The Energy Efficiency Gap – market failures and policy options

Prepared by Allen Consulting Group
November 2004

Commissioned by ICANZ

ICANZ
THE RIGHT INSULATION MATTERS

The Allen Consulting Group

The Allen Consulting Group Pty Ltd

ACN 007 061 930

Melbourne

4th Floor, 128 Exhibition St
Melbourne VIC 3000
Telephone: (61-3) 9654 3800
Facsimile: (61-3) 9654 6363

Sydney

3rd Floor, Fairfax House, 19 Pitt St
Sydney NSW 2000
Telephone: (61-2) 9247 2466
Facsimile: (61-2) 9247 2455

Canberra

Level 12, 15 London Circuit
Canberra ACT 2600
GPO Box 418, Canberra ACT 2601
Telephone: (61-2) 6230 0185
Facsimile: (61-2) 6230 0149

Perth

Level 21, 44 St George's Tce
Perth WA 6000
Telephone: (61-8) 9221 9911
Facsimile: (61-8) 9221 9922

Brisbane

Level 11, 77 Eagle St
Brisbane QLD 4000
PO Box 7034, Riverside Centre, Brisbane QLD 4001
Telephone: (61-7) 3221 7266
Facsimile: (61-7) 3221 7255

Online

Email: info@allenconsult.com.au
Website: www.allenconsult.com.au

Contents

Executive summary

This report was commissioned by the Business Council of Sustainable Energy (BCSE), the Australasian Energy Performance Contracting Association (AEPCA), and the Insulation Council of Australia and New Zealand (ICANZ), to assess whether there is a rationale for policy intervention to improve investment in energy efficiency in the stationary energy sector in Australia.

Project objectives

The objective of this report is to identify, for the stationary energy sector, the:

- extent of the 'energy efficiency gap';
- barriers and failures in the markets for energy and energy services that might be contributing to the energy efficiency gap;
- policy options to address market failures that are impeding cost effective investment in energy efficiency; and
- costs and benefits of overcoming the energy efficiency gap.

Defining energy efficiency

Energy efficiency for the purposes of this report is defined as maintaining or increasing the level of useful economic output delivered per unit of energy consumption. In this context, this report considers whether cost-effective reductions in energy consumption are available given existing levels of economic output, or alternatively, whether cost effective increases in economic output are available given existing levels of energy consumption.

This definition of energy efficiency leads us into an understanding of the ‘energy efficiency gap’. The energy efficiency gap is defined as the potential energy efficiency that is precluded by the possible existence of market failures. The existence of market *failures* by definition implies that there is potential for cost effective policy to overcome the market failure and thereby improve economic welfare. In contrast, there are also market *barriers* impeding uptake of energy efficiency that are common to other markets in the economy, which are not amenable to policy intervention.

Key market and organisational failures impeding uptake of energy efficiency

A range of barriers in the market for energy efficiency are identified (Table ES.1). In addition, there are also barriers in the market for energy, which is a key substitute for investments in energy efficiency. To the extent that policies are available to reduce these barriers in a cost effective manner that raises overall economic welfare, then the barriers can be considered to be market failures.

Table ES.1

BARRIERS IN THE MARKET FOR ENERGY EFFICIENCY

Category	Particular instance
Barriers that may represent market failures	• Public good attributes of information associated with energy efficient technologies • Positive externalities of adopting energy efficient technologies • Adverse selection in energy services markets • Moral hazard & principal-agent relationships in energy services markets • Split incentives in energy services markets
Barriers that may represent organisational failures	• Imperfect information on organisational energy use • Moral hazard & principal-agent relationships within organisations • Split incentives within organisations
Barriers that may represent rational behavior	• Heterogeneity • Hidden costs (e.g. overhead costs, disruption) • Risk (technical or business) • Access to capital

Source: S.Sorrell, J.Schleich, S.Scott, E.O'Malley, F.Trace, U.Boede, K.Ostertag and P. Radgen, 2000, *Barriers to Energy Efficiency in Public and Private Organisations*, SPRU Environment and Energy, www.sussex.ac.uk/Units/spru/environment/research/barriers.html, p26.

Key market or regulatory failures warranting consideration for policy intervention to improve uptake of energy efficiency include:

Related to issues of incorrect relative prices:

- Incorrect relative prices in markets for energy:
  - Regulated energy prices set below the incremental costs of generation, transmission and distribution, particularly for peak loads;
  - Inadequate institutional arrangements for considering energy efficiency as an alternative to network augmentation;
- Lack of incorporation of externalities in energy pricing;

Not related to issues of energy prices:

- Information failures;
  - Imperfect information, including under-provision due to public good aspects;
  - Asymmetric information, including adverse selection;
  - Principal/agent problems, including split incentives;
- Multiple decision makers;
  - Firm/agent external organisational constraints; and

– Firm/agent internal organisational and bounded rationality constraints.

Policy options for energy efficiency

Good policy should aim to close the energy efficiency gap by addressing market failures at source, cost effectively. In light of the key barriers outlined above, policies therefore could aim to:

- ensure appropriate relative prices;
- overcome information failures;
- reduce organisational barriers and bounded rationality preventing uptake of cost effective energy efficiency.

Relative prices

Improving relative price signals for energy efficiency relates largely to improving the price regulation of the supply of energy, however, policies to address environmental externalities are also important. Key measures include:

- more efficient price signals for the consumption of energy, particularly congestion pricing;
- improved processes and incentives for consideration of load management as alternatives to network expansion; and
- incorporating environmental externalities related to greenhouse gas emissions in energy prices.

Improved congestion pricing, and load management as an alternative to network augmentation, are judged to have relatively small impacts on uptake for energy efficiency. Nevertheless, there are valid reasons for undertaking these measures on other grounds (for example, more efficient markets for energy through load shifting, better network capital utilisation etc).

Policy action to address the environmental externalities of greenhouse has potential to increase average energy prices and result in improved energy efficiency. Nevertheless, while large energy users are likely to respond reasonably efficiently to changes in relative prices for energy, smaller users may not — to the extent that there are other non-price market failures impeding uptake of energy efficiency.

Information failures

Markets for energy are susceptible to information failures. As a result, end users lack awareness of many cost effective opportunities. The most powerful and direct policy mechanisms to address information failure include:

- government funding for information provision;
- energy performance disclosure;
- codes and standards; and
- transforming markets, including developing an energy services industry.

The existence of information gaps in relation to energy efficiency is well accepted. As a result, all the policies measures outlined above to encourage information provision — bar policies to specifically develop an energy services industry — already have been adopted within Australia. Given their low cost and utility in directly addressing information failure and bounded rationality, they should continue to be part of any package to optimise investment in energy efficiency.

Organisational failures and bounded rationality

Individuals (and by extension also firms) can lack the capacity to assess energy efficiency opportunities adequately due to problems of bounded rationality.[1] Firms can also suffer from organisational failures due to a lack appropriate systems and incentives for considering energy efficiency opportunities. High transactions costs associated with implementing energy efficiency also contribute to the lack of uptake.

'Transforming the market' for energy efficiency services and products has the potential to deliver cost effective demand side alternatives. Market transformation policies would aim to achieve a self-sustaining change in end-users' ability to implement cost effective investments in energy efficiency. An external industry supplying energy efficiency services could be an important part of this policy strategy, reducing transactions costs and therefore helping to overcome both internal and external organisational constraints.

However, the primary barriers to energy efficiency originate in a lack of awareness, bounded rationality and inappropriate incentives structures for firms and individuals. The range of secondary market failures related to inappropriate relative prices compounds these problems.

Optimal policy approaches for energy efficiency should target these primary market failures, thereby raising demand for energy efficiency services. With demand for energy efficiency established, it is likely that the supply of energy efficiency services could expand readily to meet the increased demand.

Key mechanisms to address firms' and individuals' behaviour include:

Voluntary mechanisms

- voluntary agreements for energy efficiency;

Price based mechanisms

- tax exemptions or subsidies for energy efficiency products;
- subsidies for energy services delivery and market transformation.

Regulation (control) mechanisms

- minimum energy performance standards (MEPS);
- government leadership;
- mandatory energy efficiency audits and implementation requirements; and
- tradable energy efficiency targets.

[1] 'Bounded rationality' refers to the limits individuals have in formulating and solving complex problems and in processing information.

Voluntary agreements, MEPS, government leadership and the mandatory audits/implementation approach work to directly influence end user behaviour. However, voluntary agreements and the mandatory audits/uptake approach are less suitable for smaller consumers. Nevertheless, both these policies can be considered as mechanisms to improve energy efficiency outcomes for larger companies.

MEPS are a key option to address directly the identified awareness and bounded rationality problems of smaller end users. However, while MEPS are important, they do not help to change the underlying organisational and behavioural failures. Targeting these failures directly for smaller consumers is difficult.

Incentives for energy efficiency offer a second best solution. Key incentive mechanisms include taxes and subsidies for energy efficiency products, subsidies for delivery of energy services to end users, and mandatory sourcing of energy efficiency through energy efficiency targets, for example applied to energy retailers. The latter two approaches can be similar, in that they both can involve an energy charge to raise funds, and then apply the funds to encouraging increased uptake of energy efficiency. However, subsidising delivery of energy services is likely to have lower costs of implementation, be easier to establish, and is likely to be more flexible in response than the mandatory targets approach.

Costs and benefits of improving energy efficiency

In the Australian context, the most recent and comprehensive large scale assessment of opportunities for energy efficiency at current prices are the studies conducted for the National Framework for Energy Efficiency (NFEE). The NFEE phase 2 estimates are extremely conservative. Even at this conservative level, the NFEE studies suggest that there are opportunities to deliver energy reductions within the next decade of around 10 per cent — across the residential, commercial and industrial sectors — at internal rates of return exceeding 50 per cent.

The pay-off is large. General equilibrium economic modelling of the NFEE estimates indicates that the adoption of 50 per cent of the identified energy–saving improvements leads to a range of economic, social and environmental benefits. GDP is just under $1 billion higher than otherwise by year 12, while employment and environmental outcomes are improved (Table ES.2).

Table ES.2

SUMMARY OF ECONOMIC IMPACTS OF IMPROVED ENERGY EFFICIENCY[a]

Macroeconomic variable	*Change relative to base case (year 12)*
GDP ($m)	975
Real Private Consumption ($m)	724
Employment (persons)	2,600
Greenhouse Gas Emissions (Mt of CO_2–e)	–9.5
Energy Use (petajoules)	–75.5

[a] Relates to the *50 per cent – low* scenario.

Source: MMRF–GREEN.

Many studies have suggested that a range of 'hidden' costs serve to reduce these highly favourable investments. For example, a recent comprehensive study by Science and Technology Policy Research Unit at the University of Sussex found that salary overheads for energy managers can be a significant hidden cost, but also questioned whether this practice was rational.

In the case of the NFEE phase 2 estimates, transactions costs of 7.5 per cent were included in the estimates. This, combined with their extremely conservative nature, mean that even if there are significant hidden costs that have not been accounted for, the overall returns are still likely to remain high compared to other standard internal rates of return in the economy. (Recall that the internal rates of return of the identified energy efficiency opportunities are in excess of 50 per cent.) Furthermore, the returns to the economy from the overall expansionary effects of the measures are estimated to add a further 4.5 per cent to the first round savings. This provides a further buffer against 'hidden costs'.

Conclusions and recommendations

Given the diverse market failures outlined above it may be difficult to rely on a single policy instrument to achieve cost effective uptake of energy efficiency. Rather, a package of policy instruments that selectively targets key market failures is required. The utility of the package approach is further supported by the heterogeneous nature of the markets for energy services (residential, commercial, industry and energy-intensive end users).

The following package of policies is likely to offer the most cost effective approach to overcome the energy efficiency gap:

- energy market pricing and institutional arrangements that reward cost effective investments in energy efficiency and provide a signal on the need to address the emerging greenhouse externality;
- information disclosure through labelling and cost effective minimum energy performance standards for appliances, equipment and buildings;
- mandatory energy efficiency audits and uptake for larger firms in the mining, manufacturing and services sectors;
- competitive sourcing of energy efficiency products and services that aims to:
  - increase awareness of opportunities and reduce bounded rationality and organisation barriers, particularly for smaller end users;
  - transform the market to improve the energy efficiency of appliances, equipment and buildings; and
  - reduce transactions costs of adopting energy efficiency goods and services by developing the energy services industry.

Finally, it is a key weakness for policy analysis that most empirical studies of energy efficiency are based on *ex ante* estimates — that do not follow up after the policy has been implemented to establish the extent to which actual savings are achieved, or the costs of implementation. Consequently, there is very little insight into the true extent of hidden costs that might explain the lack of uptake of energy efficiency opportunities. This points to the importance of conducting rigorous follow-up evaluation of actual costs and savings achieved in any future policies or programs, and also the value of identifying what market failures were overcome, and how. The competitive sourcing approach provides the flexibility to pilot sectoral policy approaches, evaluate outcomes — and then fine tune the approaches in response to the success or otherwise in addressing the primary organisational and behavioural failures.

Chapter 1

Introduction

In November 2002 the Ministerial Council on Energy (MCE) endorsed a proposal for the development of a National Framework for Energy Efficiency (NFEE) to define future directions for energy efficiency policy and programs in Australia. This response recognised the need for a significant improvement in energy efficiency in Australia.

The NFEE aims to 'unlock the significant but un-tapped economic potential associated with the increased implementation of energy efficient technologies and processes across the Australian economy to achieve a major enhancement of Australia's energy efficiency performance'.[2]

In August 2004, the MCE agreed to the implementation of nine policy packages constituting the first stage of NFEE, and to the investigation of broad-based incentive measures that could be considered for inclusion in a second stage.[3] The second stage of the NFEE is to be developed in the context of the Productivity Commission's inquiry into energy efficiency, which is due to report in 2005.

The Productivity Commission inquiry into energy efficiency results from a request from the Australian Government for it to examine and report on the 'economic and environmental potential offered by energy efficiency improvements which are cost-effective for individual producers and consumers'.[4] The Commission was also asked to consider the barriers and impediments to improved energy efficiency. The terms of reference for the Inquiry encompass both supply side (electricity generation and other primary energy conversion) and demand side (end use) efficiency. Both stationary energy use and energy used in transport are included in the terms of reference.

1.1 Report objectives

This report was commissioned by the Business Council for Sustainable Energy, the Australasian Energy Performance Contracting Association, and the Insulation Council of Australia and New Zealand to assess whether there is a rationale for policy intervention to improve investment in energy efficiency in the stationary energy sector in Australia. The report will inform these organisations' submissions to the Productivity Commission's Inquiry.

The objective of the report is to identify, *for the stationary energy sector*, the:

- extent of the 'energy efficiency gap';
- barriers and market failures that might be contributing to the energy efficiency gap;
- policy options to address market failures impeding cost effective uptake of energy efficient opportunities; and

---

2 Ministerial Council on Energy 2004, *Communiqué*, 27 August

3 Ministerial Council on Energy 2004, ibid.

4 Productivity Commission 2004, *Inquiry into Energy Efficiency: Issues Paper*, www.pc.gov.au.

- costs and benefits of overcoming the energy efficiency gap.

1.2 Structure

The remainder of this report is structured as follows.

Chapter 2 defines the term 'energy efficiency gap', and identifies the difference between a market barrier and a market failure. The Chapter also presents evidence on Australia's relative performance in investing in energy efficiency, and recent evidence on opportunities to improve energy efficiency.

Chapter 3 considers market barriers and failures in the market for energy services that could explain the energy efficiency gap. It also considers related barriers originating in the market for energy that have bearing on the market for energy services. The Chapter concludes by identifying the market failures that are likely to be contributing to under-investment in energy efficiency in Australia.

Chapter 4 assesses policies for addressing the key market failures identified in Chapter 3. It concludes with a preferred package for future policy action to improve resource allocation through investment in energy efficiency.

Chapter 5 concludes the report by considering the costs and benefits of taking action to address under-investment in energy efficiency.

Chapter 2

The Energy Efficiency Gap

It is frequently asserted that there exist significant, cost-effective opportunities for increasing energy efficiency that fail to be adopted as common practice. This is true within Australia and abroad, and has long perplexed economists and policy makers alike. Why do people not invest in more energy efficient housing, for example better insulation, when it is in their economic interest to do so? Why do consumers overlook energy efficient appliances that will save them money in the long run?

This chapter indirectly canvasses some of these driving questions and sets out the context for a discussion of potential obstacles to the uptake of energy efficiency opportunities. Specifically, this chapter frames the 'energy efficiency gap' problem within Australia by:

- defining precisely what is meant by 'energy efficiency' and an 'energy efficiency gap';
- exploring trends in energy efficiency in Australia compared with other IEA member countries; and
- examining existing evidence about a potential energy efficiency gap in Australia.

This provides the foundation for an in-depth discussion of factors impeding energy efficiency uptake and potential solutions in subsequent chapters.

2.1 Defining energy efficiency and the energy efficiency gap

The term 'energy efficiency' can be deceptively simple. As noted by the Productivity Commission, energy efficiency can mean many things to different people.[5] In order to conduct a useful examination of the issue, as well as any potential impediments to its uptake, we must first make plain the definition of energy efficiency — highlighting not only what energy efficiency is, but also what it is not.

Energy efficiency, for the purposes of the Productivity Commission's Inquiry into Energy Efficiency, is defined as 'maintaining or increasing the level of useful output or outcome delivered, while reducing energy consumption.' Added to this, the Productivity Commission also adopts an economic approach to energy efficiency, noting that:

> There is often a trade-off between using less energy and using more of another input. Many different combinations of energy and other inputs might be 'technically' efficient ways of producing a given level of output. An economic approach to the efficient use of energy takes into account the costs of all inputs, in order to discover which technically efficient combination of inputs is the least cost way of producing a given output.[6]

[5] Productivity Commission, 2004, *Energy Efficiency Issues Paper*, www.pc.gov.au, p 11.

[6] Productivity Commission, 2004, ibid, p 11.

In line with these observations, energy efficiency for the purposes of this report is defined as maintaining or increasing the level of useful economic output delivered per unit of energy consumption. In this context, this report considers whether cost-effective reductions in energy consumption are available given existing levels of economic output, or alternatively, whether cost effective increases in economic output are available given existing levels of energy consumption.

This definition of energy efficiency leads us into an understanding of the 'energy efficiency gap'. Like the definition of energy efficiency, the definition of a gap can be more complex than it appears at first glance.

The assertion that there is a gap implies that there is some optimal level of energy efficiency uptake — meaning, equivalently, an optimal application of energy savings capital equipment and services — and that the actual uptake of energy efficiency opportunities differs from this optimal rate of diffusion. For example, the Productivity Commission has defined the energy efficiency gap in the following way:

> The term 'energy efficiency gap' describes the difference between the most energy efficient processes and technologies available and those actually in use.[7]

This seems plain enough. However, the definition of the gap becomes less clear when one attempts to identify what should optimally be taken up by industry and consumers. To say simply that a more energy efficient process or technology becomes available does not necessarily imply that it is optimal for society to adopt this practice. For example, this definition ignores some of the subtleties drawn out in the Productivity Commission's earlier definition of energy efficiency in that it does not consider the economics underpinning the uptake of available technologies versus those actually in use.

Thus in order to define the energy efficiency gap, we need to examine the different concepts of optimality, which are developed by considering the different types of impediments slowing or preventing the uptake of energy efficiency. The diffusion of energy efficiency improvements may be impeded by:[8]

- *Market failures* — There are many potential theoretical barriers to the uptake of energy efficiency options. Even noting that the diffusion of energy efficiency improvements is a gradual process like the diffusion of any other technology, there appear to be potential market failures slowing the observed diffusion rate, including:
  - failures in energy markets, such that consumers are not subject to appropriate price signals for energy, including for environmental externalities, and therefore lack proper incentives to invest in energy efficiency as a substitute for energy;
  - imperfect information; and
  - organisational failures due to multiple decision-makers, both inside the firm and in markets for energy efficiency.

---

7 Productivity Commission, 2004, ibid, p 10.

8 The existence or non-existence of barriers to energy uptake is discussed in greater detail in subsequent chapters. Nevertheless, for the purposes of defining the energy efficiency gap, we need to identify some of the potential factors slowing or preventing the adoption of improved energy efficiency practices.

In the case of market failure, a cost effective policy response, which is shown to result in a better social outcome, may be an appropriate tool for increasing the diffusion rate of energy efficiency measures.

