanda.com, 2004)

Market	Currency	Exchange rate USD
1. Canada: Alberta	Canadian Dollar (CAD)	0.794
2. USA: Northern California	American Dollar (USD)	1.000
3. USA: PJM	American Dollar (USD)	1.000
4. USA: New England	American Dollar (USD)	1.000
5. Germany: Leipzig Exchange	German Mark (DEM)	0.628
6. Netherlands	Euro (EUR)	1.228
7. Britain	British Pound (GBP)	1.777
8. Spain	Euro (EUR)	1.228
9. Scandinavia	Norwegian Kroner (NOK)	0.149
10. Australia: South Australia	Australian Dollar (AUD)	0.724
11. Australia: New South Wales	Australian Dollar (AUD)	0.724
12. Australia: Queensland	Australian Dollar (AUD)	0.724
13. Australia: Victoria	Australian Dollar (AUD)	0.724
14. New Zealand: Benmore	New Zealand Dollar (NZD)	0.675

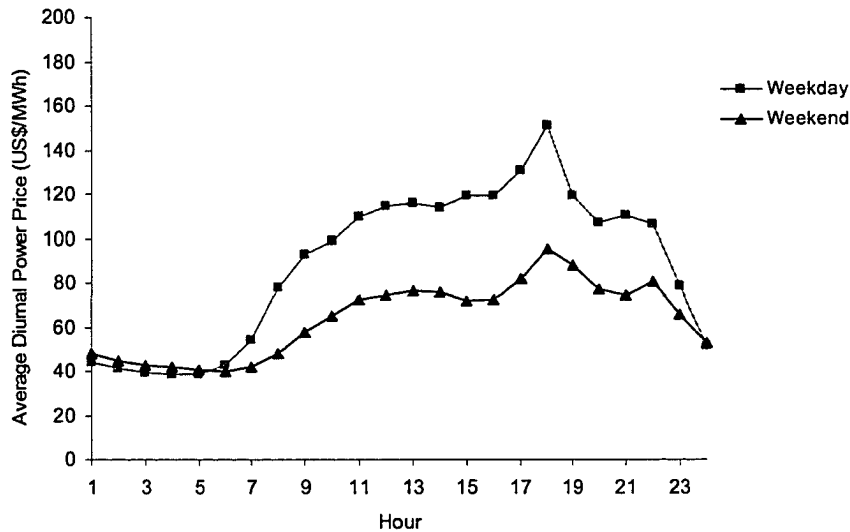


Figure 2-1. Average diurnal power price, US\$/MWh, illustrated for Alberta.

2.3 Sale of Power from Pumped Storage

Fig. 2-2 shows a conceptual layout of a pumped storage facility. When used for energy storage, the upper reservoir is typically filled on a daily basis, usually in the late evening and early morning during periods of low power demand and price, and drained during the day and early evening when demand and price are high. The majority of pumped storage utilizes a combined pump/turbo-generator, and efficiencies, measured as the power recovered per unit of power input, have ranged from 0.60 in plants built during the 1960's to around 0.80 in the most recent plants (Price, 2003; Tanaka, 2000). The ratio from the electrical input when pumping to the electrical output when generating can range from 0.9 to 1.2. However the most common mode of operation of the pump/turbo-generator is at constant power or an input to output power

ratio of 1 (ASCE, 1989), and we assume this mode of operation in our study. As a consequence, pumping time exceeds generating time by $(\text{efficiency})^{-1}$.

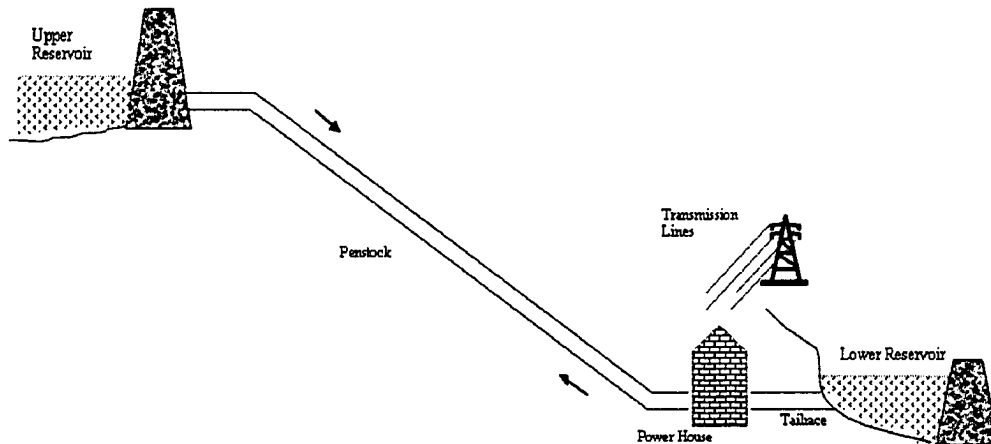


Figure 2-2. Typical layout of a pumped storage facility.

In a deregulated market, an operator does not know the system clearing price for future unbid time periods, and there is ample evidence of sudden changes in power price in markets where bids are gathered on an hour before basis. However, an initial assessment of the profitability of pumped storage of energy can be based on the long term average price behavior in a market. This is valid for a pumped storage investment whose capacity is small relative to the overall size of the power market. For very large or multiple pumped storage investments, the storage facility (or any other investment in new generation) will have an unknown impact on the diurnal price pattern. A prediction of the impact of incremental pumped storage on future diurnal patterns for 14 markets is beyond the

scope of this study, and hence our analysis is based solely on historical price patterns; limitations of this approach are discussed below.

The operating strategy for pumped energy storage is to maximize the spread between the value of power sold and power purchased. Thus, at 80% efficiency (used for the balance of this study) an operator would first identify the expected highest priced hour, and plan on purchasing power in the 1.25 hours with the lowest cost. The operator would proceed stepwise in this analysis until the cost of purchased power in 1.25 hours exceeded the cost of power sold in one hour, less the variable operating cost. Most direct operating costs associated with pumped storage, for example labor, are fixed rather than variable relative to power generation; even routine maintenance, for example, is typically scheduled on a fixed time interval rather than on operating hours. Hence, variable operating costs within the plant are very low. However, system operators can levy transmission access and dispatch charges that are purely variable, i.e. tied to the number of MWh of power put on the grid.

In this study we developed an operating plan for each market based on historical price patterns; Figure 2-3 illustrates such a plan for one market, Alberta, Canada. In the plan, hours of operation increase as one progresses down the table, and for each increment of time the available hour of highest priced power (generation) and 1.25 hours of lowest cost power (pumping) are determined. Clearly such a plan is specific to each market and to the assumed efficiency; it would have to be

recalculated if the operating efficiency of the pumped storage were different than 0.8.

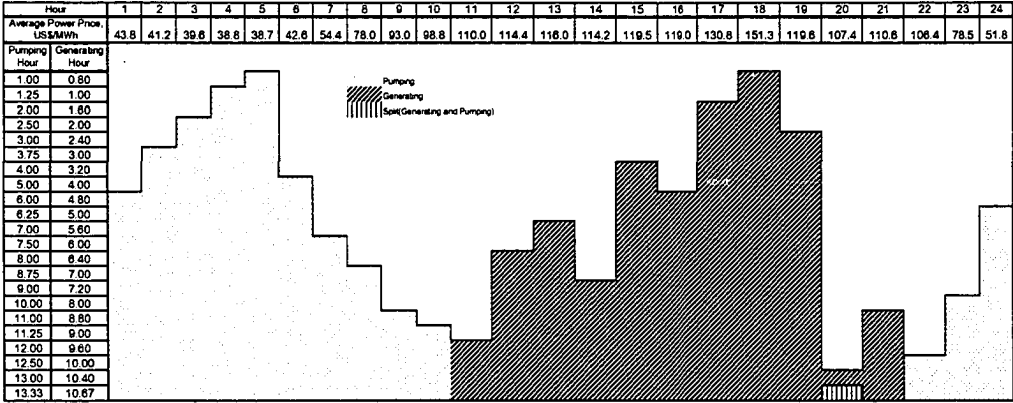


Figure 2-3. Operating plan illustrated for Alberta weekday operation with an efficiency of 80%.

From Figure 2-3 and the diurnal price pattern one can determine both the average and the incremental power sale and purchase price for each deregulated market. This is illustrated, again for the Province of Alberta, Canada, in Figure 2-4.

From Figure 2-4 and the operating plan in Figure 2-3 one can then calculate the expected incremental and average revenue per MWh of sold power from operating pumped storage for the sale of energy as a function of daily operating hours, by taking the difference in the value of power generated in an hour less the cost of power for the 1.25 hours that were required to fill the reservoir. Table 2-4 shows the details of the calculation for Alberta, Canada, and Figure 2-5 illustrates graphically the incremental and average revenue for Alberta, Canada; both Table 2-4 and Figure 2-5

are for weekday power prices. We conducted this analysis for all 14 deregulated markets in this study for both weekday and weekend power prices, and the profiles of incremental and average revenue from energy storage and sale for an efficiency of 80% for both weekday and weekend are shown in the Appendix 2-A. The profile identifies the maximum economic operating period for a pumped storage facility: when net revenue is negative, it does not make sense to continue operating pumped storage. The profiles are, in essence, a signature of energy storage economics that characterizes each market; they depend on both the diurnal power price pattern and the efficiency of the energy storage project.

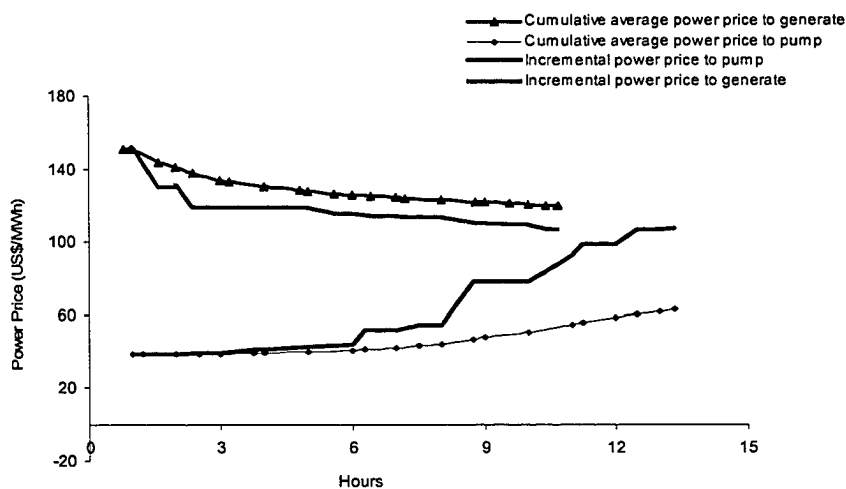


Figure 2-4. Incremental and cumulative average prices for generating from and pumping into a pumped storage facility, illustrated for Alberta weekday operation with an efficiency of 80%.

Table 2-4. Revenue calculation by hour illustrated for Alberta weekday operation of pumped storage with an efficiency of 80%

Pumping hours per day	Generating hours per day	Operating total hours	Power price for pumping US\$/MWh	Power price for generation US\$/MWh	Incremental pumping power cost US\$/MWh/day	Incremental generating power revenue US\$/MWh/day	Incremental net revenue US\$/MWh/day	Cumulative net revenue US\$/MWh/day	Incremental revenue US\$/MWh	Average revenue US\$/MWh
1.00	0.80	1.80	38.71	151.28	38.71	121.03	82.31	82.31	102.89	102.89
1.25	1.00	2.25	38.79	151.28	9.70	30.26	20.56	102.87	102.80	102.87
2.00	1.60	3.60	38.79	130.76	29.09	78.46	49.37	152.24	82.28	95.15
2.50	2.00	4.50	39.63	130.76	19.82	62.30	32.49	184.72	81.22	92.36
3.00	2.40	5.40	39.63	119.59	19.82	47.84	28.02	212.74	70.05	88.64
3.75	3.00	6.75	41.19	119.59	30.80	71.75	40.86	253.60	68.10	84.53
4.00	3.20	7.20	41.19	119.47	10.30	23.89	13.60	267.20	67.98	83.50
5.00	4.00	9.00	42.63	119.47	42.63	95.58	52.95	320.15	66.19	80.04
6.00	4.80	10.80	43.77	119.03	43.77	95.23	51.46	371.60	64.32	77.42
6.25	5.00	11.25	51.80	119.03	12.95	23.81	10.86	382.46	54.28	76.49
7.00	5.60	12.60	51.80	115.97	38.85	69.58	30.73	413.19	51.22	73.78
7.50	6.00	13.50	54.44	115.97	27.22	46.39	19.17	432.36	47.92	72.06
8.00	6.40	14.40	54.44	114.37	27.22	45.75	18.53	450.89	46.32	70.45
8.75	7.00	15.75	78.05	114.37	58.53	68.62	10.09	460.98	16.82	65.85
9.00	7.20	16.20	78.05	114.15	19.51	22.83	3.32	464.30	16.59	64.49
10.00	8.00	18.00	78.52	114.15	78.52	91.32	12.80	477.10	16.00	59.64
11.00	8.80	19.80	93.02	110.58	93.02	88.46	-4.55	472.55	-5.69	53.70
11.25	9.00	20.25	98.85	110.58	24.71	22.12	-2.60	469.95	-12.99	52.22
12.00	9.60	21.60	98.85	110.04	74.14	66.02	-8.11	461.84	-13.52	48.11
12.50	10.00	22.50	106.43	110.04	53.21	44.01	-9.20	452.64	-23.00	45.26
13.00	10.40	23.40	106.43	107.43	53.21	42.97	-10.24	442.40	-25.60	42.54
13.33	10.67	24.00	107.43	107.43	35.81	28.65	-7.16	435.23	-26.86	40.80

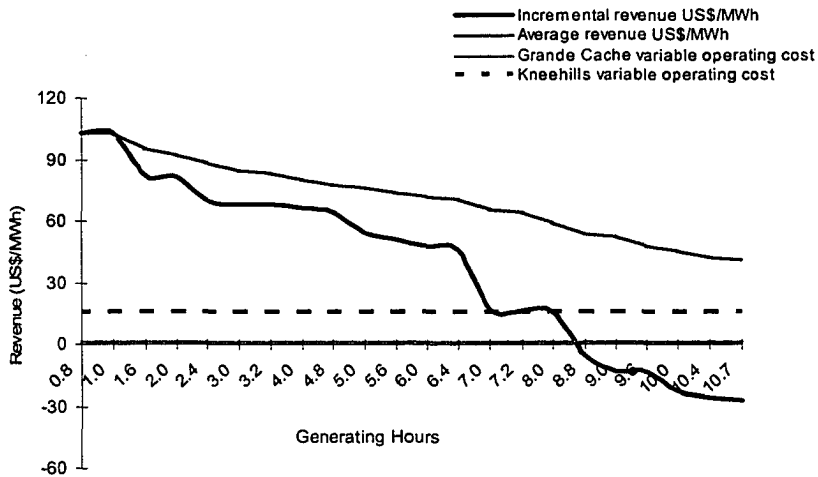


Figure 2-5. Pumped storage incremental and average revenue from energy sale illustrated for Alberta weekday operation with efficiency of 80%.

Figure 2-5 also illustrates the critical impact that variable operating costs, i.e. charges levied per unit of power sold, can exert on pumped

storage. Examples include dispatch fees levied by a system operator and transmission access charges. We studied in detail two specific locations in Alberta: Kneehills, a medium head site using a natural prairie coulee as a reservoir by building an earthen dam, and Grande Cache, a high head mountainous site that would have the potential to use existing mining pits as reservoirs. From the perspective of the transmission system operator one of these locations is far more favored than the other because it releases power into an area of net power consumption, and hence helps relieve transmission congestion. This is reflected in a different access charge between the two locations, and the impact, from Figure 2-5, is that operating hours would be lower for one location than the other: the transmission access charge is enough to remove any net revenue from operating past 7 hours in the case of Kneehills, while the Grand Cache location is forecast to make incremental net revenue by operating for an additional 1 hour per day. (This analysis presumes that at Grande Cache sufficient transmission capacity is available during the periods of power purchase, e.g. during the late evening and early morning hours.) Hence any prospective energy storage facility must assess location specific transmission charges in addition to expected power price patterns.

This data allowed us to finally calculate, for each of the markets, the aggregate income from operating pumped storage. We blend an average of five weekdays and two weekend days and rank the deregulated markets by daily revenue potential, as shown in Table 2-5.

For each market we also calculated the annual average revenue that can be earned per MW of installed capacity from pumped storage, assuming an on line availability factor of 97%; results are shown in Figure 2-6 and illustrate the impact of 75% and 80% efficiency. It is clear that deregulated power markets show substantial differences in price patterns and that these in turn impact the economic benefit of energy storage. Alberta, Canada has the highest potential annual income from energy storage, in part due to its wide period of high power price, as shown in Figure 2-1. There is negligible revenue potential in Scandinavia because the price spread is so low that revenue from even the first hour of generation is near zero, while Alberta, the Netherlands and two markets in Australia show a significant revenue potential.

Table 2-5. Daily revenue from pumped energy storage in deregulated markets with an efficiency of 80%

Power markets ranked by annual revenue	Weekday cumulative net revenue (US\$/MW/day)	Weekend cumulative net revenue (US\$/MW/day)	Weighted daily average (US\$/MW/day)
1-Canada: Alberta	477	191	395
6-Netherlands	389	62	296
12-Australia: Queensland	234	138	207
10-Australia: South Australia	231	100	193
7-Britain	153	67	128
3-USA: PJM	148	62	123
2-USA: Northern California	120	91	111
4-USA: New England	56	211	101
8-Spain	96	57	85
13-Australia: Victoria	90	45	77
14-New Zealand: Benmore	76	52	69
11-Australia: New South Wales	68	43	61
5-Germany: Leipzig Exchange	65	22	53
9-Scandinavia	0.30	0	0.21

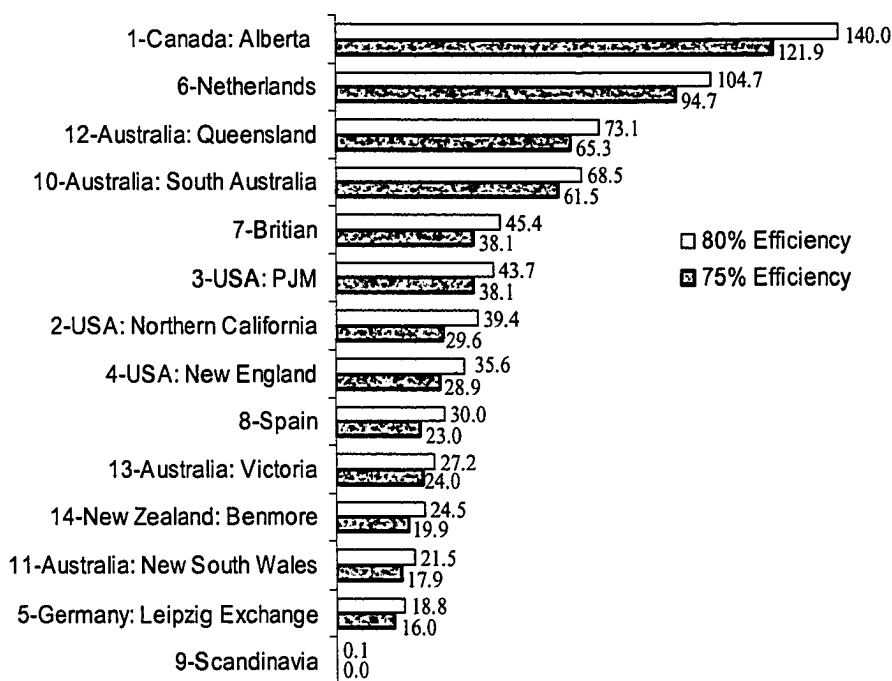


Figure 2-6. Annual revenue (US\$(000)/MW/Yr) from a pumped storage facility with 97% availability at 80% and 75% of efficiency.

2.4 Investment in Pumped Storage

The ultimate test for energy storage is whether there is adequate return on investment from the net revenue from purchase and resale of power. We analyze this for pumped storage by two different methods, both subject to the limitations noted above: income from sale of ancillary services, charges per MWh for dispatch and transmission access, and the impact of the investment in energy storage on future diurnal prices are not included in this study.

Our first approach is to define a theoretical minimum level of investment in pumped storage, i.e. a theoretical project in which all factors align to minimize net capital cost. This “best case” project would utilize

existing bodies of water for the upper and lower reservoir, and an adjacent transmission line for access to the grid. Hence, the net investment in the project would be for the land and access, penstock, reversible pump/turbine and auxiliary machinery, power house, switchyard, investigation and engineering. For a high head pumped storage facility we estimate this investment to be US \$275 per MW of capacity in a 550MW plant; Table 2-6 shows the breakdown of the estimated minimum cost plant.

Table 2-6. Estimated capital cost for an idealized minimum investment pumped storage case

High Head 550MW	US\$ (Million)
Land and Access	3
Upper and Lower Reservoir	0
Penstocks	54
Powerhouse Structure	7
Power Plant Machinery	66
Interconnection & Transmission Line	0
Contingencies (10% Direct Costs)	13
Investigation and Engineering	7
Administration/Financing	4
TOTAL	151
\$/KW	275

Figure 2-7 shows the expected return for the 14 markets in this study; the values can be thought of as the maximum possible pre-tax return on investment from pumped storage, since all real projects would have higher investment than the “best case” and thus a lower return.

Hence, it is clear from Figure 2-7 that pumped storage does not pass a minimum test of adequate return, say 10% on capital deployed, in 6 of the 14 markets in this study.

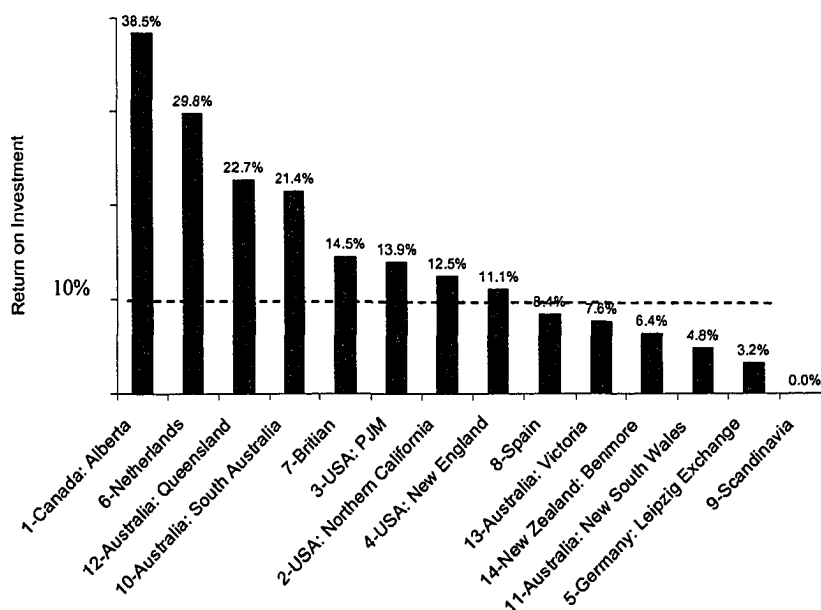


Figure 2-7. Pre-tax return on investment for an idealized minimum investment pumped storage case.

Our second approach is to determine the largest amount of investment per unit of power output that can be justified in each market to earn a pre-tax return on capital of 10%; Table 2-7 shows the values for each market in US dollars per KW. Alberta's historical diurnal price pattern would justify an investment of US \$1,190 per KW, while New England, Spain, Australia Victoria, New Zealand Benmore, Australia New South Wales, Germany Leipzig Exchange and Scandinavia would not

justify an investment in excess of US \$300 per KW. It is again clear from Table 2-7 that no practical pumped storage scheme operated for the purpose of time shifting of energy will be justifiable in many deregulated power markets.

Table 2-7. Maximum investment to earn a return of 10% on capital, US\$ per KW

Market	Allowable Investment
1-Canada: Alberta	1,190
6-Netherlands	858
12-Australia: Queensland	618
10-Australia: South Australia	579
7-Britian	382
3-USA: PJM	367
2-USA: Northern California	330
4-USA: New England	298
8-Spain	241
13-Australia: Victoria	226
14-New Zealand: Benmore	203
11-Australia: New South Wales	177
5-Germany: Leipzig Exchange	154
9-Scandinavia	~ 0

2.5 Discussion

Electricity has a time value in any deregulated market. In such markets, there is considerable volatility, and price patterns vary significantly from day to day (Li and Flynn, 2004a; 2004b; 2005a; 2005b). However, from the perspective of energy storage and resale on a diurnal cycle, the long term average price pattern in a deregulated market gives a

good first prediction of the potential revenue from the storage and sale of energy.

In this work we have used historical price patterns in deregulated markets to compare the potential for energy storage, using pumped storage as the model. All energy storage has both a capital cost and an energy inefficiency (power out vs. power in); the key question for a project developer is whether the expected net revenue from pumped storage justifies the capital investment.

The revenue from energy storage in a deregulated market is determined by the shape of the diurnal price pattern. Alberta, which has a long daily period of high power price and a long evening/morning period of low price, has the highest revenue potential for pumped storage identified in this study. An hour by hour analysis of pumped storage is required to fully assess an energy storage project. This study makes clear that in many markets the diurnal pattern simply does not justify any practical energy storage application; the allowable investment, based on the revenue potential, is far below the cost of any real project. Deregulated power markets are not all alike.

We think of the process used in this study as a "first pass" screening, i.e. a method of first estimating the potential for energy storage in a given deregulated market. When an opportunity for energy storage is identified, several other factors need to be considered:

Is the historical diurnal power price an accurate predictor of future price? Two elements must be considered in an analysis of the relationship between past and future prices: the likelihood of different price patterns, and the impact of the pumped storage itself on price patterns. Li and Flynn (2005a) did a time analysis of power price patterns and found that some markets have experienced a single period of high power prices. California and New Zealand are examples of this, with the California price excursions being related substantially to market bidding behaviors and the New Zealand price behaviors being related to an unusually severe period of drought. Neither of these circumstances is expected to reoccur in the next 20 years (bidding behaviors in US markets are under closer scrutiny and clearer rules, and the drought in New Zealand was severe enough to have a low frequency of expectation). On the other hand, there are legitimate concerns of major power price swings, i.e. "boom and bust" pricing, due to delays in investment in new generation capacity until prices are high coupled with a long construction period for major power plants; this concern has led, among other things, to a focus by some parties on separating energy and capacity auctions in deregulated power markets. As well, as noted above, simply building energy storage will have some impact on the price patterns in the market, particularly if the capacity of the storage is significant relative to the total market. Thus anyone screening investment in energy storage must give careful thought about what historical prices to consider and how representative these prices will be of

future price patterns. As with all energy projects, the projection of future price is a major determinant of the viability of the project.

What is the impact of variable system charges on the net revenue? As this study shows for two examples in Alberta, Canada, system charges, in particular transmission access charges, can have a significant impact on the net revenue available from energy storage. Transmission related charges often are location specific, and this impact would have to be factored in to any analysis of investment in energy storage.

Ancillary services can often be bid as an alternative to energy sales (Deb, 2000; Lu et al., 2004; Tanaka, 2000; Yasuda, 2000), and a pumped storage operator could make a day by day, and in some markets an hour by hour decision about whether to sell ancillary services or energy; such a decision would be made based on maximizing expected revenue. The rules for bidding ancillary services are too complex, and the price data too difficult to source, to allow for the inclusion of an analysis of ancillary services in this study of 14 different deregulated power markets, but it would be a factor in analyzing any specific project.

2.6 Conclusions

Fourteen deregulated power markets were assessed for the potential for investment in energy storage, with pumped storage as the model investment. Net revenue from energy storage and resale depends on the energy efficiency of the project and the diurnal pattern of power

price. There are significant differences in historical average price patterns between the 14 deregulated power markets. As a result, the potential for economic pumped storage varies widely. Alberta, the Netherlands, Australia Queensland and South Australia have some potential for adequate return on investment in pumped storage, but for the majority of markets in this study the diurnal price pattern does not justify the investment.

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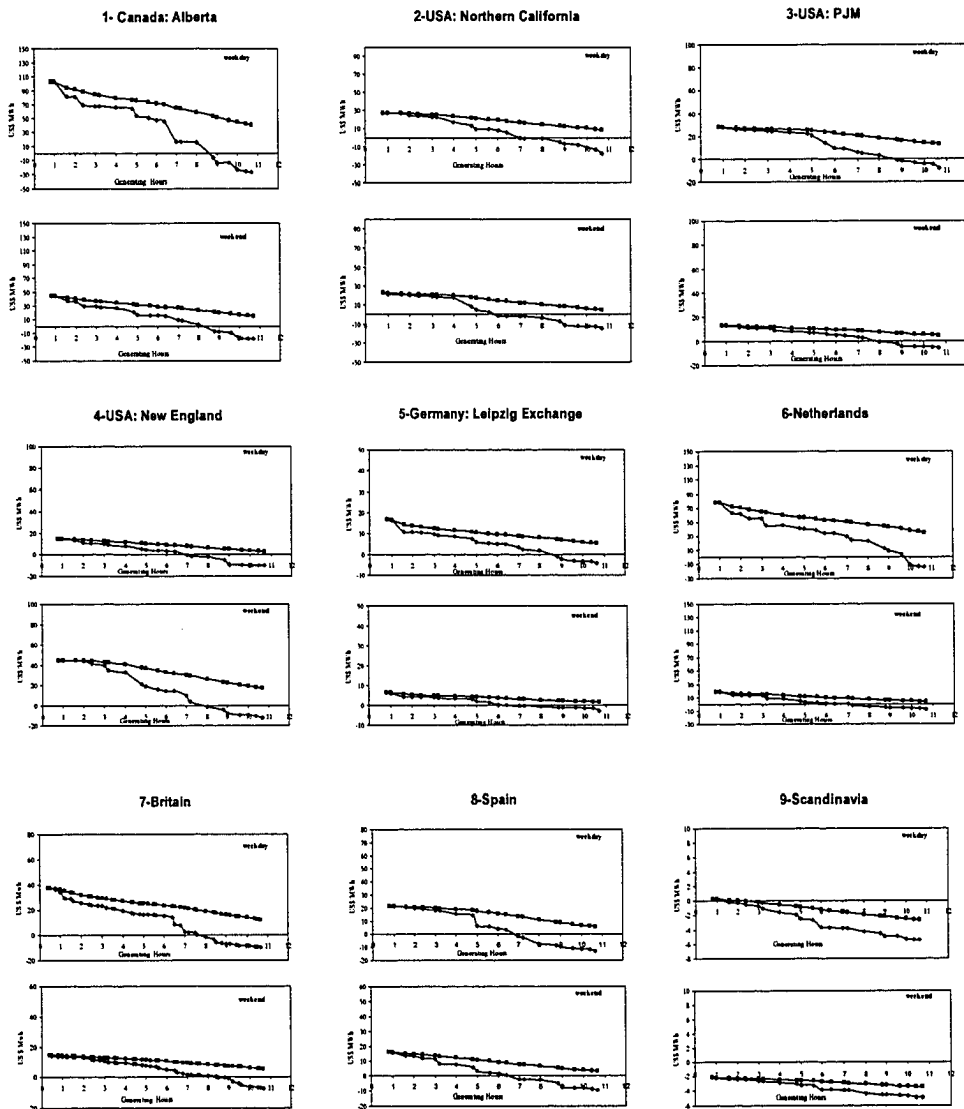
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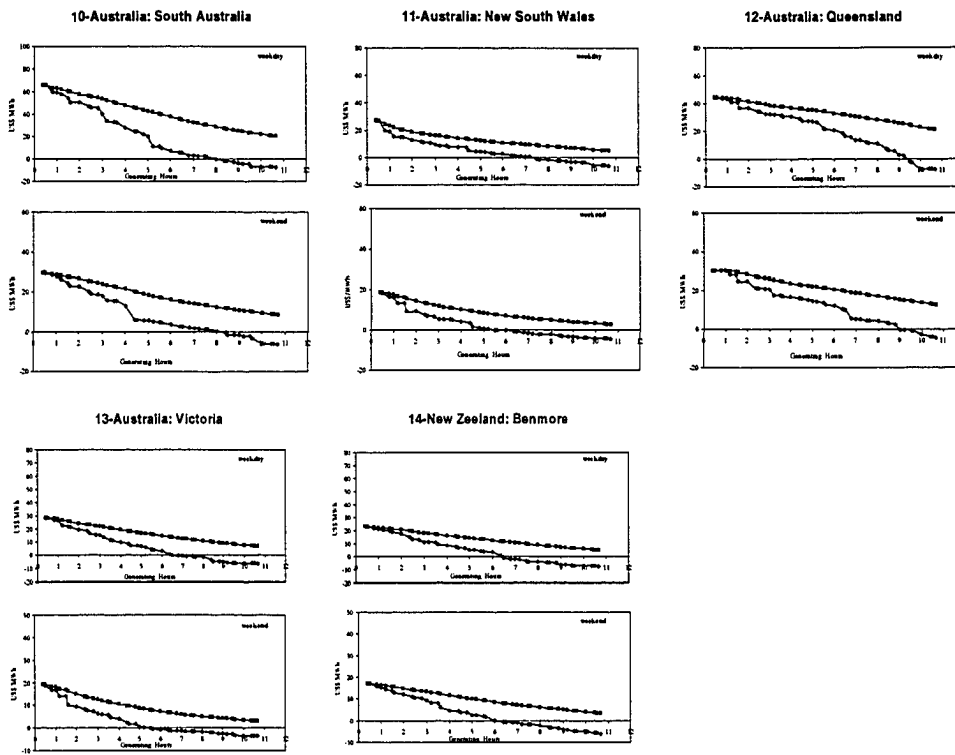
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Appendix 2-A. Profile of Incremental and Average Revenue

Profile of incremental and average revenue from energy storage and sale illustrated for 14 deregulated power markets with an efficiency of 80%.





Chapter 3

3 Using Diurnal Power Price to Configure Pumped Storage

3.1 Introduction

Electrical power can be stored by a variety of means: batteries, compressed air storage, and pumped storage are three examples. In pumped storage, water is pumped into an upper reservoir during periods of low demand or price, and the water is run from the upper reservoir into a lower reservoir or watercourse during periods of high demand or price. Pumped storage has been developed in regulated and deregulated power markets (see for example (Anonymous, 2002; Wicker, 2004; ASCE, 1975; Hayes, 2002; Leonhard and Grobe, 2005)).

Stored power can be used to improve power quality and reliability, for example through the provision of ancillary services such as frequency control (reactive power) and spinning and non-spinning reserves. It can also be used to time shift the availability of electrical energy, which we refer to subsequently as energy storage. In regulated power markets, evaluating energy storage is based on a complex analysis of the impact on total system cost of building storage vs. new generation. In a deregulated power market, the analysis is simpler: does the expected future diurnal power price pattern provide sufficient revenue to justify the capital expenditure for energy storage?

In a previous work (Figueiredo et al., 2005) we did an initial analysis of the incentive to build energy storage in 14 deregulated power markets for which extensive historical power price data has been analyzed to provide diurnal price patterns (Li and Flynn, 2004a; 2004b; 2005a; 2005b). The analysis was based on the presumption that historical average diurnal power price patterns in deregulated markets were a reasonable initial estimate of future power price patterns. We computed the expected revenue from energy storage per hour of generation, which required an analysis of both the diurnal price pattern and the energy storage efficiency (power generated per unit of power consumed). Figure 3-1 shows the weekday (Monday to Friday) and weekend (Saturday and Sunday) calculated diurnal price pattern (Li and Flynn, 2004a) and incremental revenue from energy storage as a function of the daily hours of generation (Figueiredo et al., 2005) in one market, Alberta, Canada. Incremental revenue is the value of power sold minus the value of power purchased and does not include other operating costs such as labor and maintenance (endogenous) and transmission and dispatch charges (exogenous). In Figure 3-1, the incremental revenue is based on an assumed efficiency of 80%: in the first hour of generation revenue is based on buying 1.25 hours of power in the lowest diurnal price period and selling one hour of power in the highest price period. This process proceeds stepwise to the remaining highest/lowest price periods until the incremental revenue is negative. From Figure 3-1 it is clear that operating

pumped storage in Alberta for more than eight hours per day would create a negative incremental revenue.

In this paper we take one of the 14 markets, Alberta, which showed the highest incentive for energy storage from the first study, and perform a detailed analysis of the configuration of pumped storage for two specific sites. Once a site is identified the key design decision in pumped storage is the sizing of the pump/generator, which sets the rate at which the stored energy can be recovered (MW) relative to the size of the reservoir, which sets the daily energy quantity that can be stored (MWh). In a first stage analysis we assume that the pumped storage facility will operate for the period of time that positive incremental revenue is generated and determine capital and operating cost and return on investment. In a second stage analysis we vary the capacity of the pump/generator and related equipment (e.g. penstocks, switchyard) relative to the reservoir and again determine capital and operating costs and return on investment. In this second stage a model is developed to vary the capital costs by the application of scale factors specific to the equipment type. The objective of the second stage analysis is to configure generation capacity relative to reservoir capacity and optimize the operating hours per day. Although the examples are specific to one market and one form of energy storage, the approach is generalizable and can be applied to the design of any storage system that is intended to time shift the value of power in a deregulated market.

This study utilizes historical average diurnal power price patterns to optimize the configuration of a pumped storage facility. In applying the methodology to a prospective pumped storage facility, one element that would need to be added is the extent to which historical price patterns are a valid predictor of future price patterns, and specifically the impact of the pumped storage facility itself on future diurnal price patterns, discussed below.

All costs in this study are expressed in 2004 US dollars; where required, costs in Canadian dollars were converted to US dollars at the conversion rate of October 7th, 2004, 1.26 CA\$ = 1 US\$ (Oanda.com, 2004).

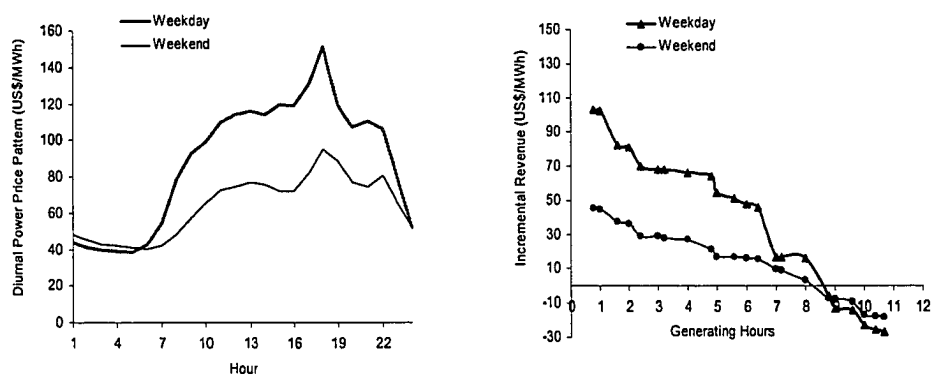


Figure 3 -1. Diurnal power price pattern and incremental revenue (power sale minus power cost) from energy storage for Alberta (efficiency 80%).

3.2 First Stage Analysis of Two Pumped Storage Cases

In this study we assume an efficiency of 80%, typical of recent designs (Bogenrieder and Groschke, 2000; Hauff, 2003; Hazzenzahl and

Donalek, 2005). Pumped storage typically uses a single component, e.g. a Francis turbine, for both pumping and generating, and can operate at a charge to discharge ratio (pump power divided by generator power) of 0.9 to 1.2. In this study we assume a charge to discharge ratio of 1.0, a common operating point (ASCE, 1989), which means that pumping hours exceed generating hours by $(\text{efficiency})^{-1}$. Endogenous operating costs are treated as independent of the amount of power generated (for example, labor cost is independent of daily generation hours). Exogenous operating costs in Alberta include a location specific interconnection charge levied by the system operator that combines transmission and dispatch fees and is based on transmission losses. Figures used in this study are based on current practice in Alberta, which assesses an interconnection fee on both generation and consumption. Alberta will change its method of recovering interconnection charges to recover them from consumers only, starting in 2006; the impact of this change on pumped storage, which both consumes and generates power, is not significant. We also provide an allowance for a payment to the Province of Alberta for use of water (in effect, a royalty payment that is now levied on all hydro power in the Province) although whether such a fee would be levied on pumped storage that recycles water is unclear.

As a starting point for analyzing two specific pumped storage cases, we assume a daily operating duration of 8.0 hours of generation based on Figure 3-1, supported by 10 hours of pumping. Two potential

projects are analyzed. The Kneehills project is located on the prairie northeast of the city of Calgary (see Figure 3-2). An upper reservoir of 450 ha is located on the prairie and is centered on an existing shallow lake that is surrounded by an earthen berm of 2 to 12 m height. A lower reservoir of 360 ha is built by damming Kneehills Creek, located in a coulee. The project is a medium head design with an average net elevation change of 90 m. Design data for the Kneehills project are taken from a 1979 study for Calgary Power (now Transalta Corporation) by the engineering firm Monenco (now AMEC). Costs that vary directly with power dispatched, mainly system interconnection charges, for the Kneehills location are relatively high at \$13 per MWh, because the site feeds energy into the grid at a point of high transmission congestion.

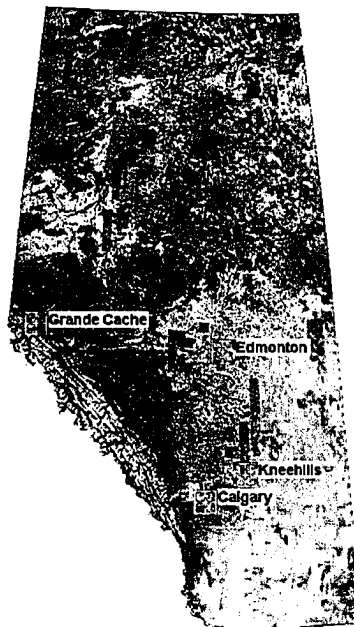


Figure 3-2. Map of Alberta showing, major urban centers, and the location of two potential pumped storage projects.

The Grande Cache project is located in the mountains of Alberta, and specifically uses existing abandoned pits from a surface anthracite coal mine. Additional excavation and construction of an earthen berm is employed to increase the storage capacity of both the upper and lower reservoirs. The upper reservoir has an area of 5 ha; the lower reservoir has an area of 8 ha. Based on a geotechnical assessment, a provision for grouting of the lower reservoir to prevent water seepage is included. The project is a high head design with an average net elevation change of 380 m. Design data for the Grande Cache project are taken from a 2003 study performed by one of the authors (Figueiredo) for Epcor. Costs that vary directly with power dispatched, again mainly system interconnection charges, for Grande Cache are \$ 1.12 per MWh; the site relieves transmission congestion. The daily cycling of the reservoir uses 94% of the Grande Cache reservoir capacity, with the remaining 6% being operating reserve; the comparable figure for Kneehills is 85%, with the difference being the higher relative impact of ice formation on a shallower reservoir. Table 3-1 summarizes the key design data for each project.

Table 3-1. Design parameters for two potential pumped storage projects

Item	Kneehills		Grande Cache	
	Qty	Description		
Combined Turbine/Pump Generator/Motor	2	194 MW, Francis Total Nominal Capacity 388 MW	218 MW, Francis Total Nominal Capacity 436 MW	
Generator Step-up Transformer	2	240 kV	240 kV	
Transmission Line	1	240 kV, 100 km long	240 kV, 8 km long, overhead	
Penstock	2	6.9 m dia. x 250 m long (3/4" max. wall thick.)	4.2 m dia. x 3.2 km long (2 3/4" max. wall thick.)	
Head (Static)		90 m	380 m	
Flow per Pipe	2	247 m ³ /s (generator) 198 m ³ /s (pump)	66 m ³ /s (generator) 53 m ³ /s (pump)	
Upper Reservoir	1	16,700,000 m ³ (450 ha), water tight slough	4,020,000 m ³ (5 ha) coal pit mine	
Lower Reservoir	1	(360 ha), dammed river	4,980,000 m ³ (8 ha) coal pit mine	

Complete detailed capital cost estimates were prepared for each project, broken down by major components; estimates were reviewed with two engineering firms, AMEC and Knight Piesold. Table 3-2 summarizes the key capital cost data for each project. Note that the relative percentage of investment in reservoir vs. penstock varies between the two projects because of the significant difference in elevation difference and relative distance between the two reservoirs. Total capital costs per KW are \$ 583 for Kneehills and \$517 per KW for Grande Cache; these are comparable to the \$700 per KW installed cost reported for the recently commissioned Goldisthal 1060 MW facility in Germany (Hazzenzahl and Donalek, 2005). Operating cost estimates were also developed, and are summarized in Table 3-3.

Table 3-2. Capital costs for two potential pumped storage projects (work prepared for Epcor by author with review by AMEC and Knight Piesold)

Item	Kneehills		Grande Cache	
	Capital Cost US\$(Million)	%	Capital Cost US\$(Million)	%
Land and Access	4.56	2.0	2.23	1.0
Upper and Lower Reservoir	67.44	29.8	42.22	18.7
Penstocks	4.76	2.1	56.44	25.0
Powerhouse Structure	9.52	4.2	9.52	4.2
Power Plant Machinery	58.73	26.0	62.54	27.7
Interconnection & Transmission Line	21.43	9.5	2.46	1.1
Contingencies	41.27	18.3	34.20	15.2
Investigation and Engineering	7.92	3.5	5.28	2.3
Administration	10.39	4.6	10.48	4.7
TOTAL	226.02	100%	225.37	100%
\$/KW Installed	583		517	

The net revenue from power (sale from generation minus purchase for pumping), the capital and operating costs and interconnection charges are then used to calculate a pre-tax return on investment, blending five week days with two weekend days and an annual availability factor of 97%. The return for Kneehills is 13.5%, and for Grande Cache is 20.7%. Two significant differences are the higher interconnection fee for Kneehills, which causes a 5.1% lower rate of return, and the higher capital cost per unit of capacity, which causes a 2.1% lower return.

Table 3-3. Operating costs for the two potential pumped storage projects (work prepared for Epcor by author)

Operational & Maintenance Costs		US\$(000)
1	Insurance	790
2	Operation	320
3	Maintenance (material and labour) (1% capital cost per year)	2,260
4	General Expenses	1,900
5	Contingencies	530
Total Annual Operational Cost		5,800

3.3 Second Stage Analysis of Two Pumped Storage Cases

The first stage analysis of pumped storage assumes that the reservoir and pump/generator are sized to allow operation for the maximum period of time for which positive net revenue can be realized from energy storage, which from Figure 3-1 is eight hours for Alberta. However, the diurnal power pattern can be used to optimize the relative size of the pump/generator and related equipment (e.g. penstock and switchyard) relative to the reservoir. For example, if the generator capacity is increased by 33%, then the reservoir could be drained in six hours rather than eight hours, and filled in 7.5 hours rather than 10 hours. In effect, power that would have been sold in hours seven and eight is now being sold in hours one to six, when the incremental revenue (Figure 3-1) is higher. The question then is whether the higher investment in the larger pump/generator is justified by the higher revenue. Clearly this is dependent on the diurnal price pattern, which is specific to each market; a perfectly flat incremental revenue curve would create no incentive for

higher investment in generation capacity for a fixed reservoir size, while a steeply dropping curve would create a high incentive. It is also specific to a project, since investment costs, for example in penstock, are impacted by the specific layout of the project and net revenue is also reduced by site specific interconnection charges.

This effect is particularly evident in the case of Kneehills. In the eighth hour of operation of pumped storage in Alberta, the incremental revenue for weekday excluding operating costs is \$16.00 per MWh. The interconnection charge for Kneehills, as noted above, is \$13 per MWh, and hence the revenue available to the operator for this hour after payment of system charges is only \$3.00 per MWh. A larger pump/generator can shift this power to a period of significantly higher incremental revenue, creating a large relative benefit compared to the minimal reward for the sale of power in hour eight. Grande Cache has a lower interconnection fee, and hence generation in hour eight is worth almost \$15; the relative reward for shifting power from this period is lower than for Kneehills. The specific project revenue pattern, which is set by the diurnal price pattern, the efficiency of energy storage and the site specific system operator charges for transmission and dispatch, will determine the optimum hours of operation per day for energy storage.

To optimize the configuration of pumped storage we take a given reservoir capacity and calculate the investment required and the revenue generated from operating the facility from one hour up to the maximum

period of positive incremental revenue; shorter operation periods require a larger capacity generator. We then calculate the return on investment. We adjust the capital cost of specific components of pumped storage using scale factors appropriate to each type of equipment. Table 3-4 shows the scale factors used in our model; values for the powerhouse structure and administration are judgmental but do not have a significant impact on the assessment because of the low relative cost of these two items.

Table 3-4. Scale factors used to adjust base case capital cost of pump/generator and related investment

Item	Scale Factor
Penstocks (Peurifoy & Oberlender, 2002)	0.600
Powerhouse Structure	0.300
Power Plant Machinery (up to 1,000 MW) (Crichton, 2005)	0.700
Power Plant Machinery (more than 1,000 MW) (Crichton, 2005)	0.789
Administration	0.200

Figures 3-3 and 3-4 show the results of this analysis for the two specific pumped storage facilities, and illustrate the importance of the analysis. The Kneehills facility is optimized by operating at five hours per day at a capacity of 620 MW; reducing the operating period from eight to five hours per day shifts the return on investment from 13.5 to 16.0%. In the same deregulated power market the Grande Cache facility is

optimized by operating at six hour per day at a capacity of 580 MW, which shifts the return on investment from 20.7 to 21.9%. The key factor that leads to the longer optimal operating time in Grande Cache is the impact of the lower interconnection charge relative to Kneehills.

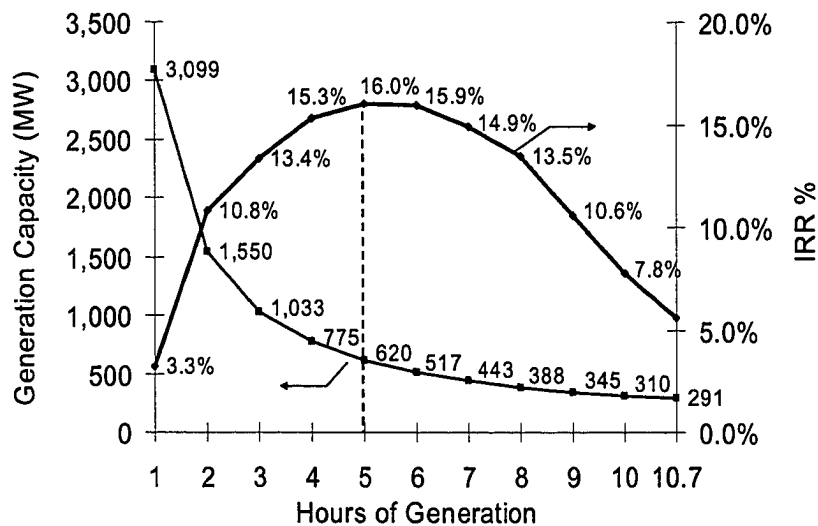


Figure 3-3. Kneehills generation capacity and pre-tax return on capital as a function of daily hours of generation.

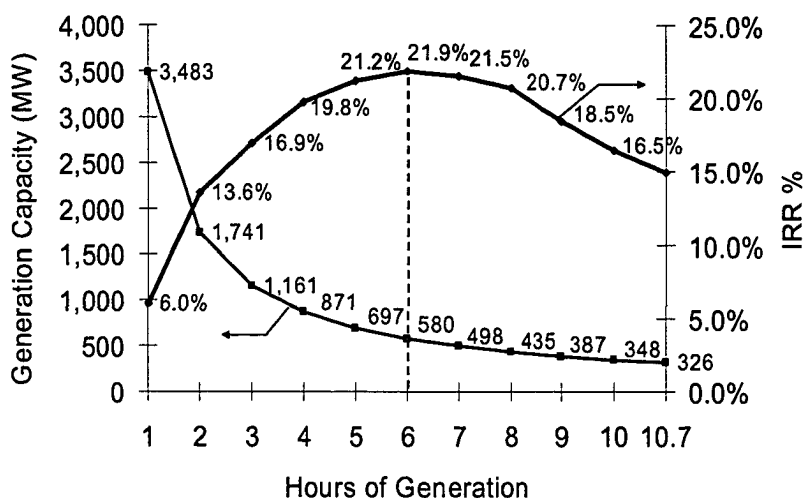


Figure 3-4. Grande Cache generation capacity and pre-tax return on capital as a function of daily hours of generation.

3.4 Discussion

Deregulated power markets have unique profiles of power price that reflect a number of factors, including the generation mix in each market, the number and nature of players, the design of the market and the effectiveness of market surveillance processes. Power price patterns and volatility differ significantly between markets (Li and Flynn, 2004b). Energy storage, in effect time shifting the usage of power, has the potential to stabilize or moderate price peaks in deregulated power markets.

Projected diurnal price patterns are the key determinant of whether energy storage is economic; in addition, the patterns play a key role in

setting the detailed configuration of an energy storage project. This paper illustrates how diurnal price patterns from a specific market can be integrated with location specific transmission and dispatch charges and project specific efficiency and cost factors to optimize the configuration of an energy storage project. The examples used are for pumped storage, where a critical design decision is the capacity of generation relative to the size of reservoir: a larger capacity pump/generator enables a given reservoir to be drained more quickly, but increases the overall capital cost of the project. Detailed analysis confirms that the optimum operating period is different for each of the two cases we analyzed, and that the optimum time of daily operation is significantly less than the time for which overall energy storage has a positive incremental revenue. Critical factors in shifting the optimum operating time of energy storage are the level of interconnection charges relative to incremental revenue and the shape of the curve of incremental revenue from energy storage, Figure 3-1. Incremental revenue from time shifting of energy is in turn determined by the diurnal power price pattern and the efficiency of the energy storage system (Figueiredo et al., 2005).

Analysis of a real energy storage project would require consideration of additional factors to the analysis presented in this study. First, an operator of energy storage would have the option of selling ancillary services such as reactive power and reserve generation capacity, as an alternative to the sale of energy. Bidding rules for ancillary services

vary widely between deregulated markets, and in some markets the design of the bidding process virtually precludes short term shifting between ancillary services and energy sale. For example, in Alberta ancillary services are purchased by the system operator on a day ahead basis while energy is sold on an hour by hour basis. Other markets sell most of the energy through a binding day ahead market. Hence, factoring in ancillary services will require a market specific analysis and is not generalizable across all deregulated power markets. Second, the construction of an energy storage facility can itself have some impact on diurnal power prices, since the demand for power in off peak periods increases as does the supply in on peak periods. If the capacity of an energy storage facility is significant relative to total power demand in a market, the historical average diurnal power price pattern would need to be adjusted to forecast the impact of the storage project; one approach would be to utilize the estimated variable cost of generation of each source in a market to predict a new diurnal price pattern. Third, historical diurnal power price patterns may include events that are not likely to reoccur in the future, and that therefore should be filtered out of historical prices. Examples might include an unusual drought in New Zealand or the California power crisis, although there is some uncertainty about the timeliness of investment in generation and whether "boom and bust" pricing patterns will emerge in deregulated power markets. All of these factors emphasize the need to adjust historical diurnal power price

patterns to a forecast price pattern in analyzing an investment in energy storage.

3.5 Conclusions

In a deregulated power market the storage of electrical power for resale at a different period can be analyzed based on an expected diurnal price pattern. By using historical diurnal price patterns, two pumped storage projects in Alberta are analyzed. For an efficiency of storage of 80%, the purchase of power for 10 hours per day and its resale in eight hours per day generates a positive incremental revenue.

By increasing the size of the pump/generator and related equipment relative to the size of the reservoir, the instantaneous capacity of the facilities (MW) is increased while the daily capacity (MWh) is held constant. The diurnal price pattern can be combined with the efficiency and the variable exogenous operating costs, i.e. transmission and dispatch charges levied per MWh, to calculate the optimum configuration of pumped storage and set the optimum operating hours per day. Analysis of the two projects in Alberta shows a different optimum operating period, five hours per day for the Kneehills project and six hours per day for the Grande Cache project; the difference arises from the impact of a higher charge to Kneehills for transmission and dispatch.

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Chapter 4

4 Conclusions and Recommendations for Future Research.

4.1 Conclusions

Historical diurnal patterns of power price in deregulated markets can be used to provide an initial forecast of expected revenue from pumped storage by calculating the difference between the value of sold power and the cost of power purchased to recharge the reservoir. Each of the 14 markets in this study has a unique profile of incremental revenue per generating hour from pumped storage, and a point above which incremental generation costs more than it returns. Diurnal price patterns can be used to develop an operating pattern for energy storage, based on selling power in the highest priced blocks and purchasing it in the lowest priced blocks. Completion of this analysis allows a comparison of the expected revenue from energy storage in each of the 14 markets. There is a wide variation in expected net power revenue, with Alberta the highest at \$395 US per day per installed MW, and Scandinavia the lowest, with essentially zero revenue from pumped storage.

The 14 deregulated markets were analysed by two methods to estimate whether there is adequate return on investment for investing in energy storage. The first method defines a theoretical minimum level of investment in pumped storage, i.e. a theoretical project in which all factors

align to minimize net capital cost. A maximum possible pre-tax return on investment from pumped storage is calculated for each of the 14 markets. Based on this analysis, it is clear that pumped storage will not pass a minimum test of adequate return, say 10% on capital deployed, in 6 of the 14 markets in this study.

The second method is to determine the largest amount of investment per unit of power output that can be justified in each market to earn a pre-tax return on capital of 10%. Alberta's historical diurnal price pattern would justify an investment of US \$1,190 per KW, while New England, Spain, Australia Victoria, New Zealand Benmore, Australia New South Wales, Germany Leipzig Exchange and Scandinavia would not justify an investment in excess of US \$300 per KW. Hence, Alberta and the Netherlands have some potential for adequate return on investment in pumped storage, but for the majority of markets in this study the diurnal price pattern does not justify the investment that practically would be required. This suggests that development of pumped storage projects in deregulated markets will be highly selective and related to historical diurnal price patterns.

In addition, this study illustrates how diurnal price patterns from a specific market can be integrated with location specific transmission and dispatch charges and project specific efficiency and cost factors to optimize the configuration of an energy storage project. As a model two pumped storage projects in Alberta are analyzed. For an efficiency of

storage of 80%, the purchase of power for 10 hours per day and its resale in eight hours per day generates positive incremental revenue. By increasing the size of the pump/generator and related equipment relative to the size of the reservoir, the instantaneous capacity of the facilities (MW) is increased while the daily capacity (MWh) is held constant. The diurnal price pattern can be combined with the efficiency and the variable exogenous operating costs, i.e. transmission and dispatch charges levied per MWh, to calculate the optimum configuration of pumped storage and set the optimum operating hours per day. This analysis confirms that the optimum operating period is different for each of the two cases we analyzed. Two Alberta cases show a different optimum operating period, five hours per day for the Kneehills project and six hours per day for the Grande Cache project; the difference arises from the impact of a higher charge to Kneehills for transmission and dispatch.

4.2 Recommendations for Future Research

The results of this study suggest that pumped storage is far more likely to be developed in some deregulated markets than in others. Application of the analysis in this study to an actual project would require an assessment of:

- The estimated impact of the pumped storage facility on future diurnal price patterns (i.e. would the pumped storage facility result in significant changes in price patterns in the deregulated market?).

- The variable cost of generation, e.g. transmission, dispatch, access or administration charges that would reduce net revenue.
- The opportunity for alternate sources of revenue, for example from ancillary services.

Based on these three points mentioned above the following are suggested as possible areas for future work:

- This study did not attempt to factor in the value of ancillary services. Two primary reasons for not considering the value of ancillary services in comparing the incentive for energy storage in deregulated markets are the difficulty in accessing price data and the different rules, between markets, that affect whether ancillary services and energy can each be bid. An example of the latter effect is seen in Alberta, where ancillary services are purchased by the system operator on a day ahead basis while energy is purchased on an hour by hour basis, with an indicative only day ahead bid. Thus, in Alberta the sale of ancillary services on a given day would preclude bidding the energy from a pumped storage facility on that day regardless of how high the price of energy rose. However, on an individual market basis ancillary price data could be collected in order to compare whether sale of ancillary services during some periods would increase the net revenue from pumped storage.

- The prediction of the impact of energy storage on power price can be done through an analysis of the likely variable cost of generation for each generator in a given market. Economists often assume that markets will migrate to a point where the highest cost supplier being dispatched at any point in time has bid power in at the variable cost of producing power. The accuracy of this assumption could be tested within a given market, and if found to be accurate for most of the time, could serve as a basis for calculating the increase in off peak pricing due to the incremental demand from pumped storage and the decrease in on peak pricing due to the displacement of high cost generation when pumped storage is delivering energy to the grid.

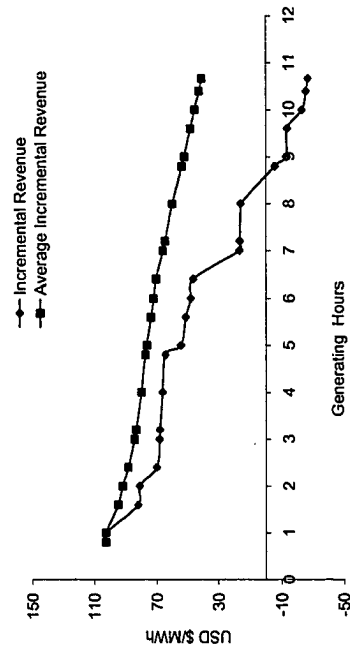
Appendices

Appendix A. Revenue Calculation Model

A model was developed for each of the 14 deregulated power markets using average diurnal power prices as input data to calculate the predicted incremental revenue, average incremental revenue and operating plan (hours of pumping and generating) for weekday and weekend for an energy storage unit at a specified efficiency. The following spreadsheets are calculated for each market and based on an energy storage efficiency of 80%.

1-Canada: Alberta Weekday

USD/MWh	Efficiency B	0.80 S	B	S	Pump	Gen	Total	paid	DiffPaid	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	43.77	1	0.80	1.25	1	1.00	0.80	0.00	38.71	151.28	36.71	121.03	82.31
2	41.19	2	1.60	2.50	2	1.25	1.00	2.25	38.79	151.28	9.70	30.26	102.87
3	39.63	3	2.40	3.75	3	2.00	1.60	3.60	38.79	130.76	29.09	78.46	152.24
4	38.79	4	3.20	5.00	4	2.50	2.00	4.50	39.63	130.76	19.82	52.30	184.72
5	38.71	5	4.00	6.25	5	3.00	2.40	5.40	39.63	119.59	19.82	47.84	212.74
6	42.63	6	4.80	7.50	6	3.75	3.00	6.75	41.19	119.59	30.90	71.75	253.60
7	54.44	7	5.60	8.75	7	4.00	3.20	7.20	41.19	119.47	10.30	23.89	267.20
8	78.05	8	6.40	10.00	8	5.00	4.00	9.00	42.63	119.47	42.63	95.58	320.15
9	93.02	9	7.20	11.25	9	5.00	4.00	9.00	42.63	119.47	0.00	0.00	320.15
10	98.85	10	8.00	12.50	10	6.00	4.80	10.80	43.77	119.03	43.77	95.23	371.60
11	110.04	11	8.80	13.75	11	6.25	5.00	11.25	51.80	119.03	12.95	23.81	382.46
12	114.37	12	9.60	15.00	12	7.00	5.60	12.60	51.80	115.97	38.85	69.58	413.19
13	115.97	13	10.40	16.25	13	7.50	6.00	13.50	54.44	115.97	27.22	46.39	432.36
14	114.15	14	11.20	17.50	14	8.00	6.40	14.40	54.44	114.37	27.22	45.75	450.89
15	119.47	15	12.00	18.75	15	8.75	7.00	15.75	78.05	114.37	58.53	68.62	450.89
16	119.03	16	12.80	20.00	16	9.00	7.20	16.20	78.05	114.15	19.51	22.83	464.30
17	130.76	17	13.60	21.25	17	10.00	8.00	18.00	78.52	114.15	78.52	91.32	477.40
18	151.28	18	14.40	22.50	18	10.00	8.00	18.00	78.52	114.15	0.00	0.00	477.40
19	119.59	19	15.20	23.75	19	11.00	8.80	19.80	93.02	110.58	93.02	88.46	472.55
20	107.43	20	16.00	25.00	20	11.25	9.00	20.25	98.85	110.58	24.71	22.12	469.95
21	110.58	21	16.80	26.25	21	12.00	9.60	21.60	98.85	110.04	74.14	66.02	461.84
22	106.43	22	17.60	27.50	22	12.50	10.00	22.50	106.43	110.04	53.21	44.01	452.64
23	78.52	23	18.40	28.75	23	13.00	10.40	23.40	106.43	107.43	53.21	42.97	442.40
24	51.80	24	19.20	30.00	24	13.33	10.67	24.00	107.43	107.43	55.81	28.65	435.23

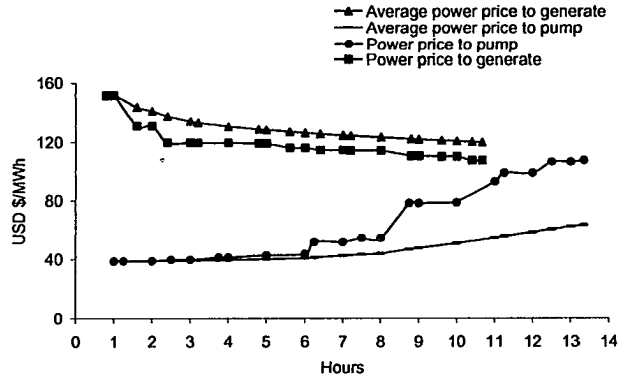


1-Canada: Alberta Weekday

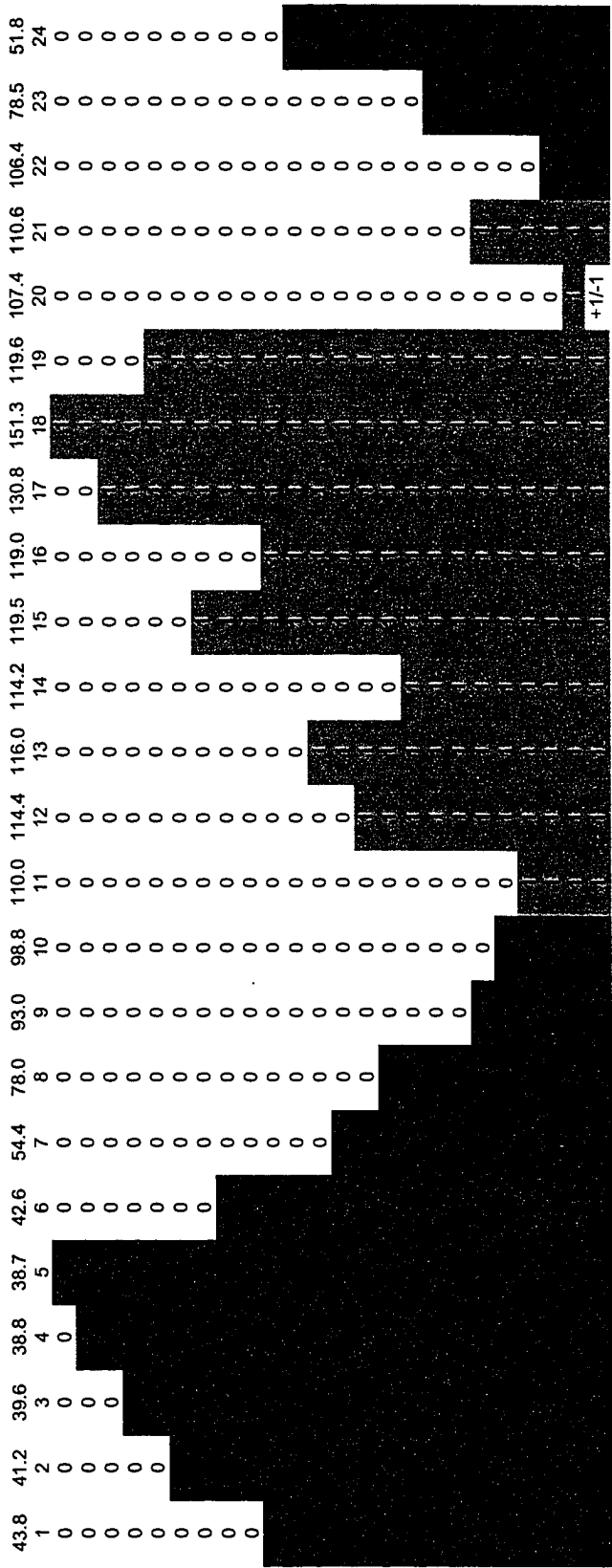
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	102.89	102.89
1.00	102.80	102.87
1.60	82.28	95.15
2.00	81.22	92.36
2.40	70.05	88.64
3.00	68.10	84.53
3.20	67.98	83.50
4.00	66.19	80.04
4.00	66.19	80.04
4.80	64.32	77.42
5.00	54.28	76.49
5.60	51.22	73.78
6.00	47.92	72.06
6.40	46.32	70.45
7.00	16.82	65.85
7.20	16.59	64.49
8.00	16.00	59.64
8.00	16.00	59.64
8.80	-5.69	53.70
9.00	-12.98	52.22
9.60	-13.52	48.11
10.00	-23.00	45.26
10.40	-25.60	42.54
10.67	-26.86	40.80

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	38.71	151.28
1.25	1.00	38.79	151.28
2.00	1.60	38.79	130.76
2.50	2.00	39.63	130.76
3.00	2.40	39.63	119.59
3.75	3.00	41.19	119.59
4.00	3.20	41.19	119.47
5.00	4.00	42.63	119.47
5.00	4.00	42.63	119.47
6.00	4.80	43.77	119.03
6.25	5.00	51.80	119.03
7.00	5.60	51.80	115.97
7.50	6.00	54.44	115.97
8.00	6.40	54.44	114.37
8.75	7.00	78.05	114.37
9.00	7.20	78.05	114.15
10.00	8.00	78.52	114.15
10.00	8.00	78.52	114.15
11.00	8.80	93.02	110.58
11.25	9.00	98.85	110.58
12.00	9.60	98.85	110.04
12.50	10.00	106.43	110.04
13.00	10.40	106.43	107.43
13.33	10.67	107.43	107.43

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	38.71	151.28
1.25	1.00	38.73	151.28
2.00	1.60	38.75	143.59
2.50	2.00	38.93	141.02
3.00	2.40	39.04	137.45
3.75	3.00	39.47	133.88
4.00	3.20	39.58	132.98
5.00	4.00	40.19	130.28
5.00	4.00	40.19	130.28
6.00	4.80	40.79	128.40
6.25	5.00	41.23	128.03
7.00	5.60	42.36	126.74
7.50	6.00	43.17	126.02
8.00	6.40	43.87	125.29
8.75	7.00	46.80	124.36
9.00	7.20	47.67	124.07
10.00	8.00	50.75	123.08
10.00	8.00	50.75	123.08
11.00	8.80	54.60	121.94
11.25	9.00	55.58	121.69
12.00	9.60	58.28	120.96
12.50	10.00	60.21	120.53
13.00	10.40	61.99	120.02
13.33	10.67	63.12	119.71



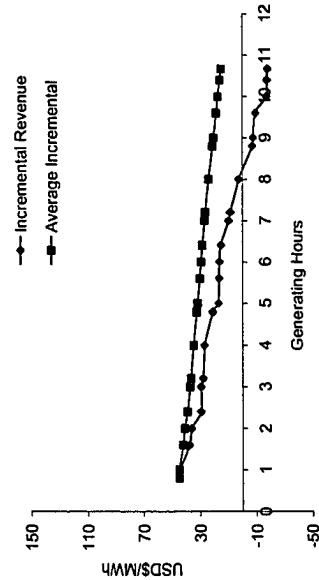
1-Canada: Alberta Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

1-Canada: Alberta Weekend

	USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	sold	DiIPaid	DiSold	Profit	Average Incremental Revenue	Cumulative Revenue
1	48.45	1	0.80	1.25	1	1.00	0.80	0.00	40.30	95.51	40.30	76.41	36.11	45.14	36.11
2	44.95	2	1.60	2.50	2	1.25	1.00	2.25	40.61	95.51	10.15	19.10	8.95	44.74	45.06
3	42.79	3	2.40	3.75	3	2.00	1.60	3.60	40.61	88.41	30.46	53.05	22.59	37.65	42.28
4	41.89	4	3.20	5.00	4	2.50	2.00	4.50	41.89	88.41	20.95	35.36	14.42	36.04	41.03
5	40.61	5	4.00	6.25	5	3.00	2.40	5.40	41.89	81.76	20.95	32.71	11.76	29.40	39.09
6	40.30	6	4.80	7.50	6	3.75	3.00	6.75	42.00	81.76	31.50	16.08	17.56	29.27	37.13
7	42.00	7	5.60	8.75	7	4.00	3.20	7.20	42.00	80.41	10.50	16.08	5.58	27.91	36.55
8	48.22	8	6.40	10.00	8	5.00	4.00	9.00	42.79	80.41	42.79	64.33	21.54	26.92	34.63
9	57.44	9	7.20	11.25	9	5.00	4.00	9.00	42.79	80.41	0.00	0.00	0.00	26.92	34.63
10	65.10	10	8.00	12.50	10	6.00	4.80	10.80	44.95	77.22	44.95	61.78	16.82	21.03	32.36
11	72.69	11	8.80	13.75	11	6.25	5.00	11.25	48.22	77.22	12.06	15.44	3.39	16.94	31.74
12	74.67	12	9.60	15.00	12	7.00	5.60	12.60	48.22	76.78	36.17	46.07	9.90	16.50	30.11
13	76.78	13	10.40	16.25	13	7.50	6.00	13.50	48.45	76.78	24.22	30.71	6.49	16.22	29.18
14	75.72	14	11.20	17.50	14	8.00	6.40	14.40	48.45	75.72	24.22	30.29	6.07	15.16	28.31
15	71.83	15	12.00	18.75	15	8.75	7.00	15.75	52.79	75.72	39.59	45.43	5.84	9.73	26.72
16	72.21	16	12.80	20.00	16	9.00	7.20	16.20	52.79	74.67	13.20	14.93	1.74	8.68	25.21
17	81.76	17	13.60	21.25	17	10.00	8.00	18.00	57.44	74.67	57.44	59.74	2.29	2.87	23.88
18	95.51	18	14.40	22.50	18	10.00	8.00	18.00	57.44	74.67	0.00	0.00	0.00	2.87	23.88
19	88.41	19	15.20	23.75	19	11.00	8.80	19.80	65.10	74.39	65.10	59.51	-5.58	-6.98	21.07
20	77.22	20	16.00	25.00	20	11.25	9.00	20.25	65.62	74.39	16.40	14.88	-1.53	-7.63	20.44
21	74.39	21	16.80	26.25	21	12.00	9.60	21.60	65.62	72.69	49.21	43.61	-5.60	-9.34	18.58
22	80.41	22	17.60	27.50	22	12.50	10.00	22.50	71.83	72.69	35.92	29.07	-6.84	-17.10	17.15
23	65.62	23	18.40	28.75	23	13.00	10.40	23.40	71.83	72.21	35.92	28.88	-7.03	-17.58	15.81
24	52.79	24	19.20	30.00	24	13.33	10.67	24.00	72.21	72.21	24.07	19.26	-4.81	-18.05	14.97



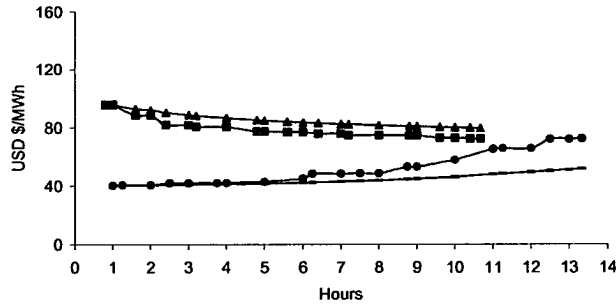
1-Canada: Alberta Weekend

Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	45.14	45.14
1.00	44.74	45.06
1.60	37.65	42.28
2.00	36.04	41.03
2.40	29.40	39.09
3.00	29.27	37.13
3.20	27.91	36.55
4.00	26.92	34.63
4.00	26.92	34.63
4.80	21.03	32.36
5.00	16.94	31.74
5.60	16.50	30.11
6.00	16.22	29.18
6.40	15.16	28.31
7.00	9.73	26.72
7.20	8.68	26.21
8.00	2.87	23.88
8.00	2.87	23.88
8.80	-6.98	21.07
9.00	-7.63	20.44
9.60	-9.34	18.58
10.00	-17.10	17.15
10.40	-17.58	15.81
10.67	-18.05	14.97

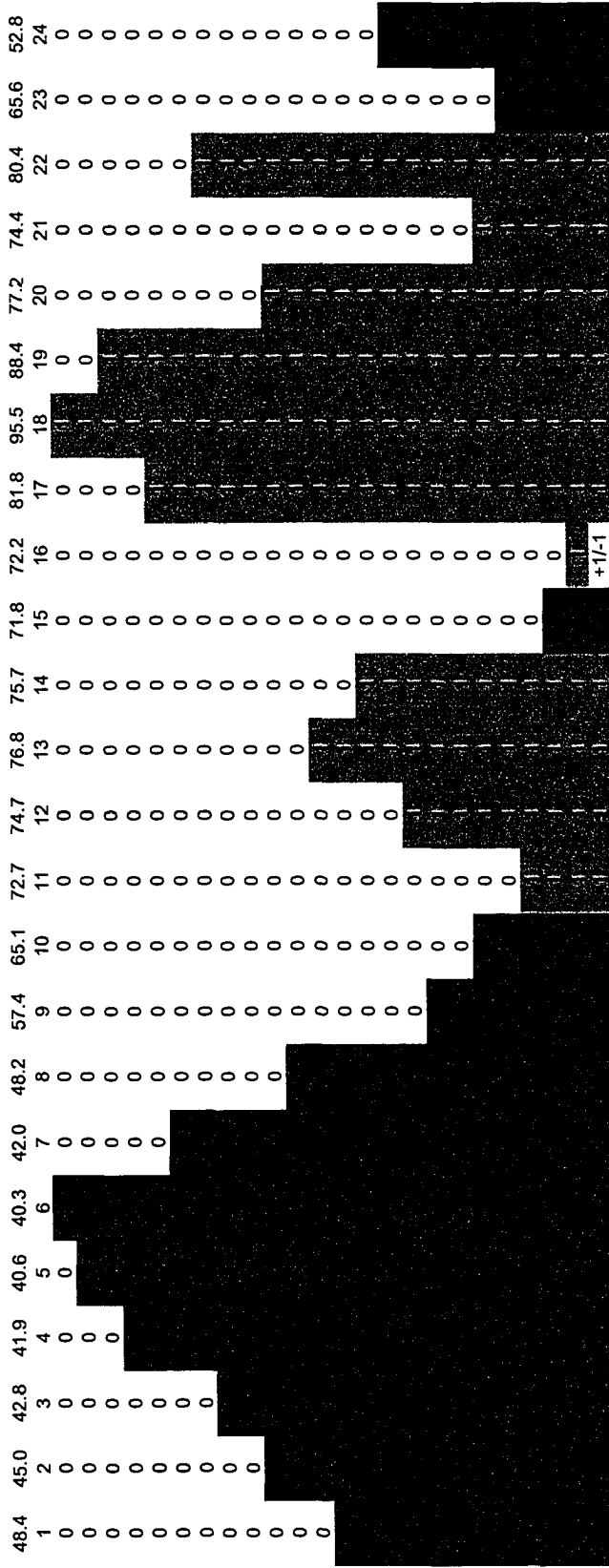
Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	40.30	95.51
1.25	1.00	40.61	95.51
2.00	1.60	40.61	88.41
2.50	2.00	41.89	88.41
3.00	2.40	41.89	81.76
3.75	3.00	42.00	81.76
4.00	3.20	42.00	80.41
5.00	4.00	42.79	80.41
5.00	4.00	42.79	80.41
6.00	4.80	44.95	77.22
6.25	5.00	48.22	77.22
7.00	5.60	48.22	76.78
7.50	6.00	48.45	76.78
8.00	6.40	48.45	75.72
8.75	7.00	52.79	75.72
9.00	7.20	52.79	74.67
10.00	8.00	57.44	74.67
10.00	8.00	57.44	74.67
11.00	8.80	65.10	74.39
11.25	9.00	65.62	74.39
12.00	9.60	65.62	72.69
12.50	10.00	71.83	72.69
13.00	10.40	71.83	72.21
13.33	10.67	72.21	72.21

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	40.30	95.51
1.25	1.00	40.36	95.51
2.00	1.60	40.45	92.85
2.50	2.00	40.74	91.96
3.00	2.40	40.93	90.26
3.75	3.00	41.15	88.56
4.00	3.20	41.20	88.05
5.00	4.00	41.52	86.52
5.00	4.00	41.52	86.52
6.00	4.80	42.09	84.97
6.25	5.00	42.33	84.66
7.00	5.60	42.97	83.82
7.50	6.00	43.33	83.35
8.00	6.40	43.65	82.87
8.75	7.00	44.43	82.26
9.00	7.20	44.67	82.05
10.00	8.00	45.94	81.31
10.00	8.00	45.94	81.31
11.00	8.80	47.68	80.68
11.25	9.00	48.08	80.54
12.00	9.60	49.18	80.05
12.50	10.00	50.09	79.76
13.00	10.40	50.92	79.47
13.33	10.67	51.45	79.28

- ▲ Average power price to generate
- Average power price to pump
- Power price to pump
- Power price to generate



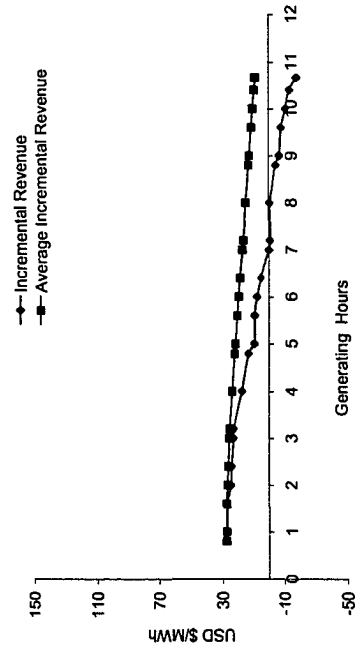
1-Canada: Alberta Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

2-USA: Northern California Weekday

USD/MWh	Efficiency	0.80	S	B	S	Pump	Gen	Total	paid	solid	DiPaid	DiSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	51.00	1	0.80	1.25	1	1.00	0.80	0.00	43.65	82.28	43.65	65.82	22.17	27.71	27.71	22.17
2	46.75	2	1.60	2.50	2	1.25	1.00	1.80	43.92	82.28	10.98	16.46	5.47	27.37	27.65	27.65
3	43.65	3	2.40	3.75	3	2.00	1.60	3.60	43.92	81.95	32.94	49.17	16.23	27.05	27.42	43.88
4	43.92	4	3.20	5.00	4	2.50	2.00	4.50	45.81	81.95	22.90	32.78	9.88	24.69	26.88	53.75
5	45.81	5	4.00	6.25	5	3.00	2.40	5.40	45.81	81.53	22.90	32.61	9.71	24.28	26.44	63.46
6	53.08	6	4.80	7.50	6	3.75	3.00	6.75	46.75	81.53	35.08	48.92	13.86	23.09	25.77	77.32
7	56.06	7	5.60	8.75	7	4.00	3.20	7.20	46.75	81.31	11.69	16.26	4.57	22.87	25.59	81.89
8	61.43	8	6.40	10.00	8	5.00	4.00	9.00	51.00	81.31	51.00	65.05	14.04	17.55	23.98	95.94
9	63.73	9	7.20	11.25	9	5.00	4.00	9.00	51.00	81.31	0.00	0.00	0.00	17.55	23.98	95.94
10	67.84	10	8.00	12.50	10	6.00	4.80	10.80	53.08	79.71	53.08	63.77	10.69	13.36	22.21	106.63
11	71.33	11	8.80	13.75	11	6.25	5.00	11.25	56.06	79.71	14.01	15.84	1.93	9.64	21.71	108.55
12	73.90	12	9.60	15.00	12	7.00	5.60	12.60	56.06	79.47	42.04	47.68	5.64	9.40	20.39	114.20
13	76.08	13	10.40	16.25	13	7.50	6.00	13.50	57.22	79.47	28.61	31.79	3.18	7.95	19.56	117.38
14	79.47	14	11.20	17.50	14	8.00	6.40	14.40	57.22	76.82	28.61	30.73	2.12	5.30	18.67	119.49
15	81.31	15	12.00	18.75	15	8.75	7.00	15.75	61.43	76.82	46.07	46.09	0.02	0.04	17.07	119.52
16	81.53	16	12.80	20.00	16	9.00	7.20	16.20	61.43	76.08	15.36	15.22	-0.14	-0.70	16.58	119.38
17	82.28	17	13.60	21.25	17	10.00	8.00	18.00	61.46	76.08	61.46	60.86	-0.60	-0.75	14.85	118.78
18	81.95	18	14.40	22.50	18	10.00	8.00	18.00	61.46	76.08	0.00	0.00	0.00	-0.75	14.85	118.78
19	79.71	19	15.20	23.75	19	11.00	8.80	19.80	63.73	75.16	63.73	60.12	-3.60	-4.50	13.09	115.17
20	76.82	20	16.00	25.00	20	11.25	9.00	20.25	65.61	75.16	16.40	15.03	-1.37	-8.85	12.64	113.80
21	75.16	21	16.80	26.25	21	12.00	9.60	21.60	65.61	73.90	49.21	44.34	-4.86	-8.11	11.35	108.94
22	65.61	22	17.60	27.50	22	12.50	10.00	22.50	67.84	73.90	33.92	29.56	-4.36	-10.90	10.46	104.58
23	61.46	23	18.40	28.75	23	13.00	10.40	23.40	67.84	71.33	33.92	28.53	-5.39	-13.47	9.54	99.19
24	57.22	24	19.20	30.00	24	13.33	10.67	24.00	71.33	71.33	23.78	19.02	-4.76	-17.83	8.85	94.44

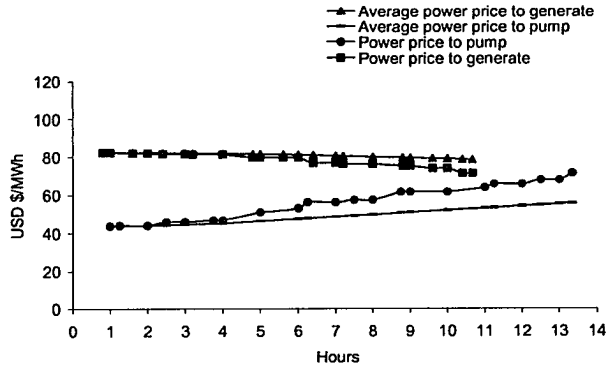


2-USA: Northern California Weekday

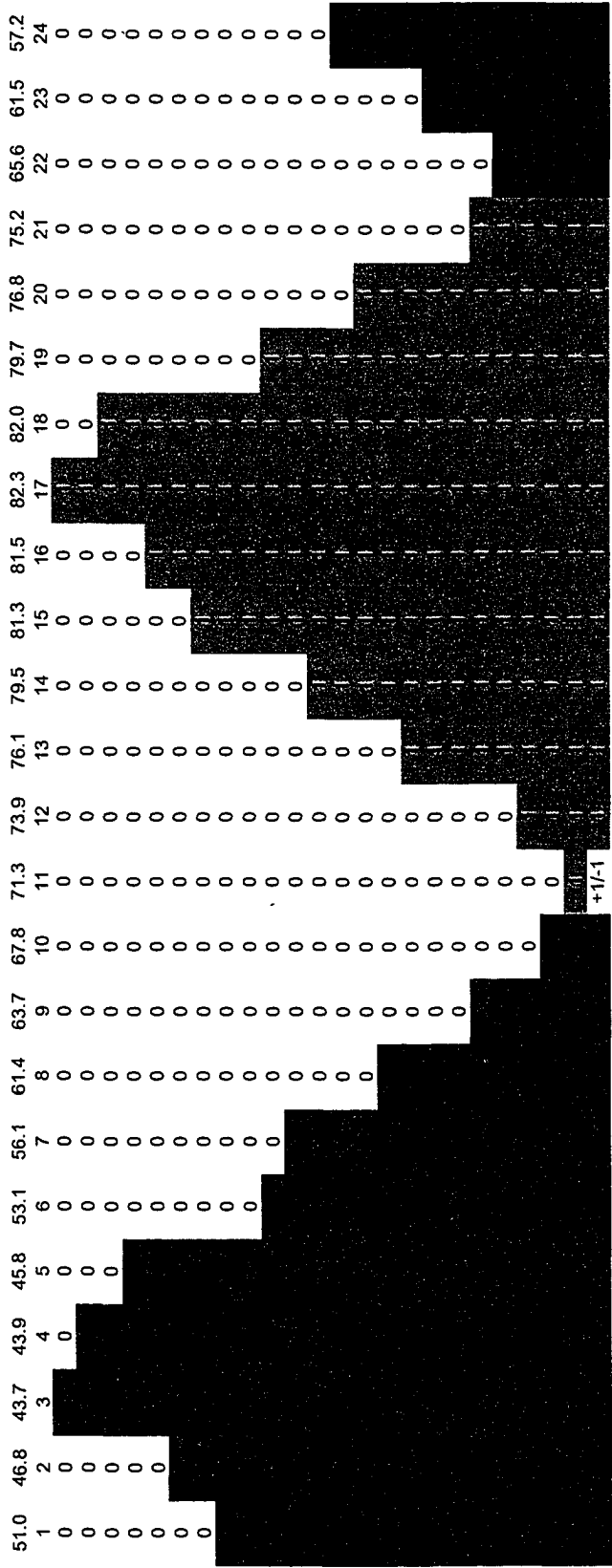
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	27.71	27.71
1.00	27.37	27.65
1.60	27.05	27.42
2.00	24.69	26.88
2.40	24.28	26.44
3.00	23.09	25.77
3.20	22.87	25.59
4.00	17.55	23.98
4.00	17.55	23.98
4.80	13.36	22.21
5.00	9.64	21.71
5.60	9.40	20.39
6.00	7.95	19.56
6.40	5.30	18.67
7.00	0.04	17.07
7.20	-0.70	16.58
8.00	-0.75	14.85
8.00	-0.75	14.85
8.80	-4.50	13.09
9.00	-6.85	12.64
9.60	-8.11	11.35
10.00	-10.90	10.46
10.40	-13.47	9.54
10.67	-17.83	8.85

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	43.65	82.28
1.25	1.00	43.92	82.28
2.00	1.60	43.92	81.95
2.50	2.00	45.81	81.95
3.00	2.40	45.81	81.53
3.75	3.00	46.75	81.53
4.00	3.20	46.75	81.31
5.00	4.00	51.00	81.31
5.00	4.00	51.00	81.31
6.00	4.80	53.08	79.71
6.25	5.00	56.06	79.71
7.00	5.60	56.06	79.47
7.50	6.00	57.22	79.47
8.00	6.40	57.22	76.82
8.75	7.00	61.43	76.82
9.00	7.20	61.43	76.08
10.00	8.00	61.46	76.08
10.00	8.00	61.46	76.08
11.00	8.80	63.73	75.16
11.25	9.00	65.61	75.16
12.00	9.60	65.61	73.90
12.50	10.00	67.84	73.90
13.00	10.40	67.84	71.33
13.33	10.67	71.33	71.33

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	43.65	82.28
1.25	1.00	43.70	82.28
2.00	1.60	43.79	82.15
2.50	2.00	44.19	82.11
3.00	2.40	44.46	82.02
3.75	3.00	44.92	81.92
4.00	3.20	45.03	81.88
5.00	4.00	46.23	81.77
5.00	4.00	46.23	81.77
6.00	4.80	47.37	81.42
6.25	5.00	47.72	81.36
7.00	5.60	48.61	81.15
7.50	6.00	49.18	81.04
8.00	6.40	49.69	80.78
8.75	7.00	50.69	80.44
9.00	7.20	50.99	80.32
10.00	8.00	52.04	79.89
10.00	8.00	52.04	79.89
11.00	8.80	53.10	79.46
11.25	9.00	53.38	79.37
12.00	9.60	54.14	79.03
12.50	10.00	54.69	78.82
13.00	10.40	55.20	78.53
13.33	10.67	55.60	78.35



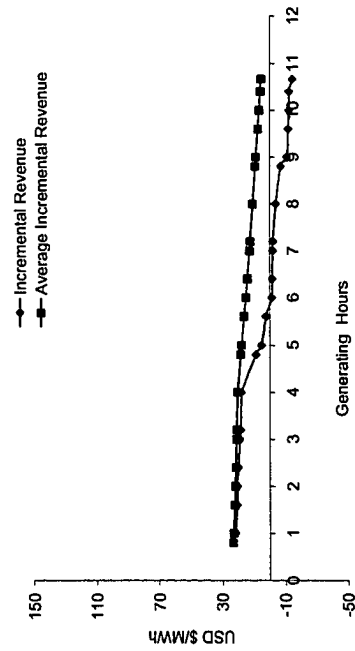
2-USA: Northern California Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

2-USA: Northern California Weekend

USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	sold	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	49.69	0	39.6	72.8	0.00	0.00	0.00	39.60	72.76	39.60	58.21	18.61	23.26	23.26	18.61
2	45.20	1	40.8	71.7	1.00	0.80	1.80	40.77	72.76	10.19	14.55	4.36	21.80	22.97	22.97
3	41.98	2	40.9	71.1	1.60	1.60	2.25	40.77	71.70	30.58	43.02	12.44	20.74	22.13	35.41
4	40.85	3	41.7	70.6	2.00	1.80	3.60	40.77	71.70	20.43	28.68	8.25	20.64	21.83	43.66
5	40.77	4	42.0	61.7	2.50	2.00	4.50	40.85	71.70	20.43	28.42	8.00	19.99	21.52	51.66
6	41.69	5	42.4	58.9	3.00	2.40	6.75	41.69	71.06	10.42	14.12	3.70	18.94	21.01	63.02
7	39.60	6	45.2	58.5	3.75	3.00	7.20	41.69	70.59	10.42	14.12	3.70	18.48	20.85	66.72
8	42.45	7	48.0	58.5	4.00	3.20	7.20	41.98	70.59	10.42	14.12	3.70	18.12	20.30	81.21
9	47.99	8	46.2	58.4	5.00	4.00	9.00	41.98	70.59	0.00	0.00	0.00	18.12	20.30	81.21
10	52.28	9	49.7	57.6	5.00	4.00	9.00	41.98	70.59	0.00	0.00	0.00	18.12	20.30	81.21
11	55.49	10	52.3	57.5	6.00	4.80	10.80	42.45	61.66	42.45	49.33	6.88	8.60	18.35	88.09
12	57.55	11	55.5	56.0	6.25	5.00	11.25	45.20	61.66	11.30	12.33	1.03	5.16	17.82	89.12
13	58.47	12	56.0	55.5	7.00	5.60	12.60	45.20	58.90	33.90	35.34	1.44	2.40	16.17	90.57
14	58.90	13	57.5	52.3	7.50	6.00	13.50	47.99	58.90	23.99	23.56	-0.43	-1.08	15.02	90.13
15	58.55	14	57.6	49.7	8.00	6.40	14.40	47.99	58.55	23.99	23.42	-0.58	-1.44	13.99	89.56
16	58.38	15	58.4	48.2	8.75	7.00	15.75	48.24	58.55	36.18	35.13	-1.05	-1.75	12.64	88.51
17	61.66	16	58.4	48.2	9.00	7.20	16.20	48.24	58.47	12.06	11.69	-0.37	-1.83	12.24	86.14
18	72.76	17	58.5	45.2	10.00	8.00	18.00	49.69	58.47	49.69	46.77	-2.91	-3.64	10.65	85.23
19	71.70	18	58.9	42.4	10.00	8.00	18.00	49.69	58.47	0.00	0.00	0.00	-3.64	10.65	85.23
20	70.59	19	61.7	42.0	11.00	8.80	19.80	52.28	58.38	52.28	46.70	-5.58	-6.97	9.05	79.65
21	71.06	20	70.6	41.7	11.25	9.00	20.25	55.49	58.38	13.87	11.68	-2.20	-10.99	8.61	77.46
22	57.54	21	71.1	40.9	12.00	9.60	21.60	55.49	57.55	41.62	34.53	-7.09	-11.82	7.33	70.37
23	56.00	22	71.7	40.8	12.50	10.00	22.50	56.00	57.55	28.00	23.02	-4.98	-12.45	6.54	65.39
24	48.24	23	72.8	39.6	13.00	10.40	23.40	56.00	57.54	28.00	23.02	-4.98	-12.46	5.81	60.40
		24	72.8	39.6	13.33	10.67	24.00	57.54	57.54	19.18	15.34	-3.84	-14.38	5.30	56.56

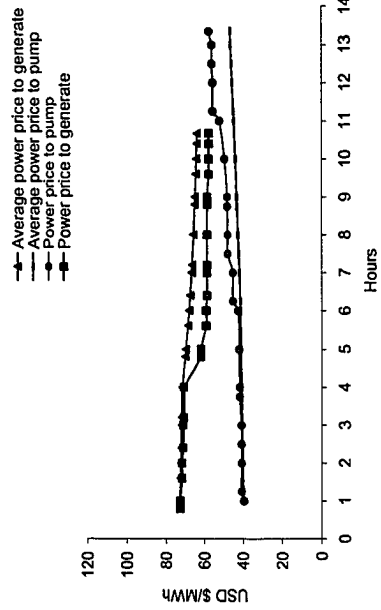


2-USA: Northern California Weekend

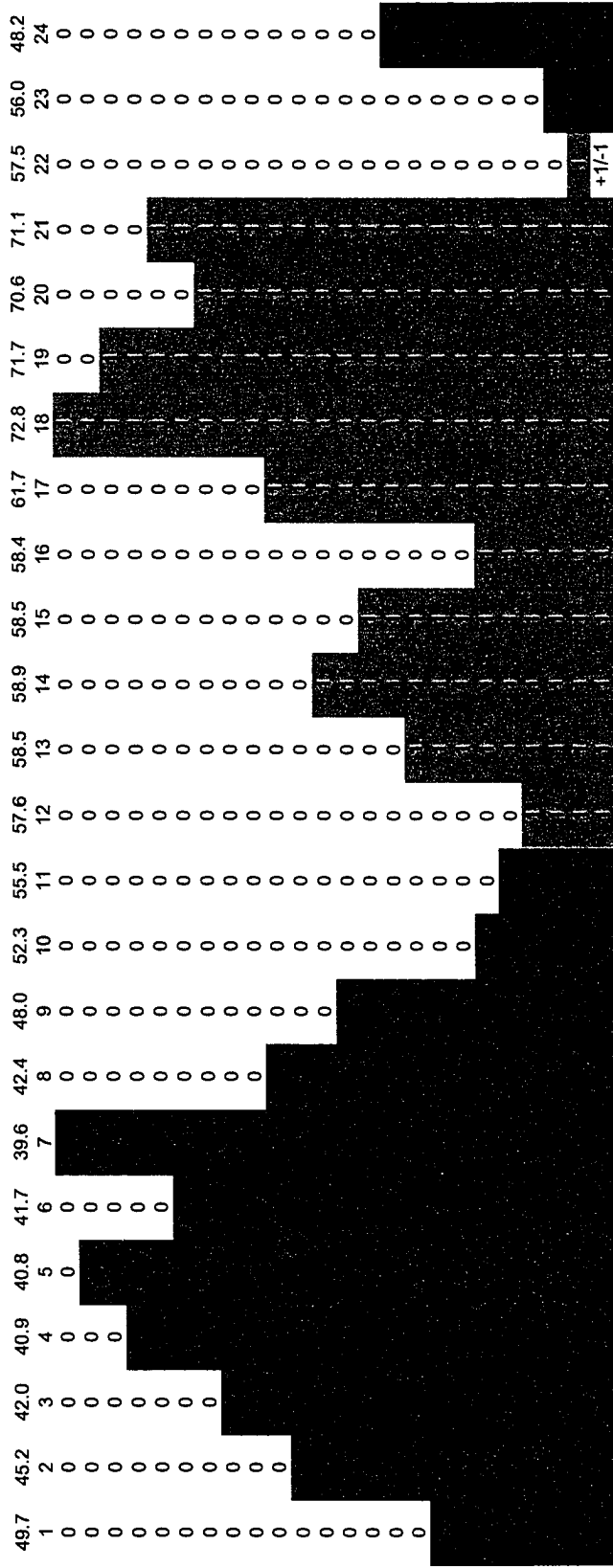
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	23.26	23.26
1.00	21.80	22.97
1.60	20.74	22.13
2.00	20.64	21.83
2.40	19.99	21.52
3.00	18.94	21.01
3.20	18.48	20.85
4.00	18.12	20.30
4.00	18.12	20.30
4.80	8.60	18.35
5.00	5.16	17.82
5.60	2.40	16.17
6.00	-1.08	15.02
6.40	-1.44	13.99
7.00	-1.75	12.64
7.20	-1.83	12.24
8.00	-3.64	10.65
8.80	-6.97	9.05
9.60	-11.82	7.33
10.00	-12.45	6.54
10.40	-12.46	5.81
10.67	-14.38	5.30

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	39.60	72.76
1.25	1.00	40.77	72.76
2.00	1.60	40.77	71.70
2.50	2.00	40.85	71.70
3.00	2.40	40.85	71.06
3.75	3.00	41.69	71.06
4.00	3.20	41.69	70.59
5.00	4.00	41.98	70.59
5.00	4.00	41.98	70.59
6.00	4.80	42.45	61.66
6.25	5.00	45.20	61.66
7.00	5.60	45.20	58.90
7.50	6.00	47.99	58.90
8.00	6.40	47.99	58.55
8.75	7.00	48.24	58.55
9.00	7.20	48.24	58.47
10.00	8.00	49.69	58.47
10.00	8.00	49.69	58.47
11.00	8.80	52.28	58.38
11.25	9.00	55.49	58.38
12.00	9.60	55.49	57.55
12.50	10.00	56.00	57.55
13.00	10.40	56.00	57.54
13.33	10.67	57.54	57.54

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	39.60	72.76
1.25	1.00	39.64	72.76
2.00	1.60	40.19	72.36
2.50	2.00	40.32	72.23
3.00	2.40	40.41	72.04
3.75	3.00	40.67	71.84
4.00	3.20	40.73	71.76
5.00	4.00	40.98	71.53
5.00	4.00	40.98	71.53
6.00	4.80	41.22	69.88
6.25	5.00	41.38	69.55
7.00	5.60	41.79	68.41
7.50	6.00	42.20	67.78
8.00	6.40	42.57	67.20
8.75	7.00	43.05	66.48
9.00	7.20	43.20	66.24
10.00	8.00	43.85	65.46
10.00	8.00	43.85	65.46
11.00	8.80	44.61	64.82
11.25	9.00	44.85	64.67
12.00	9.60	45.52	64.23
12.50	10.00	45.94	63.96
13.00	10.40	46.33	63.71
13.33	10.67	46.61	63.56



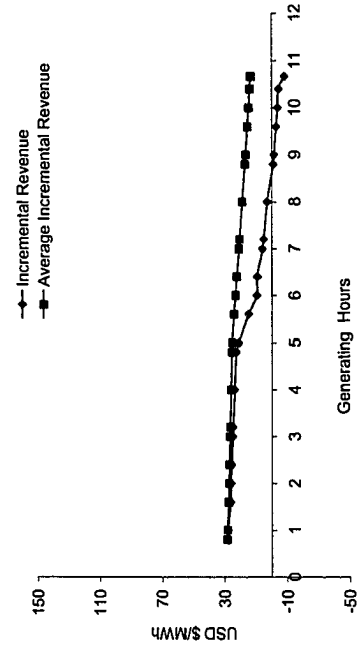
2-USA: Northern California Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

3--USA: PJM Weekday

USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	sold	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	15.73	0	13.6	45.3	0	0.00	0.00	13.63	45.33	13.63	36.26	22.63	28.29	28.29	22.63
2	14.86	1	14.0	43.7	1.00	0.80	1.80	13.96	45.33	13.96	34.9	5.58	27.88	28.20	26.20
3	13.96	2	14.1	43.3	1.25	1.00	2.25	13.96	43.66	10.47	26.20	15.72	26.20	27.45	43.93
4	13.63	3	14.9	43.1	2.00	1.60	3.60	14.13	43.66	7.07	17.46	10.40	25.99	26.90	54.32
5	14.13	4	15.7	43.1	2.50	2.00	4.50	14.13	43.28	3.71	17.31	10.24	25.61	26.46	64.57
6	16.56	5	16.6	36.9	3.00	2.40	5.40	14.86	43.13	8.63	4.91	14.82	24.70	26.34	79.39
7	24.64	6	18.0	36.7	3.75	3.00	6.75	14.86	43.13	3.71	8.63	4.91	24.56	26.34	84.30
8	29.21	7	22.0	35.9	4.00	3.20	7.20	15.73	43.13	15.73	34.50	18.77	23.47	25.77	103.07
9	26.48	8	24.6	35.0	5.00	4.00	9.00	15.73	43.13	0.00	0.00	0.00	23.47	25.77	103.07
10	28.76	9	26.5	33.6	6.00	4.80	10.80	16.56	43.11	16.56	34.49	17.93	22.41	25.21	121.01
11	33.59	10	28.8	33.0	6.25	5.00	11.25	18.00	43.11	4.50	8.62	4.12	20.61	25.03	125.13
12	35.91	11	29.2	30.0	7.00	5.60	12.60	18.00	36.90	13.50	22.14	8.64	14.41	23.89	133.77
13	36.65	12	30.0	29.2	7.50	6.00	13.50	22.03	36.90	11.02	14.76	3.75	9.37	22.92	137.52
14	43.11	13	33.0	28.8	8.00	6.40	14.40	22.03	36.65	11.02	14.66	3.65	9.11	22.06	141.16
15	43.66	14	33.6	26.5	8.75	7.00	15.75	24.64	35.91	6.16	7.18	1.02	5.86	20.67	144.68
16	43.28	15	35.0	24.6	9.00	7.20	16.20	24.64	35.91	26.48	28.73	2.25	5.12	20.24	145.70
17	43.13	16	35.9	22.0	10.00	8.00	18.00	26.48	35.91	0.00	0.00	0.00	2.81	18.49	147.95
18	45.33	17	36.7	18.0	10.00	8.00	18.00	28.76	34.98	28.76	27.99	-0.78	2.81	18.49	147.95
19	36.90	18	36.9	16.6	11.00	8.80	19.80	28.76	34.98	7.30	7.00	-0.30	-0.97	16.72	147.17
20	33.03	19	43.1	15.7	11.25	9.00	20.25	29.21	34.98	21.90	20.15	-1.75	-1.52	16.32	146.87
21	34.98	20	43.1	14.9	12.00	9.60	21.60	29.21	33.59	15.00	13.43	-1.57	-2.92	15.12	145.12
22	30.01	21	43.3	14.1	12.50	10.00	22.50	30.01	33.59	15.00	13.43	-1.57	-3.93	14.35	143.55
23	22.03	22	43.7	14.0	13.00	10.40	23.40	30.01	33.03	15.00	13.21	-1.79	-4.48	13.63	141.75
24	18.00	23	45.3	13.6	13.33	10.67	24.00	33.03	33.03	11.01	8.81	-2.20	-8.26	13.08	139.55
24	45.3	24	45.3	13.6											

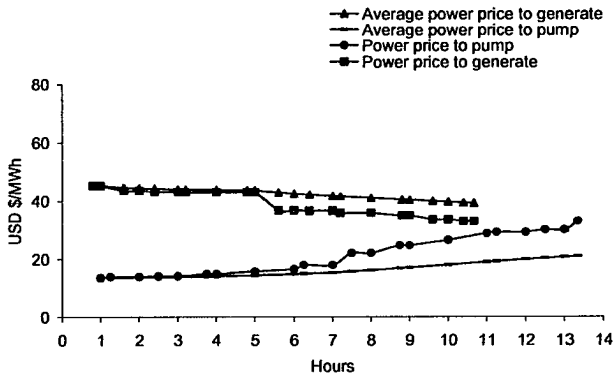


3-USA: PJM Weekday

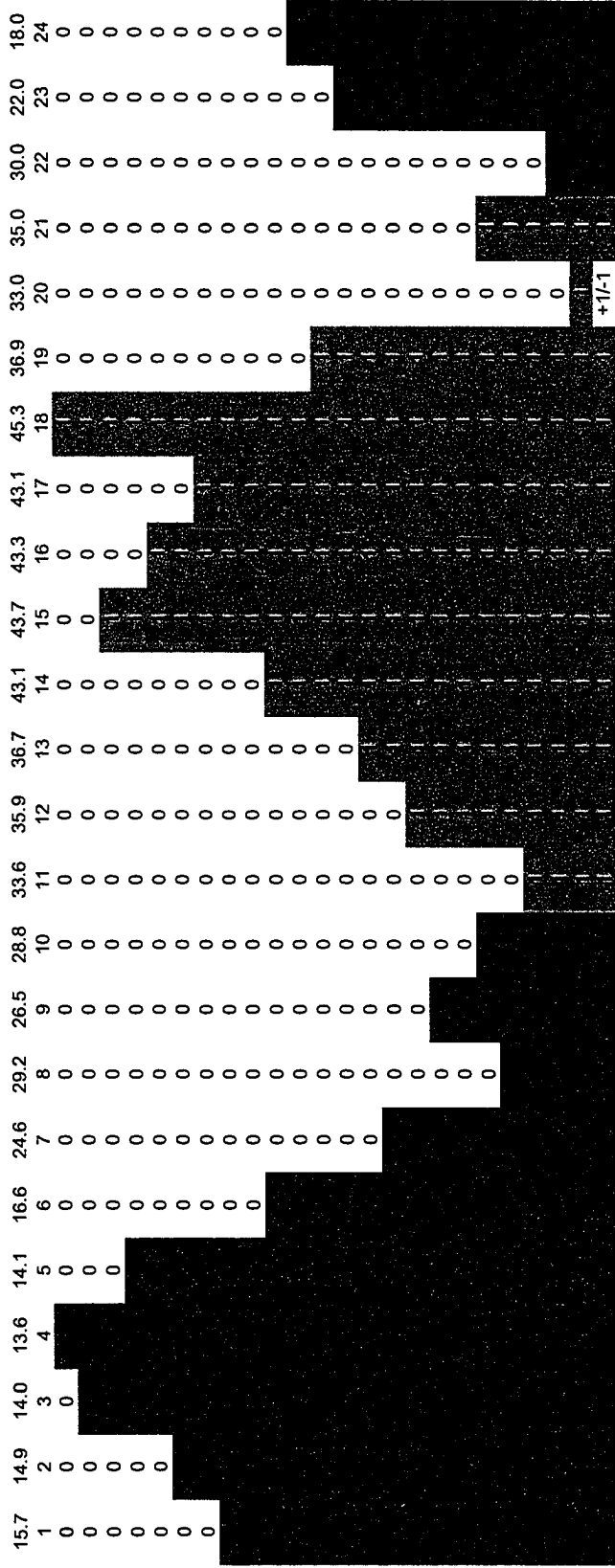
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	28.29	28.29
1.00	27.88	28.20
1.60	26.20	27.45
2.00	25.99	27.16
2.40	25.61	26.90
3.00	24.70	26.46
3.20	24.56	26.34
4.00	23.47	25.77
4.00	23.47	25.77
4.80	22.41	25.21
5.00	20.61	25.03
5.60	14.41	23.89
6.00	9.37	22.92
6.40	9.11	22.06
7.00	5.86	20.67
7.20	5.12	20.24
8.00	2.81	18.49
8.00	2.81	18.49
8.80	-0.97	16.72
9.00	-1.52	16.32
9.60	-2.92	15.12
10.00	-3.93	14.35
10.40	-4.48	13.63
10.67	-8.26	13.08

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	13.63	45.33
1.25	1.00	13.96	45.33
2.00	1.60	13.96	43.66
2.50	2.00	14.13	43.66
3.00	2.40	14.13	43.28
3.75	3.00	14.86	43.28
4.00	3.20	14.86	43.13
5.00	4.00	15.73	43.13
5.00	4.00	15.73	43.13
6.00	4.80	16.56	43.11
6.25	5.00	18.00	43.11
7.00	5.60	18.00	36.90
7.50	6.00	22.03	36.90
8.00	6.40	22.03	36.65
8.75	7.00	24.64	36.65
9.00	7.20	24.64	35.91
10.00	8.00	26.48	35.91
10.00	8.00	26.48	35.91
11.00	8.80	28.76	34.98
11.25	9.00	29.21	34.98
12.00	9.60	29.21	33.59
12.50	10.00	30.01	33.59
13.00	10.40	30.01	33.03
13.33	10.67	33.03	33.03

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	13.63	45.33
1.25	1.00	13.70	45.33
2.00	1.60	13.80	44.70
2.50	2.00	13.87	44.49
3.00	2.40	13.91	44.29
3.75	3.00	14.10	44.09
4.00	3.20	14.15	44.03
5.00	4.00	14.46	43.85
5.00	4.00	14.46	43.85
6.00	4.80	14.81	43.73
6.25	5.00	14.94	43.70
7.00	5.60	15.27	42.97
7.50	6.00	15.72	42.57
8.00	6.40	16.11	42.20
8.75	7.00	16.84	41.72
9.00	7.20	17.06	41.56
10.00	8.00	18.00	41.00
10.00	8.00	18.00	41.00
11.00	8.80	18.98	40.45
11.25	9.00	19.21	40.33
12.00	9.60	19.83	39.91
12.50	10.00	20.24	39.65
13.00	10.40	20.62	39.40
13.33	10.67	20.93	39.24



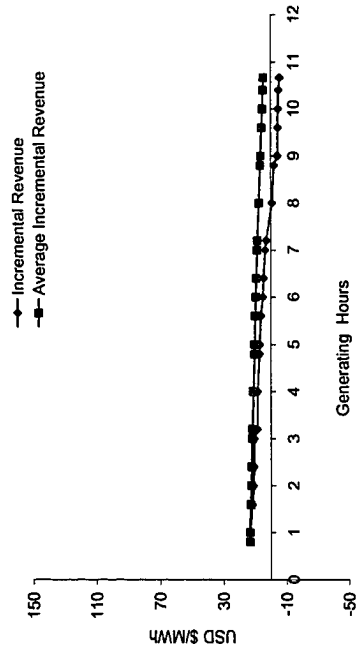
3-USA: PJM Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

3-USA: PJM Weekend

USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	paid	Diff	Diff	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	15.98	0	12.9	29.7	0.0	0.0	0.0	12.93	29.71	12.93	23.77	10.84	13.55	13.55	10.84
2	14.81	1	13.1	28.4	1.00	0.80	1.80	13.07	29.71	3.27	5.94	2.67	13.37	13.51	13.51
3	13.68	2	13.7	28.0	1.25	1.00	2.25	13.07	28.40	9.80	17.04	7.24	12.06	12.97	20.75
4	12.93	3	13.7	26.0	2.00	1.60	3.60	13.68	28.40	6.84	11.36	4.52	11.29	12.63	25.27
5	13.07	4	14.0	25.8	2.50	2.00	4.50	13.68	27.95	6.84	11.18	4.34	10.85	12.34	29.61
6	13.75	5	14.8	25.0	3.00	2.40	5.40	13.75	27.95	10.31	16.77	6.46	10.77	12.02	36.07
7	14.01	6	14.9	24.5	3.75	3.00	6.75	13.75	26.03	3.44	5.21	1.77	8.85	11.82	37.84
8	14.94	7	16.0	24.0	4.00	3.20	7.20	13.75	26.03	3.44	5.21	1.77	8.85	11.82	37.84
9	20.45	8	16.9	23.4	5.00	4.00	9.00	14.01	26.03	14.01	20.83	6.81	8.52	11.16	44.65
10	23.39	9	19.9	23.2	5.00	4.00	9.00	14.01	26.03	0.00	0.00	0.00	8.52	11.16	44.65
11	24.55	10	20.5	22.8	6.00	4.80	10.80	14.81	25.81	14.81	20.65	5.83	7.29	10.52	50.48
12	23.96	11	22.2	22.3	6.25	5.00	11.25	14.94	25.81	3.74	5.16	1.43	7.13	10.38	51.91
13	23.23	12	22.3	22.2	7.00	5.60	12.60	14.94	24.99	11.21	14.99	3.79	6.31	9.95	55.70
14	22.85	13	22.8	20.5	7.50	6.00	13.50	15.98	24.99	7.99	9.99	2.01	5.01	9.62	57.70
15	22.33	14	23.2	19.9	8.00	6.40	14.40	15.98	24.55	7.99	9.82	1.83	4.57	9.30	59.53
16	22.18	15	23.4	16.9	8.75	7.00	15.75	16.87	24.55	12.66	14.73	2.07	3.46	8.80	61.60
17	25.81	16	24.0	16.0	9.00	7.20	16.20	16.87	23.96	4.22	4.79	0.57	2.87	8.64	62.18
18	29.71	17	24.5	14.9	10.00	8.00	18.00	19.86	23.96	19.86	19.17	-0.69	-0.87	7.69	61.48
19	28.40	18	25.0	14.8	10.00	8.00	18.00	19.86	23.96	0.00	0.00	0.00	-0.87	7.69	61.48
20	26.03	19	25.8	14.0	11.00	8.80	19.80	20.45	23.39	20.45	18.72	-1.74	-2.17	6.79	59.75
21	27.96	20	26.0	13.7	11.25	9.00	20.25	22.18	23.39	5.64	4.68	-0.87	-4.33	6.54	58.88
22	24.99	21	28.0	13.7	12.00	9.60	21.60	22.18	23.23	16.63	13.94	-2.70	-4.50	5.85	56.19
23	19.66	22	28.4	13.1	12.50	10.00	22.50	22.33	23.23	11.16	9.29	-1.87	-4.69	5.43	54.31
24	16.87	23	29.7	12.9	13.00	10.40	23.40	22.33	22.85	11.16	9.14	-2.03	-5.07	5.03	52.28
24	16.87	24	29.7	12.9	13.33	10.67	24.00	22.85	22.85	7.82	6.09	-1.52	-5.71	4.76	50.76

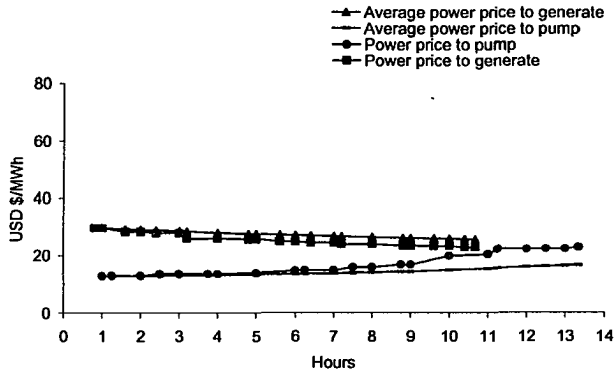


3-USA: PJM Weekend

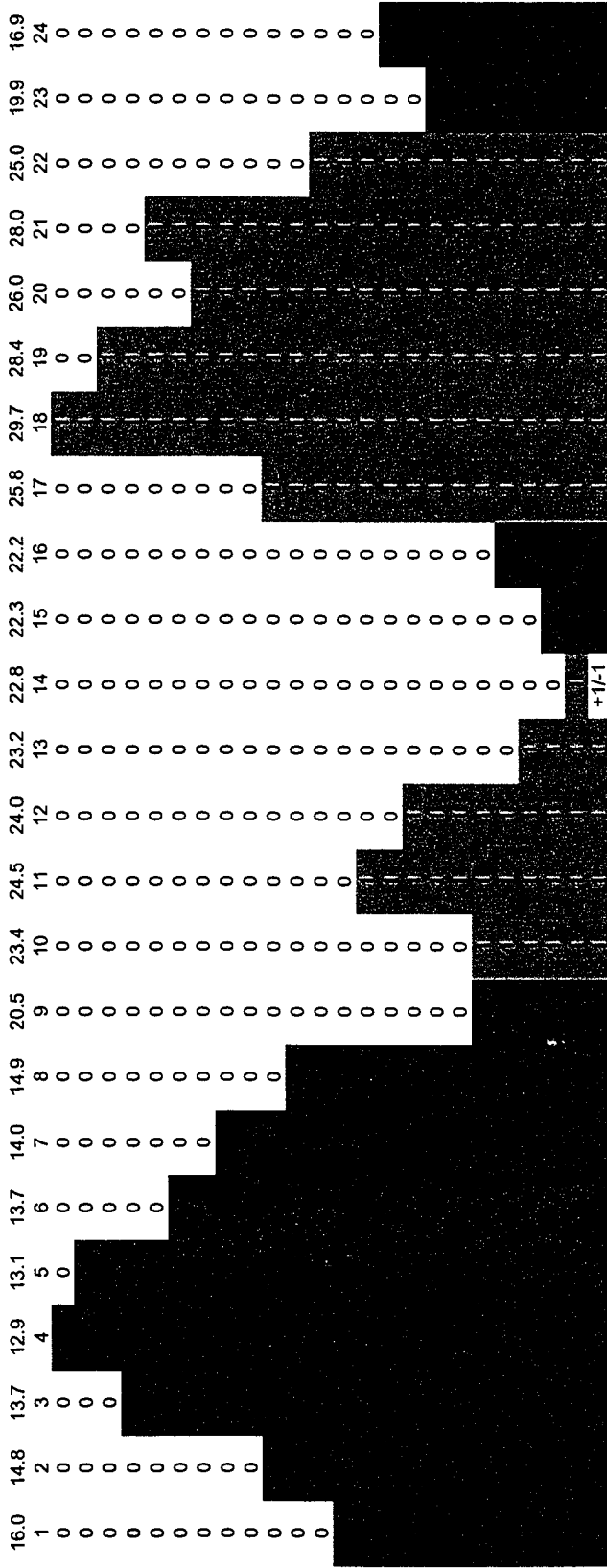
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	13.55	13.55
1.00	13.37	13.51
1.60	12.06	12.97
2.00	11.29	12.63
2.40	10.85	12.34
3.00	10.77	12.02
3.20	8.85	11.82
4.00	8.52	11.16
4.00	8.52	11.16
4.80	7.29	10.52
5.00	7.13	10.38
5.60	6.31	9.95
6.00	5.01	9.62
6.40	4.57	9.30
7.00	3.46	8.80
7.20	2.87	8.64
8.00	-0.87	7.69
8.00	-0.87	7.69
8.80	-2.17	6.79
9.00	-4.33	6.54
9.60	-4.50	5.85
10.00	-4.69	5.43
10.40	-5.07	5.03
10.67	-5.71	4.76

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	12.93	29.71
1.25	1.00	13.07	29.71
2.00	1.60	13.07	28.40
2.50	2.00	13.68	28.40
3.00	2.40	13.68	27.95
3.75	3.00	13.75	27.95
4.00	3.20	13.75	26.03
5.00	4.00	14.01	26.03
5.00	4.00	14.01	26.03
6.00	4.80	14.81	25.81
6.25	5.00	14.94	25.81
7.00	5.60	14.94	24.99
7.50	6.00	15.98	24.99
8.00	6.40	15.98	24.55
8.75	7.00	16.87	24.55
9.00	7.20	16.87	23.96
10.00	8.00	19.86	23.96
10.00	8.00	19.86	23.96
11.00	8.80	20.45	23.39
11.25	9.00	22.18	23.39
12.00	9.60	22.18	23.23
12.50	10.00	22.33	23.23
13.00	10.40	22.33	22.85
13.33	10.67	22.85	22.85

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	12.93	29.71
1.25	1.00	12.96	29.71
2.00	1.60	13.00	29.22
2.50	2.00	13.14	29.05
3.00	2.40	13.23	28.87
3.75	3.00	13.33	28.69
4.00	3.20	13.36	28.52
5.00	4.00	13.49	28.02
5.00	4.00	13.49	28.02
6.00	4.80	13.71	27.65
6.25	5.00	13.76	27.58
7.00	5.60	13.89	27.30
7.50	6.00	14.03	27.15
8.00	6.40	14.15	26.99
8.75	7.00	14.38	26.78
9.00	7.20	14.45	26.70
10.00	8.00	14.99	26.42
10.00	8.00	14.99	26.42
11.00	8.80	15.49	26.15
11.25	9.00	15.64	26.09
12.00	9.60	16.05	25.91
12.50	10.00	16.30	25.80
13.00	10.40	16.53	25.69
13.33	10.67	16.69	25.62



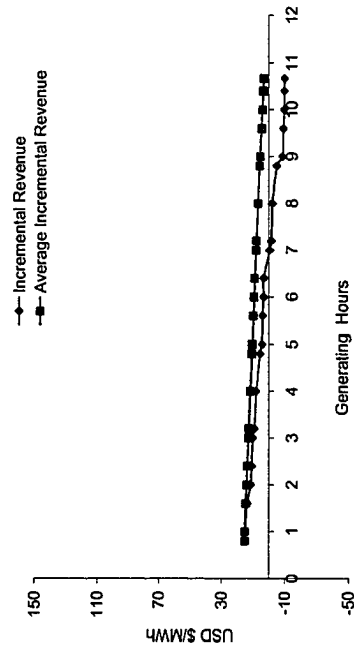
3-USA: PJM Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

4-USA: New England Weekday

USD/MWh	Efficiency	B	S	B	S	Pump	Gen	Total	paid	sold	DiPaid	DiSold	Profit	Average Incremental Revenue	Cumulative Revenue
1	26.20	0	24.8	46.1	0.80	1.25	1	0.80	1.80	24.80	46.08	36.86	12.06	15.08	12.06
2	26.66	1	25.0	44.8	1.60	2.50	2	1.25	2.25	24.99	46.08	6.25	9.22	14.84	15.03
3	24.80	2	26.7	44.2	2.40	3.75	3	2.00	3.60	24.99	44.79	18.74	26.87	13.56	23.17
4	24.99	3	27.2	43.2	3.20	5.00	4	2.50	4.50	26.66	44.79	13.33	17.91	11.46	27.75
5	27.24	4	28.2	43.1	4.00	6.25	5	3.00	5.40	26.66	44.25	13.33	17.70	10.92	32.12
6	31.10	5	30.1	42.7	4.80	7.50	6	3.75	6.75	27.24	44.25	20.43	26.55	10.19	38.23
7	34.52	6	31.1	42.6	5.60	8.75	7	4.00	7.20	27.24	43.19	8.81	8.64	9.13	40.06
8	36.99	7	31.6	41.6	6.40	10.00	8	5.00	8.00	28.20	43.19	28.20	34.55	7.94	46.41
9	39.89	8	34.5	41.2	7.20	11.25	9	6.00	9.00	28.20	43.19	0.00	0.00	7.94	46.41
10	41.58	9	35.0	40.6	8.00	12.50	10	8.00	10.80	30.12	43.05	30.12	34.44	5.40	50.74
11	42.65	10	37.0	40.6	8.80	13.75	11	8.00	11.25	31.10	43.05	7.77	8.61	4.18	51.57
12	44.25	11	39.9	40.4	9.60	15.00	12	9.00	12.60	31.10	42.65	23.32	25.99	3.78	53.84
13	43.05	12	40.4	39.9	10.40	16.25	13	7.50	13.50	31.62	42.65	15.81	17.06	3.12	55.09
14	41.22	13	40.6	37.0	11.20	17.50	14	8.00	14.40	31.62	42.62	15.81	17.05	3.09	56.32
15	40.60	14	40.6	35.0	12.00	18.75	15	8.75	15.75	34.52	42.62	25.89	25.57	-0.53	56.01
16	40.63	15	41.2	34.5	12.80	20.00	16	9.00	16.20	34.52	41.58	8.63	8.32	-1.57	55.69
17	43.19	16	41.6	31.6	13.60	21.25	17	10.00	18.00	35.00	41.58	35.00	33.27	-1.74	53.95
18	46.08	17	42.6	31.1	14.40	22.50	18	10.00	18.00	35.00	41.58	0.00	0.00	-2.17	53.95
19	44.79	18	42.7	30.1	15.20	23.75	19	11.00	19.80	36.99	41.22	36.99	32.98	-5.01	49.95
20	42.62	19	43.1	28.2	16.00	25.00	20	11.25	20.25	39.89	41.22	9.97	8.24	-8.65	48.22
21	40.43	20	43.2	27.2	16.80	26.25	21	12.00	21.60	39.89	40.63	29.92	24.38	-9.24	42.67
22	35.00	21	44.2	26.7	17.60	27.50	22	12.50	22.50	40.43	40.63	20.21	16.25	-9.91	38.71
23	31.62	22	44.8	25.0	18.40	28.75	23	13.00	23.40	40.43	40.60	20.21	16.24	-9.93	34.74
24	30.12	23	46.1	24.8	19.20	30.00	24	13.33	24.00	40.60	40.60	13.53	10.83	-10.15	32.03



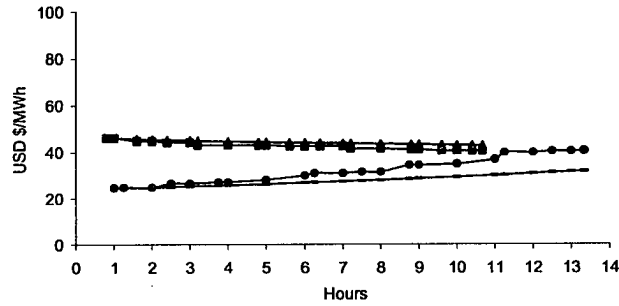
4-USA: New England Weekday

Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	15.08	15.08
1.00	14.84	15.03
1.60	13.56	14.48
2.00	11.46	13.88
2.40	10.92	13.38
3.00	10.19	12.74
3.20	9.13	12.52
4.00	7.94	11.60
4.00	7.94	11.60
4.80	5.40	10.57
5.00	4.18	10.31
5.60	3.78	9.61
6.00	3.12	9.18
6.40	3.09	8.80
7.00	-0.53	8.00
7.20	-1.57	7.73
8.00	-2.17	6.74
8.00	-2.17	6.74
8.80	-5.01	5.68
9.00	-8.65	5.36
9.60	-9.24	4.45
10.00	-9.91	3.87
10.40	-9.93	3.34
10.67	-10.15	3.00

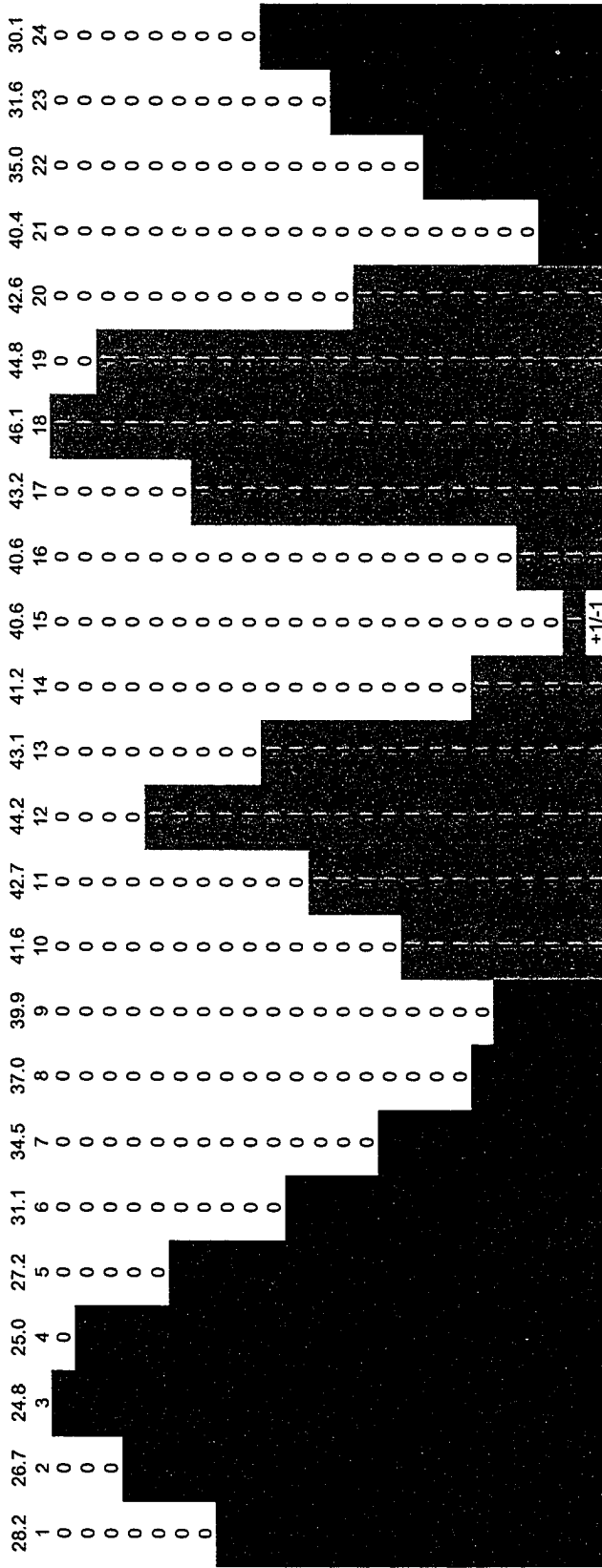
Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	24.80	46.08
1.25	1.00	24.99	46.08
2.00	1.60	24.99	44.79
2.50	2.00	26.66	44.79
3.00	2.40	26.66	44.25
3.75	3.00	27.24	44.25
4.00	3.20	27.24	43.19
5.00	4.00	28.20	43.19
5.00	4.00	28.20	43.19
6.00	4.80	30.12	43.05
6.25	5.00	31.10	43.05
7.00	5.60	31.10	42.65
7.50	6.00	31.62	42.65
8.00	6.40	31.62	42.62
8.75	7.00	34.52	42.62
9.00	7.20	34.52	41.58
10.00	8.00	35.00	41.58
10.00	8.00	35.00	41.58
11.00	8.80	36.99	41.22
11.25	9.00	39.89	41.22
12.00	9.60	39.89	40.63
12.50	10.00	40.43	40.63
13.00	10.40	40.43	40.60
13.33	10.67	40.60	40.60

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	24.80	46.08
1.25	1.00	24.83	46.08
2.00	1.60	24.89	45.59
2.50	2.00	25.24	45.43
3.00	2.40	25.48	45.23
3.75	3.00	25.83	45.04
4.00	3.20	25.92	44.92
5.00	4.00	26.38	44.57
5.00	4.00	26.38	44.57
6.00	4.80	27.00	44.32
6.25	5.00	27.16	44.27
7.00	5.60	27.59	44.10
7.50	6.00	27.85	44.00
8.00	6.40	28.09	43.91
8.75	7.00	28.64	43.80
9.00	7.20	28.80	43.74
10.00	8.00	29.42	43.52
10.00	8.00	29.42	43.52
11.00	8.80	30.11	43.32
11.25	9.00	30.33	43.27
12.00	9.60	30.93	43.10
12.50	10.00	31.31	43.00
13.00	10.40	31.66	42.91
13.33	10.67	31.88	42.85

- ▲ Average power price to generate
- Average power price to pump
- Power price to pump
- Power price to generate



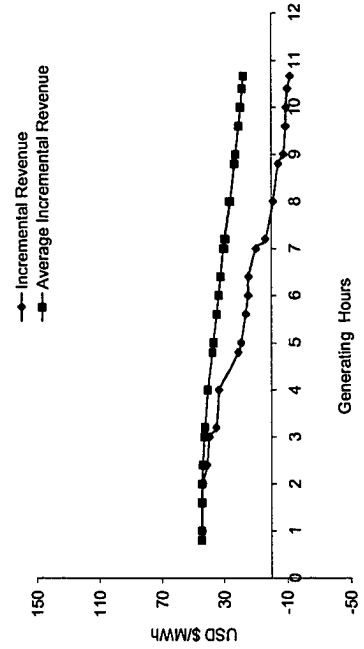
4-USA: New England Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

4-USA: New England Weekend

USD/MWh	Efficiency	0.80	S	B	S	Pump	Gen	Total	paid	sold	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	26.14	0	24.1	75.0	0.00	0.00	0.00	0.00	24.12	75.00	24.12	60.00	35.88	44.85	44.85	35.88
2	24.35	1	24.4	75.0	1.00	0.80	1.80	1.80	24.35	75.00	6.09	15.00	8.91	44.56	44.79	44.79
3	24.12	2	24.7	72.2	2.00	1.60	3.60	3.60	24.35	74.96	18.26	44.98	26.71	44.52	44.69	71.51
4	24.73	3	26.1	67.6	3.00	2.40	4.50	4.50	24.73	74.96	12.37	29.99	17.62	44.05	44.56	89.13
5	27.60	4	27.6	59.1	4.00	3.20	6.00	6.00	24.73	72.18	2.37	28.87	16.51	41.27	44.01	105.63
6	33.22	5	30.4	56.2	5.00	4.00	7.50	7.50	26.14	72.18	19.61	43.31	23.70	39.50	43.11	129.34
7	41.06	6	32.0	55.9	6.00	4.80	9.00	9.00	26.14	67.60	6.54	13.52	6.98	34.92	42.60	136.32
8	45.97	7	33.2	50.1	7.00	5.60	10.50	10.50	27.60	67.60	27.60	54.08	26.48	33.09	40.70	162.79
9	47.66	8	37.0	49.7	8.00	6.40	12.00	12.00	27.60	67.60	0.00	0.00	0.00	33.09	40.70	162.79
10	47.66	9	41.1	48.4	9.00	7.20	13.50	13.50	30.40	59.12	30.40	47.30	16.90	21.12	37.44	179.69
11	49.65	10	43.3	47.7	10.00	8.00	15.00	15.00	31.98	59.12	7.99	11.82	3.83	19.15	36.70	183.52
12	59.12	11	46.0	46.3	11.00	8.80	16.50	16.50	31.98	58.17	23.98	33.70	9.72	16.19	34.51	193.24
13	75.00	12	46.3	46.0	12.00	9.60	18.00	18.00	33.22	56.17	16.61	22.47	5.86	14.64	33.18	199.09
14	74.96	13	47.7	43.3	13.00	10.40	19.50	19.50	33.22	55.90	16.61	22.36	5.75	14.37	32.01	204.84
15	72.18	14	48.4	41.1	14.00	11.20	21.00	21.00	36.99	55.90	27.74	33.54	5.80	9.66	30.09	210.64
16	67.60	15	49.7	37.0	15.00	12.00	22.50	22.50	36.99	50.10	9.25	10.02	0.77	3.87	29.36	211.41
17	50.10	16	50.1	33.2	16.00	12.80	24.00	24.00	41.06	50.10	41.06	40.08	-0.97	-1.22	26.30	210.44
18	56.17	17	55.9	32.0	17.00	13.60	25.50	25.50	41.06	50.10	0.00	0.00	0.00	-1.22	26.30	210.44
19	55.90	18	56.2	30.4	18.00	14.40	27.00	27.00	43.33	49.65	43.33	39.72	-3.61	-4.51	23.50	206.83
20	48.43	19	59.1	27.6	19.00	15.20	28.50	28.50	45.97	49.65	11.49	9.93	-1.56	-7.81	22.81	205.27
21	43.33	20	67.6	26.1	20.00	16.00	25.00	25.00	45.97	46.43	34.47	29.06	-5.42	-9.03	20.82	199.85
22	36.99	21	72.2	24.7	21.00	16.80	26.25	26.25	46.27	46.43	23.14	19.37	-3.77	-9.41	19.61	196.09
23	31.98	22	75.0	24.4	22.00	17.60	27.50	27.50	46.27	47.66	23.14	19.06	-4.07	-10.19	18.46	192.01
24	30.40	23	75.0	24.1	23.00	18.40	28.75	28.75	47.66	47.66	15.89	12.71	-3.18	-11.91	17.70	188.83
24	75.0	24	75.0	24.1	24.00	19.20	30.00	30.00	47.66	47.66	15.89	12.71	-3.18	-11.91	17.70	188.83

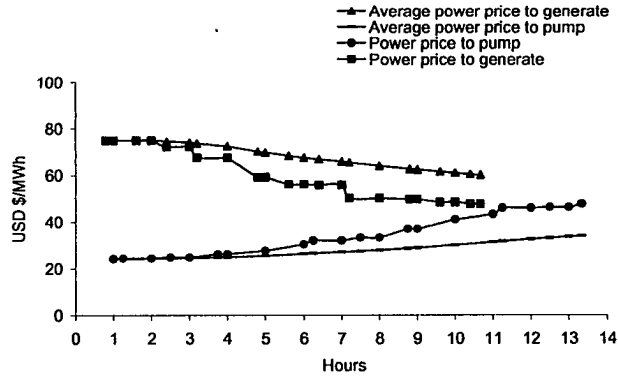


4-USA: New England Weekend

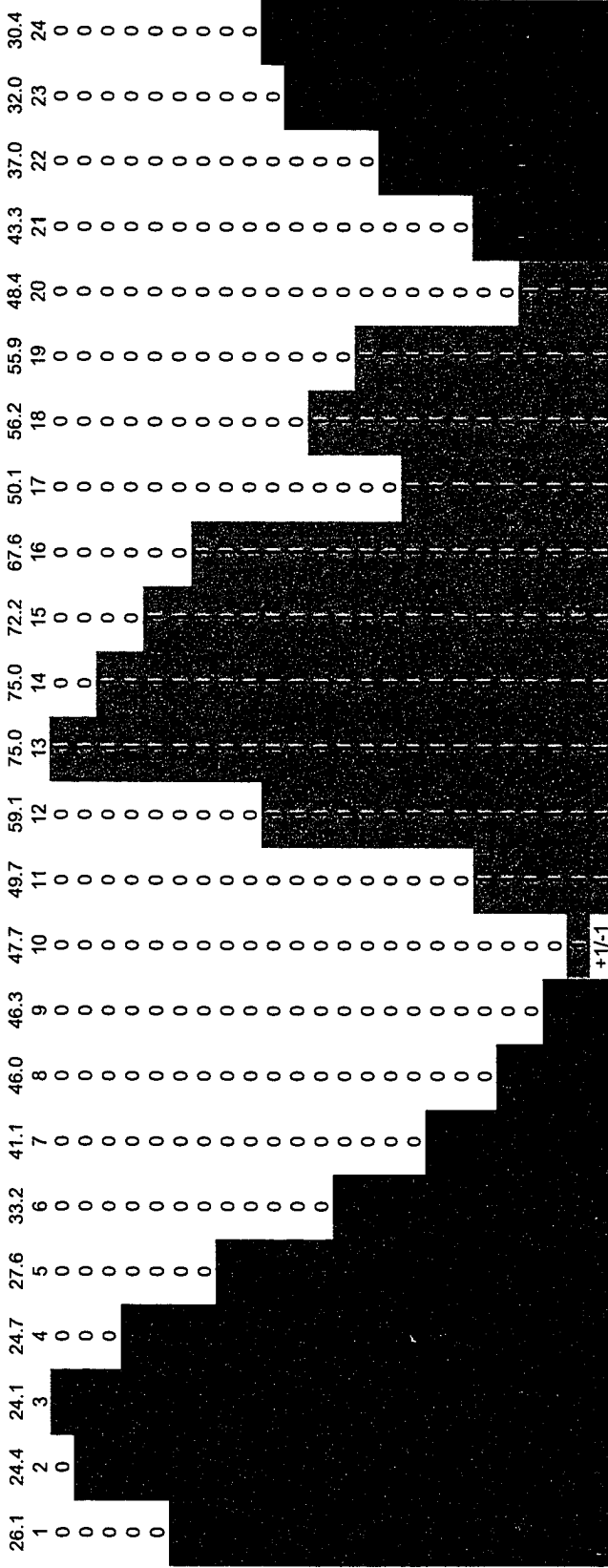
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	44.85	44.85
1.00	44.56	44.79
1.60	44.52	44.69
2.00	44.05	44.56
2.40	41.27	44.01
3.00	39.50	43.11
3.20	34.92	42.60
4.00	33.09	40.70
4.00	33.09	40.70
4.80	21.12	37.44
5.00	19.15	36.70
5.60	16.19	34.51
6.00	14.64	33.18
6.40	14.37	32.01
7.00	9.66	30.09
7.20	3.87	29.36
8.00	-1.22	26.30
8.00	-1.22	26.30
8.80	-4.51	23.50
9.00	-7.81	22.81
9.60	-9.03	20.82
10.00	-9.41	19.61
10.40	-10.19	18.48
10.67	-11.91	17.70

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	24.12	75.00
1.25	1.00	24.35	75.00
2.00	1.60	24.35	74.96
2.50	2.00	24.73	74.96
3.00	2.40	24.73	72.18
3.75	3.00	26.14	72.18
4.00	3.20	26.14	67.60
5.00	4.00	27.60	67.60
5.00	4.00	27.60	67.60
6.00	4.80	30.40	59.12
6.25	5.00	31.98	59.12
7.00	5.60	31.98	56.17
7.50	6.00	33.22	56.17
8.00	6.40	33.22	55.90
8.75	7.00	36.99	55.90
9.00	7.20	36.99	50.10
10.00	8.00	41.06	50.10
10.00	8.00	41.06	50.10
11.00	8.80	43.33	49.65
11.25	9.00	45.97	49.65
12.00	9.60	45.97	48.43
12.50	10.00	46.27	48.43
13.00	10.40	46.27	47.66
13.33	10.67	47.66	47.66

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	24.12	75.00
1.25	1.00	24.17	75.00
2.00	1.60	24.24	74.99
2.50	2.00	24.33	74.98
3.00	2.40	24.40	74.51
3.75	3.00	24.75	74.05
4.00	3.20	24.84	73.64
5.00	4.00	25.39	72.44
5.00	4.00	25.39	72.44
6.00	4.80	26.22	70.22
6.25	5.00	26.45	69.77
7.00	5.60	27.05	68.31
7.50	6.00	27.46	67.50
8.00	6.40	27.82	66.78
8.75	7.00	28.60	65.85
9.00	7.20	28.84	65.41
10.00	8.00	30.06	63.88
10.00	8.00	30.06	63.88
11.00	8.80	31.27	62.58
11.25	9.00	31.59	62.30
12.00	9.60	32.49	61.43
12.50	10.00	33.04	60.91
13.00	10.40	33.55	60.40
13.33	10.67	33.90	60.08



4-USA: New England Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

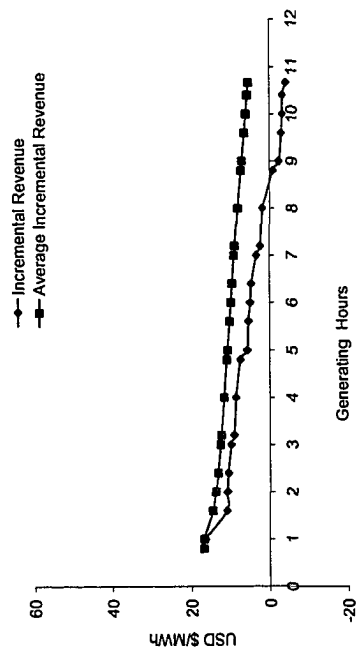
5-Germany: Leipzig Exchange Weekday

USD/MWh	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
10.17	8.1	8.3	8.4	8.9	9.0	9.4	10.2	11.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50
8.97	8.3	8.4	8.9	9.0	9.4	10.2	11.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	10.17
8.33	8.4	8.9	9.0	9.4	10.2	11.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	8.97	8.33
8.07	9.0	9.4	10.2	11.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	8.07	8.07	8.33	8.07
8.37	9.4	10.2	11.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	8.37	8.37	8.07	8.37	8.07
9.39	10.2	11.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	9.39	9.39	8.37	9.39	8.37	8.07
11.87	11.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	11.87	11.87	9.39	11.87	9.39	8.37	8.07
16.24	11.9	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	16.24	16.24	9.39	16.24	9.39	8.37	8.07
18.58	12.9	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	18.58	18.58	9.39	18.58	9.39	8.37	8.07
19.61	13.3	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	19.61	19.61	9.39	19.61	9.39	8.37	8.07
21.34	15.0	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	21.34	21.34	9.39	21.34	9.39	8.37	8.07
26.98	16.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	26.98	26.98	9.39	26.98	9.39	8.37	8.07
21.12	16.5	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	21.12	21.12	9.39	21.12	9.39	8.37	8.07
19.89	17.2	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	19.89	19.89	9.39	19.89	9.39	8.37	8.07
17.87	17.2	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	17.87	17.87	9.39	17.87	9.39	8.37	8.07
16.49	17.9	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	16.49	16.49	9.39	16.49	9.39	8.37	8.07
17.23	18.6	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	17.23	17.23	9.39	17.23	9.39	8.37	8.07
20.41	19.6	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	20.41	20.41	9.39	20.41	9.39	8.37	8.07
20.22	19.9	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	20.22	20.22	9.39	20.22	9.39	8.37	8.07
17.21	20.2	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	17.21	17.21	9.39	17.21	9.39	8.37	8.07
15.02	20.4	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	15.02	15.02	9.39	15.02	9.39	8.37	8.07
13.34	21.1	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	13.34	13.34	9.39	13.34	9.39	8.37	8.07
12.92	21.3	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	12.92	12.92	9.39	12.92	9.39	8.37	8.07
11.50	21.7	11.87	16.24	18.58	19.61	21.34	21.12	26.98	16.49	17.23	20.22	20.41	20.22	17.21	15.02	13.34	12.92	11.50	11.50	11.50	9.39	11.50	9.39	8.37	8.07

Efficiency
 B 0.80
 S 1.25 1
 B 2.50 2
 S 3.75 3
 B 5.00 4
 S 6.25 5
 B 7.50 6
 S 8.75 7
 B 10.00 8
 S 11.25 9
 B 12.50 10
 S 13.75 11
 B 15.00 12
 S 16.25 13
 B 17.50 14
 S 18.75 15
 B 20.00 16
 S 21.25 17
 B 22.50 18
 S 23.75 19
 B 25.00 20
 S 26.25 21
 B 27.50 22
 S 28.75 23
 B 30.00 24

Pump 0.00 1.00 1.25 2.00 2.50 3.00 3.75 4.00 5.00 6.00 6.25 7.00 8.00 8.00 8.00 8.00 8.00 8.00 8.00 8.00 8.00 8.00 9.60 12.50 13.00 13.33
 Gen 0.00 0.80 1.00 1.60 2.00 2.40 3.00 3.20 4.00 4.80 5.00 5.60 6.00 6.40 7.00 8.00 8.00 8.00 8.00 8.00 8.00 8.00 9.60 10.00 10.40 10.67
 Total 0.00 1.80 2.25 3.60 4.50 5.40 6.75 7.20 9.00 10.80 11.25 12.60 14.40 15.75 16.20 18.00 18.00 18.00 18.00 18.00 18.00 18.00 21.60 22.50 23.40 24.00
 paid 8.07 26.98 26.98 8.33 21.34 21.34 8.37 21.12 20.41 20.22 20.22 11.50 19.89 19.89 11.87 18.58 18.58 18.58 18.58 18.58 18.58 17.87 15.02 14.30 12.18 8.24
 DiPaid 8.07 2.08 6.25 4.18 4.18 6.73 2.24 2.24 9.39 10.17 10.17 2.88 5.93 5.93 3.72 3.72 3.72 3.72 3.72 3.72 3.72 3.72 4.06 3.57 8.24 6.88
 DiSold 21.58 5.40 12.80 8.53 8.45 12.67 4.08 4.08 16.33 16.18 16.18 4.04 7.85 7.85 11.77 14.87 14.87 14.87 14.87 14.87 14.87 14.30 10.34 6.89 6.88 4.59
 Profit 13.51 3.31 6.56 4.35 4.26 5.94 1.84 1.84 6.93 6.01 6.01 1.17 3.31 3.31 2.08 0.49 0.49 0.49 0.49 0.49 0.49 0.00 0.00 0.00 0.00 -1.15

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
16.89	16.89	13.51
16.57	16.82	16.82
10.93	14.61	23.38
10.87	13.86	27.73
10.66	13.33	31.99
9.91	12.65	37.94
9.20	12.43	39.78
8.67	11.68	46.71
8.67	11.68	46.71
7.51	10.98	52.71
5.84	10.78	53.88
5.51	10.21	57.19
5.06	9.87	59.21
4.78	9.55	61.13
3.46	9.03	63.20
2.43	8.85	63.69
1.91	8.15	65.22
1.91	8.15	65.22
-0.90	7.33	64.50
-2.43	7.11	64.01
-3.07	6.48	62.17
-3.37	6.08	60.82
-3.40	5.72	59.46
-4.30	5.47	58.31

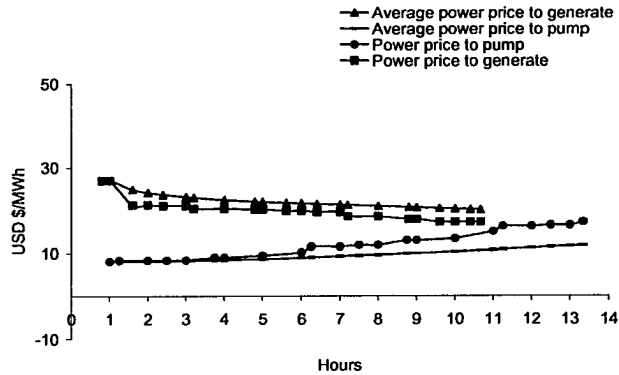


5-Germany: Leipzig Exchange Weekday

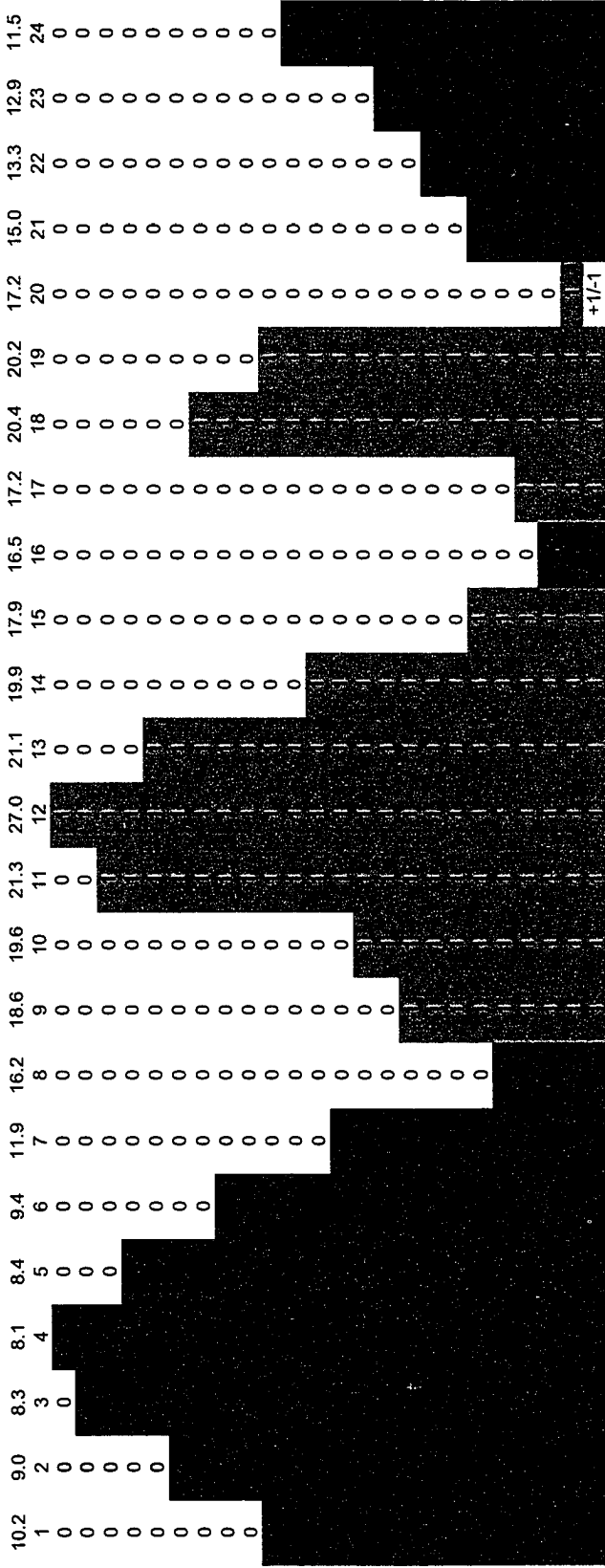
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	16.89	16.89
1.00	16.57	16.82
1.60	10.93	14.61
2.00	10.87	13.86
2.40	10.66	13.33
3.00	9.91	12.65
3.20	9.20	12.43
4.00	8.67	11.68
4.00	8.67	11.68
4.80	7.51	10.98
5.00	5.84	10.78
5.60	5.51	10.21
6.00	5.06	9.87
6.40	4.78	9.55
7.00	3.46	9.03
7.20	2.43	8.85
8.00	1.91	8.15
8.00	1.91	8.15
8.80	-0.90	7.33
9.00	-2.43	7.11
9.60	-3.07	6.48
10.00	-3.37	6.08
10.40	-3.40	5.72
10.67	-4.30	5.47

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	8.07	26.98
1.25	1.00	8.33	26.98
2.00	1.60	8.33	21.34
2.50	2.00	8.37	21.34
3.00	2.40	8.37	21.12
3.75	3.00	8.97	21.12
4.00	3.20	8.97	20.41
5.00	4.00	9.39	20.41
5.00	4.00	9.39	20.41
6.00	4.80	10.17	20.22
6.25	5.00	11.50	20.22
7.00	5.60	11.50	19.89
7.50	6.00	11.87	19.89
8.00	6.40	11.87	19.61
8.75	7.00	12.92	19.61
9.00	7.20	12.92	18.58
10.00	8.00	13.34	18.58
10.00	8.00	13.34	18.58
11.00	8.80	15.02	17.87
11.25	9.00	16.24	17.87
12.00	9.60	16.24	17.23
12.50	10.00	16.49	17.23
13.00	10.40	16.49	17.21
13.33	10.67	17.21	17.21

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	8.07	26.98
1.25	1.00	8.12	26.98
2.00	1.60	8.20	24.86
2.50	2.00	8.23	24.16
3.00	2.40	8.26	23.65
3.75	3.00	8.40	23.14
4.00	3.20	8.43	22.97
5.00	4.00	8.63	22.46
5.00	4.00	8.63	22.46
6.00	4.80	8.88	22.09
6.25	5.00	8.99	22.01
7.00	5.60	9.26	21.79
7.50	6.00	9.43	21.66
8.00	6.40	9.58	21.53
8.75	7.00	9.87	21.37
9.00	7.20	9.95	21.29
10.00	8.00	10.29	21.02
10.00	8.00	10.29	21.02
11.00	8.80	10.72	20.73
11.25	9.00	10.85	20.67
12.00	9.60	11.18	20.45
12.50	10.00	11.39	20.33
13.00	10.40	11.59	20.21
13.33	10.67	11.73	20.13



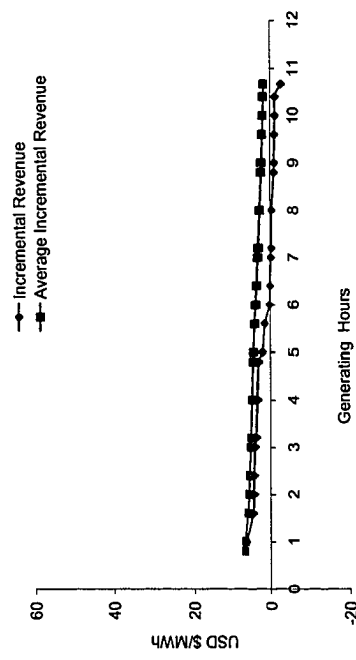
5-Germany: Leipzig Exchange Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

5-Germany: Leipzig Exchange Weekend

	USD/MWh	Efficiency	0.80	S	B	S	Pump	Gen	Total	paid	sold	DirPaid	DirSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	9.55						0.00	0.00	0.00						6.63		
2	8.28	1	0.80	1.25	1	1.00	0.80	1.80	6.42	14.66	6.42	11.73	5.31	6.14	6.63	6.63	5.31
3	7.56	2	1.60	2.50	2	1.25	1.00	2.25	6.81	14.66	1.70	2.93	1.23	4.47	6.14	6.53	6.53
4	7.17	3	2.40	3.75	3	2.00	1.60	3.60	6.81	12.98	5.11	7.79	2.68	4.27	5.76	9.22	9.22
5	6.97	4	3.20	5.00	4	2.50	2.00	4.50	6.97	12.98	3.49	5.19	1.71	4.24	5.46	10.93	10.93
6	6.81	5	4.00	6.25	5	3.00	2.40	5.40	6.97	12.98	3.49	5.18	1.69	3.99	5.26	12.62	12.62
7	6.42	6	4.80	7.50	6	3.75	3.00	6.75	7.17	12.95	5.37	7.77	2.39	3.76	5.00	15.01	15.01
8	7.42	7	5.60	8.75	7	4.00	3.20	7.20	7.17	12.71	1.79	2.54	0.75	3.44	4.93	15.76	15.76
9	9.38	8	6.40	10.00	8	5.00	4.00	9.00	7.42	12.71	7.42	10.17	2.75	3.09	4.63	18.51	18.51
10	11.21	9	7.20	11.25	9	6.00	4.80	10.80	7.56	12.54	7.56	10.03	2.47	2.19	4.37	20.98	20.98
11	12.95	10	8.00	12.50	10	6.25	5.00	11.25	8.28	12.54	2.07	2.51	0.44	1.57	4.28	21.42	21.42
12	14.66	11	9.60	15.00	12	7.00	5.60	12.60	8.28	11.93	6.21	7.16	0.94	0.20	3.99	22.37	22.37
13	12.98	12	10.40	16.25	13	7.50	6.00	13.50	9.38	11.93	4.69	4.77	0.08	0.05	3.74	22.45	22.45
14	11.23	13	11.20	17.50	14	8.00	6.40	14.40	9.38	11.78	4.69	4.71	0.02	-0.16	3.51	22.47	22.47
15	10.03	14	12.00	18.75	15	8.75	7.00	15.75	9.55	11.78	7.16	7.07	-0.09	-0.31	3.20	22.38	22.38
16	9.61	15	12.80	20.00	16	9.00	7.20	16.20	9.55	11.62	2.39	2.32	-0.06	-0.39	3.10	22.31	22.31
17	9.93	16	13.60	21.25	17	10.00	8.00	18.00	9.61	11.62	9.61	9.30	-0.31	-0.39	2.75	22.00	22.00
18	11.78	17	14.40	22.50	18	11.00	8.80	19.80	9.87	11.31	9.87	9.05	-0.82	-1.03	2.41	21.18	21.18
19	12.71	18	15.20	23.75	19	11.25	9.00	20.25	9.93	11.31	2.48	2.26	-0.22	-1.10	2.33	20.96	20.96
20	12.54	19	16.00	25.00	20	12.00	9.60	21.60	9.93	11.23	7.45	6.74	-0.71	-1.18	2.11	20.25	20.25
21	11.62	20	16.80	26.25	21	12.50	10.00	22.50	10.03	11.23	5.02	4.49	-0.52	-1.31	1.97	19.72	19.72
22	11.31	21	17.60	27.50	22	13.00	10.40	23.40	10.03	11.21	5.02	4.48	-0.53	-1.33	1.85	19.19	19.19
23	11.93	22	18.40	28.75	23	13.33	10.67	24.00	11.21	11.21	3.74	2.99	-0.75	-2.80	1.73	18.45	18.45
24	9.87	23	19.20	30.00	24												
24	14.7	6.4															
24	14.7	6.4															

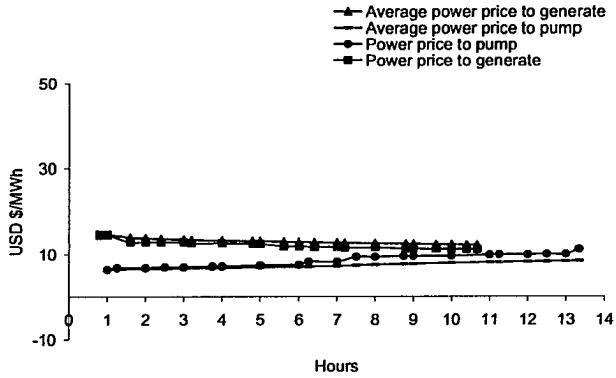


5-Germany: Leipzig Exchange Weekend

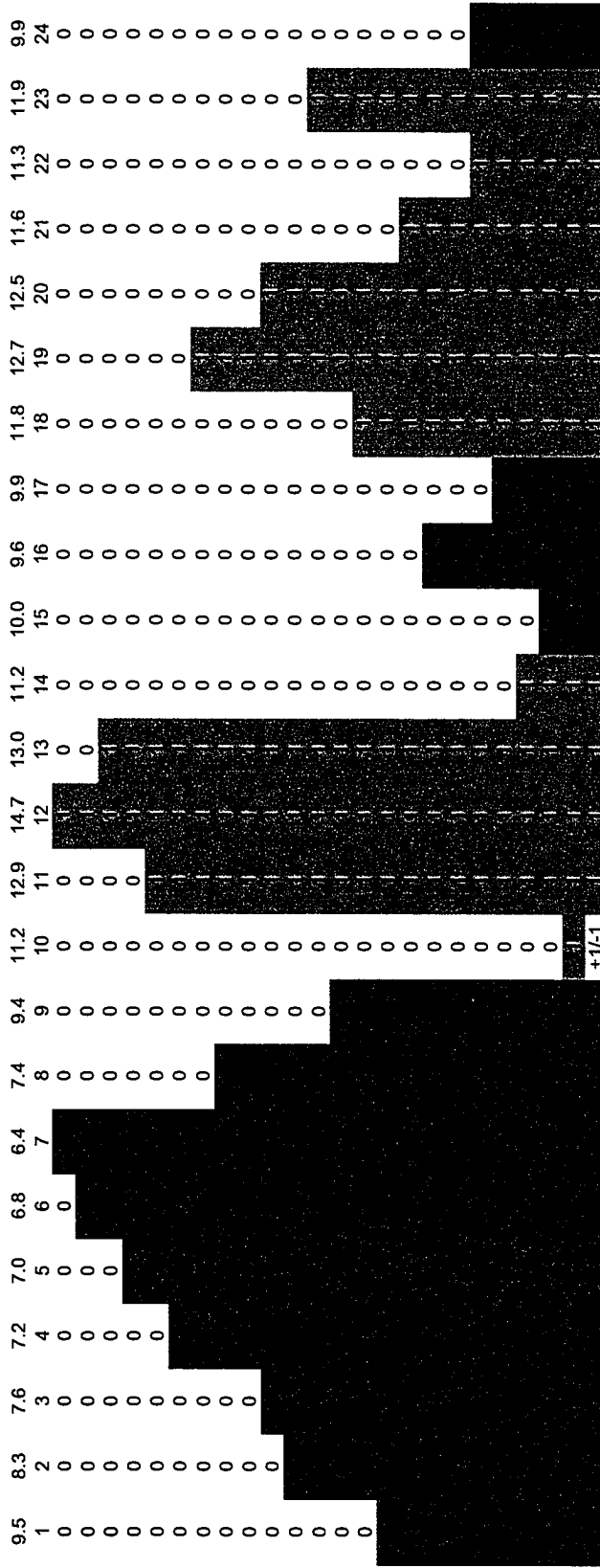
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	6.63	6.63
1.00	6.14	6.53
1.60	4.47	5.76
2.00	4.27	5.46
2.40	4.24	5.26
3.00	3.99	5.00
3.20	3.76	4.93
4.00	3.44	4.63
4.00	3.44	4.63
4.80	3.09	4.37
5.00	2.19	4.28
5.60	1.57	3.99
6.00	0.20	3.74
6.40	0.05	3.51
7.00	-0.16	3.20
7.20	-0.31	3.10
8.00	-0.39	2.75
8.00	-0.39	2.75
8.80	-1.03	2.41
9.00	-1.10	2.33
9.60	-1.18	2.11
10.00	-1.31	1.97
10.40	-1.33	1.85
10.67	-2.80	1.73

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	6.42	14.66
1.25	1.00	6.81	14.66
2.00	1.60	6.81	12.98
2.50	2.00	6.97	12.98
3.00	2.40	6.97	12.95
3.75	3.00	7.17	12.95
4.00	3.20	7.17	12.71
5.00	4.00	7.42	12.71
5.00	4.00	7.42	12.71
6.00	4.80	7.56	12.54
6.25	5.00	8.28	12.54
7.00	5.60	8.28	11.93
7.50	6.00	9.38	11.93
8.00	6.40	9.38	11.78
8.75	7.00	9.55	11.78
9.00	7.20	9.55	11.62
10.00	8.00	9.61	11.62
10.00	8.00	9.61	11.62
11.00	8.80	9.87	11.31
11.25	9.00	9.93	11.31
12.00	9.60	9.93	11.23
12.50	10.00	10.03	11.23
13.00	10.40	10.03	11.21
13.33	10.67	11.21	11.21

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	6.42	14.66
1.25	1.00	6.50	14.66
2.00	1.60	6.62	14.03
2.50	2.00	6.69	13.82
3.00	2.40	6.73	13.68
3.75	3.00	6.82	13.53
4.00	3.20	6.84	13.48
5.00	4.00	6.96	13.33
5.00	4.00	6.96	13.33
6.00	4.80	7.06	13.20
6.25	5.00	7.11	13.17
7.00	5.60	7.23	13.04
7.50	6.00	7.38	12.96
8.00	6.40	7.50	12.89
8.75	7.00	7.68	12.79
9.00	7.20	7.73	12.76
10.00	8.00	7.92	12.65
10.00	8.00	7.92	12.65
11.00	8.80	8.09	12.53
11.25	9.00	8.14	12.50
12.00	9.60	8.25	12.42
12.50	10.00	8.32	12.37
13.00	10.40	8.39	12.33
13.33	10.67	8.46	12.30



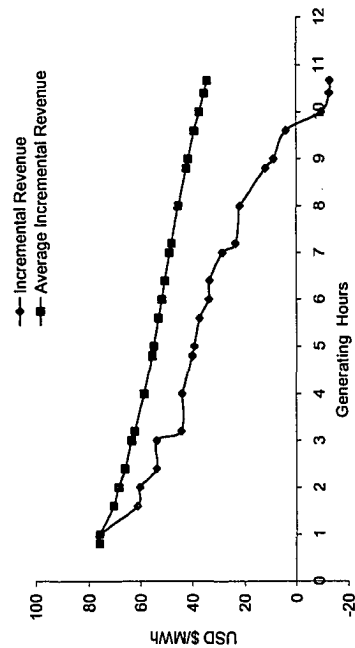
5-Germany: Leipzig Exchange Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

e-Netherlands Weekday

USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	paid	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	25.65	0	22.5	104.0	0.00	0.00	0.00	22.49	103.96	22.49	83.17	60.68	75.85	75.85	60.68
2	23.37	1	22.6	89.4	1.00	0.80	1.80	22.57	103.96	5.64	20.79	16.15	75.75	75.83	75.83
3	23.66	2	23.3	82.9	1.25	1.00	2.25	22.57	89.44	16.93	53.67	36.74	61.23	70.36	112.57
4	22.49	3	23.4	73.4	2.00	1.60	3.60	23.32	89.44	11.66	35.78	24.12	60.29	68.34	136.69
5	22.57	4	23.7	72.2	2.50	2.00	4.50	23.32	82.87	11.66	33.15	21.49	53.72	65.91	158.17
6	23.32	5	25.7	70.0	3.00	2.40	5.40	23.37	82.87	17.53	49.72	32.19	53.66	63.46	190.37
7	26.28	6	26.3	69.8	3.75	3.00	6.75	23.37	73.42	5.84	14.68	8.84	44.21	62.25	199.21
8	51.95	7	29.2	64.9	4.00	4.00	8.00	23.66	73.42	23.66	58.74	35.08	43.85	58.57	234.29
9	64.92	8	33.2	59.9	5.00	4.00	9.00	23.66	73.42	0.00	0.00	0.00	43.85	58.57	234.29
10	70.04	9	34.3	55.0	6.00	4.80	10.80	25.65	72.16	25.65	57.73	32.07	40.09	55.49	266.36
11	89.44	10	38.4	51.9	6.25	5.00	11.25	26.28	72.16	6.57	14.43	7.86	39.31	54.84	274.22
12	103.96	11	40.9	51.8	7.00	5.60	12.60	26.28	70.04	19.71	42.03	22.32	37.20	52.95	296.54
13	73.42	12	51.8	40.9	7.50	6.00	13.50	29.17	70.04	14.59	28.02	13.43	33.58	51.66	309.97
14	82.87	13	51.9	38.4	8.00	6.40	14.40	29.17	69.80	14.59	27.92	13.33	33.33	50.52	323.31
15	69.80	14	55.0	34.3	8.75	7.00	15.75	33.16	69.80	24.87	41.88	17.01	28.35	48.62	340.32
16	59.93	15	59.9	33.2	9.00	7.20	16.20	33.16	64.92	8.29	12.98	4.69	23.47	47.92	345.01
17	51.82	16	64.9	29.2	10.00	8.00	18.00	34.34	64.92	34.34	51.93	17.60	21.99	45.33	362.61
18	72.16	17	69.8	26.3	10.00	8.00	18.00	34.34	64.92	0.00	0.00	0.00	21.99	45.33	362.61
19	55.04	18	70.0	25.7	11.00	8.80	19.80	38.39	59.93	38.39	47.94	9.55	11.94	42.29	372.16
20	40.88	19	72.2	23.7	11.25	9.00	20.25	40.88	59.93	10.22	11.99	1.76	8.82	41.55	373.92
21	38.39	20	73.4	23.4	12.00	9.60	21.60	40.88	55.04	30.66	33.02	2.36	3.93	39.20	376.28
22	34.34	21	82.9	23.3	12.50	10.00	22.50	51.82	55.04	25.91	22.01	-3.89	-9.73	37.24	372.39
23	33.16	22	89.4	22.6	13.00	10.40	23.40	51.82	51.95	25.91	20.78	-5.13	-12.82	35.31	367.26
24	29.17	23	104.0	22.5	13.33	10.67	24.00	51.95	51.95	17.32	13.85	-3.46	-12.99	34.11	363.80
24	104.0	24	104.0	22.5											

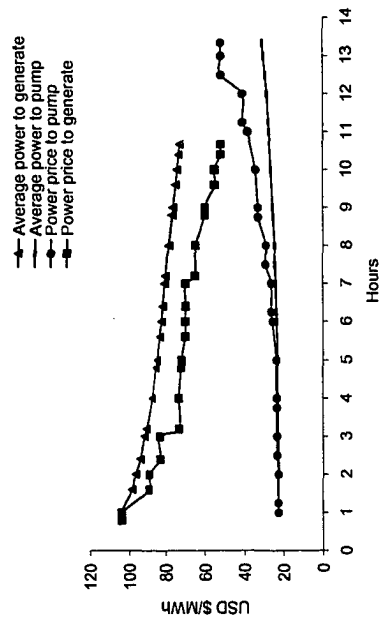


6-Netherlands Weekday

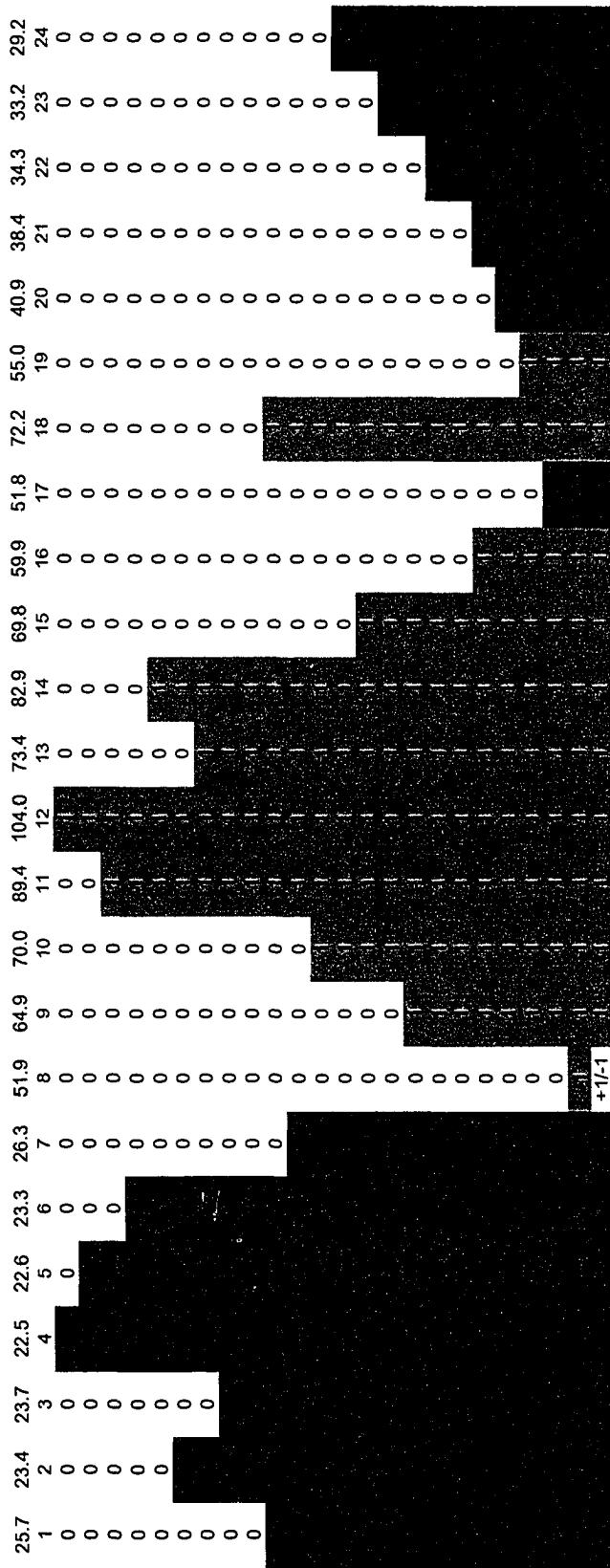
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	75.85	75.85
1.00	75.75	75.83
1.60	61.23	70.36
2.00	60.29	68.34
2.40	53.72	65.91
3.00	53.66	63.46
3.20	44.21	62.25
4.00	43.85	58.57
4.80	40.09	55.49
5.00	39.31	54.84
5.60	37.20	52.95
6.00	33.58	51.66
6.40	33.33	50.52
7.00	28.35	48.62
7.20	23.47	47.92
8.00	21.99	45.33
8.00	21.99	45.33
8.80	11.94	42.29
9.00	8.82	41.55
9.60	3.93	39.20
10.00	-9.73	37.24
10.40	-12.82	35.31
10.67	-12.99	34.11

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	22.49	103.96
1.25	1.00	22.57	103.96
2.00	1.60	22.57	89.44
2.50	2.00	23.32	89.44
3.00	2.40	23.32	82.87
3.75	3.00	23.37	82.87
4.00	3.20	23.37	73.42
5.00	4.00	23.66	73.42
5.00	4.00	23.66	73.42
6.00	4.80	25.65	72.16
6.25	5.00	26.28	72.16
7.00	5.60	26.28	70.04
7.50	6.00	29.17	70.04
8.00	6.40	29.17	69.80
8.75	7.00	33.16	69.80
9.00	7.20	33.16	64.92
10.00	8.00	34.34	64.92
10.00	8.00	34.34	64.92
11.00	8.80	36.39	59.93
11.25	9.00	40.88	59.93
12.00	9.60	40.88	55.04
12.50	10.00	51.82	55.04
13.00	10.40	51.82	51.95
13.33	10.67	51.95	51.95

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	22.49	103.96
1.25	1.00	22.50	103.96
2.00	1.60	22.53	98.52
2.50	2.00	22.69	96.70
3.00	2.40	22.79	94.40
3.75	3.00	22.91	92.09
4.00	3.20	22.94	90.92
5.00	4.00	23.08	87.42
5.00	4.00	23.08	87.42
6.00	4.80	23.51	84.88
6.25	5.00	23.62	84.37
7.00	5.60	23.91	82.94
7.50	6.00	24.26	81.98
8.00	6.40	24.56	81.22
8.75	7.00	25.30	80.24
9.00	7.20	25.52	79.82
10.00	8.00	26.40	78.33
10.00	8.00	26.40	78.33
11.00	8.80	27.49	76.65
11.25	9.00	27.79	76.28
12.00	9.60	28.61	74.95
12.50	10.00	29.54	74.16
13.00	10.40	30.39	73.30
13.33	10.67	30.93	72.77



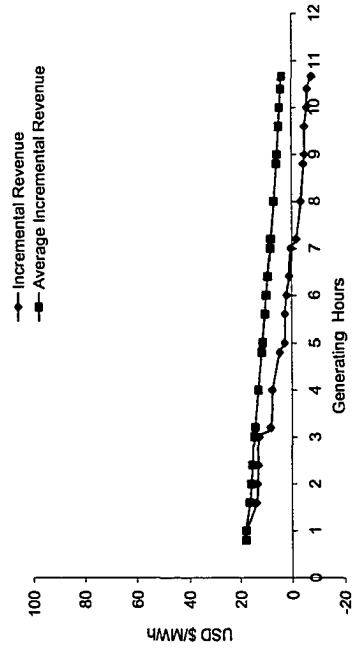
6-Netherlands Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

6-Netherlands Weekend

USD/MWh	Efficiency	0.80	S	B	S	Pump	Gen	Total	paid	paid	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	25.31	0	21.0	44.2	0.80	1.25	1	0.00	20.96	44.18	20.96	35.34	14.38	17.97	17.97	14.38
2	23.13	1	21.0	40.2	1.60	2.90	2	1.80	21.04	44.18	5.26	8.84	3.57	17.87	17.95	17.95
3	22.24	2	21.4	39.8	2.40	3.75	3	3.60	21.04	40.19	15.78	24.11	8.33	13.88	16.43	26.28
4	21.63	3	21.6	35.6	3.20	5.00	4	4.50	21.44	40.19	10.72	16.08	5.36	13.39	15.82	31.64
5	21.44	4	22.2	33.7	4.00	6.25	5	5.40	21.44	39.83	10.72	15.93	5.21	13.04	15.36	36.86
6	21.04	5	23.1	33.5	4.80	7.50	6	6.75	21.63	39.83	16.22	23.90	7.68	12.79	14.84	44.53
7	20.96	6	24.8	32.5	5.60	8.75	7	7.20	21.63	35.61	5.41	7.12	1.71	8.57	14.45	46.25
8	24.76	7	25.3	30.5	6.40	10.00	8	9.00	22.24	35.61	22.24	28.49	6.25	7.82	13.12	52.50
9	27.13	8	25.7	30.4	7.20	11.25	9	9.00	22.24	35.61	0.00	0.00	0.00	7.82	13.12	52.50
10	30.32	9	27.1	30.3	8.00	12.50	10	10.80	23.13	33.73	23.13	26.98	3.85	4.81	11.74	56.35
11	33.51	10	27.9	30.0	8.80	13.75	11	11.25	24.76	33.73	6.19	6.75	0.56	2.78	11.38	56.91
12	35.61	11	28.2	28.9	9.60	15.00	12	12.60	24.76	33.51	18.57	20.11	1.54	2.56	10.44	58.44
13	32.50	12	28.9	28.2	10.40	16.25	13	13.50	25.31	33.51	12.65	13.41	0.75	1.88	9.87	59.20
14	30.43	13	30.0	27.9	11.20	17.50	14	14.40	25.31	32.50	12.65	13.00	0.34	0.86	9.30	59.54
15	28.87	14	30.3	27.1	12.00	18.75	15	15.75	25.72	30.51	19.29	19.50	0.21	0.35	8.54	59.75
16	27.91	15	30.4	25.7	12.80	20.00	16	16.20	25.72	30.51	6.43	6.10	-0.33	-1.64	8.25	59.42
17	28.21	16	30.5	25.3	13.60	21.25	17	18.00	27.13	30.51	27.13	24.41	-2.72	-3.40	7.09	56.70
18	40.19	17	32.5	24.8	14.40	22.50	18	18.00	27.13	30.51	0.00	0.00	0.00	-3.40	7.09	56.70
19	44.18	18	33.5	23.1	15.20	23.75	19	19.80	27.91	30.43	27.91	24.34	-3.56	-4.45	6.04	53.13
20	39.83	19	33.7	22.2	16.00	25.00	20	20.25	28.21	30.43	7.05	6.09	-0.97	-4.84	5.80	52.17
21	33.73	20	35.6	21.6	16.80	26.25	21	21.60	28.21	30.32	21.16	18.19	-2.97	-4.94	5.12	49.20
22	30.01	21	39.8	21.4	17.60	27.50	22	22.50	28.87	30.32	14.44	12.13	-2.31	-5.77	4.69	46.89
23	30.51	22	40.2	21.0	18.40	28.75	23	23.40	28.87	30.01	14.44	12.01	-2.43	-6.08	4.28	44.46
24	25.72	23	44.2	21.0	19.20	30.00	24	24.00	30.01	30.01	10.00	8.00	-2.00	-7.50	3.98	42.46
24	44.2	24	44.2	21.0												



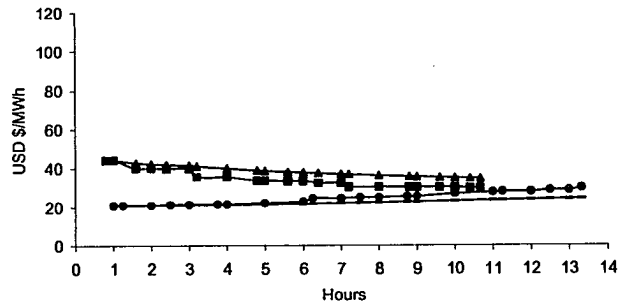
6-Netherlands Weekend

Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	17.97	17.97
1.00	17.87	17.95
1.60	13.88	16.43
2.00	13.39	15.82
2.40	13.04	15.36
3.00	12.79	14.84
3.20	8.57	14.45
4.00	7.82	13.12
4.00	7.82	13.12
4.80	4.81	11.74
5.00	2.78	11.38
5.60	2.56	10.44
6.00	1.88	9.87
6.40	0.86	9.30
7.00	0.35	8.54
7.20	-1.64	8.25
8.00	-3.40	7.09
8.00	-3.40	7.09
8.80	-4.45	6.04
9.00	-4.84	5.80
9.60	-4.94	5.12
10.00	-5.77	4.69
10.40	-6.08	4.28
10.67	-7.50	3.98

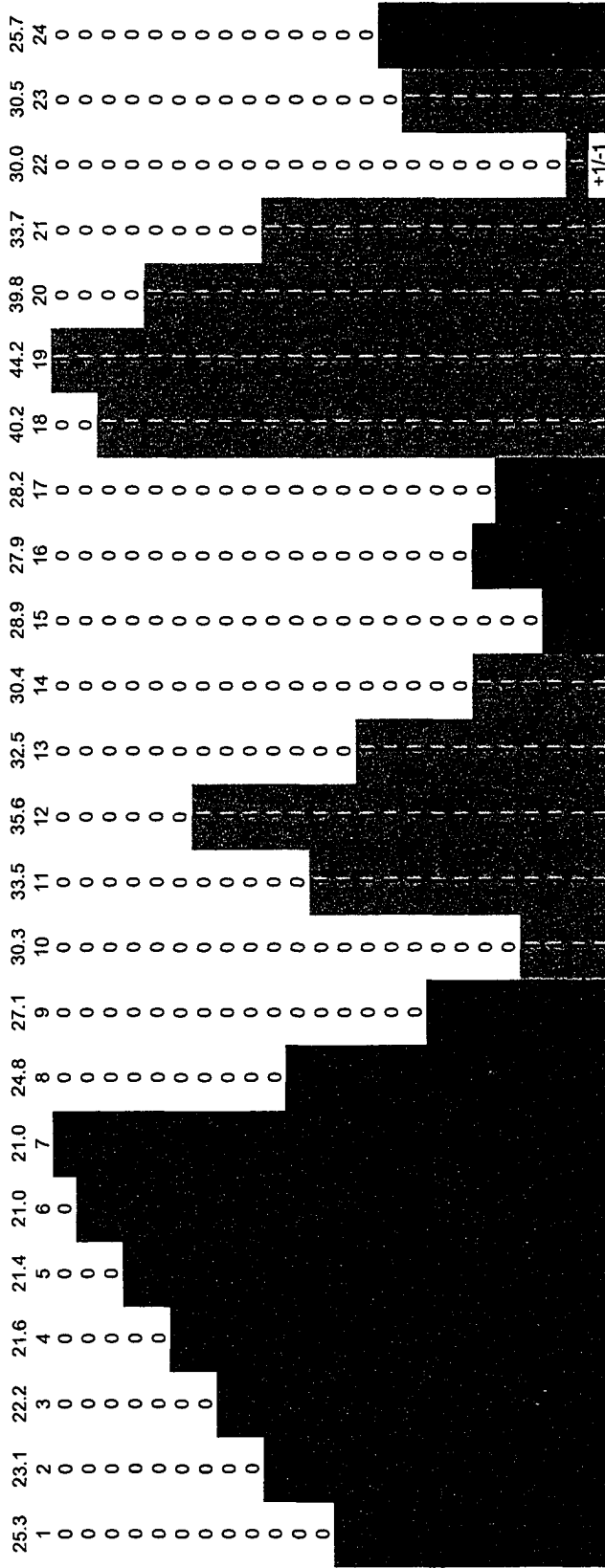
Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	20.96	44.18
1.25	1.00	21.04	44.18
2.00	1.60	21.04	40.19
2.50	2.00	21.44	40.19
3.00	2.40	21.44	39.83
3.75	3.00	21.63	39.83
4.00	3.20	21.63	35.61
5.00	4.00	22.24	35.61
5.00	4.00	22.24	35.61
6.00	4.80	23.13	33.73
6.25	5.00	24.76	33.73
7.00	5.60	24.76	33.51
7.50	6.00	25.31	33.51
8.00	6.40	25.31	32.50
8.75	7.00	25.72	32.50
9.00	7.20	25.72	30.51
10.00	8.00	27.13	30.51
10.00	8.00	27.13	30.51
11.00	8.80	27.91	30.43
11.25	9.00	28.21	30.43
12.00	9.60	28.21	30.32
12.50	10.00	28.87	30.32
13.00	10.40	28.87	30.01
13.33	10.67	30.01	30.01

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	20.96	44.18
1.25	1.00	20.98	44.18
2.00	1.60	21.00	42.68
2.50	2.00	21.09	42.18
3.00	2.40	21.15	41.79
3.75	3.00	21.24	41.40
4.00	3.20	21.27	41.04
5.00	4.00	21.48	39.95
5.00	4.00	21.48	39.95
6.00	4.80	21.74	38.92
6.25	5.00	21.86	38.71
7.00	5.60	22.17	38.15
7.50	6.00	22.38	37.84
8.00	6.40	22.56	37.51
8.75	7.00	22.83	37.08
9.00	7.20	22.91	36.90
10.00	8.00	23.34	36.26
10.00	8.00	23.34	36.26
11.00	8.80	23.75	35.73
11.25	9.00	23.85	35.61
12.00	9.60	24.12	35.28
12.50	10.00	24.31	35.08
13.00	10.40	24.49	34.89
13.33	10.67	24.63	34.76

- ▲ Average power price to generate
- Average power price to pump
- Power price to pump
- Power price to generate



6-Netherlands Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

7-Britain Weekday

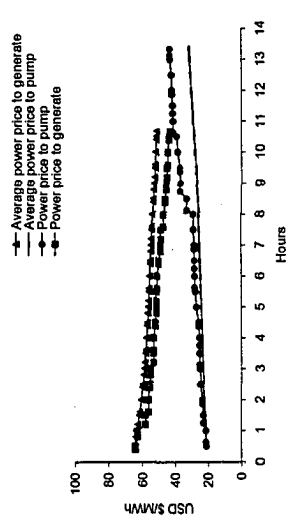
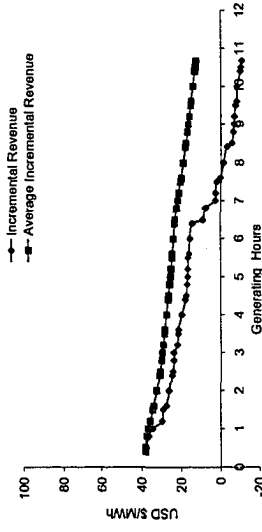
USD/MWh	Efficiency	B	S	B	S	Pump	Gen	Total	paid	solid	Diff/Paid	DI/Sold	Profit
0.5	24.86	0.0	21.1	64.3	0.5	0.40	0.63	0.5	0.50	0.40	0.90	0.00	0.00
1.0	25.17	0.5	21.3	63.0	1.0	0.80	1.25	1.0	0.63	0.50	1.13	64.35	10.57
1.5	28.06	1.0	22.9	58.2	1.5	1.20	1.88	1.5	1.00	0.80	1.80	64.35	2.66
2.0	28.71	1.5	23.3	56.4	2.0	1.60	2.50	2.0	1.25	1.00	2.25	63.00	6.43
2.5	26.95	2.0	24.3	55.6	2.5	2.00	3.13	2.5	1.50	1.20	2.70	63.00	7.99
3.0	27.85	2.5	24.9	55.1	3.0	2.40	3.75	3.0	1.88	1.50	3.38	63.00	10.91
3.5	27.51	3.0	25.2	53.4	3.5	2.80	4.38	3.5	2.00	1.60	3.60	63.00	12.60
4.0	25.56	3.5	25.2	53.3	4.0	3.20	5.00	4.0	2.50	2.00	4.50	63.00	17.45
4.5	24.33	4.0	25.6	52.3	4.5	3.60	5.63	4.5	2.50	2.00	4.50	63.00	17.45
5.0	22.89	4.5	26.9	51.6	5.0	4.00	6.25	5.0	3.00	2.40	5.40	63.00	8.73
5.5	21.31	5.0	27.5	51.5	5.5	4.40	6.88	5.5	3.13	2.50	5.63	63.00	8.73
6.0	21.14	5.5	27.9	51.0	6.0	4.80	7.50	6.0	3.50	2.80	6.30	63.00	2.42
6.5	23.28	6.0	28.1	49.9	6.5	5.20	8.13	6.5	3.75	3.00	6.75	63.00	2.42
7.0	28.61	6.5	28.2	48.7	7.0	5.60	8.75	7.0	4.00	3.20	7.20	63.00	7.10
7.5	36.83	7.0	28.6	48.5	7.5	6.00	9.38	7.5	4.38	3.50	7.88	63.00	4.73
8.0	41.28	7.5	28.7	47.0	8.0	6.40	10.00	8.0	4.50	3.60	8.10	63.00	6.42
8.5	46.01	8.0	32.9	46.0	8.5	6.80	10.63	8.5	4.00	3.50	7.50	63.00	2.13
9.0	48.72	8.5	36.8	45.2	9.0	7.20	11.25	9.0	5.00	4.00	9.00	63.00	2.13
9.5	49.92	9.0	37.3	45.0	9.5	7.60	11.88	9.5	5.00	4.00	9.00	63.00	7.83
10.0	53.36	9.5	38.6	44.5	10.0	8.00	12.50	10.0	5.50	4.40	9.90	63.00	0.00
10.5	51.61	10.0	39.3	43.8	10.5	8.40	13.13	10.5	6.00	4.80	10.80	63.00	0.00
11.0	48.54	10.5	41.3	43.2	11.0	8.80	13.75	11.0	6.25	5.00	11.25	63.00	1.58
11.5	51.54	11.0	41.6	43.1	11.5	9.20	14.38	11.5	6.50	5.20	11.70	63.00	1.58
12.0	55.12	11.5	42.0	42.2	12.0	9.60	15.00	12.0	6.88	5.50	12.38	63.00	4.90
12.5	58.18	12.0	42.2	42.0	12.5	10.00	15.63	12.5	7.00	5.60	12.60	63.00	4.90
13.0	55.63	12.5	43.1	41.6	13.0	10.40	16.25	13.0	7.50	6.00	13.50	63.00	1.58
13.5	45.04	13.0	43.2	41.3	13.5	10.80	16.88	13.5	7.50	6.00	13.50	63.00	1.58
14.0	42.22	13.5	43.8	39.3	14.0	11.20	17.50	14.0	8.00	6.40	14.40	63.00	1.58
14.5	42.03	14.0	44.5	38.6	14.5	11.60	18.13	14.5	8.13	6.50	14.63	63.00	1.58
15.0	41.65	14.5	45.0	37.3	15.0	12.00	18.75	15.0	8.50	6.80	15.30	63.00	1.58
15.5	39.29	15.0	45.2	36.8	15.5	12.40	19.38	15.5	8.75	7.00	15.75	63.00	1.58
16.0	38.59	15.5	46.0	32.9	16.0	12.80	20.00	16.0	9.00	7.20	16.20	63.00	1.58
16.5	45.22	16.0	47.0	28.7	16.5	13.20	20.63	16.5	9.38	7.50	16.88	63.00	1.58
17.0	56.36	16.5	48.5	28.6	17.0	13.60	21.25	17.0	9.50	7.60	17.10	63.00	1.58
17.5	64.35	17.0	48.7	28.2	17.5	14.00	21.88	17.5	10.00	8.00	18.00	63.00	1.58
18.0	63.00	17.5	49.9	28.1	18.0	14.40	22.50	18.0	10.00	8.00	18.00	63.00	1.58
18.5	53.25	18.0	51.0	27.9	18.5	14.80	23.13	18.5	10.50	8.40	18.90	63.00	1.58
19.0	52.15	18.5	51.5	27.5	19.0	15.20	23.75	19.0	10.63	8.50	19.13	63.00	1.58
19.5	51.03	19.0	51.6	26.9	19.5	15.60	24.38	19.5	11.00	8.80	19.80	63.00	1.58
20.0	46.95	19.5	52.2	25.6	20.0	16.00	25.00	20.0	11.25	9.00	20.25	63.00	1.58
20.5	43.05	20.0	53.3	25.2	20.5	16.40	25.63	20.5	11.50	9.20	20.70	63.00	1.58
21.0	43.05	20.5	53.4	25.2	21.0	16.80	26.25	21.0	11.88	9.50	21.38	63.00	1.58
21.5	44.45	21.0	55.1	24.9	21.5	17.20	26.88	21.5	12.00	9.60	21.60	63.00	1.58
22.0	43.19	21.5	55.6	24.3	22.0	17.60	27.50	22.0	12.50	10.00	22.50	63.00	1.58
22.5	37.29	22.0	56.4	23.3	22.5	18.00	28.13	22.5	12.50	10.00	22.50	63.00	1.58
23.0	32.86	22.5	58.2	22.9	23.0	18.40	28.75	23.0	13.00	10.40	23.40	63.00	1.58
23.5	28.15	23.0	63.0	21.3	23.5	18.80	29.38	23.5	13.13	10.50	23.63	63.00	1.58
24.0	25.19	23.5	64.3	21.1	24.0	19.20	30.00	24.0	13.33	10.67	24.00	63.00	1.58
24.0	64.3	24.0	64.3	21.1									

7-Britain Weekday

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
37.92	37.92	15.17
37.71	37.86	18.94
36.36	37.31	29.85
34.39	36.73	36.73
28.57	35.53	42.64
29.08	34.24	51.37
27.26	33.81	64.49
25.94	32.23	84.47
24.35	30.85	114.29
23.06	28.83	167.1
23.05	28.51	233.61
21.87	28.03	328.53
21.41	28.36	399.33
21.31	28.18	501.46
19.57	27.32	609.29
17.77	26.45	716.39
16.80	25.66	823.17
16.54	24.96	926.47
16.47	24.96	1027.77
15.84	24.33	1126.26
15.27	23.73	1222.37
14.04	23.12	1317.88
8.85	22.60	1488.87
7.64	22.23	1511.16
2.68	21.67	1511.70
2.48	21.14	1521.19
1.92	20.37	1527.77
0.34	20.11	1528.1
-1.29	19.04	1527.29
-3.10	17.98	1511.05
-5.59	17.70	1504.9
-6.39	16.88	1485.68
-7.02	15.85	1458.0
-8.09	15.11	1427.4
-8.32	13.94	1394.2
-8.32	13.94	1394.2
-10.05	13.02	1353.9
-10.23	12.80	1343.37
-10.80	12.43	1325.7

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	21.14	64.35
0.63	0.50	21.31	64.35
1.00	0.80	21.31	63.00
1.25	1.00	22.89	63.00
1.50	1.20	22.89	58.18
1.88	1.60	23.28	58.18
2.00	1.80	24.33	58.38
2.50	2.00	24.33	58.38
3.00	2.00	24.86	58.63
3.50	2.80	25.17	55.12
3.75	3.00	25.10	55.12
4.00	3.20	25.10	53.36
4.38	3.50	25.58	53.36
4.50	3.60	25.58	53.25
5.00	4.00	26.85	53.25
5.50	4.40	27.51	52.15
5.63	4.50	27.85	52.15
6.00	4.80	28.06	51.81
6.25	5.00	28.06	51.84
6.88	5.50	28.15	51.03
7.00	5.60	28.61	51.03
7.50	6.00	28.61	51.03
8.00	6.40	28.71	49.92
8.13	6.50	32.86	49.92
8.50	6.80	32.86	48.72
8.75	7.00	36.83	48.72
9.00	7.20	36.83	48.54
9.38	7.50	37.29	48.54
9.50	7.60	37.29	46.85
10.00	8.00	38.59	46.85
10.00	8.00	38.59	46.85
10.50	8.40	39.29	46.01
10.63	8.50	41.28	46.01
11.00	8.80	41.28	45.22
11.25	9.00	41.65	45.22
11.50	9.20	41.65	45.04
11.88	9.50	42.03	45.04
12.00	9.60	42.03	44.45
12.50	10.00	42.22	44.45
12.50	10.00	42.22	44.45
13.00	10.40	43.05	43.76
13.13	10.50	43.19	43.76
13.33	10.67	43.19	43.19

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	21.14	64.35
0.63	0.50	21.17	64.35
1.00	0.80	21.22	63.84
1.25	1.00	21.56	63.67
1.50	1.20	21.78	62.76
1.88	1.60	22.08	61.84
2.00	1.80	22.15	61.50
2.50	2.00	22.59	60.47
3.00	2.40	22.97	59.66
3.13	2.50	23.08	59.50
3.50	2.80	23.28	59.03
3.75	3.00	23.41	58.77
4.00	3.20	23.52	58.43
4.38	3.50	23.70	58.00
4.50	3.60	23.75	57.87
5.00	4.00	24.07	57.41
5.50	4.40	24.07	57.41
5.63	4.50	24.38	56.93
6.00	4.80	24.47	56.92
6.25	5.00	24.81	56.50
6.88	5.50	24.93	56.12
7.00	5.60	25.11	55.87
7.50	6.00	25.39	55.47
7.50	6.00	25.39	55.47
8.00	6.40	25.90	55.12
8.13	6.50	25.71	55.04
8.50	6.80	28.03	54.76
8.75	7.00	28.33	54.59
9.00	7.20	28.63	54.42
9.38	7.50	27.05	54.18
9.50	7.60	27.18	54.09
10.00	8.00	27.76	53.73
10.00	8.00	27.76	53.73
10.50	8.40	28.31	53.37
10.63	8.50	28.46	53.28
11.00	8.80	28.60	53.00
11.25	9.00	29.18	52.83
11.50	9.20	29.45	52.66
11.88	9.50	29.85	52.42
12.00	9.60	29.87	52.34
12.50	10.00	30.48	52.02
12.50	10.00	30.48	52.02
13.00	10.40	30.95	51.70
13.13	10.50	31.07	51.63
13.33	10.67	31.25	51.50





7-Britain Weekday

Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

7-Britain Weekend

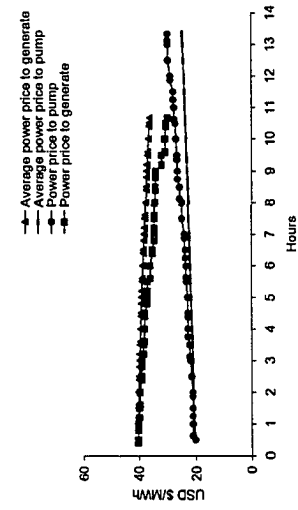
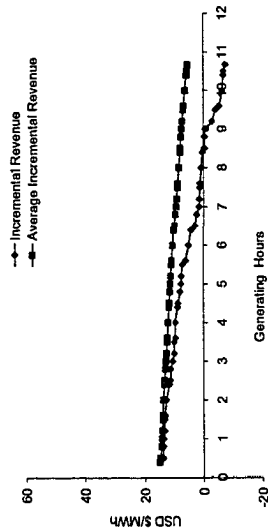
	USD/MWh	Efficiency	0.80	B	S	B	S	Pump	Gen	Total	paid	sold	DiPaid	DiSold	Profit
0.5	22.72	0.5	0.40	0.63	0.5	0.5	0.5	0.00	0.00	0.00	0.00	40.31	10.11	16.12	6.01
1.0	26.92	1.0	0.80	1.25	1.0	1.0	1.0	0.50	0.40	0.90	20.21	40.31	20.21	16.12	14.40
1.5	29.73	1.5	1.20	1.88	1.5	1.5	1.5	0.63	0.50	1.13	21.04	40.31	2.63	4.03	4.17
2.0	30.69	2.0	1.60	2.50	2.0	2.0	2.0	1.00	0.80	1.80	21.04	40.19	7.89	12.06	2.78
2.5	27.82	2.5	2.00	3.13	2.5	2.5	2.5	1.50	1.20	2.25	21.10	40.19	5.27	7.97	2.70
3.0	27.57	3.0	2.40	3.75	3.0	3.0	3.0	1.88	1.88	3.38	21.10	39.85	5.27	7.97	2.70
3.5	26.41	3.5	2.80	4.38	3.5	3.5	3.5	2.00	1.50	3.60	21.10	39.85	7.91	11.96	4.04
4.0	23.61	4.0	3.20	5.00	4.0	4.0	4.0	2.50	2.00	4.50	21.47	39.67	10.74	15.87	5.13
4.5	21.83	4.5	3.60	5.63	4.5	4.5	4.5	2.50	2.00	4.50	21.47	39.67	0.00	0.00	0.00
5.0	21.10	5.0	4.00	6.25	5.0	5.0	5.0	3.00	2.40	5.40	21.93	39.03	10.92	15.61	4.69
5.5	21.10	5.5	4.40	6.88	5.5	5.5	5.5	3.13	2.50	5.63	22.14	39.03	2.77	3.90	1.14
6.0	20.21	6.0	4.80	7.50	6.0	6.0	6.0	3.50	2.80	6.30	22.14	38.96	8.30	11.69	3.39
6.5	21.04	6.5	5.20	8.13	6.5	6.5	6.5	3.75	3.00	6.75	22.72	38.96	5.68	7.79	2.11
7.0	21.47	7.0	5.60	8.75	7.0	7.0	7.0	4.00	3.20	7.20	22.72	38.42	5.68	7.68	2.00
7.5	22.14	7.5	6.00	9.38	7.5	7.5	7.5	4.38	3.50	7.88	22.72	38.42	8.52	11.52	3.00
8.0	23.26	8.0	6.40	10.00	8.0	8.0	8.0	4.50	3.60	8.10	22.72	38.08	2.84	3.81	0.97
8.5	24.82	8.5	6.80	10.63	8.5	8.5	8.5	5.00	4.00	9.00	22.78	38.08	11.39	15.23	3.84
9.0	27.15	9.0	7.20	11.25	9.0	9.0	9.0	5.00	4.00	9.00	22.78	38.08	0.00	0.00	0.00
9.5	30.32	9.5	7.60	11.88	9.5	9.5	9.5	5.50	4.40	9.90	23.26	37.89	11.63	15.15	3.52
10.0	34.23	10.0	8.00	12.50	10.0	10.0	10.0	5.63	4.50	10.13	23.38	37.89	2.92	3.79	0.87
10.5	36.96	10.5	8.40	13.13	10.5	10.5	10.5	6.00	4.80	10.80	23.38	37.09	8.77	11.13	2.36
11.0	38.42	11.0	8.80	13.75	11.0	11.0	11.0	6.25	5.00	11.25	23.61	37.09	5.90	7.42	1.52
11.5	38.08	11.5	9.20	14.38	11.5	11.5	11.5	6.50	5.20	11.70	23.61	36.96	5.90	7.39	1.49
12.0	38.96	12.0	9.60	15.00	12.0	12.0	12.0	6.88	5.50	12.38	23.93	36.96	8.97	11.09	2.11
12.5	39.67	12.5	10.00	15.63	12.5	12.5	12.5	7.00	5.60	12.60	23.93	35.95	2.99	3.59	0.60
13.0	37.89	13.0	10.40	16.25	13.0	13.0	13.0	7.50	6.00	13.50	24.81	35.95	12.40	14.38	1.98
13.5	34.49	13.5	10.80	16.88	13.5	13.5	13.5	7.50	6.00	13.50	24.81	35.95	0.00	0.00	0.00
14.0	29.63	14.0	11.20	17.50	14.0	14.0	14.0	8.00	6.40	14.40	24.82	35.13	12.41	14.05	1.64
14.5	26.58	14.5	11.60	18.13	14.5	14.5	14.5	8.13	6.50	14.63	25.70	35.13	3.21	3.51	0.30
15.0	24.81	15.0	12.00	18.75	15.0	15.0	15.0	8.50	6.80	15.30	25.70	34.49	9.64	10.35	0.71
15.5	23.38	15.5	12.40	19.38	15.5	15.5	15.5	8.75	7.00	15.75	26.41	34.49	6.60	6.90	0.29
16.0	22.78	16.0	12.80	20.00	16.0	16.0	16.0	9.00	7.20	16.20	26.41	34.44	6.60	6.89	0.29
16.5	23.93	16.5	13.20	20.63	16.5	16.5	16.5	9.38	7.50	16.88	26.58	34.44	9.97	10.33	0.37
17.0	28.83	17.0	13.60	21.25	17.0	17.0	17.0	9.50	7.60	17.10	26.58	34.39	3.32	3.44	0.12
17.5	35.95	17.5	14.00	21.88	17.5	17.5	17.5	10.00	8.00	18.00	26.92	34.39	13.46	13.76	0.30
18.0	39.03	18.0	14.40	22.50	18.0	18.0	18.0	10.00	8.00	18.00	26.92	34.39	0.00	0.00	0.00
18.5	40.19	18.5	14.80	23.13	18.5	18.5	18.5	10.50	8.40	18.90	27.15	34.23	13.57	13.69	0.12
19.0	40.31	19.0	15.20	23.75	19.0	19.0	19.0	10.63	8.50	19.13	27.57	34.23	3.45	3.42	-0.02
19.5	39.65	19.5	15.60	24.38	19.5	19.5	19.5	11.00	8.80	19.80	27.57	34.13	10.34	10.24	-0.10
20.0	37.09	20.0	16.00	25.00	20.0	20.0	20.0	11.25	9.00	20.25	27.82	34.13	6.96	6.83	-0.13
20.5	35.13	20.5	16.40	25.63	20.5	20.5	20.5	11.50	9.20	20.70	27.82	31.94	6.96	6.39	-0.57
21.0	34.44	21.0	16.80	26.25	21.0	21.0	21.0	11.88	9.50	21.38	28.63	31.94	10.81	10.81	-1.23
21.5	34.13	21.5	17.20	26.88	21.5	21.5	21.5	12.00	9.60	21.60	28.63	30.69	3.60	3.07	-0.53
22.0	34.39	22.0	17.60	27.50	22.0	22.0	22.0	12.50	10.00	22.50	29.63	30.69	14.82	12.28	-2.54
22.5	31.94	22.5	18.00	28.13	22.5	22.5	22.5	12.50	10.00	22.50	29.63	30.69	0.00	0.00	0.00
23.0	29.65	23.0	18.40	28.75	23.0	23.0	23.0	13.00	10.40	23.40	29.65	30.32	14.83	12.13	-2.70
23.5	25.70	23.5	18.80	29.38	23.5	23.5	23.5	13.13	10.50	23.63	29.73	30.32	3.72	3.03	-0.68
24.0	22.72	24.0	19.20	30.00	24.0	24.0	24.0	13.33	10.87	24.00	29.73	29.73	6.19	4.95	-1.24

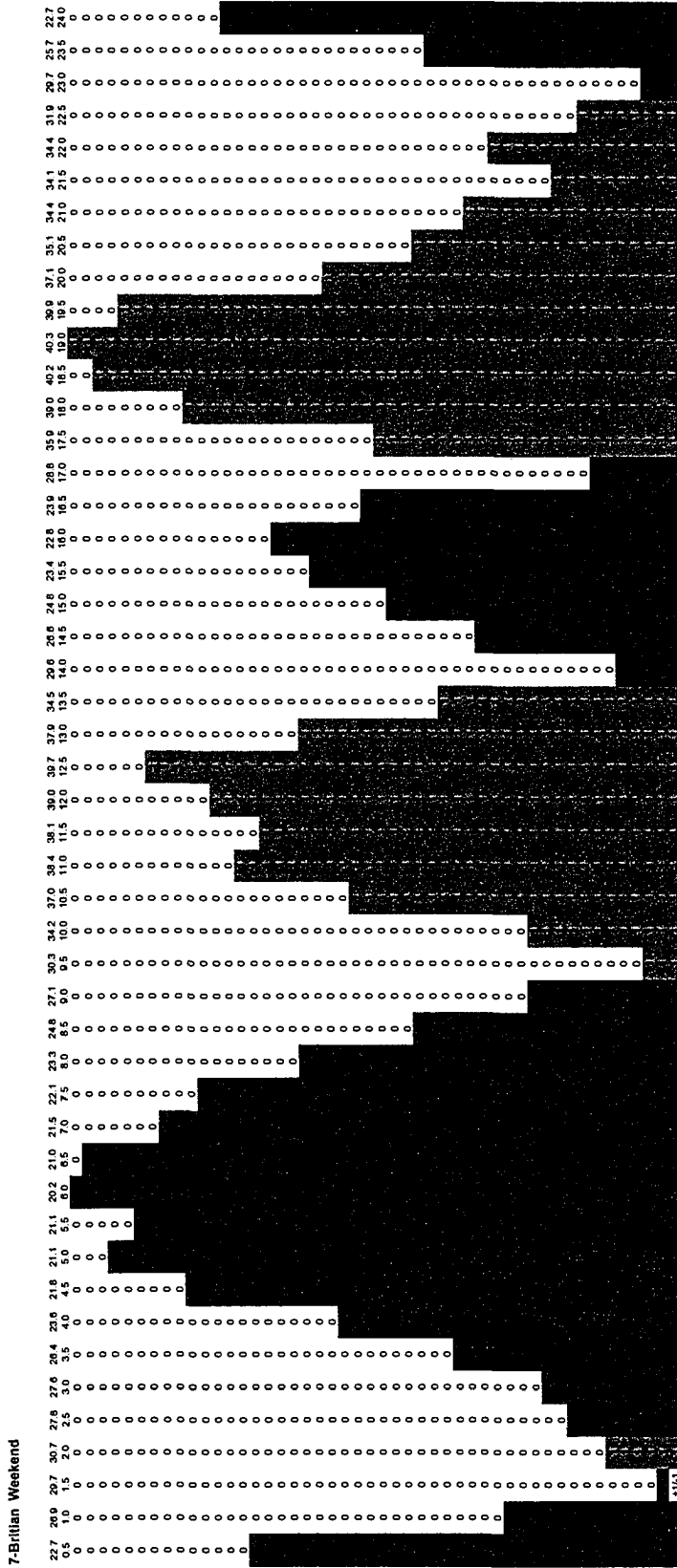
7-Britain Weekend

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
15.04	15.04	6.01
14.00	14.83	7.42
13.88	14.48	11.58
13.82	14.34	14.34
13.48	14.20	17.04
13.50	14.01	22.41
12.63	13.77	27.55
11.73	13.43	32.24
11.36	13.35	33.38
11.29	13.13	36.76
10.56	12.77	36.88
10.02	12.54	40.88
10.01	12.54	43.88
9.68	12.46	44.85
9.61	12.17	48.69
8.81	11.87	52.22
8.87	11.80	53.05
7.87	11.55	55.45
7.96	11.39	56.96
7.05	11.01	60.97
6.03	10.92	61.17
4.94	10.52	63.15
4.11	10.12	64.79
3.00	10.01	65.09
2.36	9.68	65.80
1.47	9.44	66.09
1.43	9.22	66.38
1.22	8.90	66.74
1.17	8.80	66.86
0.75	8.39	67.16
0.75	8.39	67.16
0.30	8.01	67.28
-0.24	7.81	67.25
-0.34	7.63	67.02
-0.65	7.45	66.45
-2.84	7.22	66.45
-4.09	6.87	65.23
-5.34	6.74	64.69
-6.35	6.22	62.15
-6.35	6.22	62.15
-6.75	5.72	59.45
-6.84	5.60	56.77
-7.43	5.39	57.53

Hour to pump	Hour to generate	Power Price to pump	Power Price to generate
0.50	0.40	20.21	40.31
0.63	0.50	21.04	40.31
1.00	0.80	21.04	40.19
1.25	1.00	21.10	39.85
1.50	1.20	21.10	39.85
1.88	1.50	21.10	39.67
2.00	1.60	21.47	39.67
2.50	2.00	21.47	39.67
3.00	2.40	21.83	39.03
3.13	2.50	22.14	39.03
3.50	2.80	22.72	38.96
3.75	3.00	22.72	38.96
4.00	3.20	22.72	38.42
4.38	3.50	22.72	38.42
4.50	3.60	22.78	38.08
5.00	4.00	22.78	38.08
5.00	4.00	22.78	38.08
5.50	4.40	23.26	37.89
5.63	4.50	23.38	37.89
6.00	4.80	23.38	37.09
6.25	5.00	23.61	37.09
6.58	5.20	23.61	36.98
6.88	5.50	23.63	36.98
7.00	5.60	23.83	35.95
7.50	6.00	24.81	35.25
7.50	6.00	24.81	35.25
8.00	6.40	24.92	35.13
8.13	6.50	25.70	35.13
8.50	6.80	25.70	34.49
8.75	7.00	26.41	34.49
9.00	7.20	26.41	34.44
9.38	7.50	26.58	34.44
9.50	7.60	26.58	34.39
10.00	8.00	26.92	34.39
10.00	8.00	26.92	34.39
10.50	8.40	27.15	34.23
10.63	8.50	27.57	34.23
11.00	8.80	27.82	34.13
11.25	9.00	27.82	34.13
11.50	9.20	27.82	31.64
11.88	9.50	28.83	31.64
12.00	9.60	28.83	30.69
12.50	10.00	29.63	30.69
12.50	10.00	29.63	30.69
13.00	10.40	29.65	30.32
13.13	10.50	29.73	30.32
13.33	10.67	29.73	29.73

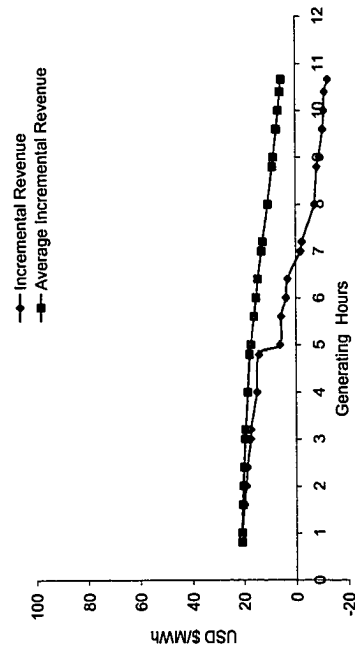
Hour to pump	Hour to generate	Average Power Price to pump	Average Power Price to generate
0.50	0.40	20.38	40.31
0.63	0.50	20.63	40.31
1.00	0.80	20.72	40.26
1.25	1.00	20.72	40.25
1.50	1.20	20.78	40.18
1.88	1.50	20.85	40.12
2.00	1.60	20.88	40.08
2.50	2.00	20.98	40.00
3.00	2.40	21.13	39.84
3.13	2.50	21.27	39.81
3.50	2.80	21.37	39.72
3.75	3.00	21.37	39.67
4.00	3.20	21.45	39.59
4.38	3.50	21.56	39.49
4.50	3.60	21.59	39.45
5.00	4.00	21.71	39.31
5.00	4.00	21.71	39.31
5.50	4.40	21.85	39.18
5.63	4.50	21.89	39.15
6.00	4.80	22.04	38.95
6.25	5.00	22.10	38.87
6.58	5.20	22.20	38.77
6.88	5.50	22.23	38.72
7.00	5.60	22.41	38.53
7.50	6.00	22.41	38.53
7.50	6.00	22.41	38.53
8.00	6.40	22.56	38.32
8.13	6.50	22.61	38.27
8.50	6.80	22.74	38.10
8.75	7.00	22.85	38.00
9.00	7.20	22.85	37.80
9.38	7.50	23.09	37.76
9.50	7.60	23.14	37.72
10.00	8.00	23.33	37.55
10.00	8.00	23.33	37.55
10.50	8.40	23.51	37.39
10.63	8.50	23.56	37.36
11.00	8.80	23.69	37.25
11.25	9.00	23.78	37.18
11.50	9.20	23.87	37.08
11.88	9.50	24.03	36.90
12.00	9.60	24.08	36.84
12.50	10.00	24.30	36.59
12.50	10.00	24.30	36.59
13.00	10.40	24.51	36.35
13.13	10.50	24.56	36.29
13.33	10.67	24.64	36.19





8-Spain Weekday

	USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	sold	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	38.21	1	0.80	1.25	1	0.00	0.00	0.00	27.59	55.37	27.59	44.30	16.71	20.89	20.89	16.71
2	31.79	2	1.60	2.50	2	1.00	0.80	1.80	27.66	55.37	6.92	11.07	4.16	20.79	20.87	20.87
3	29.36	3	2.40	3.75	3	2.00	1.60	3.60	27.66	54.58	20.75	32.75	12.00	20.00	20.55	32.87
4	28.28	4	3.20	5.00	4	2.50	2.00	4.50	28.28	54.58	14.14	21.83	7.69	19.23	20.28	40.57
5	27.59	5	4.00	6.25	5	3.00	2.40	5.40	28.28	54.14	14.14	21.66	7.52	18.79	20.03	48.08
6	27.66	6	4.80	7.50	6	3.75	3.00	6.75	29.36	54.14	22.02	32.48	10.46	17.44	19.51	58.54
7	31.26	7	5.60	8.75	7	4.00	3.20	7.20	29.36	54.07	7.34	10.81	3.47	17.37	19.38	62.02
8	39.72	8	6.40	10.00	8	5.00	4.00	9.00	31.26	54.07	31.26	43.26	12.00	15.00	18.51	74.02
9	47.46	9	7.20	11.25	9	5.00	4.00	9.00	31.26	54.07	0.00	0.00	0.00	15.00	18.51	74.02
10	50.29	10	8.00	12.50	10	6.00	4.80	10.80	31.79	53.92	31.79	43.14	11.35	14.19	17.79	85.37
11	52.74	11	8.80	13.75	11	6.25	5.00	11.25	38.21	53.92	9.55	10.78	1.23	6.16	17.32	86.60
12	53.92	12	9.60	15.00	12	7.00	5.60	12.60	38.21	53.44	28.66	32.07	3.41	5.68	16.07	90.01
13	54.07	13	10.40	16.25	13	7.50	6.00	13.50	39.72	53.44	19.86	21.38	1.52	3.79	15.26	91.53
14	51.77	14	11.20	17.50	14	8.00	6.40	14.40	39.72	52.74	19.86	21.10	1.24	3.09	14.50	92.77
15	47.99	15	12.00	18.75	15	8.75	7.00	15.75	43.55	52.74	32.66	31.65	-1.01	-1.69	13.11	91.75
16	48.64	16	12.80	20.00	16	9.00	7.20	16.20	43.55	52.12	10.89	10.42	-0.46	-2.31	12.68	91.29
17	50.07	17	13.60	21.25	17	10.00	8.00	18.00	47.46	52.12	47.46	41.70	-5.76	-7.21	10.69	85.53
18	52.12	18	14.40	22.50	18	10.00	8.00	18.00	47.46	52.12	0.00	0.00	0.00	-7.21	10.69	85.53
19	54.58	19	15.20	23.75	19	11.00	8.80	19.80	47.99	51.77	47.99	41.42	-6.57	-8.22	8.97	78.96
20	55.37	20	16.00	25.00	20	11.25	9.00	20.25	48.64	51.77	12.16	10.35	-1.81	-9.03	8.57	77.15
21	54.14	21	16.80	26.25	21	12.00	9.60	21.60	48.64	50.29	36.48	30.18	-6.30	-10.50	7.38	70.85
22	53.44	22	17.60	27.50	22	12.50	10.00	22.50	49.04	50.29	24.52	20.12	-4.40	-11.00	6.84	66.45
23	49.04	23	18.40	28.75	23	13.00	10.40	23.40	49.04	50.07	24.52	20.03	-4.49	-11.23	5.96	61.96
24	43.55	24	19.20	30.00	24	13.33	10.67	24.00	50.07	50.07	16.69	13.35	-3.34	-12.52	5.50	58.62

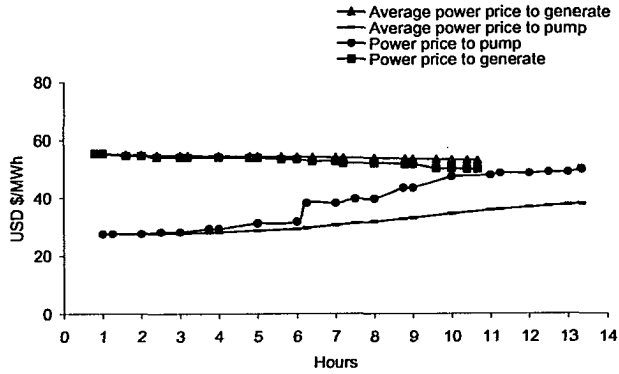


8-Spain Weekday

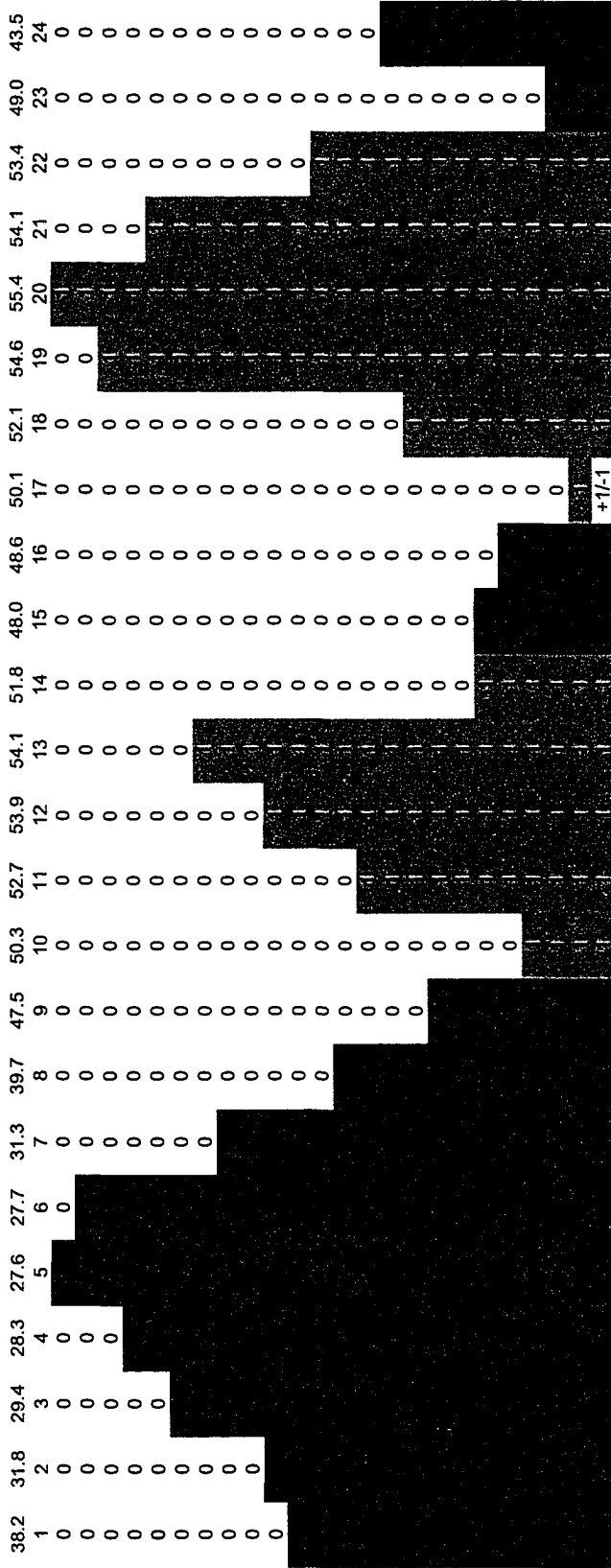
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	20.89	20.89
1.00	20.79	20.87
1.60	20.00	20.55
2.00	19.23	20.28
2.40	18.79	20.03
3.00	17.44	19.51
3.20	17.37	19.38
4.00	15.00	18.51
4.00	15.00	18.51
4.80	14.19	17.79
5.00	6.16	17.32
5.60	5.68	16.07
6.00	3.79	15.26
6.40	3.09	14.50
7.00	-1.69	13.11
7.20	-2.31	12.68
8.00	-7.21	10.69
8.00	-7.21	10.69
8.80	-8.22	8.97
9.00	-9.03	8.57
9.60	-10.50	7.38
10.00	-11.00	6.64
10.40	-11.23	5.96
10.67	-12.52	5.50

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	27.59	55.37
1.25	1.00	27.66	55.37
2.00	1.60	27.66	54.58
2.50	2.00	28.28	54.58
3.00	2.40	28.28	54.14
3.75	3.00	29.36	54.14
4.00	3.20	29.36	54.07
5.00	4.00	31.26	54.07
5.00	4.00	31.26	54.07
6.00	4.80	31.79	53.92
6.25	5.00	38.21	53.92
7.00	5.60	38.21	53.44
7.50	6.00	39.72	53.44
8.00	6.40	39.72	52.74
8.75	7.00	43.55	52.74
9.00	7.20	43.55	52.12
10.00	8.00	47.46	52.12
10.00	8.00	47.46	52.12
11.00	8.80	47.99	51.77
11.25	9.00	48.64	51.77
12.00	9.60	48.64	50.29
12.50	10.00	49.04	50.29
13.00	10.40	49.04	50.07
13.33	10.67	50.07	50.07

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	27.59	55.37
1.25	1.00	27.60	55.37
2.00	1.60	27.63	55.08
2.50	2.00	27.76	54.98
3.00	2.40	27.84	54.84
3.75	3.00	28.15	54.70
4.00	3.20	28.22	54.66
5.00	4.00	28.83	54.54
5.00	4.00	28.83	54.54
6.00	4.80	29.32	54.44
6.25	5.00	29.68	54.42
7.00	5.60	30.59	54.31
7.50	6.00	31.20	54.26
8.00	6.40	31.73	54.16
8.75	7.00	32.75	54.04
9.00	7.20	33.05	53.99
10.00	8.00	34.49	53.80
10.00	8.00	34.49	53.80
11.00	8.80	35.71	53.62
11.25	9.00	36.00	53.57
12.00	9.60	36.79	53.37
12.50	10.00	37.28	53.25
13.00	10.40	37.73	53.12
13.33	10.67	38.04	53.05



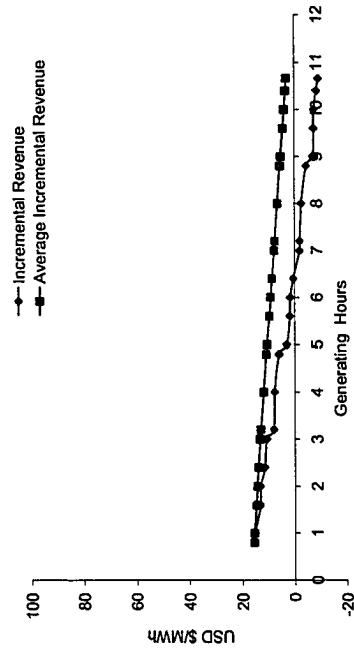
8-Spain Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

8-Spain Weekend

USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	solid	DiPaid	DiSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	42.41				0.00	0.00	0.00					12.51	15.63	15.63	12.51
2	26.9	1	0.80	1.25	1.00	1.80	26.67	48.97	48.97	26.67	39.17	3.07	15.37	15.58	15.58
3	31.39	2	1.60	2.50	2.00	3.60	26.88	20.16	20.16	6.72	28.12	7.96	13.26	14.71	23.54
4	29.19	3	2.40	3.75	2.50	4.50	26.92	13.46	13.46	18.74	18.74	5.28	13.21	14.41	28.82
5	27.83	4	3.20	5.00	3.00	5.40	26.92	45.17	45.17	13.46	18.07	4.61	11.52	13.93	33.43
6	26.92	5	4.00	6.25	3.75	6.30	27.54	20.66	20.66	27.10	27.10	6.45	10.74	13.29	39.87
7	26.88	6	4.80	7.50	4.00	7.20	27.54	42.41	42.41	6.89	8.48	1.60	7.98	12.96	41.47
8	27.54	7	5.60	8.75	5.00	8.10	27.83	29.19	29.19	27.83	33.93	6.09	7.62	11.89	47.56
9	31.50	8	6.40	10.00	5.00	9.00	27.83	42.41	42.41	0.00	0.00	0.00	7.62	11.89	47.56
10	27.54	9	7.20	11.25	6.00	10.80	29.19	42.34	42.34	29.19	33.87	4.68	5.86	10.88	52.25
11	31.39	10	8.00	12.50	6.00	11.25	31.39	42.34	42.34	7.85	8.47	0.62	3.10	10.57	52.87
12	39.83	11	8.80	13.75	6.25	12.60	31.39	41.10	41.10	23.54	24.66	1.11	1.86	9.64	53.98
13	39.75	12	9.60	15.00	7.00	13.50	31.50	41.10	41.10	15.75	16.44	0.69	1.72	9.11	54.67
14	38.66	13	10.40	16.25	7.50	14.40	31.50	39.83	39.83	15.75	15.93	0.18	0.45	8.57	54.85
15	36.71	14	11.20	17.50	8.00	15.75	33.45	39.83	39.83	25.09	23.90	-1.19	-1.99	7.67	53.66
16	34.69	15	12.00	18.75	8.75	16.20	33.45	39.75	39.75	8.36	7.95	-0.41	-2.07	7.40	53.24
17	33.45	16	12.80	20.00	9.00	17.20	33.45	39.75	39.75	33.93	31.80	-2.13	-2.66	6.39	51.11
18	33.93	17	13.60	21.25	10.00	18.00	33.93	39.75	39.75	0.00	0.00	0.00	-2.66	6.39	51.11
19	38.30	18	14.40	22.50	10.00	19.80	34.69	38.66	38.66	34.69	30.93	-3.75	-4.69	5.38	47.36
20	41.10	19	15.20	23.75	11.00	20.25	36.71	38.66	38.66	9.18	7.73	-1.44	-7.22	5.10	45.92
21	45.17	20	16.00	25.00	12.00	21.60	36.71	38.30	38.30	27.53	22.98	-4.55	-7.58	4.31	41.36
22	48.97	21	16.80	26.25	12.50	22.50	36.75	38.30	38.30	18.37	15.32	-3.05	-7.63	3.83	38.31
23	46.86	22	17.60	27.50	13.00	23.40	36.75	37.35	37.35	12.45	9.96	-3.43	-8.58	3.35	34.88
24	42.34	23	18.40	28.75	13.33	24.00	37.35	37.35	37.35	18.37	14.94	-2.49	-9.34	3.04	32.39
24	49.0	24	19.20	30.00	13.33	24.00	37.35	37.35	37.35	12.45	9.96	-2.49	-9.34	3.04	32.39

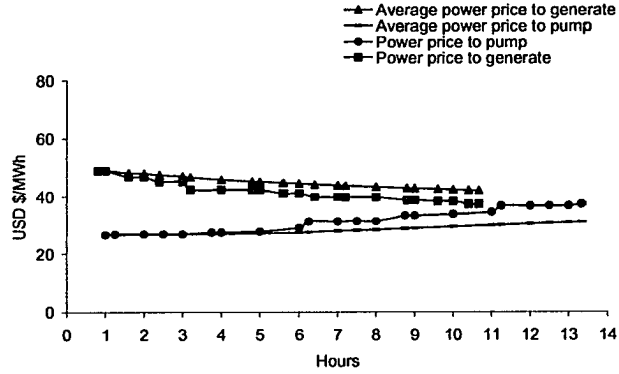


8-Spain Weekend

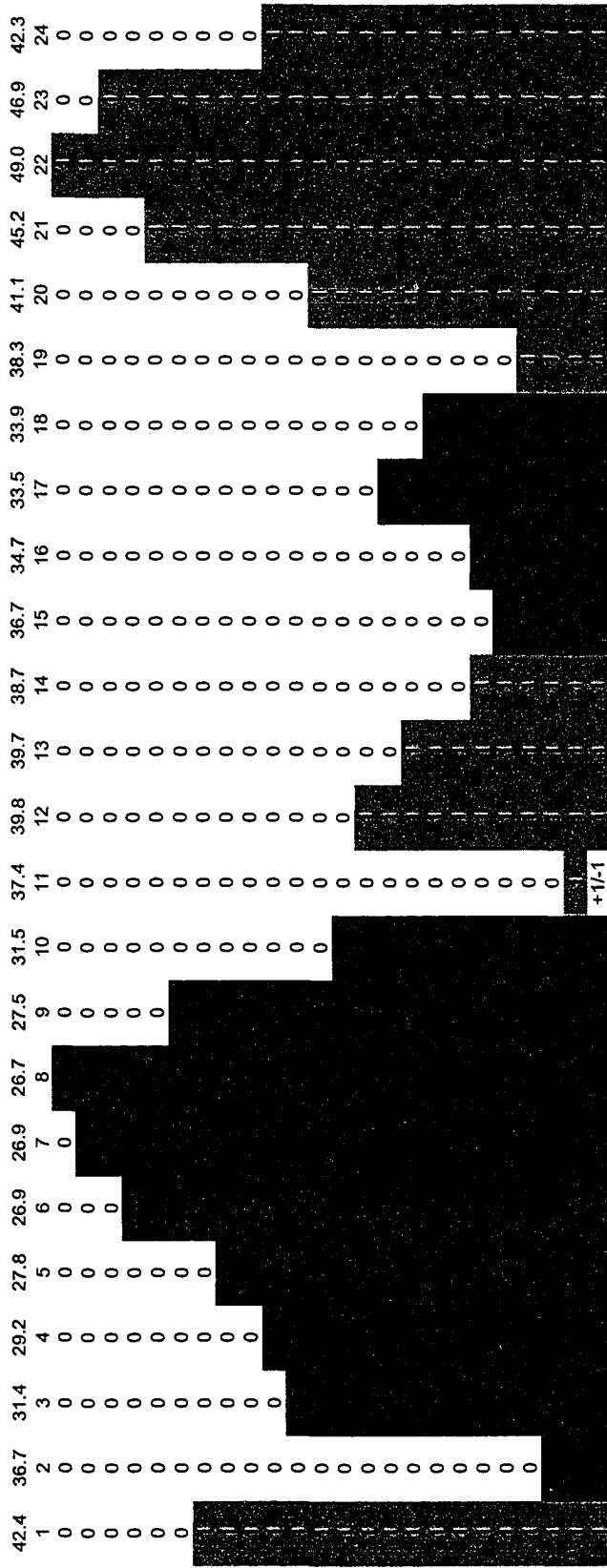
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	15.63	15.63
1.00	15.37	15.58
1.60	13.26	14.71
2.00	13.21	14.41
2.40	11.52	13.93
3.00	10.74	13.29
3.20	7.98	12.96
4.00	7.62	11.89
4.00	7.62	11.89
4.80	5.86	10.88
5.00	3.10	10.57
5.60	1.86	9.64
6.00	1.72	9.11
6.40	0.45	8.57
7.00	-1.99	7.67
7.20	-2.07	7.40
8.00	-2.66	6.39
8.00	-2.66	6.39
8.80	-4.69	5.38
9.00	-7.22	5.10
9.60	-7.58	4.31
10.00	-7.63	3.83
10.40	-8.58	3.35
10.67	-9.34	3.04

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	26.67	48.97
1.25	1.00	26.88	48.97
2.00	1.60	26.88	46.86
2.50	2.00	26.92	46.86
3.00	2.40	26.92	45.17
3.75	3.00	27.54	45.17
4.00	3.20	27.54	42.41
5.00	4.00	27.83	42.41
5.00	4.00	27.83	42.41
6.00	4.80	29.19	42.34
6.25	5.00	31.39	42.34
7.00	5.60	31.39	41.10
7.50	6.00	31.50	41.10
8.00	6.40	31.50	39.83
8.75	7.00	33.45	39.83
9.00	7.20	33.45	39.75
10.00	8.00	33.93	39.75
10.00	8.00	33.93	39.75
11.00	8.80	34.69	38.66
11.25	9.00	36.71	38.66
12.00	9.60	36.71	38.30
12.50	10.00	36.75	38.30
13.00	10.40	36.75	37.35
13.33	10.67	37.35	37.35

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	26.67	48.97
1.25	1.00	26.71	48.97
2.00	1.60	26.77	48.18
2.50	2.00	26.80	47.91
3.00	2.40	26.82	47.46
3.75	3.00	26.97	47.00
4.00	3.20	27.00	46.71
5.00	4.00	27.17	45.85
5.00	4.00	27.17	45.85
6.00	4.80	27.51	45.27
6.25	5.00	27.66	45.15
7.00	5.60	28.06	44.72
7.50	6.00	28.29	44.47
8.00	6.40	28.49	44.18
8.75	7.00	28.92	43.81
9.00	7.20	29.04	43.70
10.00	8.00	29.53	43.30
10.00	8.00	29.53	43.30
11.00	8.80	30.00	42.88
11.25	9.00	30.15	42.79
12.00	9.60	30.56	42.51
12.50	10.00	30.81	42.34
13.00	10.40	31.03	42.15
13.33	10.67	31.19	42.03



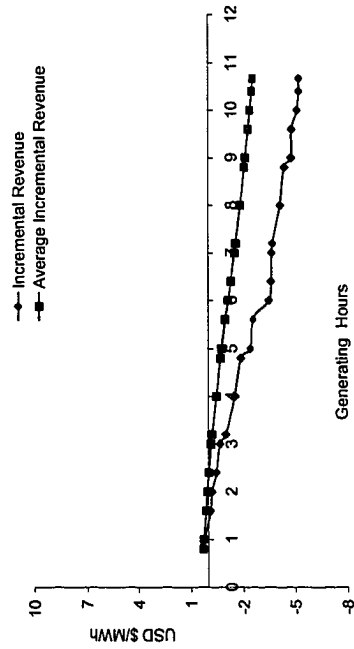
8-Spain Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

9-Scandinavia Weekday

USD/MWh	Efficiency	B	S	B	S	Pump	Gen	Total	paid	sold	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	18.62	1	0.80	1.25	1	1.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24	0.30	0.30	0.24
2	18.17	2	1.60	2.50	2	1.25	0.80	1.60	17.93	22.63	4.48	4.53	0.04	0.22	0.29	0.29
3	17.93	3	2.40	3.75	3	2.00	1.60	3.60	17.93	22.30	13.45	13.38	-0.07	-0.12	0.14	0.22
4	18.2	4	3.20	5.00	4	2.50	2.00	4.50	18.00	22.30	9.00	8.92	-0.08	-0.20	0.07	0.14
5	18.00	5	4.00	6.25	5	3.00	2.40	5.40	18.00	22.06	9.00	8.82	-0.18	-0.44	-0.02	-0.04
6	18.59	6	4.80	7.50	6	3.75	3.00	6.75	18.17	22.06	13.63	13.23	-0.39	-0.66	-0.14	-0.43
7	19.82	7	5.60	8.75	7	4.00	3.20	7.20	18.17	21.73	4.54	4.35	-0.20	-0.98	-0.20	-0.63
8	21.44	8	6.40	10.00	8	5.00	4.00	9.00	18.59	21.73	18.59	17.39	-1.21	-1.51	-0.46	-1.84
9	22.63	9	7.20	11.25	9	6.00	4.80	10.80	18.62	21.44	18.62	17.16	-1.47	-1.51	-0.46	-1.84
10	22.30	10	8.00	12.50	10	6.00	4.80	10.80	19.08	21.44	4.77	4.29	-0.48	-2.40	-0.76	-3.78
11	22.06	11	8.80	13.75	11	6.25	5.00	11.25	19.08	21.44	12.75	12.75	-1.55	-2.59	-0.95	-5.34
12	21.73	12	9.60	15.00	12	7.00	5.60	12.60	19.08	21.26	14.31	14.31	-1.40	-3.49	-1.12	-6.73
13	21.26	13	10.40	16.25	13	7.50	6.00	13.50	19.80	21.26	9.90	8.50	-1.45	-3.62	-1.28	-8.18
14	21.08	14	11.20	17.50	14	8.00	6.40	14.40	19.80	21.13	9.90	8.45	-2.19	-3.65	-1.48	-10.37
15	20.94	15	12.00	18.75	15	8.75	7.00	15.75	19.82	21.13	14.87	12.68	-2.74	-3.70	-1.54	-11.11
16	20.84	16	12.80	20.00	16	9.00	7.20	16.20	19.82	21.08	4.96	4.22	-0.74	-4.16	-1.80	-14.44
17	21.1	17	13.60	21.25	17	10.00	8.00	18.00	20.19	21.08	20.19	16.86	-3.33	-4.16	-1.80	-14.44
18	21.13	18	14.40	22.50	18	10.00	8.00	18.00	20.19	21.08	0.00	0.00	0.00	-4.40	-2.04	-17.95
19	20.96	19	15.20	23.75	19	11.00	8.80	19.80	20.29	20.96	20.29	16.77	-3.52	-4.78	-2.10	-18.91
20	20.59	20	16.00	25.00	20	11.25	9.00	20.25	20.59	20.96	5.15	4.19	-0.96	-4.80	-2.27	-21.79
21	20.29	21	16.80	26.25	21	12.00	9.60	21.60	20.59	20.94	15.44	12.57	-2.88	-5.11	-2.38	-23.83
22	20.19	22	17.60	27.50	22	12.50	10.00	23.50	20.84	20.94	10.42	8.38	-2.04	-5.21	-2.49	-25.91
23	19.80	23	18.40	28.75	23	13.00	10.40	23.40	20.84	20.84	10.42	8.34	-2.08	-5.21	-2.49	-25.91
24	19.08	24	19.20	30.00	24	13.33	10.67	24.00	20.84	20.84	6.95	5.56	-1.39	-5.21	-2.56	-27.30

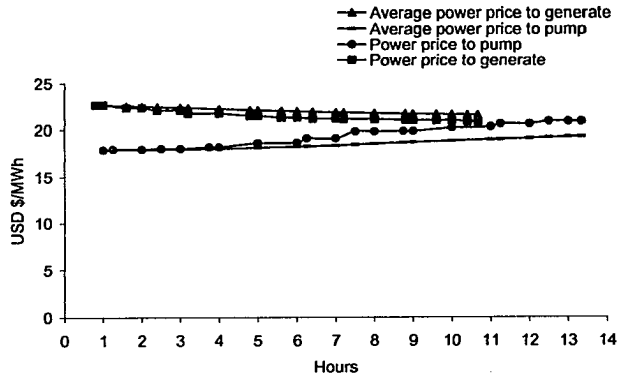


9-Scandinavia Weekday

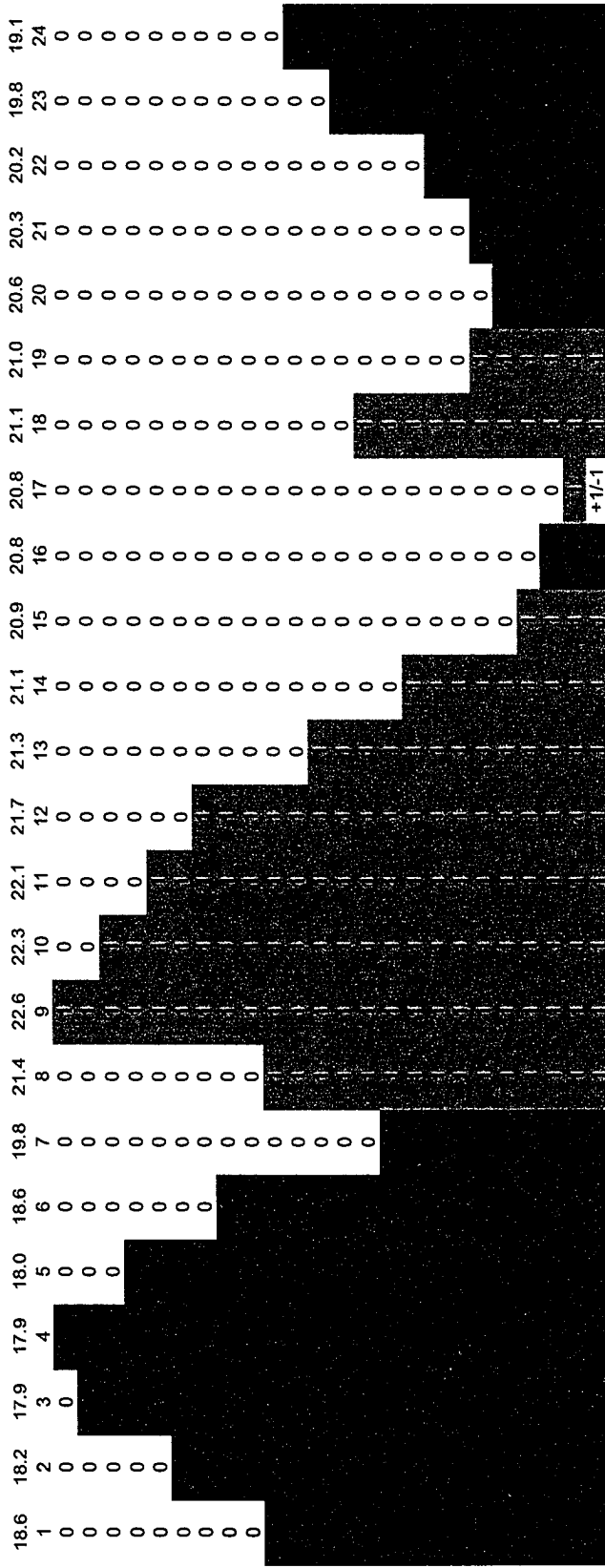
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	0.30	0.30
1.00	0.22	0.29
1.60	-0.12	0.14
2.00	-0.20	0.07
2.40	-0.44	-0.02
3.00	-0.66	-0.14
3.20	-0.98	-0.20
4.00	-1.51	-0.46
4.00	-1.51	-0.46
4.80	-1.83	-0.69
5.00	-2.40	-0.76
5.60	-2.59	-0.95
6.00	-3.49	-1.12
6.40	-3.62	-1.28
7.00	-3.65	-1.48
7.20	-3.70	-1.54
8.00	-4.16	-1.80
8.00	-4.16	-1.80
8.80	-4.40	-2.04
9.00	-4.78	-2.10
9.60	-4.80	-2.27
10.00	-5.11	-2.38
10.40	-5.21	-2.49
10.67	-5.21	-2.56

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	17.86	22.63
1.25	1.00	17.93	22.63
2.00	1.60	17.93	22.30
2.50	2.00	18.00	22.30
3.00	2.40	18.00	22.06
3.75	3.00	18.17	22.06
4.00	3.20	18.17	21.73
5.00	4.00	18.59	21.73
5.00	4.00	18.59	21.73
6.00	4.80	18.62	21.44
6.25	5.00	19.08	21.44
7.00	5.60	19.08	21.26
7.50	6.00	19.80	21.26
8.00	6.40	19.80	21.13
8.75	7.00	19.82	21.13
9.00	7.20	19.82	21.08
10.00	8.00	20.19	21.08
10.00	8.00	20.19	21.08
11.00	8.80	20.29	20.96
11.25	9.00	20.59	20.96
12.00	9.60	20.59	20.94
12.50	10.00	20.84	20.94
13.00	10.40	20.84	20.84
13.33	10.67	20.84	20.84

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	17.86	22.63
1.25	1.00	17.88	22.63
2.00	1.60	17.90	22.51
2.50	2.00	17.92	22.47
3.00	2.40	17.93	22.40
3.75	3.00	17.98	22.33
4.00	3.20	17.99	22.29
5.00	4.00	18.11	22.18
5.00	4.00	18.11	22.18
6.00	4.80	18.20	22.06
6.25	5.00	18.23	22.03
7.00	5.60	18.32	21.95
7.50	6.00	18.42	21.90
8.00	6.40	18.51	21.86
8.75	7.00	18.62	21.79
9.00	7.20	18.65	21.77
10.00	8.00	18.81	21.71
10.00	8.00	18.81	21.71
11.00	8.80	18.94	21.64
11.25	9.00	18.98	21.62
12.00	9.60	19.08	21.58
12.50	10.00	19.15	21.55
13.00	10.40	19.21	21.53
13.33	10.67	19.26	21.51



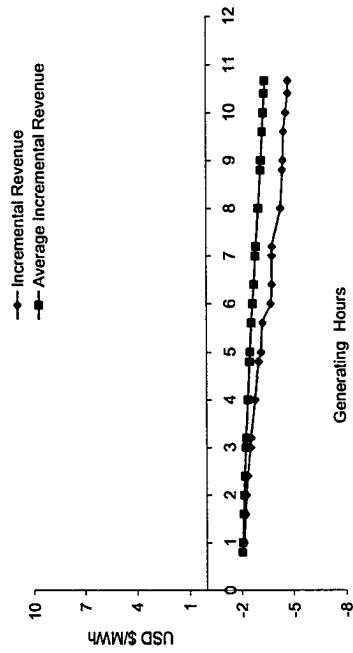
9-Scandinavia Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

9-Scandinavia Weekend

USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	sold	DiPaid	DiSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	18.32	1	0.80	1.25	1	1.00	0.00	17.22	19.49	17.22	15.59	-1.63	-2.03	-2.03	-1.63
2	17.92	2	1.60	2.50	2	1.25	1.00	17.30	19.49	4.32	3.90	-0.43	-2.13	-2.05	-2.05
3	17.67	3	2.40	3.75	3	2.00	1.60	17.30	19.41	12.97	11.64	-1.33	-2.21	-2.11	-3.38
4	17.34	4	3.20	5.00	4	2.50	2.00	17.34	19.34	8.67	7.76	-0.91	-2.27	-2.15	-4.23
5	17.22	5	4.00	6.25	5	3.00	2.40	17.34	19.34	8.67	7.73	-0.94	-2.34	-2.18	-5.23
6	17.30	6	4.80	7.50	6	3.75	3.00	17.48	19.34	13.11	11.60	-1.51	-2.51	-2.25	-6.74
7	17.48	7	5.60	8.75	7	4.00	3.20	17.48	19.31	4.37	3.86	-0.51	-2.53	-2.26	-7.24
8	17.81	8	6.40	10.00	8	5.00	4.00	17.67	19.31	17.67	15.45	-2.22	-2.77	-2.36	-9.46
9	18.31	9	7.20	11.25	9	6.00	5.00	17.67	19.31	17.67	15.44	-2.37	-2.96	-2.46	-11.83
10	18.85	10	8.00	12.50	10	6.00	4.80	17.81	19.30	17.81	15.44	-2.37	-3.11	-2.49	-12.45
11	18.14	11	8.80	13.75	11	6.25	5.00	17.92	19.30	4.48	3.86	-0.62	-3.20	-2.57	-14.37
12	19.20	12	9.60	15.00	12	7.00	5.60	17.92	19.20	13.44	11.52	-1.92	-3.68	-2.64	-15.84
13	19.04	13	10.40	16.25	13	7.50	6.00	18.31	19.20	9.15	7.65	-1.47	-3.75	-2.71	-17.34
14	18.85	14	11.20	17.50	14	8.00	6.40	18.31	19.14	9.15	7.65	-1.50	-3.76	-2.80	-19.60
15	18.73	15	12.00	18.75	15	8.75	7.00	18.32	19.14	13.74	11.48	-2.26	-3.76	-2.83	-20.35
16	18.75	16	12.80	20.00	16	9.00	7.20	18.32	19.13	4.58	3.83	-0.75	-4.26	-2.97	-23.76
17	18.99	17	13.60	21.25	17	10.00	8.00	18.71	19.13	18.71	15.31	-3.41	-4.26	-2.97	-23.76
18	19.34	18	14.40	22.50	18	10.00	8.00	18.71	19.13	0.00	0.00	0.00	-4.38	-3.10	-27.26
19	19.49	19	15.20	23.75	19	11.00	8.80	18.73	19.04	18.73	15.23	-3.50	-4.40	-3.13	-28.14
20	19.41	20	16.00	25.00	20	11.25	9.00	18.75	18.94	4.69	3.81	-0.88	-4.46	-3.21	-30.82
21	19.30	21	16.80	26.25	21	12.00	9.60	18.75	18.99	14.07	11.39	-2.67	-4.57	-3.26	-32.65
22	19.31	22	17.60	27.50	22	12.50	10.00	18.85	18.99	9.42	7.59	-1.83	-4.71	-3.32	-34.53
23	19.13	23	18.40	28.75	23	13.00	10.40	18.85	18.85	18.85	15.42	-1.88	-4.71	-3.36	-35.79
24	18.71	24	19.20	30.00	24	13.33	10.67	18.85	18.85	6.28	5.03	-1.26	-4.71	-3.36	-35.79

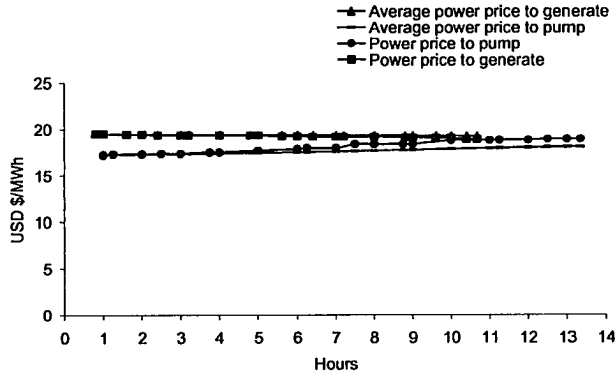


9-Scandinavia Weekend

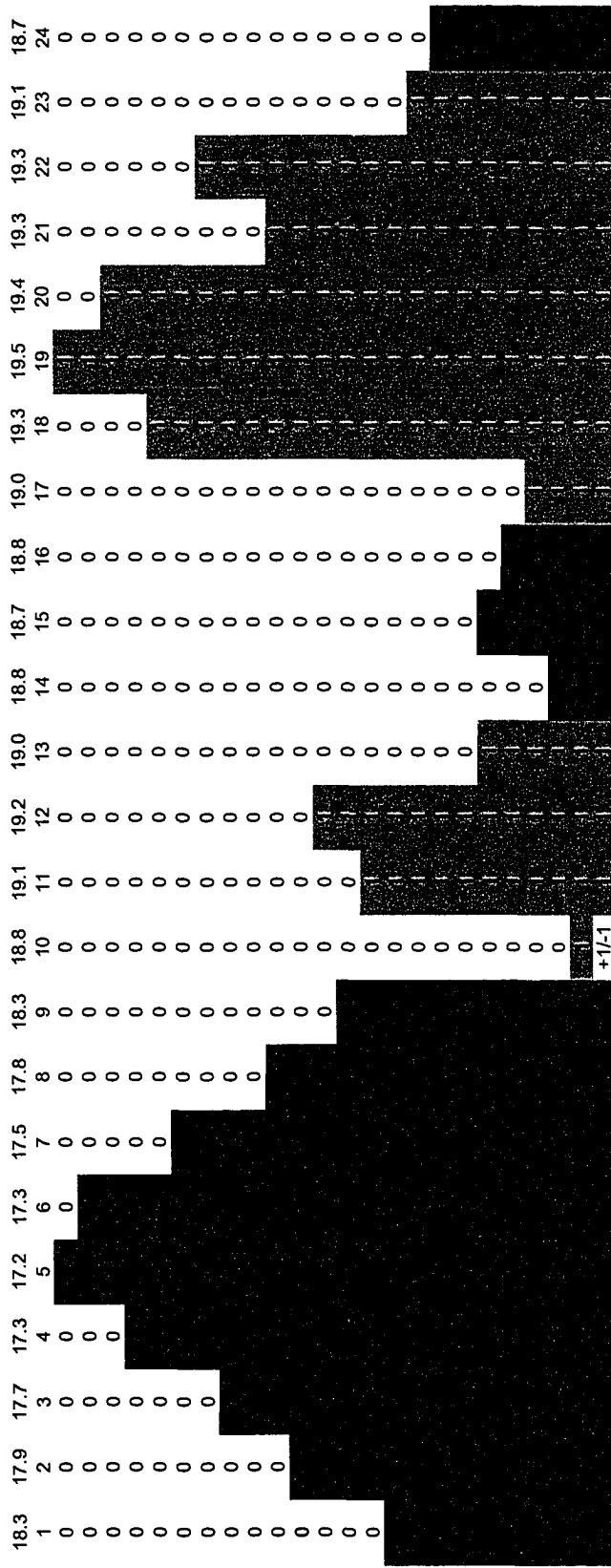
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	-2.03	-2.03
1.00	-2.13	-2.05
1.60	-2.21	-2.11
2.00	-2.27	-2.15
2.40	-2.34	-2.18
3.00	-2.51	-2.25
3.20	-2.53	-2.26
4.00	-2.77	-2.36
4.00	-2.77	-2.36
4.80	-2.96	-2.46
5.00	-3.11	-2.49
5.60	-3.20	-2.57
6.00	-3.68	-2.64
6.40	-3.75	-2.71
7.00	-3.76	-2.80
7.20	-3.76	-2.83
8.00	-4.26	-2.97
8.00	-4.26	-2.97
8.80	-4.38	-3.10
9.00	-4.40	-3.13
9.60	-4.46	-3.21
10.00	-4.57	-3.26
10.40	-4.71	-3.32
10.67	-4.71	-3.36

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	17.22	19.49
1.25	1.00	17.30	19.49
2.00	1.60	17.30	19.41
2.50	2.00	17.34	19.41
3.00	2.40	17.34	19.34
3.75	3.00	17.48	19.34
4.00	3.20	17.48	19.31
5.00	4.00	17.67	19.31
5.00	4.00	17.67	19.31
6.00	4.80	17.81	19.30
6.25	5.00	17.92	19.30
7.00	5.60	17.92	19.20
7.50	6.00	18.31	19.20
8.00	6.40	18.31	19.14
8.75	7.00	18.32	19.14
9.00	7.20	18.32	19.13
10.00	8.00	18.71	19.13
10.00	8.00	18.71	19.13
11.00	8.80	18.73	19.04
11.25	9.00	18.75	19.04
12.00	9.60	18.75	18.99
12.50	10.00	18.85	18.99
13.00	10.40	18.85	18.85
13.33	10.67	18.85	18.85

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	17.22	19.49
1.25	1.00	17.23	19.49
2.00	1.60	17.26	19.46
2.50	2.00	17.27	19.45
3.00	2.40	17.29	19.43
3.75	3.00	17.32	19.41
4.00	3.20	17.33	19.40
5.00	4.00	17.40	19.39
5.00	4.00	17.40	19.39
6.00	4.80	17.47	19.37
6.25	5.00	17.49	19.37
7.00	5.60	17.53	19.35
7.50	6.00	17.59	19.34
8.00	6.40	17.63	19.33
8.75	7.00	17.69	19.31
9.00	7.20	17.71	19.31
10.00	8.00	17.81	19.29
10.00	8.00	17.81	19.29
11.00	8.80	17.89	19.27
11.25	9.00	17.91	19.26
12.00	9.60	17.96	19.24
12.50	10.00	18.00	19.23
13.00	10.40	18.03	19.22
13.33	10.67	18.05	19.21



9-Scandinavia Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

10-Australia: South Australia Weekday

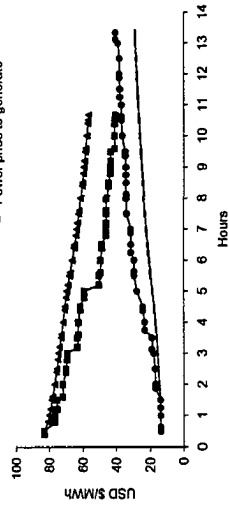
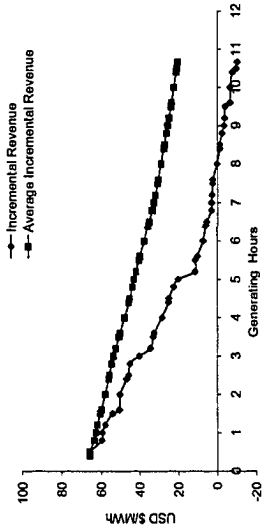
	USD/MWh	Efficiency	B	S	B	S	Pump	Gen	Total	paid	sold	DiffPaid	DiffSold	Profit
0.5	34.61	0.5	0.40	0.63	0.5	0.5	0.00	0.00	0.00	0.00	0.00	6.85	33.25	26.40
1.0	37.71	1.0	0.80	1.25	1.0	0.63	0.50	0.40	0.90	13.69	83.11	1.71	8.31	6.60
1.5	29.30	1.5	1.20	1.88	1.5	1.00	0.80	0.80	1.80	13.70	76.84	5.14	23.05	17.91
2.0	24.27	2.0	1.60	2.50	2.0	1.25	1.00	1.00	2.25	13.89	76.84	3.47	15.37	11.90
2.5	23.16	2.5	2.00	3.13	2.5	1.50	1.20	1.20	2.70	13.89	75.25	3.47	15.05	11.58
3.0	18.15	3.0	2.40	3.75	3.0	1.88	1.50	1.50	3.38	16.96	75.25	6.36	22.58	16.21
3.5	17.19	3.5	2.80	4.38	3.5	2.00	1.60	1.60	3.60	16.96	71.80	2.12	7.18	5.06
4.0	13.69	4.0	3.20	5.00	4.0	2.50	2.00	2.00	4.50	17.19	71.80	8.60	28.72	20.13
4.5	13.70	4.5	3.60	5.63	4.5	2.50	2.00	2.00	4.50	17.19	71.80	0.00	0.00	0.00
5.0	13.89	5.0	4.00	6.25	5.0	3.00	2.40	2.40	5.40	18.15	69.75	9.08	27.90	18.82
5.5	16.96	5.5	4.40	6.88	5.5	3.13	2.50	2.50	5.63	18.98	69.75	2.37	6.97	4.60
6.0	18.98	6.0	4.80	7.50	6.0	3.50	2.80	2.80	6.30	18.98	69.02	7.12	20.71	13.59
6.5	27.70	6.5	5.20	8.13	6.5	3.75	3.00	3.00	6.75	23.16	69.02	5.79	13.80	8.02
7.0	49.19	7.0	5.60	8.75	7.0	4.00	3.20	3.20	7.20	23.16	63.22	5.79	12.64	6.85
7.5	31.31	7.5	6.00	9.38	7.5	4.38	3.50	3.50	7.88	24.27	63.22	9.10	18.97	9.87
8.0	34.25	8.0	6.40	10.00	8.0	4.50	3.60	3.60	8.10	24.27	62.69	3.03	6.27	3.24
8.5	40.88	8.5	6.80	10.63	8.5	5.00	4.00	4.00	9.00	27.70	62.69	13.85	25.08	11.22
9.0	48.36	9.0	7.20	11.25	9.0	5.00	4.00	4.00	9.00	27.70	62.69	0.00	0.00	0.00
9.5	38.86	9.5	7.60	11.88	9.5	5.50	4.40	4.40	9.90	29.30	61.49	14.65	24.60	9.95
10.0	44.48	10.0	8.00	12.50	10.0	5.63	4.50	4.50	10.13	29.40	61.49	3.67	6.15	2.47
10.5	37.95	10.5	8.40	13.13	10.5	6.00	4.80	4.80	10.80	29.40	59.08	11.02	17.73	6.70
11.0	36.38	11.0	8.80	13.75	11.0	6.25	5.00	5.00	11.25	31.21	59.08	7.80	11.82	4.01
11.5	40.81	11.5	9.20	14.38	11.5	6.50	5.20	5.20	11.70	31.21	50.31	7.80	10.06	2.26
12.0	45.76	12.0	9.60	15.00	12.0	6.88	5.50	5.50	12.38	31.31	50.31	11.74	15.09	3.35
12.5	59.08	12.5	10.00	15.63	12.5	7.00	5.60	5.60	12.60	31.31	49.19	3.91	4.92	1.01
13.0	61.49	13.0	10.40	16.25	13.0	7.50	6.00	6.00	13.50	33.71	49.19	16.86	19.68	2.82
13.5	62.69	13.5	10.80	16.88	13.5	8.00	6.40	6.40	14.40	33.90	48.36	16.95	19.34	2.39
14.0	71.80	14.0	11.20	17.50	14.0	8.13	6.50	6.50	14.63	34.25	48.36	4.28	4.84	0.55
14.5	69.75	14.5	11.60	18.13	14.5	8.50	6.80	6.80	15.30	34.25	48.36	12.84	13.77	0.93
15.0	75.25	15.0	12.00	18.75	15.0	8.75	7.00	7.00	15.75	34.32	45.91	8.58	9.16	0.60
15.5	76.84	15.5	12.40	19.38	15.5	9.00	7.20	7.20	16.20	34.32	45.76	8.58	9.15	0.57
16.0	83.11	16.0	12.80	20.00	16.0	9.38	7.50	7.50	16.88	34.61	45.76	12.98	13.73	0.75
16.5	69.02	16.5	13.20	20.63	16.5	9.50	7.60	7.60	17.10	34.61	45.66	4.33	4.57	0.24
17.0	63.22	17.0	13.60	21.25	17.0	10.00	8.00	8.00	18.00	36.38	45.66	18.19	18.26	0.07
17.5	50.31	17.5	14.00	21.88	17.5	10.50	8.40	8.40	18.90	36.38	45.66	0.00	0.00	0.00
18.0	45.66	18.0	14.40	22.50	18.0	10.50	8.40	8.40	18.90	36.71	44.48	18.36	17.79	-0.57
18.5	45.91	18.5	14.80	23.13	18.5	10.63	8.50	8.50	19.13	36.80	44.48	4.60	4.45	-0.15
19.0	43.52	19.0	15.20	23.75	19.0	11.00	8.80	8.80	19.80	36.80	43.52	13.80	13.06	-0.75
19.5	43.25	19.5	15.60	24.38	19.5	11.25	9.00	9.00	20.25	37.71	43.52	9.43	8.70	-0.72
20.0	40.39	20.0	16.00	25.00	20.0	11.50	9.20	9.20	20.70	37.71	43.25	9.43	8.65	-0.78
20.5	36.80	20.5	16.40	25.63	20.5	11.88	9.50	9.50	21.38	37.95	43.25	14.23	12.98	-1.25
21.0	36.71	21.0	16.80	26.25	21.0	12.00	9.60	9.60	21.60	37.95	40.88	4.74	4.09	-0.66
21.5	38.00	21.5	17.20	26.88	21.5	12.50	10.00	10.00	22.50	38.00	40.88	19.00	16.35	-2.65
22.0	33.71	22.0	17.60	27.50	22.0	13.00	10.40	10.40	23.40	38.86	40.81	19.43	16.32	-3.11
22.5	31.21	22.5	18.00	28.13	22.5	13.13	10.50	10.50	23.60	40.39	40.81	5.05	4.08	-0.97
23.0	29.40	23.0	18.40	28.75	23.0	13.33	10.50	10.50	23.60	40.39	40.39	8.42	6.73	-1.68
23.5	33.90	23.5	18.80	29.38	23.5	13.33	10.67	10.67	24.00	40.39	40.39	8.42	6.73	-1.68
24.0	34.32	24.0	19.20	30.00	24.0	13.33	10.67	10.67	24.00	40.39	40.39	8.42	6.73	-1.68

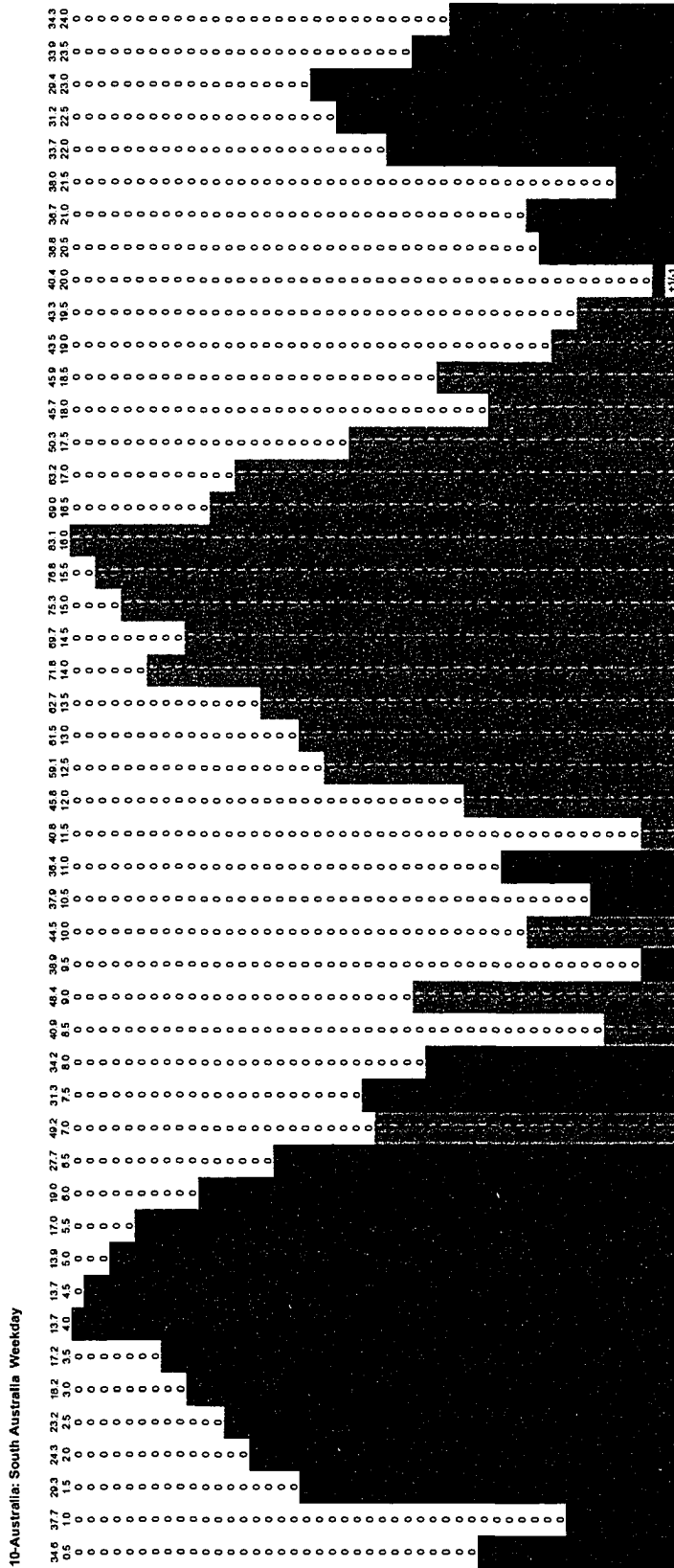
10-Australia: South Australia Weekday

Incremental Revenue	Average Incremental	Cumulative Revenue
66.00	66.00	26.40
65.99	65.99	33.00
59.71	63.64	50.91
59.48	62.81	62.81
57.89	61.99	74.38
54.05	60.40	90.60
50.60	59.79	95.66
50.31	57.99	115.78
47.06	56.09	134.61
46.02	55.68	139.21
45.30	54.57	152.80
40.08	53.60	160.81
34.27	52.40	167.67
32.89	50.72	177.54
32.36	50.21	180.77
28.06	48.00	192.00
24.87	45.80	201.94
24.74	45.43	204.42
22.33	43.96	211.12
20.07	43.03	215.13
11.18	41.81	217.39
10.06	39.60	221.75
7.05	37.43	224.57
5.98	35.46	226.96
5.54	35.00	227.52
3.10	33.60	228.45
3.01	32.72	229.05
2.86	31.89	229.62
2.50	30.72	230.37
2.40	30.34	230.61
0.18	28.83	230.68
0.18	28.83	230.68
-1.41	27.39	230.11
-1.52	27.05	229.96
-2.48	26.05	229.22
-3.62	25.39	228.49
-3.88	24.75	227.72
-4.18	23.84	226.46
-4.65	23.52	225.81
-4.62	22.32	223.16
-4.62	22.32	223.16
-7.77	21.16	220.05
-9.68	20.87	219.08
-10.10	20.38	217.40

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	13.99	63.11
0.63	0.50	13.70	63.11
1.00	0.80	13.70	76.84
1.25	1.00	13.89	76.84
1.50	1.20	13.89	75.25
1.88	1.50	18.98	75.25
2.00	1.80	18.98	71.80
2.50	2.00	17.19	71.80
3.00	2.40	18.15	69.75
3.13	2.50	18.88	69.75
3.50	2.80	18.98	69.02
3.75	3.00	23.16	69.02
4.00	3.20	23.16	63.22
4.38	3.50	24.27	63.22
4.50	3.60	24.27	62.69
5.00	4.00	27.70	62.69
5.50	4.40	29.30	61.49
6.63	4.50	29.40	59.08
6.00	4.80	29.40	59.08
6.25	5.00	31.21	59.08
6.50	5.20	31.21	50.31
6.88	5.50	31.31	50.31
7.00	5.60	31.31	49.19
7.50	6.00	33.71	49.19
7.50	6.00	33.71	49.19
8.00	6.40	33.90	48.36
8.13	6.50	34.25	48.36
8.50	6.80	34.25	45.91
8.75	7.00	34.32	45.91
9.00	7.20	34.32	45.76
9.38	7.50	34.61	45.66
9.50	7.60	34.81	45.66
10.00	8.00	36.38	45.66
10.00	8.00	36.38	45.66
10.50	8.40	36.71	44.48
10.63	8.50	36.80	44.48
11.00	8.80	36.80	43.52
11.25	9.00	37.71	43.52
11.50	9.20	37.71	43.25
11.88	9.50	37.95	43.25
12.00	9.60	37.95	40.88
12.50	10.00	38.00	40.88
12.50	10.00	38.00	40.88
13.00	10.40	38.66	40.81
13.13	10.50	40.39	40.81
13.33	10.67	40.39	40.39

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	4.90	63.11
0.63	0.50	4.90	63.11
1.00	0.80	4.70	68.16
1.25	1.00	4.70	76.76
1.50	1.20	4.76	76.88
1.88	1.50	4.40	76.18
2.00	1.80	4.56	74.40
2.50	2.00	4.59	76.75
3.00	2.40	4.59	76.75
3.13	2.50	4.60	75.58
3.50	2.80	4.68	75.35
3.75	3.00	4.65	74.30
4.00	3.20	4.69	73.60
4.38	3.50	4.79	72.71
4.50	3.60	4.77	72.44
5.00	4.00	4.67	71.48
5.50	4.40	4.40	70.56
6.63	4.50	4.80	70.35
6.00	4.80	4.80	69.65
6.25	5.00	4.86	69.23
6.50	5.20	4.86	68.50
6.88	5.50	4.86	67.51
7.00	5.60	4.86	67.18
7.50	6.00	4.84	65.98
7.50	6.00	4.84	65.98
8.00	6.40	4.84	64.83
8.13	6.50	4.84	64.83
8.50	6.80	4.46	63.80
8.75	7.00	4.45	63.29
9.00	7.20	4.45	62.80
9.38	7.50	4.45	62.12
9.50	7.60	4.45	61.90
10.00	8.00	4.45	61.09
10.00	8.00	4.45	61.09
10.50	8.40	4.45	60.30
10.63	8.50	4.45	60.11
11.00	8.80	4.45	59.55
11.25	9.00	4.45	59.19
11.50	9.20	4.45	58.85
11.88	9.50	4.45	58.35
12.00	9.60	4.45	58.17
12.50	10.00	4.45	57.48
12.50	10.00	4.45	57.48
13.00	10.40	4.45	56.84
13.13	10.50	4.45	56.69
13.33	10.67	4.45	56.43





Operating plan: -1 represents a pumping hour, +1 generating hour, -1/*1 a split hour (generating and pumping), and 0 no generation or pumping.

10-Australia: South Australia Weekend

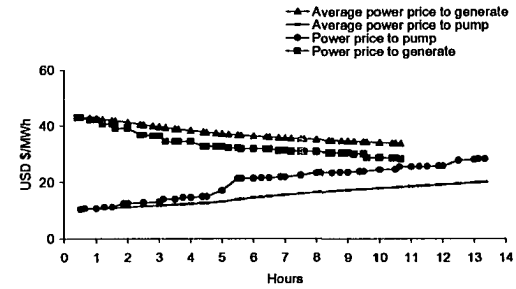
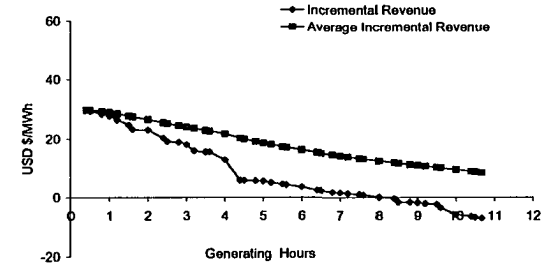
USD/MWh	Efficiency			Pump	Gen	Total	paid	sold	DiffPaid	DiffSold	Profit
	B	S	B								
0.5	30.28	0.0	10.6	43.0	0.0	0.0	0.0	0.0	0.0	17.18	11.87
1.0	42.99	0.5	10.9	42.1	0.50	0.90	10.61	42.95	5.31	4.30	2.93
1.5	36.45	1.0	11.4	40.7	0.63	0.80	1.13	10.92	42.95	4.09	12.62
2.0	31.02	1.5	12.7	39.2	1.00	0.80	1.80	10.92	42.07	2.86	8.41
2.5	31.68	2.0	12.9	36.8	1.25	1.00	2.25	11.42	42.07	2.86	8.41
3.0	23.51	2.5	13.2	36.5	1.50	1.20	2.70	11.42	40.69	4.78	12.21
3.5	14.72	3.0	14.1	34.4	1.88	1.50	3.38	12.74	40.69	4.78	12.21
4.0	13.19	3.5	14.7	34.3	2.00	1.60	3.60	12.74	39.21	1.59	3.92
4.5	11.42	4.0	15.0	32.6	2.50	2.00	4.50	12.95	39.21	6.47	15.69
5.0	10.61	4.5	17.2	32.5	2.50	2.00	4.50	12.95	39.21	0.00	0.00
5.5	10.92	5.0	21.3	32.0	3.13	2.50	5.63	14.12	36.80	1.77	3.68
6.0	12.95	5.5	21.3	31.7	3.50	2.80	6.30	14.12	36.80	5.30	10.94
6.5	12.74	6.0	21.5	31.6	3.75	3.00	6.75	14.72	36.45	3.68	7.29
7.0	14.12	6.5	21.8	31.0	4.00	3.20	7.20	14.72	34.39	3.68	6.88
7.5	15.02	7.0	22.4	30.8	4.38	3.50	7.88	15.02	34.39	5.63	10.32
8.0	17.17	7.5	23.2	30.7	4.50	3.60	8.10	15.02	34.34	1.88	3.43
8.5	21.46	8.0	23.4	30.4	5.00	4.00	9.00	17.17	34.34	8.59	13.74
9.0	23.36	8.5	23.5	30.3	5.00	4.00	9.00	17.17	34.34	0.00	0.00
9.5	25.60	9.0	23.8	29.9	5.50	4.40	9.90	21.39	32.60	10.65	13.04
10.0	27.72	9.5	24.4	28.8	6.00	4.80	10.80	21.33	32.60	2.67	3.26
10.5	30.65	10.0	24.6	28.5	6.00	4.80	10.80	21.33	32.51	8.00	9.75
11.0	30.76	10.5	25.5	28.3	6.25	5.00	11.25	21.46	32.51	5.37	6.50
11.5	31.98	11.0	25.6	28.0	6.50	5.20	11.70	21.46	31.98	5.37	6.40
12.0	31.60	11.5	25.8	27.7	6.88	5.50	12.38	21.81	31.98	8.18	9.60
12.5	34.39	12.0	27.7	25.8	7.00	5.60	12.60	21.81	31.68	2.73	3.17
13.0	39.21	12.5	28.0	25.6	7.50	6.00	13.50	22.40	31.68	11.20	12.67
13.5	36.80	13.0	28.3	25.5	7.50	6.00	13.50	22.40	31.68	0.00	0.00
14.0	32.51	13.5	28.5	24.6	8.00	6.40	14.40	23.23	31.60	11.61	12.64
14.5	28.77	14.0	28.8	24.4	8.13	6.50	14.63	23.36	31.60	2.92	3.16
15.0	27.99	14.5	29.9	23.8	8.50	6.80	15.30	23.36	31.02	8.76	9.30
15.5	28.53	15.0	30.3	23.5	8.75	7.00	15.75	23.51	31.02	5.88	6.20
16.0	23.81	15.5	30.4	23.4	9.00	7.20	16.20	23.51	30.78	5.88	6.16
16.5	23.23	16.0	30.7	23.2	9.38	7.50	16.88	23.81	30.78	8.93	9.24
17.0	25.49	16.5	30.8	22.4	9.50	7.60	17.10	23.81	30.65	2.98	3.07
17.5	32.60	17.0	31.0	21.8	10.00	8.00	18.00	24.41	30.65	12.21	12.26
18.0	34.34	17.5	31.6	21.5	10.00	8.00	18.00	24.41	30.65	0.00	0.00
18.5	40.69	18.0	31.7	21.3	10.50	8.40	18.90	24.59	30.35	12.29	12.14
19.0	42.07	18.5	32.0	21.3	10.63	8.50	19.13	25.49	30.35	3.19	3.04
19.5	30.35	19.0	32.5	17.2	11.00	8.60	19.60	25.49	30.28	9.56	9.08
20.0	29.94	19.5	32.6	15.0	11.25	9.00	20.25	25.60	30.28	6.40	6.06
20.5	25.79	20.0	34.3	14.7	11.50	9.20	20.70	25.60	29.94	6.40	5.89
21.0	24.41	20.5	34.4	14.1	11.88	9.50	21.38	25.79	29.94	9.67	8.98
21.5	22.40	21.0	36.5	13.2	12.00	9.60	21.60	25.79	28.77	3.22	2.88
22.0	21.30	21.5	36.8	12.9	12.50	10.00	22.50	27.72	28.77	13.86	11.51
22.5	21.81	22.0	39.2	12.7	12.50	10.00	22.50	27.72	28.77	0.00	0.00
23.0	21.33	22.5	40.7	11.4	13.00	10.40	23.40	27.99	28.53	14.00	11.41
23.5	24.59	23.0	42.1	10.9	13.13	10.50	23.63	28.29	28.53	3.54	2.85
24.0	28.29	23.5	43.0	10.6	13.33	10.67	24.00	28.29	28.29	5.89	4.71
		24.0	43.0	10.6							-1.18

10-Australia: South Australia Weekend

Incremental Revenue	Average Incremental	Cumulative Revenue
29.68	29.68	11.87
29.31	29.61	14.80
28.43	29.17	23.33
27.80	28.89	28.89
26.41	28.48	34.17
24.78	27.74	41.60
23.29	27.46	43.93
23.03	26.57	53.14
23.03	26.57	53.14
20.31	25.53	61.27
19.15	25.27	63.18
18.80	24.58	68.82
18.05	24.15	72.44
16.00	23.64	75.63
15.62	22.95	80.32
15.57	22.74	81.88
12.87	21.76	87.02
12.87	21.76	87.02
5.99	20.32	89.42
5.94	20.00	90.01
5.84	19.12	91.76
5.68	18.58	92.90
5.16	18.06	93.93
4.73	17.34	95.35
4.42	17.11	95.79
3.68	16.21	97.26
3.68	16.21	97.26
2.58	15.36	98.29
2.40	15.16	98.53
1.82	14.57	99.08
1.63	14.20	99.40
1.40	13.84	99.68
1.02	13.33	99.99
0.89	13.17	100.08
0.14	12.52	100.13
0.14	12.52	100.13
-1.51	11.90	99.88
-1.59	11.29	99.35
-1.73	11.00	99.01
-2.06	10.72	98.59
-2.30	10.31	97.90
-3.48	10.16	97.66
-5.89	9.52	95.20
-5.89	9.52	95.20
-6.46	8.91	92.62
-6.83	8.76	91.93
-7.07	8.51	90.75

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.61	42.95
0.63	0.50	10.92	42.95
1.00	0.80	10.92	42.07
1.25	1.00	11.42	42.07
1.50	1.20	11.42	40.89
1.88	1.50	12.74	40.89
2.00	1.60	12.74	39.21
2.50	2.00	12.95	39.21
2.50	2.00	12.95	39.21
3.00	2.40	13.19	36.80
3.13	2.50	14.12	36.80
3.50	2.80	14.12	36.45
3.75	3.00	14.72	36.45
4.00	3.20	14.72	34.39
4.38	3.50	15.02	34.39
4.50	3.60	15.02	34.34
5.00	4.00	17.17	34.34
5.00	4.00	17.17	34.34
5.50	4.40	21.30	32.60
5.63	4.50	21.33	32.60
6.00	4.80	21.33	32.51
6.25	5.00	21.46	32.51
6.50	5.20	21.46	31.98
6.88	5.50	21.81	31.98
7.00	5.60	21.81	31.68
7.50	6.00	22.40	31.68
7.50	6.00	22.40	31.68
8.00	6.40	23.23	31.60
8.13	6.50	23.36	31.60
8.50	6.80	23.36	31.02
8.75	7.00	23.51	31.02
9.00	7.20	23.51	30.78
9.38	7.50	23.81	30.78
9.50	7.60	23.81	30.65
10.00	8.00	24.41	30.65
10.00	8.00	24.41	30.65
10.50	8.40	24.59	30.35
10.63	8.50	25.49	30.35
11.00	8.80	25.49	30.28
11.25	9.00	25.60	30.28
11.50	9.20	25.60	29.84
11.88	9.50	25.79	29.84
12.00	9.60	25.79	28.77
12.50	10.00	27.72	28.77
12.50	10.00	27.72	28.77
13.00	10.40	27.99	28.53
13.13	10.50	28.29	28.53
13.33	10.67	28.29	28.29

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.61	42.95
0.63	0.50	10.67	42.95
1.00	0.80	10.77	42.62
1.25	1.00	10.80	42.51
1.50	1.20	10.98	42.21
1.88	1.50	11.33	41.90
2.00	1.60	11.42	41.74
2.50	2.00	11.73	41.23
2.50	2.00	11.73	41.23
3.00	2.40	11.97	40.49
3.13	2.50	12.06	40.35
3.50	2.80	12.28	39.93
3.75	3.00	12.44	39.70
4.00	3.20	12.58	39.37
4.38	3.50	12.79	38.94
4.50	3.60	12.85	38.81
5.00	4.00	13.29	38.36
5.00	4.00	13.29	38.36
5.50	4.40	14.01	37.84
5.63	4.50	14.18	37.72
6.00	4.80	14.82	37.40
6.25	5.00	14.90	37.20
6.50	5.20	15.15	37.00
6.88	5.50	15.51	36.73
7.00	5.60	15.63	36.64
7.50	6.00	16.08	36.31
7.50	6.00	16.08	36.31
8.00	6.40	16.52	36.01
8.13	6.50	16.63	35.95
8.50	6.80	16.93	35.73
8.75	7.00	17.11	35.59
9.00	7.20	17.29	35.46
9.38	7.50	17.55	35.27
9.50	7.60	17.63	35.21
10.00	8.00	17.97	34.98
10.00	8.00	17.97	34.98
10.50	8.40	18.29	34.76
10.63	8.50	18.37	34.71
11.00	8.80	18.62	34.56
11.25	9.00	18.77	34.46
11.50	9.20	18.92	34.37
11.88	9.50	19.14	34.23
12.00	9.60	19.21	34.17
12.50	10.00	19.55	33.96
12.50	10.00	19.55	33.95
13.00	10.40	19.87	33.75
13.13	10.50	19.95	33.70
13.33	10.67	20.08	33.61



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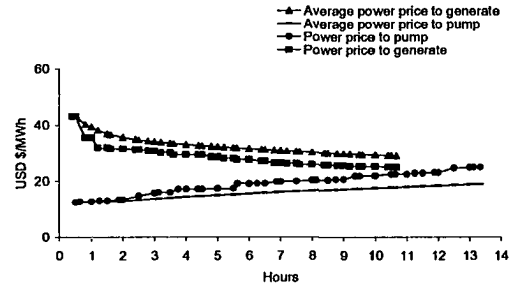
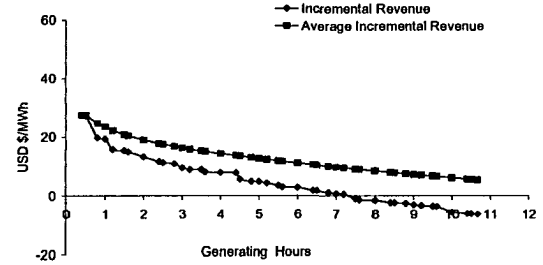
	USD/MWh	Efficiency	0.80	B	S	B	S	Pump	Gen	Total	paid	DiPaid	DiSold	Profit	
0.5	19.14	0.5	0.40	0.63	0.5	0.0	0.0	0.00	0.00	0.00	12.42	43.05	6.21	17.22	11.01
1.0	17.16	1.0	0.80	1.25	1.0	0.63	0.50	0.50	0.40	0.90	12.63	43.05	1.58	4.30	2.73
1.5	19.81	1.5	1.20	1.86	1.5	1.00	0.80	1.00	0.80	1.80	12.63	35.60	4.74	10.68	5.94
2.0	17.41	2.0	1.60	2.50	2.0	1.25	1.00	1.25	1.00	2.25	12.97	35.60	3.24	7.12	3.88
2.5	16.03	2.5	2.00	3.13	2.5	1.50	1.20	1.88	1.50	2.20	12.97	31.96	3.24	6.39	3.15
3.0	14.64	3.0	2.40	3.75	3.0	1.88	1.50	1.88	1.88	3.38	13.26	31.96	4.97	9.59	4.61
3.5	13.26	3.5	2.80	4.38	3.5	2.00	1.60	2.00	1.60	3.60	13.26	31.54	1.66	3.15	1.50
4.0	12.42	4.0	3.20	5.00	4.0	2.50	2.00	2.50	2.00	4.50	14.64	31.54	0.00	0.00	0.00
4.5	12.63	4.5	3.60	5.63	4.5	3.00	2.40	3.00	2.40	5.40	15.72	31.27	7.86	12.51	4.65
5.0	12.97	5.0	4.00	6.25	5.0	3.13	2.50	3.50	2.50	5.63	16.03	31.27	2.00	3.13	1.12
5.5	15.72	5.5	4.40	6.88	5.5	3.50	2.80	3.50	2.80	6.30	16.03	30.90	6.01	9.27	3.26
6.0	17.14	6.0	4.80	7.50	6.0	3.75	3.00	3.75	3.00	6.75	17.14	30.90	4.28	6.18	1.90
6.5	22.80	6.5	5.20	8.13	6.5	4.00	3.20	4.00	3.20	7.20	17.14	30.27	4.28	6.05	1.77
7.0	43.05	7.0	5.60	8.75	7.0	4.38	3.50	4.38	3.50	7.88	17.16	30.27	6.44	9.08	2.65
7.5	19.91	7.5	6.00	9.38	7.5	4.50	3.60	4.50	3.60	8.10	17.16	29.45	2.15	2.95	0.60
8.0	23.00	8.0	6.40	10.00	8.0	5.00	4.00	5.00	4.00	9.00	17.35	29.45	8.67	11.78	3.11
8.5	23.87	8.5	6.80	10.63	8.5	5.00	4.00	5.00	4.00	9.00	17.35	29.45	0.00	0.00	0.00
9.0	24.63	9.0	7.20	11.25	9.0	5.50	4.40	5.50	4.40	9.90	17.41	29.44	8.71	11.77	3.07
9.5	26.30	9.5	7.60	11.88	9.5	5.63	4.50	5.63	4.50	10.13	19.10	29.44	2.39	2.94	0.56
10.0	25.20	10.0	8.00	12.50	10.0	6.00	4.80	6.00	4.80	10.80	19.10	28.65	7.16	8.60	1.43
10.5	24.85	10.5	8.40	13.13	10.5	6.25	5.00	6.25	5.00	11.25	19.14	28.65	4.78	5.73	0.95
11.0	25.28	11.0	8.80	13.75	11.0	6.50	5.20	6.50	5.20	11.70	19.14	28.16	4.78	5.63	0.85
11.5	25.04	11.5	9.20	14.38	11.5	6.88	5.50	6.88	5.50	12.38	19.81	28.16	7.43	8.45	1.02
12.0	25.80	12.0	9.60	15.00	12.0	7.00	5.60	7.00	5.60	12.60	19.81	27.69	2.48	2.77	0.29
12.5	25.95	12.5	10.00	15.63	12.5	7.50	6.00	7.50	6.00	13.50	19.91	27.69	9.96	11.08	1.12
13.0	26.46	13.0	10.40	16.25	13.0	7.50	6.00	7.50	6.00	13.50	19.91	27.69	0.00	0.00	0.00
13.5	29.45	13.5	10.80	16.88	13.5	8.00	6.40	8.00	6.40	14.40	20.27	27.07	10.13	10.83	0.70
14.0	31.54	14.0	11.20	17.50	14.0	8.13	6.50	8.13	6.50	14.63	20.30	27.07	2.54	2.71	0.17
14.5	30.27	14.5	11.60	18.13	14.5	8.50	6.80	8.50	6.80	15.30	20.30	26.46	7.61	7.94	0.32
15.0	28.65	15.0	12.00	18.75	15.0	8.75	7.00	8.75	7.00	15.75	20.59	26.46	5.15	5.29	0.14
15.5	31.96	15.5	12.40	19.38	15.5	9.00	7.20	9.00	7.20	16.20	20.59	26.30	5.15	5.26	0.11
16.0	35.60	16.0	12.80	20.00	16.0	9.38	7.50	9.38	7.50	16.88	21.73	26.30	8.15	7.89	-0.26
16.5	29.44	16.5	13.20	20.63	16.5	9.50	7.60	9.50	7.60	17.10	21.73	25.87	2.72	2.59	-0.13
17.0	28.16	17.0	13.60	21.25	17.0	10.00	8.00	10.00	8.00	18.00	21.85	25.87	10.93	10.35	-0.58
17.5	27.69	17.5	14.00	21.88	17.5	10.00	8.00	10.00	8.00	18.00	21.85	25.87	0.00	0.00	0.00
18.0	30.90	18.0	14.40	22.50	18.0	10.50	8.40	10.50	8.40	18.90	22.41	25.80	11.20	10.32	-0.88
18.5	31.27	18.5	14.80	23.13	18.5	10.63	8.50	10.63	8.50	19.13	22.43	25.80	2.80	2.58	-0.22
19.0	24.89	19.0	15.20	23.75	19.0	11.00	8.80	11.00	8.80	19.80	22.43	25.55	8.41	7.66	-0.75
19.5	22.41	19.5	15.60	24.38	19.5	11.25	9.00	11.25	9.00	20.25	22.80	25.55	5.70	5.11	-0.59
20.0	21.73	20.0	16.00	25.00	20.0	11.50	9.20	11.50	9.20	20.70	22.80	25.28	6.70	5.06	-0.65
20.5	20.59	20.5	16.40	25.63	20.5	11.88	9.50	11.88	9.50	21.38	23.00	25.28	8.62	7.58	-1.04
21.0	19.10	21.0	16.80	26.25	21.0	12.00	9.60	12.00	9.60	21.60	23.00	25.20	2.87	2.52	-0.35
21.5	20.27	21.5	17.20	26.88	21.5	12.50	10.00	12.50	10.00	22.50	24.63	25.20	12.31	10.08	-2.23
22.0	17.35	22.0	17.60	27.50	22.0	12.50	10.00	12.50	10.00	22.50	24.63	25.20	0.00	0.00	0.00
22.5	22.43	22.5	18.00	28.13	22.5	13.00	10.40	13.00	10.40	23.40	24.85	25.04	12.43	10.02	-2.41
23.0	20.30	23.0	18.40	28.75	23.0	13.13	10.50	13.13	10.50	23.63	24.89	25.04	3.11	2.50	-0.61
23.5	27.07	23.5	18.80	29.38	23.5	13.33	10.67	13.33	10.67	24.00	24.89	24.89	6.18	4.15	-1.04
24.0	21.85	24.0	19.20	30.00	24.0										

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Incremental Revenue	Average Incremental	Cumulative Revenue
27.52	27.52	11.01
27.26	27.47	13.74
19.81	24.60	19.68
19.38	23.55	23.55
15.74	22.25	26.70
15.38	20.88	31.31
14.96	20.51	32.81
13.24	19.05	38.11
13.24	19.05	38.11
11.62	17.81	42.76
11.24	17.55	43.88
10.87	16.84	47.14
9.48	16.35	49.04
8.84	15.88	50.81
8.82	15.27	53.45
8.00	15.07	54.25
7.77	14.34	57.36
7.77	14.34	57.36
7.67	13.73	60.43
5.58	13.55	60.98
4.78	13.00	62.41
4.73	12.67	63.36
4.23	12.35	64.21
3.40	11.86	65.23
2.93	11.70	65.52
2.80	11.11	66.64
2.80	11.11	66.64
1.74	10.52	67.34
1.70	10.39	67.51
1.08	9.98	67.83
0.72	9.71	67.98
0.56	9.46	68.09
-0.86	9.04	67.83
-1.29	8.91	67.70
-1.45	8.39	67.12
-1.45	8.39	67.12
-2.21	7.89	66.24
-2.23	7.77	66.02
-2.48	7.42	65.27
-2.96	7.19	64.68
-3.23	6.96	64.03
-3.47	6.83	62.99
-3.54	6.52	62.64
-5.58	6.04	60.41
-5.58	6.04	60.41
-6.02	5.58	58.00
-6.07	5.47	57.39
-6.22	5.28	56.35

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	12.42	43.05
0.63	0.50	12.63	43.05
1.00	0.80	12.63	35.60
1.25	1.00	12.97	35.60
1.50	1.20	12.97	31.96
1.88	1.50	13.26	31.96
2.00	1.60	13.26	31.54
2.50	2.00	14.64	31.54
2.50	2.00	14.64	31.54
3.00	2.40	15.72	31.27
3.13	2.50	16.03	31.27
3.50	2.80	16.03	30.90
3.75	3.00	17.14	30.90
4.00	3.20	17.14	30.27
4.38	3.50	17.16	30.27
4.50	3.60	17.16	29.45
5.00	4.00	17.35	29.45
5.00	4.00	17.35	29.45
5.50	4.40	17.41	29.44
5.63	4.50	19.10	29.44
6.00	4.80	19.10	28.65
6.25	5.00	19.14	28.65
6.50	5.20	19.14	28.16
6.88	5.50	19.81	28.16
7.00	5.60	19.81	27.69
7.50	6.00	19.91	27.69
7.50	6.00	19.91	27.69
8.00	6.40	20.27	27.07
8.13	6.50	20.30	27.07
8.50	6.80	20.30	26.46
8.75	7.00	20.59	26.46
9.00	7.20	20.59	26.30
9.38	7.50	21.73	26.30
9.50	7.60	21.73	25.87
10.00	8.00	21.85	25.87
10.00	8.00	21.85	25.87
10.50	8.40	22.41	25.80
10.63	8.50	22.43	25.80
11.00	8.80	22.43	25.55
11.25	9.00	22.80	25.55
11.50	9.20	22.80	25.28
11.88	9.50	23.00	25.28
12.00	9.60	23.00	25.20
12.50	10.00	24.63	25.20
12.50	10.00	24.63	25.20
13.00	10.40	24.85	25.04
13.13	10.50	24.89	25.04
13.33	10.67	24.89	24.69

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	12.42	43.05
0.63	0.50	12.46	43.05
1.00	0.80	12.53	40.25
1.25	1.00	12.61	39.32
1.50	1.20	12.67	38.09
1.88	1.50	12.79	36.67
2.00	1.60	12.82	36.53
2.50	2.00	13.19	35.53
2.50	2.00	13.19	35.53
3.00	2.40	13.61	34.82
3.13	2.50	13.70	34.68
3.50	2.80	13.95	34.28
3.75	3.00	14.17	34.05
4.00	3.20	14.35	33.82
4.38	3.50	14.59	33.51
4.50	3.60	14.66	33.40
5.00	4.00	14.93	33.00
5.00	4.00	14.93	33.00
5.50	4.40	15.16	32.68
5.63	4.50	15.24	32.61
6.00	4.80	15.49	32.36
6.25	5.00	15.63	32.21
6.50	5.20	15.77	32.06
6.88	5.50	15.99	31.84
7.00	5.60	16.06	31.77
7.50	6.00	16.31	31.50
7.50	6.00	16.31	31.50
8.00	6.40	16.56	31.22
8.13	6.50	16.62	31.16
8.50	6.80	16.78	30.95
8.75	7.00	16.89	30.82
9.00	7.20	16.99	30.70
9.38	7.50	17.18	30.52
9.50	7.60	17.24	30.46
10.00	8.00	17.47	30.23
10.00	8.00	17.47	30.23
10.50	8.40	17.71	30.02
10.63	8.50	17.76	29.97
11.00	8.80	17.92	29.82
11.25	9.00	18.03	29.72
11.50	9.20	18.13	29.63
11.88	9.50	18.29	29.49
12.00	9.60	18.34	29.44
12.50	10.00	18.59	29.27
12.50	10.00	18.59	29.27
13.00	10.40	18.63	29.11
13.13	10.50	18.89	29.07
13.33	10.67	18.98	29.01



11-Australia: New South Wales Weekend

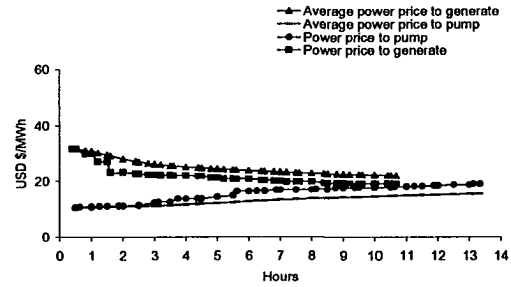
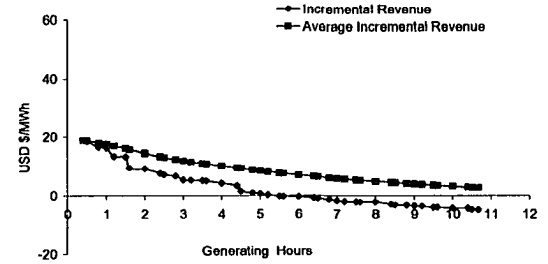
USD/MWh	Efficiency	0.80		Pump	Gen	Total	paid	sold	DifPaid	DifSold	Profit
		B	S								
0.5	18.64	0.0	10.4	31.8	0.0	0.0	10.40	31.82	5.20	12.73	7.53
1.0	16.91	0.5	10.7	30.0	0.50	0.40	10.73	31.82	1.34	3.18	1.84
1.5	18.66	1.0	11.0	27.2	0.63	0.50	10.73	29.97	4.02	8.99	4.97
2.0	16.27	1.5	11.1	23.3	1.25	1.00	10.96	29.97	2.74	5.99	3.25
2.5	14.80	2.0	11.2	22.8	1.50	1.20	10.96	27.16	2.74	5.43	2.69
3.0	13.56	2.5	12.1	22.3	1.88	1.50	11.05	27.16	4.15	8.15	4.00
3.5	12.08	3.0	12.5	22.2	2.00	1.60	11.05	23.27	1.38	2.33	0.95
4.0	11.05	3.5	13.6	22.1	2.50	2.00	11.23	23.27	5.61	9.31	3.69
4.5	10.73	4.0	13.6	21.9	2.50	2.00	11.23	23.27	0.00	0.00	0.00
5.0	10.40	4.5	14.3	21.3	3.00	2.40	12.08	22.76	6.04	9.10	3.06
5.5	10.96	5.0	14.8	20.9	3.13	2.50	12.08	22.76	1.56	2.28	0.71
6.0	11.23	5.5	16.3	20.9	3.50	2.80	12.51	22.32	4.69	6.70	2.01
6.5	12.51	6.0	16.3	20.9	3.75	3.00	13.56	22.32	3.39	4.46	1.07
7.0	13.62	6.5	16.5	20.4	4.00	3.20	13.56	22.21	3.39	4.44	1.05
7.5	14.29	7.0	16.9	19.9	4.38	3.50	13.62	22.21	5.11	6.66	1.56
8.0	16.45	7.5	16.9	19.9	4.50	3.60	13.62	22.09	1.70	2.21	0.51
8.5	19.12	8.0	17.1	19.3	5.00	4.00	14.29	22.09	7.14	8.64	1.69
9.0	22.32	8.5	17.5	19.3	5.00	4.00	14.29	22.09	0.00	0.00	0.00
9.5	22.21	9.0	17.6	19.1	5.50	4.40	14.80	21.92	7.40	8.77	1.37
10.0	21.92	9.5	17.6	19.1	5.63	4.50	10.13	16.27	21.92	2.03	2.19
10.5	21.34	10.0	17.8	19.1	6.00	4.80	10.80	16.27	21.34	6.10	6.40
11.0	20.86	10.5	18.0	19.0	6.25	5.00	11.25	16.45	21.34	4.11	4.27
11.5	20.43	11.0	18.1	18.7	6.50	5.20	11.70	16.45	20.89	4.11	4.18
12.0	20.21	11.5	18.4	18.6	6.88	5.50	12.38	16.83	20.89	6.31	6.27
12.5	19.88	12.0	18.6	18.4	7.00	5.60	12.60	16.83	20.86	2.10	2.09
13.0	19.26	12.5	18.7	18.1	7.50	6.00	13.50	16.90	20.86	8.45	8.34
13.5	19.11	13.0	19.0	18.0	7.50	6.00	13.50	16.90	20.86	0.00	0.00
14.0	18.42	13.5	19.1	17.8	8.00	6.40	14.40	16.91	20.43	8.46	8.17
14.5	17.77	14.0	19.1	17.6	8.13	6.50	14.63	17.10	20.43	2.14	2.04
15.0	17.58	14.5	19.1	17.6	8.50	6.80	15.30	17.10	20.21	6.41	6.06
15.5	17.47	15.0	19.3	17.5	8.75	7.00	15.75	17.47	20.21	4.37	4.04
16.0	18.13	15.5	19.3	17.1	9.00	7.20	16.20	17.47	19.89	4.37	3.98
16.5	17.59	16.0	19.9	16.9	9.38	7.50	16.88	17.58	19.89	6.59	5.97
17.0	18.96	16.5	19.9	16.9	9.50	7.60	17.10	17.58	19.88	2.20	1.99
17.5	23.27	17.0	20.2	16.8	10.00	8.00	18.00	17.59	19.88	8.79	7.95
18.0	27.16	17.5	20.4	16.5	10.00	8.00	18.00	17.59	19.88	0.00	0.00
18.5	31.82	18.0	20.9	16.3	10.50	8.40	18.90	17.77	19.34	8.88	7.73
19.0	29.97	18.5	20.9	14.8	10.63	8.50	19.13	17.97	19.34	2.25	1.93
19.5	22.76	19.0	21.3	14.3	11.00	8.80	19.80	17.97	19.26	6.74	5.78
20.0	22.09	19.5	21.9	13.6	11.25	9.00	20.25	18.13	19.26	4.53	3.65
20.5	20.89	20.0	22.1	13.6	11.50	9.20	20.70	18.13	19.12	4.53	3.82
21.0	19.89	20.5	22.2	12.5	11.88	9.50	21.38	18.42	19.12	6.91	5.74
21.5	19.07	21.0	22.3	12.1	12.00	9.60	21.60	18.42	19.11	2.30	1.91
22.0	17.10	21.5	22.8	11.2	12.50	10.00	22.50	18.64	19.11	9.32	7.64
22.5	17.97	22.0	23.3	11.1	12.50	10.00	22.50	18.64	19.11	0.00	0.00
23.0	16.83	22.5	27.2	11.0	13.00	10.40	23.40	18.66	19.07	9.33	7.63
23.5	19.34	23.0	30.0	10.7	13.13	10.50	23.63	18.96	19.07	2.37	1.91
24.0	16.90	24.0	31.8	10.4	13.33	10.67	24.00	18.96	18.96	3.95	3.16

11-Australia: New South Wales Weekend

Incremental Revenue	Average Incremental	Cumulative Revenue
18.81	18.81	7.53
18.40	18.73	9.37
18.56	17.92	14.33
16.26	17.59	17.59
13.46	16.90	20.28
13.34	16.19	24.28
9.45	15.77	25.23
9.24	14.46	28.92
9.24	14.46	28.92
7.66	13.33	31.98
7.12	13.08	32.69
6.69	12.39	34.70
5.37	11.93	35.78
5.26	11.51	36.83
5.19	10.97	38.38
5.07	10.80	38.89
4.24	10.15	40.58
4.24	10.15	40.58
3.42	9.53	41.95
1.58	9.36	42.11
1.00	8.84	42.41
0.77	8.51	42.57
0.33	8.20	42.63
-0.15	7.74	42.59
-0.18	7.60	42.57
-0.26	7.08	42.46
-0.26	7.08	42.46
-0.71	6.59	42.18
-0.95	6.47	42.08
-1.17	6.14	41.73
-1.63	5.92	41.41
-1.96	5.70	41.02
-2.08	5.39	40.39
-2.09	5.29	40.18
-2.10	4.92	39.34
-2.10	4.92	39.34
-2.87	4.55	38.19
-3.12	4.46	37.88
-3.20	4.20	36.92
-3.40	4.03	36.24
-3.54	3.86	35.53
-3.90	3.62	34.36
-3.91	3.54	33.97
-4.19	3.23	32.29
-4.19	3.23	32.29
-4.25	2.94	30.59
-4.63	2.87	30.13
-4.74	2.75	29.34

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.40	31.82
0.63	0.50	10.73	31.82
1.00	0.80	10.73	29.97
1.25	1.00	10.96	29.97
1.50	1.20	10.96	27.16
1.88	1.50	11.05	27.16
2.00	1.60	11.05	23.27
2.50	2.00	11.23	23.27
2.50	2.00	11.23	23.27
3.00	2.40	12.08	22.76
3.13	2.50	12.51	22.76
3.50	2.80	12.51	22.32
3.75	3.00	13.56	22.32
4.00	3.20	13.56	22.21
4.38	3.50	13.62	22.21
4.50	3.60	13.62	22.09
5.00	4.00	14.29	22.09
5.00	4.00	14.29	22.09
5.50	4.40	14.80	21.92
5.63	4.50	16.27	21.92
6.00	4.80	16.27	21.34
6.25	5.00	16.45	21.34
6.50	5.20	16.45	20.89
6.88	5.50	16.83	20.89
7.00	5.60	16.83	20.86
7.50	6.00	16.90	20.86
7.50	6.00	16.90	20.86
8.00	6.40	16.91	20.43
8.13	6.50	17.10	20.43
8.50	6.80	17.10	20.21
8.75	7.00	17.47	20.21
9.00	7.20	17.47	19.89
9.38	7.50	17.58	19.89
9.50	7.60	17.58	19.88
10.00	8.00	17.59	19.88
10.00	8.00	17.59	19.88
10.50	8.40	17.77	19.34
10.63	8.50	17.97	19.34
11.00	8.80	17.97	19.28
11.25	9.00	18.13	19.26
11.50	9.20	18.13	19.12
11.88	9.50	18.42	19.12
12.00	9.60	18.42	19.11
12.50	10.00	18.64	19.11
12.50	10.00	18.64	19.11
13.00	10.40	18.68	19.07
13.13	10.50	18.98	19.07
13.33	10.67	18.98	18.96

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.40	31.82
0.63	0.50	10.47	31.82
1.00	0.80	10.67	31.12
1.25	1.00	10.65	30.89
1.50	1.20	10.70	30.27
1.88	1.50	10.77	29.65
2.00	1.60	10.79	29.25
2.50	2.00	10.88	28.05
2.50	2.00	10.88	28.05
3.00	2.40	11.08	27.17
3.13	2.50	11.13	27.00
3.50	2.80	11.28	26.49
3.75	3.00	11.43	26.22
4.00	3.20	11.57	25.97
4.38	3.50	11.74	25.64
4.50	3.60	11.79	25.55
5.00	4.00	12.04	25.20
5.00	4.00	12.04	25.20
5.50	4.40	12.29	24.90
5.63	4.50	12.38	24.84
6.00	4.80	12.63	24.62
6.25	5.00	12.78	24.49
6.50	5.20	12.92	24.35
6.88	5.50	13.13	24.16
7.00	5.60	13.20	24.10
7.50	6.00	13.45	23.88
7.50	6.00	13.45	23.88
8.00	6.40	13.66	23.67
8.13	6.50	13.71	23.62
8.50	6.80	13.86	23.47
8.75	7.00	13.97	23.37
9.00	7.20	14.07	23.28
9.38	7.50	14.21	23.14
9.50	7.60	14.25	23.10
10.00	8.00	14.42	22.94
10.00	8.00	14.42	22.94
10.50	8.40	14.58	22.77
10.63	8.50	14.62	22.73
11.00	8.80	14.73	22.61
11.25	9.00	14.81	22.53
11.50	9.20	14.88	22.46
11.88	9.50	14.99	22.35
12.00	9.60	15.03	22.32
12.50	10.00	15.17	22.19
12.50	10.00	15.17	22.19
13.00	10.40	15.30	22.07
13.13	10.50	15.34	22.04
13.33	10.67	15.40	22.00



12-Australia: Queensland Weekday

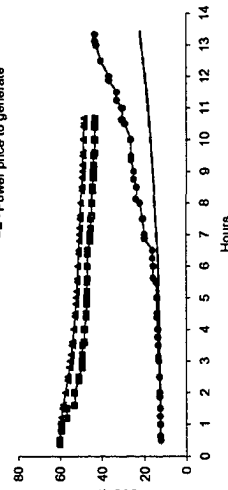
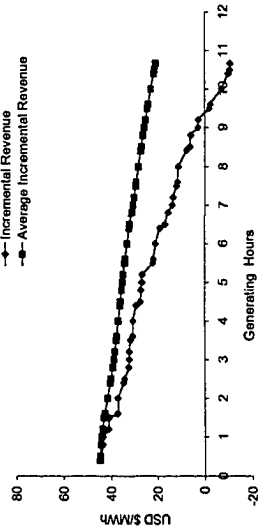
	USD/MWh			Efficiency	0.80	B	S	B	S	Pump	Gen	Total	paid	DIIPaid	DIISold	Profit	
0.5	15.87	0.0	12.3	60.2	0.5	0.40	0.63	0.5	1.0	0.00	0.00	0.00	12.33	6.17	24.08	17.92	
1.0	14.62	0.5	12.5	59.3	1.0	0.80	1.25	1.0	1.5	0.50	0.40	0.90	12.55	60.20	1.57	6.02	4.45
1.5	14.18	1.0	12.6	56.9	1.5	1.20	1.88	1.5	2.0	1.00	0.80	1.80	12.55	59.35	4.70	17.80	13.10
2.0	13.50	1.5	12.8	53.3	2.0	1.60	2.50	2.0	2.5	1.25	1.00	2.25	12.57	59.35	3.14	11.87	8.73
2.5	13.15	2.0	12.9	51.2	2.5	2.00	3.13	2.5	3.0	1.50	1.20	2.70	12.57	56.90	3.14	11.38	8.24
3.0	12.89	2.5	13.2	49.4	3.0	2.40	3.75	3.0	3.5	1.88	1.50	3.38	12.81	56.90	4.80	17.07	12.27
3.5	12.57	3.0	13.5	48.4	3.5	2.80	4.38	3.5	4.0	2.00	1.60	3.60	12.81	53.29	1.60	5.33	3.73
4.0	12.33	3.5	13.7	48.4	4.0	3.20	5.00	4.0	4.5	2.50	2.00	4.50	12.89	53.29	6.45	21.32	14.87
4.5	12.55	4.0	14.0	47.4	4.5	3.60	5.63	4.5	5.0	3.00	2.40	5.40	13.15	51.17	6.58	20.47	13.89
5.0	12.81	4.5	14.2	47.2	5.0	4.00	6.25	5.0	5.5	3.13	2.50	5.63	13.50	51.17	1.69	5.12	3.43
5.5	13.67	5.0	14.5	47.0	5.5	4.40	6.88	5.5	6.0	3.13	2.80	6.30	13.50	49.39	5.06	14.82	9.75
6.0	14.03	5.5	15.9	46.9	6.0	4.80	7.50	6.0	6.5	3.50	3.20	6.70	13.67	49.39	3.42	9.88	6.46
6.5	16.25	6.0	16.2	46.6	6.5	5.20	8.13	6.5	7.0	3.75	3.20	7.20	13.67	49.39	3.42	9.87	6.45
7.0	20.81	6.5	20.0	45.5	7.0	5.60	8.75	7.0	7.5	4.00	4.00	8.00	14.03	49.36	5.26	14.81	9.55
7.5	33.03	7.0	20.8	45.1	7.5	6.00	9.38	7.5	8.0	4.38	3.50	7.88	14.03	49.36	5.26	14.81	9.55
8.0	36.69	7.5	22.2	44.7	8.0	6.40	10.00	8.0	8.5	4.50	3.60	8.10	14.03	48.42	1.75	4.84	3.09
8.5	43.38	8.0	23.9	44.5	8.5	6.80	10.63	8.5	9.0	5.00	4.00	9.00	14.18	48.42	7.09	19.37	12.28
9.0	47.18	8.5	25.3	44.1	9.0	7.20	11.25	9.0	9.5	5.00	4.00	9.00	14.18	48.42	0.00	0.00	0.00
9.5	47.05	9.0	26.5	43.9	9.5	7.60	11.88	9.5	10.0	5.50	4.40	9.90	14.52	47.43	7.26	18.97	11.71
10.0	45.49	9.5	26.7	43.5	10.0	8.00	12.50	10.0	10.5	5.63	4.50	10.13	15.87	47.43	1.98	4.74	2.76
10.5	45.15	10.0	29.4	43.4	10.5	8.40	13.13	10.5	11.0	6.00	4.80	10.80	15.87	47.43	5.95	14.16	8.20
11.0	44.47	10.5	30.6	43.3	11.0	8.80	13.75	11.0	11.5	6.25	5.00	11.25	16.25	47.18	4.06	9.44	5.38
11.5	44.08	11.0	33.0	42.7	11.5	9.20	14.38	11.5	12.0	6.50	5.20	11.70	16.25	47.05	4.06	9.41	5.35
12.0	49.39	11.5	36.7	40.5	12.0	9.60	15.00	12.0	12.5	6.88	5.50	12.38	20.01	47.05	7.51	14.11	6.61
12.5	43.29	12.0	40.5	36.7	12.5	10.00	15.63	12.5	13.0	7.00	5.60	12.60	20.01	46.89	2.50	4.69	2.19
13.0	42.72	12.5	42.7	33.0	13.0	10.40	16.25	13.0	13.5	7.50	6.00	13.50	20.81	46.89	10.40	18.75	8.35
13.5	43.45	13.0	43.3	30.6	13.5	10.80	16.88	13.5	14.0	7.50	6.00	13.50	20.81	46.89	0.00	0.00	0.00
14.0	49.36	13.5	43.4	29.4	14.0	11.20	17.50	14.0	14.5	8.13	6.40	14.40	22.16	46.64	11.08	18.66	7.57
14.5	51.17	14.0	43.5	26.7	14.5	11.60	18.13	14.5	15.0	8.13	6.50	14.63	23.86	46.64	2.98	4.66	1.68
15.0	44.68	14.5	43.9	26.5	15.0	12.00	18.75	15.0	15.5	8.50	6.80	15.30	23.86	45.49	8.95	13.65	4.70
15.5	46.89	15.0	44.1	25.3	15.5	12.40	19.38	15.5	16.0	8.75	7.00	15.75	25.28	45.49	6.32	9.10	2.78
16.0	43.90	15.5	44.5	23.9	16.0	12.80	20.00	16.0	16.5	9.00	7.20	16.20	25.28	45.15	6.32	9.03	2.71
16.5	47.43	16.0	44.7	22.2	16.5	13.20	20.63	16.5	17.0	9.38	7.50	16.88	26.48	45.15	9.93	13.54	3.62
17.0	46.64	16.5	45.1	20.8	17.0	13.60	21.25	17.0	17.5	9.50	7.60	17.10	26.48	44.68	3.31	4.47	1.16
17.5	48.42	17.0	45.5	20.0	17.5	14.00	21.88	17.5	18.0	10.00	8.00	18.00	26.72	44.68	13.36	17.87	4.51
18.0	60.20	17.5	46.6	16.2	18.0	14.40	22.50	18.0	18.5	10.50	8.00	18.00	26.72	44.68	0.00	0.00	0.00
18.5	56.90	18.0	46.9	15.9	18.5	14.80	23.13	18.5	19.0	10.50	8.40	18.90	29.41	44.47	14.71	17.79	3.08
19.0	59.35	18.5	47.0	14.5	19.0	15.20	23.75	19.0	19.5	10.63	8.50	19.13	30.61	44.47	3.83	4.45	0.62
19.5	53.29	19.0	47.2	14.2	19.5	15.60	24.38	19.5	20.0	11.00	8.80	19.80	30.61	44.08	11.48	13.22	1.74
20.0	40.50	19.5	47.4	14.0	20.0	16.00	25.00	20.0	20.5	11.25	9.00	20.25	33.03	44.08	8.26	8.82	0.56
20.5	26.72	20.0	48.4	13.7	20.5	16.40	25.63	20.5	21.0	11.50	9.20	20.70	33.03	43.90	6.26	8.78	0.52
21.0	26.48	20.5	49.4	13.5	21.0	16.80	26.25	21.0	21.5	11.88	9.50	21.38	36.69	43.90	13.76	13.17	-0.59
21.5	25.28	21.0	49.4	13.2	21.5	17.20	26.88	21.5	22.0	12.00	9.60	21.60	36.69	43.45	4.59	4.35	-0.24
22.0	22.16	21.5	51.2	12.9	22.0	17.60	27.50	22.0	22.5	12.50	10.00	22.50	40.50	43.45	20.25	17.38	-2.87
22.5	29.41	22.0	53.3	12.8	22.5	18.00	28.13	22.5	23.0	12.50	10.00	22.50	40.50	43.45	0.00	0.00	0.00
23.0	23.86	22.5	56.9	12.8	23.0	18.40	28.75	23.0	23.5	13.00	10.40	23.40	42.72	43.38	21.36	17.35	-4.00
23.5	30.61	23.0	59.3	12.5	23.5	18.80	29.38	23.5	24.0	13.13	10.50	23.63	43.29	43.38	5.41	4.34	-1.07
24.0	20.01	23.5	60.2	12.3	24.0	19.20	30.00	24.0	24.0	13.33	10.67	24.00	43.29	43.29	9.02	7.22	-1.80

12-Australia: Queensland Weekday

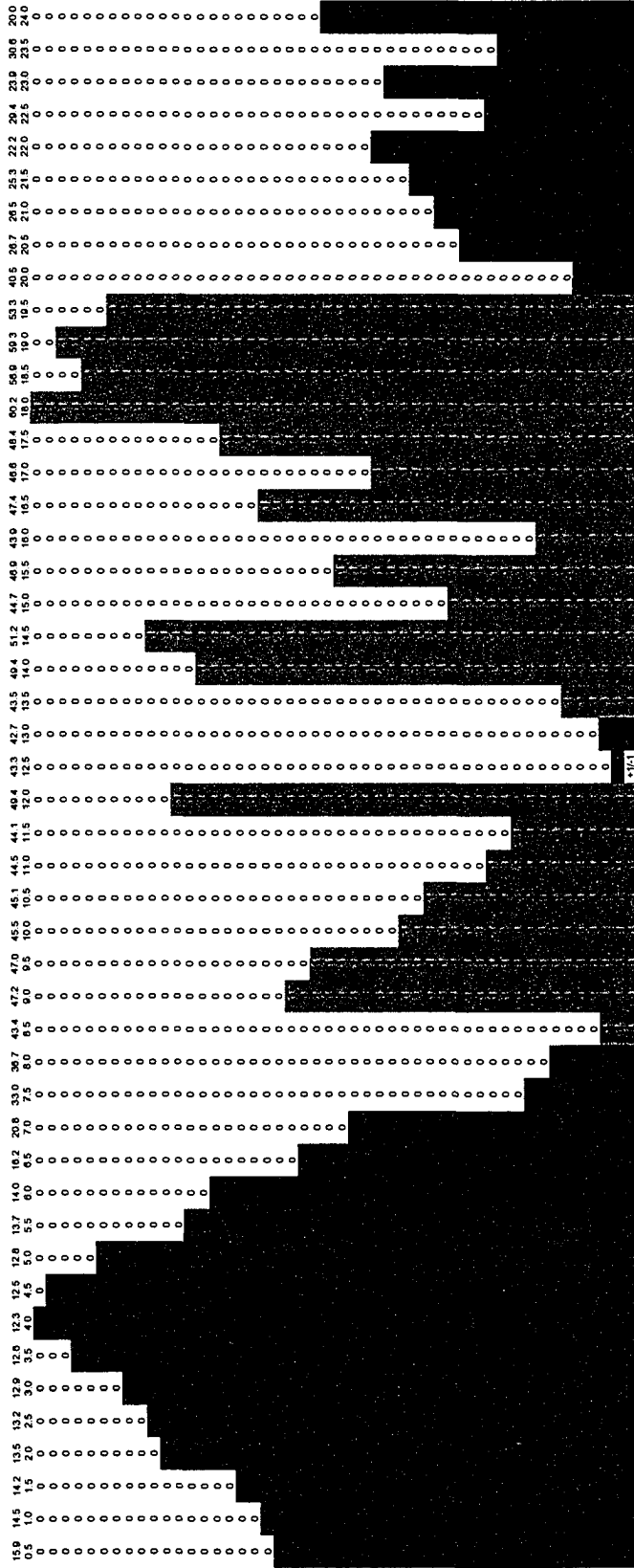
Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
44.79	44.79	17.92
44.52	44.74	22.37
43.66	44.33	35.47
43.63	44.19	44.18
40.69	43.69	52.43
40.89	43.13	64.70
37.28	42.77	68.43
37.18	41.65	83.30
37.18	41.65	83.30
34.73	40.49	97.19
34.30	40.25	100.62
32.52	38.42	110.37
32.31	38.84	116.83
32.27	38.53	123.29
31.82	37.76	132.83
30.88	37.76	135.82
30.69	37.05	148.20
29.28	36.34	159.91
27.80	36.15	162.67
26.88	35.60	170.88
26.74	34.92	181.60
22.03	34.22	188.21
21.87	34.00	190.40
20.68	33.12	198.75
18.83	32.24	206.32
16.82	32.00	208.00
15.87	31.28	212.70
13.90	30.78	215.48
13.66	30.30	218.19
12.05	29.57	221.81
11.95	29.34	221.97
11.27	28.43	227.48
11.27	28.43	227.48
7.70	27.45	230.68
6.20	27.20	231.19
5.81	26.47	232.92
2.78	25.94	233.46
2.80	25.43	234.00
-1.97	24.57	233.41
-2.42	24.29	233.17
-7.18	23.03	230.30
-7.18	23.03	230.30
-40.01	21.76	226.29
-10.73	21.45	225.22
-10.82	20.95	223.41

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	12.33	60.20
0.63	0.50	12.55	60.20
1.00	0.80	12.55	59.35
1.25	1.00	12.57	59.35
1.50	1.20	12.57	58.90
1.88	1.50	12.81	58.90
2.00	1.60	12.81	55.29
2.50	2.00	12.89	55.29
3.00	2.40	12.89	51.17
3.13	2.50	13.50	51.17
3.50	2.80	13.50	49.39
3.75	3.00	13.67	49.39
4.00	3.20	13.67	48.36
4.38	3.50	14.03	48.36
4.50	3.60	14.03	48.42
5.00	4.00	14.18	48.42
5.50	4.40	14.52	47.43
5.63	4.50	15.87	47.43
6.00	4.80	15.87	47.18
6.25	5.00	16.25	47.18
6.50	5.20	16.25	47.05
6.88	5.50	20.01	46.89
7.00	5.60	20.01	46.89
7.50	6.00	20.81	46.89
7.50	6.00	20.81	46.89
8.00	6.40	22.16	46.64
8.13	6.50	23.86	46.64
8.50	6.80	23.86	45.40
8.75	7.00	25.28	45.40
9.00	7.20	25.28	45.15
9.38	7.50	26.48	45.15
9.50	7.60	26.48	44.68
10.00	8.00	26.72	44.68
10.00	8.00	26.72	44.68
10.50	8.40	26.41	44.47
10.63	8.50	30.61	44.47
11.00	8.80	30.61	44.08
11.00	8.80	30.61	44.08
11.25	9.00	33.03	43.08
11.50	9.20	33.03	43.08
11.50	9.20	33.03	43.08
11.88	9.50	36.69	43.45
12.00	9.60	36.69	43.45
12.50	10.00	40.50	43.45
12.50	10.00	40.50	43.45
13.00	10.40	42.72	43.38
13.13	10.50	45.29	43.38
13.33	10.67	45.29	43.29

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	12.37	60.20
0.63	0.50	12.37	60.20
1.00	0.80	12.44	59.65
1.25	1.00	12.47	59.77
1.50	1.20	12.48	59.30
1.88	1.50	12.55	59.92
2.00	1.60	12.57	59.47
2.50	2.00	12.63	57.44
3.00	2.40	12.72	56.39
3.13	2.50	12.75	56.18
3.50	2.80	12.83	55.46
3.75	3.00	12.88	55.05
4.00	3.20	12.89	54.70
4.38	3.50	13.03	54.24
4.50	3.60	13.06	54.08
5.00	4.00	13.17	53.51
5.50	4.40	13.29	52.96
5.63	4.50	13.35	52.84
6.00	4.80	13.51	52.48
6.25	5.00	13.62	52.27
6.50	5.20	13.72	52.07
6.88	5.50	14.06	51.80
7.00	5.60	14.17	51.71
7.50	6.00	14.61	51.39
7.50	6.00	14.61	51.39
8.00	6.40	15.08	51.09
8.13	6.50	15.22	51.02
8.50	6.80	15.80	50.78
8.75	7.00	16.14	50.63
9.00	7.20	16.58	50.47
9.38	7.50	16.65	50.26
9.50	7.60	16.68	50.19
10.00	8.00	17.18	49.91
10.00	8.00	17.18	49.91
10.50	8.40	17.78	49.65
10.63	8.50	17.92	49.59
11.00	8.80	18.35	49.40
11.00	8.80	18.35	49.40
11.25	9.00	18.67	49.17
11.50	9.20	18.99	49.17
11.50	9.20	18.99	49.17
11.88	9.50	19.55	49.00
12.00	9.60	19.72	48.94
12.50	10.00	20.96	48.72
12.50	10.00	20.96	48.72
13.00	10.40	21.41	48.52
13.13	10.50	21.62	48.47
13.33	10.67	21.96	48.39



12-Australia: Queensland Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

12-Australia: Queensland Weekend

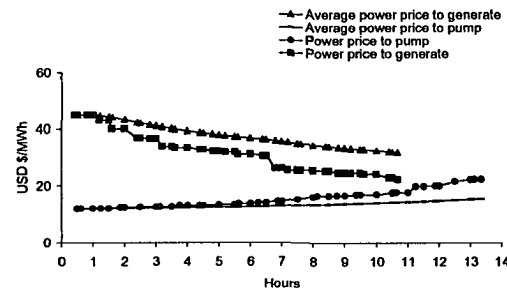
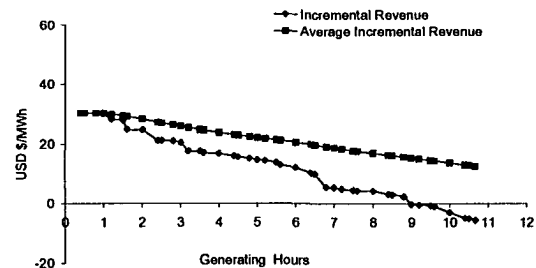
	USD/MWh	Efficiency	0.80	B	S	B	S	Pump	Gen	Total	paid	paid	DiPaid	DiSold	Profit
0.5	16.40	0.5	0.40	0.63	0.5	0.5	0.40	0.00	0.00	0.00	11.79	45.09	5.89	18.03	12.14
1.0	14.57	1.0	0.80	1.25	1.0	1.0	0.80	0.50	0.40	0.93	11.83	45.09	1.48	4.51	3.03
1.5	14.02	1.5	1.20	1.88	1.5	1.5	1.20	1.00	0.80	1.80	11.83	45.06	4.44	13.52	9.08
2.0	13.63	2.0	1.60	2.50	2.0	2.0	1.60	1.25	1.00	2.25	11.91	45.06	2.98	9.01	6.03
2.5	12.97	2.5	2.00	3.13	2.5	2.5	2.00	1.50	1.20	2.70	11.91	43.09	2.98	8.62	5.64
3.0	12.51	3.0	2.40	3.75	3.0	3.0	2.40	1.88	1.50	3.38	12.22	43.09	4.58	12.93	8.35
3.5	12.38	3.5	2.80	4.38	3.5	3.5	2.80	2.00	1.60	3.60	12.22	40.14	1.53	4.01	2.49
4.0	11.91	4.0	3.20	5.00	4.0	4.0	3.20	2.50	2.00	4.50	12.38	40.14	6.19	16.05	9.87
4.5	11.83	4.5	3.60	5.63	4.5	4.5	3.60	2.50	2.00	4.50	12.38	40.14	6.19	16.05	9.87
5.0	11.79	5.0	4.00	6.25	5.0	5.0	4.00	3.00	2.40	5.40	12.51	36.86	6.26	14.75	8.49
5.5	12.22	5.5	4.40	6.88	5.5	5.5	4.40	3.13	2.50	5.63	12.54	36.70	1.57	3.69	2.12
6.0	12.54	6.0	4.80	7.50	6.0	6.0	4.80	3.50	2.80	6.30	12.54	36.70	4.70	11.01	6.31
6.5	12.98	6.5	5.20	8.13	6.5	6.5	5.20	3.75	3.00	6.75	12.97	36.70	3.24	7.34	4.10
7.0	13.24	7.0	5.60	8.75	7.0	7.0	5.60	4.00	3.20	7.20	12.97	33.86	3.24	6.77	3.53
7.5	13.39	7.5	6.00	9.38	7.5	7.5	6.00	4.38	3.50	7.88	12.98	33.86	4.87	10.16	5.29
8.0	15.24	8.0	6.40	10.00	8.0	8.0	6.40	4.50	3.60	8.10	12.98	33.29	1.62	3.33	1.71
8.5	25.34	8.5	6.80	10.63	8.5	8.5	6.80	5.00	4.00	9.00	13.24	33.29	6.62	13.31	6.69
9.0	26.02	9.0	7.20	11.25	9.0	9.0	7.20	5.00	4.00	9.00	13.24	33.29	6.62	13.31	6.69
9.5	32.68	9.5	7.60	11.88	9.5	9.5	7.60	5.50	4.40	9.90	13.39	32.68	6.69	13.07	6.38
10.0	36.86	10.0	8.00	12.50	10.0	10.0	8.00	5.63	4.50	10.13	13.63	32.68	1.70	3.27	1.56
10.5	33.29	10.5	8.40	13.13	10.5	10.5	8.40	6.00	4.80	10.80	13.63	32.10	5.11	9.63	4.52
11.0	32.10	11.0	8.80	13.75	11.0	11.0	8.80	6.25	5.00	11.25	14.02	32.10	3.51	6.42	2.91
11.5	31.08	11.5	9.20	14.38	11.5	11.5	9.20	6.50	5.20	11.70	14.02	31.86	3.51	6.37	2.87
12.0	30.44	12.0	9.60	15.00	12.0	12.0	9.60	6.88	5.50	12.38	14.57	31.86	5.46	9.56	4.09
12.5	24.46	12.5	10.00	15.63	12.5	12.5	10.00	7.00	5.60	12.60	14.57	31.08	1.82	3.11	1.29
13.0	19.83	13.0	10.40	16.25	13.0	13.0	10.40	7.50	6.00	13.50	15.24	31.08	7.62	12.43	4.81
13.5	16.82	13.5	10.80	16.88	13.5	13.5	10.80	7.50	6.00	13.50	15.24	31.08	0.00	0.00	0.00
14.0	16.49	14.0	11.20	17.50	14.0	14.0	11.20	8.00	6.40	14.40	16.10	30.44	8.05	12.18	4.13
14.5	25.44	14.5	11.60	18.13	14.5	14.5	11.60	8.13	6.50	14.63	16.40	30.44	2.05	3.04	0.99
15.0	17.54	15.0	12.00	18.75	15.0	15.0	12.00	8.50	6.80	15.30	16.40	26.02	6.15	7.80	1.65
15.5	16.10	15.5	12.40	19.38	15.5	15.5	12.40	8.75	7.00	15.75	16.49	26.02	4.12	5.20	1.08
16.0	21.61	16.0	12.80	20.00	16.0	16.0	12.80	9.00	7.20	16.20	16.49	25.44	4.12	5.09	0.97
16.5	25.10	16.5	13.20	20.63	16.5	16.5	13.20	9.38	7.50	16.88	16.82	25.44	6.31	7.63	1.33
17.0	31.86	17.0	13.60	21.25	17.0	17.0	13.60	9.50	7.60	17.10	16.82	25.34	2.10	2.53	0.43
17.5	33.86	17.5	14.00	21.88	17.5	17.5	14.00	10.00	8.00	18.00	16.82	25.34	8.46	10.14	1.68
18.0	40.14	18.0	14.40	22.50	18.0	18.0	14.40	10.00	8.00	18.00	16.92	25.34	0.00	0.00	0.00
18.5	43.09	18.5	14.80	23.13	18.5	18.5	14.80	10.50	8.40	18.90	17.54	25.10	8.77	10.04	1.27
19.0	45.06	19.0	15.20	23.75	19.0	19.0	15.20	10.63	8.50	19.13	17.70	25.10	2.21	2.51	0.30
19.5	45.09	19.5	15.60	24.38	19.5	19.5	15.60	11.00	8.80	19.80	17.70	24.46	6.64	7.34	0.70
20.0	36.70	20.0	16.00	25.00	20.0	20.0	16.00	11.25	9.00	20.25	19.83	24.46	4.96	4.89	-0.07
20.5	24.36	20.5	16.40	25.63	20.5	20.5	16.40	11.50	9.20	20.70	19.83	24.36	7.50	7.31	-0.20
21.0	22.83	21.0	16.80	26.25	21.0	21.0	16.80	11.88	9.50	21.38	20.01	24.07	2.50	2.41	-0.09
21.5	22.18	21.5	17.20	26.88	21.5	21.5	17.20	12.50	9.60	21.60	20.01	24.07	10.81	9.63	-1.18
22.0	17.70	22.0	17.60	27.50	22.0	22.0	17.60	12.50	10.00	22.50	21.61	24.07	0.00	0.00	0.00
22.5	20.01	22.5	18.00	28.13	22.5	22.5	18.00	12.50	10.00	22.50	21.61	24.07	0.00	0.00	0.00
23.0	22.32	23.0	18.40	28.75	23.0	23.0	18.40	13.00	10.40	23.40	22.18	22.83	11.09	9.13	-1.96
23.5	24.07	23.5	18.80	29.38	23.5	23.5	18.80	13.13	10.50	23.63	22.32	22.83	2.79	2.28	-0.51
24.0	16.92	24.0	19.20	30.00	24.0	24.0	19.20	13.33	10.67	24.00	22.32	22.32	4.65	3.72	-0.93

12-Australia: Queensland Weekend

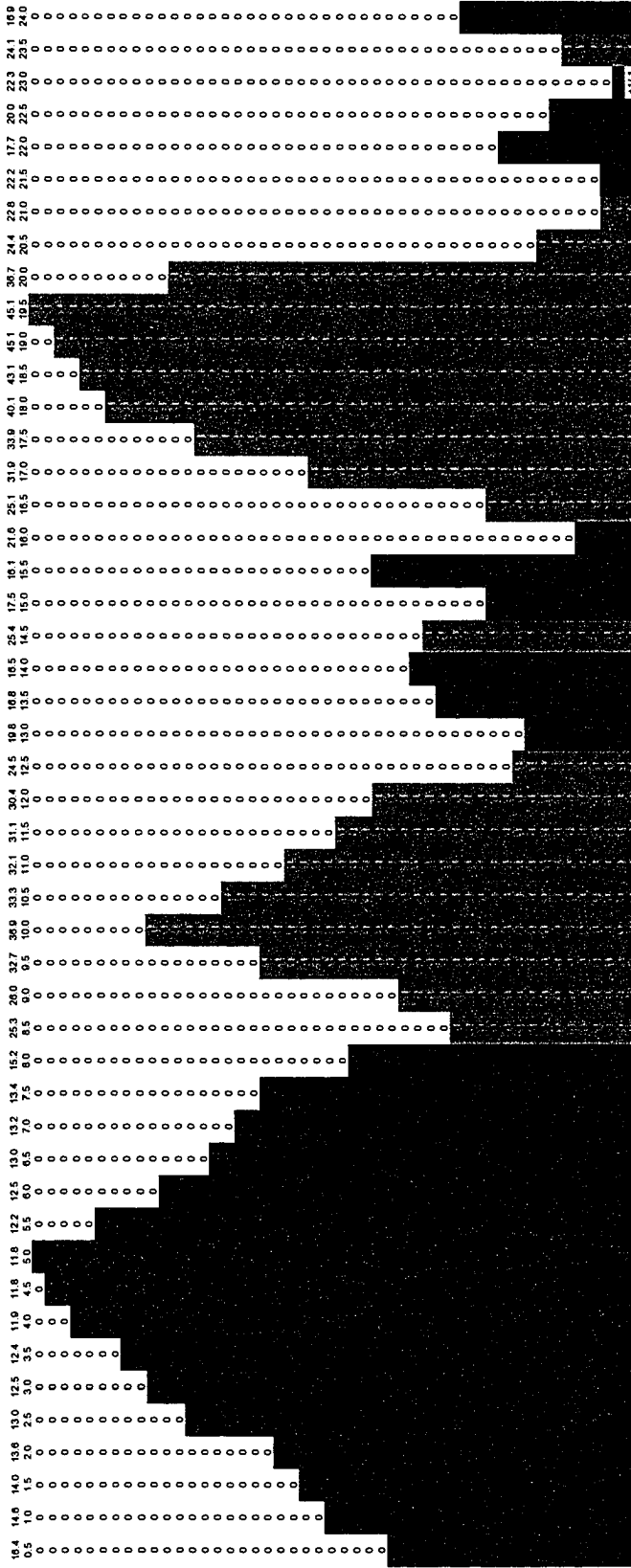
Incremental Revenue	Average Incremental	Cumulative Revenue
30.35	30.35	12.14
30.30	30.34	15.17
30.28	30.32	24.25
30.17	30.29	30.29
28.20	29.94	35.93
27.82	29.52	44.27
24.86	29.22	46.76
24.67	28.31	56.63
24.67	28.31	56.63
21.22	27.13	65.12
21.19	26.89	67.23
21.02	26.26	73.54
20.48	25.88	77.64
17.65	25.36	81.17
17.64	24.70	86.46
17.06	24.49	88.16
16.73	23.71	94.86
18.73	23.71	94.86
15.95	23.01	101.24
15.64	22.84	102.80
15.06	22.36	107.32
14.57	22.05	110.23
14.33	21.75	113.10
13.65	21.31	117.19
12.87	21.18	118.48
12.03	20.55	123.29
12.03	20.55	123.29
10.31	19.91	127.42
9.84	19.76	128.41
5.51	19.13	130.07
5.41	18.74	131.15
4.84	18.35	132.11
4.42	17.79	133.44
4.32	17.61	133.87
4.19	16.94	135.55
4.19	16.94	135.55
3.17	16.29	136.82
2.98	16.13	137.11
2.34	15.66	137.82
-0.33	15.31	137.76
-0.43	14.96	137.66
-0.65	14.47	137.47
-0.94	14.31	137.37
-2.95	13.62	136.19
-2.95	13.62	136.19
-4.89	12.91	134.24
-5.07	12.74	133.73
-5.58	12.45	132.80

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	11.79	45.09
0.63	0.50	11.83	45.09
1.00	0.80	11.83	45.06
1.25	1.00	11.91	45.06
1.50	1.20	11.91	43.09
1.88	1.50	12.22	43.09
2.00	1.60	12.22	40.14
2.50	2.00	12.38	40.14
2.50	2.00	12.38	40.14
3.00	2.40	12.51	36.86
3.13	2.50	12.54	36.86
3.50	2.80	12.54	36.70
3.75	3.00	12.97	36.70
4.00	3.20	12.97	33.86
4.38	3.50	12.98	33.86
4.50	3.60	12.98	33.29
5.00	4.00	13.24	33.29
5.00	4.00	13.24	33.29
5.50	4.40	13.39	32.68
5.63	4.50	13.63	32.68
6.00	4.80	13.63	32.10
6.25	5.00	14.02	32.10
6.50	5.20	14.02	31.86
6.88	5.50	14.57	31.86
7.00	5.60	14.57	31.08
7.50	6.00	15.24	31.08
7.50	6.00	15.24	31.08
8.00	6.40	16.10	30.44
8.13	6.50	16.40	30.44
8.50	6.80	16.40	28.02
8.75	7.00	16.49	28.02
9.00	7.20	16.49	25.44
9.38	7.50	16.82	25.44
9.50	7.60	16.82	25.34
10.00	8.00	16.92	25.34
10.00	8.00	16.92	25.34
10.50	8.40	17.54	25.10
10.63	8.50	17.70	25.10
11.00	8.80	17.70	24.46
11.25	9.00	19.63	24.46
11.50	9.20	19.83	24.36
11.88	9.50	20.01	24.36
12.00	9.60	20.01	24.07
12.50	10.00	21.61	24.07
12.50	10.00	21.61	24.07
13.00	10.40	22.18	22.83
13.13	10.50	22.32	22.83
13.33	10.67	22.32	22.32

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	11.79	45.09
0.63	0.50	11.80	45.09
1.00	0.80	11.81	45.08
1.25	1.00	11.83	45.07
1.50	1.20	11.84	44.74
1.88	1.50	11.92	44.41
2.00	1.60	11.94	44.15
2.50	2.00	12.02	43.34
2.50	2.00	12.02	43.34
3.00	2.40	12.11	42.28
3.13	2.50	12.12	42.05
3.50	2.80	12.17	41.47
3.75	3.00	12.22	41.16
4.00	3.20	12.27	40.70
4.38	3.50	12.33	40.11
4.50	3.60	12.35	39.92
4.98	4.00	12.44	39.26
5.00	4.00	12.44	39.26
5.50	4.40	12.52	38.66
5.63	4.50	12.55	38.53
6.00	4.80	12.62	38.13
6.25	5.00	12.67	37.89
6.50	5.20	12.72	37.65
6.88	5.50	12.82	37.34
7.00	5.60	12.86	37.23
7.50	6.00	13.01	36.82
7.50	6.00	13.01	36.82
8.00	6.40	13.21	36.42
8.13	6.50	13.26	36.33
8.50	6.80	13.40	35.87
8.75	7.00	13.48	35.59
9.00	7.20	13.57	35.31
9.38	7.50	13.70	34.91
9.50	7.60	13.74	34.79
10.00	8.00	13.90	34.32
10.00	8.00	13.90	34.32
10.50	8.40	14.07	33.88
10.63	8.50	14.11	33.77
11.00	8.80	14.24	33.48
11.25	9.00	14.38	33.28
11.50	9.20	14.48	33.06
11.88	9.50	14.65	32.79
12.00	9.60	14.71	32.70
12.50	10.00	14.99	32.35
12.50	10.00	14.99	32.35
13.00	10.40	15.26	31.99
13.13	10.50	15.33	31.90
13.33	10.67	15.44	31.75



12-Australia: Queensland Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

13-Australia: Victoria Weekday

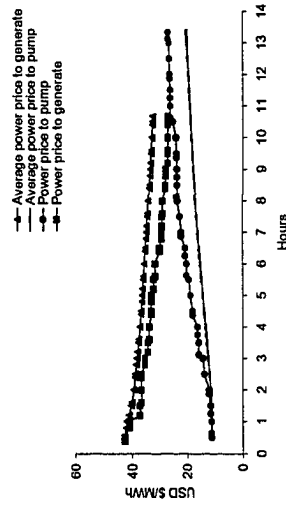
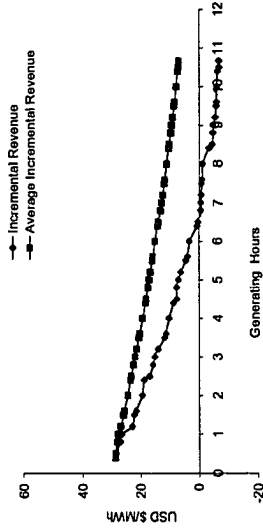
USD/MWh	Efficiency	B	S	B	S	Pump	Gen	Total	paid	sold	DifPaid	DifSold	Profit
0.5	22.64	0.0	11.2	42.6	0.0	0.0	0.0	0.0	11.19	42.58	5.69	17.03	11.44
1.0	18.83	0.5	11.3	41.1	0.5	0.40	0.63	0.5	11.32	42.58	1.41	4.26	2.84
1.5	23.99	1.0	11.6	37.4	1.5	1.20	1.88	1.5	11.32	41.09	4.24	12.33	8.08
2.0	16.04	1.5	12.2	36.8	2.0	1.60	2.50	2.0	11.64	41.09	2.91	8.22	5.31
2.5	15.80	2.0	13.9	36.7	2.5	2.00	3.13	2.5	11.64	37.41	2.91	7.48	4.57
3.0	13.87	2.5	14.3	35.4	3.0	2.40	3.75	3.0	12.17	37.41	1.52	3.68	2.16
3.5	12.17	3.0	15.8	34.2	3.5	2.80	4.38	3.5	12.17	36.77	4.56	11.22	6.66
4.0	11.19	3.5	16.3	33.8	4.0	3.20	5.00	4.0	13.87	36.77	6.94	14.71	7.77
4.5	11.32	4.0	18.0	33.0	4.5	3.60	5.63	4.5	14.32	36.71	7.16	14.69	7.52
5.0	11.64	4.5	18.8	33.0	5.0	4.00	6.25	5.0	15.80	36.71	1.98	3.67	1.70
5.5	14.32	5.0	19.4	32.1	5.5	4.40	6.88	5.5	15.80	35.43	5.93	10.63	4.70
6.0	16.27	5.5	20.3	31.6	6.0	4.80	7.50	6.0	16.27	35.43	4.07	7.09	3.02
6.5	23.71	6.0	20.8	30.0	6.5	5.20	8.13	6.5	16.27	34.23	4.07	6.85	2.76
7.0	42.58	6.5	22.1	29.2	7.0	5.60	8.75	7.0	18.04	34.23	6.76	10.27	3.50
7.5	20.28	7.0	22.5	29.1	7.5	6.00	9.38	7.5	18.04	33.77	2.25	3.38	1.12
8.0	23.49	7.5	23.5	28.9	8.0	6.40	10.00	8.0	18.83	33.77	9.42	13.51	4.09
8.5	26.91	8.0	23.7	28.0	8.5	6.80	10.63	8.5	18.83	33.77	0.00	0.00	0.00
9.0	26.54	8.5	23.7	27.8	9.0	7.20	11.25	9.0	19.45	32.98	9.72	13.19	3.47
9.5	26.94	9.0	23.8	27.1	9.5	7.60	11.88	9.5	20.28	32.98	2.53	3.30	0.76
10.0	29.23	9.5	24.0	27.0	10.0	8.00	12.50	10.0	20.28	32.98	7.60	9.89	2.29
10.5	27.80	10.0	25.2	26.9	10.5	8.40	13.13	10.5	20.78	32.98	5.19	6.60	1.40
11.0	26.05	10.5	26.0	26.9	11.0	8.80	13.75	11.0	21.70	32.13	5.19	6.43	1.23
11.5	28.05	11.0	26.1	26.5	11.5	9.20	14.38	11.5	22.14	32.13	8.30	9.64	1.34
12.0	26.97	11.5	26.3	26.4	12.0	9.60	15.00	12.0	22.14	31.58	2.77	3.16	0.39
12.5	32.98	12.0	26.4	26.3	12.5	10.00	15.63	12.5	22.64	31.58	11.32	12.63	1.31
13.0	32.13	12.5	26.5	26.1	13.0	10.40	16.25	13.0	22.64	31.58	0.00	0.00	0.00
13.5	34.23	13.0	26.9	26.0	13.5	10.80	16.88	13.5	23.49	29.98	11.74	11.99	0.25
14.0	36.77	13.5	26.9	25.2	14.0	11.20	17.50	14.0	23.71	29.98	2.96	3.00	0.03
14.5	37.41	14.0	27.0	24.0	14.5	11.60	18.13	14.5	23.71	29.98	8.77	-0.12	-0.12
15.0	33.77	14.5	27.1	23.8	15.0	12.00	18.75	15.0	23.75	29.23	5.94	5.85	-0.09
15.5	35.43	15.0	27.8	23.7	15.5	12.40	19.38	15.5	23.75	29.08	5.94	5.82	-0.12
16.0	41.09	15.5	28.0	23.7	16.0	12.80	20.00	16.0	23.85	29.08	8.94	8.72	-0.22
16.5	36.71	16.0	28.9	23.5	16.5	13.20	20.63	16.5	23.85	28.89	2.98	2.89	-0.09
17.0	29.98	16.5	29.1	22.6	17.0	13.60	21.25	17.0	23.99	28.89	12.00	11.55	-0.44
17.5	29.08	17.0	29.2	22.1	17.5	14.00	21.88	17.5	23.99	28.89	0.00	0.00	0.00
18.0	32.98	17.5	30.0	20.8	18.0	14.40	22.50	18.0	25.15	28.05	12.58	11.22	-1.36
18.5	31.58	18.0	31.6	20.3	18.5	14.80	23.13	18.5	25.15	28.05	3.25	2.80	-0.45
19.0	26.03	18.5	32.1	19.4	19.0	15.20	23.75	19.0	26.03	27.80	27.80	8.34	-1.42
19.5	27.07	19.0	33.0	18.8	19.5	15.60	24.38	19.5	26.03	27.80	6.51	5.56	-0.95
20.0	26.39	19.5	33.0	18.0	20.0	16.00	25.00	20.0	26.05	27.07	6.51	5.41	-1.10
20.5	25.15	20.0	33.8	16.3	20.5	16.40	25.63	20.5	26.26	27.07	9.85	8.12	-1.73
21.0	23.75	20.5	34.2	15.8	21.0	16.80	26.25	21.0	26.26	26.97	3.28	2.76	-0.59
21.5	23.85	21.0	35.4	14.3	21.5	17.20	26.88	21.5	26.26	26.97	13.19	10.79	-2.41
22.0	20.78	21.5	36.7	13.9	22.0	17.60	27.50	22.0	26.97	26.97	0.00	0.00	0.00
22.5	22.14	22.0	36.8	12.2	22.5	18.00	28.13	22.5	26.97	26.97	13.27	10.78	-2.49
23.0	19.45	22.5	37.4	11.6	23.0	18.40	28.75	23.0	26.94	26.94	3.36	2.69	-0.67
23.5	28.89	23.0	41.1	11.3	23.5	18.80	29.38	23.5	26.91	26.91	5.61	4.48	-1.12
24.0	26.26	23.5	42.6	11.2	24.0	19.20	30.00	24.0	26.91	26.91	0.00	0.00	0.00

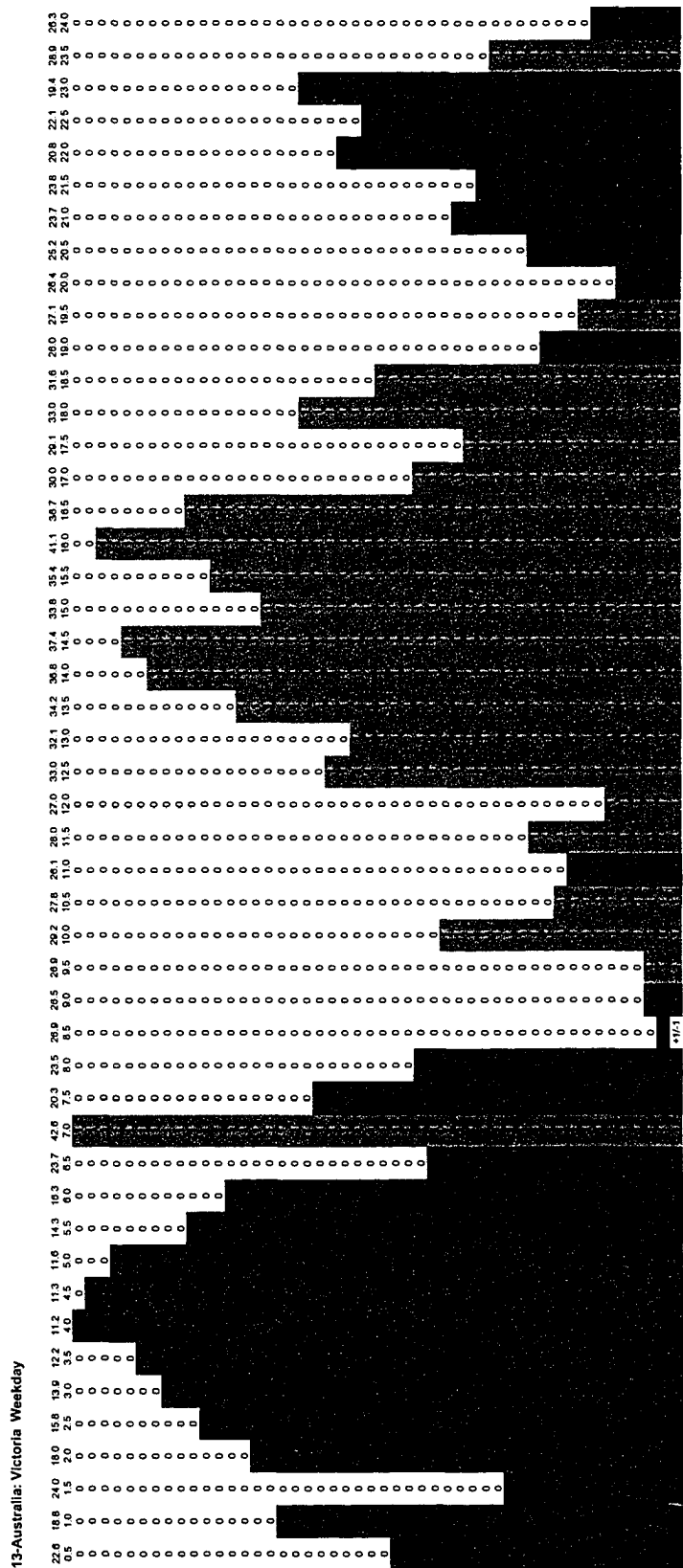
13-Australia: Victoria Weekday

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
28.80	28.60	11.44
28.44	28.57	14.28
28.95	27.96	22.37
28.54	27.66	27.68
22.86	26.87	32.25
22.20	25.94	38.91
21.55	25.66	41.06
19.43	24.42	48.83
18.81	23.48	56.36
16.96	23.22	58.05
15.98	22.41	62.76
15.10	21.93	65.78
13.89	21.42	68.56
11.68	20.59	72.06
11.23	20.33	73.18
10.23	19.32	77.28
8.67	18.35	80.74
7.64	17.46	83.80
7.01	17.04	85.20
6.16	16.62	86.43
4.46	15.96	87.77
3.91	15.74	88.16
3.28	14.91	89.47
3.28	14.91	89.47
0.82	14.02	89.72
0.34	13.81	89.75
-0.40	13.18	89.63
-0.45	12.76	89.54
-0.60	12.42	89.42
-0.71	11.89	89.20
-0.92	11.73	89.11
-1.11	11.08	88.67
-1.41	10.39	87.31
-3.29	9.22	85.86
-4.96	8.22	85.26
-7.76	6.71	84.48
-11.76	5.39	84.48
-17.6	4.06	83.39
-24.6	3.06	81.66
-33.6	2.45	81.67
-45.02	1.87	78.67
-60.2	1.32	76.17
-82.4	0.74	73.50
-110.7	0.19	70.50
-157.3	0.67	74.56

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	11.19	42.58
0.63	0.50	11.32	42.58
1.00	0.80	11.64	41.09
1.25	1.00	11.84	41.09
1.50	1.20	11.84	37.41
1.88	1.50	12.17	37.41
2.00	1.80	12.17	36.77
2.50	2.00	13.87	36.77
3.00	2.00	13.87	36.71
3.13	2.49	14.32	36.71
3.13	2.50	15.80	36.71
3.50	2.80	15.80	35.43
3.75	3.00	16.27	35.43
4.00	3.20	16.27	34.23
4.38	3.50	16.04	34.23
4.50	3.80	16.04	33.77
5.00	4.00	18.83	33.77
5.00	4.00	18.83	33.77
5.50	4.40	19.45	32.88
5.63	4.50	20.28	32.88
6.00	4.80	20.28	32.88
6.25	5.00	20.78	32.88
6.50	5.20	20.78	32.13
6.88	5.50	22.14	32.13
7.00	5.60	22.14	31.58
7.50	6.00	22.64	31.58
7.50	6.00	22.64	31.58
8.00	6.40	23.49	29.98
8.13	6.50	23.71	29.98
8.50	6.80	23.71	29.23
8.75	7.00	23.75	29.23
9.00	7.20	23.75	29.08
9.38	7.50	23.85	28.08
9.50	7.60	23.85	28.08
10.00	8.00	23.99	28.89
10.00	8.00	23.99	28.89
10.50	8.40	25.15	28.05
10.63	8.50	26.03	28.05
11.00	8.80	26.03	27.80
11.25	9.00	26.05	27.80
11.50	9.20	26.05	27.07
11.88	9.50	26.26	26.97
12.00	9.60	26.26	26.97
12.50	10.00	26.39	26.97
13.00	10.00	26.39	26.84
13.13	10.40	26.64	26.84
13.33	10.50	26.61	26.81
13.33	10.67	26.61	26.81

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	11.19	42.58
0.63	0.50	11.21	42.58
1.00	0.80	11.25	42.02
1.25	1.00	11.33	41.84
1.50	1.20	11.38	41.10
1.88	1.50	11.54	40.36
2.00	1.60	11.58	40.14
2.50	2.00	12.04	39.46
3.00	2.00	12.04	39.01
3.13	2.40	12.42	39.01
3.13	2.50	12.55	38.81
3.50	2.80	12.90	38.54
3.75	3.00	13.13	38.33
4.00	3.20	13.32	38.08
4.38	3.50	13.73	37.75
4.50	3.60	13.65	37.64
5.00	4.00	14.35	37.25
5.00	4.00	14.35	37.25
5.50	4.40	14.81	36.66
5.63	4.50	14.93	36.78
6.00	4.80	15.26	36.54
6.25	5.00	15.48	36.40
6.50	5.20	15.69	36.23
6.88	5.50	16.04	36.01
7.00	5.60	16.15	35.93
7.50	6.00	16.58	35.64
7.50	6.00	16.58	35.64
8.00	6.40	17.01	35.29
8.13	6.50	17.12	35.20
8.50	6.80	17.41	34.94
8.75	7.00	17.59	34.78
9.00	7.20	17.76	34.62
9.38	7.50	18.00	34.40
9.50	7.60	18.08	34.32
10.00	8.00	18.36	34.05
10.00	8.00	18.36	34.05
10.50	8.40	18.70	33.77
10.63	8.50	18.78	33.70
11.00	8.80	19.03	33.50
11.25	9.00	19.19	33.37
11.50	9.20	19.34	33.23
11.88	9.50	19.56	33.04
12.00	9.60	19.63	32.98
12.50	10.00	19.90	32.74
13.00	10.00	19.90	32.74
13.13	10.40	20.15	32.51
13.33	10.50	20.22	32.48
13.33	10.67	20.32	32.37





Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

13-Australia: Victoria Weekend

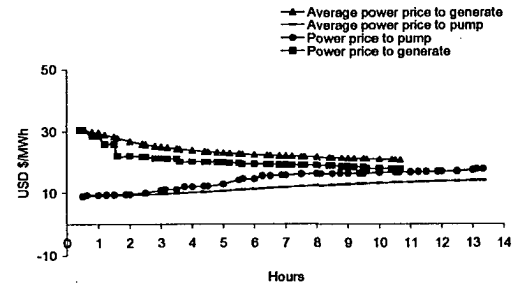
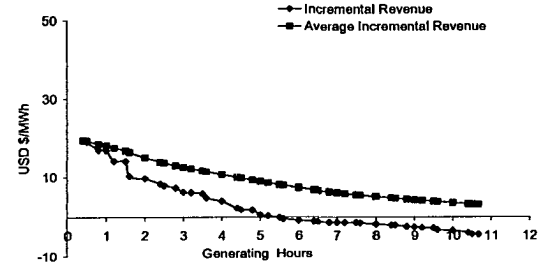
	USD/MWh	Efficiency	0.80	B	S	B	S	Pump	Ger paid	Ger paid	solid	solid	DIIPaid	DIISold	Profit
0.5	18.85	0.5	0.40	0.63	0.5	0.50	0.41	0.98	0.00	0.00	30.61	38	4.49	12.24	7.75
1.0	16.66	1.0	0.80	1.25	1.0	0.63	0.51	0.32	0.63	0.63	30.61	32	3.50	3.06	1.90
1.5	21.14	1.5	1.20	1.88	1.5	1.00	0.81	0.32	1.00	0.81	28.62	32	2.36	8.59	5.09
2.0	16.50	2.0	1.60	2.50	2.0	1.25	1.01	0.42	1.25	1.01	28.62	42	2.36	5.72	3.37
2.5	14.50	2.5	2.00	3.13	2.5	1.50	1.21	0.42	1.50	1.21	25.99	42	3.57	5.20	2.84
3.0	12.84	3.0	2.40	3.75	3.0	1.88	1.51	0.52	1.88	1.51	25.99	52	3.57	7.80	4.23
3.5	11.15	3.5	2.80	4.38	3.5	2.00	1.61	0.52	2.00	1.61	22.17	52	1.19	2.22	1.03
4.0	10.00	4.0	3.20	5.00	4.0	2.50	2.01	0.00	2.50	2.01	22.17	00	5.00	8.87	3.87
4.5	9.42	4.5	3.60	5.63	4.5	2.50	2.01	0.00	2.50	2.01	22.17	00	5.00	0.00	0.00
5.0	8.98	5.0	4.00	6.25	5.0	3.00	2.41	0.81	3.00	2.41	21.83	81	5.41	8.73	3.33
5.5	9.32	5.5	4.40	6.88	5.5	3.13	2.51	1.15	3.13	2.51	21.83	15	1.39	2.18	0.79
6.0	9.62	6.0	4.80	7.50	6.0	3.50	2.81	1.15	3.50	2.81	21.27	15	4.18	6.38	2.20
6.5	10.81	6.5	5.20	8.13	6.5	3.75	3.01	1.96	3.75	3.01	21.27	96	2.99	4.25	1.26
7.0	11.96	7.0	5.60	8.75	7.0	4.00	3.21	1.96	4.00	3.21	21.14	96	2.99	4.23	1.24
7.5	12.19	7.5	6.00	9.38	7.5	4.38	3.51	2.19	4.38	3.51	21.14	19	4.57	6.34	1.77
8.0	14.19	8.0	6.40	10.00	8.0	4.50	3.61	2.19	4.50	3.61	20.08	19	1.52	2.01	0.48
8.5	16.84	8.5	6.80	10.63	8.5	5.00	4.01	2.84	5.00	4.01	20.08	84	6.42	8.03	1.61
9.0	18.27	9.0	7.20	11.25	9.0	5.50	4.01	2.84	5.50	4.01	20.08	84	0.00	0.00	0.00
9.5	20.08	9.5	7.60	11.88	9.5	5.50	4.41	4.19	5.50	4.41	20.03	19	7.09	8.01	0.92
10.0	20.03	10.0	8.00	12.50	10.0	5.63	4.51	4.50	5.63	4.51	20.03	19	1.81	2.00	0.19
10.5	19.66	10.5	8.40	13.13	10.5	6.00	4.81	4.50	6.00	4.81	19.90	50	5.44	5.97	0.53
11.0	19.26	11.0	8.80	13.75	11.0	6.25	5.01	5.49	6.25	5.01	19.90	49	3.87	3.98	0.11
11.5	19.00	11.5	9.20	14.38	11.5	6.50	5.21	5.49	6.50	5.21	19.66	49	3.87	3.93	0.06
12.0	18.79	12.0	9.60	15.00	12.0	6.88	5.51	5.76	6.88	5.51	19.66	76	5.91	5.90	-0.01
12.5	18.43	12.5	10.00	15.63	12.5	7.00	5.61	5.76	7.00	5.61	19.26	76	1.97	1.93	-0.04
13.0	17.79	13.0	10.40	16.25	13.0	7.50	6.01	6.08	7.50	6.01	19.26	08	8.04	7.71	-0.33
13.5	17.64	13.5	10.80	16.88	13.5	7.50	6.01	6.08	7.50	6.01	19.26	08	0.00	0.00	0.00
14.0	16.95	14.0	11.20	17.50	14.0	8.00	6.41	6.19	8.00	6.41	19.18	19	8.10	7.67	-0.42
14.5	16.26	14.5	11.60	18.13	14.5	8.13	6.51	6.23	8.13	6.51	19.18	23	2.03	1.92	-0.11
15.0	16.19	15.0	12.00	18.75	15.0	8.50	6.61	6.23	8.50	6.61	19.00	23	6.09	5.70	-0.39
15.5	16.08	15.5	12.40	19.38	15.5	8.75	7.01	6.26	8.75	7.01	19.00	26	4.07	3.80	-0.27
16.0	16.65	16.0	12.80	20.00	16.0	9.00	7.21	6.26	9.00	7.21	18.94	26	4.07	3.79	-0.28
16.5	16.23	16.5	13.20	20.63	16.5	9.38	7.51	6.27	9.38	7.51	18.94	27	6.10	5.68	-0.42
17.0	17.70	17.0	13.60	21.25	17.0	9.50	7.61	6.27	9.50	7.61	18.85	27	8.25	7.54	-0.71
17.5	22.17	17.5	14.00	21.88	17.5	10.00	8.01	6.50	10.00	8.01	18.85	50	0.00	0.00	0.00
18.0	25.99	18.0	14.40	22.50	18.0	10.50	8.41	6.50	10.50	8.41	18.85	50	0.00	0.00	0.00
18.5	30.61	18.5	14.80	23.13	18.5	10.63	8.51	6.55	10.63	8.51	18.79	66	8.33	7.52	-0.81
19.0	28.62	19.0	15.20	23.75	19.0	10.63	8.51	6.55	10.63	8.51	18.79	66	2.08	1.88	-0.20
19.5	21.83	19.5	15.60	24.38	19.5	11.00	8.61	6.66	11.00	8.61	18.43	66	6.25	5.53	-0.72
20.0	21.27	20.0	16.00	25.00	20.0	11.25	9.01	6.75	11.25	9.01	18.43	66	4.19	3.69	-0.50
20.5	19.90	20.5	16.40	25.63	20.5	11.50	9.21	6.75	11.50	9.21	18.27	75	4.19	3.65	-0.53
21.0	18.94	21.0	16.80	26.25	21.0	11.88	9.51	6.94	11.88	9.51	18.27	84	6.31	5.48	-0.83
21.5	17.34	21.5	17.20	26.88	21.5	12.00	9.61	6.94	12.00	9.61	17.79	84	2.10	1.78	-0.33
22.0	15.76	22.0	17.60	27.50	22.0	12.50	10.01	6.95	12.50	10.01	17.79	95	8.47	7.12	-1.36
22.5	16.27	22.5	18.00	28.13	22.5	13.00	10.41	6.95	13.00	10.41	17.79	95	0.00	0.00	0.00
23.0	15.49	23.0	18.40	28.75	23.0	13.50	10.41	6.95	13.50	10.41	17.79	95	0.00	0.00	0.00
23.5	19.18	23.5	18.80	29.38	23.5	13.13	10.51	7.64	13.13	10.51	17.70	84	2.21	1.77	-0.43
24.0	16.75	24.0	19.20	30.00	24.0	13.33	10.61	7.64	13.33	10.61	17.64	84	3.68	2.94	-0.74

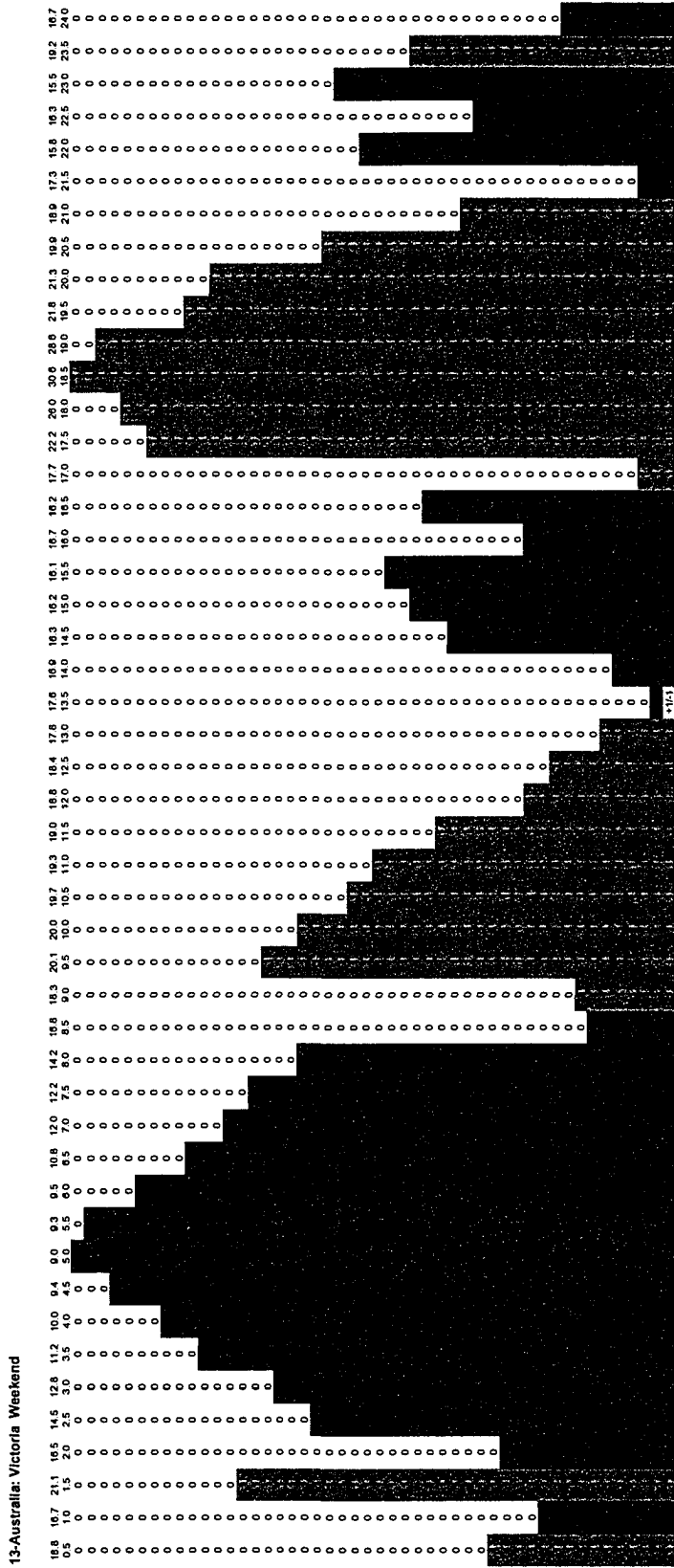
13-Australia: Victoria Weekend

Incremental Revenue	Average Incremental	Cumulative Revenue
19.39	19.39	7.75
18.96	19.30	9.65
16.97	18.43	14.74
16.84	18.11	18.11
14.21	17.46	20.95
14.09	16.79	25.18
10.27	16.38	26.21
9.66	15.04	30.07
9.66	15.04	30.07
8.31	13.92	33.40
7.89	13.67	34.19
7.33	12.99	36.38
6.32	12.55	37.65
6.19	12.15	38.89
5.89	11.62	40.66
4.84	11.43	41.14
4.03	10.69	42.75
4.03	10.69	42.75
2.30	9.92	43.67
1.91	9.75	43.86
1.78	9.25	44.39
0.54	8.90	44.50
0.29	8.57	44.56
-0.04	8.10	44.55
-0.44	7.65	44.50
-0.83	7.36	44.17
-0.83	7.36	44.17
-1.06	6.84	43.75
-1.11	6.71	43.64
-1.29	6.36	43.25
-1.33	6.14	42.98
-1.38	5.93	42.71
-1.39	5.64	42.29
-1.49	5.54	42.14
-1.78	5.18	41.43
-1.78	5.18	41.43
-2.02	4.84	40.62
-2.04	4.75	40.41
-2.40	4.51	39.89
-2.51	4.35	39.19
-2.67	4.20	38.66
-2.78	3.98	37.83
-3.25	3.91	37.50
-3.39	3.61	36.14
-3.39	3.61	36.14
-3.97	3.32	34.56
-4.35	3.25	34.12
-4.41	3.13	33.39

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	8.98	30.61
0.63	0.50	9.32	30.61
1.00	0.80	9.32	28.62
1.25	1.00	9.42	28.62
1.50	1.20	9.42	25.99
1.88	1.50	9.52	25.99
2.00	1.60	9.52	22.17
2.50	2.00	10.00	22.17
2.50	2.00	10.00	22.17
3.00	2.40	10.81	21.83
3.13	2.50	11.15	21.83
3.50	2.80	11.15	21.27
3.75	3.00	11.96	21.27
4.00	3.20	11.96	21.14
4.38	3.50	12.19	21.14
4.50	3.60	12.19	20.08
5.00	4.00	12.84	20.08
5.00	4.00	12.84	20.08
5.50	4.40	14.19	20.03
5.63	4.50	14.50	20.03
6.00	4.80	14.50	19.90
6.25	5.00	15.49	19.90
6.50	5.20	15.49	19.66
6.88	5.50	15.76	19.66
7.00	5.60	15.76	19.26
7.50	6.00	16.08	19.26
7.50	6.00	16.08	19.26
8.00	6.40	16.19	19.18
8.13	6.50	16.23	19.18
8.50	6.80	16.23	19.00
8.75	7.00	16.26	19.00
9.00	7.20	16.26	18.94
9.38	7.50	16.27	18.94
9.50	7.60	16.27	18.85
10.00	8.00	16.50	18.85
10.00	8.00	16.50	18.85
10.50	8.40	16.65	18.79
10.63	8.50	16.68	18.79
11.00	8.80	16.66	18.43
11.25	9.00	16.75	18.43
11.50	9.20	16.75	18.27
11.88	9.50	16.84	18.27
12.00	9.60	16.84	17.79
12.50	10.00	16.95	17.79
12.50	10.00	16.95	17.79
13.00	10.40	17.34	17.70
13.13	10.50	17.64	17.70
13.33	10.67	17.64	17.64

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	8.98	30.61
0.63	0.50	9.05	30.61
1.00	0.80	9.15	29.86
1.25	1.00	9.20	29.62
1.50	1.20	9.24	29.01
1.88	1.50	9.30	28.41
2.00	1.60	9.31	28.02
2.50	2.00	9.45	26.85
2.50	2.00	9.45	26.85
3.00	2.40	9.68	26.01
3.13	2.50	9.73	25.84
3.50	2.80	9.89	25.35
3.75	3.00	10.02	25.08
4.00	3.20	10.15	24.83
4.38	3.50	10.32	24.52
4.50	3.60	10.37	24.39
5.00	4.00	10.62	23.98
5.00	4.00	10.62	23.98
5.50	4.40	10.94	23.61
5.63	4.50	11.02	23.53
6.00	4.80	11.24	23.30
6.25	5.00	11.41	23.16
6.50	5.20	11.57	23.03
6.88	5.50	11.80	22.84
7.00	5.60	11.87	22.78
7.50	6.00	12.15	22.55
7.50	6.00	12.15	22.55
8.00	6.40	12.40	22.34
8.13	6.50	12.46	22.29
8.50	6.80	12.63	22.14
8.75	7.00	12.73	22.05
9.00	7.20	12.83	21.97
9.38	7.50	12.97	21.85
9.50	7.60	13.01	21.81
10.00	8.00	13.18	21.66
10.00	8.00	13.18	21.66
10.50	8.40	13.35	21.52
10.63	8.50	13.39	21.49
11.00	8.80	13.50	21.38
11.25	9.00	13.57	21.32
11.50	9.20	13.64	21.25
11.88	9.50	13.74	21.16
12.00	9.60	13.77	21.12
12.50	10.00	13.90	20.99
12.50	10.00	13.90	20.99
13.00	10.40	14.03	20.86
13.13	10.50	14.07	20.83
13.33	10.67	14.12	20.78





Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

14-New Zealand: Benmore Weekday

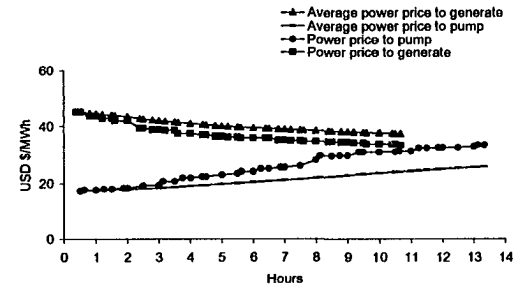
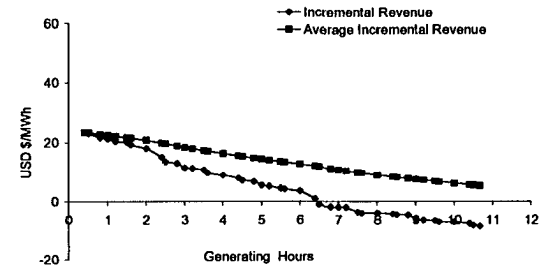
USD/MWh	Efficiency	0.80	S	B	S	Pump	Gen	Total	paid	sold	Diff	DiffSold	Profit
	B	S	B	S									
0.5	26.07	0.0	17.4	45.1	0.5	0.50	0.00	0.00	17.40	45.15	8.70	18.06	9.36
1.0	23.05	0.5	17.7	43.7	1.0	0.63	0.40	0.90	17.69	45.15	2.21	4.51	2.30
1.5	25.58	1.0	18.0	42.9	1.5	0.80	0.80	1.80	17.69	43.72	6.63	13.12	6.48
2.0	23.47	1.5	18.3	42.1	2.0	1.00	1.20	2.20	18.05	43.72	4.51	8.74	4.23
2.5	22.41	2.0	19.3	39.4	2.5	1.50	1.20	2.70	18.05	42.93	4.51	8.59	4.07
3.0	20.76	2.5	19.5	38.9	3.0	2.00	1.80	3.30	18.29	42.93	6.86	12.88	6.02
3.5	19.48	3.0	20.8	38.7	3.5	2.40	3.00	3.60	18.29	42.09	2.29	4.21	1.92
4.0	18.29	3.5	22.0	37.6	4.0	3.20	4.00	4.50	19.25	42.09	9.63	16.84	7.21
4.5	17.69	4.0	22.4	37.1	4.5	3.60	5.00	4.50	19.25	42.09	0.00	0.00	0.00
5.0	17.40	4.5	23.1	36.7	5.0	4.00	6.00	3.00	19.48	39.42	9.74	15.77	6.03
5.5	18.05	5.0	23.5	36.3	5.5	4.40	6.88	3.13	20.76	39.42	2.60	3.84	1.35
6.0	19.25	5.5	24.1	36.1	6.0	4.80	7.50	3.50	20.76	38.89	7.79	11.67	3.88
6.5	21.98	6.0	25.1	36.0	6.5	5.20	8.13	3.75	21.99	38.89	5.50	7.78	2.28
7.0	25.07	6.5	25.6	35.2	7.0	5.60	8.75	4.00	22.00	38.67	5.50	7.73	2.24
7.5	28.89	7.0	26.1	35.1	7.5	6.00	9.38	3.50	22.41	38.67	8.40	11.60	3.20
8.0	36.68	7.5	28.1	34.8	8.0	6.40	10.00	3.60	22.41	37.59	2.80	3.76	0.96
8.5	38.89	8.0	29.6	34.6	8.5	6.80	10.63	4.50	23.05	37.59	11.53	15.04	3.51
9.0	45.15	8.5	29.7	34.5	9.0	7.20	11.25	5.00	23.05	37.59	0.00	0.00	0.00
9.5	39.42	9.0	31.0	34.2	9.5	7.60	11.88	5.50	23.47	37.08	11.74	14.83	3.10
10.0	37.59	9.5	31.0	33.8	10.0	8.00	12.50	6.00	24.12	37.08	3.01	3.71	0.69
10.5	36.01	10.0	31.1	33.8	10.5	8.40	13.13	6.00	24.12	36.68	9.04	11.00	1.96
11.0	35.21	10.5	31.3	33.5	11.0	8.80	13.75	6.25	25.07	36.68	6.27	7.34	1.07
11.5	34.63	11.0	32.4	33.0	11.5	9.20	14.38	6.50	25.07	36.34	6.27	7.27	1.00
12.0	34.49	11.5	32.5	32.6	12.0	9.60	15.00	6.88	25.58	36.34	9.59	10.90	1.31
12.5	34.21	12.0	32.6	32.5	12.5	10.00	15.63	7.00	25.58	36.07	3.20	3.61	0.41
13.0	33.81	12.5	33.0	32.4	13.0	10.40	16.25	7.50	26.07	36.07	0.00	0.00	0.00
13.5	33.79	13.0	33.5	31.3	13.5	10.80	16.88	8.00	26.07	36.01	3.70	3.60	-0.10
14.0	32.54	13.5	33.8	31.1	14.0	11.20	17.50	8.00	28.13	36.01	14.06	14.40	0.34
14.5	32.41	14.0	33.8	31.0	14.5	11.60	18.13	8.13	28.59	35.21	11.10	10.56	-0.53
15.0	31.26	14.5	34.2	31.0	15.0	12.00	18.75	8.50	29.59	35.21	7.41	7.04	-0.37
15.5	30.98	15.0	34.5	29.7	15.5	12.40	19.38	8.75	29.65	35.10	7.41	7.02	-0.39
16.0	30.97	15.5	34.6	29.6	16.0	12.80	20.00	9.00	30.97	35.10	11.61	10.53	-1.09
16.5	31.08	16.0	34.8	28.1	16.5	13.20	20.63	9.38	30.97	34.79	3.87	3.48	-0.39
17.0	32.60	16.5	35.1	26.1	17.0	13.60	21.25	9.50	30.98	34.79	15.49	13.92	-1.57
17.5	33.48	17.0	35.2	25.6	17.5	14.00	21.88	10.00	30.98	34.79	0.00	0.00	0.00
18.0	34.79	17.5	36.0	25.1	18.0	14.40	22.50	10.00	31.08	34.63	15.54	13.85	-1.68
18.5	36.07	18.0	36.1	24.1	18.5	14.80	23.13	10.50	31.26	34.63	3.91	3.46	-0.44
19.0	42.93	18.5	36.3	23.5	19.0	15.20	23.75	10.63	31.26	34.49	11.72	10.35	-1.37
19.5	43.72	19.0	36.7	23.1	19.5	15.60	24.38	11.00	31.26	34.49	8.10	6.90	-1.20
20.0	42.09	19.5	37.1	22.4	20.0	16.00	25.00	11.25	32.41	34.49	8.10	6.84	-1.26
20.5	38.67	20.0	37.6	22.0	20.5	16.40	25.63	11.50	32.41	34.21	12.20	10.26	-1.94
21.0	37.08	20.5	38.7	20.8	21.0	16.80	26.25	11.88	32.54	33.81	4.07	3.38	-0.69
21.5	36.34	21.0	38.9	19.5	21.5	17.20	26.88	12.00	32.54	33.81	0.00	0.00	0.00
22.0	35.10	21.5	39.4	19.3	22.0	17.60	27.50	12.50	32.60	33.81	16.30	13.52	-2.78
22.5	32.98	22.0	42.1	18.3	22.5	18.00	28.13	13.00	32.60	33.81	0.00	0.00	0.00
23.0	29.65	22.5	42.9	18.0	23.0	18.40	28.75	13.50	32.98	33.79	16.49	13.52	-2.97
23.5	28.13	23.0	43.7	17.7	23.5	18.80	29.38	13.33	33.48	33.79	4.19	3.38	-0.81
24.0	24.12	23.5	45.1	17.4	24.0	19.20	30.00	13.33	33.48	33.48	6.98	5.98	-1.40

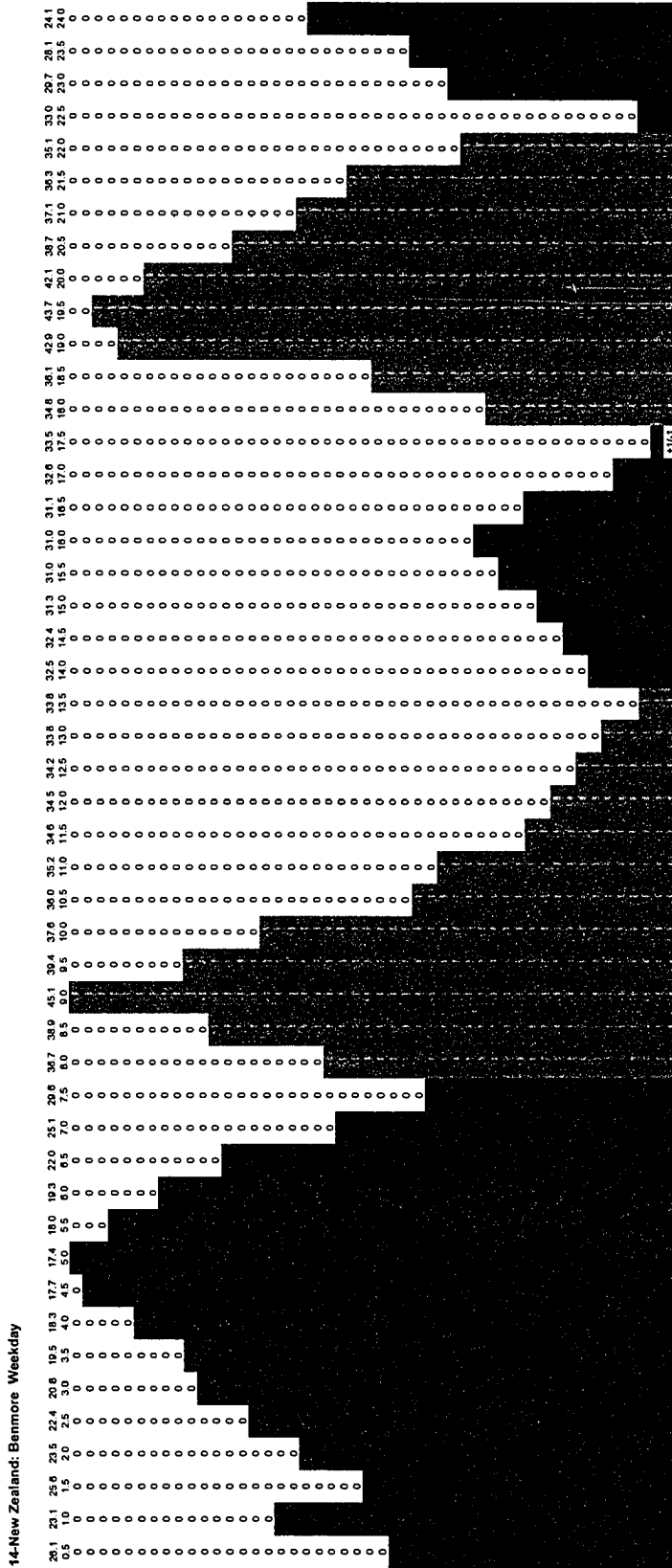
14-New Zealand: Benmore Weekday

Incremental Revenue	Average Incremental	Cumulative Revenue
23.39	23.39	9.36
23.03	23.32	11.66
21.60	22.68	16.14
21.16	22.37	22.37
20.37	22.04	26.45
20.06	21.64	32.46
19.23	21.49	34.39
18.03	20.80	41.60
18.03	20.80	41.60
15.07	19.84	47.83
13.47	19.59	48.97
12.94	18.88	52.86
11.40	18.38	55.14
11.18	17.93	57.37
10.66	17.31	60.57
9.58	17.09	61.53
8.78	16.26	65.04
8.78	16.26	65.04
7.74	15.49	68.14
6.94	15.30	68.83
6.53	14.75	70.79
5.35	14.37	71.86
5.00	14.01	72.86
4.36	13.49	74.17
4.09	13.32	74.58
3.48	12.68	75.97
3.48	12.68	75.97
0.85	11.92	76.31
-0.98	11.72	76.21
-1.77	11.13	75.68
-1.85	10.76	75.31
-1.97	10.40	74.92
-3.62	9.84	73.83
-3.92	9.66	73.44
-3.93	8.98	71.87
-3.93	8.98	71.87
-4.21	8.35	70.18
-4.43	8.20	69.74
-4.58	7.77	68.36
-6.02	7.48	67.16
-6.30	7.16	65.90
-6.47	6.73	63.96
-6.87	6.59	63.27
-6.94	6.05	60.49
-6.94	6.05	60.49
-7.44	5.53	57.52
-8.06	5.40	56.71
-8.37	5.19	55.32

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	17.40	45.15
0.63	0.50	17.69	45.15
1.00	0.80	17.89	43.72
1.25	1.00	18.05	43.72
1.50	1.20	18.05	42.93
1.88	1.50	18.29	42.93
2.00	1.60	18.29	42.09
2.50	2.00	19.25	42.09
2.50	2.00	19.25	42.09
3.00	2.40	19.48	39.42
3.13	2.50	20.76	39.42
3.50	2.80	20.76	38.89
3.75	3.00	21.99	38.89
4.00	3.20	21.99	38.67
4.38	3.50	22.41	38.67
4.50	3.60	22.41	37.59
5.00	4.00	23.05	37.59
5.00	4.00	23.05	37.59
5.50	4.40	23.47	37.08
5.63	4.50	24.12	37.08
6.00	4.80	24.12	38.68
6.25	5.00	25.07	38.68
6.50	5.20	25.07	38.34
6.88	5.50	25.58	38.34
7.00	5.60	25.58	38.07
7.50	6.00	26.07	38.07
7.50	6.00	26.07	38.07
8.00	6.40	28.13	38.01
8.13	6.50	29.59	38.01
8.50	6.80	29.59	35.21
8.75	7.00	29.65	35.21
9.00	7.20	29.65	35.10
9.38	7.50	30.97	35.10
9.50	7.60	30.97	34.79
10.00	8.00	30.98	34.79
10.00	8.00	30.98	34.79
10.50	8.40	31.08	34.63
10.63	8.50	31.26	34.63
11.00	8.80	31.26	34.49
11.25	9.00	32.41	34.49
11.50	9.20	32.41	34.21
11.88	9.50	32.54	34.21
12.00	9.60	32.54	33.81
12.50	10.00	32.60	33.81
12.50	10.00	32.60	33.81
13.00	10.40	32.98	33.79
13.13	10.50	33.48	33.79
13.33	10.67	33.48	33.48

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	17.40	45.15
0.63	0.50	17.46	45.15
1.00	0.80	17.55	44.61
1.25	1.00	17.65	44.43
1.50	1.20	17.71	44.18
1.88	1.50	17.83	43.93
2.00	1.60	17.86	43.81
2.50	2.00	18.14	43.47
2.50	2.00	18.14	43.47
3.00	2.40	18.36	42.80
3.13	2.50	18.46	42.66
3.50	2.80	18.70	42.26
3.75	3.00	18.92	42.03
4.00	3.20	19.11	41.82
4.38	3.50	19.40	41.55
4.50	3.60	19.48	41.44
5.00	4.00	19.84	41.08
5.00	4.00	19.84	41.08
5.50	4.40	20.17	40.70
5.63	4.50	20.26	40.62
6.00	4.80	20.50	40.37
6.25	5.00	20.68	40.22
6.50	5.20	20.85	40.07
6.88	5.50	21.11	39.87
7.00	5.60	21.19	39.80
7.50	6.00	21.51	39.55
7.50	6.00	21.51	39.55
8.00	6.40	21.93	39.33
8.13	6.50	22.04	39.28
8.50	6.80	22.38	39.10
8.75	7.00	22.58	38.99
9.00	7.20	22.78	38.88
9.38	7.50	23.11	38.73
9.50	7.60	23.21	38.68
10.00	8.00	23.60	38.48
10.00	8.00	23.60	38.48
10.50	8.40	23.96	38.30
10.63	8.50	24.04	38.26
11.00	8.80	24.29	38.13
11.25	9.00	24.47	38.05
11.50	9.20	24.64	37.96
11.88	9.50	24.89	37.85
12.00	9.60	24.97	37.80
12.50	10.00	25.28	37.64
12.50	10.00	25.28	37.64
13.00	10.40	25.57	37.50
13.13	10.50	25.65	37.46
13.33	10.67	25.77	37.40





Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

14-New Zealand: Benmore Weekend

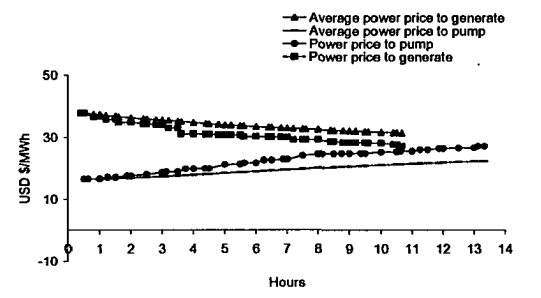
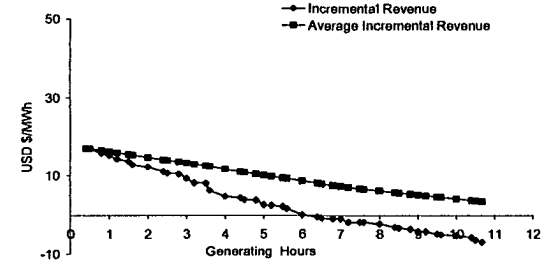
	USD/MWh	0.0	16.6	38.0	0.5	0.40	0.63	0.5	0.80	1.25	1.0	1.00	0.80	1.5	1.20	1.68	1.5	1.00	0.80	1.50	1.20	1.70	1.12	35.85	4.28	7.17	2.89		
		0.5	16.7	36.7	1.0	0.80	1.25	1.0	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	
		1.0	17.1	35.8	1.5	1.20	1.68	1.5	2.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	
		2.0	17.6	34.9	2.0	1.60	2.13	2.0	2.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	
		2.5	18.1	34.3	2.5	2.00	2.50	2.0	2.50	3.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	
		3.0	18.6	34.1	3.0	2.40	3.00	3.0	2.50	3.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	
		3.5	19.4	33.0	3.5	2.80	3.38	3.5	2.50	3.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	
		4.0	18.61	31.2	4.0	3.20	4.00	4.0	3.00	3.50	3.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	
		4.5	17.60	31.0	4.5	3.60	4.63	4.5	3.00	3.50	3.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	
		5.0	16.67	30.9	5.0	4.00	6.25	5.0	4.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	
		5.5	16.62	30.7	5.5	4.40	6.88	5.5	4.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80	
		6.0	17.12	30.3	6.0	4.80	7.50	6.0	4.80	5.30	4.80	4.30	3.80	3.30	2.80	2.30	1.80	1.30	0.80	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00	0.80
		6.5	18.08	30.2	6.5	5.20	8.13	6.5	5.20	5.70	5.20	4.70	4.20	3.70	3.20	2.70	2.20	1.70	1.20	0.70	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50	1.00
		7.0	18.93	30.1	7.0	5.60	8.75	7.0	5.60	6.10	5.60	5.10	4.60	4.10	3.60	3.10	2.60	2.10	1.60	1.10	0.60	1.50	2.00	1.50	1.00	0.80	1.50	2.00	1.50
		7.5	19.94	29.3	7.5	6.00	9.38	7.5	6.00	6.50	6.00	5.50	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.50	1.50	2.00	1.50	1.00	0.80	1.50	2.00
		8.0	21.69	29.3	8.0	6.40	10.00	8.0	6.40	6.90	6.40	5.90	5.40	4.90	4.40	3.90	3.40	2.90	2.40	1.90	1.40	0.90	1.50	2.00	1.50	1.00	0.80	1.50	2.00
		8.5	21.19	28.7	8.5	6.80	10.63	8.5	6.80	7.30	6.80	6.30	5.80	5.30	4.80	4.30	3.80	3.30	2.80	2.30	1.80	1.30	0.80	1.50	2.00	1.50	1.00	0.80	1.50
		9.0	24.14	28.4	9.0	7.20	11.25	9.0	7.20	7.70	7.20	6.70	6.20	5.70	5.20	4.70	4.20	3.70	3.20	2.70	2.20	1.70	1.20	0.70	1.50	2.00	1.50	1.00	0.80
		9.5	25.54	28.3	9.5	7.60	11.88	9.5	7.60	8.10	7.60	7.10	6.60	6.10	5.60	5.10	4.60	4.10	3.60	3.10	2.60	2.10	1.60	1.10	0.60	1.50	2.00	1.50	1.00
		10.0	28.32	28.2	10.0	8.00	12.50	10.0	8.00	8.50	8.00	7.50	7.00	6.50	6.00	5.50	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	0.50	1.50	2.00	1.50
		10.5	30.11	27.7	10.5	8.40	13.13	10.5	8.40	8.90	8.40	7.90	7.40	6.90	6.40	5.90	5.40	4.90	4.40	3.90	3.40	2.90	2.40	1.90	1.40	0.90	1.50	2.00	1.50
		11.0	30.19	27.2	11.0	8.80	13.75	11.0	8.80	9.30	8.80	8.30	7.80	7.30	6.80	6.30	5.80	5.30	4.80	4.30	3.80	3.30	2.80	2.30	1.80	1.30	0.80	1.50	2.00
		11.5	30.74	26.7	11.5	9.20	14.38	11.5	9.20	9.70	9.20	8.70	8.20	7.70	7.20	6.70	6.20	5.70	5.20	4.70	4.20	3.70	3.20	2.70	2.20	1.70	1.20	0.70	1.50
		12.0	31.01	26.6	12.0	9.60	15.00	12.0	9.60	10.10	9.60	9.10	8.60	8.10	7.60	7.10	6.60	6.10	5.60	5.10	4.60	4.10	3.60	3.10	2.60	2.10	1.60	1.10	0.60
		12.5	31.20	26.4	12.5	10.00	15.63	12.5	10.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00	6.50	6.00	5.50	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00
		13.0	29.30	26.0	13.0	10.40	16.25	13.0	10.40	10.90	10.40	9.90	9.40	8.90	8.40	7.90	7.40	6.90	6.40	5.90	5.40	4.90	4.40	3.90	3.40	2.90	2.40	1.90	1.40
		13.5	29.30	25.5	13.5	10.80	16.88	13.5	10.80	11.30	10.80	10.30	9.80	9.30	8.80	8.30	7.80	7.30	6.80	6.30	5.80	5.30	4.80	4.30	3.80	3.30	2.80	2.30	1.80
		14.0	27.73	25.4	14.0	11.20	17.50	14.0	11.20	11.70	11.20	10.70	10.20	9.70	9.20	8.70	8.20	7.70	7.20	6.70	6.20	5.70	5.20	4.70	4.20	3.70	3.20	2.70	2.20
		14.5	26.58	25.2	14.5	11.60	18.13	14.5	11.60	12.10	11.60	11.10	10.60	10.10	9.60	9.10	8.60	8.10	7.60	7.10	6.60	6.10	5.60	5.10	4.60	4.10	3.60	3.10	2.60
		15.0	25.36	24.8	15.0	12.00	18.75	15.0	12.00	12.50	12.00	11.50	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00	6.50	6.00	5.50	5.00	4.50	4.00	3.50	3.00
		15.5	24.55	24.8	15.5	12.40	19.38	15.5	12.40	12.90	12.40	11.90	11.40	10.90	10.40	9.90	9.40	8.90	8.40	7.90	7.40	6.90	6.40	5.90	5.40	4.90	4.40	3.90	3.40
		16.0	24.73	24.7	16.0	12.80	20.00	16.0	12.80	13.30	12.80	12.30	11.80	11.30	10.80	10.30	9.80	9.30	8.80	8.30	7.80	7.30	6.80	6.30	5.80	5.30	4.80	4.30	3.80
		16.5	24.82	24.6	16.5	13.20	20.63	16.5	13.20	13.70	13.20	12.70	12.20	11.70	11.20	10.70	10.20	9.70	9.20	8.70	8.20	7.70	7.20	6.70	6.20	5.70	5.20	4.70	4.20
		16.5	24.82	24.6	16.5	13.20	20.63	16.5	13.20	13.70	13.20	12.70	12.20	11.70	11.20	10.70	10.20	9.70	9.20	8.70	8.20	7.70	7.20	6.70	6.20	5.70	5.20	4.70	4.20
		17.0	26.65	24.1	17.0	13.60	21.25	17.0	13.60	14.10	13.60	13.10	12.60	12.10	11.60	11.10	10.60	10.10	9.60	9.10	8.60	8.10	7.60	7.10	6.60	6.10	5.60	5.10	4.60
		17.5	28.17	22.9	17.5	14.00	21.88	17.5	14.00	14.50	14.00	13.50	13.00	12.50	12.00	11.50	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00	6.50	6.00	5.50	5.00
		18.0	30.28	22.6	18.0	14.40	22.50	18.0	14.40	14.90	14.40	13.90	13.40	12.90	12.40	11.90	11.40	10.90	10.40	9.90	9.40	8.90	8.40	7.90	7.40	6.90	6.40	5.90	5.40
		18.5	34.09	21.7	18.5	14.80	23.13	18.5	14.80	15.30	14.80	14.30	13.80	13.30	12.80	12.30	11.80	11.30	10.80	10.30	9.80	9.30	8.80	8.30	7.80	7.30	6.80	6.30	5.80
		19.0	37.98	21.3	19.0	15.20	23.75	19.0	15.20	15.70	15.20	14.70	14.20	13.70	13.20	12.70	12.20	11.70	11.20	10.70	10.20	9.70	9.20	8.70	8.20	7.70	7.20	6.70	6.20
		19.5	36.74	21.3	19.5	15.60	24.38	19.5	15.60	16.10	15.60	15.10	14.60	14.10	13.60	13.10	12.60	12.10	11.60	11.10	10.60	10.10	9.60	9.10	8.60	8.10	7.60	7.10	6.60
		20.0	35.85	21.2	20.0	16.00	25.00	20.0	16.00	16.50	16.00	15.50	15.00	14.50	14.00	13.50	13.00	12.50	12.00	11.50	11.00	10.50	10.00	9.50	9.00	8.50	8.00	7.50	7.00
		20.5	34.87																										

14-New Zealand: Benmore Weekend

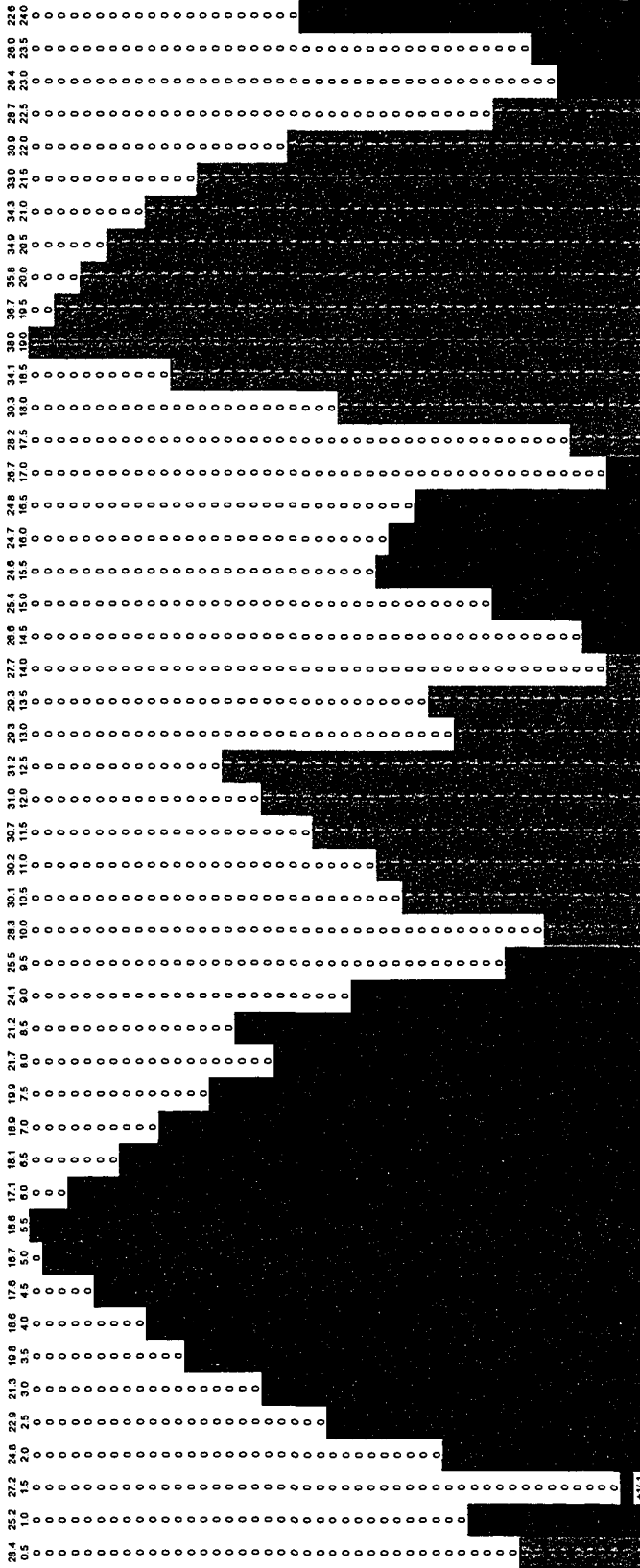
Incremental Revenue	Average Incremental	Cumulative Revenue
17.20	17.20	6.88
17.14	17.18	8.59
15.90	16.70	13.35
15.33	16.43	16.43
14.45	16.10	19.32
13.85	15.65	23.47
12.87	15.47	24.76
12.27	14.83	29.67
12.27	14.83	29.67
11.05	14.20	34.09
10.66	14.06	35.16
10.43	13.67	38.29
9.29	13.38	40.14
8.19	13.06	41.78
8.08	12.63	44.20
6.27	12.45	44.83
4.71	11.68	46.72
4.71	11.68	46.72
4.34	11.01	48.45
3.89	10.85	48.84
3.75	10.41	49.97
2.58	10.10	50.48
2.45	9.80	50.97
2.13	9.38	51.61
1.67	9.25	51.78
0.11	8.64	51.82
0.11	8.64	51.82
-0.50	8.07	51.63
-0.72	7.93	51.55
-0.81	7.55	51.31
-0.91	7.30	51.13
-1.72	7.05	50.78
-1.75	6.70	50.26
-1.75	6.59	50.08
-2.19	6.15	49.21
-2.19	6.15	49.21
-3.01	5.71	48.00
-3.23	5.61	47.68
-3.51	5.30	46.63
-4.04	5.09	45.82
-4.13	4.89	44.99
-4.73	4.59	43.57
-4.88	4.49	43.08
-5.05	4.11	41.06
-5.05	4.11	41.06
-5.59	3.73	38.83
-6.23	3.64	38.20
-6.79	3.48	37.07

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	16.62	37.98
0.63	0.50	16.67	37.98
1.00	0.80	16.67	38.74
1.25	1.00	17.12	38.74
1.50	1.20	17.12	35.85
1.88	1.50	17.60	35.85
2.00	1.80	17.60	34.87
2.50	2.00	18.08	34.87
2.50	2.00	18.08	34.87
3.00	2.40	18.61	34.32
3.13	2.50	18.93	34.32
3.50	2.80	18.93	34.09
3.75	3.00	19.84	34.09
4.00	3.20	19.84	33.00
4.38	3.50	19.94	33.00
4.50	3.60	19.94	31.20
5.00	4.00	21.19	31.20
5.00	4.00	21.19	31.20
5.50	4.40	21.33	31.01
5.63	4.50	21.69	31.01
6.00	4.80	21.69	30.87
6.25	5.00	22.63	30.87
6.50	5.20	22.63	30.74
6.88	5.50	22.89	30.74
7.00	5.60	22.89	30.28
7.50	6.00	24.14	30.28
7.50	6.00	24.14	30.28
8.00	6.40	24.55	30.19
8.13	6.50	24.73	30.19
8.50	6.80	24.73	30.11
8.75	7.00	24.82	30.11
9.00	7.20	24.82	29.30
9.38	7.50	24.84	29.30
9.50	7.60	24.84	29.30
10.00	8.00	25.19	29.30
10.00	8.00	25.19	29.30
10.50	8.40	25.36	28.69
10.63	8.50	25.54	28.69
11.00	8.80	25.54	28.41
11.25	9.00	25.96	28.41
11.50	9.20	25.96	28.32
11.88	9.50	26.44	28.32
12.00	9.60	26.44	28.17
12.50	10.00	26.58	28.17
12.50	10.00	26.58	28.17
13.00	10.40	26.65	27.73
13.13	10.50	27.17	27.73
13.33	10.67	27.17	27.17

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	16.62	37.98
0.63	0.50	16.63	37.98
1.00	0.80	16.65	37.51
1.25	1.00	16.74	37.38
1.50	1.20	16.81	37.10
1.88	1.50	16.86	36.85
2.00	1.80	17.00	36.73
2.50	2.00	17.22	36.36
2.50	2.00	17.22	36.36
3.00	2.40	17.45	36.02
3.13	2.50	17.51	35.95
3.50	2.80	17.66	35.75
3.75	3.00	17.81	35.64
4.00	3.20	17.93	35.47
4.38	3.50	18.11	35.28
4.50	3.60	18.16	35.15
5.00	4.00	18.46	34.75
5.00	4.00	18.46	34.75
5.50	4.40	18.72	34.41
5.63	4.50	18.79	34.34
6.00	4.80	18.97	34.12
6.25	5.00	19.12	33.99
6.50	5.20	19.25	33.87
6.88	5.50	19.45	33.70
7.00	5.60	19.51	33.63
7.50	6.00	19.82	33.41
7.50	6.00	19.82	33.41
8.00	6.40	20.11	33.21
8.13	6.50	20.19	33.16
8.50	6.80	20.39	33.03
8.75	7.00	20.51	32.95
9.00	7.20	20.63	32.84
9.38	7.50	20.80	32.70
9.50	7.60	20.85	32.66
10.00	8.00	21.07	32.49
10.00	8.00	21.07	32.49
10.50	8.40	21.28	32.31
10.63	8.50	21.33	32.27
11.00	8.80	21.47	32.13
11.25	9.00	21.57	32.05
11.50	9.20	21.66	31.97
11.88	9.50	21.82	31.86
12.00	9.60	21.86	31.82
12.50	10.00	22.05	31.67
12.50	10.00	22.05	31.67
13.00	10.40	22.23	31.52
13.13	10.50	22.28	31.48
13.33	10.67	22.35	31.42



14-New Zealand: Benmore Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

Appendix B. Return on Investment Calculation Model

An economic model was developed for each of the 14 deregulated power markets to calculate the maximum pre-tax return on investment for an idealized minimum investment pumped storage case. The first two pages are input parameters used in the balance of the calculations. The remaining sheets show the calculations at 80% energy storage efficiency for each market for operation during all hours that provide positive net revenue.

Operating Inputs

Operating Fixed Costs	CAD 2004	USD 2004	USD 2008
Insurance	663,610.56	526,675.05	570,090.01
Manpower (cost/year)	400,000.00	317,460.32	371,383.67
Planning and maintenance engineers	80,000.00	63,492.06	92,845.92
Craft Operators	60,000.00	47,619.05	55,707.55
Maintenance	1,896,030.17	1,504,785.85	1,693,649.73
Property taxes	1,592,665.34	1,264,020.11	1,368,216.02
Contingencies	455,230.61	361,294.13	400,333.94

Cycle Efficiency	80%
Pumping Efficiency	90%
Generating Efficiency	89%
Capacity (MW)	550
CR (Charge to Discharge Ratio)	1.00
Day Capacity Factor (MWh)	13,200.00
Annual Capacity Factor (MWh)	4,804,800.00
Number of Weeks/Year	52
Plant Availability	97%
Electrical Output Generating (MW)	550
Electrical Input Pumping (MW)	550

Capital Inputs

	CAD	USD
Capital Cost	189,603,016.61	150,478,584.61
Construction Year	3	

Financial Inputs

Escalating Factors	
power price	2%
inflation	2%
wage	4%
maintenance	3%
Conversor CAD/USD	1.26
Insurance Year (\$/1000 of Capital Cost)	3.50
Property Taxes (\$/1000 of 70% of capital cost)	12.00
Facility Life Time	30

2-USA: Northern California

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,080.00	3,850.00	3,850.00	3,850.00	3,850.00	3,850.00	3,080.00	25,410.00	1,321,320.00
Generation capacity factor	23.33%	29.17%	29.17%	29.17%	29.17%	29.17%	23.33%	27.50%	27.50%
Pumping (MWh)	3,850.00	4,812.50	4,812.50	4,812.50	4,812.50	4,812.50	3,850.00	31,762.50	1,651,650.00
Operating Hours of Pumping	7.00	8.75	8.75	8.75	8.75	8.75	7.00	57.75	3,003.00
Operating Hours of Generating	5.60	7.00	7.00	7.00	7.00	7.00	5.60	46.20	2,402.40
Net Revenue USD/MW/day	90.57	119.52	119.52	119.52	119.52	119.52	90.57		
Net Revenue	49,612.06	65,734.38	65,734.38	65,734.38	65,734.38	65,734.38	49,612.06	428,296.04	22,271,393.83
									22,716,821.71
									23,171,158.15
									23,634,581.31
									24,107,272.93
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20						
Revenue (availability 97%)					23,384,054.75	23,851,735.84	24,328,770.56	24,815,345.97	25,311,652.89	25,817,885.95	41,526,449.46
Fixed Operating Costs:											
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.18
Net Revenue Before Tax					19,093,834.84	19,438,707.17	19,789,292.53	20,145,666.69	20,507,905.65	20,876,085.60	31,691,408.28
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	19,093,834.84	19,438,707.17	19,789,292.53	20,145,666.69	20,507,905.65	20,876,085.60	31,691,408.28
Present Worth(PV)		-63,430,964.19	-56,406,269.49	-50,159,528.20	16,979,278.30	15,371,615.31	13,915,809.13	12,597,544.59	11,403,853.65	10,322,988.86	936,965.26
IRR		12.45%									

3-USA: PJM

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,960.00	4,400.00	4,400.00	4,400.00	4,400.00	4,400.00	3,960.00	29,320.00	1,555,840.00
Generation capacity factor	30.00%	33.33%	33.33%	33.33%	33.33%	33.33%	30.00%	32.38%	32.38%
Pumping (MWh)	4,950.00	5,500.00	5,500.00	5,500.00	5,500.00	5,500.00	4,950.00	37,400.00	1,944,800.00
Operating Hours of Pumping	9.00	10.00	10.00	10.00	10.00	10.00	9.00	68.00	3,536.00
Operating Hours of Generating	7.20	8.00	8.00	8.00	8.00	8.00	7.20	54.40	2,828.80
Net Revenue USD/MW/day	62.18	147.95	147.95	147.95	147.95	147.95	62.18		
Net Revenue	34,197.74	61,371.94	61,371.94	61,371.94	61,371.94	61,371.94	34,197.74	475,255.16	24,713,268.09
									25,207,533.45
									25,711,684.12
									26,225,917.80
									26,750,456.16

Cash Flow (USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20						
Revenue (availability 97%)					25,947,923.07	26,466,881.53	26,996,219.16	27,536,143.55	28,086,866.42	28,648,603.75	46,079,481.41
Fixed Operating Costs:											
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,981,196.53
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,995.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.18
Net Revenue Before Tax					21,657,703.17	22,053,852.86	22,456,741.14	22,866,464.27	23,283,119.18	23,706,803.40	36,244,440.23
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	21,657,703.17	22,053,852.86	22,456,741.14	22,866,464.27	23,283,119.18	23,706,803.40	36,244,440.23
Present Worth(PV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	21,657,703.17	22,053,852.86	22,456,741.14	22,866,464.27	23,283,119.18	23,706,803.40	36,244,440.23
IRR		13.64%									

4-USA: New England

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,960.00	3,520.00	3,520.00	3,520.00	3,520.00	3,520.00	3,960.00	25,520.00	1,327,040.00
Generation capacity factor	30.00%	26.67%	26.67%	26.67%	26.67%	26.67%	30.00%	27.62%	27.62%
Pumping (MWh)	4,950.00	4,400.00	4,400.00	4,400.00	4,400.00	4,400.00	4,950.00	31,900.00	1,658,800.00
Operating Hours of Pumping	9.00	8.00	8.00	8.00	8.00	8.00	9.00	58.00	3,016.00
Operating Hours of Generating	7.20	6.40	6.40	6.40	6.40	6.40	7.20	46.40	2,412.80
Net Revenue USD/MW/day	211.41	56.32	56.32	56.32	56.32	56.32	211.41		
Net Revenue	16,215.22	30,976.51	30,976.51	30,976.51	30,976.51	30,976.51	16,275.22	387,442.98	20,147,034.94
									2004
									2005
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									2029
									2030

Cash Flow (USD)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030		
Year																													
Period (n)		-2	-1	0	1	2	3	4	5	6																			
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20																								
Revenue (availability 97%)					21,153,564.59	21,576,635.89	22,008,168.60	22,448,331.98	22,897,298.61	23,355,244.59	23,814,191.47	24,278,138.35	24,747,085.23	25,216,032.11	25,684,978.99	26,153,925.87	26,622,872.75	27,091,819.63	27,560,766.51	28,029,713.39	28,498,660.27	28,967,607.15	29,436,554.03	29,905,500.91	30,374,447.79	30,843,394.67	31,312,341.55	31,781,288.43	
Fixed Operating Costs:																													
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	642,007.10	654,828.87	667,884.64	681,170.41	694,681.18	708,411.95	722,366.72	736,540.49	750,937.26	765,552.03	780,380.80	795,418.57	810,669.34	826,136.11	841,812.88	857,694.65	873,786.42	889,992.19	
Manpower	317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	469,896.27	488,624.02	507,934.27	527,820.02	548,285.27	569,324.02	590,930.27	613,107.02	635,848.27	659,157.02	683,036.27	707,478.02	732,485.27	758,050.02	784,175.27	810,863.02	838,116.27	865,938.02	
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	2,022,280.75	2,082,764.28	2,143,860.81	2,205,584.34	2,268,940.87	2,333,935.40	2,400,574.93	2,468,864.46	2,538,809.99	2,610,416.52	2,683,690.05	2,758,636.58	2,835,250.11	2,913,534.64	2,993,494.17	3,075,132.70	3,158,449.23	3,243,447.76	
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	1,509,282.61	1,554,480.48	1,600,943.35	1,648,675.22	1,697,689.09	1,748,077.96	1,799,845.83	1,852,996.70	1,907,534.57	1,963,463.44	2,020,787.31	2,079,500.18	2,139,606.05	2,191,108.92	2,244,012.79	2,298,322.66	2,354,043.53	2,411,179.40	
Contingencies	361,294.13				391,076.39	398,897.92	406,675.87	415,013.39	423,313.66	431,779.93	440,396.20	449,166.47	458,083.74	467,150.01	476,369.28	485,734.55	495,248.82	504,914.09	514,732.36	524,706.63	534,838.90	545,122.17	555,559.44	566,153.71	576,907.98	587,825.25	598,900.52	609,136.79	
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	5,083,853.46	5,229,906.57	5,380,069.68	5,534,342.79	5,692,729.90	5,855,227.01	6,021,838.12	6,192,557.23	6,367,388.34	6,546,334.45	6,729,399.56	6,916,587.67	7,107,892.78	7,303,318.89	7,502,869.00	7,706,538.11	7,914,329.22	8,126,245.33	
Net Revenue Before Tax					16,863,344.69	17,163,607.21	17,468,690.58	17,778,652.70	18,093,551.37	18,413,444.24	18,738,337.11	19,068,230.00	19,393,122.89	19,723,015.78	20,057,908.67	20,392,801.56	20,727,694.45	21,062,587.34	21,397,480.23	21,732,373.12	22,067,266.01	22,402,158.90	22,737,051.79	23,071,944.68	23,406,837.57	23,741,730.46	24,076,623.35	24,411,516.24	
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	16,863,344.69	17,163,607.21	17,468,690.58	17,778,652.70	18,093,551.37	18,413,444.24	18,738,337.11	19,068,230.00	19,393,122.89	19,723,015.78	20,057,908.67	20,392,801.56	20,727,694.45	21,062,587.34	21,397,480.23	21,732,373.12	22,067,266.01	22,402,158.90	22,737,051.79	23,071,944.68	23,406,837.57	23,741,730.46	24,076,623.35	24,411,516.24	
Present Worth(PV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	16,863,344.69	17,163,607.21	17,468,690.58	17,778,652.70	18,093,551.37	18,413,444.24	18,738,337.11	19,068,230.00	19,393,122.89	19,723,015.78	20,057,908.67	20,392,801.56	20,727,694.45	21,062,587.34	21,397,480.23	21,732,373.12	22,067,266.01	22,402,158.90	22,737,051.79	23,071,944.68	23,406,837.57	23,741,730.46	24,076,623.35	24,411,516.24	
IRR																													

5-Germany: Leipzig Exchange

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,520.00	4,400.00	4,400.00	4,400.00	4,400.00	4,400.00	3,520.00	29,040.00	1,510,080.00
Generation capacity factor	26.67%	33.33%	33.33%	33.33%	33.33%	33.33%	26.67%	31.43%	31.43%
Pumping (MWh)	4,400.00	5,500.00	5,500.00	5,500.00	5,500.00	5,500.00	4,400.00	36,300.00	1,887,600.00
Operating Hours of Pumping	8.00	10.00	10.00	10.00	10.00	10.00	8.00	66.00	3,432.00
Operating Hours of Generating	6.40	8.00	8.00	8.00	8.00	8.00	6.40	52.80	2,745.60
Net Revenue USD/MW/day	22.47	65.22	65.22	65.22	65.22	65.22	22.47		
Net Revenue	12,357.79	35,871.42	35,871.42	35,871.42	35,871.42	35,871.42	12,357.79	204,072.70	10,611,780.33
									10,824,015.94
									11,040,496.26
									11,261,306.18
									11,486,532.31
									2008

Cash Flow (USD)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20						
Revenue (availability 97%)					11,141,936.34	11,364,775.06	11,592,070.56	11,823,911.98	12,060,390.22	12,301,598.02	19,786,348.48
Fixed Operating Costs:											
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.18
Net Revenue Before Tax					6,851,716.43	6,951,746.39	7,052,592.54	7,154,232.70	7,256,642.97	7,359,797.67	9,951,307.30
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	6,851,716.43	6,951,746.39	7,052,592.54	7,154,232.70	7,256,642.97	7,359,797.67	9,951,307.30
Present Worth(PV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	6,851,716.43	6,951,746.39	7,052,592.54	7,154,232.70	7,256,642.97	7,359,797.67	9,951,307.30
IRR		3.20%									

6-Netherlands									
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,850.00	5,500.00	5,500.00	5,500.00	5,500.00	5,500.00	3,850.00	35,200.00	1,830,400.00
Generation capacity factor	29.17%	41.67%	41.67%	41.67%	41.67%	41.67%	29.17%	38.10%	38.10%
Pumping (MWh)	4,812.50	6,600.00	6,600.00	6,600.00	6,600.00	6,600.00	4,812.50	42,625.00	2,216,500.00
Operating Hours of Pumping	8.75	12.00	12.00	12.00	12.00	12.00	8.75	77.50	4,030.00
Operating Hours of Generating	7.00	10.00	10.00	10.00	10.00	10.00	7.00	64.00	3,328.00
Net Revenue USD/MW/day	59.75	376.28	376.28	376.28	376.28	376.28	59.75		
Net Revenue	32,861.17	206,953.84	206,953.84	206,953.84	206,953.84	206,953.84	32,861.17	1,100,492.03	57,225,585.49
									58,370,097.19
									59,537,499.14
									60,728,249.12
									61,942,814.10
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)										
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Period (n)		-2	-1	0	1	2	3	4	5	6
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20						
Revenue (availability 97%)					60,084,529.68	61,286,220.27	62,511,944.68	63,762,183.57	65,037,427.24	66,338,175.79
Fixed Operating Costs:										
Insurance	526,675.05									
Manpower	317,460.32									
Maintenance	1,504,785.85									
Property taxes	1,264,020.11									
Contingencies	361,294.13									
Total	3,974,235.45									
Net Revenue Before Tax					55,794,309.78	56,873,191.60	57,972,466.65	59,092,504.30	60,233,680.00	61,396,375.44
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	55,794,309.78	56,873,191.60	57,972,466.65	59,092,504.30	60,233,680.00	61,396,375.44
Present Worth(PV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	55,794,309.78	56,873,191.60	57,972,466.65	59,092,504.30	60,233,680.00	61,396,375.44
IRR		26.83%								

7-Britian

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	4,620.00	4,180.00	4,180.00	4,180.00	4,180.00	4,180.00	4,620.00	30,140.00	1,567,280.00
Generation capacity factor	35.00%	31.67%	31.67%	31.67%	31.67%	31.67%	35.00%	32.62%	32.62%
Pumping (MWh)	5,775.00	5,225.00	5,225.00	5,225.00	5,225.00	5,225.00	5,775.00	37,675.00	1,959,100.00
Operating Hours of Pumping	10.50	9.50	9.50	9.50	9.50	9.50	10.50	68.50	3,562.00
Operating Hours of Generating	8.40	7.60	7.60	7.60	7.60	7.60	8.40	54.80	2,849.60
Net Revenue USD/MW/day	67.28	152.81	152.81	152.81	152.81	152.81	67.28		
Net Revenue	37,001.35	64,042.91	64,042.91	64,042.91	64,042.91	64,042.91	37,001.35	494,217.27	25,699,298.05
									2004
									2005
									2006
									2007
									2008
									27,272,300.68
									27,617,746.70

Cash Flow (USD)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)				26,983,214.30	27,522,878.58	28,073,336.15	28,634,802.88	29,207,498.94	29,791,648.91	47,917,997.84	
Fixed Operating Costs:											
Insurance	526,675.05										
Manpower	317,460.32										
Maintenance	1,504,785.85										
Property taxes	1,264,020.11										
Contingencies	361,294.13										
Total	3,974,235.45										
Net Revenue Before Tax				22,692,994.39	23,109,849.91	23,533,858.13	23,965,123.60	24,403,751.69	24,849,848.57	38,082,956.66	
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	22,692,994.39	23,109,849.91	23,533,858.13	23,965,123.60	24,403,751.69	24,849,848.57	38,082,956.66	
Present Worth(PV)		-65,789,201.65	-57,445,237.54	-50,159,528.20	19,814,869.82	17,619,596.21	15,667,199.41	13,930,840.71	12,386,644.23	11,013,369.91	651,198.00
IRR		14.53%									

8-Spain

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,520.00	3,520.00	3,520.00	3,520.00	3,520.00	3,520.00	3,520.00	24,640.00	1,281,280.00
Generation capacity factor	26.67%	26.67%	26.67%	26.67%	26.67%	26.67%	26.67%	26.67%	26.67%
Pumping (MWh)	4,400.00	4,400.00	4,400.00	4,400.00	4,400.00	4,400.00	4,400.00	30,800.00	1,601,600.00
Operating Hours of Pumping	8.00	8.00	8.00	8.00	8.00	8.00	8.00	56.00	2,912.00
Operating Hours of Generating	6.40	6.40	6.40	6.40	6.40	6.40	6.40	44.80	2,329.60
Net Revenue USD/MW/day	54.85	92.77	92.77	92.77	92.77	92.77	54.85		
Net Revenue	30,166.17	51,023.02	51,023.02	51,023.02	51,023.02	51,023.02	30,166.17	315,451.46	16,403,475.86
									16,731,545.38
									17,066,176.28
									17,407,499.81
									17,755,849.80
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)	Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)			-2	-1	0	1	2	3	4	5	6	30
Capital Cost		150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)						17,222,980.31	17,567,439.92	17,918,788.72	18,277,164.49	18,642,707.78	19,015,561.94	30,585,338.14
Fixed Operating Costs:												
Insurance		526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower		317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance		1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes		1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies		361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total		3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.36	9,835,041.18
Net Revenue Before Tax					12,932,760.41	13,154,411.24	13,379,310.69	13,607,485.21	13,838,960.54	14,073,761.59	14,308,960.54	20,750,296.96
Cash Flow(FV)												
Present Worth(PV)			-50,159,528.20	-50,159,528.20	-50,159,528.20	12,932,760.41	13,154,411.24	13,379,310.69	13,607,485.21	13,838,960.54	14,073,761.59	20,750,296.96
IRR			-56,963,950.39	-54,393,079.74	-50,159,528.20	11,926,170.82	11,186,416.94	10,492,116.88	9,840,497.28	9,228,953.10	8,655,037.45	1,825,232.22
			6.44%									

9-Scandinavia										
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year	
Generation (MWh)	440.00	550.00	550.00	550.00	550.00	550.00	440.00	3,630.00	188,760.00	
Generation capacity factor	3.33%	4.17%	4.17%	4.17%	4.17%	4.17%	3.33%	3.93%	3.93%	2004
Pumping (MWh)	550.00	687.50	687.50	687.50	687.50	687.50	550.00	4,537.50	235,950.00	2005
Operating Hours of Pumping	1.00	1.25	1.25	1.25	1.25	1.25	1.00	8.25	429.00	2006
Operating Hours of Generating	0.80	1.00	1.00	1.00	1.00	1.00	0.80	6.60	343.20	2007
Net Revenue USD/MW/day	-1.63	0.29	0.29	0.29	0.29	0.29	-1.63			2008
Net Revenue	-895.14	157.69	157.69	157.69	157.69	157.69	-895.14	-1,001.86	-52,096.70	
									-53,138.64	
									-54,201.41	
									-55,285.44	
									-56,381.15	

Cash Flow (USD)											
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)					-54,699.41	-55,793.40	-56,909.27	-58,047.45	-59,208.40	-60,392.57	-97,137.66
Fixed Operating Costs:											
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,686.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.18
Net Revenue Before Tax					-4,344,919.32	-4,468,822.07	-4,596,387.30	-4,727,726.73	-4,862,955.65	-5,002,192.92	-9,932,178.84
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	-4,344,919.32	-4,468,822.07	-4,596,387.30	-4,727,726.73	-4,862,955.65	-5,002,192.92	-9,932,178.84
Present Worth(PV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	-4,344,919.32	-4,468,822.07	-4,596,387.30	-4,727,726.73	-4,862,955.65	-5,002,192.92	-9,932,178.84
IRR			0.00%								

11-Australia: New South Wales

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	2,860.00	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00	2,860.00	25,520.00	1,327,040.00
Generation capacity factor	21.67%	30.00%	30.00%	30.00%	30.00%	30.00%	21.67%	27.62%	27.62%
Pumping (MWh)	3,575.00	4,950.00	4,950.00	4,950.00	4,950.00	4,950.00	3,575.00	31,900.00	1,658,800.00
Operating Hours of Pumping	6.50	9.00	9.00	9.00	9.00	9.00	6.50	58.00	3,016.00
Operating Hours of Generating	5.20	7.20	7.20	7.20	7.20	7.20	5.20	46.40	2,412.80
Net Revenue USD/MW/day	42.63	68.09	68.09	68.09	68.09	68.09	42.63		
Net Revenue	23,447.38	37,448.89	37,448.89	37,448.89	37,448.89	37,448.89	23,447.38	234,139.20	12,175,238.37
									12,418,743.13
									12,667,118.00
									12,920,460.36
									13,178,889.56
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Year												
Period (n)			-2	-1	0	1	2	3	4	5	6	30
Capital Cost		150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)						12,783,503.48	13,039,173.55	13,299,957.02	13,565,956.16	13,837,275.28	14,114,020.79	22,701,516.77
Fixed Operating Costs:												
Insurance	526,675.05					570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,460.32					371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85					1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11					1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13					391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total	3,974,235.45					4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.18
Net Revenue Before Tax						8,493,283.57	8,626,144.87	8,760,478.99	8,896,276.88	9,033,528.04	9,172,220.44	12,866,475.59
Cash Flow(FV)			-50,159,528.20	-50,159,528.20	-50,159,528.20	8,493,283.57	8,626,144.87	8,760,478.99	8,896,276.88	9,033,528.04	9,172,220.44	12,866,475.59
Present Worth(PV)			-55,134,719.90	-52,588,321.31	-50,159,528.20	8,101,021.03	7,847,747.44	7,601,866.84	7,363,170.07	7,131,453.80	6,906,520.33	3,114,466.44
IRR			4.84%									

12-Australia: Queensland

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	4,840.00	5,060.00	5,060.00	5,060.00	5,060.00	5,060.00	4,840.00	34,980.00	1,818,960.00
Generation capacity factor	36.67%	38.33%	38.33%	38.33%	38.33%	38.33%	36.67%	37.86%	37.86%
Pumping (MWh)	6,050.00	6,325.00	6,325.00	6,325.00	6,325.00	6,325.00	6,050.00	43,725.00	2,273,700.00
Operating Hours of Pumping	11.00	11.50	11.50	11.50	11.50	11.50	11.00	79.50	4,134.00
Operating Hours of Generating	8.80	9.20	9.20	9.20	9.20	9.20	8.80	63.60	3,307.20
Net Revenue USD/MW/day	137.82	234.00	234.00	234.00	234.00	234.00	137.82		
Net Revenue	75,798.36	128,668.78	128,668.78	128,668.78	128,668.78	128,668.78	75,798.36	795,095.65	41,344,973.85
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20						
Revenue (availability 97%)					43,410,535.46	44,278,746.17	45,164,321.10	46,067,607.52	46,988,959.67	47,928,738.86	77,090,368.91
Fixed Operating Costs:											
Insurance	526,875.05										
Manpower	317,460.32										
Maintenance	1,504,785.85										
Property taxes	1,264,020.11										
Contingencies	361,294.13										
Total	3,974,235.45										
Net Revenue Before Tax					39,120,315.56	39,865,717.50	40,624,843.07	41,397,928.24	42,185,212.43	42,986,938.51	67,255,327.73
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	39,120,315.56	39,865,717.50	40,624,843.07	41,397,928.24	42,185,212.43	42,986,938.51	67,255,327.73
Present Worth(PV)		-75,532,702.70	-61,552,292.66	-50,159,528.20	31,879,504.19	26,473,904.81	21,984,638.23	18,256,412.65	15,160,247.30	12,989,015.57	144,878.17
IRR		22.71%									

13-Australia: Victoria

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	2,860.00	3,575.00	3,575.00	3,575.00	3,575.00	3,575.00	2,860.00	23,595.00	1,226,940.00
Generation capacity factor	21.67%	27.08%	27.08%	27.08%	27.08%	27.08%	21.67%	25.54%	25.54%
Pumping (MWh)	3,781.25	4,468.75	4,468.75	4,468.75	4,468.75	4,468.75	3,781.25	29,906.25	1,555,125.00
Operating Hours of Pumping	6.88	8.13	8.13	8.13	8.13	8.13	6.88	54.38	2,827.50
Operating hours of Generating	5.20	6.50	6.50	6.50	6.50	6.50	5.20	42.90	2,230.80
Net Revenue USD/MW/day	44.56	89.75	89.75	89.75	89.75	89.75	44.56		
Net Revenue	24,507.53	49,365.16	49,365.16	49,365.16	49,365.16	49,365.16	24,507.53	295,840.87	15,383,725.01
									15,691,399.51
									16,005,227.50
									16,325,332.05
									16,651,638.69
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)					16,152,283.53	16,475,329.20	16,804,835.78	17,140,932.50	17,483,751.15	17,833,426.17	28,683,946.94
Fixed Operating Costs:											
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.18
Net Revenue Before Tax					11,862,063.63	12,062,300.53	12,265,357.76	12,471,253.22	12,680,003.91	12,891,625.82	18,846,905.76
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	11,862,063.63	12,062,300.53	12,265,357.76	12,471,253.22	12,680,003.91	12,891,625.82	18,846,905.76
Present Worth(FV)		-58,126,497.24	-53,996,274.67	-50,159,528.20	11,019,195.65	10,409,010.21	9,832,164.94	9,286,855.28	8,771,373.67	8,284,104.38	2,065,263.62
IRR		7.85%									

14-New Zealand: Benmore

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,300.00	3,520.00	3,520.00	3,520.00	3,520.00	3,520.00	3,300.00	24,200.00	1,258,400.00
Generation capacity factor	25.00%	26.67%	26.67%	26.67%	26.67%	26.67%	25.00%	26.19%	26.19%
Pumping (MWh)	4,125.00	4,400.00	4,400.00	4,400.00	4,400.00	4,400.00	4,125.00	30,250.00	1,573,000.00
Operating Hours of Pumping	7.50	8.00	8.00	8.00	8.00	8.00	7.50	55.00	2,860.00
Operating Hours of Generating	6.00	6.40	6.40	6.40	6.40	6.40	6.00	44.00	2,288.00
Net Revenue USD/MW/day	51.82	76.31	76.31	76.31	76.31	76.31	51.82		
Net Revenue	28,503.74	41,970.22	41,970.22	41,970.22	41,970.22	41,970.22	28,503.74	266,858.60	13,876,646.98
									14,154,179.92
									14,437,263.52
									14,726,008.79
									15,020,528.66
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20
Revenue (availability 97%)					14,569,913.10	14,861,311.36	15,158,537.59	15,461,708.34	15,770,942.50	16,086,361.35	25,873,902.81
Fixed Operating Costs:											
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,984.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,460.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.93
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.18
Net Revenue Before Tax					10,279,693.19	10,448,282.68	10,619,059.56	10,792,029.06	10,967,195.26	11,144,561.00	16,038,861.63
Cash Flow(FV)					10,279,693.19	10,448,282.68	10,619,059.56	10,792,029.06	10,967,195.26	11,144,561.00	16,038,861.63
Present Worth(PV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	9,661,230.32	9,228,890.21	8,815,417.89	8,420,002.82	8,041,868.91	7,680,273.08	2,493,113.34
IRR		6.40%									

Appendix C. Economic Model Developed for Kneehills Project

Appendix C1. Capacity calculation

Appendix C2. Capital cost

Appendix C3. Operational cost

Appendix C4. Input sheet

Appendix C5. Return on investment

Appendix C6. Results from optimizing daily operating time

Appendix C1. Capacity Calculation

Kneehills Capacity Calculation

STORAGE	
Upper reservoir volume:	16,700,000 m3
Volume considered (85%)	14,195,000 m3
Hours of storage	8
Seconds of Storage	28,800
Flow = Considered Volume / second	
Flow =	493 m3/sec

Generating		KW= (Q x H x e)/11.81	
MW = (9.81 x Q x H x e)/1000			
g= m/sec ²	9.81		
Q= m3/sec	493	Q= cuft/sec	17404
H = gross head in meters	90	H = gross head in feet	295
E = generating efficiency	89%	E = generating efficiency	89%
Assumptions:			
Cycle efficiency =	80%		
Pumping efficiency =	90%		
Generating efficiency =	89%		
MW=	388 MW	KW=	388,000 388 MW

Pumping		Q= KW(11.81 x E)/H	
g= m/sec ²	9.81		
Q= m3/sec	395	Q= cuft/sec	13,950
H = gross head in meters	90	H = gross head in feet	295
E = pumping efficiency	90%	E = pumping efficiency	90%
Pumping capacity	388 MW	KW= Pumping capacity	388,000

Appendix C2. Capital Cost

Kneehills Capital Cost						
Item		Unit	Size	Quantity	Unit Cost	Total Cost
DIRECT COSTS						
Division 1 - Land and Access						
1.1	Property Acquisition					
	Public Consultation					50,000
	Land Purchase/Lease	ha		500	2,000	1,000,000
	Right of Way	ha		750	2,000	1,500,000
1.2	Relocations					
	Farm Buildings	group		3	133,000	399,000
	Highway	km		1	100,000	100,000
1.3	Preliminary & General Construction Overheads					
	Mobilization			1	500,000	500,000
	Demobilization			1	250,000	250,000
	Bonds			1	500,000	500,000
	Insurance			1	500,000	500,000
	Permits			1	250,000	250,000
1.4	Construction					
	New Access Roads	km		2	250,000	500,000
	Road Improvement	km		4	50,000	200,000
Division 1 Total						5,749,000
Division 2 - Upper & Lower Reservoirs						
2.1	Upper Reservoir	ha / wetted	450			
	Dewatering	m3				0
	Excavation	m3		912,000	7	6,384,000
	Earthfill Dam (or Dyke)	m3		1,142,680	15	17,140,200
	Rip Rap	m3		349,778	40	13,991,120
	Grouting	m3		4,005	200	801,000
	Reservoir Clearing - including topsoil stripping/replacement and seeding	ha		450	4,000	1,800,000
	Concrete Intake Structure and Control Gates	m3		30,000	550	16,500,000
	Gates and Hoists			2	250,000	500,000
2.2	Lower Reservoir	ha / wetted	360 ha			
	Dewatering	m3				0
	Excavation	m3		196,000	7	1,372,000
	Earthfill Dam (or Dyke)	m3		1,367,713	15	20,515,695
	Rip Rap	m3		47,083	40	1,883,320
	Special Slope Stabilization					
	Grouting	m3		920	200	184,000
	Reservoir Clearing - including topsoil stripping/replacement and seeding	ha		200	4,000	800,000
	Concrete Spillway			1	2,500,000	2,500,000
	Gates and Hoists			2	250,000	500,000
	Diversion and Care of River			1	100,000	100,000
Division 2 Total						84,971,335
Division 3 - Penstocks/Pipelines						
3.1	Upper/Lower Reservoir Penstock					
	Excavation	m3		31,000	10	310,000
	Penstock and Valves (and mitered fittings)	m		500	4,260	2,130,000
	Penstock Installation/Welding					2,000,000
	Penstock External Coating					500,000
	Concrete (Anchors)	m3				1,000,000
	Backfill	m3		2,100	30	63,000
3.2	Lower Reservoir/River Fill/Drain Pipeline	m		n/a		
Division 3 Total						6,003,000
Division 4 - Powerhouse Structure						

386 new capacity / MW

308 old capacity / MW

0.6 factor

4.1	Sub/Intermediate/Super Structure						
	Powerhouse Building				L=44.5m, W=31.7m, H=55.5m		12,000,000
Division 4 Total					388 new capacity MW 388 old capacity MW 0.3 factor		12,000,000
Division 5 - Power Plant & Auxiliaries Machinery							
5.1	Generating Plant/Pumping Equipment						
	Main Generating/Pumping Equipment		MW	200	2	35,000,000	70,000,000
		- supply (F.O.B. manufacturer)					
		- freight to site					
		- insurance & bonding					
		- install					
		- commissioning/training					
	Generator Bypass or Spillway for flood control						
		- bifurcation					
		- valving					
		- dissipation structure					
	Auxiliary Mechanical Systems						1,000,000
		- emergency generator					
		- heating and ventilating system					
		- open cooling water system					
		- closed cooling water system					
		- potable water system					
		- fire protection system					
		- service/instrument air system					
		- plant drainage & sewage system					
		- miscellaneous					500,000
	Electrical/Instrumentation/Controls						
		- generator output busduct and cabling					
		- medium voltage distribution					
		- low voltage distribution					
		- uninterruptible power supply					
		- instrumentation/control					
		- grounding					
	Generator Step-up Transformer						
	Station Services Transformer						
	Integrated Plant Controls/Communication and Data Acquisition						
		- control room					
		- HMI 600k					
		- communications					
	Administration Offices						
		- offices					
		- lunchroom					
		- changerooms					
	Shops/Stores						
		- storage system					
		- major equipment spare parts					
		- shop equipment					
		- mobile equipment					

5.2	River Water Pumphouse (to lower reservoir)					
	Pumphouse Building					
	Intake					
	Pumps Supply/install					
	Auxiliaries					
5.3	Lower Reservoir Gravity Drain (to river)					
	Intake					
	Valving					
	Dissipation Structure					
5.4	Switchyard					2,500,000
Division 5 Total						
						74,000,000
Division 6 - Interconnections & Transmission Lines						
388 new capacity MW 388 old capacity MW 0.7 factor						
6.1	Interconnections					
	240 kV Interconnection					7,000,000
6.2	Transmission Lines					
	240 kV		km	100	200,000	20,000,000
Division 6 Total						
						27,000,000
Division 7 - Contingencies						
7.1	Land and Right of Way			30%	2,500,000	750,000
7.2	Dams and Spillway			30%	84,971,335	25,491,401
7.3	Power Plant Machinery			15%	74,000,000	11,100,000
7.4	Power House Structure			30%	12,000,000	3,600,000
7.5	Contractors Profit & Mgmt. Staff (excl. Main Turbine/Pump Generator- already included)			10%	95,674,335	9,567,434
7.6	Engineering			15%	9,975,000	1,496,250
Division 7 Total						
						52,005,084
DIRECT COSTS TOTAL						
						261,728,419
INDIRECT COSTS						
Division 8 - Investigation and Engineering						
8.1	Engineering Services (excluding Owner's staff)					
	Pre-Development Due Diligence Studies and Conceptual Engineering					150,000
	Phase 1 (Preliminary) Engineering					450,000
	Phase 2 (Preliminary/Value) engineering incl. fatal flaw analysis and risk assessment					450,000
	Independent Phase 2 Engineering Assesment					75,000
	Phase 3 (Detailed) Engineering & Specifications					5,250,000
	Independent Phase 3 Engineering Assesment					150,000
	Construction/Contract Management (Phases 4/5)					1,500,000
			Civil/Structural Design/Project Engineer			
			Mechanical Design/Project Engineer			
			Electrical Design/Project Engineer			
			Instrumentation/Control/Communication Design /ProjectEngineer			

Appendix C3. Operational Cost

Kneehills Operational & Maintenance Cost		Unit	Amount	Unit Cost	(US\$)2004	(US\$)2008
1	Insurance					
1.1	Insurance (year) \$/1000 of capital cost	Ls		-	791,083	856,294
2	Operation				317,460	371,384
2.1	Manpower Allocation	men/year	6	-	317,460	371,384
	Planning and maintenance engineers	men/year	1	100,000	79,365	92,846
	Craft Operators	men/year	5	60,000	238,095	278,538
3	Maintenance (material and labour) (1% capital cost per year)	Ls			2,260,237	2,543,916
	Subtotal				3,368,780	3,771,594
4	General Expenses				1,898,599	2,055,105
4.1	Property Taxes (\$/1000 of 70% of capital cost)	Ls		-	1,898,599	2,055,105
	Annual Cost				5,267,379	5,826,698
5	Contingencies	%	10%	-	526,738	582,670
	Total Annual Operational Cost				5,794,117	6,409,368

Appendix C4. Input Sheet

Kneehills Project

Operating Inputs

Operating Fixed Cost	CAD 2004	USD 2004	USD 2008
Insurance	996,764.44	791,082.89	856,293.56
Manpower (cost/year)	400,000.00	317,460.32	371,383.67
Planning and maintenance engineers	100,000.00	79,365.08	92,845.92
Craft Operators	60,000.00	47,619.05	278,537.75
Maintenance	2,847,898.40	2,260,236.83	2,543,916.46
Property taxes	2,392,234.66	1,898,598.93	2,055,104.54
Contingencies	663,689.75	526,737.90	582,669.82
Demand Interconnection Charge (\$/MW/month)	1,365.91	1,084.06	1,173.42

Variable Costs	CAD	USD
Interconnection Charge		
Demand / Pumping (\$/MWh)	1.96	1.56
Supply / Generating (\$/MWh)	2.62	2.08
Operating Reserve Charge		
Demand / Pumping (MWh x % x pool price)	2.95%	
Supply / Generating (on-peak metered energy/hr x % x pool price)	2.77%	
Other System Support Service (\$/MW/month of highest metered demand)	22.40	17.78
Water fees (\$/MWh)	0.60	0.48

Transmission Losses (factor location)	
Dec/Jan/Fev	4.30%
Mar/Ap/May	-0.20%
Jun/Jul/Ago	2.40%
Sep/Out/Nov	3.80%

Cycle Efficiency	80%
Capacity (MW)	388
CR (Charge to Discharge Ratio)	1.00
Day Capacity Factor (MWh)	9,312.00
Annual Capacity Factor (MWh)	3,389,568.00
Number of Weeks/Year	52
Electrical Output Generating (MW)	388
Electrical Input Pumping (MW)	388

Capital Inputs

	CAD	USD
Capital Cost	284,789,840	226,023,683
Availability	97%	
Construction Year	3	

Financial Inputs

Escalating	
power price	2%
inflation	2%
wage	4%
maintenance	3%

Conversor CAD/USD	1.26
Insurance Year (\$/1000 of Capital Cost)	3.50
Property Taxes (\$/1000 of 70% of capital cost)	12.00

Facility Life Time (years)	30
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Appendix C5. Return on Investment

Return on Investment - Kneeshills Project

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,104.00	3,104.00	3,104.00	3,104.00	3,104.00	3,104.00	3,104.00	21,728.00	1,129,856.00
Generation capacity factor	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%
Pumping (MWh)	3,879.90	3,879.90	3,879.90	3,879.90	3,879.90	3,879.90	3,879.90	27,159.29	1,412,282.83
Operating Hours of Pumping	10.00	10.00	10.00	10.00	10.00	10.00	10.00	70.00	3,639.90
Operating Hours of Generating	8.00	8.00	8.00	8.00	8.00	8.00	8.00	56.00	2,912.00
Net Revenue USD/MWh/day	190.90	476.76	476.76	476.76	476.76	476.76	190.90		
Average incremental revenue per MWh	23.86	59.59	59.59	59.59	59.59	59.59	23.86		
Total revenue per day	74,070.00	164,982.01	164,982.01	164,982.01	164,982.01	164,982.01	74,070.00	1,073,050.08	55,799,603.92
									56,914,576.00
									58,052,867.52
									59,213,924.87
									60,386,203.37
									2004
									2005
									2006
									2007
									2008

Transmission Costs (US\$)

	2004	2005	2006	2007	2008
Demand Transmission Service (Pumping)					
Interconnection charge	5,047,362.67	5,148,309.92	5,251,276.12	5,356,301.64	5,463,276.67
(\$/MWh/month) Fixed operate cost	2,196,884.55	2,240,822.25	2,285,638.69	2,331,351.46	2,377,976.49
Operating reserve charge	2,113,009.09	2,155,269.27	2,198,374.66	2,242,342.15	2,287,189.00
(MWh*\$/pool price)					
Other system support services	82,773.33	84,428.80	86,117.38	87,839.72	89,596.52
(\$/MWh/month of highest metered demand)					
Supply Transmission Service (Generating)					
Interconnection charge	2,349,383.11	2,396,370.77	2,444,298.19	2,493,184.15	2,543,047.84
Losses charge	3,550,765.77	3,621,781.08	3,694,216.70	3,768,101.04	3,843,483.06
(MWh x loss factor location x pool price)					
Operating reserve charge	3,849,268.46	3,926,253.83	4,004,778.91	4,084,874.49	4,166,671.96
(on-peak metered energy/hr x 3.50% x pool price)					
Water fee (US\$)	538,026.67	548,787.20	559,762.94	570,958.20	582,377.37
\$/MWh					

Cash Flow (USD)		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Year	Period (n)											
	Capital Cost	226,023,682.50	75,341,227.50	-1	75,341,227.50	75,341,227.50	75,341,227.50	75,341,227.50	75,341,227.50	75,341,227.50	75,341,227.50	75,341,227.50
	Revenue (availability 97%)											
	Variables O&M Costs											
	Water rental	538,026.67				582,377.37	594,024.91	605,905.41	618,023.52	630,383.99	642,991.67	1,034,211.75
	Demand Transmission Services:											
	Interconnection charge	2,186,884.55				2,377,978.49	2,425,538.06	2,474,048.82	2,523,529.80	2,574,000.40	2,625,480.40	4,222,920.48
	Operating reserve charge	2,113,009.09				2,287,189.00	2,332,932.78	2,379,591.43	2,427,183.26	2,475,726.93	2,525,241.46	4,061,692.43
	Other system support services	82,773.33				89,596.52	91,388.45	93,216.22	95,080.54	96,982.15	98,921.80	159,109.50
	Supply Transmission Services:											
	Interconnection charge	2,349,383.11				2,543,047.84	2,593,908.79	2,645,786.97	2,698,702.71	2,752,676.76	2,807,730.30	4,516,056.00
	Losses charge	3,550,765.77				3,843,463.06	3,920,332.32	3,998,738.96	4,078,713.74	4,160,288.02	4,243,493.78	6,825,393.46
	Operating reserve charge	3,849,268.46				4,166,571.98	4,249,903.42	4,249,903.42	4,249,903.42	4,249,903.42	4,249,903.42	4,249,903.42
	Total variable Operating Cost	14,680,110.99				15,690,224.26	16,206,028.73	16,747,181.24	17,311,936.99	17,903,961.96	18,517,923.83	25,069,289.05
	Fixed Operating Costs:											
	Demand transmission service(interconnection)											
	Insurance	5,463,427.67				5,572,696.23	5,684,150.15	5,797,833.15	5,913,789.82	6,032,065.61	6,152,851.51	9,702,199.02
	Maintenance	856,293.56				873,419.43	890,887.82	908,705.58	926,879.69	945,417.28	964,314.37	1,520,644.37
	Property taxes	371,383.67				386,239.02	401,686.58	417,756.12	434,466.37	451,845.02	469,906.40	1,158,216.22
	Contingencies	2,543,916.46				2,620,233.95	2,698,840.97	2,779,806.20	2,863,200.39	2,949,036.40	3,034,229.42	5,994,905.78
	Total	2,055,104.54				2,116,757.68	2,180,260.41	2,245,668.22	2,313,038.27	2,382,429.42	2,452,988.48	4,842,988.48
		582,669.82				594,323.22	606,209.68	618,333.88	630,700.56	643,314.57	656,168.30	1,034,731.11
		11,872,795.73				12,163,866.53	12,462,037.82	12,768,103.15	13,082,076.08	13,404,168.30	13,734,168.30	24,285,864.99
	Net Revenue Before Tax	30,823,237.29				31,386,284.15	32,043,913.21	32,712,964.75	33,393,612.25	34,086,030.85	34,791,119.85	54,717,119.85
	Cash Flow(FV)											
	IRR											

Appendix C6. Results from Optimizing Daily Operating Time

Hours of Generation	IRR %	Generation Capacity (MW)	Capital Cost (USD)
1	3.3%	3,099	575,691,441
2	10.8%	1,550	395,593,866
3	13.4%	1,033	326,677,297
4	15.3%	775	281,239,599
5	16.0%	620	260,607,640
6	15.9%	517	245,922,100
7	14.9%	443	234,748,205
8	13.5%	388	226,023,683
9	10.6%	345	218,901,906
10	7.8%	310	212,875,021
10.67	5.6%	291	209,504,337

Appendix D. Economic Model Developed for Grande Cache Project

Appendix D1. Capacity calculation

Appendix D2. Capital cost

Appendix D3. Operational cost

Appendix D4. Input sheet

Appendix D5. Return on investment

Appendix D6. Results from optimizing daily operating time

Appendix D1. Capacity Calculation

Grande Cache Capacity Calculation

STORAGE	
Upper reservoir volume	4,020,000 m ³
Volume considered (94%)	3,778,800 m ³
Hours of storage	8
Seconds of Storage	28,800
Flow = Considered Volume / second	
Flow = 131 m³/sec	

Generating		KW= (Q x H x e)/11.81	
$MW = (9.81 \times Q \times H \times e)/1000$			
g= m/sec ²	9.81		
Q= m³/sec	131	Q= cuf/sec	4633.06
H = gross head in meters	380	H = gross head in feet	1246.70
E = generating efficiency	89%	E = generating efficiency	89%
Assumptions:			
Cycle efficiency =	80%		
Pumping efficiency =	90%		
Generating efficiency =	89%		
MW= 436 MW		KW= 436,000 436 MW	

Pumping		Q= KW/(11.81 x E)/H	
g= m/sec ²			
	9.81		
Q= m³/sec	105	Q= cuf/sec	3,717
H = gross head in meters	380	H = gross head in feet	1246.704
E = pumping efficiency	90%	E = pumping efficiency	90%
Pumping capacity	436 MW	KW= Pumping capacity	436,000

Appendix D2. Capital Cost

Grande Cache Capital Cost						
Item		Unit	Size	Quantity	Unit Cost	Total Cost
DIRECT COSTS						
Division 1 - Land and Access						
1.1	Property Acquisition					
	Public Consultation					50,000
	Land Purchase/Lease	ha	uppr & lwr resrv.	19	2,000	37,392
	Right of Way	ha	prnstk/ppine	10	2,000	19,944
1.2	Relocations					
	Farm Buildings	group		n/a		0
	Highway	km		n/a		0
1.3	Preliminary & General Construction Overheads					
	Mobilization					500,000
	Demobilization					250,000
	Bonds					500,000
	Insurance					500,000
	Permits					250,000
1.4	Construction					
	New Access Roads	km		2	250,000	500,000
	Road Improvement	km		4	50,000	200,000
Division 1 Total						2,807,336
Division 2 - Upper & Lower Reservoirs						
2.1	Upper Reservoir	ha / wetted		7	119,600	
	Dewatering	m3				100,000
	Excavation	m3		1,440,000	7	10,080,000
	Earthfill Dam (or Dyke)	m3		486,720	15	7,300,800
	Rip Rap	m3		119,600	40	4,784,000
	Grouting	m3		23,920	200	n/a
	Reservoir Clearing - including topsoil stripping/replacement and seeding	ha		7	4,000	28,160
	Concrete Intake Structure and Control Gates	m3		15,000	550	8,250,000
	Gates and Hoists			1	250,000	250,000
2.2	Lower Reservoir	ha / wetted		9	171,000	
	Dewatering	m3				100,000
	Excavation	m3		171,000	7	1,197,000
	Earthfill Dam (or Dyke)	m3		36,500	15	547,500
	Rip Rap	m3		171,000	40	6,840,000
	Special Slope Stabilization					5,000,000
	Grouting	m3		34,200	200	6,840,000
	Reservoir Clearing - including topsoil stripping/replacement and seeding	ha		9	4,000	34,160
	Concrete Spillway			1	1,500,000	1,500,000
	Gates and Hoists			1	250,000	250,000
	Diversion and Care of River					100,000
Division 2 Total						53,201,620
Division 3 - Penstocks/Pipelines						
3.1	Upper/Lower Reservoir Penstock					
	Excavation	m3	4m deep	186,144	10	1,861,440
	Penstock and Valves (and mitered fittings)	m	4.2 m dia.	6,648	4,260	42,480,720
	Penstock Installation/Welding					20,300,000
	Penstock External Coating					2,000,000
	Concrete (Anchors)	m3				4,000,000
	Backfill	m3		3,324	30	99,720
3.2	Lower Reservoir/River Fill/Drain Pipeline	m	1 m dia.	250	1,500	375,000
Division 3 Total						71,116,880
Division 4 - Powerhouse Structure						
						436 new capacity
						436 old capacity
						0.60 factor

4.1	Sub/Intermediate/Super Structure	L=44.5m, W=31.7m, H=55.5m				12,000,000
	Powerhouse Building					
	Division 4 Total				436 New Capacity 436 Old Capacity 0.30 factor	12,000,000
	Division 5 - Power Plant & Auxiliaries Machinery					
5.1	Generating Plant/Pumping Equipment					
	Main Generating/Pumping Equipment		MW			
		- supply (F.O.B. manufacturer)				52,000,000
		- freight to site				1,500,000
		- insurance & bonding				1,000,000
		- install				2,500,000
		- commissioning/training				500,000
	Generator Bypass or Spillway for flood control					
		- bifurcation				1,000,000
		- valving				1,000,000
		- dissipation structure				1,000,000
	Auxiliary Mechanical Systems					2,000,000
		- emergency generator				
		- heating and ventilating system				
		- open cooling water system				
		- closed cooling water system				
		- potable water system				
		- fire protection system				
		- service/instrument air system				
		- plant drainage & sewage system				
		- miscellaneous				
	Electrical/Instrumentation/Controls					2,500,000
		- generator output busduct and cabling				
		- medium voltage distribution				
		- low voltage distribution				
		- uninterruptible power supply				
		- instrumentation/control				
		- grounding				
	Generator Step-up Transformer		235 MVA, 23.8 kV/240 kV	2		6,000,000
	Station Services Transformer		240 kV/13.8 kV	2	500,000	1,000,000
	Integrated Plant Controls/Communication and Data Acquisition					1,500,000
		- control room				
		- HMI 600k				
		- communications				
	Administration Offices					
		- offices				200,000
		- lunchroom				20,000
		- changerooms				20,000
	Shops/Stores					
		- storage system				10,000
		- major equipment spare parts				1,000,000
		- shop equipment				500,000
		- mobile equipment				100,000

Appendix D3. Operational Cost

Grande Cache Operational & Maintenance Cost		Unit	Amount	Unit Cost	(US\$)2004	(US\$)2008
1	Insurance					
1.1	Insurance (year) \$/1000 of capital cost	Ls		-	788,801	853,824
2	Operation				317,460	371,384
2.1	Manpower Allocation	men/year	6	-	317,460	371,384
	Planning and maintenance engineers	men/year	1	100,000	79,365	92,846
	Craft Operators	men/year	5	60,000	238,095	278,538
3	Maintenance (material and labour) (1% capital cost per year)	Ls			2,253,718	2,536,580
	Subtotal				3,359,980	3,781,687
4	General Expenses				1,893,123	2,049,178
4.1	Property Taxes (\$/1000 of 70% of capital cost)	Ls		-	1,893,123	2,049,178
	Annual Cost				5,253,104	5,830,865
5	Contingencies	%	10%	-	525,310	583,086
	Total Annual Operational Cost				5,778,414	6,413,951

Appendix D4. Input Sheet

Grande Cache Project

Operating Inputs

Operating Fixed Cost	CAD 2004	USD 2004	USD 2008
Insurance	993,889.81	788,801.43	853,824.04
Manpower (cost/year)	400,000.00	317,460.32	371,383.67
Planning and maintenance engineers	100,000.00	79,365.08	30,948.64
Craft Operators	60,000.00	47,619.05	23,211.48
Maintenance	2,839,685.16	2,253,718.38	2,536,579.90
Property taxes	2,385,335.54	1,893,123.44	2,049,177.70
Contingencies	661,891.05	525,310.36	583,086.49
Demand Interconnection Charge (\$/MW/month)	1,365.91	1,084.06	1,173.42

Variable Costs		
Interconnection Charge	CAD	USD
Demand / Pumping (\$/MWh)	1.96	1.56
Supply / Generating (\$/MWh)	2.62	2.08
Operating Reserve Charge		
Demand / Pumping (MWh x % x pool price)	2.95%	
Supply / Generating (on-peak metered energy/hr x % x pool price)	2.77%	
Other System Support Service (\$/MW/month of highest metered demand)	22.40	17.78
Water fees (\$/MWh)	0.60	0.48

Transmission Losses (factor location)	
Dec/Jan/Fev	-11.70%
Mar/Ap/May	-1.30%
Jun/Jul/Ago	-6.00%
Sep/Out/Nov	-9.60%

Cycle Efficiency	80%
Capacity (MW)	436
CR (Charge to Discharge Ratio)	1.00
Day Capacity Factor (MWh)	10,464.00
Annual Capacity Factor (MWh)	3,808,896.00
Number of Weeks/Year	52
Electrical Output Generating (MW)	436
Electrical Input Pumping (MW)	436

Capital Inputs

	CAD	USD
Capital Cost	283,968,516	225,371,838
Availability	97%	
Construction Year	3	

Financial Inputs

Escalating	
power price	2%
inflation	2%
wage	4%
maintenance	3%

Conversor CAD/USD	1.26
Insurance Year (\$/1000 of Capital Cost)	3.50
Property Taxes (\$/1000 of 70% of capital cost)	12.00

Facility Life Time	30
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Appendix D5. Return on Investment

Return on Investment - Grande Cache Project

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,488.00	3,488.00	3,488.00	3,488.00	3,488.00	3,488.00	3,488.00	24,416.00	1,289,632.00
Generation capacity factor	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%
Pumping (MWh)	4,360.00	4,360.00	4,360.00	4,360.00	4,360.00	4,360.00	4,360.00	30,520.00	1,587,040.00
Operating Hours of Pumping	10.00	10.00	10.00	10.00	10.00	10.00	10.00	70.00	3,640.00
Operating Hours of Generating	8.00	8.00	8.00	8.00	8.00	8.00	8.00	56.00	2,912.00
Net Revenue USD/MW/day	190.90	476.76	476.76	476.76	476.76	476.76	190.90		
Average incremental revenue per MWh	23.86	59.59	59.59	59.59	59.59	59.59	23.86		
Total revenue per day	83,233.30	207,866.39	207,866.39	207,866.39	207,866.39	207,866.39	83,233.30	1,205,798.54	62,701,523.99
									63,955,554.47
									65,234,665.56
									66,539,358.87
									67,870,146.05
									2003
									2004
									2005
									2006
									2007

	2004	2005	2006	2007	2008
Transmission Costs (US\$)					
Demand Transmission Service (Pumping)					
Interconnection charge	5,671,778.67	5,785,214.24	5,900,918.52	6,018,936.90	6,139,316.63
(\$/MWh/month) Fixed operate cost	2,468,728.89	2,518,103.47	2,568,465.54	2,619,834.85	2,672,231.54
Operating reserve charge	2,374,474.61	2,421,964.10	2,470,403.38	2,519,811.45	2,570,207.68
(MWhx#xpool price)					
Other system support services					
(\$/MWh/month of highest metered demand)	93,013.33	94,873.60	96,771.07	98,706.49	100,680.62
Supply Transmission Service (Generating)					
Interconnection charge	2,640,028.44	2,692,829.01	2,746,685.59	2,801,619.31	2,857,651.66
(\$/MWh)					
Losses charge					
(MWh x loss factor location x pool price)	-11,079,128.41	-11,300,710.98	-11,526,725.20	-11,757,259.70	-11,992,404.60
Operating reserve charge					
(on-peak metered energy/hr x 3.50% x pool price)	4,325,466.62	4,411,975.96	4,500,215.48	4,590,219.79	4,682,024.16
Water fee (US\$)					
(\$/MWh)	604,586.67	616,678.40	629,011.97	641,592.21	654,424.05

Cash Flow (USD)											
Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2036
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	225,371,836.44	75,123,946.15	75,123,946.15	75,123,946.15							
Revenue (availability 97%)						65,834,041.67	67,150,722.50	68,493,736.95	71,260,883.92	72,686,101.60	16,911,033.34
Variables O&M Costs											
Water rental	604,586.67										
Demand Transmission Service:											
Interconnection charge	2,468,728.89										
Operating reserve charge	2,374,474.61										
Other system support services	93,013.33										
Supply Transmission Service:											
Interconnection charge	2,640,028.44										
Losses charge	-11,079,128.41										
Operating reserve charge	4,325,466.62										
Total variable Operating Cost \$/MWh	1,427,170.15										
Fixed Operating Costs:											
Demand transmission service(interconnection)											
Insurance											
Manpower											
Maintenance											
Property taxes											
Contingencies											
Total	12,533,367.43										
Net Revenue Before Tax	51,755,859.36	-75,123,946.15	-75,123,946.15	-75,123,946.15	51,755,859.36	52,737,691.30	53,833,000.34	54,948,489.56	56,084,507.72	57,241,408.73	92,287,509.77
Cash Flow(FV)											
IRR											

Appendix D6. Results from Optimizing Daily Operating Time

Hours of Generation	IRR %	Generation Capacity (MW)	Capital Cost (USD)
1	6.0%	3,483	728,632,366
2	13.6%	1,741	474,743,214
3	16.9%	1,161	375,125,488
4	19.8%	871	311,938,001
5	21.2%	697	279,763,793
6	21.9%	580	256,698,108
7	21.5%	498	239,165,177
8	20.7%	436	225,371,838
9	18.5%	387	213,961,807
10	16.5%	348	204,748,362
10.67	15.0%	326	199,247,653