CASE STUDY: ORGANIZATIONAL DECISION MAKING ON ENERGY EFFICIENCY

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Introduction

For the purposes of the IEA Energy Efficiency Project, two significant types of barriers to energy efficiency have been identified that give rise to market failures where firms are unable to act to maximize their economic benefits:

• the principal/agent barrier which leads to participants in the market having split incentives with respect to purchase and use of energy-efficient equipment and appliances; and

• the transaction costs barrier which relates to the significant costs involved in acquiring adequate information about energy-efficient options – this may give rise to market failure barriers such as imperfect information.

However market failures (in this case manifesting as a lack of investment in profitable energy efficiency) seem to be caused by much more than the identified barriers. This chapter of the report investigates aspects of so-called ‘institutional barriers’, including organisational impediments, cultural issues, and personal preferences. Together these constitute what could be described as ‘organizational decision making’. Often they will act to reinforce the effects of other barriers; sometimes they are a dominant force in themselves. While their effects are difficult to quantify, it is important to appreciate the nature of the problem.

Overview of the End-Use

The purpose of this chapter is to provide some background to enable further exploration of the possible reasons for unrealized profitable energy efficiency investments evident in many economic sectors in many countries. The chapter is not meant to be an academic thesis on the sociology of rational decision making, nor a quantification of how much energy is wasted through organizational decision making. Rather, the reader will find an outline of some approaches to the problem, issues to be resolved and guidance for methodology development.

The primary audience for this material comprises energy efficiency stakeholders who would like to gain further appreciation of the complexities of realizing energy efficiency within firms and the significant role of unquantifiable factors. This audience could include: programme managers who would like to better understand how an energy efficiency application will be received in the broader market; policy analysts needing an appreciation of barrier variations across market sectors; or energy performance contractors seeking market intelligence for targeting their approach to specific customers.
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Many (but not all) governments stipulate that market intervention through measures to promote energy efficiency should be predicated by evidence of market failure, even if the technical potential for energy efficiency is documented as being large. Policy and regulation are not free, and their design should be supported by quantification as much as practicable.

To identify the occurrence of market failure, three questions can be asked about a firm that fails to implement profitable energy efficiency measures: is the firm able to act to maximize its economic benefits, able to undertake profitable energy efficiency and aware of the benefits and costs of taking such actions? If the answer to all these questions is ‘no’, then classical market failure caused by the principal/agent barrier and/or the transaction costs barrier has occurred. If the answer to all three questions is ‘yes’, and the firm still fails to implement profitable energy efficiency measures, then other more complex factors are at play, including the possibility that organizational decision making is having an influence on the firm’s prima facie economically non-rational behaviour.

Characterization of the Transaction

The context for the following discussion of organizational decision making is the selection criteria specified for the case studies presented in other chapters, namely that they should:

- apply to all countries participating in the IEA Energy Efficiency Project;
- exhibit “true” barriers to energy efficiency;
- be capable of being quantified; and
- be associated with significant energy use.

In the other case studies, the key question is whether clearly identified market failure logically arises from one or more of the classical barriers to energy efficiency (principal / agent and transaction costs). This is significant from a public policy perspective because the relevant barrier dictates the targeted intervention that could be employed. In contrast, organizational decision making tends to cut across considerations of specific barriers and its impact is very difficult to quantify.

Further, whereas in other cases policy mechanisms can be clearly targeted at the removal of identifiable barriers, organizational decision making is most appropriately addressed indirectly eg better delivery of information; third party sharing of performance risk and so on. Structural change of management to directly deliver better energy efficiency outcomes is not on the policy agenda in market economies.

Organizational decision making that leads to a successful, albeit energy inefficient, firm is not easily characterised as an example of market failure. In fact, applying this label to energy inefficient but otherwise successful firms could well be regarded as being unfair. In many ways the firm can be regarded as analogous to the wider economy within which it operates – often the organizational structures in place are based more on history than current logic and exist to get a job done, and the barriers to real progress often contain elements that are both universal and firm-specific.
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Description of the Barrier, the Actors, and the Transactions Between Them

Firms in all countries display different types of organizational structures (for economic and other reasons) that can be categorized into two main classes – mechanistic structures such as functional, product and geographical types, and organic structures such as the organizational matrix. Given that the nature of a specific business can differ markedly from country to country, to compare results about decision making between countries or regions it may be useful to categorize results according to these different types of firm organizational structures.

