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iGrid Project 4 -
Institutional Barriers, Economic Modelling and Stakeholder Engagement

Pre-Publication Draft

Institutional Barriers to Intelligent Grid:

A Discussion Paper



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Institutional Barriers, Economic Modelling and Stakeholder Engagement

Institutional Barriers to Intelligent Grid:

A Discussion Paper

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This Discussion Paper is being produced to stimulate debate on issues of institutional barriers to the development of "Intelligent Grid" and Distributed Energy resources in Australia. This Pre-Publication Draft is provided to participants in the iGrid Industry Forum in Adelaide on 5 December 2008 as a basis for discussion. Following the Industry Forum the Discussion Paper will be finalised and published for public comment later in December 2008. Submissions on the final draft of the Discussion Paper will then be invited. Comments and feedback should be sent by Friday 20 February 2009 to: chris.dunstan@uts.edu.au

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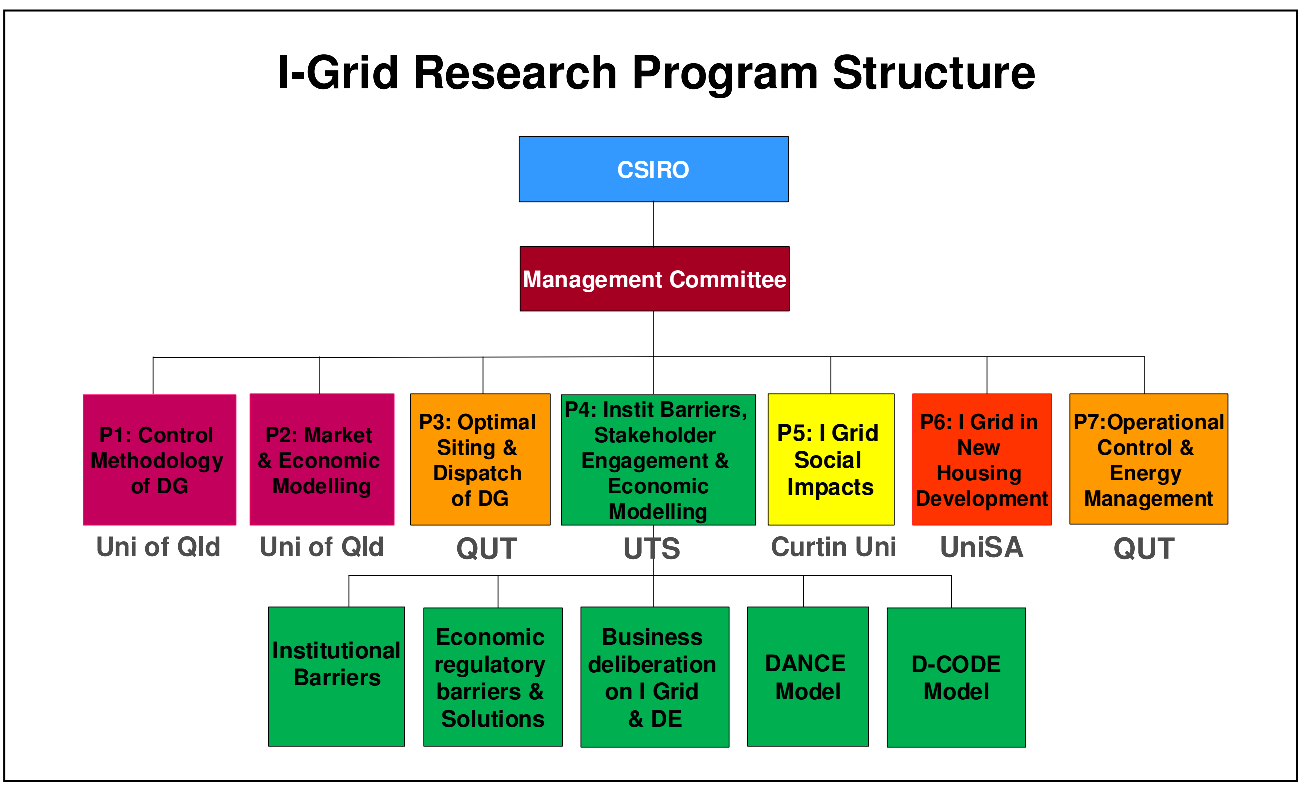
1 Introduction

The interlinked challenges of climate change and energy security are prompting a shift away from an electricity sector based on large-scale, fossil fuel power stations and transmission networks. In its place, is the emerging potential of an "Intelligent Grid" that will use low-emission, distributed energy (DE) technologies and advanced electricity network control systems to transform the sustainability of the electricity sector.

The Intelligent Grid (iGrid) Research Program is a three-year collaborative research venture between the CSIRO and five leading Australian universities under the CSIRO Energy Transformed Flagship. Its aim is to elaborate the economic, environmental and social impacts and benefits of the large-scale deployment of intelligent grid technologies in Australian electricity networks. The Research Program is an interdisciplinary venture that complements other research being undertaken through the Energy Transformed Flagship. It brings together economists, engineers, social scientists, systems scientists and policy scientists to develop integrated insights that could not be achieved by working separately.

The Structure of the iGrid Research Program is illustrated below and how Project 4, which focuses on Institutional Barriers, Stakeholder Engagement and Economic Modelling fits into the wider Program context. This Discussion Paper forms part of the Institutional Barriers work of Project 4. For more details about the iGrid Research Program please refer to the iGrid website, www.igrid.net.au .

Figure 1



1.1 Purpose of this Discussion Paper

One element of Project 4 is to improve understanding of the institutional barriers to establishment of the intelligent grid. This Discussion Paper is the key step in improving this understanding. A literature review of the barriers to distributed energy and intelligent grid has been undertaken and is summarised in Section 2 of this Discussion Paper.

The purpose of the Discussion Paper is:

1. to propose a simple, practical classification of institutional barriers to the use of distributed energy technologies in the context of an intelligent grid;

2. to consider policy responses to address these institutional barriers; and

3. to invite feedback from stakeholders on the issues of institutional barriers.

Feedback on this Discussion Paper will be used:

1. in drafting the final Report on institutional barriers, which is one of the outputs of the iGrid Research Program; and

2. as an input to other research within the iGrid Research Program.

1.2 Intelligent Grid and Distributed Energy

The terms "Intelligent Grid" and "Smart Grid" have become such catchphrases over the past few years that care needs to be taken to clearly define their meaning. For the purposes of the research program, the "Intelligent Grid" refers to an electricity network that uses "distributed energy" resources and advanced communication and control technologies to deliver electricity more cost-effectively, with lower greenhouse intensity than the current electricity supply mix and responsive to consumer needs.

In this context, "Distributed Energy" means electricity generation and management of energy use applied at the consumer or distribution network level. It includes distributed generation, load management and energy efficiency options. These types of energy resources can generally be located closer to the users than large centralised sources. Some distributed energy resources rely on renewable energy with no greenhouse emissions and others make more efficient use of fossil fuels. For example, distributed energy resources could involve heating, cooling and powering a commercial building using a combination of solar panels, micro turbines, fuel cells, energy efficiency and load control.

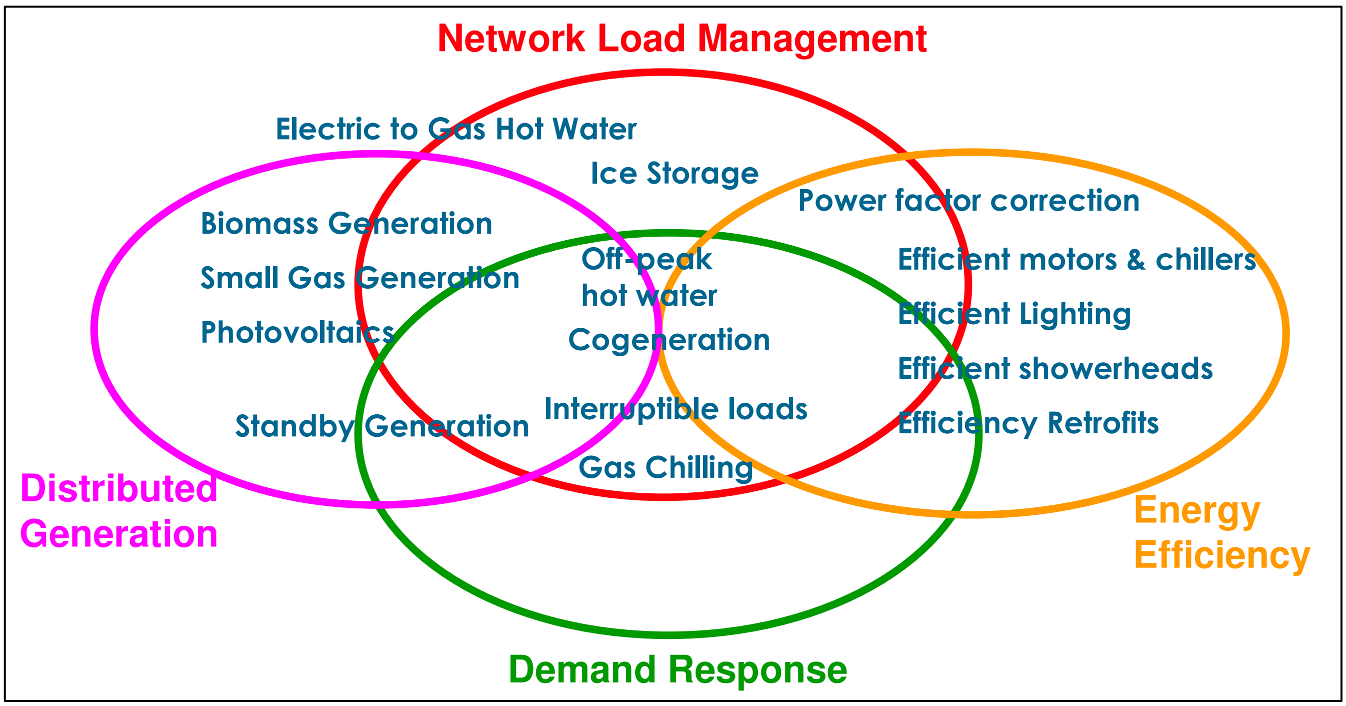
Distributed generation can include wind turbines (but not those connected to the high voltage transmission network), solar panels, micro turbines, fuel cells and cogeneration (combined heat and power).

