Single Electricity Market

DEMAND SIDE VISION FOR 2020

Consultation Paper

17 August 2010

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EXECUTIVE SUMMARY

The Regulatory Authorities (RAs) in the Republic of Ireland (RoI) and Northern Ireland recognise the potential which demand side management has to deliver significant economic and environmental benefits to the All-Island market. They believe that realisation of this potential will require a high level of co-ordination between stakeholders and policymakers across a broad range of areas including energy efficiency, smart metering, large-scale demand side response, new forms of electric demand, aggregation of distributed generation and storage.

This consultation document forms a key part of the RAs' assessment of the merits of different DSM options, the associated development of a Demand Side Vision for 2020, and the identification of supporting policy measures and their implementation path to seek to enable the 2020 Demand Side Vision to be delivered.

Throughout this consultation we raise a number of questions regarding our assessment, observations and provisional conclusions; where we welcome the views of all existing and potential stakeholders. For ease of reference these have been compiled in Annex C of this document. Furthermore to help us capture and compare the views of all stakeholders and to understand the basis of their interest in the development of DSM in the All Island market; there is a standard Questionnaire Form published alongside this consultation paper which stakeholders can use to provide their responses to this consultation.

It is important to note that the Irish Regulatory Authorities does not have responsibility for all of the areas covered by this consultation and that some of the aspects highlighted are a matter for consideration by Government.

CONTEXT AND BACKGROUND TO THIS CONSULTATION

Lack of participation by the demand side has long been identified as a weakness in electricity markets. It is well-established that demand side participation brings a number of benefits to electricity markets, including increased security of supply (or a reduced cost of delivering the same security of supply), greater efficiency in consumption and increased competition both in the wholesale and retail markets.

Historically, the high levels of security of supply demanded by governments, regulators and customers has led to electricity companies focusing on having sufficient generation capacity to reduce the probability of loss of load to almost vanishing levels. The advantage of a generation-led strategy is essentially one of control: it has been easier to be certain of delivering power station capacity than controlling demand.

During the coming decade, this paradigm will be eroded from two directions by changes in the characteristics of the market and in technology. The first is that generation will become inherently less controllable as the installed wind capacity increases on the Island. This will make it more technically difficult and costlier to vary generation levels in response to fluctuations in demand. The second is the emergence of new technologies, including economically-viable smart metering, which have the potential to lower the cost of demand side participation – a factor that has been a significant barrier in the past. Awareness of climate change and higher energy costs are likely to accelerate these trends, as consumers become more aware of the implications of their energy consumption.

WHY ARE POLICIES NEEDED TO SUPPORT DEMAND SIDE MANAGEMENT?

The intent of the work is primarily to identify those demand side measures which are economically advantageous and which may merit some form of policy intervention. Within the context of a competitive electricity market, the rationale for any form of policy intervention needs to be considered carefully. The default assumption should be that – except for the existence of a specific barrier – then to the extent that demand side management of any form is economically viable, it should also be financially viable and the market participants themselves should deliver it without policy support.

Therefore, in cases where some policy intervention is justified, we would generally expect that intervention should be to correct a barrier of some description. This might be one of the classic types of market failure from economic literature, or a correction to the existing set of policy or regulatory arrangements. It should be made clear that the need for a policy intervention does not necessarily imply any direct financial support; an important issue given the current need for thrift from within the public budget. Generally, we would expect the types of demand side response which merit immediate policy intervention to be broadly self-financing for the key stakeholders, although, perhaps over relatively long timescales.

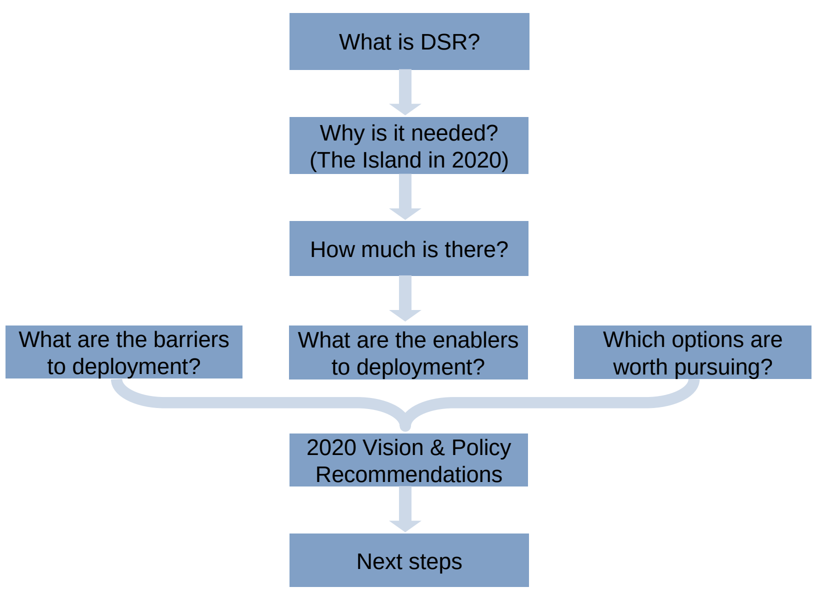
CONTRIBUTION TO COMPETITIVENESS

One potentially valid reason for providing a supportive policy framework for demand side management is to provide a competitive advantage in the world economy. Direct fiscal measures to reduce electricity prices to consumers (such as industrial customers in energy-intensive and internationally competitive industries) are not generally considered desirable and are likely to contravene European state aid provisions. However, there is scope for various forms of policy support for newly formed industries and to support energy efficiency, CO2 emissions reduction and renewables.

The All Island economy is relatively strong in the areas of finance, software and systems development and high-level design, but with no real competitive advantage in mass manufacturing. As a result, we see some value in supporting the development of intelligent systems for automation of demand response, but it is unlikely that this will lead to significant employment in the mass manufacturing of smart appliances or electric vehicles.

ROADMAP FOR THE DEVELOPMENT OF A 2020 DEMAND SIDE VISION

Our approach to the development of a Demand Side Vision for the Island in 2020 is illustrated below.



First we define what is meant by demand side response, its role and benefits, and discuss the generic lessons obtained from the experience of international deployment. Moving from the general to the specific, we examine the current policy drivers and the likely characteristics of the electricity market on the Island in 2020, and the how this will affect the need for the services which demand side measures can deliver. Having established the need we then attempt to evaluate the size of the potential demand side resource, attempt to identify the barriers and enablers to deployment and attempt to evaluate which of the different demand side options on the Island are worth pursuing.

This evaluation of demand side options in a 2020 context allows us to propose a Demand Side Vision for the Island in 2020 and suggest policy recommendations to realise it. We conclude by outlining some proposed next steps towards defining a demand response programme for The All Island market.

ROLE AND BENEFITS OF DEMAND SIDE RESPONSE

Within the context of this consultation paper the term 'demand side response' (DSR) is defined to include changes in the characteristics and behaviour of a range of decentralised demand and (distributed) generation types. This includes overall demand reductions, changes in the profile of demand (or distributed generation) to alleviate peaks, and the provision of flexibility to allow the system to adapt to unexpected events. The scope of this project encompasses energy efficiency, behavioural change, smart metering, home and office automation, industrial and commercial demand side response, new forms of electric demand, aggregation of distributed generation and micro-generation, and storage.

DSR confers a range of other benefits. These include reducing generators' market power, enhancing security of supply (or reducing the cost of delivering a given level of supply security) and facilitating retail competition.

The benefits which different forms/types of demand side response provide may be classed under one or more of the following three types of modification to the demand profile (or to the effective demand profile, via changes to the profile of distributed generation):

- **overall demand reduction** which refers to measures which reduce energy consumption, typically the target of efficiency programmes;
- **static peak reduction** which encompasses measures which enable changes to be made to the profile of demand to alleviate system peaks – obvious examples of this are static time of use tariffs and interruption contracts; and
- **flexible measures** which allow demand, or load, to be shifted in response to system condition on the day, such as dynamic time-of-use tariffs and system operator interruption contracts.

Demand-side measures can also provide a fourth type of benefit, namely, **ancillary services** – we have not evaluated this issue in detail, except briefly to discuss new technologies, currently being trialled which enable devices such as fridges and freezers to respond automatically to changes in system frequency.

Different demand side measures will deliver one or more of these benefits. Understanding the nature and materiality of the benefits delivered forms a critical part of assessing the relative merits of different demand side options and thus the development of a Demand Side Vision for 2020.

INTERNATIONAL EXPERIENCE OF THE BENEFITS OF DEMAND SIDE ACTIVITY

We have made a detailed analysis of international experience and best practice in demand side management schemes covering more than 200 schemes. Our findings break down into four main categories and these are summarised below (with further detail provided in Section 2.3). Our findings from the analysis of international experience and best practice break down into four main categories and these are summarised below:

ENERGY EFFICIENCY

- significant economies of scale can be achieved by targeting a whole sector or industry;
- actual savings from efficiency schemes can be lower than estimated beforehand as they fail to take into account complex technical, economic and behavioural factors;
- small and medium-sized enterprises can be particularly difficult to engage;
- publicity is important for targeting households but the effect of advertising in itself is short-lived;

ENHANCED FEEDBACK

- increased awareness of energy use consistently leads to reductions;
- maintaining consumers' interest can be difficult, but in some cases the response persists (particularly where there is an interactive element to the feedback or a comparison with past performance or peer' performance);
- helping consumers to interpret data can enhance energy savings;

TIME OF USE TARIFFS

- critical peak pricing schemes which expose consumers to higher prices at times of system stress, usually with day-ahead notification to consumers can significantly reduce demand at peak;
- most of the demand reduction in peak periods is shifted rather than removed;
- financial savings need to be considerable for consumers to be interested in time of use pricing;

DEMAND SIDE FLEXIBILITY AND HOME AUTOMATION

- where customers can opt out from direct control, the effectiveness of the programmes tends to reduce as the length of time for which the response is required increases;
- changes to end-use technologies can reduce the potential for demand side flexibility as a consequence of compatibility issues with control technology; and
- even decentralised responses can be highly predictable – automated devices and human actions can also produce a reliable response at peak.

In general, the technical, or theoretical, potential for demand side resource tends to be significantly higher than can be realised. Therefore, of key interest to policy makers is what proportion of this response can be delivered to the market and how it can be maximised.

QUANTITATIVE BENEFITS REALISED

Our main 'quantitative' insights include the following:

- measures that improve energy efficiency or rely on modifying electricity users' behaviour consistently reduce the relevant customers' total energy demand, with reported savings often in the range 5%-15% of those customer total demand;
- introducing automation in the home and in commercial and industrial settings significantly increases the potential for peak reduction compared to other measures i.e. by up to 80% compared to less than 20%; and
- distributed generation and microgeneration can offer significant flexibility as a percentage of their capacity (depending on their energy source) i.e. above 50%.

POLICY DRIVERS AND THE ALL-ISLAND ELECTRICITY MARKET IN 2020

The respective governments of Ireland and Northern Ireland are pursuing a number of energy policy goals which are closely aligned. The Republic of Ireland's Energy White Paper of 2007 sets out strategic goals under the three headings of Security of Supply, Sustainability of Energy and Competitiveness of Energy Supply. In its recent consultation on the Draft Strategic Energy Framework 2009, DETI uses a similar structure to propose a policy framework for Northern Ireland. The table below summarises some of the main common policy themes appearing in these two documents.

Policy area	Policy goals
Competitiveness	Encouraging competition and consumer choice in energy markets
	Maximising innovation, enterprise and job creation in the energy sector
Security of Supply	Ensuring electricity supply consistently meets demand
	Increasing fuel diversity in electricity generation
	Maintaining and upgrading networks to ensure efficient and reliable gas and electricity delivery to consumers
Sustainability	Incentivising and accelerating the growth of renewable energy sources
	Maximising energy efficiency and energy savings opportunities

These policy goals and the measures used to deliver them – notably those relating to sustainability and concerns over security and diversity of energy supply – will cause significant changes to the electricity system in the All

Island market over the coming decade. Coupled with the increases in fossil fuel prices over recent years these policy goals will also impact on prices and affordability, driving investment in energy efficiency and end use technologies.

In attaining the Island's electricity goals for 2020 and responding to changes in the electricity system relying only on generation to balance the system will not be necessary or desirable. The demand side can play a substantial and economically valuable role.

IRISH MARKET DRIVERS OF THE FUTURE REQUIREMENT FOR DEMAND SIDE ACTIVITY

In assessing the future need for – and value of – demand side response in the Island, a number of common themes arise and these are set out below.

In the day-to-day timescales over which demand response can be exercised, variation in the underlying level of demand is currently the most important determinant of electricity price and the cost of production. Such demand variation is (to a high degree) predictable, and the critical times in each day can generally be forecast significantly in advance.

In 2020 and beyond, the electricity system will be characterised by high levels of wind generation whose output profile will become a dominant driver of the electricity system. As a consequence, the key times (of peak 'effective demand') within each day will become far less predictable, at least more than one or two days ahead.

It is expected that new forms of load such as electric vehicles or heat pumps, if not influenced by time-of-day pricing, will increase the magnitude of peak demand.

Changes in the Irish electricity system will be dominated by the planned increase in wind generation to 2020 and beyond. This is a key driver of the need for and the value of demand side activity in the All Island market, for the following reasons:

- total installed generation capacity required to meet a given level of peak demand will increase and some build of dedicated peaking plant is expected; therefore, to the extent that demand side management can deliver reliable peak load reduction (at times of low wind output), the cost of this additional build can be avoided and the value of the demand measures will be high;
- there will increasingly be times at which not all of the wind on the Island can be accommodated, and the price of electricity at these (overnight) times is expected to fall, leading to a significant value in being able to increase demand in these off-peak periods (especially at times of high wind availability);
- there will be greater uncertainty over the timing of the 'effective peak' (meaning the peak of demand, net of wind, which determines the output of thermal generation) and therefore the value of flexibility (the ability to move load at relatively short notice in response to changing wind conditions), in order to avoid generator part-loading and unit starts, will increase;
- as thermal generation is squeezed from the merit order, the cost of provision of frequency response and similar ancillary services will increase, and the contribution of the demand side to these services will be increasingly valuable;

- the incidence of transmission constraints is expected to increase; therefore to the extent that demand-side measures are able to mitigate transmission constraints, then the need for demand side management may differ by region; and
- distribution network issues may place a limit on the potential for demand side response at the lower voltage levels (or, alternatively, to the extent that the needs of the distribution networks are not considered in the roll-out of demand side response, some of the potential benefits of demand-side response to substitute for distribution investment may be lost).

DEMAND SIDE POTENTIAL IN THE ALL ISLAND MARKET

In both the Republic of Ireland and in Northern Ireland, a number of existing policies, initiatives, and market design features already assist and enable demand side participants to participate actively in electricity markets. The policies and measures currently in place will form the starting point for any set of new measures that need to be put in place to realise the Demand Side Vision for 2020.

In the SEM, Demand Side Units (with a minimum size of 4MW) can offer demand reductions into the pool, receiving a capacity payment for availability and a payment for demand reductions actually delivered as a result of receiving a dispatch instruction.

There are a number of SO schemes already in existence to incentivise reward demand reduction at peak times, for example the EirGrid's STAR (interruptible load) scheme which has been operating for more than 20 years, and its Winter Peak Demand Reduction Scheme (WPDRS); and ESB Customer Supply's WDRI tariff scheme. The form of and need for these are currently under review by EirGrid and SONI.

A number of energy efficiency initiatives have also been put in place in the Republic of Ireland and in Northern Ireland. In the Republic of Ireland, these currently focus on a few key areas across the residential and business sectors. Building improvements span from building energy ratings (BERs), to mandatory standards for new housings and Greener Homes schemes. The Home Energy Savings Scheme (HES) provides financial support for home energy performance upgrades. The Power of One programme provides online tools for the residential sector and monitoring and benchmarking tools for the business sector. It has also developed energy labelling schemes, advertising campaigns and information guides have been produced in order to change consumer behaviour.

In Northern Ireland, NIE's SMART programme already encourages the use of demand side management and embedded generation as alternatives to conventional network reinforcement, and in the Republic of Ireland ESB Networks is also doing some work of relevance to smart grids, for example by increasing its use of SCADA technologies.

Looking forward to 2020, our analysis of Irish demand suggests a number of key messages.

KEY MESSAGES ARISING FROM ANALYSIS OF TOTAL DEMAND

Demand from new types of load is expected to be relatively small, compared to existing demand. Even if the Republic of Ireland's electric vehicles goal were to be met fully, the total demand from these would be an order of magnitude smaller than demand from domestic water heating, for example. Projected demand from heat pumps is larger but still only around half of the existing electric domestic space heating load.

There is significant uncertainty and lack of information on the components of demand, particularly electricity end-use in the industrial and commercial sectors. This makes it difficult to draw insights into the nature of the flexibility which might be available and where within these sectors any additional measures should be targeted.

KEY MESSAGES ARISING FROM ANALYSIS OF THE FLEXIBLE DEMAND RESOURCE

The potential for flexibility from heat pumps and electric vehicles is relatively small in absolute terms. Unless there are compelling reasons to concentrate on deriving flexibility from new sources of demand, it may be more effective to concentrate on taking advantage of existing demand with potential for flexibility, such as space and water heating.

Among existing demand, space and water heating appear to offer the largest potential for flexible operation in the industrial, commercial and domestic sectors. The degree to which appliances and non-heating loads can be flexible in these sectors is unclear, but it appears to be considerably smaller than the potential flexibility of heating. There is considerable uncertainty over the scale of flexibility available from different industrial processes, suggesting the need for some form of sector by sector audit.

CURRENT POLICY BASELINE FOR DEMAND SIDE MANAGEMENT

In developing a Demand Side Vision for the Island in 2020, we have considered a wide range of areas relevant to demand side response. These are:

- energy efficiency;
- consumer behaviour change;
- smart meters;
- home and office automation;
- demand side bidding;
- new forms of electrical demand i.e.:
  - renewable heat; and
  - electric vehicles;
- aggregation of distributed generation; and
- storage.

Some of these measures, for example, electric vehicle penetration and smart meter roll-out, are the subject of well-defined policy goals. Others, such as home automation and storage, have received less attention from government and regulators.

In all of the areas, there are further measures that could be taken in order to increase the volume of demand side response that may be expected to materialise by 2020 beyond the level that is expected under current market arrangements and with existing policies. These are demand side 'options', which may be technically feasible, economically cost-effective, but which would be expected to require further policies measures or regulatory changes to realise.

IDENTIFICATION OF POSSIBLE POLICY OPTIONS FOR DELIVERING THE PROPOSED 2020 DEMAND SIDE VISION

Potential policy options for delivering the proposed 2020 Demand Side Vision are summarised below. All measures considered are presented, including those which do not ultimately form part of the 2020 Demand Side Vision outlined in Section 6. The rationale for this is to ensure that a broad range of policy options is available for consideration as part of the consultation process.

Demand-Side Measure	Immediate	Short to Mid Term	Long Term
Energy efficiency		More ambitious roll-out of energy efficiency measures	
Behavioural change		Labelling scheme & education programme for smart appliances	
Smart meters	Smart meter specifications to allow for advanced displays & in future dynamic ToU tariffs	Education programme on benefits of smart meters	
		Interventions to accelerate adoption of ToU tariffs	
Home & office automation	Smart meter specifications to allow for future needs of smart appliances	Smart meter trial with focus on home & office automation	Mandatory standards &/or subsidies to encourage adoption of smart appliances
		Labelling scheme for smart appliances	Review the impacts of demand-side management on distribution networks
			Assess value of dynamic demand based on GB trials
Industrial / commercial demand side response	Create visible / firm day-ahead price and schedule for the SEM	Study on volume and nature of flexible demand available in the I&C sectors	
	Review of TSC & Grid Code to identify barriers to participation of I&C demand	Programme of engagement with I&C sectors to increase awareness of potential for demand-side participation	
New demand – heat pumps			Incentivise storage technologies for heat pumps
New demand – electric vehicles	Smart meter specifications to allow for interaction with EV charging systems	Review the impact of EVs for the electricity system	
			Review in detail the impacts of demand-side management on distribution networks
Microgeneration	Smart meters required to interact with microgenerators		
Aggregation of distributed generation	Create visible / firm day-ahead price and schedule for the SEM	Develop standard contract structures and/or other measures to facilitate participation from DG	Detailed review of barriers facing distributed generators
	Review of TSC & Grid Code to identify barriers to	Review of network design standards or practices – identify barriers	
Storage	Review payments to pumped storage through the SEM	Review support for R&D activities relating to distribution-level storage	

ASSESSMENT OF OPTIONS AND PRIORITIES

Our approach to evaluating the different demand side implementation options has been to perform a qualitative assessment of costs and benefits of the various options. Costs consist of high level estimates of the costs of implementing demand side options over and above that which is assumed to be implemented under a policy 'baseline' for 2020. The baseline reflects what would be the outcome of a 'business as usual' approach to demand side management on the Island i.e. no government, or regulatory intervention, over and above that which is envisaged in the current policy framework.