For each type of organizational structure there exist a number of generic management and cultural issues (see Table 1) that can impact the decision making process for proposals to implement energy efficiency. In some cases these issues mimic the behavioural barriers identified in energy efficiency studies, eg the influence of bounded rationality. In other cases, the issues act to reinforce the effect of the behavioural barriers to energy efficiency being considered, eg sectional goals at the expense of firm-wide goals.

Gruber and Brand (1991) point out that in some sectors there are quite general reasons why profitable energy efficiency measures are not pursued. Bakeries, for example, need to give priority to the ‘salesroom’ and hence the shop fit-out claims priority for investment capital. Smaller firms involved with meat production are mainly interested in cost reduction to compete on a daily basis with their larger competitors - and this is achieved most easily by cutting labour costs. Firms involved with perishable foods, for example dairies, will not take any risks with product quality or undisturbed and secure production.

At the individual firm level there also exists the informal or semi-formal structures within the firm – such as trade associations, sporting and social clubs and so on - that can enhance or constrain the ability of a firm to embrace new concepts. Similarly, at the individual employee level there can be issues related to trust, attitude to risk, stress, fears and anxieties, social interactions, and factions and politics that can significantly influence a key employee’s attitude to the business of the firm. It is expected that the influence of these issues may average out over a number of firms – however, a situation such as fear of an economic recession may create negative mindsets that are pervasive and not captured at the firm structural level.
Table 1. Organizational Structures of Firms

<table>
<thead>
<tr>
<th>Organizational structure</th>
<th>Characteristics</th>
<th>Common generic management and cultural issues</th>
<th>Decision making hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td>Division of work is paramount; jobs and activities are grouped together into departments or sections; clear discrete functions; concentrations of specialist expertise</td>
<td>Sectional goals at the expense of firm-wide goals</td>
<td>Department manager (technical services, finance etc) CFO / General Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sections resistant to any change, because of the separation from the customer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coordination between sections onerous and not well defined</td>
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<tr>
<td></td>
<td></td>
<td>Perception of a wide gap between ‘top and bottom’ levels of the firm</td>
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<tr>
<td></td>
<td></td>
<td>Duplication of functions between sections and consequent negative effects of competition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of strong central control over each separate section</td>
<td></td>
</tr>
<tr>
<td><strong>Product or process orientation</strong></td>
<td>Reflects the different types of materials handled or processes undertaken; used by complex organizations to encourage specialist expertise</td>
<td>Sectional goals at the expense of firm-wide goals</td>
<td>Manager (retail sales, networks etc) CFO / General Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duplication of functions between sections and consequent negative effects of competition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coordination between sections onerous and not well defined</td>
<td></td>
</tr>
<tr>
<td><strong>Geographical</strong></td>
<td>Branches working as autonomous units; head office provides some support services but is not involved in the daily running of the business</td>
<td>Conflict between area and central management</td>
<td>Area branch manager CFO / General Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duplication of resources and functions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coordination between sections onerous and not well defined</td>
<td></td>
</tr>
<tr>
<td><strong>Matrix – task force</strong></td>
<td>Based on project groups drawn from various departments; flexibility to meet unforeseen challenges; employees gain a wider understanding of a firm’s needs</td>
<td>Pressures on management to deal with increased complexity (including of the management hierarchy) and greater co-operation</td>
<td>Project leader and / or department manager CFO / General Manager</td>
</tr>
</tbody>
</table>

*Case Study: Organizational Decision Making*
Case Study: Organizational Decision Making

Energy Use Affected by the Barrier

Following are key questions that can identify ‘sub-optimal’ organizational decision making.

| Can cases be identified where it is reasonable to expect implementation of profitable energy efficiency measures but those measures have not been implemented? |
| Is this lack of action adequately explained by market failures operating at the economy-wide level (rather than at the firm level) as a result of classical barriers such as a lack of information or financing and risk issues? |

Sæle et al (2005) interviewed seven Norwegian companies that had not yet implemented energy efficiency measures two years after deciding to do so based on a technical and economic analysis of the measures. The analysis had been offered to 40 companies, 20 of which had decided to implement energy efficiency measures. The goal of this study was to investigate the reasons for not implementing the actions, rather than the usual approach of highlighting ‘success stories’. Results suggested that the major impediments within the firms were information overload, bad timing, lack of appropriate address for the information and uncertain responsibility for action. Aspects of financial management systems such as lack of ready access to investment funds and aversion to poorly understood cost items were also flagged as being important.

In a telephone survey of 500 German firms Gruber and Brand (1991) found that only 40% to 60% of energy efficiency measures discussed with the firms were implemented. The authors concluded that further initiatives could not be expected without serious efforts to motivate firm managers.