Advanced types of control and management technologies for the electricity grid can also make it run more efficiently overall. These include, for example, advanced control systems and "smart" electricity meters that show real-time use and costs and can respond to remote communication and dynamic electricity pricing.

In the words of the US Electric Power Research Institute:

> "The 21st century vision of the Intelligent Grid is a crucial enabler for greater use of distributed energy while maintaining power quality and reliability. The vision is enabled by advanced communication and control technologies. The deployment of smart distribution grids and communication infrastructures will enable widespread end-use efficiency technology deployment, distributed generation and plug-in hybrid electric vehicles" (EPRI 2007).

Figure 2: Some Distributed Energy Resources



(Adapted from IPART 2002)

Identified potential benefits of distributed energy resources include:

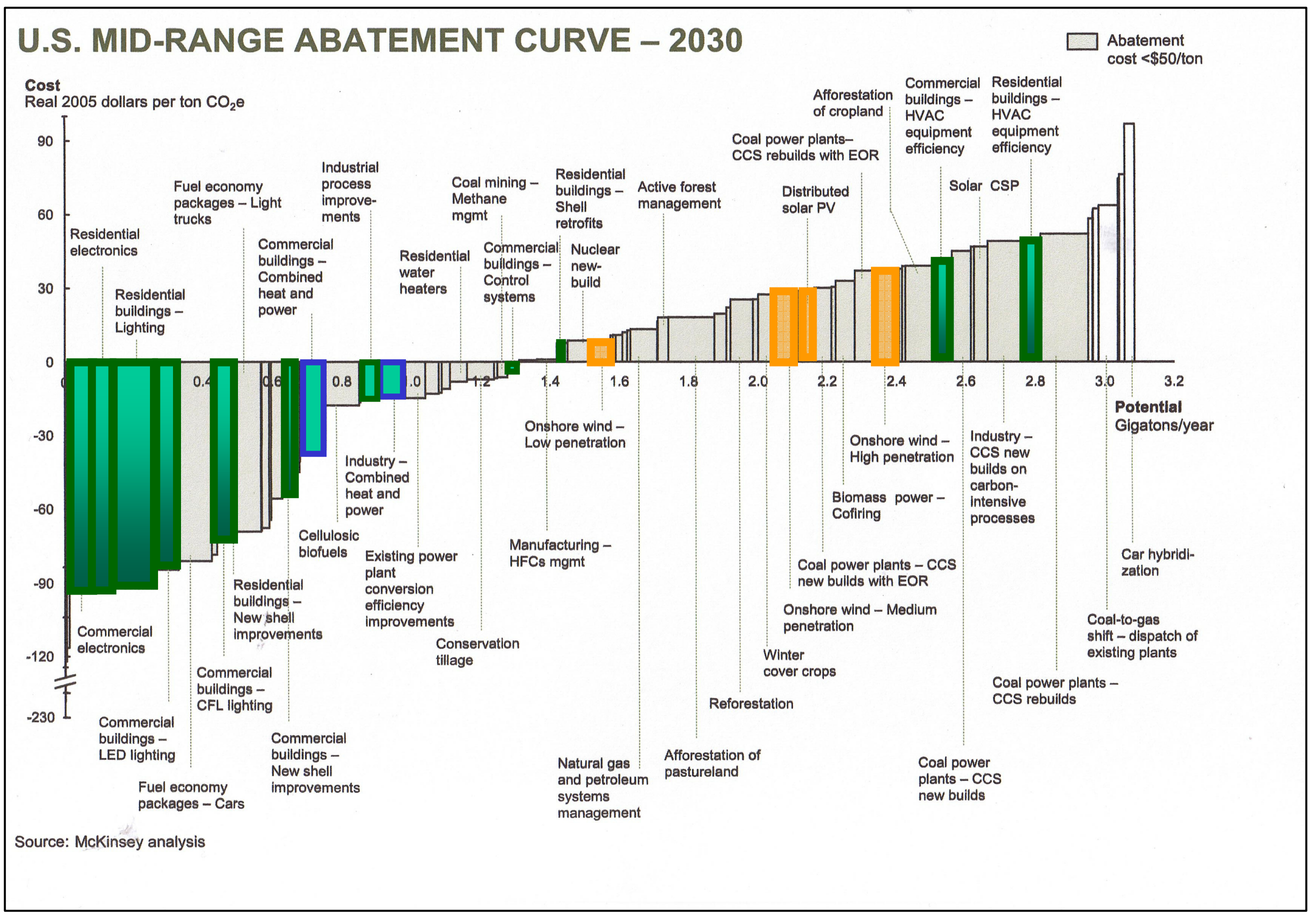
- Lower greenhouse gas emissions
- Improved fuel efficiency
- Exploitation of cheap fuel options
- Lower network system losses
- Managed peak load
- Reduced and optimised network investment
- Other network benefits such as voltage support and reduce reactive power losses
- Increased reliability
- Improved energy security
- Provides system ancillary services, such as black start capability and spinning reserves
- Enhanced social equity and delivers social benefits
- Reduced fuel poverty

Of course, there are also costs associated with the use of distributed energy and technical issues to be addressed in their deployment. However, numerous studies have concluded that the large cost effective

potential of distributed energy is far from being realised. Figure 3 illustrates the potential for greenhouse emissions reduction in the United States as assessed by the McKinsey and Co. This study found that:

> "Relying on tested approaches and high-potential emerging technologies, the US could reduce annual GHG emissions by as much as …7 to28 percent below 2005 levels [by 2030]. And [these reductions] could be made at a marginal cost of $50 per ton [of carbon dioxide equivalent], while maintaining comparable levels of consumer utility…
>
> *Without a forceful and coordinated set of actions, it is unlikely that even the most economically beneficial options would materialize at the magnitude and costs estimated here… (original emphasis)*
>
> **Almost 40 percent of abatement could be achieved at "negative" marginal costs** (original emphasis), meaning that investing in these options would generate positive economic returns over their lifecycle… Unlocking the negative cost options would require overcoming persistent barriers to market efficiency…" (Creyts, Derkach et al. 2007)

Figure 3 Greenhouse Gas Emission Reduction Potential and Distributed Energy



(Adapted from Creyts, Derkach et al. 2007)

A similar study undertaken by McKinsey and Co for Australia reached similar conclusions.

As highlighted in Figure 3, the large majority of these "negative cost" options are distributed energy resources. If the benefits of creating an intelligent grid to foster these distributed energy are so substantial, what is stopping it from being achieved? What are the barriers? These questions are the focus of this Discussion Paper.

1.3 The structure of this Discussion Paper

The remainder of this Discussion Paper is structured as follows:

- Section 2 discusses some of the issues relating to barriers to intelligent grid and distributed energy.
- Section 3 reviews the literature of institutional barriers to distributed energy.
- Section 4 introduces a proposed systematic classification of institutional barriers.
- Section 5 considers policy implications of this classification of institutional barriers and proposes a parallel classification of policy responses.

2 Barriers to Intelligent Grid

2.1 Technical vs Institutional Barriers

As will be discussed in Section 3, there are numerous ways to analyse and classify barriers to intelligent grid and distributed energy. As the iGrid Research program is particularly concerned with supporting distributed energy resources that are already technologically and economically viable, this Discussion Paper makes a fundamental distinction between technical barriers and institutional barriers. Technical barriers relate to the characteristic of the distributed energy resources themselves –that is, their technological characteristics, what they do and their economic characteristics- what they cost. Institutional barriers refer to the barriers that exist in how humans relate to the distributed energy resource, through laws and regulations, and through values and culture.

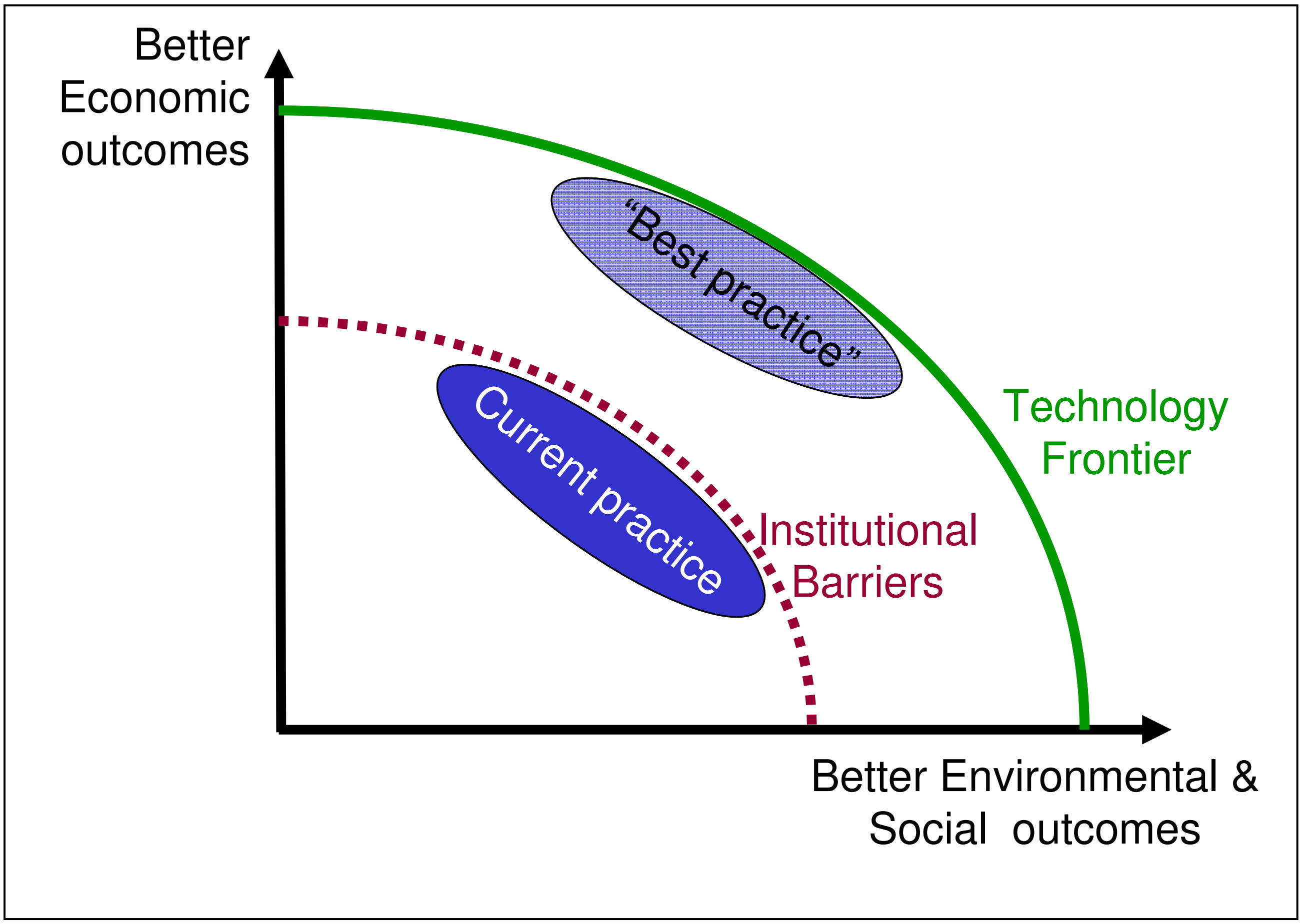
An example of these institutional barriers, in the United States context, is described by Marilyn Brown:

> "Efficient magnetic ballasts for fluorescent lighting were commercially available as early as 1976. They were a well-tested technology, with performance characteristics equal to or better than standard ballasts by the early 1980s. By 1987, five states – including California and New York – had prohibited the sale of standard ballasts. But the remaining three-quarters of the population chose standard ballasts over efficient ballasts by a ratio of 10-to-1, even though the efficient magnetic ballast paid back its investment in less that two years for virtually all commercial buildings (Koomey et al., 1996). The time required to establish retail distribution service networks and to gain consumer confidence are typical causes of slow innovation diffusions such as this. (Since 1990, federal standards have prohibited the sale of the standard ballast)." (Brown 2001)

In this example, the distributed energy technology was technically proven and economically attractive but was not being adopted. While it is possible that the free operation of the market would have eventually led to the elimination of the less efficient option, in this case the understanding of the institutional barriers led to a policy response (banning standard magnetic ballasts) that delivered an outcome that was both economically and environmentally superior.

Figure 4 provides a conceptual framework for describing this relationship between technical and institutional barriers. As illustrated, there is an optimum range of outcomes that is limited by technical barriers of what is technologically and economically possible. Within this range, collective and individual judgements must be made relating to the balance between economic outcomes on the one hand, and environmental and social outcomes on the other. However, it is crucial to recognise that we have the potential to achieve better outcomes in all three of these dimensions- economic, social and environmental- if we are able to reduce the institutional barriers that currently obstruct us from attaining "best practice".

Figure 4. Conceptual Framework for Institutional Barriers to Distributed Energy



2.2 Energy policy making and market failures

Energy policy decision making has to date been largely aimed at addressing market failures. In the case of a market failure, government regulatory action can be justified provided the nature of the market failure can be identified to policy makers. In the current Australian political culture, identifying a significant market failure is often seen as an essential condition for receiving a "licence" to intervene in the market.

A market failure occurs where there is a flaw in the way a market operates. The Australian Government Best Practice Regulation Handbook (Commonwealth of Australia 2007) defines a market failure as 'a situation in which the free market fails to generate an efficient outcome or maximise net benefits'. Similarly, Brown (2001) considers a market failure to have occurred where there are 'conditions of a market that violate one or more of the neoclassical economic assumptions that define an ideal market for products and services such as rational behaviour, costless transactions, and perfect information'(Brown 2001). Brown (2001) explains that market failures arise due to: '(1) misplaced incentives; (2) distortionary fiscal and regulatory policies; (3) unpriced costs or externalities; (4) unpriced public goods or benefits; and (5) insufficient and incorrect information' (Jaffe and Stavins, 1994; IPCC, 1996; cited in (Brown 2001), p. 1199 and (IEA 2007)).

There are however, additional circumstances where efficient outcomes may not be realised. These can be due to market barriers. As Geller and Attali (2005) explain, market barriers 'are not market failures, but limit the adoption of energy efficiency measures nonetheless' (Geller and Attali 2005). Brown (2001) refers to four market barriers that are not considered to be based on market failures, 'but which nonetheless

contribute to the slow diffusion and adoption of energy efficiency innovations…these include: (1) the low priority of energy issues, (2) capital market imperfections, and (3) incomplete markets for energy-efficient features and products.' (Jaffe and Stavins, 1994; Hirst and Brown, 1990; Levine et al., 1995, and US Department of Energy, Office of Policy and International Affairs, 1996b; cited in Brown 2001, p. 1199).

As Brown (2001) concludes 'the existence of market failures and barriers that inhibit socially optimal levels of investment in energy efficiency is the primary reason for considering public policy interventions.

3 An Introduction to Research on Institutional Barriers

Institutional barriers to distributed energy have been discussed for some time. The benefits of addressing the barriers have also been discussed in countless government reports, inquiries, independent studies and in the academic literature. What is clear from the literature is that classification models of institutional barriers appear diverse and relatively unstructured. Furthermore, there is some disagreement amongst analysts of whether an institutional barrier warrants policy interventions if it cannot also be classed as a 'market failure'.

Shortly after the first oil price shocks of the early 1970s, Amory Lovins articulated a new alternative vision for energy policy in 1976 in the influential paper *Energy Strategy: The Road Not Taken* (Lovins 1976). Lovins introduced the concept of energy efficiency: 'using less energy to produce more economic output' (Golove & Eto 1996, p.6). Soon after Lovins' publication, the ideas he presented on energy efficiency began to have a significant impact on energy policy (Golove and Eto 1996).

Golove and Eto (1996) explain how the concept Lovins introduced, 'coupled with the review of the apparently highly inefficient use of energy by society at the time, led to a conclusion that the market alone was not working to provide the most desirable social outcome' (Golove and Eto 1996).

The ideas that followed about energy efficiency 'were often expressed as questions about the existence and magnitude of an efficiency gap' which 'refers to the difference between levels of investment in energy efficiency that appears to be cost effective based on engineering-economic analysis and the (lower) levels actually occurring' (Golove & Eto 1996, p.6; SERI 1981 cited in Golove & Eto 1996, p.6).

The significant gap between current and optimum levels of energy efficiency was thought to exist because 'for a variety of reasons, households, businesses, manufacturers, and government agencies all fail to take full advantage of cost-effective, energy-conserving opportunities' (Hirst & Brown 1990, p267). In addition, following on from the energy crisis, 'some analysts insisted that efforts should also be made to moderate the demand for energy by adoption of conservation measures' (Blumstein et al 1980, p. 355).

Blumstein presented the first analysis of this apparent divergence or "gap" and proposed that 'although economically rational responses to the energy crisis, energy conservation actions may be hindered by social and institutional barriers' and that 'a "hands-off" strategy may not be sufficient' (Blumstein, Krieg et al. 1980).

Analysts began to present a case for closing the energy-efficiency gap, pointing out many economic and societal gains to be had such as cost savings, improved industrial competitiveness and environmental benefits (Hirst and Brown 1990). Additionally, analysts shifted attention to analysis of the possible obstacles inhibiting energy efficiency and increasingly paid attention to identifying and classifying the 'institutional barriers' to energy efficiency and energy conservation.

Despite all of the discussion that has taken place since, the barriers first identified by Blumstein et al almost thirty years ago remain just as relevant today.

3.1 Academic literature

Blumstein et al first asserted that barriers inhibiting the market from achieving a satisfactory outcome were embedded in social norms and institutional arrangements, Blumstein et al (1980) then went on to offer a taxonomy of barriers that occur regularly. The paper identified six classes of market barriers. These included:

1) misplaced incentives,
2) lack of access to financing,
3) flaws in market structure,
4) mis-pricing imposed by regulation,
5) decision influenced by custom, and
6) lack of information or misinformation. (Blumstein, Krieg et al. 1980)

Subsequently a seventh barrier, referred to as "gold plating," was added to the taxonomy. (Golove and Eto 1996)

Some have classified barriers as either structural or behavioural. For example, Hirst and Brown (1990) explain structural barriers as including 'distortions in fuel prices, uncertainty about future fuel prices, limited access to capital, government fiscal and regulatory policies, codes and standards, and supply infrastructure limitations' (Hirst & Brown 1990, p.267). Additionally, they consider behavioural barriers to exist also, namely 'attitudes toward energy efficiency, perceived risk of energy-efficiency investments, information gaps, and misplaced incentives' (Hirst & Brown 1990, p.267). Hirst and Brown (1990) make the distinction between the two types of barriers:

> Structural barriers result from the actions of many public and private sector organisations and are primarily beyond the control of the individual end-user. Behavioral barriers, on the other hand, are problems that characterise the end-user's decision-making, although they may also reflect structural constraints (Hirst & Brown 1990, p.269).

Other types of classifications of barriers also appear in the literature. For example Blumstein et al (1980) after presenting their six main classes of barriers, further discuss how barriers can be classified as stable or transient. According to Blumstein et al (1980), 'transient barriers may be tenacious, but when broken down, they stay down' and that 'for the most part, one expects that transient barriers will eventually be overcome by the normal workings of the market' (Blumstein et al 1980, p. 358). On the other hand Blumstein et al describe stable barriers as 'more deeply embedded in the social and institutional fabric' and 'when broken down, they tend to reappear in altered form' (Blumstein et al 1980, p. 358).

Another form of typology is presented by Reddy in the form of barriers by actor, from the energy consumer to global financial agencies (Reddy 1991). Under Reddy's typology, for the case of energy consumers, there are the ignorant, the poor and/or first-cost sensitive, the indifferent, the helpless, the uncertain and the inheritors of inefficiency. For the end-use equipment manufacturers there are the efficiency-blind and for the end use equipment providers there are the operating-costs blind. On the side of the energy carrier producers and distributors there are the supply obsessed, the centralization biased and the supply monopolists. In the case of the local and national financial institutions, there are the supply biased, the unfair and the anti-innovation attitude.

For government/country actors, Reddy's typology presents the uninterested government, the skills-short government, the government without adequate training facilities, the government without access to hardware and software, the capital-short government of an infrastructure-poor country, the sales-promoting regulator, the powerless energy-efficiency agency, the cost-blind price fixer, the fragmented decision maker, the large-is-impressive syndrome and the large-is-lucrative sponsor. Lastly, for the international, multilateral

and industrialised country funding and aid agencies, Reddy presents the inefficient technology exporter, the supply biased, the anti-innovation attitude, the large-is-convenient funder, the project-mode sponsor and the self-reliance underminer (Reddy 1991).

DeCanio explains certain barriers faced by firms can mean that 'many investments in energy efficiency fail to be made despite their apparent profitability' because 'internal hurdle rates are often set at levels higher than the cost of capital to the firm' (DeCanio 1993, p906). The reason for this DeCanio explains as including 'bounded rationality, principal-agent problems, and moral hazards' (DeCanio 1993, p.906). Were government to provide informational and organisational services beyond the traditional regulatory framework, the dual goals of improving overall energy efficiency and increasing private sector productivity could be achieved (DeCanio 1993).

Additionally, an analysis by Weber (1997) suggests that the market barrier classifications are not typologies as such and 'in fact each real barrier has its institutional, economic and organisational and behavioural aspects' (Weber 1997, p834). According to Weber, as barriers are invisible and not observable, they cannot be empirically classified, thus barrier classifications are 'derived from theory and propelled by different concepts of action in order to remove obstacles, that is, theories of institutions, economic theories, organisational theories and theories of human behaviour' (Weber 1997)

3.2 Non-academic literature

The Stern Report

The widely acclaimed report on the economics of climate change, the Stern Report (Stern 2006) makes the case for policies which price greenhouse gases and which support low-emission technology development in order to tackle climate change. However, Stern writes that 'even if these measures are taken, barriers and market imperfections may still inhibit action, particularly on energy efficiency' (Stern 2006, p. 427).

Stern sees the considerable untapped energy efficiency opportunities in buildings, transport, industry, agriculture and power sectors as evidence of the impact of market failures and barriers which include 'hidden and transaction costs such as the cost of the time needed to plan new investments; lack of information about available options; capital constraints; misaligned incentives; as well as behavioural and organisational factors affecting economic rationality in decision-making' (Stern 2006, p. 427).

Stern groups the barriers into three main categories: (1) financial and 'hidden' costs and benefits; (2) multiple objectives, conflicting signals, or, information and other market failures; and (3) behavioural and motivational factors (Adapted from the Carbon Trust, The UK Climate Change Programme: Potential Evolution for Business and the Public Sector cited in Stern 2006, p.429).

While an individual or firm would typically balance the financial costs and benefits of any investment in energy-using technologies, Stern notes that hidden or transaction costs are also required to assess the full range of costs and benefits. One study by Hein and Blok (1994) found search and information costs of energy efficiency measures of between 3 and 8 per cent of total investment costs (Stern 2006, p.430).

As well, a lack of available capital will prevent actors from investing in more energy efficient processes which usually have a high upfront capital cost but a lower overall cost when the energy cost savings are taken into

account. Likewise, Stern also discusses the occurrence of incentive failures restricting the effectiveness of price instruments ie. 'in the buildings sector is the 'landlord-tenant' problem in which landlords do not invest in the energy efficiency of their asset, because tenants benefit from lower energy bills, and more efficient capital typically does not command sufficiently higher rents' (Stern 2006, p. 431).

The Garnaut Review

The most recent Australian review on the economics of climate change, the Garnaut Review, discusses externalities in the provision of information and principal-agent issues as inhibiting 'the use of distributed generation and energy-saving opportunities in appliances, buildings and vehicles (Garnaut 2008, p.443). As Garnaut puts it:

> Two kinds of market failures are especially important in inhibiting the adoption of low-emissions technologies and practices. One relates to externalities in the supply of information and skills. The other involves a principal-agent problem – where the party that makes a decision is not driven by the same considerations as another party who is affected by it (Garnaut 2008).

Garnaut adds that some recent work by McKinsey & Company 'suggests that the majority of technically low-cost mitigation opportunities in Australia occur in sectors affected by information and principal-agent market failures (McKinsey & Co 2008, cited in Garnaut 2008, p. 445). Garnaut writes that market failures are most likely to occur 'where mitigation opportunities are small relative to the transaction costs of securing them' (Garnaut 2006, p.444).

The review presents a market failure framework comprising:

- Public good information market failures (& 'bounded rationality');
- Information asymmetry market failures (& 'adverse selection');
- Information spillover market failures; and
- Principal-agent market failures (Garnaut 2008, p. 445).

The table below summarises each of the market failures highlighted within the Garnaut framework (Garnaut 2008, p445-454).

Table 1: A Summary of Market Failures (Garnaut 2008)

Public good information market failures	▪ Includes the public good nature of some information and bounded rationality. ▪ As some information is a pure public good, one person's use of that information does not prevent others from using it. ▪ Where information has public good characterstics it is likely to be underprovided by the private sector (Jaffe & Stavins 1994 cited in Garnaut 2006, p. 446) and 'as firms are not able to capture all of the benefits from public good information, there is insufficient incentive to make information as extensive and widely available as consumers may demand' (Garnaut 2006, p.446).
Information asymmetry market failures	▪ Information asymmetry occurs when two parties to a transaction do not have equal access to relevant information (Garnaut 2006, p.452). ▪ Eg 'There are potentially significant information asymmetries

	where appliances, vehicles and houses are not energy rated. It would be extremely difficult for non-experts to determine the ongoing energy use of an appliance, for example, without outside assistance. This allows opportunism, as a product manufacturer could mislead a buyer before they buy it. However, this can be costly and individuals may choose not to invest in further information gathering, avoid the transaction or place a risk premium on the transaction (Garnaut 2008, p.452). ▪ "Information asymmetry can lead to adverse selection, which can occur where sellers are better informed than buyers, resulting in lower-quality goods dominating a market" (Akerlof 1970, cited in Garnaut 2008, p.453).
Information spillover market failures	▪ 'Some actions by parties can result in benefits to other parties, without those other parties paying for them. Early adopters of some low-emissions options bear additional costs in gathering information, developing skills for adopting the option and testing the reliability of the option (Jeffee et al. 2004). In some cases, the boundary between early adoption and innovation can be blurred. However, early adopters are often unable to capture the knowledge and skill spillover benefits that accrue to other firms, other industries, and the community more broadly. This acts as a disincentive to early adoption of novel technologies and practices' (Garnaut 2008, p.454).
Principal-agent market failures	▪ Occurs when one person (the principal) pays an agent for a service, but the parties face differing incentives and the principal cannot ensure that the agent will act in the principal's best interest. ▪ 'Principal-agent problems may entirely insulate some decisions from a carbon price, potentially reducing the adoption of low-emissions options. For example, as residential tenants pay energy bills, landlords may not install energy efficient appliances' (IEA 2007a cited in Garnaut 2008, p.454).

The International Energy Agency

The International Energy Agency's (IEA 2007) information paper on the experience with energy efficiency policy and programmes in IEA countries summarises the following:

> "Energy efficiency proponents point to a wide range of market failures or barriers in order to justify energy efficiency policies and programmes. These market barriers and failures include:
>
> - the limited supply and availability of relatively new energy efficiency measures in the marketplace;
> - consumers lacking or having incomplete information about energy efficiency options;
> - some consumers lacking the capital to invest in energy efficiency measures;
> - fiscal or regulator policies that discourage energy efficiency;

- misplaced incentives whereby the party designing, constructing or purchasing a building or price of equipment, or the landlord in rental property, generally seeks to minimize first cost rather than lifecycle cost;
- consumers or businesses paying little attention to energy use and energy savings opportunities if energy costs are a small fraction or the total cost of owning or operating a home, business or factory; and
- energy prices that do not reflect the full costs imposed on society by energy production and consumption (Geller and Attali 2005).

3.3 Limitations of barrier classifications

In discussing barrier classification models, it is important to note also the limitations of such models. Weber gives an explanation of how most barrier classifications fall down:

> First, barrier models assume that improved efficiency is the result of a particular action (eg buying more efficient equipment, retrofitting building shell or decree of an energy tax). Energy conservation which results from the omission of an action (eg not buying a certain machine) or doing something in a different way (eg integrating instead of isolated planning), cannot be described by a barrier model. Barrier models are limited insofar as they can only describe energy conservation in the sense of positive actions. Thus, they do not represent the whole range of energy conservation options.
>
> Second, barrier models do not question the purpose of an action. They focus on means to given ends. Preferences are exogenous and need not to be legitimised. Action is modelled technically in the sense that the challenge lies within the minimisation of means (ie energy consumption). The barrier model approach ignores the level of consumption and favours technical solutions.
>
> Third, barrier models are based on the assumption that there is an ideal level of efficiency. The existence of barriers as well as the level of inefficiency is derived by technical options (eg state of the art). Barrier models ignore social techniques and the social conditions of technology development (cf Shove, 1995) (Weber 1997, p834).

Weber adds however that 'practical measures can be realised for better institutional, organisational, behavioural and market conditions to make energy conservation more successful' (Weber 1997, p834).

3.4 Market failures vs. Market barriers

Analyses of market barriers are wide and varied with each arguing that barriers prevent optimal levels of economic and social efficiency from being achieved. To distinguish between market barriers and market failures, Brown (2001) describes a market failure as occurring when there is a flaw in the way a market operates. That is, where there are 'conditions of a market that violate one or more of the neoclassical economic assumptions that define an ideal market for products or services such as rational behaviour, costless transactions, and perfect information' (Brown 2001, p.1199).

According to Brown, market failures can be caused by:
(1) misplaced incentives;
(2) distortionary fiscal and regulatory policies;
(3) unpriced costs such as air pollution;
(4) unpriced goods such as education, training, and technological advances; and
(5) insufficient and incorrect information (Jaffe & Stavins 1994; IPCC 1996 cited in Brown 2001, p.1199).

However, Brown adds that there are additional barriers to clean energy technologies and that these 'refer to obstacles that are not based on market failures but which nonetheless contribute to the slow diffusion and adoption of energy-efficient technologies' (Brown 2001, p.1199). These are: '(1) the low priority of energy issues among consumers, (2) capital market imperfections, and (3) incomplete markets for energy efficient features and products' (Brown 2001, p.1199).

In the same vein and interested whether 'in what circumstances, and in what ways government action is appropriate', Fisher and Rothkopf (1989) explore how market failures distort the efficient allocation of resources in the energy sector and suggest activities for government on the basis of those market failures (Fisher & Rothkopf 1989, p397); the market failures being:

(1) National security – inadequate incentive to individual importer to restrict oil imports;
(2) Environmental quality – no incentive to protect environment;
(3) Increasing returns – natural monopoly;
(4) New technology – spillovers from research, downstream market failures;
(5) Residential conservation – inability of low income consumers to finance;
(6) Landlord/tenant – inadequate incentives for either party to conserve;
(7) Non-renewable resources – private market discount rate too high; and
(8) Transaction costs – inadequate or hard-to-use information on energy efficiency (Fisher & Rothkopf 1989).

3.5 Market barriers - A case for government intervention?

There is significant debate about the extent to which market barriers provide a justification for government policy intervention. For example, Sutherland argues that 'some market barriers are simply characteristics of the normal functioning of markets – even perfectly competitive markets' and that 'most of the market barriers are not "market failures", if market failures are the appropriate analytical foundation for government policy' (Sutherland 1991).

Sanstand and Howarth maintain, 'with few exceptions…the concept of market barriers has not been developed in terms of well established economic concepts or using standard economic techniques' and 'the conclusions are that, with a few narrow exceptions, the market barriers concept is inappropriate for energy policy and that there is little reason to believe that markets for energy services are economically inefficient' (Sanstad & Howarth 1994, p.811). Sanstad and Howarth add that 'this has opened the way for skeptics to argue that, in fact, there is at best a tangential relation between market barriers and market imperfections as the latter are defined in economic theory' (Sanstad & Howarth 1994, p.811).

According to Sutherland, reducing market barriers 'will not appreciably encourage conservation investments nor will resources be allocated more efficiently' and 'conservation policies, such as appliance standards, that are based on the assumption of market barriers, may adversely affect economic efficiency' (Sutherland 1991).

Sutherland's analysis finds that 'the market failures that illuminate the need for government conservation efforts are based on externalities, public goods and national energy security…a more efficient use of energy could be achieved through an efficient energy price, not through efforts to reduce market barriers' (Sutherland 1991, p.2).

Additionally, Nichols (1994) explains how many of the electric utilities in the USA have provided rebates to customers who purchase energy-efficient lights and other equipment and how these programs have been

deemed highly cost effective, with some analysts even characterising these measures as 'not a free lunch; it's a lunch you are paid to eat' (Fickett, Gellings & Lovins 1990, cited in Nichols 1994). However, Nichols also discusses how many economists have been sceptical of these claims and cites Alfred Khan (1991):

> The economist is forced irresistibly to question these estimates: if there are such enormous opportunities available, why aren't consumers taking advantage of them? If the answer is lack of information, or lethargy, why then aren't there hordes of entrepreneurs vying strenuously to overcome these obstacles? (Khan 1991 cited in Nichols 1994, p.840).

On the other hand, Sanstad and Howarth (1994) present the following counter argument to the market failures/market barriers discussion:

> The conventional distinction between 'economic' and 'engineering' approaches to energy analysis obscures key methodological issues concerning the measurement of the costs and benefits of policies to promote the adoption of energy-efficiency technologies. The engineering approach is in fact based upon firm economic foundations: the principle of lifecycle cost minimisation that arises directly from the theory of rational investment. Thus, evidence that so-called 'market barriers' impede the adoption of cost-effective energy-efficient technologies implies the existence of market failures as defined in the context of microeconomic theory. Problems of imperfect information and bounded rationality on the part of consumers, for example, may lead real world outcomes to deviate from the dictates of efficient resource allocation. A widely held contrary view, that the engineering view lacks economic justification, is based on the fallacy that markets are 'normally' efficient (Sanstad & Howarth 1994, p.811).

Sanstad and Howarth further argue that 'the equation of normal and efficient markets is a fallacy that can only serve to distort energy policy analysis' and that 'in light of contemporary theory, the intuitions expressed by the market barriers concept may in fact be closer to the theoretical mainstream than the views of the skeptics' (Sandstad & Howarth 1994, p. 812).

On this basis, Sanstad and Howarth (1994) discuss key market imperfections such as (1) the existing regulatory environment, (2) imperfect information, (3) asymmetric information, (4) transaction costs, (5) imperfections in capital markets and (6) bounded rationality in energy decisions.

4 Classification of Institutional Barriers

As with any classification system, the objective in classifying institutional barriers is not to devise "the correct system" but rather to develop "a useful system" given the context. To paraphrase "Occam's Razor", such as system should be as simple as possible, but no simpler. Ideally, the classification should include categories that are "mutually exclusive and collectively exhaustive". In other words, each barrier should fit into one category but no others. On the basis of these criteria the following simplified classification of seven institutional barriers to distributed energy is proposed:

1. **Imperfect information** - lack of access to relevant information;
2. **Split incentives** - the challenge of capturing benefits spread across numerous stakeholders;
3. **Payback gap** - the gap in acceptable payback periods between energy consumers and suppliers;
4. **Inefficient pricing -** failure to reflect costs (including environmental costs) properly in energy prices;
5. **Regulatory barriers** - the biasing of regulation against distributed energy resources;
6. **Cultural values** - insufficient attention given by individuals and organisations to energy use; and
7. **Interaction between barriers** - the additional barriers created by the interplay of other six types of barrier.

Alternatively, to adopt a less formal language, the "Seven D.E. Sins" are[1]:

1. ***Ignorance***

2. ***Disarray***

3. ***Impatience***

4. ***Mispricing***

5. ***Maladministration***

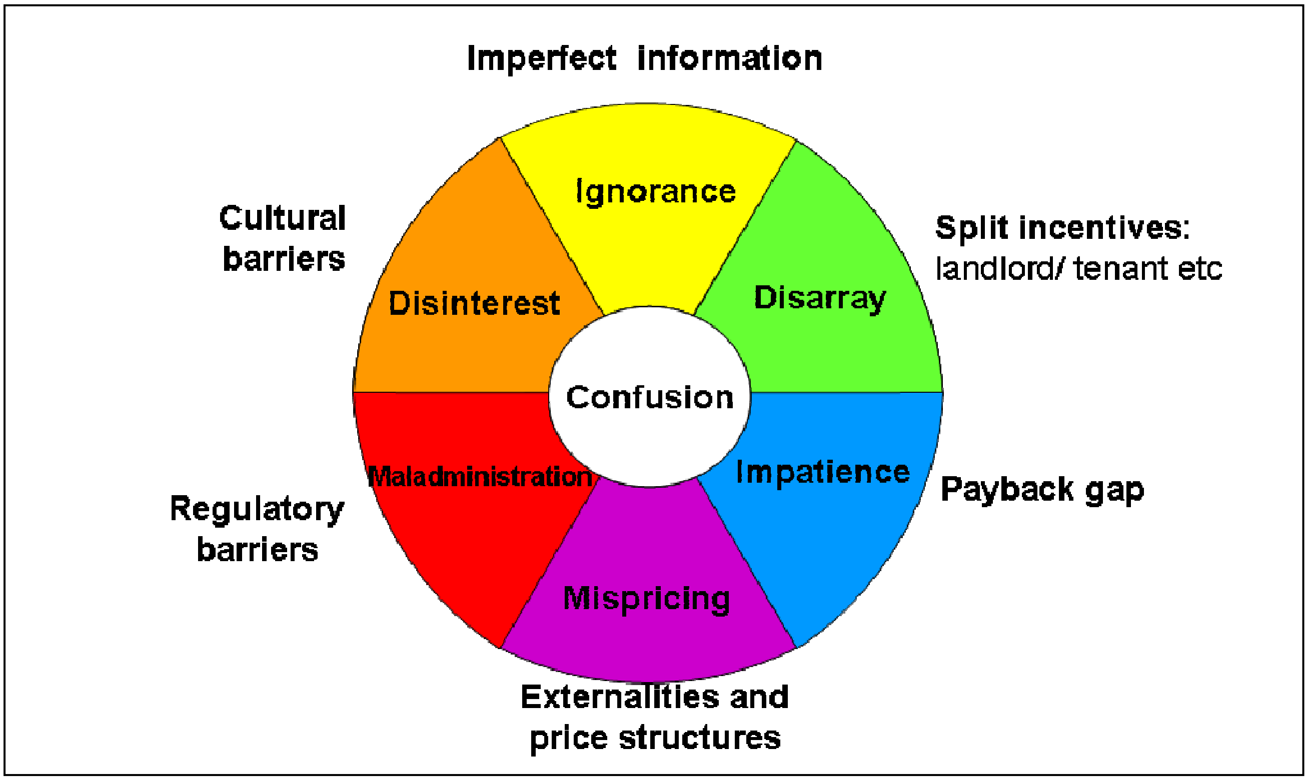
6. ***Disinterest***

7. ***Confusion***

These categories are illustrated in Figure 5.

[1] For an alternative characterisation of the "seven sins" of energy efficiency, see Smith (2007).

Figure 5. Institutional barriers to Distributed Energy- "the Seven DE Sins"



Each of these barriers is discussed below.

Transaction costs

It is worth noting that high transaction costs have not been included as an institutional or a technical barrier. This is because higher transaction costs are a consequence or a symptom of barriers rather than a barrier in their own right. Indeed, all of the institutional barriers discussed below can be considered in terms of how they increase transaction costs for DE. For example, as Sanstad and Howarth point out:

> "Problems of imperfect and asymmetric information may be viewed from the perspective of transaction cost analysis: the economic gains available from increased energy efficiency may be outweighed by costs in gathering, assessing and applying information on the characteristics and performance of energy using equipment, installing such measures as thermal shell improvements, making decisions about energy efficiency and energy utilization, or reaching and enforcing agreements among interested parties" (Sanstad and Howarth 1994)

4.1 Imperfect Information ("Ignorance")

If the aphorism "information plus analysis equals intelligence' is true of electricity networks, then information is crucial to the intelligent grid. Conversely, lack of appropriate information is a major barrier to the establishment of intelligent grids.

In orthodox economic theory, "perfect information" is one of the fundamental assumptions of perfect competition on which the fully efficient operation of the market depends. This essentially means that consumers and firms have free and immediate access to all relevant information in making decision about

how to make and choose goods and services. While economists understand that this is never strictly true, it is often used a useful simplifying assumption.   As the Garnaut Report noted,

> "Individuals can never have perfect information relevant to a decision they are making. However, development of an efficient market in goods and services requires individuals to know:
>
> - the options available
> - the rough costs and benefits of the different options
> - how to deploy the options (including hiring experts)
> - the cost of investigating the options.   (Garnaut 2008)

However, in the case of DE, this simplifying assumption can disguise major inefficiencies in the operation of markets.   As Brown notes, "The time and cost of collecting information is part of the transaction costs faced by consumers. Where the consumer is not knowledgeable about the energy features of products and their economics (for any of a large number of reasons, including technical difficulties and high costs of obtaining information, investments in energy efficiency are unlikely." (Office of Technology Assessment, US Congress, 1993; Levine et al., 1995; cited in (Brown 2001)

"Governments should not be expected to fill the gap in every situation where individuals lack sufficient information to make good decisions. Producing, finding, and processing information has economic costs that need to be considered in decision making. However, where information barriers are caused by market failures, governments may be able to improve the efficiency of the market". (Garnaut 2008)

This is the key rationale in Australia for mandatory energy performance labelling of many appliances and rating of buildings.

The following discusses where the lack of easy access to timely relevant information can present a significant barrier to DE options.

4.1.1 Energy operating costs (when purchasing): "First cost disease"

Many DE options involve higher initial purchase or capital costs but lower ongoing operating costs. For example, this is true of solar and wind power, solar water heating, cogeneration and many energy efficiency options. If reliable information on operating costs is not easily and cheaply available at the time of purchase, this creates a bias in favour of the choosing the lowest "up front" cost. This phenomenon is sometimes called "the first cost disease".

"Even while recognizing the importance of life-cycle calculations, consumers often fall back to simpler first-cost rules of thumb. While some energy-efficient products can compete on a first cost basis, many of them cannot. Properly trading off energy savings versus higher purchase prices involves comparing the time-discounted value of the energy savings with the present cost of the equipment – a calculation that can be difficult for purchasers to understand and compute. This is one of the reasons builders generally minimize first costs, believing (probably correctly) that the higher cost of more efficient equipment will not be capitalized into a higher resale value for the building." (Brown 2001) p. 1202.

4.1.2 Energy operating costs (when operating): "Who pays the bill?"

Even when energy using equipment is purchased and installed, useful information about operating costs may still be unavailable. Many consumers either do not personally receive billing information at all (for example, it may be directed the accounts payable section of a company) or only receive an aggregated bill once every several months. It is hard to respond appropriately to cost signals if no signals are received.

4.1.3 Benchmarks for energy performance: "What's normal?"

Even where energy use data is available, it may be difficult to interpret. If credible performance benchmarks are not available, then judging between a good and poor energy performance may be difficult. So, for example, a factory may continue to use an expensive, inefficient and polluting coal-fired boiler, simply because its operators are not aware of better options.

4.1.4 Lack of DE precedents: "Will DE work?"

Even where credible information about relative energy performance is available, reliable information about DE alternatives may be hard or costly to access. So, for example, while the costs of deploying advance metering infrastructure may be reasonably estimated, the impact of and benefits that flow from such an investment can be much harder to anticipate with confidence.

4.1.5 DE technologies and opportunities: "What does DE really cost?"

Even where technical information is available and the performance of DE has been demonstrated, reliable information about the fixed and operating costs may be unavailable, particularly in relation to more innovative technologies.

4.1.6 Network planning information: "DM: when, where, how much?"

One of the key potential benefits of DE, compared to centralised generation, is its ability to locate close to centres of energy demand and therefore reduce (avoid or defer) the need for network capacity. Smith (2007) has noted that the opportunities for demand management within a network context is constrained by three factors: location; timing; and the amount of peak reduction, as follows:

> "**Location**: opportunities arise only in those specific parts of the network system that are facing constraints and require augmentation;
>
> **Timing**: demand management is only required for short periods of system peaks and has its highest value in the period immediately before planned system augmentation investments are to be made; and
> **Amount** – a specific quantum of peak load reduction is required to replace the need for a system augmentation in time to defer construction of supply side assets. Too little will not allow a deferral and any surplus has no value once a deferral can be achieved" (Smith 2007)

However, it is difficult for DE options to take advantage of these potential benefits, unless reliable timely information about such emerging network constraints is easily accessible. As Szatow notes, "Planning

information can help level the playing field for alternative energy supply options by providing accurate forecasts of network constraints and opportunities for investment". (Szatow 2008)

4.2 Split Incentives ("Disarray")

"Split incentives" refer to situations where a course of action that is collectively efficient outcome is obstructed because it is not in the interests of a particular party. While in principle, all such split incentives could be resolved by the party that benefits from the action compensating the party that does not benefit. Indeed, such transactions make up a large share of normal economic activity. However, all such transactions have costs associated with them in terms of time, risks and resources, so in practice many split incentives are not resolved.

The greater the number of parties involved in decisions related to DE investment, the greater will be the transaction costs associated with devising and negotiating a mutually acceptable outcome. Similarly, the lower the level of trust and sense of common purpose between the relevant parties, the more difficult and costly it will be to overcome such barriers.

Facilitation through negotiation, awareness raising, education, confidence building, and access to reliable independent energy performance information can often assist in addressing these barriers.

4.2.1 "Landlord /Tenant" problem

The classic example of split incentives is the "tenant/landlord" problem, which is often cited in relation to energy efficiency investments in rental accommodation. In this case the landlord is reluctant to invest in energy efficiency, because the benefit would accrue to the tenants over time through lower energy bills; while the tenant is reluctant to pay for investment in energy efficiency as they be uncertain that stay a tenant long enough to reap the benefits. This situation could apply as much to insulating a low income residential flat as to installing intelligent lighting controls in a premium office space.

A variant of this principal is the "principal/agent" problem. "This problem occurs when an agent has the authority to act on behalf of a consumer, but does not fully reflect the consumer's best interests" (Brown 2001). An example of this is where a design consultant is either rewarded for minimising initial costs rather than life cycle cost for a client.

4.2.2 Complex decision making within groups

Split incentives can be as pervasive within groups or organisations as between them. In particular, where organisations do not have established processes for considering and deciding issues like investment in DE, through for example an energy manager or en energy management plan, then the costs associated in formulating, negotiating, deciding on and implementing a proposal relating to DE.

4.2.3 "Tragedy of the Commons"

It the highest level of complexity, split incentives can be characterised as the "tragedy of the commons" where all parties are disadvantaged by the failure of each to act for the common good (Hardin 1968). This is particularly relevant to the intelligent grid in relation to investment in research and development as described by Brown:

> "The risk of innovation leakage and exploitation by competing firms puts pressure on firms to invest for quick returns (Mansfield, 1994`; cited in Brown 2001). Technology innovation is typically a longer-term investment fraught with risks to the investor. The result is an under-investment in R&D from the standpoint of overall benefits to society. The problem is particularly difficult in the newly restructured electric sector, where R&D funding has decreased dramatically. Companies will not fund the optimal societal level of basic R&D of new technologies, since many of the benefits of such research will flow to their competitors and to other parts of the economy" (Brown 2001).

4.3 The Payback Gap ("Impatience")

Given that DE options often have higher initial or capital costs but lower ongoing or operating costs, it is not surprising that limited access to finance to manage the higher initial costs is often cited as a barrier to DE. However, some care needs to be taken in relation to this issue. Given the massive growth both in the finance industry and in the provision of personal and corporate debt over the past two decades, it is far from clear that limited access to finance has been a major barrier in retarding the development of DE and the intelligent grid. On the other hand, there appears to be ample evidence that is a large neglected reservoir of cost effective investment opportunities in DE with relatively short payback periods of a few years or less. As the Stern Report observed,

> "Individuals and firms should invest until the expected savings are equal to the opportunity cost of borrowing or saving (assuming risk neutrality). Studies suggest that individuals and firms appear to place a low value on future energy savings. Their decisions expressed in terms of standard methods of appraisal would imply average discount rates of the order of 30% or more. (Stern 2006)

This 30% discount rate implies that consumers and businesses require DE investments to pay back their initial investment within about three years. The so-called "payback gap" refers to this discrepancy between the payback period that consumers and business demand to be met by many DE investments and the payback period that is required of many other investments (including those made by utility companies in energy supply infrastructure). Why is it that many households appear to be willing to invest in superannuation and other assets that offer a return on investment of say, 7% per annum, but often seem not prepared to invest in efficient lighting that may offer a return on investment of many times this rate. Why are many households able to borrow thousands of dollars to spend on an energy intensive large screen television? There is clearly more at play here than simply access to finance. If the obvious answer is that a wide screen TV is more fun, then this should give us pause for thought about the limitations of relying solely on economic principles in explaining human behaviour.

The answer is likely to lie, in part, with the other institutional barriers described in this paper. However, there is another side to the question of financing and the notion of the "payback gap". Much debate and analysis around this theme has focussed on why energy consumers often seem to require their DE investments to pay for themselves through operating costs savings within two or three years. However, of equal significance to the DE payback gap is why the short payback periods do not apply to centralised energy resources, in other words why regulated monopolies have ready access to finance with long payback periods relative to competitive providers or energy consumers. This reflects the historical development of the electricity industry, and is a key barrier to the development of DE resources.

4.4 Inefficient pricing ("Mispricing")

There are two dimensions to inefficient pricing that represent institutional barriers to Distributed Energy and Intelligent Grid. These are:

- unpriced "external costs", which relates to the average level of prices; and
- the structure of prices.

4.4.1 Externalities (Environmental costs/ Carbon price)

External costs are costs that are caused by the supply of a good but are not included in the price of that good. The most obvious external cost of electricity supply is the costs of climate change caused by burning of fossil fuels to generate electricity. This means that the average price of electricity is set below its true cost of supply, thus leading to excessive consumption of fossil fuel based centralised electricity supply and reducing the uptake of low emission DE resources such as energy efficiency, renewable energy and cogeneration.

> "Unpriced costs include a range of negative impacts from the discovery, extraction, production, distribution, and consumption of fuels and power. A strong case can be made that energy fuels are underpriced, because market prices do not take full account of the variety of social costs associated with fuel use. Fossil energy using today's conversion technologies produces a variety of unpriced costs (or negative externalities) including greenhouse gas emissions; air, water and land pollution; and oil supply vulnerabilities associated with the need to import oil and the uneven geographic distribution of petroleum resources. As a result of these unpriced costs, more fossil energy is consumed than is socially optimal (Brown 2001).

The simplest mechanism to redress this barrier is to put a price on carbon through either a carbon tax or a carbon emission trading scheme as proposed by the Garnaut Review and the Federal Government. For such a mechanism to overcome this barrier fully, the price of carbon must apply to all carbon emissions without exemption and be set at a level high enough to fully cover the cost of the environmental harm being caused.

4.4.2 Inefficient Price Structures

While more subtle than excluded external costs, pricing structures can be an even greater barrier than the exclusion of external costs. Some of the ways that inefficient price structures can create barriers to DE are described below.

- Average rather than marginal cost pricing

Although interval meters and time of use tariffs are becoming more common, most electricity consumers in Australia, particularly smaller consumers, still pay a flat electricity tariff. That is, the same electricity price all day, everyday throughout the year[2]. This flat tariff is in stark contrast to the wide variations in the cost of providing electricity both in the wholesale (generation) price and reflecting the cost of providing peak capacity in networks. This flat price structure creates a bias against DE resources that are well suited to respond to these cost fluctuations including peak load management resources such as demand side response. While these flat tariffs are sometimes defended as protecting vulnerable consumers, the effect is

[2] The main exception to this rule is off peak electric water heating.

often to impose avoidable costs on all consumers to pay for large investment in centralised generation and networks to meet occasional peak demand.

As Brown notes, "Because most customers buy electricity as they always have – under time-invariant prices that are set months or years ahead of actual use – consumers are not responsive to the price volatility of wholesale electricity. Time-of-use pricing would encourage customers to use energy more efficiently during high-price periods" (Brown 2001).

Greater use of cost-reflective, time of use tariffs is a key conditions for encouraging greater use of DE and delivering the benefits of the intelligent grid.

- Undervaluing DE options

The converse of flat electricity tariffs for centralised electricity supply is that often the value that distributed energy resources can offer to support the centralised power system is not appropriately reflected in pricing arrangements for distributed energy. Historically, in Australia there have been relatively few offers to pay providers of distributed energy for the services and support they can offer to the electricity system. The current Draft Decision by the Australian Energy Regulator to endorse $17.6 billion of network infrastructure investment in NSW with little regard to the potential role of distributed energy, suggests that there is still some way to go before distributed energy options are appropriately value in the electricity supply system.

4.5 Regulatory barriers ("Maladministration")

To justify policy measures to address the institutional barriers to distributed energy, it is not enough to demonstrate that a significant barrier or market failure exists and that a viable policy initiative exists. also It is also important to make the case that any anticipated or unforeseen costs and consequences of the policy initiative will be outweighed by the benefits of addressing the barrier. To understand the reason for this tougher test, one need look no further than the analysis of institutional barriers itself.

Some of the biggest institutional barriers have been created as a by-product of trying to address other public policy objectives. Regulatory barriers fall into this category. These are barriers created by the operation of laws and regulation. Some of these potential regulatory barriers are discussed below.

4.5.1 "Coupling" (monopoly) profits to sales volumes

One of the most prominent regulatory barriers results from the goal of limiting the abuse of market power by monopoly electricity suppliers. In the Australian context this now applies to electricity network. Many electricity networks in Australia and overseas are subject to economic regulation in the form of a maximum average price they can charge. As network costs are mainly driven by capital costs which in turn are linked to peak demand, it means that their cost structure is not strongly influenced by the volume of electricity that flows though their wires.

As a consequence, since revenue equals price times sales volume, a maximum price cap means that total revenue is directly related to the volume of electricity delivered. On the other hand, total cost is not related to sales volume except for sales at the time of peak demand. Since profit equals total revenue minus total cost, this means that the profitability of the network business is closely tied to the total sales volume. This puts the financial interests of the network business in direct conflict with any measures that would reduce the volume of electricity sales passing through the network. This means that DE measures that reduce network sales volume are a threat to the profitability of the network business.

Fortunately, this process of "coupling" network profitability to sales volume is not an inevitable consequence of effective economic regulation or price control. There are now well established techniques for protecting both consumers and the network business profitability, while simultaneously removing barriers to distributed energy. For further discussion of these issues see (Dunstan, Abeysuriya et al. 2008).

4.5.2 Distortionary fiscal and regulatory policies

There are many distortionary fiscal and regulatory policies that act as barriers to distributed energy, and many of these have been recently identified, based on an analysis of 65 projects (Alderfer et al., 2000; cited in (Brown 2001). Typical examples cited in this work include "prohibitions against uses of distributed energy resources (other than emergency backup when disconnected from the grid) and state-to-state variations in environmental permitting requirements that result in significant burdens to project developers" (Brown 2001).

4.6 Inappropriate cultural values ("Disinterest")

In one sense, all the preceding institutional barriers are cultural. They reflect the way that people relate to the technology and the operation of institutions created by society. However, there is also specific set of barriers that are more fundamentally cultural in that they directly reflect cultural values attitudes and habits of thought.

As Brown notes "Energy efficiency is not a major concern for most consumers because energy costs are not high relative to the cost of many other goods and services. In addition, the negative externalities associated with the US energy system are not well understood by the public. The result is that the public places a *low priority on energy issues* and energy efficiency opportunities (Brown 2001).

On the one hand, it can be argued that cultural values should not be considered a barrier at all, because people are what they are and should be simply free to consider important whatever they consider important. On the other hand, the values we hold as individuals and as participants in the economy are shaped by our society and culture. Cultural values are constantly evolving. Values that evolve in the past may no longer be appropriate in to the present circumstances. So for example, attitudes about the desirability of centralised energy supply that evolved when this was the dominant technology may become a significant barrier when times change and technological change and environmental concerns mean distributed energy and intelligent grid should play a bigger role.

This is not to argue simply that the development of distributed energy resources is being retarded because people do not give them enough priority. This would essentially be a circular argument. Rather, the argument is that society's collective desire to tap the benefits of distributed energy may be frustrated by individual and organisational values and attitudes that are inconsistent with this social aspiration. In other words, if society as a whole considers energy abundant and energy use harmless then individuals and organisations wasting energy at their own expense is not a problem. On the other hand, if society considers the by-products of energy use such as greenhouse gas emission a matter of serious concern, then the inefficient use of energy by individuals and organisations becomes a legitimate target of policy consideration.

There are therefore two dimensions to the institutional barriers of cultural values.

4.6.1 Cultural lag

The first dimension of inappropriate cultural values is what might be called "cultural lag", in which the prevailing attitudes and values are no longer appropriate to the current circumstances. These values be reflected in the behaviours of individuals or organisations. There is a natural tendency to base investment and other decisions on past experience and favour technologies and practices with which one is familiar. This inherent "conservatism" represents a barrier to innovative concepts like intelligent grid and distributed energy. This cultural lag can also have a powerful impact through the accumulated skills base of organisations

4.6.2 Social Dilemmas

The second dimension to inappropriate cultural values is "Social Dilemmas". Analogous to at the level of society to the concept of the "Prisoners Dilemma", this is where the individual attitudes lead to behaviour of individuals which conflicts with collective interests of the society. For example, while the prevailing values in society may be that that "everyone should use energy efficiently", if this attitude is not also reflected in personal values that "I will use energy efficiently" then it will not flow through to actual behaviour.

4.7 Interaction of Barriers ("Confusion")

It should be clear from the preceding discussion, that many of the institutional barriers are interrelated. The final category of institutional barriers emerges from the observation that due to the interaction of these barriers, the total impact of institutional barriers is likely to be greater than the sum of the parts.

It is much easier to overcome a single barrier than a several barriers at once. Where any one of a number of barriers can obstruct a distributed energy option from proceeding, it can be impractical to address effectively all barriers simultaneously.

Potential examples of this effect include the following:

- Management complexity or policy paralysis, in which the difficulties associated with coordinating action frustrate any effective action.
- Interagency and intergovernmental discord, which is exacerbated in a federal system, with strong historical state government involvement in energy planning and investment.

5 Policy Implications

The ultimate purpose of analysing institutional barriers to intelligent grid and distributed energy, is of course, to develop effective strategies to overcome these barriers. While the focus of this discussion paper is primarily on understanding the barriers, it is appropriate here to consider some of the implications of this analysis. As stated by (Sanstad and Howarth 1994): “The important question for policy purposes is whether there are possible interventions or alternative institutional arrangements by means of which such costs can be overcome when they are present”.

This section considers policy measures to overcome these barriers and thereby capture the opportunities for the efficient use of distributed energy resources.

Market Support vs Market Transformation

While offering “market support” through subsidies can encourage the adoption of distributed energy options, if this not strategically targetted at reducing barriers then it may have little long term effect and may even add additional barriers and inefficiencies of its own. “Market Transformation” has been defined as: “a strategic effort by a utility and other organization to intervene in the market, causing beneficial, lasting changes in the structure or function of the market, leading to increases in the adoption of energy efficient products, services and / or practices.” (Schlegal, J., et al. 1997)

Moreover, the potential gains from distributed energy options will only be realised if the costs associated with adopting these policy measures is less than the value of the efficiency gains from applying the distributed energy options.

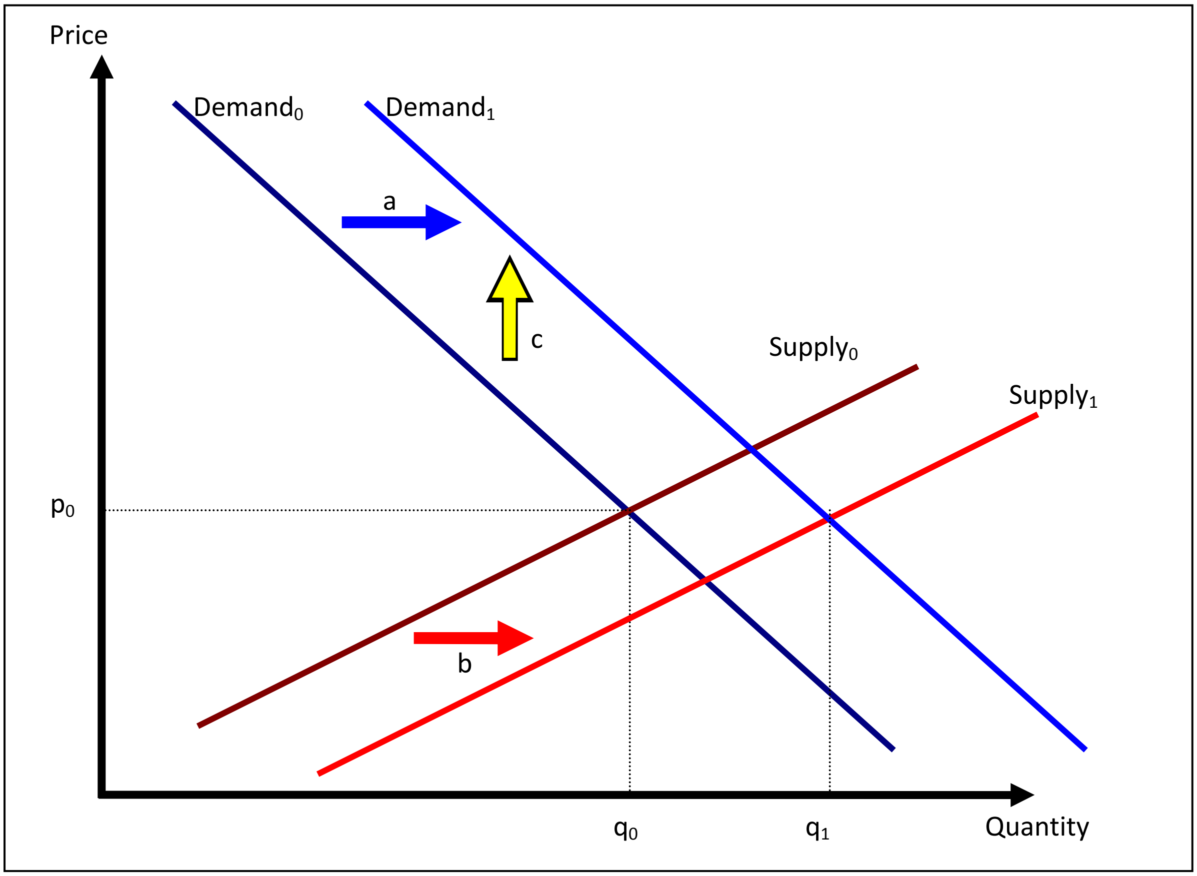
5.1 Reducing Institutional Barriers to Distributed Energy Options

Market Transformation is informed by a view that markets are shaped as much by conscious and unconscious social factors as by technical factors and are therefore amenable to a range of deliberate strategies for change. Figure 6 illustrates this concept in terms of the standard supply and demand curves.

The quantity of a given commodity such as a distributed energy option, being used in the economy is initially at level q_0, reflecting the cost of supply. To increase the uptake of this commodity, there are essentially three options:

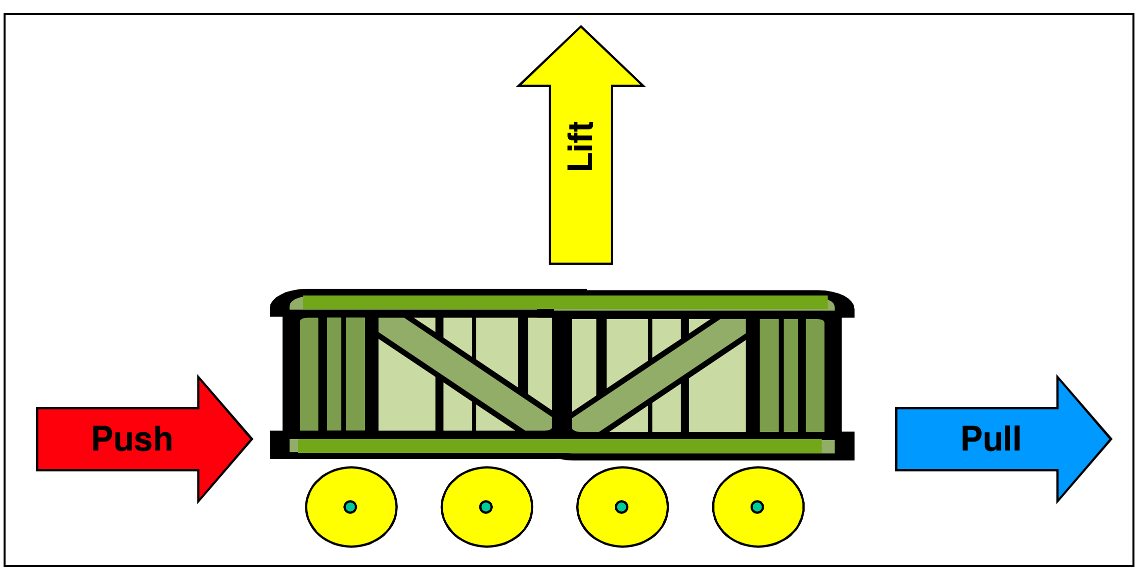
a) Lower the cost of supply (moving the supply curve to the right, from S_0 to S_1);
b) Increase the demand for the commodity (moving the demand curve to the right, form D_0 to D_1); or
c) Reduce the transaction costs that mean that the effective demand is lower than the true demand (this could be represented as either a lowering of the supply curve or as lift in the demand curve).

Figure 6: Moving the market (Demand & Supply)



The same principles are illustrated in a simpler form in Figure 7, in the form of "pushing" the market through mandatory measures such as regulation, "pulling" the market through incentives such as rebates or "lifting" the market by reducing transaction cost such as making better information available. The test of market transformation is whether these changes are effected as permanent and self sustaining or as temporary.

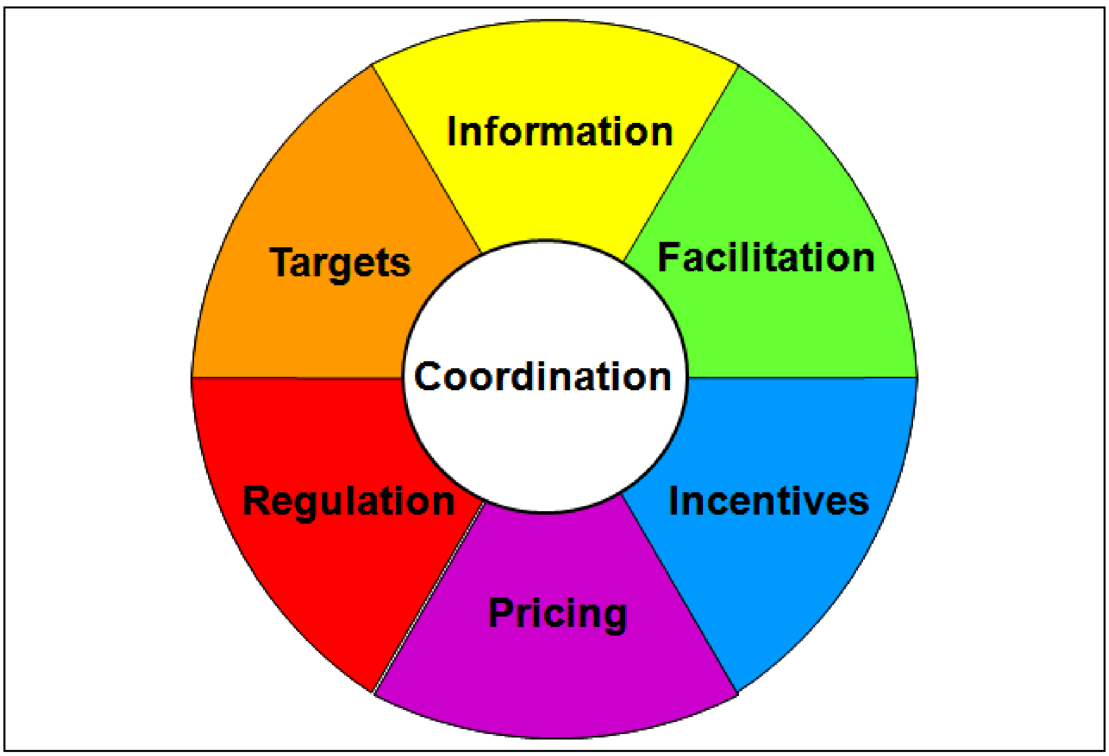
Figure 7: Moving the market ("Push, Pull, *Lift*")



The nature of the available policy options for moving the market is illustrated in the "Policy Palette" in Figure 8 shows the "push, pull and lift" replaced by the categories of policy options: regulation, incentives and information as the primary drivers, and complemented by the secondary drivers of targets, facilitation and pricing. This does not imply that these secondary drivers are less important, but rather that they are less simply defined.

This framework offers a structure that can be further developed for classifying and coordinating policy options to support distributed energy options.

Figure 8: The Palette of Policy Drivers to Move the Market – "PIRFICT"



These seven categories of policy options provide, as indicated, a palette with which to address the institutional barriers described in Section 4. One of the key conclusions is that the use of these policy options is most effective when the full range of policy options is deployed, that is, including policy options from the whole palette. By itself, the use of regulation can promote backlash, and reduced effectiveness due to lack of information. Conversely, the use of incentives and information alone will often result in a weak uptake, or 'cream-skimming'. Above all, the need for overall co-ordination of the implementation of the range of policy options is important, to reduce the risk of fragmentation.

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