- *Market barriers or impediments that are <u>not</u> market failures* — Some market barriers that might slow the diffusion of more energy efficient technologies or processes are *not* market failures. Impediments of this type that might contribute to the energy efficiency gap include:
  - uncertainty about future energy prices and hence the potential savings from an investment in energy efficiency, resulting in individuals applying a higher discount rate than is typically used to show the existence of a gap (although if there is scope for governments and/or others to act in ways that are cost-effective to reduce the level of perceived risk and hence the discount rate applied, then this could be classed as a market failure);
  - the non-account of intangible differences between goods, such as differences in qualitative attributes between more and less energy efficient products;
  - hidden costs excluded from studies that show an energy efficiency gap, such as costs of adoption;
  - heterogeneous outcomes for different consumers, in that while the process may be shown to be cost-effective on average, there will be populations for which the adoption is not cost-effective due to different behaviour or usage patterns;
  - constraints on capital; and
  - inertia in adoption behaviour that is widespread across all economic activities.

To the extent that the energy efficiency gap exists as a result of market barriers that are not market failures, policy responses are not required.

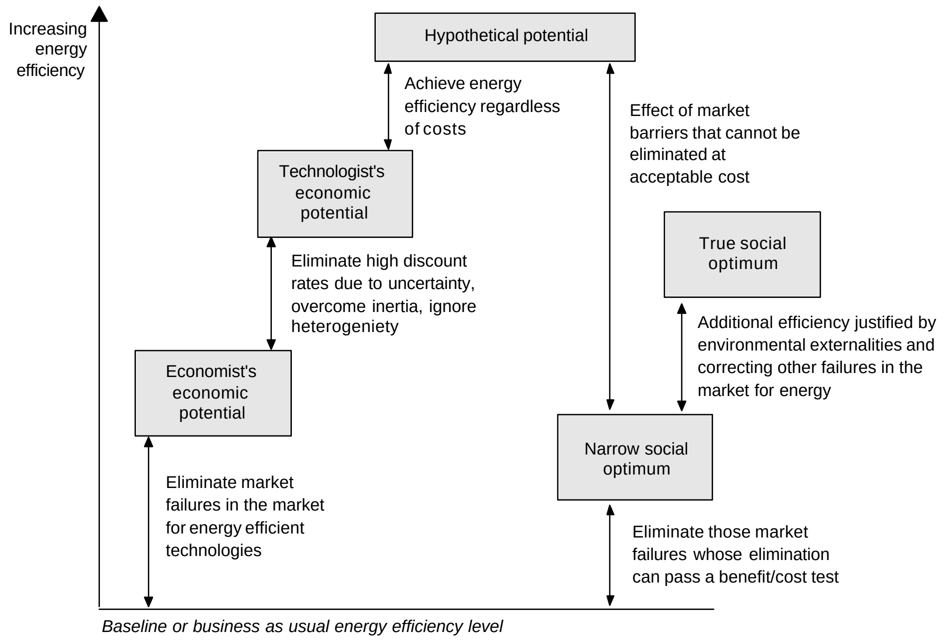
Hence what is optimal depends on which market failures one believes to be present and preventing the uptake of more energy efficient technologies or processes, and whether these market failures could feasibly be overcome.

Figure 2.1 below illustrates the different potential definitions and corresponding size of the energy efficiency gap. The horizontal axis represents the theoretical observed rate of energy efficiency diffusion. The vertical y-axis shows increasing levels of energy efficiency diffusion; the higher up on the axis, the greater the uptake of available energy efficiency opportunities. Using this Figure as a road map, we can explore alternate definitions of optimality. Starting from the bottom left, the Figure shows the economist's conception of optimality — where the elimination of any existing market failures will raise the observed rate of uptake by some corresponding amount.

If one also considers other potential market barriers, which are not market failures but still impede the spread of energy efficiency technologies, then the potential size of the energy efficiency gap is increased. This is articulated as the technologist's conception of optimality (and corresponding definition of the energy efficiency gap). If the Productivity Commission were to ignore the cost effectiveness of adoption, then this would be the appropriate definition of the energy efficiency gap. However because the Commission is also concerned with overall economic welfare and hence the costs of adoption, the economist's definition of optimality and associated energy efficiency gap estimation is more appropriate.

Figure 2.1

ALTERNATE CONCEPTIONS OF OPTIMALITY AND 'ENERGY EFFICIENCY GAPS' IN THE MARKET FOR ENERGY EFFICIENT TECHNOLOGIES



Source: Adapted from A.B. Jaffe and R.N. Stavins, 1994, The Energy Efficiency Gap: What Does It Mean?, *Energy Policy* 22 (10), p 808.

Figure 2.1 also includes the potential impact of reforming energy markets to achieve efficient relative prices, such as ensuring appropriate cost reflective pricing signals for energy. This is an important consideration for optimum uptake of energy efficient technologies, although is not an explanator for the energy efficiency gap *at current prices*.

On the right hand side, Figure 2.1 examines social optimality. The narrow social optimum in the market for energy efficiency technologies is defined as the rate of energy efficiency uptake that would be observed if all barriers that were deemed to be irrational on a cost-benefit basis were eliminated — that is, if people adopted all measures that would leave them economically better off given the current pricing environment (for example, where greenhouse gases are not priced). In addition, we are also interested in getting energy prices right, implying that the narrow social optimum should include cost effective removal of market failures in the market for energy. The 'true' social optimum would include the additional efficiency diffusion that would likely be seen if the negative externalities associated with greenhouse gas emissions were also priced.

Therefore caution needs to be applied in defining the energy efficiency gap. In light of the focus on cost-effective reductions in energy consumption for a given level of output, we would characterise the energy efficiency gap for the purposes of the Commission's Inquiry according to the economist's definition of an energy efficiency gap — that is conceptually equal to the potential uptake of energy efficiency precluded by the possible existence of market failures. The application of the cost-effectiveness criteria indicates that the Productivity Commission's inquiry will result in a presentation of means by which Australia's rate of improvement in energy efficiency might be brought into line with the narrow social optimum, but specifically excluding externalities relating to climate change.

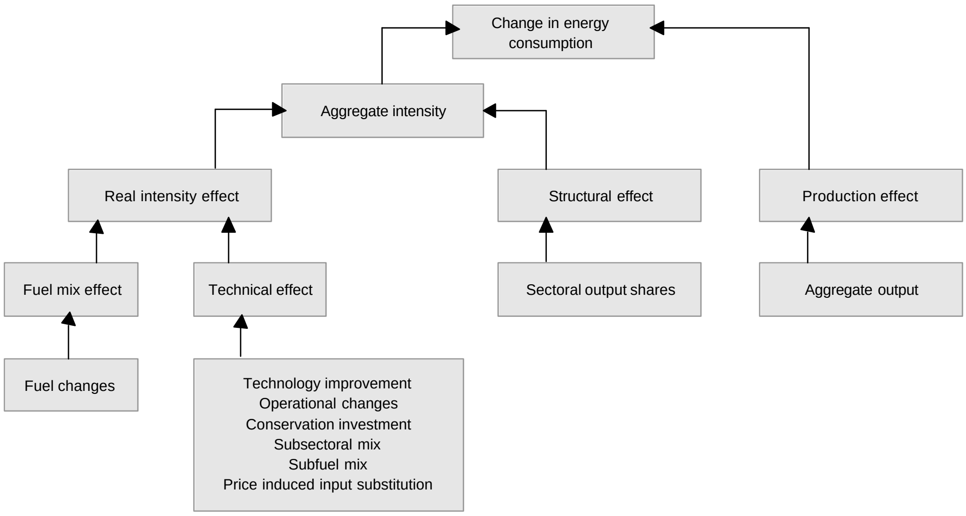
By excluding externalities relating to greenhouse gas emissions, the Terms of Reference of the Commission's Inquiry limit consideration of energy efficiency options to a sub-set of those that could feasibly be cost-effective, both at the private and societal level.

2.2 Trends in energy efficiency in the Australian economy

Building on this conceptual framework for understanding the possible existence of an energy efficiency gap, we now consider trends in energy efficiency improvements in Australia. It is first important to distinguish that changes in aggregate energy use are not the same as changes in aggregate energy efficiency. Figure 2.2 shows the components of changes in aggregate energy use, showing changes in energy efficiency to be a sub-component influencing movements in aggregate energy consumption.

Figure 2.2

FACTORS OF CHANGES IN ENERGY USE



Source: Adapted from ABARE, 2003, *Trends in Australian Energy Intensity: 1973-74 to 2000-01*, report for the Ministerial Council on Energy.

As the figure highlights, changes in energy use over time are explained by:

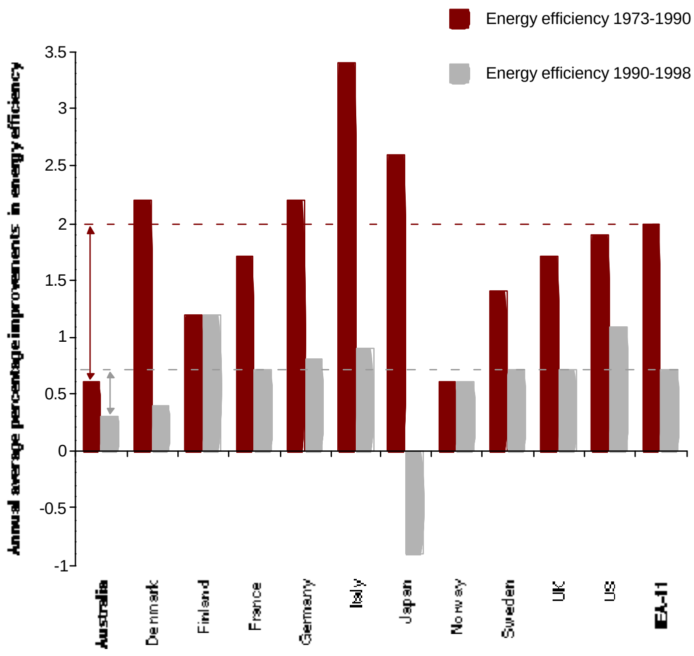
- Changes in the level of economic growth — the *production* effect. To the extent that economic activity expands or contracts, energy use will also increase or decrease, respectively, all other things being equal.
- Shifts in the composition of the economy to or from energy intensive activities — the *structural* effect. Different industries require different levels of energy per unit of economic output, and further over time the structure of economies will change as different industries grow or decline as a proportion of total economic activity. As the mix of industries in an economy shifts, so will the overall economy's total need for and usage of energy per unit of economic output.
- Changes to fuel input choices — the *fuel mix* effect. Inputs for economic activity have different energy values. Some fuel types have very high energy content and potential conversion efficiencies. As the use of fuel inputs shifts from lower conversion efficiency to higher conversion efficiency fuels, its usage of primary energy will decrease for a given level of useful energy output. Conversely, as the use of fuel inputs shifts from higher energy content to lower energy content fuels, its aggregate usage of energy will increase.
- Changes to alternative, efficient technical practices — the *technical* effect. The technical effect captures all changes due to improved technology, component uses or optimal operational practices. Thus if a process is developed that allows an output to be produced using less energy, this change will be included in the technical effect.

It is with the last effect — the technical effect — with which this discussion is primarily concerned. Trends in aggregate Australian energy efficiency diffusion are measured by movements in this parameter.[9]

In order to gain a sense of Australia's progress in energy efficiency uptake, it is useful to benchmark its rates of diffusion against other international jurisdictions — specifically International Energy Agency (IEA) member countries. These countries — which include the United Kingdom, the United States and other European countries — share similar socio-economic and technological development pathways and therefore represent an appropriate sample set against which to measure Australia's relative performance in energy efficiency uptake.

Figure 2.3

AVERAGE ANNUAL IMPROVEMENTS IN ENERGY EFFICIENCY BY IEA MEMBER COUNTRIES — FROM 1973-1990 AND 1990-1998



Source: The Allen Consulting Group, adapted from information available in F. Unander, 2003, *From Oil Crisis to Climate Challenge: Understanding CO_2 Emission Trends in IEA Countries*, prepared for the IEA.

[9] However, the Productivity Commission do say that they are interested in the efficiency of conversion on the supply side. This is where cogeneration and fuel switching have a potential influence on overall economic energy efficiency (defined as value of economic output per unit of energy input).

The data reveals that Australia has seen some uptake of technical energy efficiency opportunities, but at a far slower rate than many other IEA member countries (Figure 2.3 — note that this data covers all energy use including transport energy).[10] The arrows in the figure show the average annual lag in Australian technical energy efficiency uptake compared with the average for the IEA. Over the period from 1973 to 1990, Australian energy efficiency improved by 0.6 per cent per annum on average, compared with average technical energy efficiency improvements of 2.0 per cent per annum for the IEA average. Similarly, Australian energy efficiency improved at an average annual rate of 0.3 per cent from 1990 to 1998, while the IEA average showed member countries improved by 0.7 per cent per year on average.

There may be many reasons for the relatively slow uptake of energy efficiency improvements. For example, it could be a product of the low energy costs that Australia has historically enjoyed relative to other IEA member countries: these low energy costs may have weakened incentives to invest capital in energy saving technology. Further, there may be a greater disparity of likely outcomes among Australian consumer groups than in other IEA member countries, which tend to have more densely concentrated population groups. Or there may be relatively higher hidden costs associated with energy efficiency opportunities in Australia, which may be a recursive function of the historically slow rate of energy efficiency uptake.

While Australia has been behind its IEA counterparts in absolute energy efficiency improvements, it is joined by the other IEA countries in an overall slowdown of energy efficiency improvements from the 1973-1990 period to the 1990-1998 period. The uniform slowdown in energy intensity reductions among the IEA member countries surveyed has been attributed to energy price variations, particularly for oil. Energy price rises in the late 1970s and early 1980s associated with the oil shocks are argued by the IEA to have contributed to the relatively higher average annual percentage increase in energy efficiency improvements in the 1973-1990 period, while conversely, falling energy prices and rising incomes in the 1990s are argued to have combined to weaken the impetus for energy efficiency improvements.

The IEA's argument for the consistent decline in energy efficiency diffusion across its member states sheds some light on why Australia's rate of energy efficiency uptake has also been trending downwards. Aside from declining oil prices in real terms, this period coincided with a significant period of electricity market restructuring, in particular, a move to competitive markets. Prices for electricity declined for residential users, and even more for business. Declining energy prices will tend to increase energy use and decrease investments in energy efficiency (through substitution effects and production expansion effects).

Investigating further, we can see that several key sectors have been influencing Australia's aggregate energy efficiency diffusion profile. ABARE data reveals that cumulative technical efficiency of energy use decreased from 1973-74 to 2000-01 in the following key sectors (Figure 2.4):

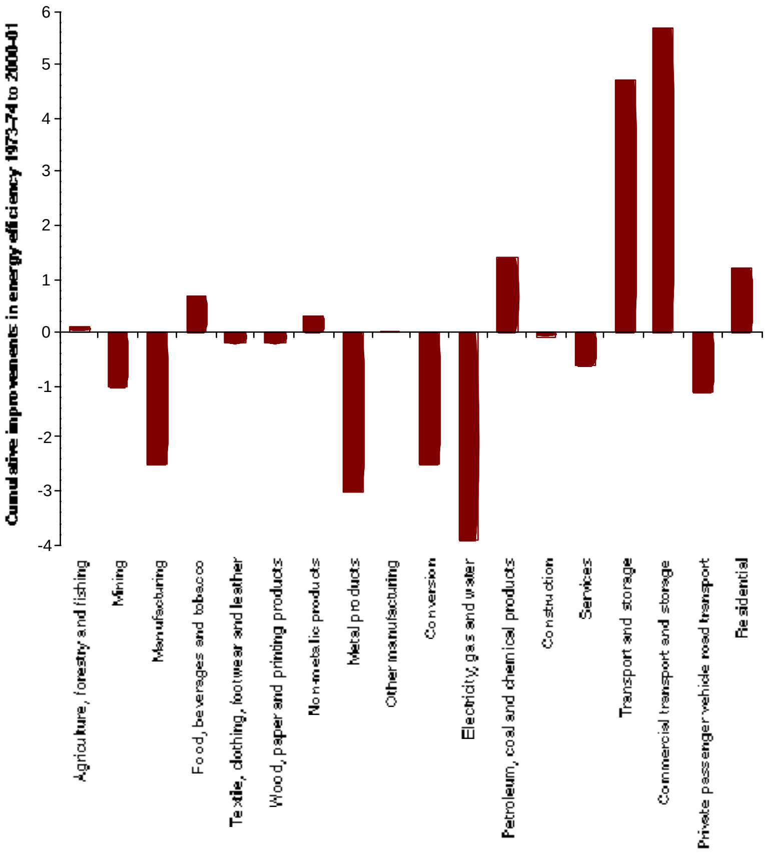
---

[10] Countries included in survey: Australia, Denmark, Finland, France, Germany, Italy, Japan, Norway, Sweden, the United Kingdom and the United States. These are the countries for which the IEA has consistent time series data with detailed energy and activity data going back to 1973. These countries together accounted for more than 80 per cent of IEA member country CO_2 emissions in 2001. See F. Unander, 2003, *From Oil Crisis to Climate Challenge: Understanding CO_2 Emission Trends in IEA Countries*, prepared for the IEA, p 15.

- technical energy efficiency in the *mining* sector declined by 1.0 per cent;
- technical energy efficiency in the *manufacturing* sector declined by 2.5 per cent;
- technical energy efficiency in the *metals* sector declined by 3.0 per cent;
- technical energy efficiency in the *utilities* sector — which, according to ABARE classifications, includes electricity, gas and water sectors — declined by 3.9 per cent; and
- technical energy efficiency in the private passenger vehicle road transport sector declined by 1.1 per cent.

Figure 2.4

CUMULATIVE IMPROVEMENTS IN TECHNICAL ENERGY EFFICIENCY FOR MAJOR SECTORS OF THE AUSTRALIAN ECONOMY — 1973-74 TO 2000-01



Source: Ibid, ABARE, 2003,

This decline in technical energy efficiency significantly countered the positive technical energy efficiency improvements seen in the transport and storage (including commercial), residential, and petroleum, coal and chemical products sectors: 5.7, 4.7, 1.2 and 1.4 per cent improvements were estimated, respectively, for these sectors.

Thus the picture for energy efficiency in various sectors of Australia's economy is mixed, but has the overall result of less aggregate improvement in energy efficiency diffusion compared with other comparable countries.

2.3 The 'efficiency gap' in Australia

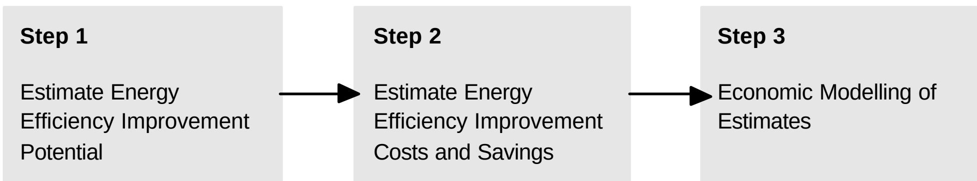
Synthesizing the theoretical framework for the existence of an energy efficiency gap and the evidenced lags in energy efficiency uptake in Australia compared to other IEA countries, a key consequential question becomes: is there any evidence to show the existence of a gap in Australia?

The most recent estimates of the potential energy efficiency gap in Australia were conducted for the Sustainable Energy Authority of Victoria, as a part of the work program for the National Framework for Energy Efficiency (NFEE).[11] The aim of this work was to develop comprehensive estimates of energy efficiency improvement-potential curves for each sub-sector of the Australian economy and to compare this with an estimated baseline or business as usual rate of energy efficiency uptake. This work was conducted in three stages (Figure 2.5):

- *Step 1* — Estimate the potential for energy efficiency improvements;
- *Step 2* — Estimate the costs and benefits for each of these identified improvements; and
- *Step 3* — Estimate the aggregate energy efficiency improvements that could feasibly be seen if the more energy efficient technology or process were to be adopted.

Figure 2.5

THREE STEP PROCESS FOR ESTIMATING POTENTIAL ENERGY EFFICIENCY IMPROVEMENTS



Source: SEAV

Step 1 is of particular use for understanding the potential energy efficiency gap within Australia. This step involved examining lists of specific energy efficiency measures, ranked in order of increasing simple payback periods. No energy efficiency improvement measure was considered that had a simple payback period of more than four years. An estimate of the baseline, business-as-usual uptake of energy efficiency was also developed. In total, three levels of energy efficiency improvement potential were considered at current energy prices:

- *Technical Energy Efficiency Improvement Potential* — this included all measures that were technically possible for a specific energy service. This was conducted for a range of sub-sectors within the residential, commercial and industrial stationary energy end-use sectors.
- *Economic Energy Efficiency Improvement Potential* — for this level of possible improvements in energy efficiency, the technical potential of

[11] See The Allen Consulting Group 2004, *Economic Impact Analysis of Improved Energy Efficiency: Phase 2 Report*, Report for the Sustainable Energy Authority of Victoria, www.seav.gov.au — the material in this section follows closely Appendix 2 of this report.

different measures were also constrained by taking into account standard financial considerations. For this work it was generally based on simple paybacks from energy savings, for a number of scenarios. It assumes that as long as the economic criteria are met, the energy efficiency improvements could be implemented. That is, it assumes that potential market failures or barriers precluding the uptake of these energy efficiency improvement measures are overcome.

- *Market Rate of Energy Efficiency Uptake* — this is the expected rate of energy efficiency improvements that are likely to be delivered by the market, that is, the baseline, business as usual level.

The NFEE Step 1 methodology then derived an estimate of the net energy efficiency improvement potential — or conversely, the 'energy efficiency gap' — by subtracting the expected Market Rate of Energy Efficiency Uptake from the Economic Energy Efficiency Improvement Potential. Stepping back to the conceptual model of alternate definitions of the potential energy efficiency gap, it is clear that this work roughly estimates the narrow social optimum of energy efficiency diffusion and the corresponding energy efficiency gap, at current prices.[12]

Over the period from 2005 to 2014 NFEE estimates indicated that net technical energy efficiency improvements of between two and 35 per cent were possible for various sectors of the Australian economy (Table 2.1). Thus the available evidence suggests that the energy efficiency gap in Australia could be significant within certain sectors of the Australian economy.

It supports the view that a significant proportion of the relatively poor performance of Australia compared to other countries is unlikely to be explained simply by differences in energy prices. First, the NFEE opportunities are assessed for electricity and for gas at current Australian prices. Given that Australia's energy prices tend to be cheaper than in other countries, and that therefore we would tend to have a more limited set of cost effective opportunities for energy efficiency improvement, the size of the identified opportunities becomes even more significant. Secondly, the assessment of opportunities for the NFEE process was conservative — the average of the simple paybacks of the estimates in Table 2.1 was 2.4 years, which equates to an average internal rate of return of more than 50 per cent. This is an extremely high rate compared to hurdle rates elsewhere in the economy, and indicates that most of the identified savings were within the bounds of hurdle rates that often are quoted as acceptable for non-core investments. Together then, the evidence tends to point to factors other than relative prices as a cause.

What the above estimates do not cast light on is whether there are other factors impeding uptake that are rational. As noted above, these might include hidden costs of adoption, including uncertainty over performance. We consider the potential of these other factors as a cause in what follows in this report, as well as the potential contribution of market failures such as lack of information and organisational constraints.

12 Although to the extent that the estimates are ex ante estimates, and do not incorporate hidden costs, then they will overstate the opportunities. Hidden costs are discussed in more detail in later chapters.

Table 2.1

SUMMARY OF EEI POTENTIAL ESTIMATES

Sector / Case Studies	Energy Efficiency Improvement Potential	
	Electricity	**Gas**
Industrial sector		
Agriculture — estimated	5.0%	5.0%
Mining	8.4%	1.8%
Manufacturing	11.4%	6.9%
Food, Beverages & Tobacco	13.8%	11.0%
Textile, Clothing & Footwear — estimated	6.3%	6.3%
Wood and Paper Products — Pulp and Paper Manufacturing	13.5%	9.8%
Chemicals (ex petroleum) — Basic Chemicals	12.1%	8.4%
Non-Metallic Minerals — Ceramics and Cement	6.0%	10.3%
Iron and Steel	9.3%	17.2%
Alumina and Aluminium	12.8%	0.0%
Other Metals — estimated	3.0%	3.0%
Machinery and Equipment — estimated	6.3%	6.3%
Other Manufacturing — estimated	6.3%	6.3%
Construction — estimated	6.3%	6.3%
Industrial sub-total	*10.7%*	*9.1%*
Commercial sector		
Wholesale and Retail Trade	14.7%	7.1%
Accommodation, Cafes and Restaurants	6.2%	34.1%
Communication Services	4.4%	23.3%
Finance, Insurance, Property and Business Services	11.1%	11.1%
Govt. Administration, Education, Health and Community Services	9.4%	4.3%
Culture and Recreation, Personal Services	5.3%	39.5%
Commercial sub-total	*10.1%*	*11.0%*
Residential sector (electricity and gas)	11.9%	

Source: SEAV, reproduced in The Allen Consulting Group, 2003, *Economic Impacts of a National Energy Efficiency Target*, prepared for SEAV.

Chapter 3
Market failures impeding energy efficiency

Chapter 2 discussed the difference between market barriers and failures that might theoretically exist to impede the diffusion of more energy efficient technologies and practices in Australia. This Chapter identifies that it is theoretically possible that there may be plausible impediments to the uptake of energy efficiency that are not market failures — including the potential for significantly high rates of discounting and other hidden costs.

To highlight the differences, Chapter 2 briefly canvassed some of the potential barriers or failures that may prevent the optimal uptake of energy efficiency. This chapter expands on these previous observations by discussing whether consumer choices — and by implication, the energy efficiency gap — are rational.

The Chapter starts by considering market failures in the market for energy, with particular reference to the implications for relative prices. It then considers barriers and failures in the markets for energy efficiency services. The Chapter concludes by summarising the potential market failures preventing cost effective uptake of energy efficiency.

3.1 Energy market issues

This section explores the impact of the current energy market structure on incentives for adopting more energy efficient technologies and practices. It charts reforms to Australian energy markets, highlighting the impact of these on the incentives for energy efficiency uptake. The discussion limits itself to the theoretical impediments to energy efficiency improvements; it does not comment on the possible complexity or net benefits of these reforms.

It is important to note at the outset that energy markets have bearing on energy efficiency largely through the influence on prices for energy.[13] Inefficiencies in terms of a misallocation of resources, including in relation to energy efficiency, can occur to the extent that energy prices are inefficient. The 'energy efficiency gap' is usually taken to refer to failures *at current prices for energy*. However, failures in energy markets influence *relative prices* for energy, and also therefore investments in the 'substitute' energy efficiency product or service. We therefore consider energy markets in this relative price context first, before going on to consider potential impediments in market for energy efficiency goods and services, which are not dependent on price. It is also worth noting that energy market issues are most significant for large energy users, as they are the end users most likely to be influenced by energy prices.

Energy market reform in Australia

Energy markets in Australia have undergone a substantial transformation in the past decade as policy makers have sought to remove legislative and regulatory barriers to competition in order to improve the efficiency of the energy industry.

[13] While energy prices are the key driver, there are also institutional issues related to energy market decisions that can preclude efficient investment in energy efficiency — for example, in relation to network augmentation decisions. Chapter 4 considers these issues in more detail.

In the main, the reform program in Australia, started in 1991 by the Council of Australian Governments, has been focused on the restructuring of the supply side of the market, which has resulted in increased competition in electricity and gas markets. In electricity, these changes saw the vertical disaggregation of state-owned monopolies and the creation of the National Electricity Market (NEM) in December 1998 — a wholesale market for the supply of electricity to retailers and end-users in Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory. There has been a general decline in real electricity prices across the NEM as a result.[14] Other states have also experienced real price declines in response to corporatisation of former government utilities. On the gas side of the market restructuring also resulted in a mild reduction in prices.[15]

In 2002, The Parer Report explored issues of demand side involvement for the electricity side of the energy market, and found that there has been relatively low demand side participation in the NEM due to:[16]

- the supply side focus of NEM information systems;
- the inability of load-reducing market participants to capture the full value of their market actions; and
- the insulation of residential customers from time-of-use price signals.

Influence of current market structure on energy efficiency diffusion rates

As a result of imcomplete reform processes, a range of energy market inefficiencies remain. The majority of these are related to regulatory failures in the governance of markets or inadequate transitional arrangements. Against this reform backdrop we consider the current market structure and its influence on rates of energy efficiency uptake, first for gas and then for electricity.

Gas markets — influence of reforms to date

During the Australian natural gas market's initial development phase through the 1960s and 70s, monopoly gas producers and utilities negotiated long-term supply agreements that supported gas infrastructure and market development. Gas competed with other fuels in end-use markets but gas-on-gas competition was completely absent at both wholesale and retail levels.

---

14 While on average electricity prices have fallen since the 1990s, the character of the price decreases varies by jurisdiction and by sector. For example, real electricity prices in South Australia have risen on average compared with other NEM jurisdictions. Similarly, while on average real electricity prices fell for households and businesses from 1990-91 to 2002-03 (by roughly 18 per cent), this average change masks a real rise in energy prices for households during that period of (on average) three per cent. Energy prices for businesses fell by on average 25 per cent. The trends in Australian real electricity prices have been further affected by the introduction of the Goods and Services Tax (GST) in 2000. The GST has been included in prices paid by households for all infrastructure services other than water, however the input tax rebate system exempts businesses from the GST. See Productivity Commission, 2004, *Review of National Competition Policy*.

15 From 1990-91 to 1997-98, gas prices fell on average by one per cent. Breaking this down by sector reveals that gas prices for businesses fell by roughly three per cent while price increases for the housing sector increased by three per cent. See Productivity Commission, 2004, *Review of National Competition Policy*.

16 W. Parer, 2002, *Towards a Truly National Energy Efficiency Market*, Council of Australian Governments Energy Market Review, Chapter 6.

Since the introduction of downstream competition during the 1990s, the legacy of long-term agreements has continued to provide the majority of supply and to set the benchmarks for wholesale gas prices. The key transactions in the gas wholesale market are long-term contracts between producers and buyers such as retailers, generators and large industrials. These contracts will reflect the full cost of usage, including the regulated costs of transmission pipeline capacity. The activities of producers and buyers in this primary market are unregulated, though some retailers' prices for smaller customers are capped by state governments. The transmission sector is regulated under the National Third Party Access Code for Natural Gas Pipeline Systems promulgated in 1997. Many transmission pipelines in Eastern Australia are covered by the Code and their tariffs are regulated by the ACCC.

In terms of energy efficiency incentives, the small number of suppliers participating in the market has tended to provide upward support to gas prices, such that prices tend to exceed marginal costs of production. For example, the Parer Report noted:

> The degree of supply competition in Australia's eastern markets is still weak — particularly compared to Western Australia. This is reflected in lower gas prices in Western Australia.[17]

If anything, by raising relative prices of energy above their economically optimal level, and constraining supply, this will have result in over signalling of the need for investments in energy efficiency in downstream gas use.

On the other hand, to the extent that gas can increase efficiencies in end use, and supplies on reasonable terms are constrained by lack of adequate competition, then end use efficiency is affected where inefficient alternatives are adopted. A key example of this is the stated difficulties by proponents of cogeneration projects to secure long term supplies of gas on reasonable terms. Cogeneration provides a major opportunity to increase the energy efficiency of electricity generation and heat raising.

With large players able to trade pipeline capacity in gas transmission pipelines among themselves, there are also theoretically adequate incentives for these major players to invest in cost effective energy efficiency measures as alternatives to increasing pipeline capacity. However, many transmission pipelines and (for all practical purposes) all gas distribution systems are not capacity constrained, and unlike in the electricity market, additional demand does not create requirements for balancing. As a result, appropriate signals for demand management are less crucial.

For these reasons — that pricing more than reflects costs of production and that there are adequate price signals for demand side management — the remainder of this section focuses more on the electricity portion of Australian electricity markets. This is likely to be a larger contributor to the potential energy efficiency gap than the gas side of the market.

[17] W. Parer, 2002, ibid, p190.

Electricity — influence of supply side and other implemented reforms on energy efficiency incentives

Supply side reforms that have fostered an increasingly competitive environment for the generation sector have also contributed to declining prices for electricity in Australia. Similarly, the introduction of full-retail contestability in some jurisdictions is also working to increase retail competition and encourage lower prices for energy. These reforms, while removing some inefficiencies in pricing, are also likely to have weakened incentives for consumers to invest in energy efficiency opportunities. Chapter 1 illustrated a decline in the uptake of energy efficiency across IEA member countries, which was generally attributed to reform-induced energy price reductions. From an economist's perspective, this fall in efficiency investment in response to declining energy prices is a rational outcome, and does not require any regulatory response.

However, a significant component of the price decline was due to the overhang in generation capacity, particularly in NSW, which resulted in electricity prices below long run marginal cost (LRMC).[18] If, as a result, misplaced expectations of price falls have developed, then there will be commensurate under-investment in energy efficiency. This is irrational, and over the longer term, will result in a misallocation of resources based on unreal future price expectations.

Further, despite the broad thrust towards improving competitive efficiency in the Australian market over the past decade, many consumers still have highly averaged prices that do not signal the costs of use on a time and location basis.

Because consumers have little information about the costs of using energy at times of peak demand or when the network is congested, and because some jurisdictions still impose caps on the price for energy, the market operates inefficiently — leading to high cross subsidies between user-types, dead weight loss, and muted incentives for energy efficiency uptake. While the current response of the industry and end use consumers therefore is rational within the current constraints, there remains scope for eliminating such inefficiencies and improving the overall allocation of resources. Chapter 4 considers these issues in more detail.

Externalities

Externalities refer to the costs and benefits from energy consumption that are not factored into the energy choices of consumers. Air pollution is commonly cited as a negative externality associated with energy consumption – though, of course, the adverse social impact can vary according to the type of energy consumed (eg. fossil fuel, renewable, etc) and the location of emissions.

To the extent that negative externalities are associated with energy consumption, economists would argue that the cost of energy is under-estimated in the market, and private decision-making will lead to over-use of this resource and excessive levels of consumption.

[18] Wholesale prices fell below $15 per MWh in the NEM in the late 1990s as a result. The supply overhang in NSW is now receding, resulting in prices approaching LRMC.

Box 3.1

EXAMINING ENERGY EXTERNALITIES: THE ExternE PROGRAM

The ExternE project is the first comprehensive attempt to use a consistent 'bottom-up' methodology to evaluate the external costs associated with a range of different fuel cycles. The European Commission launched the project in collaboration with the US Department of Energy in 1991. The EC and US teams jointly developed the conceptual approach and the methodology and shared scientific information for its application to a range of fuel cycles. During this first phase the EC side concentrated on the nuclear and coal fuel cycles which together were expected to raise most of the fundamental issues.

Work in the EC continued with a second phase of the project under the JOULE II programme. In January 1996, phase III of the ExternE project began, with country reports available from the end of 1997.

The main objectives are to apply the methodology to a wide range of different fossil, nuclear and renewable fuel cycles for power generation and energy conservation options, and a series of National Implementation Programmes to implement the methodology for reference sites throughout Europe. The methodology is also being extended to address the evaluation of externalities associated with the use of energy in the transport and domestic sectors and a number of non-environmental externalities such as those associated with security of supply.

Source: http://externe.jrc.es/overview.html

Owen (2004) lists the following energy sector 'spill-overs' that need to be taken into account in determining the true ‘social’ cost of energy[19]:

- solid wastes;
- liquid wastes;
- gaseous and particulate air pollutants;
- risk of accidents;
- occupational exposure to hazardous substances;
- noise; and
- others (e.g., exposure to electro-magnetic fields, emissions of heat).

Similar lists of impacts have been developed, and in some cases quantified, through the ExternE Project sponsored by the European Commission to examine the full life cycle impacts of different power generation technologies (see box 3.2). For instance, the study for the United Kingdom estimates that inclusion of non-greenhouse externalities would add around 10 per cent to prevailing production costs for low emission technologies such as gas, nuclear and certain renewable technologies (wind energy was found to have the smallest negative spillover implications) and add more than 50 per cent to the costs of electricity produced from coal and oil. Inclusion of notional greenhouse costs significantly amplifies the additional cost impost borne by fossil fuels.[20]

[19] Owen A.D. (2004), ‘Environmental Externalities, Market Distortions and the Economics of Renewable Energy Technologies’, The Energy Journal, 25(3), pp. 127-156.

[20] AEA Technology 1998, *Power Generation and the Environment – a UK Perspective*, Vol 1, commissioned report under the ExternE project, No. AEAT 3776, Oxfordshire, p. ix.

These results cannot be translated to Australia because of differences in location, demographics and background environment, and comparable comprehensive Australian studies are not available. However, they serve to highlight the potential implications that environmental factors can have for market energy prices, and subsequent consumption decisions. To the extent that externalities are not factored into energy prices, then there will be a corresponding under-investment in energy efficiency.

Other distortionary policies in the market for energy

Government policies can also have a direct influence on national and regional energy prices and the competitiveness of major energy consumers. Such influences can take the form of taxes, subsidies, regulations and concessions that affect the relative cost of resources and production options within Australia.

A variety of arrangements exist at a State and Commonwealth level that can impact on energy use. Fuel excise arrangements are a high profile example of these, and have recently been a focus for reform as part of the policy initiatives announced in the Commonwealth government statement on 'Securing Australia's Energy Future'.

Potentially distorting tax and subsidy arrangements affecting relative prices for energy efficiency investments include:

- historic subsidies paid to energy infrastructure in pursuit of economic development — while this is a sunk cost, it has contributed to the culture of 'build and generate', and also perhaps to the unrealistic expectations for energy prices in the future (as noted above);
- non-uniform taxation treatment of plant and equipment replacement and upgrades that create incentives to keep older equipment longer than might otherwise be the case:
  - repair of existing assets is deductible in the year the expenditure is incurred;
  - improvements to pre-September 1999 assets are eligible for accelerated rates of depreciation;
  - post-September 1999 assets are not eligible for accelerated rates of depreciation;
- concessional treatment for upstream energy investment, but not for investments in energy efficiency.

Taxation is a complex area beyond the scope of this report. While taxation is unlikely to be a significant element influencing the energy efficiency gap, it does warrant consideration as a potential impediment.

3.2 Markets for energy efficient technologies and services

As discussed above, it is possible that failures in the market for energy encourages over-consumption of energy and weakens incentives for energy efficiency uptake, through the influence on relative prices. Here, we discuss potential barriers and impediments in the market for *energy efficiency* goods and services, which could contribute to the energy efficiency gap *at current prices*.

As discussed in Chapter 2, there is a key distinction between barriers and impediments that can be classed as market failures, and hence warrant policy intervention, and those that do not. A useful summary is developed by Sorrell et al, who have undertaken the most exhaustive examination of the existing literature on the potential causes of the energy efficiency gap to date (Table 3.1). In this section we consider each of the summary categories in turn.

Table 3.1
BARRIERS TO ENERGY EFFICIENCY

Category	Particular instance
Barriers that may represent market failures	• Public good attributes of information associated with energy efficient technologies • Positive externalities of adopting energy efficient technologies • Adverse selection in energy services markets • Moral hazard & principal-agent relationships in energy services markets • Split incentives in energy services markets
Barriers that may represent organisational failures	• Imperfect information on organisational energy use • Moral hazard & principal-agent relationships within organisations • Split incentives within organisations
Barriers that may represent rational behavior	• Heterogeneity • Hidden costs (e.g. overhead costs, disruption) • Risk (technical or business) • Access to capital

Source: S.Sorrell, J.Schleich, S.Scott, E.O'Malley, F.Trace, U.Boede, K.Ostertag and P. Radgen, 2000, *Barriers to Energy Efficiency in Public and Private Organisations*, SPRU Environment and Energy, www.sussex.ac.uk/Units/spru/environment/research/barriers.html, p26.

3.3 Barriers that are not market failures

The first category we consider are those in the last row of Table 3.1 — barriers that 'may represent rational behaviour'. These are the barriers that are common to decision making elsewhere in the economy, and hence do not warrant special attention in the context of the market for energy efficiency.

The most important of these, and perhaps most disputed, are the hidden costs of adopting energy efficiency investments — that may not be picked up in engineering/financial evaluations that are typically conducted as part of energy audits. While it is possible to test the importance of hidden costs empirically, there are very few studies that have done so. As Sorrell et al note:

> The relevant empirical questions for hidden costs are:
>
> - what is the magnitude of the hidden costs associated with an energy efficient investment (a *cardinal* approach)?

- are their instances where the hidden costs associated with an energy efficient technology are comparable with those of an inefficient technology, but where the latter are still predominantly chosen (a *ordinal* approach)?

Both questions may be tested empirically, but the research design must be comprehensive to ensure that all factors are taken into account. Unfortunately, there are relatively few examples in the literature. One example of a cardinal approach is the 1994 study by Hein & Blok. This found the search and information costs of a range of energy efficiency investments to form between 3% and 8% of the total investment cost. Levine et al (1994) provide a much cited example of an ordinal approach. They studied a number of energy efficient technologies that were: i) commercially available; ii) identical to inefficient technologies in the quality of service provided; iii) highly cost effective; and iv) apparently free of any hidden costs. Despite this, inefficient technologies with a somewhat lower capital cost were generally preferred.[21]

In their detailed study of barriers impeding uptake of energy efficiency, Sorrell et al noted that salary overheads could be a key hidden cost if time constraints in considering energy efficiency investments are to be overcome (see Box 3.5 below). Nevertheless, Sorrell et al question the extent to which salary costs should be considered as part of the decision process, noting 'that given the wide range of tasks within energy management, it seems hard to justify loading all the salary overhead costs onto energy-saving investment projects'.[22]

The potential importance of hidden costs for cost effective policy suggests that any programs designed to improve uptake of energy efficiency should have a clear ex post evaluation process built in, to ensure that the *ex ante* estimates of benefits and costs are evaluated, and true *ex post* returns estimated.

Other rational barriers include:

- heterogeneity — where despite an energy efficiency investment being cost effective on average, it is not cost effective for all users due to their specific characteristics;
- risk — to the extent that energy efficiency investments are discounted for risk at the same rate as investments of equivalent risk elsewhere in the economy, leading to excessively high discount rates;
- access to capital — to the extent that energy efficiency investments are constrained by capital scarcity in similar fashion to investments of equivalent return elsewhere in the economy.

There is contention as to whether some of these barriers are actually more pronounced in the market for energy efficiency. Some have argued that both discounting for risk and rationing of capital are excessive for energy efficiency investments, and are therefore symptoms of more pervasive irrational reluctance to adopt cost effective energy efficiency. If this were the case, then these barriers could represent market failures. For example, in relation to access to capital, Sorrell et al noted:

---

21 S.Sorrell, J.Schleich, S.Scott, E. O'Malley, F.Trace, U.Boede, K.Ostertag, P. Radgen, 2000, *Barriers to Energy Efficiency in Public and Private Organisations*, SPRU Environment and Energy, www.sussex.ac.uk/Units/spru/environment/research/barriers.html, p39.

22 S. Sorrell et al 2000, ibid, p170.

> … as with the observation that organisations have strict investment criteria … this [lack of capital] largely restates the problem to be explained rather than providing an explanation. In the higher education sector, there were constraints on borrowing imposed by public sector rules. But in mechanical engineering and brewing there was practically no evidence that the case study organisations had difficulties in obtaining capital at reasonable rates - as would be the case with a capital market failure … Instead, the restrictions on capital were self imposed through a reluctance to take on additional borrowing …. it does not follow from this that the reluctance to borrow represents rational behaviour.[23]

3.4 Barriers that represent market failures

There are a range of barriers that are consistent with the neo-classical economics interpretation of market failures, which are generally accepted as being important in markets for energy efficiency. These contribute, to a greater or lesser degree, to the slower diffusion rates observed for new energy efficiency technologies.

Information: incompleteness and asymmetries

Energy efficiency investment may be hindered by the existence of imperfections or asymmetries in the markets for information. This results in households and firms having insufficient information to enable them to make efficient decisions on investments in energy efficiency. As a result, they under-invest in energy efficient technologies, processes and products and consume more energy than is socially optimal.

Within the residential sector, there is often a pervasive ignorance about energy efficiency opportunities. This limited awareness and interest in energy costs and reducing energy expense is in part due to the 'secondary' and 'invisible' characteristic of appliances and other energy efficiency goods and also to the small proportion of energy in total expenditure. Energy is prima facie taken for granted. However, it is also generally accepted that ignorance about the net benefits of energy efficiency investments are due to incompleteness and asymmetry of information in energy markets.

Incomplete information in the market for energy efficiency goods and services arises due its public good characteristics (Box 3.2).[24]

Asymmetric information arises where sellers of energy efficient technologies, products or processes have superior information to buyers. In the residential sector, this situation may arise between a house owner and tenant, or between a home builder and home owner. This can result in problems of adverse selection, where buyers are unable to distinguish between product characteristics. Akerlof demonstrated that such a market can quickly collapse or simply reduce to the selection of low-quality products.[25]

Decisions by consumers not to invest at the optimal rate of energy efficiency uptake may be 'rational' in the context of these market failures. However this is not a socially optimal outcome, and will result in under-investment in energy efficiency opportunities. Further, from a perspective of private cost-effectiveness, consumers are failing to capture the optimal level of benefits.

---

[23] S. Sorrell et al 2000, ibid, p171.

[24] Public good characteristics mean that the costs associated with sharing information are rarely excessive. However, simply providing information does not ensure that it is utilised. Interventions in this area need to consider the optimal targeting of information and advice to affect behaviour.

[25] This is the classic 'lemons market', first explained by Akerlof in 1970.

Box 3.2

PUBLIC GOODS

Public goods are an externality with two distinctive features. One person's consumption does not reduce the amount available for someone else (non-rivalry) and no one can be kept from sharing in the consumption of the good (non-excludability). As Stavins and Jaffe observe:

…. information has important public good attributes: once created it can be used by many people at little or no additional cost. It may be difficult or impossible for an individual or firm that invests in information creation to prevent others who do not pay for the information from using it. It is well known that such public goods will tend to be underprovided by ordinary market activity.

The existence of public goods (and more often mixed goods with a large public element) gives rise to the free rider problem – whereby an individual lacks the incentive to pay for a good if that payment has no effect on the quantity of the good he or she may consume. Since it pays everyone to free ride, no revenue can be raised from the sale of a public good that is privately provided. In such a situation, no public goods would be privately provided. The responsibility for providing public goods thus rests with government.

Source: The Allen Consulting Group and Stavins and Jaffe 2004, op. cit., p 805.

The industrial and commercial sectors also are vulnerable to the same information failures as for the residential sector. Firms or other agents lack full incentive to invest in information about energy efficiency opportunities due to public good characteristics of that information — and where firms do invest in energy efficiency, firms have an incentive to protect this information from other firms in order to gain a competitive advantage through a more nimble cost structure.

In addition, a range of studies, such as the Bureau of Industry Economics (1994) survey of industrial motor users, have identified significant levels of uncertainty among industrial energy users about the energy performance characteristics of alternative technologies — that could be readily and cost effectively alleviated through appropriate government action on their behalf.[26]

The inherent 'shareability' of information means that it can be difficult for information providers to capture all of the benefits from its creation and provision. In such circumstances it is likely to be under-provided, and hence the level and quality of information reaching individual energy users can be diminished. From a policy perspective, the capacity for information to be produced and used over and over again by several users without diminution represents a powerful rational for policy intervention in this area.

Principal-agent problems

The principal-agent phenomenon arises in part from information asymmetries, and leads to difficulties for the consumer in achieving optimal levels of energy efficiency. Well known examples can be found in the building industry, where cost minimisation objectives can mean different things for the construction company (which will focus on up-front equipment costs) and the occupant (who has an interest in running costs) (Box 3.4).

[26] Bureau of Industry Economics 1994, *Energy Labelling and Standards*, Australian Government Publishing Service.

Box 3.3

PRINCIPAL-AGENT PROBLEMS FOR ENERGY EFFICIENCY

Architects, engineers, and builders, who generally seek to minimize first [initial] costs, select the energy technologies that homeowners and apartment dwellers must use. In this case, the consumer's best interest would be better met by selecting technologies based on life-cycle costs. Similarly, industrial buyers choose the technologies that are used in the production process and are mainly concerned with availability and the known dependability of standard equipment. ….

…. Lovins (1992) describes how typical fee structures for engineers and architects cause incentives to be distorted, thereby penalizing efficiency. Interviews with more than ?fty design professionals and analysts showed that the prevailing fee structures of building design engineers are based on a percentage of the capital cost of the project. Such fee structures are pernicious because additional first costs are typically needed to enable the installation of superior heating, ventilation, and air-conditioning systems that reduce operating costs. These additional expenditures beyond the typical ‘‘rule-of-thumb’’ equipment sizing used by most engineers result in a net penalty for designers of efficient systems. Even though this type of fee structure has been strongly discouraged in the United States since the early 1970s, both the designer and procurer of design services still generally base their fee negotiation on percentage-of-cost curves. ….

…. Another example of misplaced incentives is the landlord-tenant relation in the buildings sector. If a landlord buys the energy-using equipment while the tenants pay the energy bills, the landlord is not incentivised to invest in efficient equipment unless the tenants are aware of and express their self-interest. Thus, the circumstance that favours the efficient use of equipment (when the tenants pay the utility bills) leads to a disincentive for the purchase of energy-efficient equipment. The case that favours the purchase of efficient equipment (when the landlord pays the utility bills) leads to a disincentive for the tenants to use energy efficiently.

Source: M.A. Brown 2001, Market Failures and Barriers as a Basis for Clean Energy Policies, *Energy Policy* 29 (2001) 1197-1207.

In the case of split incentives affecting residential or commercial leases, it is feasible for more energy efficient buildings to be specified and contracted for between the landlord and the tenant. For example, the tenant may contract for the landlord to undertake building improvements and agree to pay a slightly higher rent. At the same time, the tenant will be better off, saving a greater amount in energy bills than the rent increase. However, the prospects for a contractual solution of this type will be influenced by the time horizon of occupancy, and hence the ability of the landlord to recoup the capital expense through higher rents over time. The landlord may be reluctant to enter into contractual arrangements overcoming the split incentive if he or she does not believe the next tenant will value the investment in energy efficiency and hence pay a corresponding rental differential.

There are also 'moral hazard' situations that arise where the seller uses information asymmetry to extract unfair commercial advantage from the consumer. For example, if sales people can regularly convince customers to buy bigger (and more expensive and energy intensive) models than they actually need, they are unlikely to support provision of improved information. In this case, the provision of information works against the interests of a supplier.

Externalities from energy innovation

Often those that adopt new technologies act as leaders to others, and lower the risks and uncertainties for those who would follow (Box 3.4). The process of technological development and innovation is a well known pathway for those seeking competitive advantage, and can occur across the full range of economic activities including energy use. An innovator will often have an incentive to try to keep secret their technological successes and failures — at a potential cost not only to their direct rivals but also to other organisations that might benefit from their experiences. On the other hand, innovators must often accept that, as soon as their product is put on sale, competitors will purchase and analyse its features, then incorporate them into their products, usually with sufficient differences to avoid patent claims. Thus, innovators can find it difficult to capture the full advantage of their work. Where the choice for R&D priorities lies between an invisible technical improvement such as energy efficiency and a visible improvement such as aesthetics, the latter may be preferred because it is more visible.

Box 3.4

USE OF CONCRETE EXTENDER IN THE 60L BUILDING

Refurbishment of the 60L building in Melbourne by the Business Council for Sustainable Energy aimed to demonstrate cost effective energy efficient technologies.

One option for significantly reducing life cycle energy use was to use a concrete with higher level of extender. There was considerable opposition to this from both concrete manufacturers, builders and regulators, who lacked information on the performance of the new concrete. However, following considerable investment of time by the BCSE — to establish the case for extender concrete and convince the various stakeholders — the high extender concrete was eventually approved and used in the 60L building.

This provided a demonstration effect (to builders) and overcame regulatory barriers (building code requirements) such that now, 2 years later, 30 per cent of the commercial construction market in Melbourne uses the high extender concrete.

Source: Business Council of Sustainable Energy

Governments typically support research and development and limited duration patenting within economies as a means of promoting information flow and the provision of property rights that allow technological pioneers to earn a return on their investments.

Policies that promote demonstration of new technologies and provision of information on energy use and efficiency opportunities can help generate these positive externalities and accelerate the diffusion of new technologies within the economy.

3.5 Barriers that represent organisational failures

A further range of potential failures preventing efficiency uptake of energy efficiency occurs in the difficulties of coordinating complex activities. These arise because implementation of energy efficiency will often involve multiple decision makers. Organisational economics suggests that many of these difficulties are rooted in the transactions costs of using market based mechanisms, and also in the problems of organisations and the 'bounded rationality' of individual agents.

Organisational failures external to the firm

As observed by Golove and Eto, the complexity of organising energy efficiency across a chain of players can allow small imperfections to combine to create a market failure:

> An intriguing illustration of the magnitude question [of the energy efficiency gap] examined from the point of view of transaction costs suggests that market barriers can sometimes accumulate and reinforce one another …. the idea of chains of market barriers refers to small imperfections, any of which individually represents an insignificant distortion to efficiency, but which in combination are of a magnitude sufficient to be considered a market failure. … The chain of market barriers phenomenon explicitly recognizes that there are series of decisions, actions, and transactions between the production of goods and their ultimate sale to the end user.[27]

For example, the householder seeking to build or extend their home will need to coordinate with the building designer, equipment suppliers, the local council, and their builder, to install successfully energy efficient features. While it is true that this complexity is a feature of the home building process, if any party in this chain of coordination lacks interest in the energy efficiency option, then optimal investment in energy efficiency can become much harder to achieve.

Transaction costs

Transaction costs — including search costs — are the administrative costs of making and implementing a purchase decision. The transaction costs involved in investing in a new technology can be substantial. Further, the existence of transactions costs may also render some energy efficiency opportunities that are marginally profitable using 'appropriate' discount rates unprofitable. In the case of energy efficiency, the lack of a well developed energy services industry that organises products and information for end users can increase the transactions costs of trying to implement energy efficiency.

Organisational failures internal to the firm

Similar issues of external coordination also arise for firms — for example when occupying a new building or when installing new plant and equipment. At the same time, the larger firm has even greater problems, as significant coordination may also be required inside the firm.

Because of the complex organisational structure of many firms, internal information asymmetry also can arise in the context of their day to day operations. The complex decisions that must be made by organisations are in fact made by a diverse set of individuals making up the firm. In some cases, this may result in private agents making decisions that maximise their own welfare, rather than the welfare of the company — this is the classic agency problem within economics and theoretically may be observed when it comes to energy efficiency investments.

De Canio highlights this aspect in his analysis of barriers to energy efficiency, citing a range of reasons why uptake of energy efficiency by firms might be less than optimal:

---

27 W.H. Golove and J.H. Eto 1996, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*, LBL-38059, eetd.lbl.gov/ea/EMP/ee-pubs.html, p32.

> The individuals making up a business firm may all be rational seekers after their own interest, but the outcome of their collective action may be suboptimal. The logic of collective action is such that, in general, 'rational, self-interested individuals will not act to achieve their common or group interests. This principle applies to private sector corporations as well as to government bureaucracies or political collectives. The presence of public goods, externalities, and the clash between individuals' private incentives and the good of the whole all combine to produce outcomes that fall short of what could be obtained if all the resources of the group were deployed by a single guiding intelligence.
>
> … It follows from these considerations that deviations from full profit maximization should not be surprising. Indeed, a long standing and respected tradition in economic thought holds that business organizations can only approach or approximate profit maximizing behaviour, because of the complexity of the environment they face and limitations on the decision making resources they command. The most famous proponent of this view is Herbert Simon, the Nobel laureate who pioneered the notion that 'satisficing' rather than 'maximizing' is descriptive of how firms actually operate.
>
> … Under this view of the operation of the firm, a understanding of the forces that lead to any particular pattern of behaviour (regarding, say, energy management) could only be obtained by a careful, microlevel examination of the actual decision making processes of the firms themselves. It would be necessary to see, in specific instances, exactly what sort of informational, computational and organisational constraints were faced by particular firms in order to understand why they did or did not make particular investments.[28]

As a result business managers may be reluctant to invest in projects where a potentially negative outcome may adversely impact on their own welfare. Thus if the benefits of an investment are difficult to quantify and estimate to a reasonable degree of certainty, or do not show a short-term positive outcome (such that they are likely to gain credit), then the manager may under-invest in energy efficiency. The owner of the business or the senior executive, lacking information about why the decision was made, will not be able to intervene to ensure that an investment is taken that is an economically rational decision.[29]

Some decision-makers, such as managers, may also confront perverse incentives in relation to energy efficiency measures. For example, if energy efficient measures involve a long payback period, but a manager's performance is assessed over a shorter period, it may not be in the manager's interest to invest in energy efficiency, despite it being optimal from the firm's perspective. This may be compounded where managers do not have the expertise to assess the future prospects of a potential energy efficient investment, as there is greater risk inherent in adopting the measure.

Within an organisation, this strong emphasis on quick returns may be fuelled by managerial rotation practices that, on the one hand, keep managers interested and engaged in their work, but, on the other hand, likely privilege investments with shorter payback periods than may otherwise be the case. This is likely to be amplified by tying managerial compensation to short term performance targets. To the extent, too, that managers are risk averse, managers will be deterred from investing in projects where there is any uncertainty in the performance of the investment. Where managers fail to invest in investments that are profitable but have longer payback periods than is targeted, this is an 'irrational' decision in that it will fail to fail to maximise profit for shareholders.

[28] S.J. De Canio 1993, Barriers Within Firms to Energy Efficient Investments, *Energy Policy*, September, p 906 – 914.

[29] RA Lambert, 1986, 'Executive effort and Selection of Risky Projects,' *Rand Journal of Economics*, Vol 17, No 2, Spring 1986.

Box 3.5

THE SPRU BARRIERS PROJECT

The most highly developed assessment of barriers to uptake of energy efficiency was undertaken by the Science and Technology Policy Research Unit at the University of Sussex. The primary objective of the project was to link empirical results to a systematic theoretical framework using ideas from several traditions. The validity of these ideas was then tested using in-depth case studies of energy decision-making in a number of representative organisations. A total of 46 case studies are used, drawn from the higher education, brewing and mechanical engineering sectors in three countries - Germany, Ireland and the UK.

The research results suggest very strongly that, considering capital and operating costs alone, there are a large number of highly cost effective efficiency opportunities in all the organisations studied. The research therefore supports the results of engineering-economic models in pointing to the existence of a wide range of barriers.

One of the strongest messages is the importance of staff time constraints. If salary overheads are required to be recovered from investment projects, stringent payback criteria for the capital cost alone can often be justified. But while it is hard to justify loading all salary overhead costs onto investment projects, it is difficult to state what proportion of costs should be treated in this way. A second strong message is the importance of limited access to capital. This reflects both an overall reluctance to borrow and the low priority given to energy efficiency within internal capital budgeting procedures. This can be explained through a combination of difficult business situations, perceptions of risk associated with increased gearing and the strategic priorities of management. But assessment of whether this is rational will depend upon judgements about the future business situation, the response of the financial market to increased gearing, and movements in interest and exchange rates.

A third strong message is that there is more than one plausible explanation for the adoption of strict investment criteria. These include: recovery of salary overhead costs; responding to business risk; monitoring & control problems in principal-agent relationships and the financing risk associated with increased gearing.

The results show that the majority of observed behaviour can be explained using economic theory - additional concepts from behavioural theory and organisational theory do not significantly aid understanding. However, there is considerable value in replacing traditional economic assumptions about decision-making with that of ‘bounded rationality’, where individuals make decisions subject to severe constraints on attention, resources and their ability to process information. An important consequence of this is that energy efficiency may be ignored even if the individual or department is paying the energy bill and even if they are relatively well informed. Generally bounded rationality provides a limit to what can be achieved through correcting market and organisational failures.

The most important barrier - salary overheads and time constraints - does not provide a rationale for policy intervention. However the importance of this barrier may be reduced by changing the ratio of energy to employment costs through revenue neutral energy taxation. Such measure can be legitimated with reference to environmental externalities and can have an impact that is out of proportion to its effect on costs alone.

Other barriers can be seen as creating a systematic bias against energy efficiency. While energy efficiency and energy supply provide alternative means of supplying energy services, the transaction costs of purchasing the former greatly exceed those for the latter. This is compounded by bounded rationality in individual decision making and failures in organisational decision making owing to problems in transmitting information between individuals and departments. Taken together, these provide a strong case for government intervention, both to correct failures in the market for energy services and to improve organisational decision-making. Through such measures governments can help organisations to make economically efficient decisions which benefit both themselves and society at large.

Given the diversity of barriers in different contexts a wide ranging policy mix is recommended, with initiatives at the organisational, sectoral, national and international level. For example, possible measures in the higher education sector include: improved reporting and benchmarking of university energy consumption; reform of university purchasing procedures; promotion of energy service contracting; market transformation programs for technologies such as motors; and a series of measures within the construction industry, including the use of partnering and integrated design.

Source: www.sussex.ac.uk/Units/spru/environment/research/barriers.html#outputs

Uncertainties in the performance of energy efficiency investments are also likely to be driven by owners of commercial and industrial firms. Some economists[30] have theorised that owners set the hurdle rate for investments significantly higher than is actually required by the underlying cost of capital as a 'premium' to ensure that only profitable projects are undertaken and as a guard against managerial 'slack'.

Evidence on the 'micro-level examination of the actual decision making processes of firms' is thin on the ground. Programs that have analysed corporate processes and the associated decision-making on energy efficiency are the United Kingdom's and the Australia's Energy Efficiency Best Practice Program, and the SPRU BARRIERS project (Box 3.5). These programs have shown that a lack of resources dedicated to examining energy efficiency, and a lack of capacity to deal effectively with information where it is available, have led to significant cost-reducing opportunities being overlooked. To quote Rigby:

> The UK's major energy efficiency programme of the last decade, the EEBPp (Energy Efficiency Best Practice programme), has been widely regarded as the canonical example of an approach which addresses market failures that result when insufficient or inappropriate information impedes the diffusion of energy efficiency technologies and techniques to all those who have an economic interest in using such information. OECD publications on energy efficiency policy cites the UK as a leading example of such an information programme, giving as the reason for its need the low level and poor quality of information about energy efficiency technologies. However, the development and delivery of this Programme has seen considerable attention given by the civil servants required to implement it to the skills, abilities and resources that individual firms require to install, configure and operate energy efficiency technologies and techniques. While therefore "dealing with market failure" has been a popular shorthand for the model of Programme operation, in practice, the Programme managers have relied upon broadening and deepening capacities of firms and also modifying the practices of those supplying firms with technologies and techniques.
>
> Information shortages for firms appear often not to be so important for technology choice and implementation as the resources of the firms themselves. A key theoretical distinction which is made between firms' specific and common information costs also proves to be difficult to observe in practice. The operationalisation of this major piece of the UK's energy efficiency policy therefore suggests that the notion of market failure based on in informational problems of the market, while a useful construct, is problematic. The empirical work reported here on the implementation of Energy Efficiency Best Practice programme suggests that programme managers evaded the rhetorical requirements of policy and were able to deal with the capabilities of firms. (Consequently, energy efficiency information provided by government is not a pure public good.)[31]

What this suggests is that firms (and by extension also individuals) first lack the capacity to assess energy efficiency opportunities adequately, and secondly, lack appropriate internal systems and incentives to do so.

Bounded rationality

For the small energy consumer, the situation is not helped by energy comprising a small proportion of expenditure for the householder — consumers are often more informed about upfront costs than ongoing costs, which can tend to lead to irrational decision making. Furthermore, behavioural theory highlights that 'bounded rationality', or inability to process information, which is compounded by constraints on time and attention, and can also lead to less than optimal decision making. This adds to existing inertia to change, preventing uptake.

[30] R. Antle and GD Eppen, 1985, 'Capital rationing and organizational slack in budgeting,' *Management Science*, Vol 31, No 2, p163-174.

[31] J. Rigby 2002, *When Rhetoric Meets Reality — Implementing Policies Based on Market Failure: Some Observations from the Development and Delivery of the UK's Energy Efficiency Best Practice Program*, University of Manchester PREST Discussion Paper 02-10, les.man.ac.uk/PREST.

In economics, satisficing is behaviour observed when a person or organisation attempts to achieve at least some minimum level of a particular variable — but which does not strive to achieve its maximum possible value. As noted above, this can reflect the difficulties of internal organisation, but it can also reflect 'bounded rationality': persons that exhibit bounded rationality' experience 'limits in formulating and solving complex problems and in processing (receiving, storing, retrieving, transmitting) information'[32] This behaviour is likely to be a major component in the potential gap that may exist for the residential sector, where private agents have relatively limited resources to examine potentials for increasing their financial returns for all investments (Box 3.6).

Box 3.6

UPFRONT COSTS AND BOUNDED RATIONALITY

An irrational focus on upfront costs is one of the primary candidates for slow rates of energy efficiency uptake, and is symptomatic of bounded rationality. Consider the example of an investment in more energy efficient water heating. In Perth, it is possible to make an investment in a gas boosted solar water heating unit for $4,200 (ignoring any potential Mandatory Renewable Energy Target rebates). This is a $3,000 increase over the alternative gas storage water heating technology, which costs customers an average of $1,200 for the unit. Taking a purely rational perspective, consumers should prefer to invest in the more expensive gas boosted solar water heating unit because they could borrow money on their home loan and pay less interest and principal than the actual savings in energy they make — the annual cost of financing the $3,000 difference on a hypothetical 25 year home loan would be approximately $236 at prevailing market rates, while the annual energy savings in gas would be $300. Thus, in rational terms, the consumer would be better off even in the first year of investment, by $64 dollars.

However relative to their total income these savings are likely to be quite small. From a bounded rationality perspective, the agent will work towards saving money on their expenditure, but may not be willing to outlay upfront costs to eke out the extra $64 dollars in savings per year, which over a 25 year life would be worth roughly $1,000 if discounted at an appropriate opportunity cost of capital (here a riskless four per cent).

In addition, the impact of the size of the upfront investment in energy efficiency on the decisions made by the consumer should not be ignored. Take again, the example of the $3,000 investment. It is plausible that many consumers have a threshold above which a cash outlay is considered a 'major' investment. The thought process, when deciding on whether to invest in energy efficiency is likely to start with a consideration of what they might reasonably do with such a 'major' outlay of cash — say, invest in equity stocks or aesthetic housing improvements. Consumers tend to ascribe to these investments far higher expected rates of return.

The consumer then considers the feasible basket of investments toward which he may allocate this 'major' cash outlay, including the investment in energy savings. While economics would argue that rational investors should discount the expected stream of cash flows at the opportunity cost of capital for the next-best alternative investment of *comparable* risk — it may be that consumers do not adopt this approach. Rather, they may discount the future savings expected for the energy efficiency investment using an opportunity cost of capital for the other, alternative investment that they could feasibly make with such a substantial cash outlay — the investment in equity or the home improvement. This would have the effect of making the relatively riskless cash flows associated with the energy efficiency investment appear relatively unattractive — especially if one were to add in the effect of potential transaction costs (researching what the price of gas will be for the next 25 years, calculating the returns compared with other investments) and the potential influence of satisficing. This would the action of an 'irrational' agent and economic theory would suggest that this should not happen in reality.

Source: The Allen Consulting Group

[32] Williamson, Oliver (1981). 'The Economies of Organization: The Transaction Cost Approach'. *American Journal of Sociology*. Vol 87, pp. 533.

Bounded rationality of individuals is also an issue for firms, as the theory of bounded rationality originated in examinations of the firm's true profit maximisation behaviours. Within the commercial and industrial sectors, satisficing behaviour may also be a contributing factor in the poor uptake of more energy efficient technologies and practices. In fact the most common application of the concept of bounded rationality or satisficing in economics is in the behavioural theory of the firm, which, unlike traditional accounts, postulates that producers treat profit not as a goal to be maximized, but as a constraint.

Under these theories, although at least a critical level of profit must be achieved by firms, this is accomplished by setting priorities using approximations rather than exact first order condition maximisation calculations. Firms accomplish this by looking for 'satisfactory goals rather than optimal ones,' dividing global goals into many sub-goals, or 'divide up the decision making task among many specialists.'[33] In part, at the commercial and industrial level, because complex organisational structures are devised to manage complex investment decisions, it is likely that firms fail to make 'optimal' investments. In this sense, even if all the agents are rational decision makers, the organisation may be an imperfectly formed structure, such that information and calculations about investments are sub-optimal (though generally satisfactory or difficult to identify as non-equilibrium outcomes). This provides opportunity for policy — as Paton notes:

> … opportunities for firms to harbor inefficiencies abound. Conventional economic theory — if properly attuned to these inefficiencies — could provide potentially valuable methods for approximating the efficiency frontier against which the efficiency of actual firms could be estimated.[34]

3.6 Conclusions

Based on the literature, a range of barriers to investing in energy efficiency have been identified. To the extent that policies are available to reduce these key barriers in a cost effective manner that raises overall economic welfare, then the barriers can be considered to be market failures.

In this context, key market or regulatory barriers warranting consideration for policy intervention include: [35]

Related to issues of incorrect relative prices:

- Incorrect relative prices in markets for energy:
  - Regulated energy prices set below the incremental costs of generation, transmission and distribution, particularly for peak loads;
  - Inadequate institutional arrangements for considering energy efficiency as an alternative to network augmentation;
- Lack of incorporation of externalities in energy pricing;

---

33 S.J. DeCanio, 1993, 'Barriers within Firms to Energy-Efficient Investments', *Energy Policy*, p 907.

34 B. Paton 2000, Efficiency gains within firms under voluntary environmental initiatives, *Journal of Cleaner Production*, 9 (2001), p 176.

35 This distinction between market failures related to relative prices and to other factors draws from the analysis in Energy Modeling Forum 1996, *Markets for Energy Efficiency*, EMF Report 13 Volume 1, www.stanford.edu/group/EMF/home.

Not related to issues of energy prices:

- Information failures;
  - Imperfect information, including under-provision due to public good aspects;
  - Asymmetric information, including adverse selection;
  - Principal/agent problems, including split incentives;
- Multiple decision makers;
  - Firm/agent external organisational constraints; and
  - Firm/agent internal organisational and bounded rationality constraints.

.

Chapter 4

Cost effective policy for energy efficiency

Economic theory suggests that overall economic welfare is maximised when the costs and benefits of actions undertaken by individual agents in the economy are aligned with the 'social' costs and benefits of those actions. In this context, optimal policy for energy efficiency should aim to close any divergences between the marginal social costs and benefits and the marginal private costs and benefits of investing in energy efficiency, where it is cost effective to do so.

The net social benefits of investing in energy efficiency may diverge from the net private benefits where there are market failures —affecting either the uptake of energy efficiency goods and services directly, or arising indirectly from within the market for energy (given that energy is a substitute for energy efficiency goods and services).

As noted in Chapter 2, impediments to uptake of energy efficiency, that cannot be overcome cost effectively, are not classed as divergences between net social and private benefits. Examples of these types of impediments include features common to day to day decision-making in all markets across the economy, such as high discount rates (related to risk) and scarcity of resources, including capital. However, to the extent that these barriers are more pronounced in markets for energy efficiency compared to largely equivalent investments in the rest of the economy, and can be overcome cost effectively, they may justify intervention.

The cost effectiveness requirement recognises that there can be costs to intervening in markets, and the possibility of regulatory or other government failures when intervening. As a result, careful design of any policy intervention is required at the outset. Ex post follow-up and evaluation is also important, to assess outcomes and ensure that ex ante expectations for policy are met.

The notion that there are net social benefits from cost effective intervention does not necessarily imply that all individuals will be better off, but rather that the benefits for those individuals in the economy who are better off outweigh the costs to other individuals and the costs of intervention, leading to an overall net social benefit. It is worthwhile noting that overcoming market failures in energy efficiency is likely to be of benefit to many, leaving very few worse off. In this sense, cost effective improvements in energy efficiency are likely to be close to the Pareto ideal for improvements in economic welfare.

Economic theory further suggests that the costs of intervention can be minimised by adopting first-best policies. First-best policy involves making an appropriate policy intervention as close as possible to the point of divergence.[36] For example, a first best policy to overcome an information failure would provide the information directly. Where a first best policy is not available due to constraints on the form of intervention, or where other market failures exist, it is still possible to design a policy that is welfare improving, even if welfare is not optimised.[37] In the case of an information failure affecting energy efficiency, a second-best policy might involve subsidising uptake of energy efficiency.

In summary, a first best approach to reduce market failures impeding investments in energy efficiency should aim to overcome directly the barriers causing the divergence in benefits, as close as possible to their source, where it can be demonstrated that the benefits of intervention outweigh the costs, including the costs of intervention.

4.1 The key barriers to energy efficiency

Chapter 3 identified a range of key market or regulatory barriers impeding uptake of energy efficiency, including:

Related to issues of incorrect relative prices:

- Incorrect relative prices in markets for energy:
  - Regulated energy prices set below the incremental costs of generation, transmission and distribution, particularly for peak loads;
  - Inadequate institutional arrangements for considering energy efficiency as an alternative to network augmentation;
- Lack of incorporation of externalities in energy pricing;

Not related to issues of energy prices:

- Information failures;
  - Imperfect information, including under-provision due to public good aspects;
  - Asymmetric information, including adverse selection;
  - Principal/agent problems, including split incentives;
- Multiple decision makers;
  - Firm/agent external organisational constraints; and
  - Firm/agent internal organisational and bounded rationality constraints.

[36] Intervening further from the point of divergence imposes additional by-product distortions, reducing the economic efficiency of the intervention (for example see W.M.Corden 1974, *Trade Policy and Economic Welfare*, p. 28).

[37] This is the 'theory of second best', whereby second-best policies improve welfare but do not deliver the optimum outcomes associated with first-best policies.

To the extent that policies are available to reduce these key barriers in a cost effective manner that raises overall economic welfare, then the barriers can be considered to be market failures. The rest of this chapter considers policy options to address each of these barriers, and assesses whether intervention is likely to be welfare enhancing.

Table 4.1

POLICY MECHANISMS

Type	Description
Control mechanisms	
C1	Mandatory sourcing of energy efficiency
C2	Energy efficiency license conditions for electricity businesses
C3	Integrated resourced planning
C4	Energy efficiency and load management as alternatives to network expansion
C5	Monopoly regulation and pricing[38]
C6	Codes and standards (building codes, MEPS)
C7	Licences, permits and trading schemes for greenhouse gas emissions
Funding mechanisms	
F1	Public benefits charge for energy efficiency
F2	Financing of energy efficiency by electricity businesses
Support mechanisms	
S1	Sustainable energy training schemes for practitioners
S2	Energy centres
S3	Creating entrepreneurial energy organizations
S4	Developing the ESCO industry
S5	Promotion of energy efficiency by industry associations
S6	Aggregating electricity purchases to achieve energy efficiency
S7	Voluntary agreements for energy efficiency
Market mechanisms	
M1	Taxes on energy
M2	Tax exemptions, subsidies and incentives for energy efficiency
M3	Providing consumption information on customers' electricity bills
M4	Communicating pricing and other information for energy efficiency
M5	Energy performance labelling
M6	Developing an energy efficiency brand
M7	Cooperative procurement of energy efficiency appliances and equipment
M8	Energy performance contracting
M9	Competitive sourcing of energy services
M10	Competitive sourcing of demand-side resources
M11	Demand side bidding in competitive markets

Source: E. Vine, J. Hamrin, N. Eyre, D. Crossley, M. Maloney, G.Watt 2003, Public policy analysis of energy efficiency and load management in changing electricity businesses, *Energy Policy* 31 (2003) 405-430.

[38] 'Revenue regulation' has been changed in this paper to 'Monopoly regulation and pricing' to reflect a broader set of options.

4.2 Policy options

A useful list of generic policy mechanisms available to address market barriers and failures for energy efficiency is outlined by Vine et al, sorted according to the method of operation of the mechanism (Table 4.1). Policy options range from support mechanisms that provide expertise and information, through to more stringent market fiscal and regulatory (control) approaches.

4.3 Analysis of policy options

Having identified the key barriers and market impediments in Australia working against energy efficiency, and the range of available policy mechanisms, we are in a position to assess what mechanisms might improve energy efficiency in a cost effective way in Australia.

As noted above, good policy should aim to close the energy efficiency gap by addressing failures at source, cost effectively. In light of the key barriers outlined above, policies could therefore aim to:

- ensure appropriate relative prices;
- overcome information gaps;
- reduce organisational, bounded rationality and transactions cost constraints preventing uptake of cost effective energy efficiency.

A range of barriers was identified earlier in the paper. Each of the foregoing three key objectives for action to improve energy efficiency has the potential to help address a range of the identified barriers, including the primary identified barrier (Table 4.2).[39]

Policy intervention for energy efficiency can be evaluated in terms of the overall effectiveness in improving energy efficiency, as well as its impact on economic efficiency and equity:

- effectiveness — does the instrument improve energy efficiency;
- efficiency — is the increased energy efficiency achieved economically (does not necessarily imply the most technically efficient solution from an engineering perspective);
  - relative benefits of the policy outcomes in terms of overcoming market failures;
  - budgetary and other cost impacts;
  - by-product distortionary impact; and
- equity
  - is the burden distributed fairly;
  - and by implication, is the policy politically feasible.
- dynamic efficiency — an instrument might be preferred if it is not only effective in meeting a specified goal, but if it provides incentives to

[39] The list of barriers addressed in Table 4.2 draws on that set out in Vine et al 2003 op. cit.

encourage further efficiency, is adaptable to changing economic circumstances and helps adjust to long-term trends in technology, consumer tastes and the broader market..

In what follows, policy interventions first are discussed in detail, then at the end of each section, a brief evaluation of each intervention is made in terms of the criteria listed above.

Table 4.2

GROUPING ACTIONS WITH BARRIERS

Action to address EE gap	Key market or regulatory failure
Ensure appropriate relative prices	• Poor incentives from monopoly regulation, including inadequate price signals for end use • Inadequate institutional arrangements for considering energy efficiency as an alternative to network augmentation • Lack of incorporation of environmental externalities related to greenhouse in energy pricing
Overcome information gaps	• Imperfect information • Public good under-provision • Information asymmetries • Principal/agent problems • Information search costs, lack of awareness or data on energy efficiency opportunities *also* • Views of upper management • Lack of available expertise to advise on implementing energy efficiency • Performance uncertainties
Reduce organisational constraints preventing uptake of cost effective energy efficiency	• Multiple decision makers • High transactions costs in implementation • Inadequate attention to market transformation, particularly during energy market restructuring • Lack of energy efficiency industry *also* • Product or service unavailability • Inseparability of product features • Lack of legal or contract precedent • Limited investment capital available for energy efficiency • High initial cost • Increased product choices in energy efficiency

Source: The Allen Consulting Group

4.4 Relative prices

At noted in Chapter 3, relative prices are a contributor to a lower than optimal rate of uptake of energy efficiency, although the response by end users —to use more energy in the face of energy prices below socially optimal levels — is perfectly rational. As such, 'the energy efficiency gap', which refers to neglect of energy efficiency investments that are cost effective at current prices, is not influenced by relative prices. Nevertheless, relative prices are included in the policy prescription because of the longer term value to foster appropriate price signals in energy markets. To the extent that current prices for energy are too low, corrective policy will result in an increased uptake of energy efficiency in the future.

Improving relative prices relates largely to the regulation of the monopoly elements of the supply chain of energy, however, policies to address environmental externalities are also important. Key measures include:

- more efficient price signals for the consumption of energy;
- improved processes and incentives for consideration of load management as alternatives to network expansion; and
- incorporating environmental externalities related to greenhouse gas emissions in energy prices.

Improved price signals

As noted in Chapter 3, reform of energy markets has been underway in Australia for a number of years. Governments have made significant progress developing appropriate market and regulatory arrangements, but scope for improvement remains. For example, the NSW Independent Pricing and Regulatory Tribunal (IPART) found in their 2002 review of demand management:

> A range of barriers … to implementing network driven demand management options have been identified. Some of the most important of these relate to the regulatory environment. In NSW, revenues and average network prices are regulated by the Tribunal, so network investment decisions are made within a regulated environment, not a competitive one. Within this environment, DNSPs [distribution network service providers] have responsibility for setting network charges. Currently, network tariffs are largely uniform throughout a distribution area and do not signal peak or location costs to consumers. This means end users do not have an incentive to modify their behaviour in ways that would reduce capacity constraints.[40]

This lack of efficient pricing will have a bearing on decisions on uptake of energy efficiency by consumers, as greater use of energy is a substitute for investment in energy efficiency.[41]

40 Independent Pricing and Regulatory Tribunal of NSW 2002, *Inquiry into the Role of Demand Management and Other Options in the Provision of Energy Services Final Report*, www.ipart.nsw.gov.au, p76.

41 Lack of efficient pricing also influences decisions in relation to distributed energy resources more generally — including solar hot water, renewables such as photovoltaics, and domestic scale cogeneration.

A key problem in energy markets relates to the current rapid growth in peak loads, particularly use of air conditioners on hot summer days. Appropriate pricing of electricity in peak periods would reduce the implicit subsidy received by consumers installing air conditioning, which is currently a major driver of the rapidly increasing summer electricity peak across much of Australia.[42] In turn, by facing the true costs of their adoption of air conditioning, consumers will have greater incentive to consider more efficient appliances, as well as cost effective alternatives to keeping cool, such as improved building shells.

Box 4.1

MANAGEMENT OF PEAK LOAD GROWTH IN NEW ZEALAND

In New Zealand concerns over the cost of system augmentations at both the distribution and transmission levels have created considerable interest in the cost signalling role of network charges. For some years now two South Island distributors, Dunedin Electricity and Orion New Zealand, have used a form of congestion pricing to signal the cost of network demand constraints. This approach involves:

- a separate congestion period charge is applied at times when demand on the network (coincident demand) is high
- the charge is based on the long run incremental cost of those network elements sized to meet coincident system demand; separate congestion charges are applied to distribution and transmission network use
- the charges apply to electricity used during declared congestion periods when demand on the network reaches levels at which the distributor is required to control load; the timing and duration of the congestion periods is determined by the level of coincident demand, allowing real time demand responses from customers
- information provision and market activation programs are used to support the price signal; customers and retailers are provided with regular updates on the likelihood of congestion conditions emerging; notice of an impending congestion period is provided through a range of media
- for customers with compliant metering a ripple control signal is sent out; in combination with the advance notice of a congestion period provided by the distributor, this allows demand responses, either automated or manual, to be triggered
- congestion periods only apply during the months of peak demand; network areas are designated as either winter peaking or summer peaking.

Both Dunedin and Orion use the congestion charge in combination with fixed charges and capacity charges. The congestion charges are significant. Currently Orion recovers approximately 45 per cent of its distribution network revenue from this source.

As Dunedin comment in their pricing statement:

> By signalling demand constraints in this way, Dunedin Electricity is able to defer the need for investment in more capacity which is a very expensive alternative. Load is controlled only when the network loading is approaching the network's capacity. Consumers do not have to respond every time the signal is sent. Many will respond only when it suits, however the rewards for responding are substantial.

Since introducing congestion period pricing in the mid-1990s, Orion has recorded minimal growth in system peak demand. Consequently its customers have been spared the expense of peak driven additions to distribution and transmission network capacity. Interestingly these pricing approaches have been developed by the distributors without the need for any regulatory prompting.

Source: East Cape 2002, *Efficient Network Pricing and Demand Management*, IPART Research Paper No 18, www.ipart.nsw.gov.au.

[42] CRA estimated that a 1Kw increase in air conditioning load that is run for 24 cumulative hours a year (during peak hot summer demand periods) will receive a subsidy — quantified as the difference in marginal revenue that should be earned over the period to cover capacity expansion and the actual marginal revenue earned — of $91.15. The average new household air conditioner uses 4 Kw, so the potential subsidy is $365. The air conditioner would need to be run for 2,170 hours to recover marginal costs fully. (Charles River Associates 2003, *Impact of Air Conditioning on Integral Energy's Network*, Consultancy Report prepared for Integral Energy, www.ipart.nsw.gov.au/submiss/ENR_DNSPs_03/).

IPART, for example, have in response flagged that they will encourage trials of congestion pricing to address peak load issues. By extending appropriate time of use pricing arrangements to smaller commercial and household customers (many larger customers already face time of use pricing), it is possible to influence consumer behaviour and significantly attenuate growth in peak demand through congestion pricing (see Box 4.1).

Metering is an important element facilitating time of use pricing. Advances in technology now make it cost effective to offer interval metering to even small customers. For example, Victoria recently has mandated the full roll-out of interval meters to all customers. In taking that decision, the Essential Services Commission noted that:

> Interval meters have strong potential to improve the efficiency of the electricity market. These benefits arise from avoided generation, transmission and distribution capacity costs (demand management) …. the demand management benefits are likely to ….. provide the capacity and incentive for customers to manage their electricity consumption more efficiently. The efficiency of the electricity markets increases when customers respond to high price signals by reducing their demand for electricity or shifting their use to lower priced times. In this way, the market would benefit from the reduced need for capacity to meet otherwise higher peak demands.[43]

However, it is clear that substantial effort will be needed to access the full benefits of interval metering. As the Ministerial Council on Energy User Participation Group note:

> The work undertaken to date suggests that the full benefits of interval metering would only be harnessed if both distribution and retail charges were based on time-of-use data and the wholesale electricity market settled on the basis of this information.[44]

Nevertheless, interval meters present a promising approach to delivering increased cost reflectivity in energy prices, and improved signals to consumers for alternatives to energy consumption.

Where interval meters are not widely available, consideration can be given to varying tariffs to better reflect peak loads, for example through seasonal or increasing block tariffs, or to more comprehensive approaches such as those adopted in New Zealand (Box 4.1).

In similar fashion to peaks, many consumers in more remote locations do not face the full cost of the network services used to deliver energy because network prices tend to be averaged across the whole network. While this is a political decision to address equity for regional users, it is feasible that community service obligations could be paid explicitly as a lump sum compensation, allowing remote locations to face the full price for their energy. End users would then have greater incentive to take cost effective actions that improved the efficiency of energy use.

Finally, unnecessary retail price regulation that shields consumers from the true costs of energy provision also discourages investment in cost effective energy efficiency. As retail markets become progressively more competitive, the need for price regulation should diminish.

---

[43] Essential Services Commission 2004, *Mandatory Rollout of Interval Meters for Electricity Customers: Final Decision*, www.esc.vic.gov.au.

[44] Ministerial Council on Energy Standing Committee of Officials 2004, *Improving User Participation in the Australian Energy Market: Discussion Paper*, User Participation Working Group, www.industry.gov.au.

In summary, improved pricing in energy markets has a clear potential to deliver better economic outcomes. Many of these benefits arise from the direct benefits of reduced network capital requirements to deliver consumers' energy needs. However, there is also the indirect benefit in terms of signalling appropriate investments to alternatives to energy consumption, such as end user energy efficiency. While non-cost reflective energy prices may not be the most important market failure affecting investment in energy efficiency, it is a contributor.

Load management as an alternative to network expansion

Regulatory arrangements for distribution network service providers (DNSPs), particularly price capping arrangements, can create barriers to demand side actions. This is because DNSPs do not receive full recompense for demand side actions under network pricing structures.[45] IPART, for example, have recognised this and have adopted a range of mechanisms to improve incentives for network driven demand management.[46] These include DNSPs being able to:

- pass through demand management costs, up to the avoided distribution costs;
- recover foregone revenue as a result of demand management programs.

Box 4.2

ENERGY EFFICIENCY AS AN ALTERNATIVE TO NETWORK EXPANSION

Over the past four years, electricity consumption in Castle Hill area in Sydney has increased by 32 per cent, and is forecast to grow by a further 54 per cent over the next 10 years. Integral Energy is the local electricity distribution company. Because of the continued rapid development of the Castle Hill district, Integral forecasts that it will need to spend more than $3 million to expand the Castle Hill electricity substation within two years. Integral is examining ways in conjunction with the NSW Department of Energy and Utilities (DEUS) to reduce strain on the network, and to defer the need for an upgrade on the Castle Hill substation, by reducing the demand for electricity during the peak periods. A reduction in peak demand by 1,350kVA is required (approximately 4% of the peak electrical load on the local network).

Some of the initiatives for the Castle Hill Demand Management Project include:

- Castle Towers Shopping Centre:
  - better use of a Building Management System to ensure equipment is only turned on when it is needed;
  - more efficient lighting in common areas;
  - use of a monitoring system in the car park to ensure exhaust fans are only used when needed;
- Bi-Lo Supermarket
  - improved use of existing air-conditioning controls;
  - upgrading air-conditioning equipment by installing more efficient compressor valves as well as equipment to reduce the humidity and temperature of air being drawn into the system from outside;
  - installing lighting controls to allow more efficient use of existing lighting system; and
  - optimised controls for refrigeration.

Integral are willing to pay up to $150 per KVa of reduced load. This provides a revenue stream for DEUS to implement the project, as well as provide a $60 per KVa 'bounty' to subsidise the uptake of the energy efficiency initiatives.

Source: Department of Energy, Utilities and Sustainability 2004, *Fact Sheet: Electricity Demand Management in Castle Hill*, www.energysmart.gov.au

[45] Independent Pricing and Regulatory Tribunal of NSW 2002, op. cit.

[46] Independent Pricing and Regulatory Tribunal of NSW 2004, *Treatment of Demand Management in the Regulatory Framework for Electricity Distribution Pricing 2004/05 to 2008/09*, www.ipart.nsw.gov.au, p1.

Among other things, these arrangements provide scope for DNSPs to contract for energy efficiency as an alternative to network augmentation, in constrained sections of the network, where it is cost effective to do so (see Box 4.2). The demand from DNSPs for energy efficiency in these areas has the potential to add to the incentives for individual consumers and firms to adopt cost effective energy efficiency, further affecting relative prices between energy supply and energy efficiency.[47]

Environmental externalities

To the extent that major energy production and industrial facilities are required to address environmental issues as part of their licensing processes, then the costs of that control of environmental impacts will be included in energy prices.

Environmental impacts currently controlled in Australia include local ambient air quality and the release of air toxics. Emission of scheduled pollutants must meet the standards of the relevant National Environment Pollutant Measures, administered by the Environment Protection and Heritage Council.[48]

However, a major environmental impact omitted from energy pricing in most jurisdictions in Australia relates to the greenhouse gas emissions associated with energy production and use. A first best approach to dealing with emissions of greenhouse gas emissions is to put a price on emissions, commensurate with the marginal damages caused. However, there is considerable uncertainty as to the impacts of climate change and the associated damages. Despite the uncertainties, global action to mitigate greenhouse gas emissions is underway under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC).

Australia has chosen to meet its greenhouse objectives independently of the international actions proposed under the Kyoto Protocol to the UNFCCC (which include provision for 'flexibility mechanisms' such as emissions trading). The Commonwealth Government has committed not to introduce domestic emissions trading, which would put a price on carbon, in advance of 'effective longer-term global action on climate change'.[49]

---

[47] For example, two firms out of twenty major industrial enterprises that participated in a survey of demand side response implemented energy efficiency as a long term load management strategy. Firms in this survey had the expectation that retailers should offer demand side programs compared to other market participants such as DNSPs and generators. This expectation was in part raised by retailers already having approached firms offering demand side initiatives and/or that retailers were likely to have the best understanding of their business operations. The surveyed firms expected retailers to provide:

- technical expertise in load reduction technologies;
- assistance in identifying and scooping demand side opportunities on the customers site; and
- a sufficiently attractive incentive to make participation worthwhile.

PHB Hagler Bailly 2002, *Survey of Demand Side Participation in the National Market*, prepared for the National Electricity Code Administrator, www.neca.com.au.

[48] For the details of National Environment Pollutant Measures, see the Environment Protection and Heritage website: www.ephc.gov.au.

[49] Commonwealth of Australia 2004, *Securing Australia's Energy Future*, Energy Task Force, Department of Prime Minister and Cabinet, www.pmc.gov.au, p25.

The exception is in NSW, where the Greenhouse Gas Abatement Scheme (GGAS) creates a mechanism to reduce the greenhouse gas intensity of electricity production and use. This mechanism has been estimated to raise the price of electricity in NSW by around $3 per MWh, although the price impact will be less to the extent that the provisions in the GGAS for demand side contributions are successful.[50]

By raising the price of energy supply, such as for electricity and gas, emissions charges help to close or 'internalise' the environmental externality in energy pricing, and work to reduce energy use by changing relative prices. In response, investment in energy efficiency will increase, although the amount of change will depend on the elasticity of energy demand. This 'demand side' response will tend to be most pronounced for large users of energy, such as major industrial facilities, who have a more elastic demand for energy (at least in the long run). Smaller residential and business consumers tend to be less affected by relative prices, given that energy bills are a small proportion of their overall costs.

The existence of other market failures will also tend to mute the impact of relative price signals. Nevertheless, the existence of even small emissions charges can have important signalling effects that help to influence behaviour in the short term, and over the longer term, induce significant technological response.

Relative prices — evaluation

Improved pricing and load management as an alternative to network augmentation are judged to have relatively small impacts on uptake for energy efficiency (Table 4.3). Nevertheless, the first two options tend to have low costs as there are valid reasons for undertaking these measures on other grounds (for example, more efficient markets for energy through load shifting, better network capital utilisation etc). Addressing environmental externalities in greenhouse has potential to increase average energy prices significantly, and result in long run dynamic benefits through induced technical change. In the short term, however, other non-price market failures may retard optimal energy efficiency response to greenhouse pricing (and also other price reforms relating to energy markets).

Table 4.3

ASSESSMENT OF POLICIES TO IMPROVE RELATIVE PRICES

Mechanisms	Impact on EE	Benefits to end users	Cost to budget	Political feasibility	Dynamic benefits
Improved energy price signals	Small	Moderate	Small	Moderate	Large
EE alternative to network expansion	Small	Moderate	Small	High	Moderate
Environment Externalities	Moderate	Potentially Large	Small	Moderate	Large

Source: The Allen Consulting Group

[50] National Economics 2004, *Impact of Greenhouse Policy on Electricity Demand*, A Report for the National Electricity Market Management Company, www.nemmco.com.au/nemgeneral/410-0046.pdf.

4.5 The information gap

Markets for energy are susceptible to information failures. The most powerful and direct policy mechanisms to address information failure include:

- government funding for information provision;
- energy performance disclosure;
- codes and standards; and
- transforming markets by developing an energy services industry.

Government funding for information

Due to public good characteristics and other market imperfections information on energy efficiency can tend not to be provided to an economically efficient level.[51] In the case of energy efficiency, private markets for information also tend not to develop because energy expenditure is often small, while the transactions costs of accessing the information are relatively large.

Governments can address this problem by funding the provision of information on energy efficiency products and services directly. This helps to reduce the costs of information access and search for individuals, thereby improving their decision making and increasing the efficiency of resource allocation in the economy.

However, simply providing information does not ensure that it is utilised. Sorrell et al draw on behavioural studies to note:

> …. The effectiveness of information depends on more than its availability and content.' (Stern, 1994). In other words, the form of information is crucial. …. Five elements of information in particular are important:
>
> - Information should be specific and personalised. e.g. individual energy audits will be more effective than general information on cost saving opportunities.
> - Information should be vivid. For example, a US study showed that people who viewed a video about implementing domestic energy saving measures were significantly more likely to cut energy use than those who received the information in writing (Winett et al., 1982, p24). Similarly, demonstration of tangible success with a technology is likely to have far more persuasive power than a sales pitch - hence the emphasis in government information programmes on technology demonstration schemes.
> - Information should be clear and simple.
> - Information should be available close in time to the relevant decision.
> - Feedback should be given on the beneficial consequences of previous energy decisions if subsequent efficiency measures are to be encouraged (Seligman et al, 1981).
>
> Of particular importance is the implications such observations have for the design of energy efficiency programmes. The empirical studies of residential energy decision making suggest that people's responses to information are complex: 'Human learning processes and the effective coupling of energy information to incentives are complex topics that remain poorly understood in the energy conservation area.' (Lutzenheiser, 1993, p 255).[52]

---

[51] Other information failures can relate to a) lack of available information; b) the cost of gathering information; c) the accuracy of information; and d) the ability to act upon or use the information.

[52] S.Sorrell, J.Schleich, S.Scott, E. O'Malley, F.Trace, U.Boede, K.Ostertag, P. Radgen, 2000, *Barriers to Energy Efficiency in Public and Private Organisations*, SPRU Environment and Energy, www.sussex.ac.uk/Units/spru/environment/research/barriers.html, p48.

Interventions in this area therefore need to consider the optimal targeting of information and the form of advice to affect behaviour. Successful programs that have adopted such targeted approaches include:

- the Commonwealth Government's Energy Efficiency Best Practice Program — resulted in extensive cost effective improvement in industrial energy efficiency in targeted sectors; and
- Travel Smart program — a program influencing commuter choice of transport mode.

Training and education can also help to overcome information failures. Again, the role of governments in funding education and training recognises the extensive public good characteristics.

Energy performance disclosure

Energy performance labelling and associated energy performance disclosure initiatives address information failures directly. Energy efficiency goods and services can be more susceptible to information failure than other goods and services in the economy because energy efficiency tends to be an unobservable product characteristic. Hence consumers are unable to judge performance until after they have consumed the product, and even then can have difficulties assessing performance if they lack adequate metering arrangements. Credible and accessible labelling helps to overcome the information asymmetry problems that impede informed choice, and to address the public good characteristics of the information search process.[53]

Labelling can be either voluntary, or mandated by governments. Mandating labelling through comprehensive regulation can improve the consistency and brand recognition of the information, thereby building credibility and trust and increased response by the consumer. Australia has had appliance labelling in various guises for over a decade (Box 4.3).

In the case of buildings, development of energy rating tools and mandatory disclosure of energy performance are a key first step in helping to develop awareness of energy performance, improve information flows (and thereby facilitate appropriate contracting to overcome split incentives), create an asset value for energy performance (that can then be reflected in sale prices) and drive innovation by building designers.

The benefits of labelling can outweigh the costs by a significant margin. For example, the Regulatory Impact Statement for the nationally coordinated scheme for household electrical appliances in Australia suggested that the program has a benefit cost ratio of 1.8 at a discount rate of 8 per cent, with the annual energy savings for consumers approximately three times the annual cost of administering the program.[54]

[53] As noted in Chapter 3, asymmetric information is one possible explanation for why energy efficiency opportunities are not adopted. Where buyers of energy efficient technologies, products or processes find it difficult to access information on product performance, problems of adverse selection (where the buyer decline to pay for the product feature) or even principal-agent problems (where a supplier may not supply the product feature, despite the consumer having paid for it) can arise.

[54] George Wilkenfeld and Associates 1999, *Regulatory Impact Statement: Energy Labelling and Minimum Energy Performance Standards for Household Electrical Appliances in Australia*, www.energyrating.gov.au/library/index.html.

Minimum Energy Performance Standards

Minimum Energy Performance Standards (MEPS) work to remove from the market equipment and building designs with the worst energy performance. Better performing appliances or building designs often cost no more than poorer designs, and in many cases offer equivalent or better features to those eliminated. Hence, MEPS can be a very cost effective policy for improving energy efficiency and overall economic welfare.

MEPS help to overcome information and other failures by helping to:

- remove the need for consumers to invest time and other resources to ensure that products with significant economic lives, such as water heaters, do not have energy costs that quickly erode initial purchase price differentials;
- address some of the split incentives problem, for example by ensuring that landlords install insulation in a rental houses or that commercial buildings have efficient lighting; and
- overcome the 'market for lemons' adverse selection problem, by providing a signal to manufacturers that energy improvement is a valued product feature, thereby encouraging innovation and helping to transform the market.

Like labelling, national approaches to MEPS have been gathering pace in Australia since the 1990s (Box 4.3). This is because labelling and MEPS tend to be complementary measures. Together MEPS and labelling can be effective in transforming the rate of diffusion of energy efficiency innovations through the economy. Labelling tends to empower consumer choice, leading to 'demand pull' for improved energy efficiency, whereas MEPS eliminate the poorer performing products and induces 'supply push' through manufacturing innovation.[55]

National approaches to labelling and MEPS help to reduce the complexity of meeting multiple requirements across differing jurisdictions, using different ratings tool. For example, Victoria and NSW have adopted more stringent residential buildings standards than those in the national Australian Buildings Code, albeit based on different measurement tools:

- Victoria has adopted a mandatory 5 star standard based on the First Rate tool;
- NSW has developed BASIX, which rates new residences according to a range of sustainability indicators, including energy and water use.

While there are clear benefits in a national approach for reducing compliance costs, there is also the question of whether the national approaches become a 'lowest common denominator' requirement. For example, the Australian Building Codes Board notes that mandatory national buildings standards will be of 'an appropriate minimum and … cost effective'.[56] While local communities should have the ability to choose more stringent requirements, it is clear that efficiency is served if consistent ratings tools for evaluating standards are used. Hence it is unfortunate that there is a current proliferation of ratings tools and an associated 'war of the ratings tools'.

[55] See for example, North American Energy Working Group 2001, *North American Energy Efficiency Standards and Labelling*, www.eere.energy.gov

[56] Commonwealth, State and Territories of Australia 2001, *Energy Efficiency in Buildings: Directions Report*, www.abcb.gov.au, p13.

Box 4.3

LABELLING AND MEPS IN AUSTRALIA

Mandatory energy performance labelling for appliances has been in operation in Australia in one form or another since the mid 1980s. A nationally coordinated scheme for major appliances was agreed in 1992, but was not fully adopted until 2000. The Energy Rating label has two main features:

- a star rating which gives a quick comparative assessment of the model's energy efficiency; and
- a comparative energy consumption (kwh/year) rating which provides an estimate of the annual energy consumption of the appliance based on the tested energy consumption and information about the typical use of the appliance in the home.

Australia's national Minimum Energy Performance Standards (MEPS) program commenced with standards for refrigerators, freezers and electric storage water heaters in 1999. Since then the scope of the MEPS program has been steadily expanded and a rolling update program for the existing standards commenced.

- MEPS programs are implemented through coordinated state based regulation for technical standards, with offences and penalties for lack of compliance.
- National standards ensure that costly differences do not arise between state based requirements.

Mandatory standards for the ratings of new residential and commercial buildings are being implemented through the Australian Building Code. Development of ratings tools for residences and commercial buildings is a key prerequisite for buildings energy ratings, and available tools now include:

- NAThers, and more recently Accu-rate and First Rate for residences; and
- Australian Buildings Greenhouse Ratings tool developed by SEDA and the Green Star ratings tool developed by the Green Building Council.

Recognition of the benefits of labelling and MEPS has led to the recent announcement by the Ministerial Council on Energy (MCE) that Stage One of the National Framework for Energy Efficiency will, among other things:

- extend national labelling and MEPS programs to gas appliances;
- expand the MEPS program through the introduction of new or more stringent MEPS for residential, commercial and industrial products, with a key focus on increasing the number of commercial and industrial products regulated;
- institute MEPS for government buildings;
- require mandatory disclosure of the energy performance of residential and commercial buildings;
- ensure that benchmark data is provided on consumers energy bills (thereby widening information to include a comparison of the individual's consumption with that of a standard consumer with similar characteristics).

Source: The Allen Consulting Group and Ministerial Council on Energy 2004, op.cit.

Transforming markets by developing an energy services industry

Lack of adequate provision of information on energy efficiency can be compounded by a lack of markets to organise information in a readily accessible way for consumers. Generally, adequately functioning markets for goods and services across the economy play a key role in transmitting information to consumers, for example through advertising or as part of the sales process.

In the case of energy efficiency goods and services, the current lack of information therefore can in part be related to the lack of a well-developed energy services industry supplying energy efficiency goods and services. If such an industry existed, at adequate levels of scale and scope, it could have the ability to significantly reduce the search costs of information and other transactions costs for consumers, and to package this information with the provision energy efficiency and other services (for example finance, building services etc).

In the section below on overcoming organisational and institutional constraints we consider policies to facilitate the development of the energy services industry in more detail.

Information failures — evaluation

The existence of information gaps in relation to energy efficiency is well accepted. As a result, all policies measures to encourage information provision outlined above, bar policies to specifically develop an energy services industry, have been adopted broadly within Australia. This reflects the fact that these mechanisms perform well against all evaluation criteria, with reasonably small costs and high political feasibility (Table 4.4).

These mechanisms are amenable to any market segment or product within the residential, commercial or industrial sectors. Given their low cost and utility in directly addressing information failure and bounded rationality, they should continue to be part of any package to raise investment in energy efficiency.

The final option, developing an energy services industry, comes at higher cost. While a broader evaluation is contained in the next section, Table 5.4 notes that an energy services industry could have a moderate to large effect on overcoming the information gap, with potentially large dynamic benefits for the future as overall awareness of energy efficiency opportunities is raised and as transactions costs of providing that information fall.

Table 4.4

ASSESSMENT OF POLICIES TO CLOSE THE INFORMATION GAP

Mechanisms	Impact on EE	Benefits to end users	Cost to budget	Political feasibility	Dynamic benefits
Government funding for information provisions	Low-Moderate	Low-Moderate	Moderate	Large	Low
Energy Performance Labelling	Large	Large	Moderate	Large	Moderate
Codes and Standards	Moderate	Large	Moderate	Moderate	Large
Energy services industry to overcome information gap	Moderate	Moderate-Large	Low	Large	Large

Source: The Allen Consulting Group

4.6 Organisational failures

Chapter 3 noted that key organisational barriers relate to the multiple decision makers involved in organising energy efficiency investments, concluding that the key barriers related to:

- Firm/agent external organisational constraints;
- Firm/agent internal organisational constraints and bounded rationality constraints.

Firms (and by extension also individuals) first lack the capacity to assess energy efficiency opportunities adequately, and secondly, lack appropriate systems and incentives to do so. This is a key barrier to uptake of energy efficiency.

Drawing on transactions costs theory to provide insight to the problem of organisational constraints, Sorrell et al note that:

> …. transaction cost economics has much to offer in understanding barriers to energy efficiency. … A very important point is *that transaction costs are contingent on the institutional structure.* Some structures may lower transaction costs and thereby lead to greater energy efficiency. For example, energy services companies may overcome many of the transaction costs faced by energy using firms.
>
> In a classic paper, Coase (1960) shows that transaction costs may provide a rationale for policy measures to internalise externalities when the costs of administration and enforcement are less than the associated benefits. Intervention circumvents transaction costs by avoiding the costs of information dissemination and bargaining. The important policy question then becomes: *are there possible interventions or alternative institutional arrangements that can overcome transaction costs at positive net benefit?* (Sanstad & Howarth, 1994, p815).[57]

Box 4.4

ENERGY PERFORMANCE CONTRACTING IN NSW

The NSW Government Energy Management Program has been instrumental in driving demand for energy efficiency in NSW, thereby sustaining the NSW energy performance contracting industry.

- In the New South Wales public sector context, the funding for energy performance contracts (EPCs) by Government agencies has come from the NSW Treasury which has, since 1998, provided annually a $20 million rolling fund from which government agencies can draw down to finance the capital upgrade.
- To be viable, an EPC project needs to be in excess of $500,000 and to have an internal rate of return of 12 per cent or better.
- As a result of this support, in 2002 there were about $40 million worth of EPCs in Australia, with the vast majority of these in New South Wales.

The NSW programme and associated arrangements for EPCs have created an incentive for the growth of an energy efficiency industry in New South Wales. While initial EPCs were difficult, experience gained through the NSW GEMP program has allowed the EPC approach to prosper in NSW. More recently, EPC's have been adopted by a number of local governments in NSW and also in the private sector, in part facilitated by the ready adaptability of the model contracts developed for the NSW GEMP.

Source: NSW Legislative Assembly Standing Committee on Public Works 2002, *Report on Government Energy Reduction Targets*, Report No 52/8 and The Allen Consulting Group 2003, *The NSW Government Energy Management Program: A Triple Bottom Line Analysis*, Report to the Sustainable Energy Development Authority of NSW.

[57] S.Sorrell et al 2000, op. cit.

Importantly, Sorrell et al note the role that an external 'energy services' industry could play in helping to deliver energy services, reducing both internal and external organisational constraints. An energy services industry would focus on deliver the end use needs — whether it be cool houses or furnaces — in the most cost effective manner through an optimal mix of energy carrier and end use (energy efficiency) equipment and services.

While the role for energy services industry is clear, such an industry will not thrive if there is a lack of demand for such services by firms and individuals. If the awareness of individuals and firms of available energy efficiency opportunities were raised, and the other identified market failures overcome, then an energy services industry could develop rapidly to meet the need (Box 5.5).

Market transformation

The foregoing analysis suggests that there could be an appropriate role for government to transform the market for energy efficiency — to increase the ability for the 'demand side' to compete with energy supply — by ensuring that energy end users have appropriate capability and incentive to adopt cost effective demand side alternatives. In transforming the market, policy would aim to achieve a self-sustaining change in end-users' ability to implement cost effective investments in energy efficiency.

While significant effort has been focused over the past decade to transform the supply side of the energy industry and increase competition, little concerted effort has been made on the demand side, to develop appropriate incentives for the market and thereby deliver a well-functioning competitive alternative to the supply side (perhaps with the exception of NSW).

The culture of 'build and generate' — which developed in the years when subsidising energy supply infrastructure was an economic development mechanism — has prevailed. At the same time, the energy services industry has been undermined by failures to get relative prices right; the low prices for electricity, that were the legacy of the 40 per cent over-capacity in NSW generation extant at the inception of the National Electricity Market, have also been a barrier.

Market transformation is often discussed in the context of markets for energy efficiency equipment, but the concept can apply equally to the market (or lack of it) for energy *services*, in the sense of providing a source of advice and design capability (see Box 4.5). A dynamic energy services industry could organise products and services and package these for consumers, reducing transactions costs. The energy services industry option is attractive because it is a market-based solution.

The potential pay-off to a measure that develops a sustainable energy services industry, in terms of impacts on energy efficiency, is high. Such a measure would help to deliver other key ingredients in the energy services equation:

- entrepreneurial energy organisations;
- aggregated purchases to reduce costs of appliances and equipment;
- communication of opportunities for energy efficiency and their pricing;
- development of energy efficiency brands with high consumer recognition;

Box 4.5

MARKET TRANSFORMATION

Market transformation has been the subject of extensive analysis in current discussions about how to achieve energy efficiency in a deregulated environment. NARUC (1996) recently completed a major study of Market Transformation in a Changing Utility Environment.

The NARUC study concludes that:

> Transforming a market means changing the types of products or services that are offered in the market, the basis on which purchase and behavioral decisions are made, the type or number of actors in the market, or in some other way altering this set of interactions in a self-sustaining way. Market transformation is actually a result or a desired outcome, more than it is a type of program. For our purposes, market transformation refers only to those programs explicitly designed to cause changes in the structure of the market for energy efficiency products or services (e.g., new players, different rules, different prices), or in the behavior of some group of market actors, in such a way that energy efficiency is improved and the changes remain after the program has ended. Unlike traditional DSM programs, market transformation programs explicitly try to change the market so that energy efficiency products will be purchased in the future without ongoing programmatic intervention…

They note that most market transformation programs tend to involve multiple market actors, with significant activity upstream from the customer, and tend to involve longer time frames to achieve impacts. The NARUC study also provides a very detailed and useful "typography of market transformation tools," including:

- Technology Research and Development — facilitating development of a new or more efficient technology by manufacturers. ..
- Demonstrations and Field Tests — helping to demonstrate that a specific product, service or practice is ready for the market (i.e., works in the 'real world'), typically by funding, publicizing and/or disseminating results of product demonstrations or field tests. …
- Customer Education — facilitating changes in customer attitudes and/or behavior regarding specific products or how they use energy-related equipment…
- Training — facilitating understanding of specific technologies or the benefits of specific energy-related practices among selected market actors, typically by funding development, implementation, or promotion of training programs…
- Financial Incentives — facilitating development, production, sales or use/specification of efficient products or practices in a manner than ensures sustainable changes in the market once the incentives are removed, by providing cash grants or loans to market actors (e.g., manufacturers, equipment specifiers, or dealers/distributors, builders)…
- Bulk Purchases/Market Aggregation — facilitating a relationship between large-volume purchasers interested in specific high-efficiency equipment with manufacturers of this equipment, by organizing and educating purchasers so that they can present manufacturers with their equipment purchase criteria. …
- Branding — creating a uniform brand, seal or endorsement for high-quality, energy-efficient products and services, to increase customer/trade ally comfort with and perceived value regarding these products and services, by funding campaign development, quality testing and promotional efforts…
- Public Recognition — facilitating energy-efficient installations and practices in organizations, by offering significant publicity and/or technical assistance in exchange for organizations making significant efficient purchase/practice decisions…
- Building/Equipment Code Upgrades and Enforcement — facilitating installation of more efficient equipment and/or construction of more efficient buildings, by changing or enforcing codes in municipalities, states or the country.

NARUC notes that these tools are "building blocks," and that a typical program would include a number of these strategies. These tools serve to reduce costs of acquiring information for various market actors, to economize on information costs by establishing trust, to reduce information asymmetries, to reduce inefficiencies in decision making due to bounded rationality and quasi-rationality, to pool risk, or otherwise to reduce transaction costs.

Source: National Association of Regulatory Utility Commissioners 1996, *Market Transformation in a Changing Utility Environment*. Washington, DC, quoted in M.J.Hewett 1998, *Achieving Energy Efficiency in a Restructured Electric Utility Industry*, Center for Energy and Environment, www.mncee.org/pub.htm, p3.33

- finance for energy efficiency, for example through energy performance contracting; and
- increased product choice (and thus helping to overcome product inseparabilities).

The question then arises, are there cost-effective policy instruments to transform the markets for energy efficiency, reducing the transactions costs of adopting energy efficiency over the longer term? The analysis above related to organisational constraints suggests that the primary barrier is in the bounded rationality and inappropriate incentives structures for firms and individuals, which are then compounded by the range of other market failures including information failures, and to a lesser extent, inappropriate relative prices.

These primary barriers are the key market failures to target. As Sorrell et al note:

> …. policy should have the general objective of minimising the transaction costs of improving energy efficiency - both for individuals and organisations. The key elements of this are:
>
> - economising on bounded rationality: allowing actors to make efficient choices without requiring extensive effort in gathering and analysing information;
> - aligning incentives: ensuring, as far as possible, that incentives of different groups are complementary and act in the direction of improved efficiency; and
> - safeguarding against opportunism: ensuring, as far as possible, that asymmetric information does not encourage decisions or actions that undermine efficiency.[58]

If the demand for energy efficiency is optimised, then it is likely that the supply of energy efficiency services could expand readily to meet that demand.

Greenhouse considerations reprised

A key issue to note at this point is that the emerging greenhouse externality is likely to add significantly to the need to overcome these awareness and organisational failures in the future. Energy efficiency is one of the most cost effective options to mitigate emissions, and hence is one of the lowest cost ways to take precautionary action against the threat of human-induced climate change.

It is economically efficient to adopt energy efficiency options up to the marginal benefit of carbon abatement elsewhere in the economy. For example, the marginal benefit of abating a tonne of CO_2-e from the electricity generation sector is currently set at $15 in NSW through the Greenhouse Gas Abatement Scheme, and this price is similar to the prices emerging through the Kyoto Protocol for parties that have ratified. Most predictions are that carbon prices may need to be higher again in the future in order to maintain global concentrations of greenhouse gases below dangerous concentrations.

[58] Sorrell et al 2000, op.cit.

As noted above, while emissions trading schemes are likely to influence large energy consumers, smaller consumers in the industrial, commercial and residential sector may not deliver the optimal response in response to the greenhouse price signal because of the range of organisational and other market failures. Hence, there would be an even more pronounced need to overcome market failures impeding efficient uptake of energy efficiency – which brings us back to this report. So, intervention to transform the market for energy services becomes even more compelling once the need for future significant action on greenhouse is factored in.

Mechanisms to improve awareness and overcome organisational constraints

The foregoing discussion suggests that optimal policy for energy efficiency should target the lack of awareness and organisational failures preventing optimal demand for energy efficiency.

The key is to tailor the measures to the unique nature of the awareness and organisational barriers in each sector, and the associated transactions costs of taking action. These barriers will differ for the residential, commercial, industrial and large energy user sectors (see Box 4.6 for a successful approach in the dairy industry). The following provides a brief overview of some of the most prominent instruments to achieve this. However, given the constraints of this paper, it is not exhaustive. Nor does it consider the best combination of approaches. Careful policy assessment is needed to establish the best package of policy approaches for each sector — it is unlikely that any single measure in isolation will be a 'silver bullet'. The following major measures would need to be complemented by a range of subsidiary support actions to ensure that the transformation process was achieved in a measured, sequential fashion.

That said, key institutional and market mechanisms for addressing the incentives of end users include:

Voluntary mechanisms

- voluntary agreements for energy efficiency;

Price based mechanisms

- tax exemptions and subsidies for energy efficiency products;
- subsidies to energy services delivery;

Regulation (control) mechanisms

- Minimum Energy Performance Standards;
- government leadership;
- mandatory energy efficiency audits and implementation requirements; and
- tradable energy efficiency targets.

Box 4.6

ENERGY EFFICIENCY IMPROVEMENT IN THE DAIRY INDUSTRY

A team-based approach relying on ‘people know-how’, combined with sound measuring and monitoring, enabled the Murray-Goulburn dairy processing company to gain bottom line savings. The company's Rochester site used around $7 million of energy to produce 114 000 tonnes of product, including milk powder and cheese—in 2001–2002.

The project followed the Best Practice People and Processes methodology developed by Department of Industry and Resources' Energy Efficiency Best Practice programme, which had bee tested successfully across a range of industries. Integral to the success of the project was the formation of an energy management team with representatives from each part of the factory, including operators, supervisors, and maintenance and boiler personnel. The approach involved:

- establishing and training a strong site-based Energy Management Team (EMT) through a series of facilitated workshops;
- developing a business plan for site-based energy efficiency projects;
- developing a strategy for the ongoing involvement of the team in energy management; and
- implementing projects.

Achievements to date include:

- Savings based on projects already implemented, amounting to $180 000 per year with a reduction in greenhouse gas emissions of 1 536 tonnes.
- Additional short-term future savings, based on projects currently being implemented, of $223 000 per year with a reduction in greenhouse gas emissions of 1 895 tonnes.
- Demonstrating the success of a cross-functional team approach to improving operational efficiencies—an approach Rochester plans to use as part of their waste and yield program.

Source: Commonwealth of Australia 2003, *Case Study: Dairy Processing Sector: Murray-Goulburn Cooperative Rochester Branch*, www.industry.gov.au.

Voluntary agreements

Voluntary agreements for energy or greenhouse management are a 'soft' approach to align the incentives to adopt energy efficiency within firms with the perceived social benefits. In particular, voluntary agreements secure the commitment of senior management, thereby legitimising energy efficiency within firms, and work to lift the capacity within firms to measure energy use and assess opportunities. The classic example in Australia is the Greenhouse Challenge Program, which although concerned primarily with greenhouse, has a significant focus on energy use and opportunities for abatement through efficiency. Voluntary agreements are suited to larger organisations, such as larger firms or industry associations.

Voluntary approaches are a useful step in seeking to overcome the organisational failures within firms. However, they can be susceptible to 'window dressing', with firms or government agencies doing the minimum in terms of measurement and reporting, while undertaking very few actions beyond 'business as usual'. As a result, little or no real organisation change may be effected.

More recently, the Commonwealth Government's energy white paper has mandated energy efficiency audits for large energy using firms, but has left implementation to voluntary decision. As such, the program is a mix of compulsion and voluntary decision making and marks a halfway point between the voluntary and regulatory approach.

Price Based Mechanisms

Price based mechanisms include:

- tax exemptions and subsidies for energy efficiency products; and
- subsidies for energy services delivery and market transformation.

At the outset, it is worth noting that the issues of individual and organisational failures are likely to be less amenable to strictly price based interventions. While price based mechanisms might work for energy intensive industry, for smaller firms and for the residential sector the small proportion of energy in total expenditure tends to preclude price-based intervention as an effective tool.

Box 4.7

SUBSIDISING ENERGY EFFICIENCY FUNDED BY WIRES CHARGES

Question for Program Design	Recommendations
Rationale for Ratepayer Funding	Capture cost-effective energy-efficiency opportunities that will be missed by the competitive market Facilitate transition to more competitive markets Ensure benefits of restructuring are shared broadly among all customers
Creation of a Public-Benefit Charge	Ensure competitively neutral mechanism for collecting funds
• Funding level	Establish funding based on bottom-up analysis of cost-effective energy-efficiency opportunities remaining after restructuring and an assessment of likely private-sector activities in the absence of ratepayer funding; at a minimum, continue funding at historic levels.
• Duration	Decouple sunset date from recovery of competition transition charges; establish a five-year review period over which to assess accomplishments and determine continuing need for programs.
• Rate design	Collect funds through a nonbypassable, volumetric charge .
Energy-Efficiency Policy Objective	Ensure that benefits to society exceed cost Target activities to areas not adequately addressed by private sector Design programs to effect lasting beneficial changes in the market
Administration and Governance of Programs	Systematically assess desirability of utilities, state agencies, and independent institutions to manage public-benefits funds based on: (1) institutions' past performance, current ability, and level of interest; (2) geographic scope needed to implement policies; (3) duration of funding; (4) utility conflicts of interest and ability to manage these conflicts; (5) flexibility of state procurement and hiring procedures; and (6) degree of political support for creation of new, nonutility institutions.

Source: J. Eto, C. Goldman and S. Nadel 1998, Ratepayer-Funded Energy-Efficiency Programs in a Restructured Electricity Industry: Issues and Options for Regulators and Legislators, eetd.lbl.gov/EA/EMP/

So for example, differential taxation or subsidies for energy efficiency products are less likely to be effective in driving uptake, except for energy intensive firms. While there may be justification for removing existing distortions in taxation working against energy efficiency, there are questions about the effectiveness of these instruments as a measure to influence energy efficiency choices.

In contrast, subsidising energy services delivery allows more flexibility, in that government can either directly, or competitively through third parties ('competitive sourcing'), undertake targeted programs that aim to address the lack of awareness, bounded rationality and organisational failures at the heart of the energy efficiency gap.

Subsidies for energy services delivery and market transformation programs can be funded either from general revenue, or by a non-bypassable 'network charge'. A wires charge based on the amount of electricity consumed (eg fraction of a cent per kWh) is common in the United States. These funds are then used to fund market transformation and other energy efficiency activities by either public utilities or third parties (Box 5.7).

Regulatory (control) mechanisms

The most common regulatory mechanisms used to date are Minimum Energy Performance Standards (see Information failures section above). As noted, MEPS are efficient in removing the need for smaller consumers to calculate, or even understand, the whole of life cycle costs of an energy service, while also working to transform the supply side of the market. As such, MEPS work around key barriers, rather than working directly to overcome these. For example, MEPS are a powerful tool in the face of the difficulties caused by bounded rationality. As Sanstad and Howarth note:

> If consumers cannot, on average, make correct calculations regarding energy efficiency, as may be implied by the findings of high implicit discount rates, then efficiency standards may serve to replicate the correct calculations on a centralized, cost-efficient basis. Thus direct regulation may in some cases bypass the problem of bounded rationality altogether by focusing on technologies rather than behavior. By contrast, demand-side management programs aimed at residential users must confront the problem head-on, a difficulty that might account for the rather modest results achieved by many residential demand-side management programs.[59]

While MEPS target the market failures at the lower end of the product spectrum, they do not provide incentive for improved energy efficiency to move beyond minimum standards. Incentive mechanisms that worked to overcome lack of awareness by consumers and organisational failures in firms would encourage increased uptake of energy efficiency across the board, not just remove the bottom quartile.

Government leadership, for example requiring government agencies to meet energy efficiency targets, combined with a range of supporting mechanisms, has also proved to be effective in changing behaviour and demonstrating the potential for energy efficiency (see Box 4.4).

[59] A.H.Sanstad and R.B. Howarth 1994, Consumer Rationality and Energy Efficiency, *Proceedings of the ACEEE 1994 Summer School on Energy Efficiency in Buildings*, enduse.lbl.gov/Projects/EfficiencyGap.html, p9.

Regulatory mechanisms to provide incentives to change firms' and individuals' behaviour include:

- mandatory energy efficiency audits and implementation requirements;
- tradable energy efficiency targets.

Mandatory audits and implementation requirements can target directly the organisational barriers in larger firms. For example, the Victorian State Environment Protection Policy — Air Quality Management program requires firms to undertake energy audits and implement projects with a payback of less than 3 years. By mandating this requirement, energy efficiency opportunities with internal rates of return exceeding 40 per cent are adopted. The measure encourages firms to develop internal arrangements energy efficiency assessments, while senior management are forced to include energy efficiency within their span of control.

However, mandatory audits and implementation requirements are less amenable to smaller firms and the residential sector because of the difficulties of monitoring outcomes to ensure compliance — there are too many entities and it is likely that non-compliance would rapidly undermine the credibility of the mechanism. There are also the difficulties of equalising the marginal cost of response and hence equity. Thus there is a need to consider an alternative mechanism for these sectors.

Mandatory energy efficiency targets for energy suppliers, such as energy retailers, are a relatively new mechanism that has been adopted in Italy and the United Kingdom as a way of driving uptake of energy efficiency. In the case of the energy retailer, the measure works by requiring the retailer to reduce their energy sales by a pre-specified amount, which is demonstrated by acquitting a corresponding amount of 'white certificates' (which represent a unit of energy saved) with the regulatory authority. The requirement is tradable, to equalise the marginal costs of compliance. In this sense, the measure is similar to the Mandatory Renewable Energy Target.

To meet the target, retailers need to initiate eligible energy efficiency activities to earn the 'white certificates' (or contract with third parties to acquire certificates). Eligible activities could include selling more efficient appliances with a deemed 'white certificate' value, subsidising upgrades to achieve higher star rated buildings and thereby earn associated deemed 'white certificates', or by reducing the energy intensity per unit of output of small manufacturing enterprises, again to create 'white certificates' at a pre-determined rate.

This mechanism has promise, but also has significant challenges. On the plus side, energy retailers are probably the best placed entities to identify cost effective opportunities for energy efficiency in their small customer base — by virtue of their energy use data and ability to benchmark customers for energy use. Energy retailers also offer a smaller number of participants to monitor for compliance. The mechanism could be a key element helping to move energy retailers from being sellers of energy to sellers of energy services. The mechanism would thus give a large boost to developing a true energy services market.

The key question is whether the mechanism will be successful in changing individuals' and organisations' behaviour, thereby overcoming the awareness and organisational failures identified as key. To the extent that the measure funds energy services companies (whether they be the retailers themselves or third parties) to approach consumers offering low transaction cost energy efficiency solutions, then the answer is yes (but it is worth noting that this could be done equally well by a competitive sourcing program subsidising similar delivery of energy services by the retailers or by third party).

The mandatory approach does have the advantage of working through the retailers, who are closest to end use customers, and by funding the mechanism through increased energy prices. One could imagine, in extremis, energy retailers giving away compact fluorescent light bulbs, while informing consumers that if they installed the light bulbs around the house, they would be better off, despite the fact that their electricity prices were increasing slightly to fund the compact fluorescent light bulbs (the price increase information could be provided on their bills).

However, to the extent that there is no inducement on consumers to change their behaviour (that is, actually install the light bulbs), then the answer is no. Sansted and Howarth observe:

> … even if we agree that consumers are boundedly rational when it comes to making energy-related decisions, this fact does not necessarily provide a blanket justification for policies aimed at promoting energy efficiency. If consumers are inexpert at dealing with energy choices, this constitutes a potential barrier not only to effective market decisions but also to programs designed to improve on market outcomes. If, for example, consumers have trouble understanding how energy "works" when left to their own devices, how can they appreciate the benefits that demand-side management programs offer them? The consistent finding that information programs directed at energy use often have very limited effects (McMahon 1991) is relevant to this point. Changing people's behavior is of course feasible, but it can be very difficult and costly to accomplish. This is one true "hidden cost" that must be confronted by policy makers: limitations on consumer rationality do not simply disappear in the face of policy; indeed, they may undermine efforts to fix observed imperfections in markets for energy and energy-using technologies.[60]

Evaluation – mechanisms for awareness and organisational change

Voluntary agreements, MEPS and the mandatory audits/implementation approach directly target end user behaviour. As noted, voluntary agreements and the mandatory audits/implementation approach are less suitable for smaller consumers.

Aside from MEPS, there are limited options to address directly the identified awareness and organisational failures for smaller consumers. While MEPS are important, they do not help to change the underlying failures and do not provide incentives to increase the rate of uptake of cost effective technologies beyond the minimum standard.

This suggests a second best solution for incentives — either subsidies for delivery of energy services or energy efficiency targets for retailers — should be considered as a policy approach. Subsidising delivery of energy services is likely to have lower costs of implementation (despite potentially higher budgetary costs), be easier to establish, and is likely to be more flexible in response.[61]

---

[60] A.H. Sanstad and R.B. Howarth 1994, ibid, p9,

[61] The subsidies approach could be used initially to test the best approaches to changing end user behaviour through a series of targeted pilots programs.

ASSESSMENT OF POLICIES TO OVERCOME AWARENESS AND ORGANISATIONAL FAILURES

Mechanisms	Impact on EE	Benefits to end users	Cost to budget	Political feasibility	Dynamic benefits
Voluntary approaches	Low	Low	Low	Large	Low
Taxes and subsidies	Low	Low	Low - Large	Low	Low
Subsidising delivery of energy services	Moderate-large	Moderate-large	Small-large	Low - Moderate	Moderate-large
Mandatory audits and adoption	Moderate	Moderate	Moderate	Moderate	Moderate
Energy efficiency targets	Moderate-large	Moderate-large	Small	Moderate-high	Moderate-large

Source: The Allen Consulting Group

In the final analysis, the 'white certificates' policy has many of the hallmarks of a subsidies based approach. As noted, it has the advantage of the retailers having access to data on end users' consumption. On the other hand, the approach has large fixed costs of establishment, and is possibly less flexible than the subsidies based approach.[62]

4.7 Conclusions

Given the diverse market failures outlined above it may be difficult to rely on a single policy instrument to achieve cost effective uptake of energy efficiency. Rather, a package of policy instruments that selectively targets key market failures is required. The package approach may be further supported by the heterogeneous nature of the markets for energy services (residential, commercial, industry and energy-intensive end users), with differing market failures in each case. Golove and Eto summarise this neatly:

> We do not believe the market barriers debate can be settled by ideological fiat; instead, it must be addressed in a highly disaggregate fashion, considering particular markets and a realistic assessment of the limitations of particular institutions and policies. It is unlikely that, even when public policies are appropriate, there will ever be a single best policy solution (e.g., government minimum efficiency standards); instead, multiple approaches to overcoming market failures or reducing high transaction costs tailored to particular circumstances are more likely to be appropriate.[63]

[62] The existence of pre-existing model and associated infrastructure — such as that for the Mandatory Renewable Energy Target — does provide scope to reduce the fixed costs of establishing such a scheme to the extent that a new program could 'piggy back' on the old.

[63] W.H.Golove and J.H.Eto 1996, *Market Barriers to Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*, p34, LBL-38059, eetd.lbl.gov/ea/EMP/ee-pubs.html.

We have identified the key market failures impeding the uptake of energy efficiency as being:

- distorted relative prices;
- information imperfections; and
- institutional and organisational constraints.

The following package of policies is likely to offer the most cost effective approach to overcome these failures:

- energy market pricing and institutional arrangements that reward cost effective investments in energy efficiency and provide a signal on the need to address the emerging greenhouse externality;
- information disclosure through labelling and cost effective minimum energy performance standards for appliances, equipment and buildings;
- mandatory energy efficiency audits and uptake for larger firms in the mining, manufacturing and services sectors;
- competitive sourcing of energy efficiency products and services that aims to:
  - increase awareness of opportunities and reduce organisation barriers, particularly for smaller end users;
  - transform the market to improve the energy efficiency of appliances, equipment and buildings; and
  - reduce transactions costs of adopting energy efficiency goods and services by developing the energy services industry.

Chapter 5

Costs and benefits of improving energy efficiency

There is a large number of studies examining the costs and benefits of addressing energy efficiency. These range from the thousands of energy efficiency audits that have been conducted through to large scale economic studies. This Chapter provides a brief survey of a small subset of the estimates of the costs and benefits of improving energy efficiency. It is by no means an exhaustive survey, rather, it is intended to give a sense of the magnitude of the savings that are available, and their net benefits.

5.1 NFEE study

In the Australian context, the most recent and comprehensive assessments of opportunities for energy efficiency at current prices are the studies conducted for the National Framework for Energy Efficiency (NFEE), which were summarised in Chapter 2. While the initial NFEE estimates were based on a diverse review of the literature, the second phase of the NFEE assessment (see Table 2.1) were far more robust. First, these estimates involved detailed assessment of current opportunities for energy efficiency in the industrial, commercial and residential sector — undertaken by respected Australian energy efficiency experts familiar with the range of opportunities that are commonly available. Secondly, the phase 2 estimates were extremely conservative, only adopting those opportunities with a payback of less than or equal to 4 years.[64] As noted in Chapter 2, the resulting average payback of all opportunities — of 2.4 years — is equivalent to an internal rate of return of more than 50 per cent.

To assess the full economy-wide estimates of the costs and benefits of implementing these opportunities, the estimates were then modelled using the computable general equilibrium (CGE) model MMRF–GREEN, operated by the Centre of Policy Studies (CoPS) at Monash University.

The phase 2 modeling utilised revised input data on the direct costs and benefits associated with the adoption of energy–saving technologies in different industries, derived from the phase 2 technical studies. The Sustainable Energy Authority of Victoria integrated the new data into a single dataset, which was then provided to The Allen Consulting Group and CoPS. Importantly, costs were inflated by 7.5 per cent in the industrial and commercial sectors reflect hidden costs and other transactions costs that may not have been accounted for.

A single scenario was modelled: one in which opportunities for energy–saving improvements with up to four–year payback period are taken up economy–wide at a rate of 50 per cent (the 50 per cent – low scenario). With the 50 per cent penetration rate, a further element of conservatism was introduced.

[64] The Phase 1 work was based on measures with an *average* payback of 4 years.

The adoption of energy–saving improvements under this scenario leads to a range of economic, social and environmental benefits. Over the complete period of the policy simulation (23 years — the effective life of the investments), the net present value (NPV)[65] of the projected rise in national consumption — or in broad terms, national economic welfare — brought about by improved energy efficiency is around $5.3 billion. The equivalent figure for gross domestic product (GDP) is around $6.6 billion. Employment is estimated to increase by around 2,600 persons by year 12, when the full impact of the investments is being realised, than would otherwise have been the case without the improvements. The improvements also lead to substantial reductions in both greenhouse gas emissions from the stationary energy sector and energy consumption in year 12 — around 9.5 Mt of CO_2–e and 75.5 petajoules respectively. Table 5.1 summarises the effects of improved energy efficiency in year 12.

Table 5.1

SUMMARY OF ECONOMIC IMPACTS OF IMPROVED ENERGY EFFICIENCY[a]

Macroeconomic variable	*Change relative to base case (year 12)*
GDP ($m)	975
Real Private Consumption ($m)	724
Employment (persons)	2,600
Greenhouse Gas Emissions (Mt of CO_2–e)	–9.5
Energy Use (petajoules)	–75.5

[a] Relates to the *50 per cent – low* scenario.

Source: MMRF–GREEN.

Two features of these results are worth highlighting.

First, the rebound factor in this study was around 28 per cent. This reflects that savings from energy efficiency tend to be expansionary, resulting in second round increases in energy consumption in the economy. While the overall savings from cost effective uptake of energy efficiency are therefore less than the raw sum of the individual savings, this does not mean that the benefits for individuals adopting energy efficiency measures are diminished.

Second, the conservative nature of the estimates, and the addition of transactions costs included in the estimates mean that even if there are hidden costs that have not been accounted for, the overall returns are still likely to remain high compared to other standard internal rates of return in the economy. (Recall that the internal rates of return of the energy efficiency opportunities were in excess of 50 per cent.) As a final point, the returns to the economy from the overall expansionary effects of the measures are estimated to add a further 4.5 per cent to the first round savings. This provides a further buffer against 'hidden costs'.

65 Assuming a real discount rate of 4 per cent per annum, and expressed in terms of 1999 dollars.

5.2 Sectoral considerations

Residential sector

The NFEE study suggested that savings approaching 12 per cent are available at current prices in the residential sector with paybacks up to 4 years. However, the analysis in Chapters 3 and 4 suggested that lack of awareness and bounded rationality are likely to be significant barriers to uptake of energy efficiency in the residential sector. In addition, the transactions costs associated with the sector are likely to be large. This suggests care is needed to pick key products and services that have a potential to be amenable to cost effective intervention. Subsequent policy intervention could aim to transform the market for these selected products, by working on the supply side arrangements and importantly, the attitudes and decision-making capacity in the residential sector.

In light of the transactions costs, approaches such as minimum energy performance standards (MEPS) become important, as they sidestep the need to change behaviour. The ability of MEPS to enhance economic welfare has been demonstrated in a wide range of cost benefit analyses conducted for appliance MEPS, and more recently for proposed buildings standards. For example, appliance MEPS were estimated to deliver overall net benefits to consumers of $4.2 billion in net present value terms over the period 2003 to 2018.[66] Similarly, the 5 star building standards coming into force in Victoria from 2005 were estimated to have GDP net present value benefits in the range of $30 to 566 million over the period 2002 to 2012.[67]

Commercial sector

The commercial sector offers significant energy efficiency savings opportunities from energy efficiency. The NFEE commercial sector study estimated savings of around 10 per cent are available at paybacks of up to 4 years or less. The conservative nature of these estimates is highlighted by other studies, which suggest that savings exceeding this magnitude have been achieved in a wide range of buildings. For example, estimates of private returns to energy improvements undertaken as part of the NSW Energy Smart Buildings program have exceeded 24 per cent in office buildings, and 18 per cent in the healthcare sector.[68]

Industrial sector

Numerous studies on potential savings in the industrial sector support the NFEE estimates. For example, ABARE reviewed evidence from opportunities identified as part of the Energy Efficiency Audit Program conducted by the Commonwealth Government during the 1990s. ABARE found that the program unambiguously benefited firms (Box 5.1).

---

66 Commonwealth of Australia 2003, *National Appliance and Equipment Energy Program: Projected Impacts 2000-2020*, www.energyrating.gov.au.

67 The Allen Consulting Group 2002, *Cost-Benefit of New Housing Energy Performance Regulations: Impact of Proposed Regulations*, www.seav.gov.au.

68 The Allen Consulting Group 2003, *The NSW Government Energy Program: A Triple Bottom Line Analysis*, Report to the Sustainable Energy Development Authority.

Box 5.1

ENERGY EFFICIENCY AUDIT PROGRAM

ABARE conducted a survey of 100 firms that took part in the Commonwealth Government's Enterprise Energy Audit Program (EEAP) — which ran for six years until May 1997 and was monitored by ABARE. The survey included detailed questions about each firm's implementation of audit report recommendations. Implementation rates were found to be high and audits to be cost effective.

Using both the (one-off total) cost and savings (per year) reported by the auditor, the NPV of each investment was calculated assuming a 10 year investment life, and a discount rate of 8 per cent. The average NPV per firm from implementing all recommendations was calculated to be A$429 000, and the NPV of the recommendations actually implemented was A$364 000 per firm.

While the estimates did not include all hidden costs, such as risks, ABARE concluded that 'it can probably be concluded that the EEAP audit process was cost effective to firms. This is backed up by the 93 per cent or so of EEAP participants who said that it was worthwhile …. In addition it is probably safe to say that, given the magnitudes of the results, audits are worthwhile for many firms even without government subsidies'.

Source: J.Harris, J.Anderson, W.Shafron 2000, Investment in energy efficiency: a survey of Australian firms, *Energy Policy* 28 (2000) 867-876.

As noted in Chapter 3, evidence from programs such as the Energy Efficiency Best Practice Programs of the United Kingdom and Australia, and the detailed investigations by the SPRU BARRIERS project, also support the existence of cost effective energy savings in the industrial sector.

5.3 Conclusions

There is a wealth of empirical evidence to suggest that significant savings are available from investments in energy efficiency in the residential, commercial and industrial sectors. Generally, the studies support the contention that savings exceeding 10 per cent of energy use are available in all sectors of the economy, at internal rates of return that exceed 50 per cent.

However, many of these empirical studies are *ex ante* studies that do not follow up to establish the extent to which actual savings are achieved after implementation. Consequently, there is very little insight into the extent of hidden costs that might explain the lack of uptake of these opportunities. This points to the importance of conducting rigorous follow-up evaluation of actual savings achieved in any future policies or programs, and also the value of identifying what market failures were overcome, and how.