Anderson and Newell (2002) evaluated the decisions of firms that had been provided with energy audits through the US Department of Energy Industrial Assessment Centers programme and found that about one half of the recommended measures had been adopted. In particular they reported that while firms responded as expected to financial factors – payback periods, implementation costs, annual energy savings, energy prices – this could not explain the situation in total. There was evidence that the firms were more responsive to implementation costs than annual savings, and to energy savings rather than to energy prices. Payback periods of two years or less were demanded and other barriers (including those defined as organizational) were described as not playing a large role in rejecting information provided under the programme.

The historic decrease in specific energy consumption and the effect of possible energy efficiency measures were investigated for the building materials industry in The Netherlands by Farla and Blok (1995). They found that unrealized energy efficiency investments were a consequence of barriers such as the long lifetime of equipment in the sector, fear of decreased product quality and doubts about the technical feasibility of the measures. They found that lack of information did not play an important role in preventing measures from being implemented and financial barriers such as stringent investment criteria also did not play a large role.
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Hansen and Lund (2002) looked at strategies for optimizing companies’ energy management through employee involvement. In particular they sought to identify the factors crucial to successful integration of a new energy management system, where in the system the most effective results could be obtained, and what methodologies had been adopted. The results of their work with 14 Danish companies showed that implementation of an energy management system is not a guarantee that employees will become involved. Four factors are important for this to occur:

- the existence of change agents, particularly persons in addition to the person in charge of energy;
- managerial behaviour, including: committing to energy efficiency as a legitimate part of the business, establishing communication channels with employees, and realistically allocating time and money to energy efficiency measures;
- the effective organization of production and responsibility for energy management incorporating such things as horizontal networks, delegation of responsibility to production groups and line management commitment; and
- knowledge management through skills development, acceptance of change and internal liaison.

The New South Wales (Australia) Department of Energy, Utilities and Sustainability together with a communications consultant (Impact Employee Communications) explored a communication-driven approach to reducing energy consumption (rather than energy efficiency investment) within a large manufacturing firm. Of particular interest were the way that employee behaviour influenced consumption and how employees could be engaged and involved in the identification and implementation of energy saving ideas. The project – the Green Light Communication Program - identified a number of staff-related barriers to success: largely non-English speaking backgrounds, cynicism, previous failure, unions, self interest, lack of environmental appreciation, and concerns about both safety and productivity losses. The approach to overcome these barriers was:

- developed in consultation with the unions and the environmental committee;
- promoted an internal brand “Green light: bright ideas for a green future”;
- gathered support from a wide range of key stakeholders from management to the factory floor;
- provided education, training and guidelines regarding desired behaviour changes; and
- communicated and celebrated outcomes.

Early results from the project saw staggering energy savings during off-peak times – energy reductions of 30% overnight and 70% on weekends. It was also reported that organizational culture became more positive and that employees were applying the ideas away from the workplace.
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Description of Data Sources, including Limitations

Energy data and information about organizational behaviour are readily available in many countries and can be used to gain an understanding of the role of organizational decision making in limiting investment in profitable energy efficiency. Using available information often provides a compromise between usefulness to the analyst and the cost associated with more comprehensive approaches. Readily available – but not necessarily fit-for-purpose - data may include government or utility-funded end-user energy efficiency and/or demand reduction programmes. In these cases the usefulness of the data may be limited unless the end-users were asked specifically why they have not already implemented the energy efficiency measures being considered.

Further analysis of one such dataset was carried out for this case study. The dataset was obtained from a study that investigated the potential to reduce electricity demand in the Sutherland and St George regions of Sydney, Australia (the St George study). The study was carried out in late 2004 and early 2005 by the New South Wales (Australia) Department of Infrastructure, Planning and Natural Resources, transmission utility TransGrid and distribution utility EnergyAustralia. The St George study was part of the larger Demand Management and Planning Project (DMPP) carried out within the Sydney metropolitan region.

The St George study carried out a Level 1 site investigation at each of 125 commercial and industrial customer sites with peak demands lying between 150 kVA and 5,000 kVA (Energetics, 2005). The purpose of these investigations was to identify opportunities for demand reduction, and provide initial indicative (±40%) estimates of the size and cost of these opportunities. Total annual energy consumption for the study sites was calculated from electricity bills as 348,200 MWh which is about 0.5% of Australia’s commercial and services final energy consumption (see Figure 1).

Figure 1. Final Energy Consumption in Australia by Industry
(Source: ABARE 2005)
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The original St George study involved:

- inspection and audit of all major energy-using equipment at each individual customer site;
- discussions with site staff regarding operating times and methods, and levels and types of control exerted over electrical equipment;
- analysis of electrical load profiles for every site to identify key characteristics, followed by discussions with individual customers;
- modelling of electricity use and demand for each site, with estimated electricity use and demand by end use equipment adjusted to fit the known annual electricity usage and peak demand; and, finally
- proposing to the site owner and/or manager the implementation of a range of energy efficiency and demand reduction measures with various payback periods.

Unfortunately this impressive dataset does not reveal the specific reasons why some apparently profitable energy efficiency measures had not been implemented by site managements at the time of the original Level 1 site investigations.

Discussion of the Results

Further Analysis of the St George Study Dataset

A further analysis of the St George dataset was undertaken for both the potential relative energy savings and potential absolute energy savings from building energy management systems (BMS) and efficient motors. Potential explanatory independent variables used in the analysis included:

- the effect of organization size - measured by the total annual electricity consumption - to identify the extent to which organizational resources and transaction costs may influence the uptake of the energy efficiency measures;
- the business model category, to compare the extent to which, at current energy prices, energy efficiency measures capture the interest of the various types of organizations;
- the nature of the business, as above but to check the validity of the business model approach and identify specific cases of interest;
- the simple payback period for the energy efficiency measures originally proposed by the energy auditors, to investigate the extent to which commercial decision making imposes itself on other institutional factors.

Figure 2 shows the results of an analysis of the simple payback period for proposed improvements to building energy management systems (BMSs), and the size of the organization. The horizontal axis indicates the size of the firm as represented by the total annual electricity consumption in kWh. The vertical axis presents the calculated simple
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payback periods (in years) for optimizing or installing a BMS. Data points show recommended BMS measures that were not taken up by the relevant firm.

![Figure 2](image)

Figure 2. Unrealised Opportunities to Optimise or Install a Building Energy Management System: Simple Payback Period versus Size of Firm in the St George Study

From Figure 2, it appears that the larger the firm, the more likely that measures with a lower payback period have already been implemented (relative to the smaller firms). The figure could be said to show the ‘smaller firm’ effects, echoing the findings from Germany (Gruber and Brand, 1991) which indicated that the percentage of realized technical measures increases with the size of the companies (from around 40% for less than 20 employees to 60% for several hundred employees). In the Gruber and Brand study, relevant training was much more likely in larger companies, and larger companies used consultants more often.

Of particular interest are the ‘outrider’ data points (in red in Figure 2), ie the energy efficiency measures with lower payback periods. Why have these opportunities not been pursued? Is it reasonable to assume that the reasons are not economically rational in this area of the diagram? Or do the original data simply overstate the benefits? Studies of individual cases may provide some insights.

Case 1: For a major shopping mall, the payback period on recommended improvements to building energy management may be beyond the limit of expectations, but the technology is low risk and information is readily available concerning various electric cooling and refrigeration measures. Further, the investment required represents about 4% of the annual energy cost and the energy savings amount to about 1% of consumption.
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Case 2: A large pharmaceuticals manufacturer faces a very large up-front investment (about 10% of the annual electricity cost) to improve an HVAC system, but the return is similarly impressive and would save about 4% of total electricity consumption. However a key point is the extent to which measures to improve HVAC efficiencies raises concerns in this industry about the impact on product quality should not be dismissed (also refer to Gruber and Brand, for example).

Case 3: Two clubs (large entertainment centres also serving food and beverages) simply have to review their BMS control strategies to achieve significant cash flow improvements and no risk to their business – with outlays of between 3 and 6% of their annual electricity costs. More obvious similar potentials exist for a small manufacturer and a gymnasium.

Looking at a grouping of firm types rather than the end use opportunity does not provide better clarification. Thirteen supermarkets showed a range of payback periods for various energy efficiency measures (Figure 3a), but there is no obvious relationship between the size of the firm and the payback period of opportunities not pursued (Figure 3b). Similar results are evident for the 11 plastics moulding firms that were analysed (Figures 4a and b).
**Key to energy efficiency measures:** 11 – ventilation 12 – install demand based control 13 – various ventilation controls 14 – various ventilation controls 15 – demand based ventilation 16 – resolve heating / cooling conflicts 17 – VSD on cooling tower fans 18 – VSD on cooling tower fans 19 – demand based control of ventilation

**Figure 3a. Payback Periods for Energy Efficiency Measures in Supermarkets in the St George Study**

**Figure 3b. Payback Periods for Energy Efficiency Measures versus Total Annual Electricity Consumption of Supermarkets in the St George Study**
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Figure 3a. Payback Periods for Energy Efficiency Measures in Plastic Moulding Firms in the St George Study

** Key to energy efficiency measures: 11 – cooling tower fans 12 – chilled water circulation pumps 13 – AC: timer setting and run-on time

Figure 3b. Payback Periods for Energy Efficiency Measures versus Total Annual Electricity Consumption of Plastic Moulding Firms in the St George Study
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With some significant assumptions, there were some useful conclusions that could be drawn from the further analysis of the St George dataset:

- without knowing an individual firm’s investment criteria it was not possible to accurately determine whether the lack of investment constituted market failure; and
- creating a proxy payback requirement for the firms may simply distort the issues of concern.

Moreover, the authors of the original St George study concluded that the principal barriers to the implementation of the energy efficiency measures were the economic performance of the measures, availability of capital and human resources, and information on best-practice end-of-life replacement technologies. These were regarded as more significant than any cultural factors.

St George Follow Up Studies

During late 2005 and early 2006, the Demand Management and Planning Project (DMPP) commissioned follow up studies to the original St George study. The follow up studies included:

- investigating the extent to which the recommendations made in the original study had been taken up via telephone interviews with many of the original 125 customers sites;
- carrying out “Level 2” detailed investigations at 15 of the original 125 customer sites to verify high potential opportunities identified in the Level 1 investigations;
- facilitating and providing financial assistance to demonstration projects at selected customer sites.

DMPP commissioned a consultant, Sinclair Knight Merz, to review the results of both the original St George study and the follow up studies (Sinclair Knight Merz, 2006).

Take-up of Original Recommendations

Telephone interviews with contacts at 89 of the original 125 customer sites showed that:

- at 74 sites (83%) the contact remembered reading the report (in other cases, the report may have gone to another person at the organisation, or not been read);
- at 50 sites (63%) the report was read by senior management at the site;
- 105 out of 338 (31%) of identified demand reduction opportunities\(^1\) had already been implemented\(^2\);

\(^1\) There were multiple demand reduction opportunities at many sites.

\(^2\) Sinclair Knight Merz commented that this self-reported incidence of take up of demand reduction opportunities is inconsistent with their understanding of typical levels of implementation. SKM considers that this figure is likely to significantly overstate the actual number of opportunities taken up.
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- 47 out of 338 (14%) of identified opportunities were intended to be implemented in the future;
- 186 out of 338 (55%) would not be implemented for the following reasons:
  - do not understand the opportunity (1 = 0.3%)
  - not core business (8 = 2%)
  - inability to secure funding (9 = 3%)
  - not a high priority (20 = 6%)
  - high payback period (38 = 11%)
  - other reasons (110 = 33%).

Level 2 Investigations

The results of the Level 1 investigations were used to identify and target a number of sites for more thorough Level 2 investigations, in order to determine the technical practicality and viability of identified demand reduction opportunities, and to develop more accurate estimates of the size of potential demand reductions and implementation costs.

Level 2 investigations were carried out at 15 of the original 125 sites by different consultants from those who carried out the Level 1 investigations. Whereas Level 1 investigations were intended to develop estimates to within ±40%, Level 2 estimates were intended to be within ±20%. Changes in the estimates of the size of potential demand reductions and the capital costs of implementing these measures are shown in Table 1 below:

<table>
<thead>
<tr>
<th>Demand Reduction Measure</th>
<th>Level 1 Investigation</th>
<th>Level 2 Investigation</th>
<th>Comparison (% change L2 from L1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All kVA</td>
<td>Attractive kVA</td>
<td>Average cost ($/kVA)</td>
</tr>
<tr>
<td>Energy efficiency</td>
<td>4,958</td>
<td>2,698</td>
<td>$1,398</td>
</tr>
<tr>
<td>Power Factor Correction</td>
<td>7,325</td>
<td>4,659</td>
<td>$157</td>
</tr>
<tr>
<td>Standby generation</td>
<td>15,727</td>
<td>6,020</td>
<td>N/A</td>
</tr>
<tr>
<td>Load shifting</td>
<td>10,205</td>
<td>8,257</td>
<td>N/A</td>
</tr>
<tr>
<td>Fuel switching</td>
<td>5,068</td>
<td>189</td>
<td>$1,229</td>
</tr>
<tr>
<td>Total</td>
<td>44,083</td>
<td>21,823</td>
<td>$347</td>
</tr>
<tr>
<td>Total demand of surveyed</td>
<td>86,635</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sites</td>
<td>% demand reduction</td>
<td>51%</td>
<td>25%</td>
</tr>
</tbody>
</table>

* Attractive demand reduction opportunities were defined as having simple payback periods less than four years.

** Costs are in 2006 Australian dollars (AUD).
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In the Level 2 investigations, estimates of the size of the identified demand reductions were generally significantly lower than the estimates in the Level 1 investigations, and the estimated implementation costs were very significantly higher. The exception was Power Factor Correction measures, where the Level 1 estimates were reasonably similar to the Level 2 estimates of both the size of demand reduction and the implementation cost.

Demonstration Projects

The following descriptions of attempts by DMPP to implement demand reduction demonstration projects are taken from Sinclair Knight Merz (2006).

Warehouse lighting dimming project

A warehouse was partially retrofitted with a fluorescent light dimming system to test and demonstrate the effectiveness of the dimming systems.

Three dimming units were installed to provide dimming for approximately 15 kW of fluorescent lights, of a total fluorescent lighting load of around 60 kW. Measurements of power and light levels were taken with and without the dimming units to determine the impact of the units.

The tests found energy and demand savings of some 28% with the dimming units operational. The installation did not degrade the site power factor (it improved marginally). Light levels decreased by <4%, but were still above what was required by Australian Standards and company OH&S policies.

The savings results confirmed the Level 1 investigation estimates for this opportunity. DMPP facilitation and implementation costs for this project were AUD3,000, comprising internal resources spent facilitating the project, and consultants engaged to conduct the evaluation.

Multi-unit residential lighting dimming project

A multi-storey residential development was partially retrofitted with mini compact fluorescent reflector lamps that replaced standard dichroic (tungsten halogen) downlights. The lamps were used in internal passageways that have no natural light and operate 24 hours a day, seven days per week.

The Level 1 investigation identified this opportunity, with a capital cost of AUD10,000 and payback period of two years. DMPP decided to pursue this opportunity as a demonstration project, with the potential to be replicated at other multi-unit residential developments throughout Sydney.

DMPP assisted the project through facilitation and testing of a pilot installation of the new efficient alternative lamps for downlights. The first approach to the building manager, who was keen to be involved, took place in August 2005, and it was agreed to do a pilot installation of the compact fluorescent reflector lamps on one floor, with the lamp supplier to supply the five lamps required to retrofit one floor, and DMPP to engage a consultant to conduct photometric testing.
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A proposal was developed in consultation with the lamp supplier, building manager, and DMPP which was completed in October 2005 and referred to the residents executive committee and then body corporate for approval. The proposal was approved in late December.

DMPP facilitation for this project included negotiations with the various parties, engaging the lighting consultant, assisting the lamp supplier and building manager to develop a business case, and attendance at executive committee and body corporate meetings. The time taken for approval to conduct a pilot installation of five lamps was some four months and 30 hours of DMPP facilitation time, with the support of an enthusiastic building manager. While this might seem excessive, in SKM’s experience it is not atypical of the time and effort involved in facilitating such projects, which would generally not occur otherwise.

Following installation of the five lamps in January 2006, a lighting specialist conducted tests in February 2006 to ensure light levels required by the Australian Standard were being maintained. These photometric tests revealed that the new lamps were not providing adequate illumination to the requirements of the relevant Australian Standard (which measures light level and uniformity at floor level). Because the compact fluorescent reflector lamps had a broader beam than the standard dichroic lamps, they tended to provide more even illumination and better lighting of walls (which was noted positively by residents), but not enough light on the floor to meet the level required.

It was decided with the building manager to conduct further tests with brighter 11W compact fluorescent lamps that can be fitted with an external reflector, as it was felt these may be able to meet the required light levels. However, during development of this alternative proposal, the building manager resigned and the project was placed on hold for several months until a new building manager was engaged and familiarised with the history of the project. It was subsequently discovered that the larger 11W lamps would require new larger fittings, which would prevent the site from reverting to the original fittings and lamps if they were not satisfied with the trial. At this point the new building manager decided not to proceed further with the trial.

Overall, the project took some nine months and AUD6,000 of DMPP facilitation and consultant costs, before it was determined the project was technically unviable (ie the building manager was unwilling to incur further time and cost in exploring viable alternatives). This highlights the practical difficulties faced in implementing energy efficiency projects, and the relatively high level of transaction costs incurred.

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3 Transaction costs include the time and effort required both by the party implementing the project (DMPP), and also the host site, for tasks such as developing a specification and business case, seeking approvals, and arranging for implementation of the project.
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Lighting and HVAC projects at clubs

Level 1 investigations found four clubs (large entertainment venues which also sell food and beverages) where similar lighting and HVAC efficiency and demand reduction opportunities were identified.

DMPP decided to pursue these opportunities as demonstration projects, that could be replicated in other clubs throughout Sydney. Level 2 investigations were commissioned, and further facilitation work undertaken to engage the club management regarding implementation of financially attractive options and development of business cases for these investments.

Total DMPP costs over three months were AUD8,000 for facilitation, meetings with club management, development of business cases, and engagement of consultants to conduct Level 2 investigations (AUD4,000).

At the conclusion of this three month period, it was determined that some of demand reduction opportunities identified in the Level 1 investigations were not technically viable, and others were either confirmed or found to have longer payback periods. Given limited interest from the clubs to implement even projects with attractive payback periods, it was decided not to further pursue facilitation of these projects, and no actual implementation of demonstration projects proceeded.

Conclusions from the St George Study

In the St George study, the original Level 1 site investigations identified significant numbers of apparently profitable demand reduction opportunities that had not been taken up by site managements at the time of the investigations. Information obtained from the follow up telephone surveys suggested that a relatively high 31% of identified opportunities were taken up subsequent to the investigations. However, there is some doubt about whether this self-reported information actually significantly overstated the actual number of opportunities taken up.

The follow up Level 2 investigations at 15 of the original 125 customer sites showed significant discrepancies as compared with the original Level 1 investigations. It appears that over-optimistic conclusions were drawn in the Level 1 investigations with respect to the technical practicality and financial viability of the identified opportunities. In the Level 2 investigations, estimates of the size of potential demand reductions were, on average, only 39% of those claimed in the Level 1 investigations. Estimates of implementation costs in the Level 2 investigations were, on average, more than twice those in the Level 1 investigations and only about one-half of the opportunities originally identified were actually attractive in terms of the payback period being less than four years.

Finally, the attempts by DMPP to facilitate and provide financial assistance to demonstration projects at selected customer sites showed that actually implementing demand reduction measures was more complicated than originally envisaged and additional transaction costs could be quite high.
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These results suggest that, in the St George study, the initial low take up of apparently profitable demand reduction opportunities identified in the Level 1 investigations may not have been an example of market failure. In fact, the opportunities were not as commercially attractive as they initially appeared to be. However, it is unlikely that managements made active decisions to not take up demand reduction opportunities at their sites. It is more likely that the innate conservatism of organisational decision making actually resulted in outcomes which were not far from being economically optimal.

Results from Other Similar Studies

An understanding of the interaction of four key factors was identified by Sæle et al (2005) as able to explain why energy efficiency fails to achieve a higher priority in the firm decision making process:

- how the results of energy auditing were received. An audit document can be yet another item of business in a busy day, may be outside the technical experience of staff or may simply not reach the right person (if indeed they exist). Even if none of the preceding apply, the timing may simply be wrong;

- the person responsible for making things happen. Is there a person or team nominated to handle matters such as energy efficiency? Does the top executive have a role with regard to energy efficiency;

- the impact of the firm’s economic management. An adverse impact on investment in energy efficiency is highly likely where budget processes are complicated, there is strong aversion to financial risk, the financial benefits are not tangible and electricity price movements are not visible;

- the decision making structure of the organization (as outlined in the previous section). Interestingly, there may be some balancing considerations; while a large organization may have to take decisions through multiple levels in the organization (compared with the smaller firm) these larger organizations are also often willing to accept longer payback periods for energy efficiency investments.

A confidential survey carried out by the Australian (federal) Government of twelve major firms operating in Australia revealed a number of similarities between their approaches to energy efficiency despite their different operations and a number of barriers, sometimes at the firm level, which provides an obvious challenge for any policy response. On the positive side, awareness of energy efficiency tends to be high across the whole firm, and is often incorporated in training practices; investment decision-making structures are not perceived to act against energy efficiency per se; examples of successful case studies are very attractive and valued. However, energy efficiency does not rate highly on a list of competing priorities within a firm; energy efficiency investment options do not necessarily come with the standard information required by some decision makers; and, although good on paper, some options do not fit the firm’s requirements at that point in time (resources, priorities etc).
Gruber and Brand (1991) specifically noted that more information was not required, rather “a group-specific approach to the design of the information”. They commented that there was no need for special brochures or seminars but that existing channels – trade literature and meetings – should be harnessed. Straighforward and low-risk access to qualified assistance and appropriate third party resources is seen as fundamental. Government has a significant role in underwriting this required confidence in the external expertise. Work carried out in Australia on designing a training program for energy assessors (auditors) indicates that (often behavioural) issues surrounding the client / auditor interface can be quite challenging.

The four factors identified by Sæle et al (2005) appear to be fundamental to any serious investigation of organizational decision making, whether the investigation is empirical (as presented earlier for the St George study) or an attempt to model the impact of organizational decision making. This modelling approach has not enjoyed success to date but is attractive as it can save the cost of expensive market surveys, allows for economy-wide estimates of the affected energy consumption, and is appealing to economists and policy-makers who seek algorithms and quantification.

A large body of work has been published regarding empirical investigations of behaviour relating to energy savings. Pedersen (1997) presents an extensive bibliography (more than 90 references) on this topic. Pedersen investigated whether a theoretical approach involving new sociological institutional theory could supplement the neoclassical economic approach that does not adequately explain decisions (or lack of decisions) that are not linked to profitability. Institutional theory takes into consideration that decision making is often founded on imperfect information and that people are affected by their social and institutional environment. Pedersen explains that, in neoclassical economic theory, rationality dictates choices that optimize the amount of utility given the actor’s beliefs and desires; decisions are believed to be well-informed, and there is no distinction made between reality and perception. On the other hand the sociological perspective focuses on beliefs and desires, and considers where preferences come from and how they change. The economists’ rational perspective sees institutions as external to the individual while the sociological perspective sees the institution as structuring meaning, framing actions and affecting behaviour. Pedersen concluded that, from a theoretical perspective, new institutional theory can indeed supplement the neoclassical economic approach, but that further empirical work is required.

Gillissen (1995) commented that studies of the impact of barriers and failures at the micro (individual firm) level are scarce. He proposes a three phase conceptual model with an underlying statistical model. Specific variables affect the decision making outcome at each step – information gathering, economic evaluation and implementation decision. Those variables with a negative effect are barriers to energy efficiency for that particular firm. Gillissen concluded that:

- during the information gathering phase, the main barriers are the priority given to costcutting projects, and the complexity and inaccessibility of new technologies;
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- during the economic evaluation phase, concern about costs and uncertainty about future prices act to increase the objective payback period (representing risk assessment);
- the implementation decision is hampered by few barriers such as lack of capital and an inflexible depreciation strategy, but is implicitly affected by the variables in the economic evaluation phase (with both these phases being dependent on the outcome of the information gathering phase).

Martin et al (1999) proposed a model to describe the individual firm’s energy efficiency decision making process over time. The model provides seven stages of decision making:

- no energy saving decision making;
- initial efforts;
- programme implementation;
- programme direct effect;
- routinization of programme;
- inculturation of programme; and
- steady state.

Throughout the process, the relative magnitude of four factors can be described: total number of opportunities, number of decisions analyzed, number of decisions that should be implemented and actual implementations. With progress through the stages the number of opportunities steadily decreases and the remaining three factors firstly increase and then decrease. Martin postulated that government energy efficiency programmes (if appropriately targeted) will accelerate the firm’s progress through the seven stages.

Summary and Conclusions

Active strategies to promote increased energy efficiency within a firm (such as targeted employee communications campaigns, focus groups and so on) are unlikely to be a low cost option. Modelling firm behaviour as the basis for these strategies has some appeal but only if it can be clearly demonstrated that the model results are realistic. A number of approaches show some promise – the bottom line being that there should be a very clear understanding of the scope of the problem to be addressed before selecting an approach.

Issues of Importance for the Case Study

For most firms, energy efficiency does not feature as a business priority at current energy price levels. Consequently, the term ‘market failure’, while having significance for economists and academics, places an unfair label on successful, but energy inefficient, firms whose priorities for the capital budget may lie in other directions. There may simply be much less risky ways of improving the firm’s cash flow situation.
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Many government programmes that encourage energy efficiency are already addressing organizational decision making by default. This may not have been a primary consideration when a particular programme was designed, but it usually soon becomes obvious that moving beyond a certain level of energy savings, particularly in a low energy price environment, requires cultural change in firms. An example is Australia’s Energy Efficiency Best Practice Programme which saw an evolution from its initial focus on benchmarking and information, to concentrate more on innovation and capacity building.

Insights from the Case Study

The approaches discussed in this chapter may help to identify organizations that may be worth interviewing about their decision making processes. The most useful approach to understanding and attempting to quantify organizational decision making is to survey companies that have been informed about cost-effective energy efficiency measures, may have agreed to implement the measures, and have then failed to do so.

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