We break benefits down into two groups, namely, those which are associated with broader energy policy objectives, as detailed in Section 2.4; and those which reflect specific electricity market metrics, relating to investment and operational cost savings. Inevitably, there is a degree of overlap between the two. The benefits include some consideration of the scale of the option which might be expected given an appropriate policy environment.

COSTS - IMPLEMENTATION

In this category we have attempted to provide an indicative ranking of the costs associated with implementing each of the demand side options. This is based on our views of the activities and potential investments associated with the implementation of each measure.

BENEFITS - POLICY IMPACTS

In this category we have qualitatively assessed the impact of demand side options on the broader energy policy goals of the Republic of Ireland and Northern Island, as set out in Section 2.4. These energy policy goals address three main areas:

- Competitiveness:
    - This encompasses two distinct policy objectives. The first is to further competition (including by encouraging new entry) and consumer choice in energy markets. The second refers to maximising innovation, enterprise and job creation in the energy sector. In our assessment matrix, we use 'competition & consumer choice' to refer to the former and 'job creation and innovation' to the latter
- Security of supply:
    - There are a number of policy objectives related to ensuring electricity supply consistently meets demand; increasing fuel diversity in electricity generation; and maintaining and upgrading networks to ensure efficient and reliable gas and electricity delivery to customers. In our assessment we focus on two of these objectives, namely, ensuring that electricity supply can meet demand (in the sense that there is adequate capacity margin) and maximising the maintenance and upgrade of networks.
- Sustainability:

- Two main policy objectives fall under the heading of Sustainability. The first is the acceleration of growth of renewable energy resources and the second is to enhance the efficiency of electricity use and realise savings in electricity use.

BENEFITS - ELECTRICITY MARKET

In this category we qualitatively assessed the impact of the demand side options on the All Island electricity system against four different metrics:

- effect on generation capacity costs i.e. requirements for investment in new generation capacity;
- impact on variable generation costs;
- effect on levels of CO2 emissions; and
- provision of frequency response.

ASSESSMENT OF DEMAND SIDE OPTIONS AND THE 2020 DEMAND SIDE VISION FOR THE ALL ISLAND MARKET

The results of our qualitative assessment and the proposed 2020 Demand Side Vision are set out in the table below.

	Competitiveness		Security of supply		Sustainability		Electricity market metrics			Cost of delivery	Overall ranking
	Competition & consumer choice	Green job creation	Generation capacity margin	Transmission capacity	Energy efficiency	Accelerated growth of RES	Generation costs / CO_2 emissions	Generation capacity costs	Frequency response		
Energy efficiency - Industrial	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Medium	No	Medium	High
Energy efficiency - Commercial	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Low	No	Medium	Medium
Energy efficiency - Domestic	Neutral	Medium	High	High	Medium	Medium	High	High	No	Medium	High
Behavioural change - Education	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Low	No	Low	Low
Smart meters - Advanced displays	Medium	Medium	High	High	Medium	Low	High	High	No	Low	Medium
Smart meters - Static ToU tariff	Medium	Medium	High	High	Medium	Medium	High	High	No	Low	Low
Smart meters - Dynamic ToU tariff	Medium	Medium	High	High	Medium	High	High	High	No	Medium	High
Home & office automation - Direct load control	Medium	Medium	High	High	Neutral	High	Medium	High	?	Medium	Medium
Home & office automation - Autonomous	Medium	Medium	High	High	Neutral	High	Medium	High	No	Low	Medium
Home & office automation - Frequency-responsive relays	Medium	Medium	Neutral	Neutral	Medium	Neutral	Low	Low	Yes	Medium	Medium
Industrial & Commercial DSR - Interruption contracts	Medium	Neutral	High	High	Neutral	High	Medium	High	No	Low	High
Industrial & Commercial DSR - Direct load control	Medium	Neutral	High	High	Neutral	High	Medium	High	?	High	High
Industrial & Commercial DSR - Demand-side bidding	Medium	Neutral	High	High	Neutral	High	Medium	High	No	High	High
Industrial & Commercial DSR - Autonomous	Medium	Neutral	High	High	Neutral	High	Medium	High	No	Medium	High
Heat pumps - Heat pumps are fitted with storage	Neutral	Low	Medium	Medium	Neutral	High	Medium	Medium	No	High	Neutral
Electric vehicles - Night charge	Neutral	Medium	Medium	Neutral	Neutral	Low	Low	Medium	No	Low	Neutral
Electric vehicles - Hybrid vehicles	Neutral	Medium	Medium	Medium	Neutral	Medium	Low	Medium	No	Medium	Neutral
Electric vehicles - Intelligent (price-reponsive) charging	Neutral	Medium	Medium	Medium	Neutral	Medium	Low	Medium	No	Medium	Medium
Microgeneration - Microgeneration - controllable	Neutral	Neutral	Medium	Medium	Neutral	Low	Low	Medium	?	Low	Neutral
Aggregation of DG - Aggregation of DG	Low	Neutral	Medium	Medium	Neutral	Medium	Medium	High	?	Low	Medium
Storage - Storage	Neutral	Neutral	Medium	Neutral	Negative	Medium	Low	Medium	Yes	High	Low

Our provisional categorisation of the value of the demand side measures defining the 2020 Demand Side Vision is as follows:

HIGH VALUE

- Energy efficiency: reach for more of the economically-viable energy efficiency potential, particularly in the domestic sector.
- Smart metering: advanced in-home displays and dynamic time-of-use tariffs.
- Industrial and commercial demand side response: more participation from loads in the industrial and commercial sectors.

MEDIUM VALUE

- Home and office automation: participation from domestic and small-commercial loads in response to price signals plus frequency relays.
- Electric vehicles: dynamic price-responsive charging of electric vehicles.
- Aggregation of Distributed Generation: more involvement from aggregations of Distributed Generation in the wholesale market.

LOW VALUE

- Behavioural change: education programmes to encourage more use of intelligent devices and smart meters, and more energy-efficient behaviour.
- Storage: growth in electricity storage on the Island.

DESCRIPTION OF THE 2020 DEMAND SIDE VISION

The 2020 Demand Side Vision is for a world in which electricity consumers make informed choices about their use of electricity in the short term and their selection of appliances in the longer term. The prices they face will reflect the cost of supply at those times, and will provide appropriate rewards for reductions in total consumption and changes in the profile of consumption. Consumers will face appropriate incentives to 'invest' (perhaps in terms of effort rather than financially) in methods which will allow them to better manage their consumption.

In the 2020 Vision, demand plays an active part in the process of system balancing and market price formation through a combination of autonomous response to expected market prices, dynamic response to market prices over a range of timescales and the inclusion of some dispatchable demand (and distributed generation) in the centralised processes of price formation and dispatch. It is recognised that different types of consumption are flexible over different timescales and with varying degrees of notice; and the demand side mechanisms offered will reflect these different needs and the different degrees of value that such flexibility delivers.

There may be certain requirements for demand management which cannot be dealt with through price alone, perhaps due to specific needs of the transmission or distribution system operators (e.g. within-hour dispatch or local network constraints), and appropriate arrangements will be in place to allow demand side flexibility to be captured for these purposes where required.

Consumers will have a different attitude to their electricity consumption compared with today. They will recognise the consequences of their consumption and the level of consumer awareness will be high.

Towards 2020 and beyond, we expect that electrification of heat and transport will play a significant role in the decarbonisation of the entire energy system for the Island, facilitating high levels of production of electricity from renewable sources. Flexibility of demand will play a key role in balancing the output of the variable sources of generation, alongside interconnection, flexible thermal generation (including distributed generators) and perhaps bulk electricity storage.

PROPOSED POLICY PATHWAYS

In the table, below, we summarise a number of policy recommendations which we believe could be required to support delivery of the 2020 Demand Side Vision, grouped by 'value' and implementation time frame.

	Demand-Side Measure	Immediate	Short to Mid Term	Long Term
High value	Energy efficiency		More ambitious roll-out of energy efficiency measures	
High value	Smart meters	Smart meter specifications to allow for advanced displays & in future dynamic ToU tariffs	Education programme on benefits of smart meters	
High value	Smart meters		Interventions to accelerate adoption of ToU tariffs	
High value	Industrial / commercial demand side response	Create visible / firm day-ahead price and schedule for the SEM	Study on volume and natures of flexible demand available in the I&C sectors	
High value	Industrial / commercial demand side response	Review of TSC & Grid Code to identify barriers to participation of I&C demand	Programme of engagement with I&C sectors to increase awareness of potential for demand-side participation	
Medium value	Home & office automation	Smart meter specifications to allow for future needs of smart appliances	Smart meter trial with focus on home & office automation	Mandatory standards &/or subsidies to encourage adoption of smart appliances
Medium value	Home & office automation		Labelling scheme for smart appliances	Review the impacts of demand-side management on distribution networks
Medium value	Home & office automation			Assess value of dynamic demand based on GB trials
Medium value	New demand – electric vehicles	Smart meter specifications to allow for interaction with EV charging systems	Review the impact of EVs for the electricity system	Review in detail the impacts of demand-side management on distribution networks
Medium value	Aggregation of distributed generation	Create visible / firm day-ahead price and schedule for the SEM	Develop standard contract structures and/or other measures to facilitate participation from DG	Detailed review of barriers facing distributed generators
Medium value	Aggregation of distributed generation	Review of TSC & Grid Code to identify barriers to participation of I&C demand	Review of network design standards or practices – identify barriers	
Low value	Behavioural change		Labelling scheme & education programme for smart appliances	
Low value	Storage	Review payments to pumped storage through the SEM	Review support for R&D activities relating to distribution-level storage	
Limited value	New demand – heat pumps			Incentivise storage technologies for heat pumps
Limited value	Microgeneration	Smart meters required to control and interact with microgenerators		

This provisional categorisation of policy recommendations can be used to define a number of potential policy pathways, which can be tailored to meet institutional responsibilities, capacity and government funding where required.

NEXT STEPS

This consultation document provides a first formal opportunity for all existing and potential stakeholders in the development of the demand side to both to review and respond our initial thinking regarding;

- the role and benefits that enhanced demand side activity can provide for the All Island market;
- a 2020 Vision for demand side based on a high level assessment of the relative merits in terms of economics, deliverability and wider aspects of different forms of demand side activity;
- potential policy developments which might be required to help support delivery of a 2020 Demand Side Vision; and
- possible policy “pathways” for delivery of the identified policy options in order to successfully deliver the proposed 2020 Demand Side Vision.

Consequently, throughout this consultation document, we have explicitly identified key questions which we would welcome views and responses from all stakeholders in order to help inform and guide our thinking. A full list of the consultation questions is provided in Annex C.

In order to best inform our thinking we welcome all views and comments which all existing and potential stakeholders wish to bring forward under this consultation. We are seeking written responses to the questions posed in this consultation by Monday, 18 October 2010. To help us capture and compare the views of all stakeholders and to understand the basis of their interest in the development of the demand side in the All Island market; there is a standard Questionnaire Form published alongside this consultation paper which stakeholders can use to provide their responses to this consultation.

To help support the consultation process we will be holding a workshop on the issues raised in this consultation on 16 and 17 September in Belfast and Dublin respectively (venues to be confirmed). In addition we will be happy to hold bilateral discussions with any industry stakeholder who wishes to do so.

These steps will be followed by a Decision Paper, outlining the Regulator’s views. This Decision Paper will include a proposed Demand Response Programme which will set out the next steps in developing a detailed Demand Side Vision for 2020 and the necessary actions to realise it.

1 INTRODUCTION

The Regulatory Authorities (RAs) in the Republic of Ireland (RoI) and Northern Ireland recognise the potential which demand side management has to deliver significant economic and environmental benefits to the All-Island market. They believe that realisation of this potential will require a high level of co-ordination between stakeholders and policymakers across a broad range of areas including energy efficiency, smart metering, large-scale demand side response, new forms of electric demand, aggregation of distributed generation and storage.

This consultation document forms a key part of the RAs' assessment of the merits of different DSM options, the associated development of a Demand Side Vision for 2020, and the identification of supporting policy measures and their implementation path to seek to enable the 2020 Demand Side Vision to be delivered.

It is important to note that the Irish Regulatory Authorities does not have responsibility for all of the areas covered by this consultation and that some of the aspects highlighted are a matter for consideration by Government.

1.1 CONTEXT FOR DEFINING A 2020 VISION FOR DEMAND SIDE RESPONSE

Lack of participation by the demand side has long been identified as a weakness in electricity markets. It is well-established that demand side participation brings a number of benefits to electricity markets, including increased security of supply (or a reduced cost of delivering the same security of supply), greater efficiency in consumption and increased competition both in the wholesale and retail markets.

Historically, the high levels of security of supply demanded by governments, regulators and customers has led to electricity companies focusing on having sufficient generation capacity to reduce the probability of loss of load to almost vanishing levels. The advantage of a generation-led strategy is essentially one of control: it has been easier to be certain of delivering power station capacity than controlling demand.

During the coming decade, this paradigm will be eroded from two directions by changes in the characteristics of the market and in technology. The first is that generation will become inherently less controllable as the installed wind capacity increases on the Island. This will make it more technically difficult and costlier to vary generation levels in response to fluctuations in demand. The second is the emergence of new technologies, including economically-viable smart metering, which have the potential to lower the cost of demand side participation – a factor that has been a significant barrier in the past. Awareness of climate change and higher energy costs are likely to accelerate these trends, as consumers become more aware of the implications of their energy consumption.

WHY ARE POLICIES NEEDED TO SUPPORT DEMAND SIDE MANAGEMENT?

The intent of the work is primarily to identify those demand side measures which are economically advantageous and which may merit some form of policy intervention. Within the context of a competitive electricity market, the rationale for any form of policy intervention needs to be considered carefully. The default assumption should be that – except for the existence of a specific barrier – then to the extent that demand side management of any form is economically viable, it should also be financially viable and the market participants themselves should deliver it without policy support.

Therefore, in cases where some policy intervention is justified, we would generally expect that intervention should be to correct a barrier of some description. This might be one of the classic types of market failure from economic literature, or a correction to the existing set of policy or regulatory arrangements. It should be made clear that the need for a policy intervention does not necessarily imply any direct financial support; an important issue given the current need for thrift from within the public budget. Generally, we would expect the types of demand side response which merit immediate policy intervention to be broadly self-financing for the key stakeholders, although, perhaps over relatively long timescales.

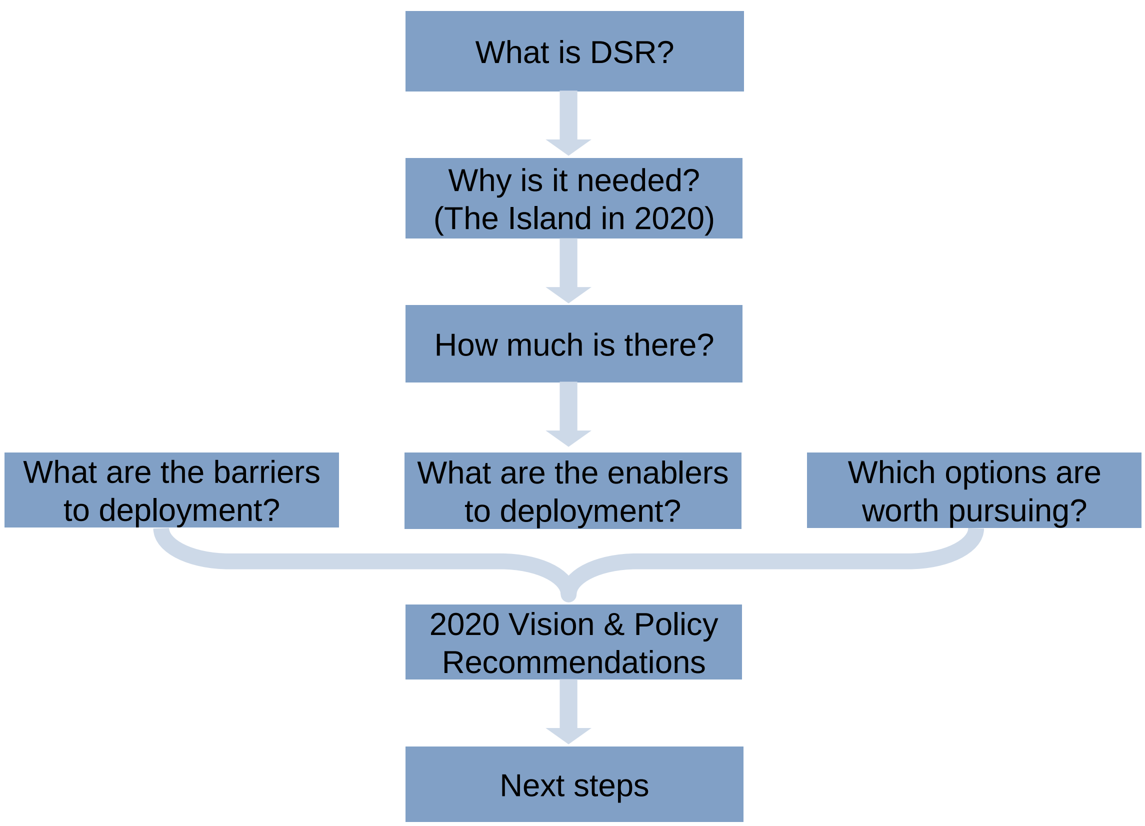
CONTRIBUTION TO COMPETITIVENESS

One potentially valid reason for providing a supportive policy framework for demand side management is to provide the All Island market with a competitive advantage in the world economy. Direct fiscal measures to reduce electricity prices to consumers (such as industrial customers in energy-intensive and internationally competitive industries) are not generally considered desirable and are likely to contravene European state aid provisions. However, there is scope for various forms of policy support for newly formed industries and to support energy efficiency, CO_2 emissions reduction and renewables.

The All Island economy is relatively strong in the areas of finance, software and systems development and high-level design, but with no real competitive advantage in mass manufacturing. As a result, we see some value in supporting the development of intelligent systems for automation of demand response, but it is unlikely that this will lead to significant employment in the mass manufacturing of smart appliances or electric vehicles.

1.2 ROADMAP FOR THE DEVELOPMENT OF A 2020 DEMAND SIDE VISION

Our approach to the development of a Demand Side Vision for the Island in 2020 is illustrated below.



First we define what is meant by demand side response, its role and benefits, and discuss the generic lessons obtained from the experience of international deployment. Moving from the general to the specific, we examine the current policy drivers and the likely characteristics of the electricity market on the Island in 2020, and the how this will affect the need for the services which demand side measures can deliver. Having established the need we then attempt to evaluate the size of the potential demand side resource, attempt to identify the barriers and enablers to deployment and attempt to evaluate which of the different demand side options on the Island are worth pursuing.

This evaluation of demand side options in a 2020 context allows us to propose a Demand Side Vision for the Island in 2020 and suggest policy recommendations to realise it. We conclude by outlining some proposed next steps towards defining a demand response programme for the All Island market.

1.3 STRUCTURE OF THE CONSULTATION

This Section 1 has set out the context and the roadmap for development of 2020 Demand Side Vision. The remainder of this consultation is structured as follows:

- Section 2 sets out the roles and benefits of demand side response:
    - What is demand side response?
    - Market benefits of demand side response
    - International experience of demand side response/management
    - Policy drivers and the All-Island electricity market in 2020
    - Drivers of future value for demand side response in the All Island market
- Section 3 provides an assessment of the demand side potential in The All Island market, covering:
    - Types of demand side response
    - Current demand side activity in the All Island market
    - Potential for demand side activity in the All Island market in 2020
- Section 4 examines the support for development of demand side activity in the All Island market:
    - Current policy baseline for demand side management
    - Identification of possible policy options for delivering the proposed 2020 Demand Side Vision
- Section 5 provides an assessment of the demand side options and determination of proposed priorities:
    - Assessment methodology
    - Results of high level assessment of potential demand side response options
- Section 6 proposes a Demand Side Vision for the Island in 2020

    - The 2020 Demand Side Vision for the All Island market
    - Proposed policy recommendations
- Section 7 outlines our proposed next steps within the consultation process;
- Annex A provides detailed background on current demand in the All Island market and projections for 2020;
- Annex B provides a list of key international studies and reports which have been referred to in assessing the potential benefits of greater demand side activities in the All Island market; and
- Annex C provides a full list of the questions raised throughout the consultation document for which we are seeking views from the industry.

In addition, to help us capture and compare the views of all stakeholders and to understand the basis of their interest in the development of DSM in the All Island market; there is a standard Questionnaire Form published alongside this consultation paper which stakeholders can use to provide their responses to this consultation.

2 ROLE AND BENEFITS OF DEMAND SIDE RESPONSE

2.1 WHAT IS DEMAND SIDE RESPONSE?

Within the context of this consultation paper the term 'demand side response' (DSR) is defined to include changes in the characteristics and behaviour of a range of decentralised demand and (distributed) generation types. This includes overall demand reductions, changes in the profile of demand (or distributed generation) to alleviate peaks, and the provision of flexibility to allow the system to adapt to unexpected events. The scope of this project encompasses energy efficiency, behavioural change, smart metering, home and office automation, industrial and commercial demand side response, new forms of electric demand, aggregation of distributed generation and micro-generation, and storage. DSR confers a range of other benefits. These include reducing generators' market power, enhancing security of supply (or reducing the cost of delivering a given level of supply security) and facilitating retail competition.

The benefits which different forms/types of demand side response provide may be classed under one or more of the following three types of modification to the demand profile (or to the effective demand profile, via changes to the profile of distributed generation):

- **overall demand reduction** which refers to measures which reduce energy consumption, typically the target of efficiency programmes;
- **static peak reduction** which encompasses measures which enable changes to be made to the profile of demand to alleviate system peaks – obvious examples of this are static time of use tariffs and interruption contracts; and
- **flexible measures** which allow demand, or load, to be shifted in response to system condition on the day, such as dynamic time-of-use tariffs and system operator interruption contracts.

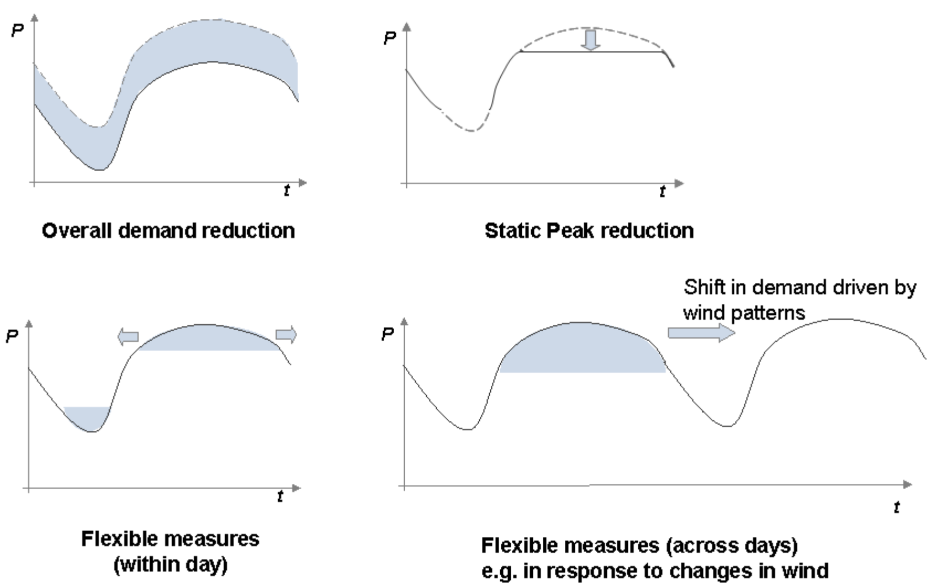


Figure *1* illustrates these three metrics, highlighting the two different forms of flexible DSR.

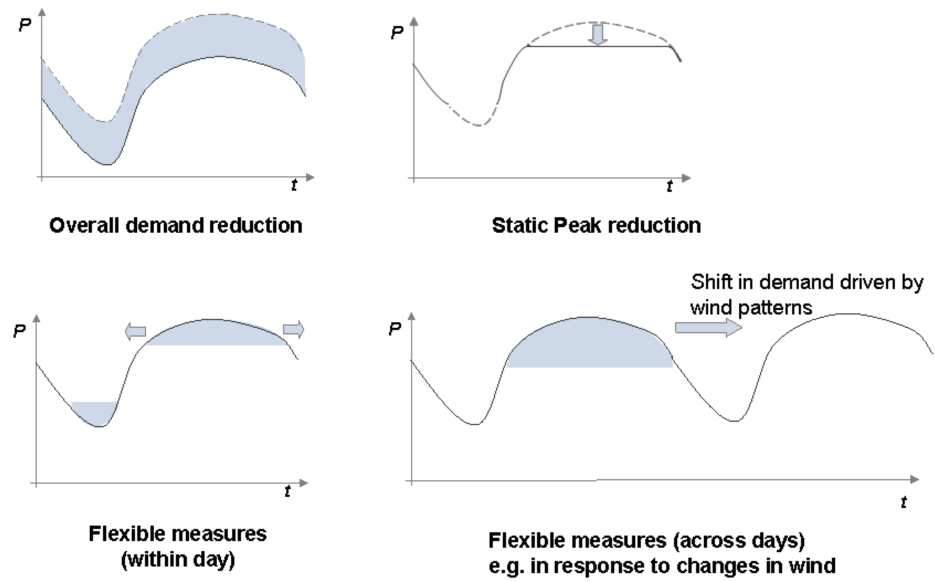


***Figure 1** – Quantitative metrics evaluated in international cases*

Demand-side measures can also provide a fourth type of benefit, namely, **ancillary services** – we have not evaluated this issue in detail, with the exception of new technologies, currently being trialled which enable devices such as fridges and freezers to respond automatically to changes in system frequency.

Different demand side measures will deliver one or more of these benefits. Understanding the nature and materiality of the benefits delivered forms a critical part of assessing the relative merits of different demand side options and thus the development of a Demand Side Vision for 2020.

QUESTION 1: DO YOU AGREE WITH OUR CHARACTERISATION OF THE FOUR TYPES OF BENEFITS THAT DEMAND SIDE MANAGEMENT CAN PROVIDE?

2.2 MARKET BENEFITS OF DEMAND SIDE RESPONSE

2.2.1 COST REDUCTIONS

In this consultation, the term demand side response is defined to include changes in the characteristics and behaviour of a range of decentralised demand and (distributed) generation types. This includes overall demand reductions, changes in the profile of demand (or distributed generation) to alleviate peaks, and the provision of flexibility to allow the system to adapt to unexpected events.

Figure 2 shows the physical value chain for electricity (generation, transmission and distribution), and illustrates how demand side flexibility can reduce costs at all steps throughout this chain.

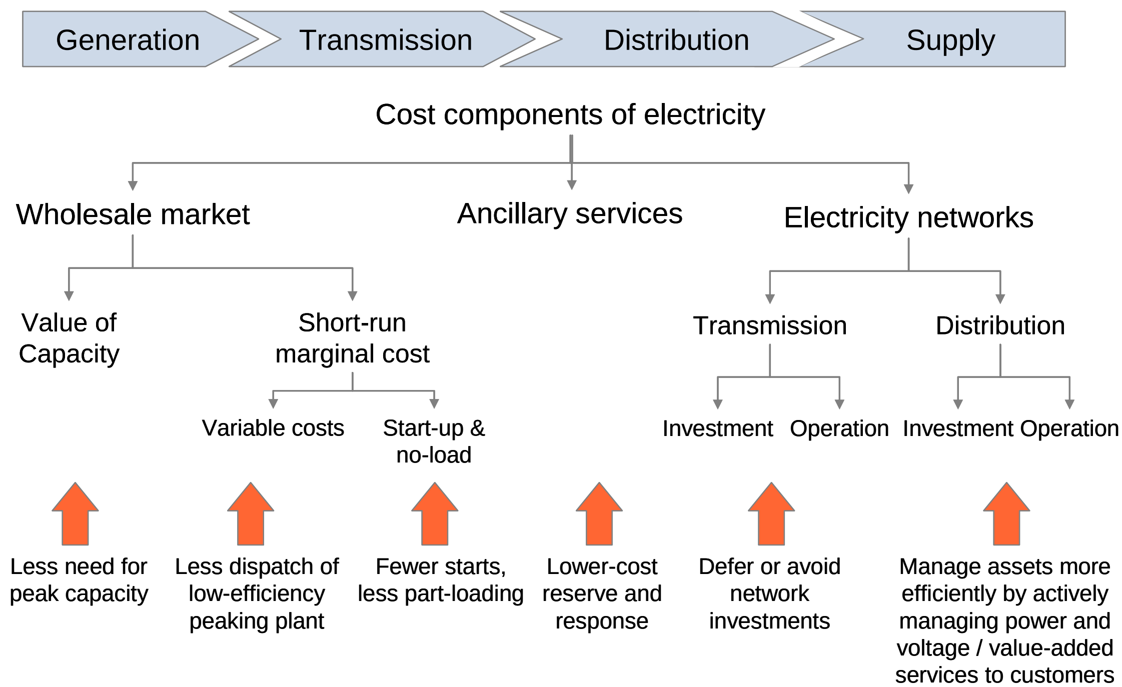


Figure 2 *– Cost reductions from demand side flexibility across the electricity value chain*

It is also possible to group the cost reductions arising from DSR according to the timescales over which they occur.

Planning timescales: demand side response can avoid the need for investments in generation capacity and in network assets. Energy efficiency measures, for example, can consistently reduce peak demand, allowing for peaking plants or network investments to be avoided or deferred.

Scheduling timescales: DSR can reduce costs within scheduling timescales by avoiding dispatch of costly generation units and reducing the value of capacity. For example, direct load control could be used to reduce demand instead of dispatching OCGTs at times of peak thermal demand.

Operational timescales: DSR can reduce costs within operational timescales by providing reserve and response. This can reduce start-up and part-loading costs from thermal plant. For example, frequency-responsive relays in domestic appliances can displace the need for frequency response from thermal generation.

2.2.2 OTHER BENEFITS

Demand side response confers a range of other benefits. These include:

- reducing generators' market power;
- enhancing competition in supply by offering suppliers new tools to innovate and differentiate their offer to customers; and
- enhancing security of supply (or reducing the cost of delivering a given level of supply security).

In general, wholesale electricity markets function more efficiently when the demand is more responsive to price. Further, it offers significant growth opportunities for the All Island market, capitalising on its strengths in knowledge-based economy of the ICT sector, for example in software development, data handling, systems design and the commercialisation of new technologies.

QUESTION 2: ARE THERE OTHER COST SAVINGS WHICH YOU BELIEVE DEMAND SIDE MANAGEMENT CAN DELIVER?

2.3 INTERNATIONAL EXPERIENCE OF DEMAND SIDE RESPONSE/MANAGEMENT

There is a considerable amount of experience of demand side response/management measures both in the All Island market and internationally. A number of published studies and reports exist that describe and review this experience and we have identified 15 individual reports that detail case-based experience of demand response/management. Many of the reports included a summary of multiple demand side response initiatives, so that a total of 225 demand side response/management cases are described across all the reports. The documents fall into three categories:

- **International comparative studies:** Reports by international governmental organisations, such as IEA DSM and the UN, using a case-based approach to reviewing a broad range of demand side response initiatives.
- **Individual project reports**: Summaries of an individual initiative, or a small number of related initiatives in one country or region, and their results.
- **Theoretical and model-based studies:** General reports on a particular type of demand side response measure, based on theoretical estimates of potential often using top-down assumptions.

Annex B contains detailed publication information on the sources used, including titles, authors, dates and publishers.

QUESTION 3: ARE THERE ADDITIONAL STUDIES AND REPORTS (TO THOSE LISTED IN ANNEX B) WHICH YOU ARE AWARE OF AND BELIEVE WE SHOULD REVIEW?

2.3.1 EXAMPLES OF DEMAND SIDE RESPONSE MEASURES ADOPTED GLOBALLY

From our review of international experience it is evident that adoption of DSR measures has been driven by different factors in different contexts. This section briefly describes three regions where demand side response has been used to respond to supply-side constraints in the wholesale power market, network investment costs, and provide ancillary services to the TSO.

2.3.1.1 MANAGING GENERATION CAPACITY SHORTAGES IN CALIFORNIA

California has for many decades implemented demand side participation programmes. Following the serious shortages of generation capacity experienced during the Californian crisis of 2001/2002, a number of new demand side initiatives were trialled, including automatic demand response and dynamic pricing for both industrial and residential consumers.

A state-wide pricing pilot trialled several types of time-of-use pricing; including static and dynamic time of use pricing that included critical peak pricing. In addition to this initiative a number of utilities jointly piloted an automatic demand response programme in order to test the additional response that could be obtained by controlling flexible loads such as air conditioning units and pool pumps. Both initiatives achieved significant reductions in peak demand, suggesting a potential for demand side response/management measures to contribute to managing the state's generation and transmission shortages.

2.3.1.2 REDUCING NETWORK INVESTMENT COSTS IN NEW ZEALAND

In New Zealand, a distribution-network owner has been using demand side management to reduce peak demand on its network and reduce the charges it pays to the transmission network owner or use of the transmission network.

The company has achieved this by implementing ripple control of electric immersion heaters, so that demand from this type of load can be curtailed during peak periods. This has resulted in avoided transmission use of system costs for consumers, reflecting lower transmission system investment requirements.

2.3.1.3 PROVISION OF ANCILLARY SERVICES IN GREAT BRITAIN

In the British electricity market, most forms of ancillary service are procured by competitive tender. This creates a market for ancillary service provision with opportunities for any provider that is able to deliver reserve, response or other services at low cost. Currently, a large-scale trial is under way of domestic refrigerators fitted with frequency-responsive relays. This technology, if deployed at scale, would be capable of delivering several hundred MW of frequency response.

2.3.2 QUALITATIVE FINDINGS FROM REVIEW OF INTERNATIONAL EXPERIENCE STUDIES

2.3.2.1 ENERGY EFFICIENCY

Among the cases we considered, there were three dominant types of programme in the industrial & commercial sector, and three in the domestic sector.

In the industrial and commercial sectors, these are:

- programmes designed to increase the use of a specific technology in a single sector;
- sector-specific agreements designed to induce reductions in emissions across an entire sector or set of sectors; and
- energy audits or programmes of information provision designed to aid companies to manage their energy consumption without a target or other compulsory element.

In the domestic sector, these are:

- measures designed to increase the use of specific efficient technologies;
- setting energy efficiency standards for appliances or buildings; and
- information and marketing campaigns, including labelling of appliances and homes according to their efficiency.

The reports on the cases we examined made a number of observations about the factors that contributed to the success and failure of each programme. Some of the key lessons are as follows.

Significant economies of scale can be achieved by targeting a whole sector or industry. Because there is a degree of technological uniformity between competing firms in the same sector, energy-saving measures identified as being appropriate for one firm are likely to be applicable across the sector. As well as reducing the costs of identifying energy-saving opportunities, this can also open the possibility of reducing implementation costs. For example, a programme in Sweden procured hundreds of efficient boilers for installation in homes, significantly reducing the cost to the residents compared to what they would have spent if they had each purchased a boiler individually.

Actual savings were lower than estimated beforehand in many cases. Basic estimates of energy savings tend to omit a number of effects. These include technical factors (e.g. poor installation of insulation) and economic or behavioural effects (e.g. improving thermal insulation in fuel-poor homes may not reduce their energy demand as residents it is now more affordable for them to heat their homes to an acceptable level of comfort).

Small and medium-sized enterprises can be particularly difficult to engage. A number of programmes found that small and medium-sized firms did not have the appropriate resources or did not see energy consumption as a sufficiently high priority to participate in energy efficiency schemes.

Publicity is important for targeting households but the effect of advertising in itself is short-lived. Although advertising campaigns were generally found to be useful in creating awareness of a new programme, other means were usually required in order to maintain consumers' interest in the programmes, if their continued involvement was required.

2.3.2.2 ENHANCED FEEDBACK

Specific measures designed to provide consumers with enhanced feedback on their energy use have usually been aimed at domestic or commercial consumers. The cases we examined fell into three categories:

- self-metering, where customers regularly read their existing meters and use this information to monitor their consumption;
- more regular and accurate billing, where utilities provide regular bills (perhaps monthly or bi-monthly) based on actual meter readings; and
- in-home electronic displays, which are capable of showing information on electricity consumption to the dweller in real time.

Among the lessons observed from these programmes are the following.

Increased awareness of energy use consistently leads to reductions. Even the most basic schemes, where consumers manually read and recorded their own meter readings, resulted in reductions in overall consumption. This is the result of increased awareness on the consumer's part of their own energy consumption.

Maintaining consumers' interest can be difficult, but in at least some cases the reduction persists. Some schemes found that consumers' response declined after an initial period of interest following the introduction of an in-home display or other feedback technology. Additional measures to maintain consumer engagement over a longer period were implemented in some cases.

Helping consumers to interpret data can enhance savings. A number of programmes and technologies in this category helped consumers to interpret the data they were receiving. For example, this could include showing consumption in an equivalent period in the previous year or information about their peers' electricity consumption. Where the effect of this contextual information was measured, it was found that this could enhance savings compared to a case where only consumption information (without context) was provided.

2.3.2.3 TIME OF USE TARIFFS

Most of the cases that used time of use (ToU) tariffs were focused on the domestic sector, although these have also been applied in industrial and commercial contexts.

Three main classes of ToU tariff were used in the cases that we examined:

- Static ToU tariffs, where a seasonal and/or time-of-day variation in prices is agreed at the outset of the contract. The simplest of these is a day/night tariff such as the Economy 7 tariff in the UK.
- Dynamic period ToU tariffs. These usually consist of more than one set of price bands agreed at the outset of the contract. The utility has a degree of freedom in which price bands it applies on each day of the year, and informs the customer which set of prices it has selected close to the day in question (often day-ahead). France's Tempo tariff is an example of such a tariff.
- Dynamic price ToU tariffs, where the customer faces price volatility, possibly including exposure to the spot price for the wholesale component of their electricity cost.

Critical peak pricing schemes can significantly reduce demand at peak. A number of the dynamic ToU tariffs we examined were focused on reducing demand in annual peak periods. These schemes resulted in reliable reductions of 5%-15% during those peak periods, from participating loads (even without use of automation).

Most of the demand reduction in peak periods is shifted rather than removed. ToU tariffs can produce a small reduction in overall energy demand, both through consumers' increased awareness of energy use and because some types of demand removed at peak periods are not shifted into low-price periods (e.g. lighting). The main effect however is to defer or advance consumption away from high-price periods within a day and into other price periods.

Financial savings need to be considerable for consumers to be interested in ToU pricing. Because ToU schemes primarily shift rather than reduce demand, customers' savings depend on the differential between high and low-price periods. If the saving that results from load-shifting is small then consumers may not perceive the economic rewards to be proportionate to the effort required to change their behaviour.

It is worth noting that these findings are largely based on a market dominated by conventional generation. As wind penetration increases the effect on the variability of wind on the level of demand net wind becomes more significant. Not only does it become more volatile but it the relationship between overall demand and wholesale market price begins to degrade (the natural correlation being between price and demand net wind). In this context only dynamic ToU tariffs will be effective but designing and deploying effective ToU tariffs will become increasingly more complex and difficult to do.

2.3.2.4 DEMAND SIDE FLEXIBILITY AND HOME AUTOMATION

A number of the cases we analysed sought to take advantage of unused demand side flexibility. In an industrial and commercial context, these include:

- direct load control, where a network company or supplier is able to control a customer's load, within pre-agreed parameters;
- interruption contracts, where a customer receives a discount on their electricity bill in return for agreeing to be forcibly curtailed at times of system stress; and
- demand side bidding, where demand side units are able to participate in central balancing markets.

In a domestic context, we examined cases that implemented:

- direct load control, where some household appliances can be controlled by a utility or network company; and
- automated device response to prices, where home devices are capable of responding automatically to price signals, curtailing their own consumption during high price periods and consuming during low-price periods.

Among the main lessons from these cases were the following.

Where customers can opt out from direct control, the effectiveness of the programmes tends to reduce as the duration of the required response increases. This was true, for example, when air conditioning units were cycled in order to reduce summer peaks in warm climates. Where customers had the option of overriding the utility's control of their air conditioning units, they would begin to do so after a few hours of curtailment.

Changes to end-use technologies can reduce the potential for demand side flexibility. For example, one network company found that newer models of air conditioning units were not appropriate for its direct load control programme because the new units' electronic control system was not compatible with their control technology.

Even decentralised responses can be highly predictable. The cases suggest that direct control of loads is not required to obtain a reliable response from flexible demand: automated devices and human actions can also produce a reliable response at peak.

2.3.2.5 FREQUENCY-SENSITIVE RELAYS, GENERATION AND NEW DEMAND TYPES

This review included some newer areas of demand side response, where international experience is limited. It also considered more active management of distributed generation and microgeneration, and in these areas there is – to our knowledge – less information available on the outcomes of such schemes.

Aggregating distributed generation can provide considerable flexibility. As part of our review of international experience of demand side response, we looked at two case studies where backup generators or dedicated generators were used to defer network upgrades. The nature of the generators' use patterns meant that they could operate very flexibly, offering up to 100% of their capacity reliably at times of system peak.

Frequency-sensitive relays are currently on trial in the UK. A study produced for the UK Government estimated that the average frequency response available from a mass roll-out of the technology would be 20-30W per participating refrigeration unit.

QUESTION 4: WHAT OTHER INSIGHTS DO YOU HAVE FROM YOUR EXPERIENCE OF DEMAND SIDE MANAGEMENT ADOPTED INTERNATIONALLY?

2.3.3 QUANTITATIVE RESULTS FROM INTERNATIONAL EXPERIENCE

As highlighted above we have identified 15 reports detailing case based international experience of demand side response and many of these included a summary of multiple, so that a total of 225 DSR cases are described across all the studies. From this set of cases of international experience, we selected those reports that included quantitative results from the DSR measures as well as a qualitative description of the scheme. This yielded 41 DSR cases containing 54 data points relating to the three metrics described in Section 2.1.

We recorded four types of quantitative result from the case studies, to the degree that these were reported. We found that few of the studies reported maximum peak reductions or indicated quantitatively how much flexibility had been added to the system as the result of a DSR measure. As a result there are two indicators where there is data across a reasonable number of DSR cases.

Figure 3 shows the average energy reduction for each case where an energy reduction against a baseline was recorded. Each point represents data from a single case; the bars show the range within each DSR category.

These numbers are expressed as percentages of the load that was covered by each DSR programme. For example, results for domestic energy efficiency programmes consider reductions to total domestic electricity demand for those homes participating in the scheme described by the case study. Similarly, for time-of-use tariffs, the changes reported in consumption are aggregate values for all homes using the tariff. For microgeneration and distributed generation, the load in question is the load being managed as part of the scheme which can imply very high levels of response – particularly peak response. To calculate the overall decrease in system demand, it would be necessary to multiply these figures by the fraction of system demand represented by the load involved in each case, and also by the degree of take-up of the measure. For example, the response indicated for home automation would need to be multiplied by domestic demand as a fraction of total demand, and then multiplied by the number of domestic consumers adopting home automation technologies, as a fraction of the total.

There is a noticeable outlier in the reductions from the domestic sector: this relates to a case where reductions of 51% were reported in the electricity bills of participating customers. This was a particularly aggressive efficiency campaign, targeted at two specific areas and including monetary incentives for participants and free installation of efficiency products.

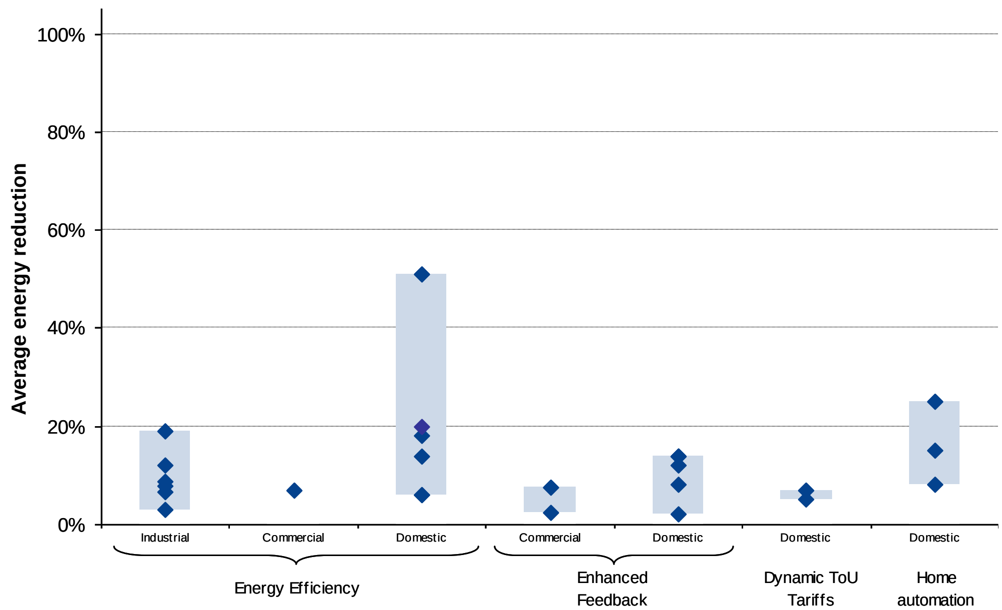


***Figure 3** – Reported average energy reduction from international case studies*

Figure 4 shows the reduction in average peak demand for each case where this was reported. As with the data in Figure 3 these are expressed as a percentage of the load (or distributed generation capacity) participating in the scheme.

There is a particularly wide range of results for demand side flexibility and home automation. This reflects differences in the load being controlled (air conditioning loads in warm climates can represent a high proportion of demand at peak, for example, and curtailing this at peak can result in proportionally-large reductions at peak. Distributed generation and microgeneration are also capable of providing a very high response at peak, relative to their total generating capacity, if they are low-load-factor plant capable of operating very flexibly.

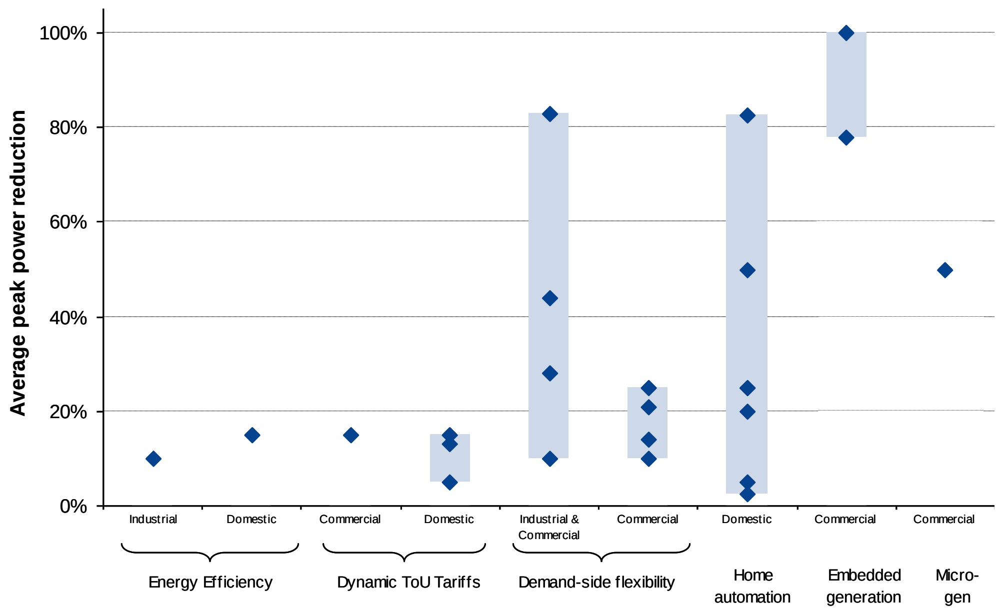


***Figure 4** – Reported average peak power reduction from case studies*

Figure 5 shows the average peak reduction data from Figure 4, together with average energy reductions for all cases that reported this figure but did not report average peak reduction data. This provides an indication of peak demand reduction for all the cases where quantitative results were reported, assuming that the reduction in peak power demand reflects the average reduction in energy use for those cases that only reported the latter of these two figures.

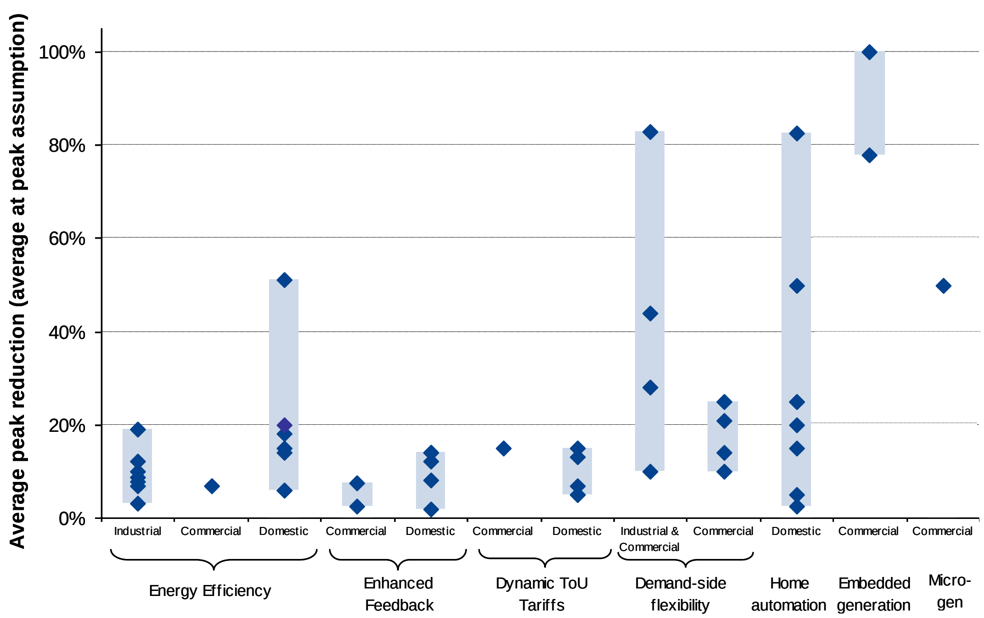


***Figure 5** – Combined data for average peak demand reduction and average energy reduction*

The technical, or theoretical, potential for demand side resource tends to be significantly higher than can be realised. Therefore, of key interest to policy makers is what proportion of this response can be delivered to the market and how it can be maximised. Our main 'quantitative' insights include the following:

- measures that improve energy efficiency or rely on modifying electricity users' behaviour consistently reduce the relevant customers' total energy demand, with reported savings often in the range 5%-15% of those customer total demand;
- introducing automation in the home and in commercial and industrial settings significantly increases the potential for peak reduction compared to other measures i.e. by up to 80% compared to less than 20%; and
- distributed generation and microgeneration can offer significant flexibility as a percentage of their capacity (depending on their energy source) i.e. over 50%.

QUESTION 5: ARE YOU AWARE OF OTHER QUANTITATIVE FINDINGS FROM INTERNATIONAL EXPERIENCE WHICH YOU BELIEVE ARE IMPORTANT FOR US TO CAPTURE AND CONSIDER?

2.4 POLICY DRIVERS AND THE ALL-ISLAND ELECTRICITY MARKET IN 2020

The respective governments of the Republic of Ireland and Northern Ireland are pursuing a number of energy policy goals which are closely aligned. The Republic of Ireland's Energy White Paper of 2007[1] sets out strategic goals under the three headings of Security of Supply, Sustainability of Energy and Competitiveness of Energy Supply. In its recent consultation on the Draft Strategic Energy Framework 2009[2], DETI uses a similar structure to propose a policy framework for Northern Ireland. Table 1 summarises some of the main common policy themes appearing in these two documents.

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[1] 'Energy White Paper 2007, Delivering a Sustainable Energy Future for Ireland, The Energy Policy Framework 2007-2020', DCMNR, March 2007.

[2] 'Consultation for the Draft Strategic Energy Framework for Northern Ireland 2009', DETI, July 2009.

Policy area	Policy goals
Competitiveness	Encouraging competition and consumer choice in energy markets
	Maximising innovation, enterprise and job creation in the energy sector
Security of Supply	Ensuring electricity supply consistently meets demand
	Increasing fuel diversity in electricity generation
	Maintaining and upgrading networks to ensure efficient and reliable gas and electricity delivery to consumers
Sustainability	Incentivising and accelerating the growth of renewable energy sources
	Maximising energy efficiency and energy savings opportunities

***Table 1** – Common policy themes for the Republic of Ireland and Northern Ireland*

These policy goals and the measures used to deliver them – notably those relating to sustainability and concerns over security and diversity of energy supply – will cause significant changes to the electricity system in the All Island market over the coming decade. Coupled with the increases in fossil fuel prices over recent years these policy goals will also impact on prices and affordability, driving investment in energy efficiency and end use technologies.

2.4.1 RENEWABLE ENERGY TARGETS

The passing of the EU Renewables Directive[3] in December 2008 by the European Parliament reiterates the EU's commitment to renewable energy use. The Directive outlines country-specific targets that will enable the EU to reach its binding target of 20% of total energy consumption from renewables by 2020. The target for the RoI has been agreed at 16%, covering the transport, heat and electricity sectors. Within this the Republic of Ireland has adopted domestic renewable electricity production targets of 15% by 2010 and 40% by 2020.

NI has set a target of producing 12% of electricity from renewable sources by 2012[4]. A further target to achieve 40% of electricity consumption by 2020 from renewable sources was proposed by DETI in its 2009 consultation on a Strategic Energy Framework for Northern Ireland[5], although this has not yet been ratified.

These ambitious targets for renewables imply a substantial change in the generation mix in the All Island market, away from a system comprising mainly of fossil-fuel plants towards a situation where by 2020 intermittent renewable sources – particularly wind – equal or exceed the contribution of gas to become the dominant element of the generation mix.

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[3] European Parliament legislative resolution of 17 December 2008 on the proposal for a directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (COM(2008)0019 – C6-0046/2008 – 2008/0016(COD)), 17 December 2008.

[4] DETI Strategic Energy Framework, June 2004.

[5] 'Consultation for the Draft Strategic Energy Framework for Northern Ireland 2009', DETI, July 2009

Figure 6 is taken derived from Pöyry's recent study on the impacts of intermittency for the GB and Irish electricity markets[6]. It shows the evolution of the generation mix in the SEM in the core scenario developed by Pöyry for the study, which included 6.1GW of wind generation on (and off) the Island by 2020, rising to 8GW by 2030. By 2020 the renewable share of generation was assumed to be around 44%, before considering reductions in wind generation due to transmission, reserve of response constraints.

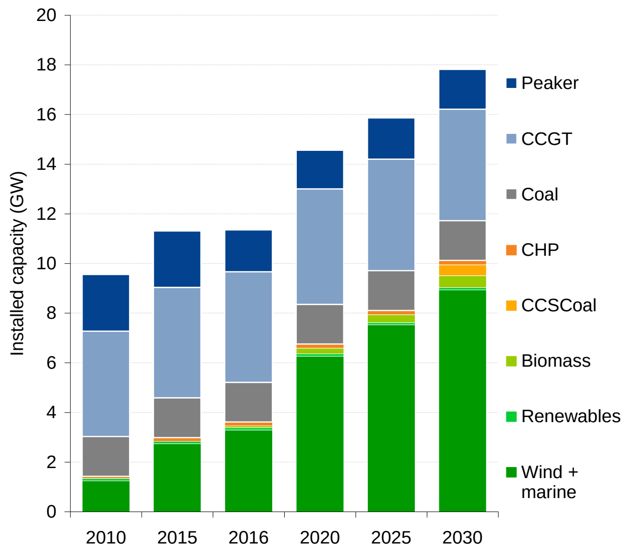

***Figure 6** – Installed capacity in the SEM – core scenario, 2010-2030*

Source: 'The Impact of Intermittency' – Pöyry Energy Consulting, 2009

The increase in intermittent renewable generation will present new challenges for security of supply and will require cost-effective investments in networks (including interconnection), peaking plant and increased demand side participation.

Under these conditions, peak shifting actions of demand will become more cost effective, to help increase the system flexibility and as a result reduce system costs. This is because although wind speeds on average do increase during daytime peak hours, and are higher in winter than in summer there is significant variation of generation around the averages (the relationship between wind and demand is weak).

[6] 'Implications of Intermittency'. Pöyry Energy Consulting, May 2009.

A summary of the work was published: 'The impact of intermittency: how wind variability could change the shape of the British and Irish electricity markets.' Pöyry Energy Consulting, July 2009. http://www.ilexenergy.com/pages/documents/reports/renewables/Intermittency%20Public%20Report%202_0.pdf

The underlying model framework was used for a subsequent publication looking forward to 2035 'Low carbon generation options for the All-Island market'; Pöyry for EirGrid., March 2010. http://tinyurl.com/33463w5

Peak shifting will allow for the movement of load at any time of the day, without implying a reduction of total energy demand. This will mean that demand can moved from coinciding with the system peak to periods of lower system demand.

As a result, peak shifting can be considered to be similar to electricity storage. This type of solution can lead to a number of benefits including:

- reduced system costs – allows more efficient optimisation of generation;
- reduced emissions – less need to part-load thermal plant to provide reserve and response;
- lower requirement to curtail wind; and
- reduction in the volatility of the SMP.

The dramatic increase in wind generation that will occur over the next decade will also have implications for peak demand management. Controllable generation must meet the difference between instantaneous demand and instantaneous generation from uncontrollable generation[7] (including wind). With current, relatively low, levels of wind penetration the profile of demand net of wind is not significantly affected by instantaneous wind generation.

As installed wind capacity increases, wind will begin to significantly affect the shape and variability of the profile of demand net of wind. Figure 7 uses data from Pöyry's recent study on the impacts of intermittency on the SEM to illustrate this effect. The chart shows within-day profiles for demand on 18 December 2020. The installed wind capacity assumed is in line with the Core scenario shown in Figure 6, and the wind generation profile is based on the wind pattern observed in December of the year 2000. This is the day during which the annual hourly demand peak occurs: this peak is at 6pm.

As well as wind generation and demand, the chart shows effective demand, net of wind generation. This can be sketched to approximate to the amount of thermal generation needed throughout the day (although in practice pumped storage, import/exports and generation from other sources including hydro make a contribution).

Due to the generation pattern of wind over the course of the day, demand net of wind peaks at 10am, so that thermal generation during the annual peak demand hour (6pm) is over 500MW lower than at 10am.

[7] Technically and under the requirements of the Grid Code much of the installed wind capacity in Ireland is controllable and subject to dispatch instructions, notwithstanding its 'priority dispatch' status. However, to de-load wind is costly in terms of lost value, given its near-zero marginal cost of generation.

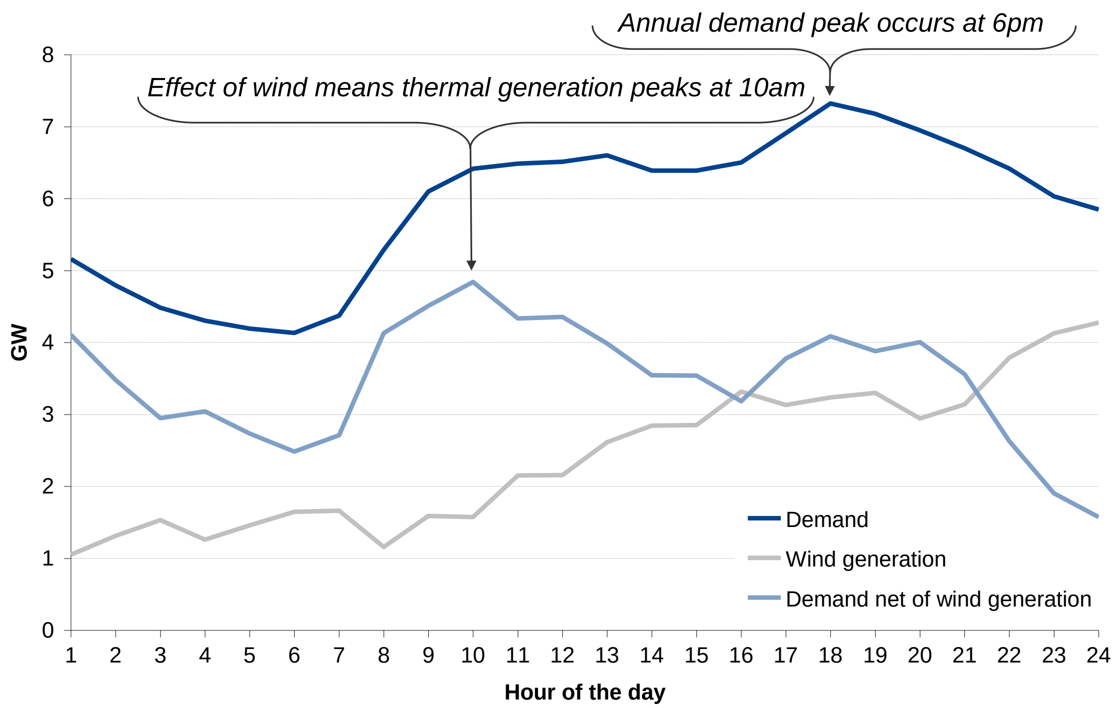

Figure 7 – Monthly average within-day profile of SEM demand and wind generation in November 2020 (assuming 6.1 GW of installed wind capacity)

Source: Pöyry Energy Consulting.

Further to these effects on average system behaviour, the variance exhibited by wind generation is also large and so these peak shifting effects will be more marked on individual days. This will necessarily call into question traditional approaches to the notion of 'system peak' and peak management.

From the perspective of the wholesale market, the definition of the daily 'peak' will become 'peak demand net of wind' (or 'effective demand') and its timing will be variable from day to day. From the perspective of the transmission and distribution networks, the timing of peak flows may diverge from the timing of the wholesale market peak, meaning that choices are required over which services demand side management should provide.

2.4.2 ENERGY EFFICIENCY TARGETS

The Sustainable Energy Future White Paper released by the Republic of Ireland Government placed energy efficiency at the heart of its strategy for 2007-2020. The ambitious targets the Government has proposed are:

- an overall national energy-saving target of 9% for 2016, as part of the EU Energy End Use Efficiency and Energy Services Directive (ESD);
- a 20% savings in energy across all sectors, as described in the National Energy Efficiency Action Plan (NEEAP), with a 33% target specific to the public sector; and
- an indicative 30% energy saving by 2020 to surpass the EU ambition.

Energy efficiency measures are implemented from the smallest scales – households and small business – to the largest. A recent study identified opportunities to enhance energy efficiency across the domestic, commercial and industrial sectors[8]. This implies that a broad range of stakeholders have the potential to contribute to meeting this disaggregated potential, including homeowners.

In Northern Ireland energy efficiency also forms an important part of energy strategy. Northern Ireland had set its own target of reducing electricity consumption from 2007 by 1% annually until 2012. However this target was effectively superseded by the UK Energy Efficiency Action Plan published in 2007, which requires an overall 9% reduction across all fuels by 2016.

In addition the Northern Ireland regulator has recently published its Sustainable Energy Programme Framework document[9] (which was prepared by the Energy Saving Trust). The objective of this framework is to set out which energy saving schemes are eligible for funding and how the funding will be allocated.

2.4.3 OTHER EUROPEAN POLICY DRIVERS

The requirements of the EU Renewables Directive and the Energy End Use Efficiency and Energy Services Directive are discussed above. There are other European policy drivers which relate to demand-side response, although the requirements other than for smart metering are rather non-specific.

The EU's Third Energy Package was adopted by the Commission on 19 September 2007. In order to meet the goals of the Third Package, the Commission set out two Directives and three Regulations aimed at creating an integrated European-wide energy market. With regard to encouraging smart metering and smart grids the Internal Electricity Directive (2009/72/EC) set out that:

- "Member States should encourage the modernisation of distribution networks, such as through the introduction of smart grids."
- "Member States shall implement measures to achieve the objectives of social and economic cohesion and environmental protection, which shall include energy efficiency/demand-side management measures and means to combat climate change, and security of supply, where appropriate."
- "Member States shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the electricity supply market."

With regard to this latter point the Directive states that the implementation of smart meters may be subject to an economic assessment of the costs and benefits to the market and the individual consumer. This should assess which type of intelligent metering is economically reasonable and cost-effective, and which timeframe is feasible for their distribution. This assessment must take place by 3 September 2012 and subject to the assessment, Member States should prepare a timetable with a target of up to 10 years for the implementation of intelligent

[8] ‘Demand Side Management in Ireland – Evaluating the Energy Efficiency Opportunities’. KEMA, for Sustainable Energy Ireland. January 2008.

[9] http://www.niaur.gov.uk/uploads/publications/2009-09-15_NISEP_Framework_Document.pdf

metering systems. Where roll-out of smart meters is assessed positively, at least 80% of consumers shall be equipped with intelligent metering systems by 2020.

2.5 DRIVERS OF FUTURE VALUE FOR DEMAND SIDE RESPONSE ON THE ISLAND

In assessing the future value of demand side response in the All Island market a number of common themes arise and these are set out below.

In the day-to-day timescales over which demand response can be exercised, variation in the underlying level of demand is currently the most important determinant of electricity price. Such demand variation is (to a high degree) predictable, and the critical times in each day can generally be predicted significantly in advance.

In 2020 and beyond, the electricity system will be characterised by high levels of wind generation whose output profile will become a dominant driver of electricity value. As a consequence, the key times (of peak 'effective demand') within each day will become far less predictable, at least more than one or two days ahead.

In Pöyry's 'Intermittency study'[10] they modelled the effects of wind intermittency on the future SEM and GB electricity markets. The levels of wind generation foreseen for the Island by 2020 was found to include the following issues which are relevant to the Demand Side Vision:

- the annual demand peak sets a requirement for some dedicated (peaking) capacity to be built and maintained:
    - by implication, peaking generation capacity could be reduced if the absolute demand peak (at times of low wind output) could **reliably** be reduced.
- wind generation will on occasion – typically overnight – exceed demand on the Island, even allowing for the assumed interconnection to GB, and the market will begin to see some level of curtailment:
    - as levels of wind generation increase curtailment could be mitigated with a shift in demand towards greater overnight consumption.
- in the SEM, the requirements to keep thermal plant synchronised to provide frequency response will cause further curtailment of wind and will have a material impact on dispatch patterns:
    - the provision of frequency response from the demand side could reduce the extent of wind curtailment and the requirements for part-loading.

It is possible that new forms of load such as electric vehicles or heat pumps, if not influenced by time of day pricing, will increase the magnitude of peak demand.

2.5.1 THE VALUE OF RELIABILITY VARIES WITH THE NEED FOR NEW GENERATION CAPACITY

[10] *Ibid.* The underlying model framework was used for a subsequent publication looking forward to 2035 'Low carbon generation options for the All-Island market'; Pöyry for EirGrid, March 2010.

The most notable aspect of wind generation is its limited ability to make a significant capacity contribution towards meeting future peaks in demand. The provision of **reliable** demand reduction at the effective system peak could offset the need for investment in alternative generation capacity. The value of this reliability in any year will be dependent on the system need for generation capacity at the time, i.e. the expected balance of (peak) demand and the level of (available, reliable) generation capacity.

For example, if the future electricity system is characterised by greater interconnection, low take-up of new forms of electric demand, and a strong move to energy efficiency, then there will be limited need for new generation capacity, and the additional value of **reliability** of demand response in terms of avoided generation investment costs will be low. Conversely, with a rapid growth in (effective) peak demand, and limited development of interconnection and other reliable forms of generation capacity (e.g. biomass), then new generation capacity will be required (sooner) and the reliable delivery of effective demand reduction will have greater value.

2.5.2 THE VALUE OF FLEXIBILITY WILL INCREASE AS WIND DRIVES SYSTEM CONDITIONS

The value of flexibility in the electricity system increases with the level of wind capacity installed, as the time of effective peak demand becomes less predictable. The implication is that effective peaks will in future be driven predominantly by wind generation and not demand. This increasingly means that demand side flexibility needs to be dynamic (in response to conditions on the day), not static (in response to a preconceived definition of 'peak' demand hours).

2.5.3 ANCILLARY SERVICES WILL INCREASE IN VALUE

The Island has a small electricity system with relatively large generation unit sizes, which causes a high requirement for primary frequency response as insurance against the event of unexpected generation plant failure. The Pöyry intermittency work supports the findings of a series of previous studies[11] which note that that the provision of primary (low) frequency response in the All Island market is a significant driver of generation dispatch.

A consequence of the growth in wind generation will be squeeze conventional thermal generation – the traditional provider of primary and secondary frequency response – from the generation mix and to increase the cost of the provision, and therefore the value of frequency response. It can be inferred that the value of demand side solutions to the provision of frequency response in the All Island market will be of greater value than in other markets in Europe and will increase with the level of wind penetration.

2.5.4 TRANSMISSION CONSTRAINTS WILL INCREASE IN COST

The management of transmission flows will become more challenging in future as more generation is located in remote areas. There is a major programme of grid reinforcement being planned under the Grid25 banner, and the deployment of renewables is currently constrained by the availability of the networks. We expect that the cost of managing transmission constraints will increase over time. We note that if the demand side is to help in alleviating these constraints, this will require significant quantities of demand to be subject to dispatch instructions at short notice.

[11] These studies include the All Island Grid Study, SEI Wind and Reserve study, and modelling by Pöyry for CER in support of MAE.

2.5.5 DISTRIBUTION NETWORK ISSUES MAY LIMIT DEMAND RESPONSE POTENTIAL

Changes in demand patterns could potentially trigger investment in distribution networks, which are currently sized to meet the existing expected peak flows.

An increase in distribution peak flows could occur with the development of new forms of demand such as electric heating or electric vehicles, depending on their patterns of consumption. This will be mitigated if such new forms of demand are subject to time-of-use tariffs.

If, in future, distribution-connected demand responds to market prices (or other signals) in large volumes, it is possible that new peak distribution flows will emerge at low voltage levels outside the normal peak times[12]. Therefore, if demand side management becomes widespread, there is a risk of forcing new distribution reinforcements; alternatively distribution network constraints might prevent the full potential of demand response from being realised.

Mitigating measures could include, for example, more cost-reflective time-of-use distribution network tariffs, or direct DNO control of (some) demand.

QUESTION 6: DO YOU AGREE WITH OUR IDENTIFIED DRIVERS OF FUTURE VALUE FOR DEMAND SIDE RESPONSE/MANAGEMENT? ARE THERE ANY ADDITIONAL DRIVERS WE SHOULD CONSIDER?

[12] New peaks on distribution network flows could emerge if the impact of several GW of variation in wind output is balanced by large-scale swings in demand at the lower voltage levels. Fingrid, the Finnish TSO, reports a 1GW step increase in overnight demand at the time when the night heating tariff starts, and this effect is also seen in the distribution networks.

3 DEMAND SIDE POTENTIAL IN THE ALL ISLAND MARKET

3.1 TYPES OF DEMAND SIDE RESPONSE

There are a number of different specific types of demand side response present in the All Island market, which are addressed throughout this consultation. These are listed below in **Error! Reference source not found.** together with an indication of the type of benefit(s) they provide.

Demand-side measure	System benefit		
	Overall demand reduction	Peak reduction	Flexibility
Energy efficiency – industrial	✓		
Energy efficiency – commercial	✓		
Energy efficiency – residential	✓		
Behavioural change – Education	✓		
Smart meters – Advanced displays (billing, real-time)	✓		
Smart meters – Static ToU tariff	✓	✓	
Smart meters – Dynamic ToU tariff	✓		✓
Home and Office Automation – direct control			✓
Home and Office Automation – autonomous (price responsive)			✓
Home and Office Automation – Frequency response			Ancillary service – frequency response
Industrial / commercial DSR – Interruption contracts			✓
Industrial / commercial DSR – direct control			✓
Industrial / commercial DSR – autonomous (price responsive)		✓	✓
Heat pumps with storage			✓
Electric vehicles – Night charge		✓	
Electric vehicles – Hybrid vehicles			✓
Electric vehicles – Price responsive charging			✓
Microgeneration – Controllable			✓
Aggregation of DG			✓
Storage			✓

Table 2 *– System benefits of evaluated demand side options*

Overall demand reduction refers to measures which reduce energy consumption, typically the target of efficiency programmes. Peak reduction encompasses measures which enable changes to be made to the profile of demand to alleviate demand peaks – an obvious example of this is the static time of use tariff. Flexible measures allow demand, or load, to be shifted in response to unexpected events, and assume dynamic (near-real time) time-of-use tariffs. While storage, aggregation of distributed generation and controllable microgeneration are not strictly demand side measures they are considered to be within the scope of this study and provide similar sorts of flexibility to the system.

Demand-side measures can also provide ancillary services – we have not evaluated this issue in detail, but have reviewed some new technologies, currently being trialled which enable devices such as fridges and freezers to respond automatically to changes in system frequency.

3.2 CURRENT DEMAND SIDE ACTIVITY IN THE ALL ISLAND MARKET

In both the Republic of Ireland and in Northern Ireland, a number of existing policies, initiatives, and market design features already assist and enable demand side participants to participate actively in electricity markets.

The policies and measures currently in place will form the starting point for any set of new measures that need to be put in place to realise the Demand Side Vision for 2020.

Domestic consumers in the All Island market have access to differentiated day/night electricity tariffs under the Nightsaver and Economy 7 schemes operated respectively in the Republic of Ireland and in Northern Ireland.

In the SEM, Demand Side Units (with a minimum size of 4MW) can offer demand reductions into the pool, receiving a capacity payment for availability and a payment for demand reductions actually delivered as a result of receiving a dispatch instruction.

There are a number of SO schemes already in existence to incentivise reward demand reduction at peak times, for example the EirGrid's STAR (interruptible load) scheme which has been operating for more than 20 years, and its Winter Peak Demand Reduction Scheme (WPDRS); and ESB Customer Supply's WDRI tariff scheme. The form of and need for these are currently under review by EirGrid and SONI[13].

A number of energy efficiency initiatives have also been put in place in the Republic of Ireland and in Northern Ireland. In the Republic of Ireland, these currently focus on a few key areas across the residential and business sectors. Building improvements span from building energy ratings (BERs), to mandatory standards for new housings and Greener Homes schemes. The Home Energy Savings Scheme (HES) provides financial support for home energy performance upgrades. The Power of One programme, provides online tools for the residential sector, monitoring and benchmarking tools for the business sector. It has also developed energy labelling schemes, advertising campaigns and information guides have been produced in order to change consumer behaviour.

In Northern Ireland, NIE's SMART programme already encourages the use of demand side management and embedded generation as alternatives to conventional network reinforcement, and in the Republic of Ireland ESB

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[13] EirGrid: 'Demand Side Management'. Undated. Viewable at:
http://www.eirgrid.com/operations/ancillaryservices/demandsidemanagementdsm/

Networks is also doing some work of relevance to smart grids, for example by increasing its use of SCADA technologies.

QUESTION 7: ARE THERE ANY OTHER ASPECTS OF CURRENT DEMAND SIDE ACTIVITY IN THE ALL ISLAND MARKET WHICH SHOULD BE CAPTURED?

3.3 POTENTIAL FOR DEMAND SIDE ACTIVITY IN THE ALL ISLAND MARKET IN 2020

The technical and economic potential for demand side response in the All Island market in 2020 will depend on the nature of electricity demand. This section provides a summary of the more detailed analysis of electricity demand and demand trends in the All Island market which is contained in Annex A. The material in this section and the Annex provides estimates of the potential for reductions in the overall level of demand by 2020 and the degree of flexibility that could be exhibited by the demand side in that year, and forms the foundation of our evaluation of the different demand side measures

3.3.1 TOTAL DEMAND AND THE POTENTIAL FOR ENERGY EFFICIENCY

Table 3 shows our estimate of demand in each of the sectors included in this analysis in 2020.

<table>
<tr><th></th><th>Space heating</th><th>Water heating</th><th>Other processes</th><th>Total</th></tr>
<tr><td>Industry</td><td colspan="2" rowspan="2">0.7-0.8</td><td rowspan="2">23.9-28.0</td><td>13.1-14.9</td></tr>
<tr><td>Commercial</td><td>11.5-14.6</td></tr>
<tr><td>Domestic</td><td>1.5-1.9</td><td>3.0-3.1</td><td>5.5-8.5</td><td>10.1-13.5</td></tr>
<tr><td>Electric vehicles</td><td>N/A</td><td>N/A</td><td>0 – 0 24</td><td>0.0-0.24</td></tr>
<tr><td>Heat pumps</td><td>N/A</td><td>N/A</td><td>0 – 0.7</td><td>0.7</td></tr>
</table>

Table 3 *– Projection of total demand in energy terms by 2020 (TWh)*

3.3.1.1 TOTAL DEMAND FOR EACH SECTOR

The upper end of the range of possible total electricity demand in 2020 is given by 'business as usual' rates of demand growth. The lower end is given by subtracting from these numbers the technical efficiency savings projected by SEAI's report on demand response[14].

As noted in A.3.2, the SEAI report numbers are not strictly comparable with any projection of demand growth as the report does not contain a judgement of the demand that it assumes in 2020. Compared with our own

[14] SEAI, 2008: Demand Side Management in Ireland: evaluating the energy efficiency opportunities.

‘business-as-usual’ projection of demand growth, the savings projected by the SEAI report are significant: 8% in the industrial sector, 25% in the residential sector, and 21% in the commercial sector. This is higher than the range of reported improvements in energy efficiency we discovered during our review of international experience of energy efficiency. However, the duration of most of the cases we looked at was around 1-3 years, and it may be that a greater reduction would be possible over a decade-long period, given an appropriate package of policies.

3.3.1.2 SPACE AND WATER HEATING

Demand from space and water heating is separated from other processes because of the potential for these types of load to be flexible in their operation and as sufficient data exists to allow these to be estimated separately from other loads.

Space and water heating in the industrial and commercial sectors are estimated based on the differences between demand profiles on summer days and demand profiles during the rest of the year (this is, as discussed in the Annex A, Section A.2.3). The demand for other processes in these sectors is implied from the sectoral total.

For the domestic sector, space and water heating are inferred from current end use (as illustrated in Annex A, Section A.2.2.3).

3.3.1.3 OTHER SOURCES OF DEMAND

All other domestic end uses (lighting, appliances, and cooking) have not been categorised as time-flexible or inflexible. Some appliances (e.g. dishwashers and washing machines) are potentially flexible in their operation, but other forms of demand – lighting, for example – are not. Existing information is insufficient to identify how many appliances belong to each category.

Electric vehicles’ demand is based on the estimate in Annex A, Section A.3.3.1, and as discussed in that section the charging behaviour patterns are unknown, and it is therefore uncertain to what degree this load will be time-flexible. Heat pump demand is based on our modelling of Irish and UK renewable energy targets, the detail of which is presented in Annex A, Section A.3.3.2.

3.3.1.4 KEY MESSAGES ARISING FROM TOTAL DEMAND

Demand from new types of load is expected to be relatively small, compared to existing demand. Even if the Republic of Ireland’s electric vehicles goal were to be met fully, the total demand from these would be an order of magnitude smaller than demand from domestic water heating, for example. Projected demand from heat pumps is larger but still only around half of the existing electric domestic space heating load.

There is significant uncertainty and lack of information on the components of demand, particularly electricity end-use in the industrial and commercial sectors. This makes it difficult to draw insights into the nature of the flexibility which might be available and where within these sectors any additional measures should be targeted.

3.3.2 TOTAL DEMAND AND THE POTENTIAL FOR ENERGY FLEXIBILITY

Table 4 shows an estimate of flexible demand and the potential for demand side management in 2020. The table shows estimates of the maximum simultaneous flexible demand in each category – that is, the total demand from that class of demand at its peak.

Space and water heating in the industrial and commercial and the domestic sectors are based on the changes in demand profiles within year, as described in Section A.2.3; the only exception is the estimate for water heating, which is derived from the discussions in the Demand Side Vision Workshop held in Dundalk, in February 2010.

The demand from industrial processes is estimated from the baseload in summer, and is divided into time-flexible and time-inflexible demand by assuming that participation in existing demand side response schemes reflects the amount of flexible load available in the industrial sector. Given economic and other barriers to demand side flexibility and the possibility for loads to participate as demand side bidding units in the SEM, this number is probably a pessimistic estimate of the technical capacity that may be available in 2020.

Commercial and domestic demand that is not related to heating is estimated from the peak demand on summer business and non-business days. Due to the absence of information about the flexibility of loads in the sector this has all been allocated to the 'time-inflexible' column; this is also likely to be an underestimate of the available flexible capacity in these sectors.

For electric vehicles, storage, and distributed generation, there is little data and few projections of current and future capacity: these have therefore been derived mainly from the views expressed in the Demand Side Vision Workshop. The minimum heat pump demand has been estimated by distributing total annual demand (from Annex A, Section A.3.3.2) evenly over the year: as such this is a minimum estimate rather than an expectation.

	Space heating	Water heating	Other flexible demand	Total
Industry	790-920		320-370	**1100-2300**
Commercial			0-1020	
Domestic	520-690	700	0-950	**1200-2300**
Electric vehicles	N/A	N/A	0-100	**0-100**
Heat pumps	80+		N/A	**N/A**
Storage	N/A	N/A	240+	**240+**
Distributed generation	N/A	N/A	>120	**>120**

Table 4 *– Estimated flexible demand in capacity terms for the Island in 2020 (MW)*

International experience suggests that with home automation a considerable amount of this flexible load could become flexible and responsive. Much of this experience has been in managing thermal loads (e.g. immersion heaters or air conditioning).

3.3.2.1 KEY MESSAGES ARISING FROM THE ESTIMATE OF FLEXIBLE DEMAND RESOURCE

The potential for flexibility from heat pumps and electric vehicles is relatively small in absolute terms. Unless there are compelling reasons to concentrate on deriving flexibility from new sources of demand, it may be more effective to concentrate on taking advantage of existing demand with potential for flexibility, such as space and water heating.

Among existing demand, space and water heating appear to offer the largest potential for flexible operation in the industrial, commercial and domestic sectors. The degree to which appliances and non-heating loads can be flexible in these sectors is unclear, but it appears to be considerably smaller than the potential flexibility of heating. There is considerable uncertainty over the scale of flexibility available from different industrial processes, suggesting the need for some form of sector by sector audit.

QUESTION 8: DO YOU AGREE WITH OUR HIGH LEVEL ASSESSMENT OF THE POTENTIAL FOR DEMAND SIDE MANAGEMENT IN THE ALL ISLAND MARKET BY 2020?

4 SUPPORTING DEVELOPMENT OF DEMAND SIDE ACTIVITY IN THE ALL ISLAND MARKET

4.1 CURRENT POLICY BASELINE FOR DEMAND SIDE MANAGEMENT

4.1.1 INTRODUCTION

In developing a Demand Side Vision for the Island in 2020, as outlined in Table 2 (Section 3.1) previously we have considered a wide range of areas relevant to demand side response. These are:

- energy efficiency;
- consumer behavioural change;
- smart meters;
- home and office automation;
- industrial and commercial scale demand side response;
- new forms of electrical demand:
    - renewable heat; and
    - electric vehicles;
- microgeneration;
- aggregation of distributed generation; and
- storage.

Some of these areas, for example, electric vehicle penetration and smart meter roll-out, are the subject of well-defined policy goals. Others, such as home automation and storage, have received less attention from government and regulators.

In all of the areas, there are further measures that could be taken in order to increase the volume of demand side response that may be expected to materialise by 2020 beyond the level that is expected under current market arrangements and with existing policies. These are demand side 'options', which are technically feasible but which may require further policy measures or regulatory changes to realise them. These are discussed in detail in Section 4.2.

In the following sections, for each of the demand side areas we have examined we set out:

- a definition of the topic; and
- a summary of the current policy framework and description of the status of each topic, or demand side option, at the present time.

4.1.2 ENERGY EFFICIENCY

4.1.2.1 DEFINITION

Energy efficiency in this consultation refers to technical improvements in technologies that consume electricity to deliver improved energy performance i.e. less energy consumption for the same function. This includes a wide range of measures including improving thermal insulation in homes that are electrically heated, installing more efficient air-conditioning systems in commercial premises, or using more efficient motors and drives in industrial processes.

Within this project, we discuss energy efficiency measures in the context of the sectors in which they occur i.e. industry, commercial, and domestic. Given the breadth of the project's scope we have not identified in more detail the specific measures that would need to be undertaken within these sectors.

4.1.2.2 EXISTING POLICY

Both the Republic of Ireland and Northern Ireland have had policies in place for many years designed to improve energy efficiency.

The EU Energy End Use Efficiency and Energy Services Directive (ESD)[15] requires Member States to achieve a 9% energy saving by 2016, although this is not a legally enforceable obligation. The EU's 20/20/20 Climate and Energy Package encompassed the Commission's Action Plan for Energy Efficiency[16], which commits Member States to making a reduction of 20% by 2020, although again this is not legally binding[17].

The Republic of Ireland has developed a National Energy Efficiency Action Plan that encompasses both the 9% target of 2016 and the 20% target for 2020. It describes a package of measures that are designed to achieve the two targets, with an accompanying estimate of the size of saving that could be achieved by each measure.

The UK's Energy Efficiency Action Plan includes policy measures that apply to Northern Ireland. These include a number of Northern Ireland specific policies, such as the NI Energy Efficiency Levy. This Plan was developed in response to the ESD, but envisages going beyond the 9% target and achieving 18% savings over the period to 2020.

4.1.3 BEHAVIOURAL CHANGE – EDUCATION

[15] Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.

[16] Action Plan for Energy Efficiency: Realising the Potential. Communication from the Commission, 19 September 2006. COM(2006)545 final.

[17] The basis of the definition of the targets is different as the 2016 target excludes savings in sectors that are covered by the EU ETS., whereas these savings are included in the 2020 target. In the context of the Energy Savings Directive, the 9% saving by 2016 is defined as a final energy demand that is lower than a 'business-as-usual' projection by a volume of energy that is the same as 9% of the average final energy demand in the period 2001-2005.

4.1.3.1 DEFINITION

Education and information provision can influence the way consumers behave including the choices they make in purchasing goods and consuming services.

Our definition of education and information campaigns includes campaigns directed towards domestic consumers and the commercial sector.

The delivery of education campaigns or the provision of information can be done by a range of actors, including government agencies or departments, electricity suppliers, and retailers of domestic appliances.

4.1.3.2 EXISTING POLICY

Education and information campaigns do not currently feature in the Republic of Ireland's National Energy Efficiency Action Plan, but are a part of the UK's equivalent document. For Northern Ireland this includes the work of the Energy Saving Trust Northern Ireland which has two information centres to provide advice for individuals and small businesses. In the Republic of Ireland, the Sustainable Energy Agency of Ireland (SEAI) plays a similar role to the EST in Northern Ireland, running information campaigns and providing some information and advice to businesses and individuals.

4.1.4 SMART METERS

4.1.4.1 DEFINITION

In this consultation, smart meters are understood as a new type of meter for electricity consumers that would currently not have interval meters. Smart meters are capable of interval metering (an imperative for the implementation of time-of-use tariffs) and of providing feedback to consumers about their energy consumption (for example through an in-home display unit or a web interface).

Smart meters can also have other features including the ability to allow remote disconnection or interact with a home area network (HAN) in order to communicate with domestic appliances.

Smart meters change consumers' behaviour by providing feedback to them about their energy use – for example through in-home display units or more detailed and regular billing – and by exposing them to more dynamic price signals such as time-of-use pricing.

4.1.4.2 EXISTING POLICY

The EU's Internal Electricity Directive (2009/72/EC) sets out that "*Member States shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the electricity supply market.*"

With regard to this latter point the Directive states that the implementation of smart meters may be subject to an economic assessment of the costs and benefits to the market and the individual consumer. This should assess which type of intelligent metering is economically reasonable and cost-effective, and which timeframe is feasible for their distribution. This assessment must take place by 3 September 2012 and subject to the assessment, Member States should prepare a timetable with a target of up to 10 years for the implementation of intelligent metering systems. Where roll-out of smart meters is assessed positively, at least 80% of consumers shall be equipped with intelligent metering systems by 2020.

Both Republic of Ireland and Northern Ireland are committed to a smart-meter roll-out in line with this time-scale. In the Republic of Ireland, the commitment to a full roll-out was made in the 2007 Programme for Government, and the savings arising from implementing smart metering are included in the National Energy Efficiency Action Plan. CER is currently conducting a large-scale technical and behavioural trial of smart-meters in order to ascertain the costs and benefits and to inform the technologies chosen for the roll-out.

In Northern Ireland, NIAUR has started to consider the specification for smart meters, including by commissioning a report outlining the main options for smart meters in the region[18]. DETI consulted on smart metering in its May 2009 consultation on Energy Billing and Metering – Changing Customer Behaviour. In this it stated that compatibility issues in relation to the SEM will be taken into account in the development of a Northern Ireland solution.

4.1.5 HOME AND OFFICE AUTOMATION

4.1.5.1 DEFINITION

Currently, the operating pattern of most electricity-consuming devices in homes and offices is driven only by the service they provide, irrespective of the implications for the electricity system.

Some of these devices could operate more flexibly without any deterioration in the service level experienced by the consumer. For example, a dishwasher running overnight can provide the same service to a family – clean dishes in the morning – as a dishwasher that runs during the evening.

Home and office automation technology allows this potential flexibility to be realised by giving appliances and electrical heating systems the capacity to change their operating patterns in response to price or other control signals.

Smart meters are a key potential enabler for home and office automation technologies. As well as providing interval metering at domestic and small commercial premises, smart meters could also play an important role as an enabling technology for automatic devices, providing time-varying prices and therefore acting as a hub for home area networks (HANs). This would allow intelligent domestic devices to respond to price or other signals without human intervention.

4.1.5.2 EXISTING POLICY

There are currently no specific policy measures in place relating to automation of home and office equipment.

By 2020, the Island will be exposed to particularly acute fluctuations in within-day electricity prices as a result of wind generation. International experience of demand side automation suggests that there may be considerable potential for domestic loads to provide flexibility at times of system stress. A significant proportion of the Island's

[18] 'Smart Metering for Demand Response'. Gemserv for NIAUR, 26 March 2010.

domestic and commercial electricity demand is used for potentially flexible applications (particularly space and water heating).

For these reasons, home and office automation represents a promising part of the 2020 Demand Side Vision.

Smart meters will remove a major barrier to home and office demand side response by introducing interval metering to small consumers. This will allow suppliers to be credited for the behaviour of their individual customers (rather than a standard load profile being applied to all non-interval-metered customers). In turn they will be able to pass this back to customers.

In the near future, devices capable of providing frequency response have the potential to provide a valuable ancillary service. Given that the technology is not yet available in a mass-market product, this does not form part of the status quo.

4.1.6 INDUSTRIAL/COMMERCIAL-SCALE DEMAND SIDE RESPONSE

4.1.6.1 DEFINITION

Industrial and large commercial sites are usually interval-metered, and many of their electricity-consuming activities are also capable of operating flexibly in response to price or other signals. This is especially true over longer timescales in which changes to business processes and various types of 'storage' e.g. back-up gas boilers to supplement electrical heat, can be added.

Within the scope of this project, industrial and commercial-scale demand side response relates to such price-responsive behaviour in these sectors.

4.1.6.2 EXISTING POLICY

Under current market arrangements, industrial and commercial loads have several options for responding to varying within-day electricity prices.

Loads, or aggregated portfolios of more than 4MW, can choose to participate actively in the SEM as a Demand Side Unit (DSU). DSUs participate as Predictable Price Maker Generation Units, so that they submit price-quantity pairs and other data and are dispatched by the system operator.

There is no requirement for loads to participate in the SEM. Unless they choose to participate as DSUs, their demand is simply treated as part of a Supplier Unit. As part of a supplier unit, interval-metered sites can also participate passively in the market, by avoiding demand during periods within the day when prices are high, to the extent possible (given that actual prices are calculated after the event, and the day-ahead prices published are only indicative and exclude the capacity element of price), and demanding at periods when the price is low.

In addition to participating in the wholesale market directly, large demand sites can be rewarded for their flexibility by participating in a number of specific peak reduction or demand curtailment schemes run by EirGrid and supply companies.

The Short Term Active Response (STAR) scheme allows non-residential electricity consumers to make their loads available for brief (usually around 5 minute) instantaneous curtailments as an ancillary service to EirGrid.

Powersave, also administered by EirGrid, provides a financial incentive to large- and medium-sized loads for energy reductions they make during periods in the year when the capacity margin is lowest.

The Winter Peak Demand Reduction Scheme was introduced as a temporary measure in the winter of 2003/4 and has been repeated every year since. It incentivises industrial and commercial customers with interval meters to reduce their loads between 5pm and 7pm during winter weekdays. This scheme is also administered by EirGrid.

As well as these schemes run by EirGrid, ESB Customer Supply offers a Winter Demand Reduction Incentive to low-voltage maximum-demand customers. Under this, maximum demand (the basis for part of the payment) is only measured over 5pm-7pm on weekdays, so that there is a strong incentive to reduce demand during those periods.

4.1.7 NEW DEMAND – RENEWABLE HEAT

4.1.7.1 DEFINITION

Renewable heat technologies include biomass and solar heating. They also include heat pumps, which consume electricity but have a coefficient of performance (CoP) that means that the heat energy delivered is greater than the electrical energy used. In this consultation we only consider heat pumps within this category.

Heat pumps can be categorised by their source (air source or ground source) and whether they provide heat directly or via a separate storage vessel designed to store the heat (in the form of high temperature water) for later use. Without a storage system, the need to maintain comfort levels limits the flexibility in operation to the very short term (e.g. a few minutes). With a storage system, that part of the electricity consumption related to extracting the heat from the source (but not that part related to circulating the heat around the house) can be re-scheduled.

Air-to-air systems run when heat is required, so that their operation is driven by the timing of space heat requirement (in an air-to-air system, the heat extracted from the environment is circulated immediately by fans).

Air-to-water systems, which can be used in water-based under floor heating systems or radiator systems, have a greater potential for flexible operation as heat can be stored in the water. The flexibility that can be derived from air-source heat pumps comes at the expense of efficiency, however, which declines with the requirement for higher output temperatures for storage. The difference between day and night air temperatures means that there is a further efficiency loss if the system attempts to extract heat from the air at night.

Ground source heat pumps are insensitive to the daily variation in ambient temperature, so there is less efficiency loss associated with nigh-time heat extraction, compared with air source pumps.

4.1.7.2 EXISTING POLICY

The Republic of Ireland has adopted a target of supplying 12% of its heat requirements from renewable sources by 2020. Northern Ireland has an indicative 10% target.

In the Republic of Ireland, the ReHeat programme and Greener Homes Scheme provide economic support for renewable heat technologies. There are plans for a support scheme for renewable heat technologies in Northern Ireland, but this is not yet in place.

It is expected that growth in renewable heat technologies will come largely from biomass and biomass CHP. Some of the growth will also come from air-source heat pumps (and to a lesser extent, ground source heat-pumps and solar water heating, both of which are relatively high-cost technologies).

Renewable heat technologies will tend mainly to replace oil-fired heating, so that any electrical heating technologies will be additional to current demand rather than replacing it.

4.1.8 NEW DEMAND – ELECTRIC VEHICLES

4.1.8.1 DEFINITION

Pure-electric vehicles are powered by electricity only. Plug-in hybrid vehicles are able to substitute electricity consumption for petrol (or in future, diesel) consumption if required, allowing them to switch between fuels for reasons of convenience or cost. Note that in principle the hybrid option permits much more flexibility in electricity consumption with the ability to defer consumption indefinitely which may be useful when there are extended periods of low wind conditions.

4.1.8.2 EXISTING POLICY

The Irish Government has set a target of achieving 10% electric vehicles by 2020. This would mean 230,000 electric vehicles if fully achieved. Assuming a glide path for the take-up this implies around 40% of new cars sold in the REPUBLIC OF IRELAND in 2020 would be electric.

A number of measures have been enacted in order to promote electric vehicles, including tax incentives for corporations on electric vehicle purchases, information and guidance for individuals on electric vehicle purchases, and funding for research, development and demonstration of electric vehicle technologies. Plans to create a national task force on electric vehicles were also announced, with a remit to examine the infrastructure implications of a mass electric vehicle roll-out.

A subsequent report by the Joint Committee on Climate Change and Energy Security outlined the main contours of the policy and technology choices that relate to electric vehicles in the Republic of Ireland.

On 12th of April 2010 the Irish Government, the ESB and the Renault-Nissan Alliance announced a comprehensive partnership to position the Republic of Ireland as a European leader in electric transport. The agreement included the development of a nationwide electric car charging infrastructure by ESB (3,500 charge points nationwide by December 2011), the supply of electric cars by the Renault-Nissan Alliance from 2011, as well as Government policies and incentives that will support the widespread adoption of such vehicles. Policies are expected to include a €5,000 grant for those who purchase electric cars and exemption from Vehicle Registration Tax.

In addition to this on the 24th May 2010 DCENR, ESB and Mitsubishi Motors Corporation, MC (Automobile) Europe and MMC Commercials announced the signing of a Memorandum of Understanding between the parties to further promote the electric car industry in the Republic of Ireland.

Further, ESB has announced the first electric car trial programme, as part of the trial the all-electric, zero emission Mitsubishi i-MiEVs will be used throughout the Republic of Ireland to support the planning and implementation of the ESB nationwide charging infrastructure. Associated with this Trinity College Dublin will undertake research into customer behaviour and attitudes towards electric vehicles.

There are no targets or policy measures in place for electric vehicles in Northern Ireland.

4.1.9 MICROGENERATION

4.1.9.1 DEFINITION

The demand side option relating to microgeneration is to ensure that the potential flexibility of microgeneration (for example micro-CHP) is realised. For those microgeneration technologies that have some inherent flexibility in their operating patterns, it would be possible to ensure that they could respond dynamically to system conditions, for example by mandating that they be fitted with a management system capable of interacting with smart meters.

4.1.9.2 EXISTING POLICY

Microgeneration is expected to grow over the next decade in both the Republic of Ireland and Northern Ireland. The Dundalk Workshop syndicate group on microgeneration estimated a 5 to 10-fold growth in microgeneration by 2020, from current levels. A recent report for NIAUR makes a similar projection[19].

Even with rapid growth to 2020, and beyond, microgeneration will not form a significant component of electricity generation.

Some microgeneration technologies are inherently inflexible in their operation: PV and wind are examples of technologies where the primary energy source varies stochastically and has zero cost.

Others, however, are able to operate flexibly and as such could play a positive part in the 2020 Demand Side Vision. Micro-CHP could generate electricity at times when this is valuable, if the heat generated can be stored until needed.

4.1.10 AGGREGATION OF DISTRIBUTED GENERATION

4.1.10.1 DEFINITION

In this consultation, aggregation of distributed generation refers to the active control of a portfolio of distributed generation.

Currently, distributed generators built as backup units for security of supply reasons or to power industrial processes do not generally respond to wholesale market prices. Grouping a set of distributed generators together and allowing an aggregator to manage their output can allow distributed generators to participate actively in electricity markets, with benefits for the system as a whole and for the owners of the generators..

4.1.10.2 EXISTING POLICY

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[19] 'Smart Metering for Microgeneration'. Gemserv for NIAUR, March 2010.

Currently aggregated distributed generators can participate in the SEM as part of an Aggregated Generator Unit (AGU) or within a DSU. Energia's AGU is the only example of an AGU.

The syndicate group on Aggregation at the Dundalk Workshop estimated there was potential for three to four units of 20-50MW in size across the Island. Many back-up generators have restrictions placed on their operation by the Environmental Pretection Agency which prevent their operation except as a back-up.

4.1.11 STORAGE

4.1.11.1 DEFINITION

This is intended to cover bulk electricity storage such as pumped storage or compressed air energy storage. Currently the Turlough Hill pumped storage facility (292MW) is the Island's main dedicated storage plant. Its activities include arbitrage of peak and off-peak power prices and provision of ancillary services to the system operator.

4.1.11.2 EXISTING POLICY

There are nascent plans for additional bulk energy storage in the Republic of Ireland, including pumped storage and compressed air energy storage – for example, EirGrid has a contracted connection offer for a 70MW pumped storage project in County Cork. However, it is not yet clear that bulk storage purely for wholesale energy arbitrage is viable as a commercial proposition.

There is no specific policy in place to encourage storage technologies. For all generation technologies, the SEM market rules are designed to allow plant to bid in a way that reflects their underlying cost structure. For storage plants, this means bidding an efficiency value and capacity and volume constraints.

QUESTION 9: DO YOU AGREE WITH OUR DEFINITION OF EACH INDIVIDUAL DEMAND SIDE MEASURE?

QUESTION 10: IS OUR DESCRIPTION OF THE CURRENT POLICY BASELINE FOR EACH DEMAND SIDE MEASURE ACCURATE AND COMPLETE? IF THERE ARE OMISSIONS PLEASE POINT THEM OUT.

4.2 IDENTIFICATION OF POSSIBLE POLICY OPTIONS FOR DELIVERING A DEMAND SIDE VISION FOR 2020

4.2.1 INTRODUCTION

In this section we describe the barriers and enablers for each of the demand side measures that we have identified. We follow this with recommendations for how gaps in the current policy framework might be addressed. It is important to note that the Irish Regulatory Authorities does not have responsibility for all of the areas of the policy framework for demand side measures and that some of the gaps and recommendations identified in this section would be a matter for consideration, and as appropriate implementation by Government.

All measures considered are presented, including those which do not ultimately form part of the 2020 Demand Side Vision outlined in Section 6. The rationale for this is to ensure that a broad range of policy options is available for consideration as part of the consultation process.

For those measures which are part of the 2020 Demand Side Vision we categorise the policy recommendations according to whether they are expected to have high, medium, or low value, using the methodology established for the evaluation of different demand side options in Section 5. Also, for each policy measure we suggest an indicative implementation timeframe, ranging from immediate (within 1 year); to short to mid term (from immediate to 3 years) and to long term (4 years onwards) on the following basis:

- 'Immediate' measures relate to policy programmes which are currently underway, for example the Smart Meter trials and consultation process and the SEM Capacity Payment Mechanism review, or those which require relatively minor modifications to the SEM TSC, such as reduction in the 4MW DSU participation threshold.
- 'Long term' measures are those for which there is an element of wait and see, for example, the take-up of industry DSU participation, or reviewing the impacts of demand side management on distribution networks before embarking on policy interventions.
- 'Short to mid term' measures are those which fall somewhere in between Immediate and Long term measures, and which can crudely be characterised as those for which there is no reason not to progress as soon as the policy process permits.

Economists use the term "market failure" to describe where the market by itself does not deliver economically efficient outcomes. Policy interventions are typically designed to address such market failures or market issues, specifically to address those aspects of the workings of the market which are preventing the delivery of economically-efficient outcomes. In our discussion of barriers to and enablers for the realisation of the 2020 Demand Side Vision we have classified the associated policy gaps into one, or more, of the following categories of market issue and associated remedy as set out in Table 5.

Market issue	Typical remedy
Externality	Internalise the externality e.g. carbon trading
Split incentives (an example of this is the 'common good' market failure of economic literature)	Regulated brokered solution to ensure costs / benefits are shared appropriately e.g. WPDRS.
Imperfect information	Better market information and education programmes to ensure that decisions are based on better understanding.
Inability to finance investments due to short-term view of benefits	Capital loan scheme direct to consumers or brokered e.g. energy suppliers invest in smart meters and get returns from customer over a number of years; tax relief schemes.
Economies of scale	Central co-ordination of standards or co-ordinated roll-out.
Overly restrictive rules	Review, and relax if possible e.g. de minimis threshold for DSU participation.

Insufficient competition	Directly targeted regulation of incumbents e.g. requirement to offer cost-reflective tariffs.

***Table 5** – Market issue categories*

QUESTION 11: DO YOU AGREE WITH OUR CATEGORISATION OF DIFFERENT TYPES OF "MARKET ISSUE" AND TYPICAL REMEDIES FOR EACH?

Within the context of a competitive electricity market, the rationale for any form of policy intervention needs to be considered carefully. The default assumption should be that - absent any form of 'market failure' then to the extent that demand side management of any form is economically viable, it should also be financially viable and the market participants themselves should deliver it without policy support.

In cases where some policy intervention is required, we would generally expect that this intervention should be to correct one of the issues described above. It should be made clear that the need for some form of policy intervention does not necessarily imply any direct financial support; a critical issue given the current need for thrift from within the public budget. Generally, we would expect the types of demand side response which merit immediate policy support to be self-financing, at least over relatively short timescales.

4.2.2 ENERGY EFFICIENCY

4.2.2.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

The elements of the 2020 Demand Side Vision that relate to energy efficiency are to exceed the existing policy goal (of achieving 20% energy savings by 2020) and instead to aim for a higher target of 25%-30%.

In the Republic of Ireland, SEAI commissioned a major study into the technical and economic potential for energy savings to 2020[20]. This concluded that significant volumes of savings were achievable and economically viable beyond the measures identified to reach the 2020 target.

Barriers to implementation of energy efficiency measures are generally associated with split incentives and imperfect, or incomplete information. For example, the current tenant of a domestic property has little motivation to invest in improving the dwelling's efficiency if most of the benefits accrue to future tenants, similarly the landlord may not be prepared to invest if the tenant is the main beneficiary. With respect to imperfect information, consumers may not be sufficiently familiar with energy-saving technologies and their associated costs and benefits to make rational decisions on whether to invest in them.

Currently there are no policy measures in place to realise the further economic savings identified in the SEAI study.

4.2.2.2 ENABLERS

The energy efficiency action plans that apply to both the Republic of Ireland and Northern Ireland contain policies designed to overcome some of the market issues that affect energy efficiency measures. To enable further energy

[20] 'Demand Side Management in Ireland'. KEMA for Sustainable Energy Ireland, January 2008.

savings beyond those identified in existing energy efficiency plans, further policy instruments would need to be put in place (or current ones extended).

4.2.2.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Split incentives Imperfect information	Subject to a review of progress with the NEEAP; the governments of the Republic of Ireland and Northern Ireland – or other relevant bodies in the public sector (e.g. SEAI, EST) or private sector (e.g. manufacturers of 'smart' appliances) should consider developing policies to realise the further economic opportunities for energy efficiency that exist beyond measures contained in current energy efficiency action plans. Developing such policies will require participation from the governments in both jurisdictions, the electricity sector, the construction industry, and appliance manufacturers. Agencies currently working in the area of energy efficiency, such as the Energy Saving Trust (EST) and SEAI would also be natural participants in this process. The work undertaken by SEAI and KEMA would form a useful starting point for developing these policies in the All Island market. This is identified as important to address in the short to mid term and high value given the size of the potential benefits identified.

4.2.3 BEHAVIOURAL CHANGE – EDUCATION

4.2.3.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

Lack of knowledge, or (appropriate) information, is a key barrier to facilitating behavioural change with regard to patterns of consumption.

The arrival of new technologies, including smart meters and intelligent devices, will raise a new challenge for educating the public. This is a particularly critical area as public acceptance of, and engagement with, these new technologies may be a critical determinant of the speed at which they are adopted and whether the benefits of the new technology – once installed – are realised.

4.2.3.2 ENABLERS

Institutions are already in existence in the Republic of Ireland and Northern Ireland with experience of informing and educating the public on issues relating to energy use, for example SEAI in the Republic of Ireland and EST in Northern Ireland. Their continued involvement with demand side issues would ensure that publicity campaigns and other activities are relevant to new and emerging demand side technologies.

4.2.3.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Imperfect information	SEAI, the EST, and other agencies that are currently involved in educating and informing businesses and consumers about energy efficiency should continue with their promotion of energy awareness and trialling proprietary and other products to capture the benefits of smarter energy consumption. This has also been identified as a recommendation to pursue in the short to mid term but of low value.

4.2.4 SMART METERS

4.2.4.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

In developing the Demand Side Vision, we have assumed that smart metering implies as a minimum requirement interval meters with a simple in-home display unit that gives basic information on consumption.

Currently, policy relating to smarter metering is under development, with CER and NIAUR playing a strong role in this in their respective jurisdictions. The baseline we have assumed is consistent, however, with the simplest option being trialled in the CER smart meter trials and with the most basic interpretation of the smart meters being proposed for Britain; this baseline does not presume a widespread roll-out of time-of-use tariffs (although our expectation is that this should and will occur).

We note that there is the potential for the general public to reject any external 'interference' in their patterns of electricity consumption, whether through direct control, monitoring of half-hourly consumption or higher peak pricing, unless there are clear incentives. Such resistance would make it difficult for energy suppliers to roll-out time-of use tariffs and might encourage a continuation of flat charging structures.

The way in which smart meters are used depends on the structure of the electricity sector. Firstly, suppliers have an obvious disincentive to encourage their customers to reduce their electricity bills. The degree of competition in the electricity retail market will influence the nature and degree to which suppliers will innovate to gain or retain market share. Secondly, the presence of vertically-integrated utilities may create a further disincentive to experiment with dynamic or static time-of-use tariffs or other smart-meter-enabled reductions at times of system peak. This is because some of the value of generation plant is derived from peak price periods in the form of 'infra-marginal rent' (or 'producer surplus'), and the magnitude of these price peaks will tend to decline with time-of-use tariffs[21].

[21] The existence of the capacity mechanism in SEM mitigates this effect to some extent, compared with the BETTA 'energy-only' market in which market prices are more sensitive to peak conditions.

The options we have identified for smart meters, which include better feedback for users and static or dynamic time-of-use tariffs, imply a higher implementation cost but a higher level of demand side response, as supported by evidence from our International Best Practice Review.

In the current context, where the detail of smart metering policy in the Republic of Ireland and Northern Ireland is not yet clear but some form of mandated roll-out is expected, it is not meaningful to speak of specific barriers to realising any of the options that form part of the Demand Side Vision.

4.2.4.2 ENABLERS

The enablers for the smart-metering options will be an appropriate regulatory framework and technical architecture and a set of charges to consumers which reflect the (marginal) cost of energy at different times.

A positive response to smart meters by consumers will also be an important enabler for some of the options: the degree to which they are willing to experiment with new tariffs and respond to more information about their consumption will be a critical determinant of the benefits realised from smart meters. Ultimately, a successful early adaption to smart metering will facilitate the (later) adoption of more dynamic tariffs and later automated demand management, as discussed below.

4.2.4.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Imperfect information	The governments of the Republic of Ireland and Northern Ireland should commission In an education campaign designed to inform the public of the direct benefits of smart metering to consumers, encouraging the adoption of time-of-use tariffs and adaption of consumption patterns as a way of cutting electricity bills. Whilst information on the nature of the market and the opportunities it presents for early adopters would be a good starting point; an experience based campaign is believed will be much more successful in changing behaviour. We see this as a high value option to be pursued in the short to mid term, given the timescales of the smart meter roll-out in the Republic of Ireland.

RECOMMENDATION 2

Market issue	Remedy
Economies of scale	The regulators in the Republic of Ireland and Northern Ireland should ensure that the specifications for their smart meters allow for advanced information displays and time-of-use tariffs, including the facility (at least in future) for dynamic time-of-use tariffs which vary with the conditions on each day. We would expect the ICT community would be in a good position to comment on the possibilities for functionality. Static time-of-use tariffs are currently being trialled by the CER and can be seen as an

	important stepping stone in familiarising users with electricity tariff structures. It will be important to ensure that dynamic time-of-use tariffs are feasible in future when prices are driven by wind rather than demand, if the full benefits of a smart meter roll-out are to be captured. This is identified as an immediate, high value recommendation, given the immediacy of major decisions on smart metering in both the Republic of Ireland and Northern Ireland.

RECOMMENDATION 3

Market issue	Remedy
Imperfect information Lack of competition	As the smart meter roll-outs proceed, the regulators should consider whether further interventions are required to accelerate the adoption of time-of-use tariffs. Section 4.2.4.1 discussed how market structure and consumer behaviour may limit the adoption of time-of-use tariffs. If it emerges that these factors seriously weaken the adoption of time-of-use pricing, then it would be desirable for the regulators to intervene in the interest of the consumer. This is identified as a high value recommendation to pursue in the short to mid term in line with smart meter roll-out beginning in 2011.

4.2.5 HOME AND OFFICE AUTOMATION

4.2.5.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

The focus of the current smart meter behavioural trial in the Republic of Ireland is on consumer response to price signals and overall demand reduction. These are important aspects of the benefits that smart meters can deliver and there remains uncertainty over the magnitude of these benefits and the technical challenges, so we consider that it is essential for the technical and behavioural trials to cover these issues in the Irish context.

The specification for smart meters in the Republic of Ireland and Northern Ireland is yet to be determined. If this specification were not to include the capability to serve as a hub for a HAN – or at least communicate with a HAN – the potential for automation could be precluded in the future. This is on the assumption that a vital mechanism for balancing electricity supply and demand will be price (not simply central dispatch), and that the smart meter is intended to be the gateway to the home for the delivery of price information.

Lack of interest or engagement (or active opposition) from consumers and manufacturers of home appliances in automation and intelligent behaviour may also act as a barrier to automation.

New technologies that enable devices (e.g. fridges, freezers and water heaters) to respond automatically to changes in system frequency are currently under development (and trial in GB[22]), but these currently provide no value to the individual consumer, the appliance manufacturer or the supplier.

Widespread adoption of automatic domestic and office appliances may give rise to a large number of devices capable of responding simultaneously to price or other control signals. At high levels of penetration, such 'herding' behaviour may raise challenges for the operators of distribution networks and/or for the transmission system operator. This in turn could create unnecessary costs for consumers, if not managed appropriately. In some circumstances, there is the possibility for some direct control of demand by either the transmission or the distribution system operator. We expect this to be limited in application, perhaps to a few large sites.

4.2.5.2 ENABLERS

Ensuring that smart meters can in future play a role in enabling home and office automation is an important aspect of enabling this type of response.

Engaging with the manufacturers of 'smart' appliances and other relevant companies to understand the technology and the infrastructure it requires will be important. A key issue is to ensure that the benefits of installing smart devices are passed to those paying for them, either directly through the market or otherwise.

Understanding and influencing consumer attitudes will also be crucial to ensuring that automation technologies are widely-adopted.

It can be difficult to engage small and medium-sized enterprises in energy efficiency programmes, and it is possible that this will also be true of automation technologies. Providing clear incentives, good information, and appropriate support for firms in this category may help to stimulate uptake of automation technology.

Paying specific attention to the implications of demand automation for distribution networks and system operation will ensure that unnecessary additional costs are avoided.

4.2.5.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Economies of scale	In developing the specification for smart meters in the Republic of Ireland and Northern Ireland, the regulators, national standards bodies and other relevant organisations involved in defining smart meter functionality – including utilities, meter manufacturers and appliance manufacturers – should ensure that the future needs of domestic appliances are fully considered. While uncertainties remain over the exact architecture that home and office automation would require, a number of features can be identified as requirements beforehand. These may include 'real-time' , two-way communication, for example.

[22] See http://tinyurl.com/34s959u for further details of the trial.

	We have identified this as a medium value for the immediate term, because of the risk of locking out important functionality while developing smart meter specifications over the coming months.

RECOMMENDATION 2

Market issue	Remedy
Economies of scale Overly restrictive rules	The regulators or another agency – perhaps in conjunction with utilities and meter manufacturers –should instigate a trial which builds upon the current technical and behavioural smart meter trials in the Republic of Ireland. However, there should be an explicit focus on dynamic pricing and the further support of home and office automation where there is a huge amount to be learnt in relation to appliance performance that will feed into appliance purchase behaviour and behaviour in use. Aside from the technical feasibility, such an investigation would need to encompass price barriers – whether the technology and the tariffs faced by consumers provide cost-reflective signals – and non-price factors, including perception and risk aversion. This would provide a better understanding of consumer attitudes and responses. We have deemed this to be a medium value recommendation to be pursued in the short to mid term. It is not an immediate action given the absence of a market for such technologies at present (partly due to the lack of smart metering and the early stage of development of appropriate devices).

RECOMMENDATION 3

Market issue	Remedy
Imperfect information	The governments of the Republic of Ireland and Northern Ireland, working with the EU and/or other relevant bodies should commission the development of a labelling scheme for smart appliances, if evidence suggests that this will encourage their adoption. This might facilitate the adoption of 'smart' technologies by allowing consumers to make more-informed choices about their purchases. This has been identified as a medium value recommendation to be pursued in the short to mid term as 'smart' domestic appliances are already beginning to appear in the market place although their take-up is initially expected to be low.

RECOMMENDATION 4

Market issue	Remedy
Inability to finance	The governments of the Republic of Ireland and Northern Ireland should consider the need for going beyond using consumer 'pull' to encourage adoption by labelling and other promotion, by using measures that 'push' the technology, including launch subsidies and/or mandatory standards (subject to European law). We describe this also as a medium value recommendation for the long-term, as intervention will only be required if market issues serve to slow the adoption of automatic devices.

RECOMMENDATION 5

Market issue	Remedy
Split incentives	The regulators should review the impacts of demand side management on distribution networks, specifically future demand growth and demand behaviour in order to avoid undertaking unnecessary reinforcements in the future. We also class this as a medium value, long term recommendation, given that penetration levels are currently low. A similar recommendation is also made in the context of electric vehicles (Section 4.2.9).

RECOMMENDATION 6

Market issue	Remedy
Split incentives Economies of scale	The regulators (or another agency) should assess the value of 'dynamic demand' in the All Island market, based on the outcome of the GB trials. Although the total value is expected to be low (depending on the device take-up), the benefit-to-cost ratio could be high especially if there is a mass roll-out at the European scale. The nature of the Island's electricity system means that the devices would have more value than in most European countries. The payment mechanism would need further consideration, as there is no direct means of rewarding an individual consumer with the devices installed. This option has not been quantified. We have identified this as a low value option for the long term, pending the outcome of the GB trials.

4.2.6 INDUSTRIAL/COMMERCIAL-SCALE DEMAND SIDE RESPONSE

4.2.6.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

Active participation in the market need not imply that load is subject to central dispatch or subject to penalties if it fails to respond in a pre-agreed way. Provided that consumers face appropriate prices, an effective means of demand response in many markets is for the consumers to voluntarily re-profile their demand based on the expected electricity prices across the day. However, demand sites wishing to respond to market prices without participating actively as DSUs in the SEM have little information about within-day prices. No firm day-ahead prices are computed or published (although there is an ex-ante indicative set of market prices published at 12:00 day-ahead). As a result it is difficult for demand sites to respond to within-day price levels with certainty. Capacity prices for each half hour trading period are unknown until the end of the month.

The Grid Code places strict information provision requirements on any demand management measures which exceed 10MW.

To date, only one DSU, operated by Energia, has been registered for participation in the SEM. (This consisted of distributed generators rather than actively-managed loads). We understand that most of the assets that participated in this DSU are now participating as part of an Aggregated Generation Unit (AGU).

There is a minimum size threshold of 4MW for a DSU. Although it would be infeasible to have very small individual units participating in the SEM and dispatched by the TSOs, some have questioned whether the 4MW threshold is arbitrary and unnecessarily high. To the degree that it is higher than necessary, this threshold presents an unnecessary barrier to demand side participation.

Another specific barrier arising from the Trading and Settlement Code[23] is that DSUs may not be located on a site with a non-zero export capacity. This precludes most sites with on-site generation from offering any flexible loads as part of a DSU. Sites with Demand Side Units are also required to have costly real-time monitoring equipment[24].

Industry workshop participants also identified lack of knowledge of the size of the resource (the volume of industrial load that is potentially price-responsive), and a lack of knowledge on the part of large demand sites of how they could, autonomously shift load, thereby creating value for their commercial operations by taking advantage of within-day price variations. They also suggested that lack of predictability in revenues from demand side participation is a potential barrier. For businesses where electricity is not their core business, a volatile stream of income in return for reduced autonomy of their consumption has limited commercial appeal.

Participants also raised a related point on technology: some perceived that lack of standard technologies for industrial demand side participation also represents a barrier to demand side participation from this sector. Financing the cost of such communication and control equipment may also be difficult under short supply contracts of approximately one-year’s duration.

These factors partially explain the success of EirGrid’s Winter Peak Demand Reduction Initiative, which had a powerful education programme, requires very little infrastructure on the part of the customer and provides considerable clarity on the timing and the revenue stream to consumers of reliable load reduction. However, the WPDRS is a static scheme which encourages response at the same times each winter weekday irrespective of the level of wind or the generation costs on the day, and it is likely that at times consumers are being overpaid to reduce load at times when it is not economically valuable. Therefore, we consider the continued existence of the WPRDS to be a barrier to the adoption of more dynamic and cost-reflective schemes.

[23] Section 5.151 4 of the TSC states “the Demand Site shall have a Maximum Import Capacity and shall not have a Maximum Export Capacity”.

[24] Section 5.151 3 of the TSC states “the Demand Site shall have appropriate equipment to permit real-time monitoring of delivery by the System Operator”.

4.2.6.2 ENABLERS

In the absence of any other barriers, fully cost-reflective price signals should deliver an optimal amount of response from large loads whether they are dispatched or otherwise. However consumers need simplicity and certainty before they are willing to participate in such schemes, especially if any investment is required on their part. In this sense the removal of the TSO-led demand reduction schemes (to the extent that such schemes are not themselves cost-reflective) would improve the value of the demand response, provided that the lack of certainty associated with the transition to a new mechanism does not reduce the amount of useful response available. We note that the SEM prices for energy and capacity are intended as the primary market signals and that any other schemes are likely to present conflicting incentives to potential providers of demand side response.

Reviewing the 4MW de minimis size threshold for DSUs with a view to reducing it to the lowest level practicable would remove one (perhaps) unnecessary barrier to participation, and we have noted other rules which merit review with a view to enabling as much industrial load to participate in the market.

Lack of knowledge about the potential scale of response from the industrial and commercial sectors has been identified as a further barrier. Conducting a review of the size of this potential would allow an informed evaluation of the suitability of current market arrangements. This would provide a useful basis for making policy decisions, and in particular in evaluating whether the size of the resource is sufficiently large to merit further policy interventions.

A programme of industry engagement in order to raise awareness, provide information, and identify further unknown barriers would address the lack of demand side response knowledge on the industry's part. The existence of standardised contract structures between customers and suppliers would permit customers to compare offers on a like-for-like basis.

Finally, technology standardisation – either by regulation or legislation or through an industry governance process undertaken jointly by the power sector, large- and medium-sized users, and technology companies – could address concerns about lack of common technology standards.

4.2.6.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Imperfect information Overly restrictive regulation	The regulators should consider the possibility of creating a visible day-ahead price or even a firm forward market for the SEM. (We note that there is an ongoing regulatory process to consider this very issue for the purpose of facilitating market coupling and therefore efficient use of the interconnectors[25].) This would allow large consumers to make more informed decisions about their

[25] The SEM Committee decision paper SEM-10-011 states "The RAs will investigate the feasibility of and bring forward proposals during the course of 2010 for the development of … a viable means of establishing a day-ahead price in the SEM …"

	consumption patterns based on knowledge of the value of their actions. This is classed as a high value recommendation for the immediate term. The immediate nature of the recommendation reflects the opportunity that exists currently through the ongoing review of coupling the SEM with BETTA. A related recommendation is also made in relation to the aggregation of distributed generation (Section 4.2.7).

RECOMMENDATION 2

Market issue	Remedy
Overly restrictive regulation	The regulators should oversee a review of the TSC and Grid Code with a view to changing provisions that currently serve as unnecessary barriers to participation by industrial and commercial demand. In particular these changes should include the 4MW size threshold for DSUs currently specified in the Grid Code,, the bar on DSUs at sites with an export capacity, the requirements for real-time monitoring and the Grid Code provisions for demand response of 10MW or more. We describe this as a high value recommendation for the immediate term. An equivalent recommendation is made for the rules for AGUs in the context of aggregation of distributed generation (Section 4.2.7).

RECOMMENDATION 3

Market issue	Remedy
Imperfect information	The regulators should carry out or commission a study of the volume of flexible demand available in the industrial and commercial sectors, and whether this might be subject to central instruction or autonomous reaction to market prices. Alternatively (or in conjunction), the regulators could ensure inclusion of a research element in a programme being delivered by SEAI or EST or perhaps pursue a pilot in a single promising sector. The purpose of the review would be to identify the potential for and nature of enhanced participation from this sector, given the lack of data available on this at present. It should also identify specific barriers to demand side participation from this resource (including those discussed in Section 4.2.6.1, e.g. lack of revenue predictability). This would require detailed engagement with site managers and other relevant personnel, perhaps with a priority given to those industry sectors which contribute most to (peak) demand. We have identified this as a high value recommendation to be pursued in the short to mid term, as the unused resource is potentially large and the uncertainty in this area is great.

RECOMMENDATION 4

Market issue	Remedy
Imperfect information	The governments of the Republic of Ireland and Northern Ireland should ensure that a programme of engagement with firms in the industrial and commercial sectors is undertaken in order to increase awareness of the potential for demand side participation. As part of this programme, the existence of the day-ahead indicative market prices and the opportunity to participate as a Demand Side Unit should be publicised, and consideration should be given to developing a standard set of contract terms for use between suppliers and customers wishing to engage in demand side management. We have identified this as a (potentially) high value recommendation to be pursued in the short to mid term for the largest industrial consumers, with further roll-out conditional on the review of potential confirming the view that there is a significant amount of demand side participation available in the commercial and industrial sectors.

4.2.7 AGGREGATION OF DISTRIBUTED GENERATION

4.2.7.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

The 4MW size threshold for AGUs was identified by the discussion group at the industry workshop as a possible – and potentially unnecessary – barrier precluding some participation from distributed generators.

The complexity of current market rules have been noted as potential barriers to further take-up. As noted in Section 4.2.6.1, there is no firm day-ahead price or schedule calculated within the SEM and AGUs are expected to respond to dispatch instructions at relatively short notice. The all-or-nothing nature of the AGU option, which precludes contributing generators from retaining control for some parts of the day, exacerbates this issue.

A barrier identified at the Demand Side Vision Workshop was the lack of appropriate, standard contracting structures between aggregators and capacity providers, reflecting the requirements of different capacity providers. This makes it difficult for small generators to compare offers on a like-for-like basis.

A further issue raised at the Demand Side Vision workshop was that some short-term technical constraints limit the flexibility that distributed generation can exhibit, for example the inability of some substations to handle reverse power flows and the limitations imposed by fault levels. While some of these constraints are physical in nature and might be costly to overcome, others might be alleviated by changes to operational practices.

Local environmental restrictions relating to emissions or noise (e.g. such as those applied by the Environmental Protection Agency in the Republic of Ireland) are known in some circumstances to preclude the use of diesel generators other than as emergency backup power supplies.

4.2.7.2 ENABLERS

The inclusion of Aggregated Generator Units within the SEM has served as an enabler for participation of distributed generation, provided that it is willing and able to respond to dispatch instructions by the TSO.

The creation of a firm day-ahead market, and/or improving the options for AGUs to offer reduced flexibility within-day would permit more aggregated generation units to participate in the market.

Developing a standard contracting structure between aggregators and different capacity providers could help to address some of the barriers arising from the complexity of market rules and the lack of experience within the industrial and commercial sector of participation in the wholesale electricity market.

Reviewing network constraints affecting the operation of distributed generators arising either from current design standards or practices and modifying these if necessary could remove some of the barriers relating to technical issues.

A review of local environmental rules such as those applied by the EPA could establish the degree to which this is a real barrier to DG participation and whether the benefits of these regulations outweigh their costs in this context.

4.2.7.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Imperfect information	The regulators should consider the possibility of creating a firm day-ahead market (including both firm prices and quantities) for the SEM, to accommodate those players which do not have flexibility close to real time. This is classed as a medium value recommendation for the immediate term. The immediate nature of the recommendation reflects the opportunity that exists currently through the ongoing review of coupling the SEM with BETTA, which is considering the creation of a firm day-ahead price at least for some market participants. A related recommendation is also made in relation to industrial and commercial demand side participation (Section 4.2.6).

RECOMMENDATION 2

Market issue	Remedy
Overly restrictive regulation	The regulators should oversee a review of the restrictions within the Grid Code and Trading and Settlement Code as applied to AGUs, with a view to changing these restrictions (perhaps on a trial basis) if there are no compelling reasons to leave them unchanged. In particular this review should include the 4MW size threshold for AGUs and should explore the possibility for more freedom to be given to AGUs, for example to permit them to offer flexibility for just parts of the day. We view this as an immediate, medium value recommendation. An equivalent recommendation is made for the threshold for DSUs in the context of

	industrial and commercial demand side participation (Section 4.2.6).

RECOMMENDATION 3

Market issue	Remedy
Imperfect information	The regulators or another relevant body should commission a working group to develop standard contract structures between aggregators and capacity providers and/or other measures to facilitate participation from DG in aggregated units. Membership of this working group would be drawn from the operators of industrial sites and electricity suppliers. This is a medium value recommendation to be pursued in the short to mid term.

RECOMMENDATION 4

Market issue	Remedy
Overly restrictive regulation	The regulators should review whether current network design standards or operating practices are creating unnecessary barriers to participation by distributed generation. This review could also encompass a more general review of unintended barriers arising from technical standards, for example whether the costs of monitoring and control (SCADA) technologies are too high and if these can be reduced. This is also a medium value recommendation to be pursued in the short to mid term.

RECOMMENDATION 5

Market issue	Remedy
Overly restrictive regulation	If participation of DG continues to be considerably lower than the estimated potential over the next two to three years, the regulators should commission a more detailed review of the barriers facing DG participation with a view to removing these. This review should consider the barriers discussed in Section 4.2.7.1 (e.g. local environmental constraints) and could also encompass a more structured exercise to determine the exact size of the available resource. This is a medium value recommendation for the long term, and will not be required if current arrangements prove to be capable of bringing more aggregated distributed generation into the market.

4.2.8 NEW ELECTRIC DEMAND – RENEWABLE SPACE HEATING (HEAT PUMPS)

4.2.8.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

Renewable heat technologies such as heat pumps are likely to increase rather than reduce total electric demand, and will therefore not contribute positively towards meeting efficiency goals for the electricity sector in isolation, which are measured as an absolute reduction in demand (although of course they may improve energy efficiency across the whole economy by reducing demand for other fuels).

4.2.8.2 ENABLERS

From a technological perspective, the capacity to interact with smart meters or other control technology will allow electrical heat technologies to be controlled and operate flexibly according to the needs of the system.

If storage of renewable heat is believed to be economical but does not emerge under the current framework for these technologies, there may be a need to investigate this and identify any relevant market or other failures (such as building regulations whose CO2 criteria favour gas -fired heating at the expense of electric[26]).

4.2.8.3 POLICY GAPS AND OPTIONS

Renewable heat is possibly of limited value for the 2020 Demand Side Vision because of its relatively high cost and low value.

RECOMMENDATION 1

Market issue	Remedy
Inability to finance investments	Whilst, heat pumps are already supported under the Greener Homes and RE Heat schemes, the governments of the Republic of Ireland and Northern Ireland should consider the need for incentivising storage technologies accompanying renewable heat technologies, subject to a positive cost-benefit analysis and the presence of market issues. Similarly, incentivising installations of heat pumps in buildings of high heat inertia, or mass, could also be considered. This would be a recommendation for the long term, if adopted. If it is found that the benefits of the additional flexibility provided by renewable heat technologies outweigh the costs in reduced efficiency and additional control equipment, this would merit a preliminary examination to establish whether there were any other barriers to flexible operation from air-source heat pumps, if adoption is not large.

4.2.9 NEW DEMAND – ELECTRIC VEHICLES

4.2.9.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

The degree to which electric vehicles contribute positively rather than negatively to the electricity system in the All Island market will depend on the charging infrastructure and the control technologies associated with it.

[26] The GB building regulations have been recently amended in light of this issue, but the current status in Ireland and Northern Ireland has not been investigated.

The timing of the charging with respect to other demand and (in future) the level of wind generation will determine the additional system costs. For example, if charging happens only during periods when there is a high level of wind generation or low levels of other electricity demand, then the additional costs will be relatively low; whereas charging at peak demand and/or low wind periods may require additional peaking capacity, with a higher cost implication. The worst outcome, from the perspective of the electricity system, would be for the charging of electric vehicles to add significantly to the conventional peak demand periods.

If the needs of the electricity system (in particular the distribution networks) are not taken into account in designing the electric vehicle infrastructure, their existence could trigger unnecessary costs, and barriers could be created to demand side participation by electric vehicles.

4.2.9.2 ENABLERS

The most important enabler for demand response is the exposure to cost-reflective prices by the users of electric vehicles, which is linked to the roll-out of appropriate smart metering and other dedicated charging infrastructure.

As well as changing the shape of demand at a system level, the introduction of electric vehicles could have implications for distribution networks. The size of the impact will depend on the geographical distribution of electric vehicle charging points and the technologies used to charge them. It is possible that electric vehicle uptake will be highly-concentrated in some urban areas, so that particular attention will need to be paid to distribution network management in these areas, although such impacts are expected to be highly localised until very high penetration levels are reached.

Managing this in a way that minimises costs to the consumer could require a charging infrastructure that is capable of allowing charging to be controlled by supply companies, or even distribution companies, within the bounds of acceptable performance required by consumers.

4.2.9.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Split incentives	The regulator or government or other relevant body in the All Island market should consider in detail the implications of electric vehicles from the perspective of the electricity system (or commission an agency to do so), both in terms of the contribution to peak demand and to the effective peak of demand net of wind and other zero marginal cost generation such as run-of-river hydro. The electric vehicle task force has started to meet on an ad-hoc basis, and this may be an appropriate forum for considering this topic in the context of other decisions relating to electric vehicles. This is identified as a medium value recommendation but worth pursuing in the short to mid term. Although the impact of electric vehicles will not be significant (beyond some possible highly local effects) for a significant period of time, it will make sense to influence consumers' patterns of behaviour and also the infrastructure plans before they become fixed.

RECOMMENDATION 2

Market issue	Remedy
Split incentives	The regulators should review the impacts of demand side management on distribution networks, specifically future demand growth and demand behaviour in order to avoid undertaking unnecessary reinforcements in the future. We class this as a medium value recommendation but for the long term, given that penetration levels are currently low. A similar recommendation is also made in the context of home & office automation Section 4.2.5.3.

RECOMMENDATION 3

Market issue	Remedy
Economies of scale	Regulators should ensure that smart meters have the capacity to interact with electric vehicles' charge management systems. If domestic charging points are widely adopted, smart meter technology could be an enabler for managing the charging patterns of large numbers of electric vehicles in order to ensure that charging occurs at the best times of day from the perspective of the wholesale market and the distribution networks. This will require early engagement between electric vehicle manufacturers and the electricity sector. This is identified as a medium value recommendation for the immediate term.

4.2.10 MICROGENERATION

4.2.10.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

Lack of appropriate metering and control technology for micro generators is a barrier to achieving a vision where flexible microgeneration (especially micro CHP) can operate flexibly in response to the needs of the electricity system.

4.2.10.2 ENABLERS

Smart meters could be an important enabling technology for micro generators. Interval metering functionality for micro generators has been examined by Gemserv in their report for NIAUR and is being tested under CER's smart meter trials[27]. Heat storage is also a potential enabler for micro CHP and the development of standards around storage would probably be desirable.

[27] 'Smart metering project phase 1: Information paper 3', CER, 7 December 2009.

As discussed in the section on home and office automation, smart meters could also be an enabling technology for control and automation.

4.2.10.3 POLICY GAPS AND OPTIONS

Microgeneration is possibly of limited value for the 2020 Demand Side Vision because of its relatively high cost and low value, and the inherently inflexible nature of the renewable microgeneration which is expected to be installed in the coming years.

RECOMMENDATION 1

Market issue	Remedy
Economies of scale	Regulators should ensure that the functionality required to control and interact with micro generators, including the heat storage aspects of micro CHP, should be considered explicitly during the process of defining smart-meter functionality. Although smart meters are not necessarily the technology that will be used to control micro generators, this will ensure that any opportunity to use smart meters to help take advantage of the inherent flexibility of CHP and other flexible microgeneration is not missed. This recommendation, if pursued, should fall into the immediate timeframe, given the potential impact on the smart meter roll-out.

4.2.11 STORAGE

4.2.11.1 BARRIERS TO REALISATION OF 2020 DEMAND SIDE VISION

It has been argued that the flexibility of pumped storage over and above conventional plants is not adequately rewarded under the SEM rules – unlike other forms of generation, any 'out of merit' dispatch of pumped storage plants for system needs is entirely ignored for the purpose of Pool settlement, and the market schedule software which determines prices only considers a very simple set of technical constraints on the operation of generation plant.

At present there are no specific market rules for bulk storage plants other than pumped storage.

On a distribution-network level, there is no use of storage technologies to manage local constraints or assist in maintaining power quality. Given the projected growth in wind generation and new forms of demand, it may be that these technologies could have a bigger part to play in coming decades. Cost appears to be the main barrier to small-scale storage, as other, conventional, forms of network management are usually considered more cost-effective than storage in most situations.

4.2.11.2 ENABLERS

Market rules that fully reflect the value associated with the flexibility of storage technologies (as well as the flexibility of other generation or demand side technologies) are an important enabler for encouraging new storage and for maximising the value of existing storage facilities.

For distribution-level storage, further support for research and development activities may be appropriate, if increasing experience in the All Island market of using these technologies is likely to further understanding of the contribution that these can make and increase the institutional capacity in the All Island market to use these where appropriate.

4.2.11.3 POLICY GAPS AND OPTIONS

RECOMMENDATION 1

Market issue	Remedy
Overly restrictive regulation	The regulators should review Pool and other payments to pumped storage through the SEM in the light of concerns that current arrangements do not fully reflect the flexibility of these plants. One option would be to include more technical requirements in the MSP Software which better reflect dispatch requirements. A review of the capacity payment mechanism is currently under way and should encompass the structure and value of capacity payments for pumped storage. This is a low value recommendation for the immediate time frame, given that the capacity payment mechanism review is still ongoing.

RECOMMENDATION 2

Market issue	Remedy
Inability to finance investments	The regulators or government should consider whether research, development and demonstration (RD&D) activities relating to distribution-level storage should be supported by consumers or taxpayers. This recommendation, if pursued, should fall into the short to mid term timeframe.

QUESTION 12: DO YOU AGREE WITH OUR IDENTIFIED BARRIERS AND ENABLERS FOR EACH OF THE SPECIFIC DEMAND SIDE MEASURES WE HAVE IDENTIFIED?

QUESTION 13: DO YOU AGREE WITH OUR IDENTIFIED MARKET ISSUES FOR EACH SPECIFIC DEMAND SIDE MEASURE AND OUR PROPOSED REMEDIES TO ADDRESS THESE?

QUESTION 14: WHAT ARE YOUR VIEWS ON THE LIKELIHOOD AND EFFECTIVENESS OF THE IDENTIFIED POLICY OPTIONS ADDRESSING THE SPECIFIED MARKET ISSUE AND DELIVERING THE DESIRED CHANGE?

QUESTION 15: ARE THERE ANY UNINTENDED UNDESIRABLE CONSEQUENCES THAT ANY OF THE OPTIONS MIGHT CREATE ELSEWHERE?

5 ASSESSMENT OF OPTIONS AND PRIORITIES

5.1 INTRODUCTION

The definition of a Demand Side Vision should, in principle, focus on those demand side measures which yield the greatest value at least cost. In this section we describe our evaluation of the different demand side options we have identified for the SEM market.

The section presents our high level, qualitative assessment of the different demand side options.

- Section 5.2 provides an overview of the analysis which frames our approach and methodology.
- Section 5.3 describes the methodology we adopted to assess the different demand side resources
- Section 5.4 presents the results of our evaluation.

5.2 INSIGHTS FROM EXISTING MODELLING AND ANALYSIS

Our qualitative assessment of the different demand side options is framed by three key pieces of analysis, namely:

- a review of International Best Practice, which forms the first phase of this project and is summarised in Section 2.3;
- Pöyry's 'Implications of Intermittency'[28] study for the UK and Ireland; and
- Ecofys's All Island Renewable Grid Study[29] (Updated to Include Demand Side Management).

Key lessons drawn from these studies are summarised below.

5.2.1 INTERNATIONAL BEST PRACTICE

The results of our analysis of international best practice are set out in detail in Section 2.3. Our findings break down into three main areas, namely:

- Energy efficiency – encompassing programmes for both the I&C and domestic sectors.
- Enhanced feedback – including measures such as self-metering, more regular and accurate billing and in home electronic displays providing information on real time consumption behaviour.
- Time-of-use (ToU) tariffs – consisting of static ToU tariffs, dynamic period ToU tariffs and dynamic price ToU tariffs.

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[28] *Ibid.* The underlying model framework was used for a subsequent publication looking forward to 2035 'Low carbon generation options for the All-Island market'; Pöyry for EirGrid., March 2010.

[29] 'All Island Renewable Grid study Updated to Include Demand Side Management'. Ecofys, March 2009.

5.2.1.1 ENERGY EFFICIENCY: KEY FINDINGS

Significant economies of scale can be achieved by targeting a whole sector or industry. Because there is a degree of technological uniformity between competing firms in the same sector, energy-saving measures identified as being appropriate for one firm are likely to be applicable across the sector. As well as reducing the costs of identifying energy-saving opportunities, this can also open the possibility of reducing implementation costs. For example, a programme in Sweden procured hundreds of efficient boilers for installation in homes, significantly reducing the cost to the residents compared to what they would have spent if they had each purchased a boiler individually.

Actual savings were lower than estimated beforehand in many cases. Basic estimates of energy savings tend to omit a number of effects. These include technical factors (e.g. poor installation of insulation) and economic or behavioural effects (e.g. improving thermal insulation in fuel-poor homes may not reduce their energy demand as residents it is now more affordable for them to heat their homes to an acceptable level of comfort).

Small and medium-sized enterprises can be particularly difficult to engage. A number of programmes found that small and medium-sized firms did not have the appropriate resources or did not see energy consumption as a sufficiently high priority to participate in energy efficiency schemes.

Publicity is important for targeting households but the effect of advertising in itself is short-lived. Although advertising campaigns were generally found to be useful in creating awareness of a new programme, other means were usually required in order to maintain consumers' interest in the programmes, if their continued involvement was required.

5.2.1.2 ENHANCED FEEDBACK: KEY FINDINGS

Increased awareness of energy use consistently leads to reductions. