



The University of Sydney presents

Getting Value out of Utility Deregulation

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by

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Part 1 – Coming to terms with deregulation

Introduction

The University of Sydney took a bold approach to accommodating the deregulation of the energy market and looked at all aspects of energy procurement. After all, the university procures upwards of 4 million dollars of energy annually.

The first half of this paper outlines this approach and provides an indication of what we believe has been achieved and we aim to achieve.

The second half will explain the design and function of the Utilities Information and Management System (UIS) which has been a key component of our strategy.

Reality of Deregulation

Deregulation will impact on procurement depending upon location and organisational circumstances but the reality of deregulation exists for all and will not go away. Furthermore, however you address deregulation today, expect further changes and developments to upset your current approach.

The new players in the industry are making large investments in the deregulated energy market. Consider the substantial commercial imperatives which will drive these new players. Consider also the multiple links in the supply chain with each phase of energy supply covered by separate businesses.

Could the proverbial crystal ball be any cloudier? The only guarantee is that change and uncertainty will continue. Where there is uncertainty, large commercial investments, complex distribution structures combined with State and Commonwealth politics there will be risk to the consumer.

In NSW, we appear to have ended our honeymoon with our electricity suppliers. The substantial benefits of our electricity contract from four years ago – which gave us approximately a 25% saving – has today been significantly eroded. Recent procurement indicated that we were close to returning to the deregulation rates.

As for gas, the potential to-date has been small. Based on current indications, gas deregulation looks unlikely to achieve anything similar to the reductions in electricity costs.

Deregulation and Risk

Deregulation clearly meant risk to the university. This view and the tendency to assume that deregulation will provide no permanent benefit will be held by any experienced facilities manager with a healthy skepticism.

Such a conclusion could be based on a variety of arguments. One could simply envisage the unreasonable executive expectations due to slick industry PR. Alternatively, anticipate long term unreliability of supply due to lack of adequate investment in maintenance. Any university facilities manager should recognise either issue.

The promise of lean and hungry, hence efficient, businesses with lower costs and improved service for the consumer may be in part true. Nevertheless, the inherent uncertainty of this market should establish that the consumer needs to be very wary.

We need to know how to avoid penalty costs and identify potential areas of reduced service reliability. We should assess administration requirements – including the need to find errors in meter reading and billing.

Recognising the underlying uncertainty, we need to continuously reassess our risk. With the high levels of private and public sector involvement – at a national and state level, don't be surprised by sudden changes in where the industry is headed.

Deregulation, although it has a real potential to capture short term savings, means that we need to identify and manage the risks for long term cost and functional control.

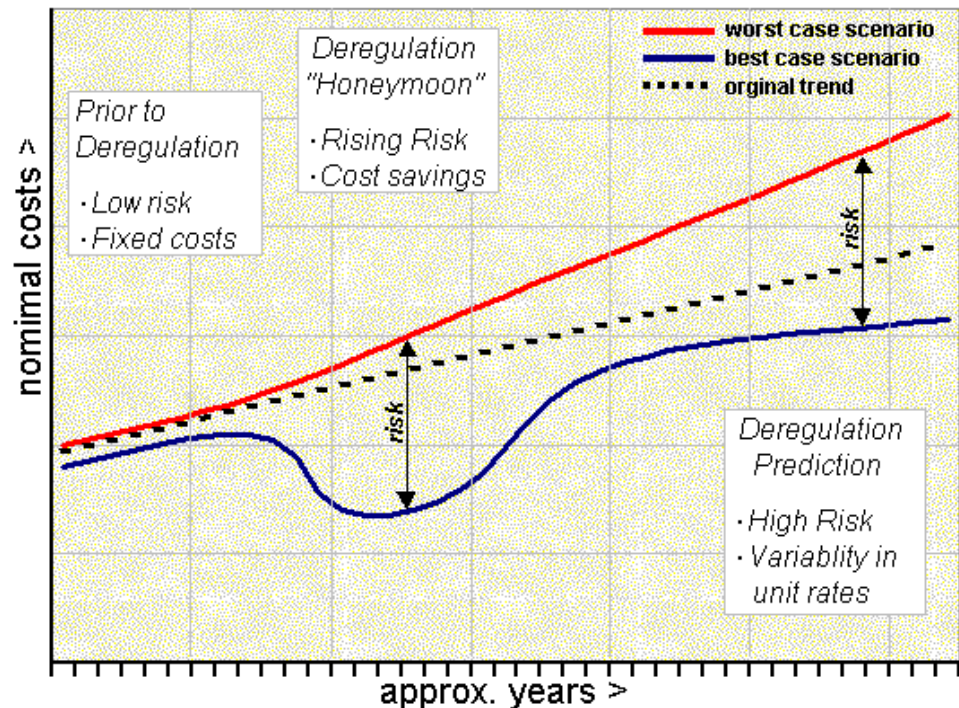
The University Responds

At the University of Sydney, our first response was to ask “is it worth worrying about?” Initially, we were captivated by the immediate savings which were likely to be achieved and said “yes” on these grounds. With a 4 million dollar plus utilities bill and 25% savings who would say “no”?

Nevertheless, being facilities managers and fairly suspicious we felt that someone was going to pay for this short-term largess. Consequently, we concluded that a structured long-term approach was required to maintain control. This resulted in decisions establishing responsibilities, budgets and the preparation of a functional management plan.

Our latest procurement contract for electricity seems to confirm our original suspicions. Adjusted for time, our costs are close to pre-deregulation figures. Our justification for a long-term approach is now vindicated.

Below: Diagrammatic analysis of the potential for saving from the pre-deregulation period over the transitional “honeymoon” period to the predicted future deregulated environment. The actual position is somewhere between the best and worst case scenario – with good management the best case scenario can be achieved.



As with all new and uncertain tasks a “champion” is absolutely vital. In Grahame Pepper, who manages our energy and utilities portfolio, we found that champion. It would be only fair to tell that Grahame wrote the brief. He convinced management and has delivered the goods.

The management plan provided the brief for the computer based Utility Information System (UIS) which was required to support the operation. This had been designed in an iterative process and the rigor of developing UIS has been of great value in reviewing our management plan.

It was identified at an early stage the value of extending the system to all utilities and not just the electricity sector.

With the full implementation of UIS now in hand, we are looking to closer integration with our Facilities Management Information System, on the Archibus platform, to tie utility analysis to our space information. We are also commencing the use of UIS in support many of our environmental management needs.

System Objectives

UIS addresses six principal objectives which cover almost all information technology aspects of energy management. These are as follows:

1. Procurement of Energy

UIS should provide quality information for informed procurement with consequent cost savings. Particularly relevant to demand management, it allows us to identify areas to which better control can be applied plus areas which will remain volatile or are difficult to predict.

Accurate information on both consumption and maximum demand is of the greatest benefit when seeking prices for new contracts and negotiations of variations, which often include penalty rates.

Recently UIS has been used in discussions with our gas supplier. An assessment of our position on Maximum Daily Quantities was crucial.

2. Control of Energy Use

The management of consumption and demand, especially to preventing cost blowouts requires the analysis of real time and historical information. Accurate and focused information can target operational problems whether it be due to equipment malfunction, commissioning of new equipment or operational efficiencies.

The data is also a catalyst to facilitate continuous improvement in operational functional and in energy conservation across our campuses.

3. Billing System

With UIS we also took the opportunity to integrate and automate the financial processes related to utility management.

Campus tenants, who were sub-billed using hand calculations and old spreadsheets, were to be provided with accurate, integrated and detailed electronic reports tied to recoveries in the university's financial system. The same accuracy is needed at a broader level to manage the utility budgets and the analysis of expenditure trends.

As UIS would provide an electronic record of our bills, payments, invoices and journals, a key objective was the detection of billing errors from suppliers.

4. Maintenance Management Tool

The system would provide for the analysis of information and establishment of benchmarks for maintenance needs. These range from tracking actual usage against benchmarks to close tracking of problematic or high-risk plant.

Early warning of variances from historical or expected norms can not only save direct energy costs and but forestall functional problems, extend the life of plant and equipment and even improve the operational environment for staff.

The across the board interest, from suppliers to maintenance staff and to users, is of great value in finding a co-operative approach to solving problems. The relatively aged and energy-inefficient buildings of the University of Sydney makes this ability to quickly identify variances, very desirable.

5. Strategic Planning

The information gained on both engineering systems and more comprehensive building solutions needs to be continually built upon whilst allowing succinct trend and performance data to be extracted. This is essential not simply for general management but also to identify if keystone projects are in-fact viable and will perform to design.

6. Engaging Users in Energy Programs

At the facilities management scale it is unlikely such procurement approaches such as purchasing on the spot market are feasible. Whilst our investigation to-date indicates that major initiatives such as co-generation plants are not viable, we are pursuing a number of possibilities.

Presently and for the immediate future, the best opportunities for the University of Sydney are in heightening user awareness and involvement by providing clear and informative advice and an invitation to participate. This requires timely and easily assimilated information which can be distributed with billing information and web based “near real-time” information.

Why develop UIS?

With such extensive objectives an explanation of our decision to develop software in-house should be explained – after all is there not substantial facilities management software already in the marketplace? This decision could be criticised as expensive, risky and naive.

Our reasoning is fundamental to our objectives and close to the heart of facilities management. The facilities team is there to support the university in

the delivery of academic and research business balancing competing demands, coping with limited funds and increasing functionality. We rely upon quality information, flexible day to day management tools and advanced risk management techniques.

We did complete a review of potential software systems, however we were not prepared to listen to sales lines of “we can easily adapt/add/modify our system” or “we can fit your essential requirements”. This rarely works.

Quite simply, the system we wanted was not available and therefore we chose to go our own way.

With independent development, the university can ensure the system supports our management, is flexible and can respond to changing needs. The university has total understanding and control of data and processing. We obtain thorough confidence in the analysis and conclusions derived from the system.

It should be pointed out such a decision requires the support and commitment of executive management to the management plan, the in-house software development and the continuing ownership of the system. This support was achieved with the co-operation of both the computing and facilities management departments.

Benefits to-date

As managers, when you first get the chance to see UIS, you will be impressed by the flexibility in analysing information. Real-time information, be it consumption, maximum demand or billing and can be compared against any other period or benchmark. The analysis is presented in a very user friendly format.

This is a great benefit in its own right as an resource management tool, but it also serves as a means to improve the credibility of our facilities management team with the wider university community. A close relationship with academics and researchers is becoming ever more important.

In hard dollar terms it is too early to accurately quantify the benefits but there are some clear indicators. Recent savings on small one-off issues such as plant malfunction are in the order of \$10,000 per month. Substantial savings have also been shown through detection of billing errors.

On the larger scale a particular example is the recently commissioned veterinary waste incinerator. During an extended commissioning, burn temperatures and times were dramatically reduced from the manufacturer’s commissioned settings. This achieved clean burns with savings of around 10,000 megajoules per burn day, which represents some \$16,000 per annum.

For a service life of, say, twenty years, this represents at least a quarter of a million dollars plus a substantial extension of the refractories' service life.

Clearly, the greatest benefit is the knowledge we now have of where and when energy is being consumed across all our buildings and campuses. This helps us to draw the broadest involvement from the University's academic research and management staff and students and the commitment to energy conservation which is essential to our long term goals.

Deregulation tomorrow

The challenges will undoubtedly come from many directions – fluctuations in rates, extension of penalty-based contracts, risks to service reliability or new environmental standards.

With our management plan enacted, our objectives in hand and our development of UIS completed the University of Sydney is in solid position to respond to the uncertainties of energy deregulation.

In the next section, the current level of functionality for UIS will be covered and its flexibility and usability will be outlined. However the ownership of this system by the university, will ensure our ability to respond to all challenges deregulation brings. The ability to modify and adapt the system, based upon hard won experience, reflects our fundamental management plan.

Part 2 – Utility Knowledge

Introduction

Reading about the increased uncertainty and risks to customers in the next stage of deregulation, the importance of a solid management strategy cannot be overstated. The next challenge will be to put this plan into practice and this requires a sound knowledge of your electricity gas and water usage across all campuses.

In this section, you will discover that the tools needed to analyse consumption, demand and billing information need to be powerful, intelligent, flexible and responsive. You will also learn that the University of Sydney has developed such a tool – the Utility Information System (UIS).

Drowning, not waving

The miracle of information technology can provide detailed information about your campus and how utilities are used. Available today are smart meters, building management systems, data-loggers and supplier usage reports. All are in use at the University of Sydney.

Unfortunately, the more information collected, the less capacity to make sense of that information.

At Sydney, the Utilities Manager was drowning in data – spending more and more time hunched over his computer, rather than actively responding to what had been learnt. Yet still more metering was needed if the whole campus was to be suitably monitored.

The key to knowledge is not having information, but being able to use it. Energy management must be the definitive example of this truth.

Why? Because the amount of information needed to get a comprehensive understanding of utility usage is enormous. A campus the size of Sydney University can generate over 20 megabytes of data every month – enough to fill the telephone book of a large city.

At the time UIS was commenced, the university had collected three years of electricity monitoring data and a significant volume regarding water and gas. Computers were pushed to their limits when asked to process this information. The Utility Manager was not happy about the situation either.

Building UIS

The University of Sydney was successful in solving the problem of information-overload and thus deregulation uncertainty, firstly because it had a management strategy and secondly because it decided to build UIS.

New challenges required new thinking and new ideas,

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Objectives taken

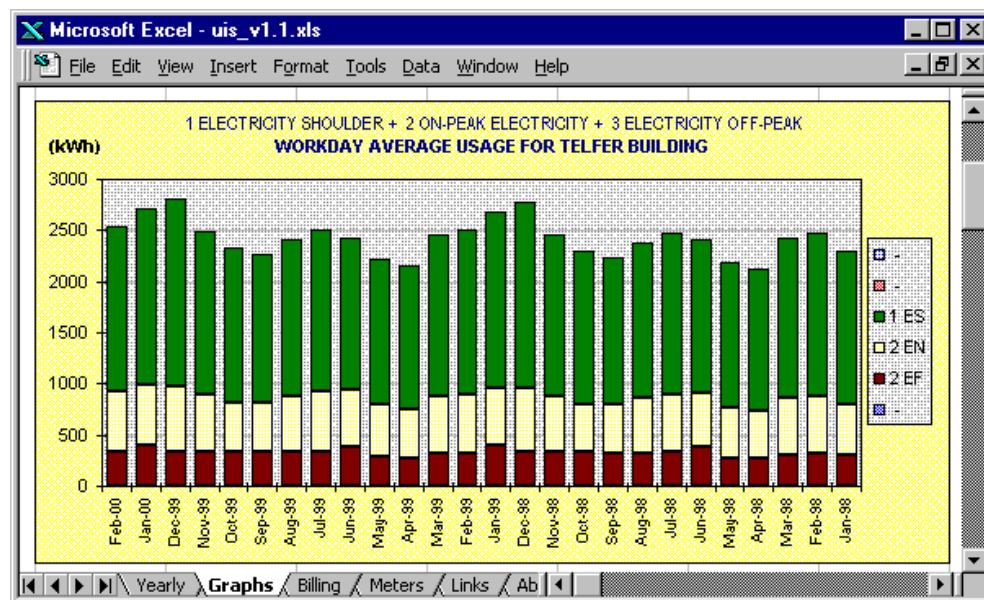
As described earlier, the university set its management objectives carefully. These objectives were broken down in a detailed proposal, design and risk management analysis. A description of how UIS fulfills each original objective follows:

1. Utility Procurement

UIS records all historical procurement information, including maximum demand and any ancillary costs. A schematic model of the physical utilities network interpolated with actual consumption, demand and expenditure provides a complete description of the flow of electricity, water and gas across all campuses and properties of the university.

Armed with this information, UIS can interpret current trends and project these into the future, while taking into consideration historical cycles. From its relational database, UIS extracts the relevant summary or cross-section to Microsoft Excel for graphical presentation and extended analysis.

The flexibility of this hybrid process is unlimited. The Utility Manager can readily even build his or her own models or “what-if” scenarios. These are used to investigate the cost-benefit-penalty relationship of proposed contracts.



Above: Monthly averages for a university building. Workdays averages are used because weekends and public holidays are charged at off-peak rates and are disproportionately represented in daily averages.

2. Control of Energy Use

UIS collects and processes consumption and demand data at the earliest possible instant. Where smart meters are connected on-line, action can be prompted within minutes of an incident.

In demand management, UIS is used to monitor the electrical load as it increases over the morning hours. By projecting the trend, a Utilities Manager can anticipate maximum demand and avoid contract penalties.

In practice, this immediacy is not the whole story. Some of the most impressive savings have been obtained by investigation over extended periods.

3. Billing/Sub-billing System

UIS collects, through data entry, the bills of all suppliers, be they for electricity, water or gas. This is necessary to meet procurement objectives, but it has been instrumental in identifying errors in supplier bills. You would be surprised how frequently this happens.

Although the data entry operator is presented with the simplest possible user interface, they are alerted to potential errors after every save. Warning overrides are recorded so the Utility Manager may monitor data entry operations.

A significant percentage of the university's electricity, water and gas is used by residences, student bodies and others who are charged through the finance system. UIS allowed the university to fully automate this sub-billing process.

The automation is so complete, the system can determine not just the cost but also the consumption and derived unit rate. Even minor price fluctuations are fairly carried through to sub-bills in accordance with the relevant authority regulations.

Bills are integrated, firstly in the sense that electricity, water and gas are detailed together on one monthly or quarterly bill. In the second sense, the system integrates data from suppliers, smart meters and interpolated values.

The delivery of usage reports over the Internet completes the automation. The only need for hardcopy has come from the accountants.

4. Maintenance Management Tool

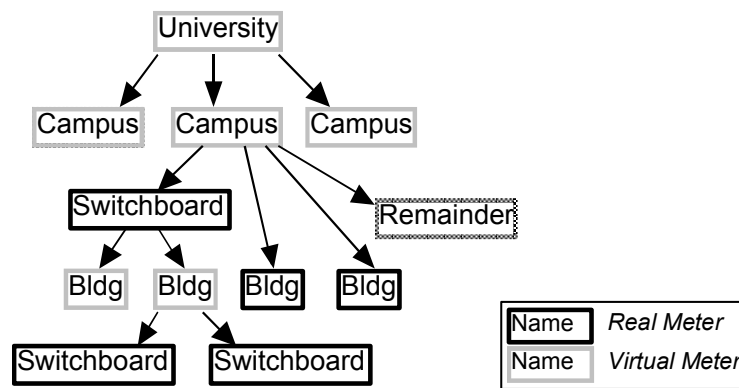
The database/spreadsheet hybrid, described earlier, is used to help maintenance engineers and other stakeholders resolve operational problems. The key here is again accurate, targeted and presentable reporting – not a data deluge.



Most alternatives allow the manual formulation of such links, but for a university network this is impossibly complex. Consequently, UIS intelligence is left with this daunting task.

- ◆ - . A complete schematic of the electricity, gas and hydraulic networks is modeled within the software. When “virtual meters” are inserted into the network, the system can interpolate consumption and costs based upon real meters in its neighbourhood. This would be extremely complex, especially with co-incidental maximum demand values, but its rendered intuitively simple.

Below: Virtual meters are inserted into a network schematic. They don't really exist, but are based upon neighbouring real meters.



- ◆ - A computer system can only be as responsive as its data inputs, so what happens when the data for the last day of a monthly calculation is due in next quarter's bill?

Most computer systems would simply stop right there. UIS intelligence however generates an interim result, which can be used in any report except sub-billing. When the missing data is found, the interim result is updated with a final result.

- ◆ refers to the underlying processes which allow UIS to process megabytes of data every day. They “know” exactly what to process, what to reprocess and what to leave alone.

These and other innovations will add years to the life of any conscientious Utility Manager. They will gain the days needed to commence their energy savings programs and squeeze their procurement contracts. The utility manager and/or data entry operator needs only an intuitive idea of how processing is handled.

The results are seen in faster and more effective training plus simpler configuration procedures. Fundamental errors are dramatically reduced and the system can respond quicker to changing circumstances.

A practical interface

When developing a complex computer system, issues such as the user-interface are often given a secondary consideration. After all as the old adage says: If it was difficult to build, it must be difficult to use.

Fortunately, the development team took the opposite attitude. UIS would be so difficult to build, it needed to be as easy as possible to use.

You may think “user-friendliness” is a tired phrase, but aside from a professional design rarely seen in such a specialist system, the designers adopted two important principles.

Firstly, the billing data entry forms should be as close as possible to the bills themselves. The latest deregulated electricity bills contain thirty to forty input values, so this decision was readily justified.

Start Date	Finish Date	Charge (c)	Used	Cost (\$)
01-01-1997	01-02-1997	8.624c	154,724.	11,607.20
01-01-1997	01-04-1997	6.18c	328,334.	19,441.02
01-04-1997	01-05-1997	4.131c	527,985.	21,251.36
01-01-1997	01-05-1997	2.79c	154,724.	3,769.56
01-07-1997	01-08-1997	2.4c	328,334.	7,596.68
01-08-1997	15-09-1997	.95c	527,985.	4,903.92
01-05-1997	01-09-1997	1200.c	2,760.	32,080.00
01-01-2000	01-02-2000			350.00
				Market Charges
		0.0134c	831,123.	83.11
				Market Meter
				Metering Charge

Above: Example of a deregulated market electricity bill. This data entry screen appears almost exactly like the actual printed bill from Energy Australia – saving time and reducing errors.

Seven supplier-specific forms were designed plus a “generic” form suitable for all billing data entry. The advantage was demonstrated when a new data entry operator was fully trained in under eight hours.

The second design principle involved transferring all the time-consuming calculations to a background processor. Just as in electrical demand management, the most complex processes are undertaken in the “off-peak” periods. Without this innovation, the computer would be unlikely to complete the day’s analysis.

Database/spreadsheet hybrid

If your Utilities Manager uses a computer, it is likely they have discovered the spreadsheet as an stop-gap solution to information overload.

A spreadsheet allows flexible access to information. Both tabular and graphical information can be analysed and printed and a vast range of output formats are possible. Spreadsheet cells may be programmed with useful formulae, including complex statistical tests, modeling and “what-if” scenarios.

Unfortunately, spreadsheets are let down by data size limitations. Regardless, the manual operation of a very large data-set is not just time-consuming but dangerous, with an insidious potential for human error and data loss.

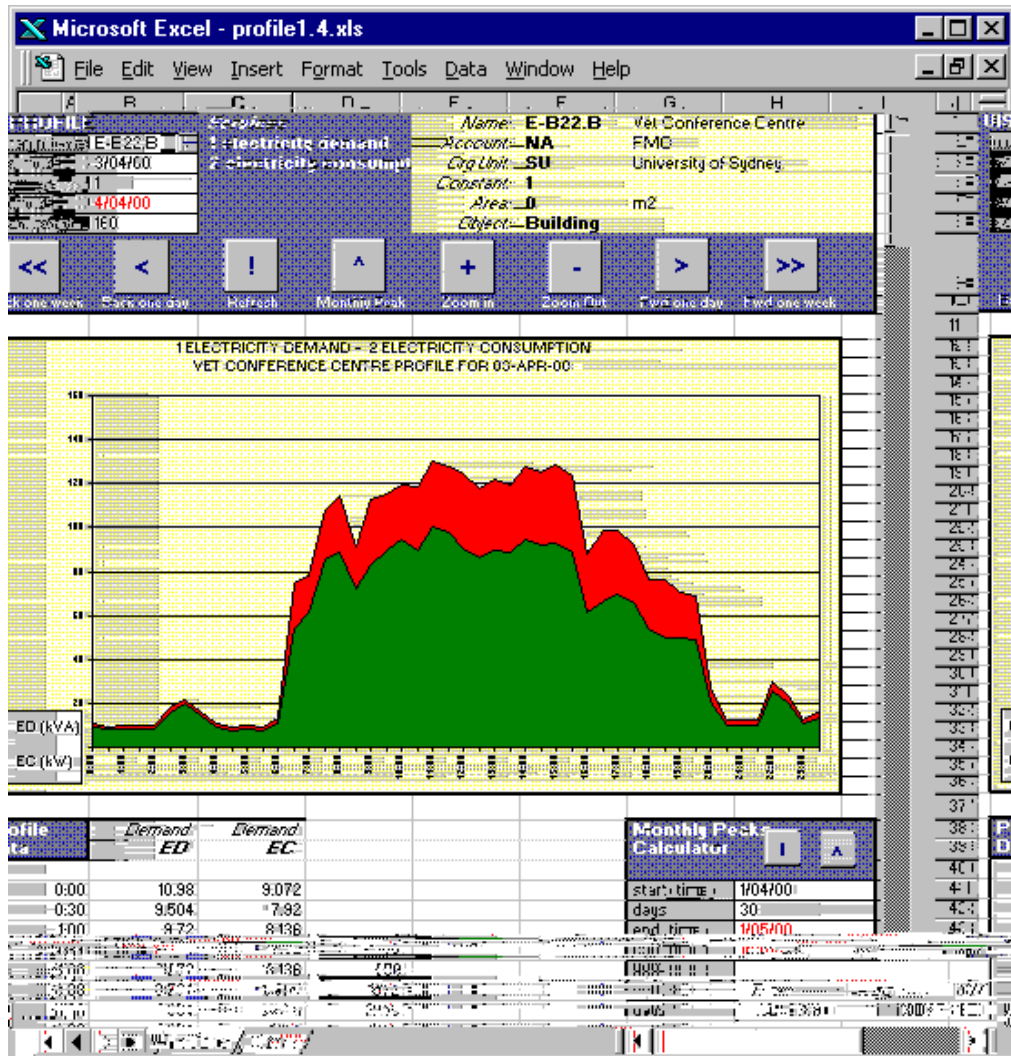
Aware that many Utility Managers make use of this flexible technology, the UIS solution makes good use of a spreadsheet/database hybrid – that is, a spreadsheet with a database (SQL/ODBC) connection.

Each of the newly designed spreadsheets collects a small segment or a summary of the whole database – data that would otherwise need to be retyped. Graphs, statistical formulae and summations are then inserted. Any number of spreadsheets may be constructed without risk to the original data. It is also prudent to run the same graphs and formulae with different data selection criteria, for example a different building or different year.

The hybrids make it easy to create modified versions of an existing spreadsheet. For instance, a growth chart rather than a consumption chart. The basic data is the same, however the spreadsheet formulae are altered. Note that once altered, a modified spreadsheet will continue to work with different data selection criteria.

The spreadsheets can also travel. Although they lose their connection to the database, they retain the data which was last collected, so the Utility Manager can email an analysis to a colleague or complete a study off-site.

Below: A spreadsheet with two database connections. The first finds the profile data for a particular day (tabular data bottom left) and this is used to display the chart (centre). The second finds the peak value over thirty days (bottom right). This spreadsheet is reusable, meaning that different meters and time periods may be selected. Using the buttons a whole month may be quickly scanned.



Five more features

With UIS, the list of features is quite extensive. Some features are indispensable, others are highly technical, but all are useful. Included below are five features which are simple to explain but deserve a mention:

1. Electricity, water and gas information is integrated in every report, spreadsheet and web page. It's three systems in one.

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2. Any meter or service may be automatically double-checked. For example, if an energy supplier provides a usage report which is also provided by a smart meter, the two sources are continuously compared.
 3. The unit rates for any bill entered are always checked against the previous month. Any rate increases are thus immediately noticed.
 4. Smart meters and data-loggers may provide consumption readings with varying frequencies, such as 5, 15, or 30 minutes. UIS records the original frequency, as a high resolution can be very useful. It also complies with the industry standard of 30 minutes for sub-billing, maximum demand and wherever else necessary.
 5. A new administration charge is introduced, a meter identifier is renumbered, times of use (peak/shoulder) are altered or the facilities office is renamed – these and many other changes in a university utility network are handled by UIS, without interrupting operations.

Deregulation and UIS

For the facilities manager, deregulation represents yet another increase in risk and uncertainty to be dealt with. The risks can be managed and uncertainty can be opposed by preparedness. This can lead to great advantage.

If your organisation can negotiate a good deal and make some internal savings along the way, there's a good chance you have seized the opportunities and thus improved your bottom-line. This may even assist environmental outcomes.

The Utility Information and Management System is the vehicle through which the University of Sydney will be cutting those deals, improving its bottom-line and meeting its responsibilities. This is not without emphasising the role of management in the driving seat, making further innovations and taking other bold steps.

The development of UIS has benefited the university's deregulation strategy far beyond the initial information overload problems. Working across different professional disciplines and attacking such a variety of theoretical and practical issues has generated valuable knowledge and experience – all used to enhance the energy management plan.

It is important that such difficult issues are reviewed in a wider forum, so to develop the management approach and to enhance our tools for analysis. We look forward to a continuing dialogue in the future. ♦

UIS Technical Specifications

Minimum Requirements

Operating System	Windows 2000, Windows NT or Windows 98
Hardware Requirements	
Client or Network Hard Disk:	40 Megabytes
Client RAM:	8 Megabytes (above Operating System)
Database Requirements	
Database Server:	Sybase Server 11 or 12
Database Server Size (min):	200 Megabytes
Client Drivers:	Sybase Open Client ODBD Client
Application Requirements	Microsoft Excel Internet Explorer or Netscape
Internet Server Requirements (optional)	v32 modem HTTP Server with Perl scripting enabled

Application Specifics

Current version:	V3.0
Last Release date:	23 June 2002
Internationalisation:	Only supports Australian dates and symbols
Calculation Methods:	10 profile calculation methods 6 supplier billing methods 2 virtual methods (summary and remainder)
Account code support:	20 characters (excluding spacing) 6 accounts per organisational unit
Selected database record maximums	
Max number of organisations:	32,000
Max number of meters/buildings:	32,000
Max number of bills:	20,000,000 (assuming average of 10 lines per bill)
Max num. of time of use definitions	36
Utility data types stored	Gas Consumption and Costs Gas Market Charges Gas Maximum Hour Standard Volume Gas Maximum Daily Standard Quantity Water Consumption and Costs Water Service Charge Sewerage Consumption and Costs Sewerage Service Charges Trade Waste Service Charges Wastewater Service Charges Stormwater Service Charges Electricity Split Consumption and Costs Domestic Electricity Consumption and Costs Block Electricity Consumption and Costs Electricity Deregulated Market Charges
Utility Companies Supported:	"Generic" Company Energy Australia Integral Energy AGL Sydney Water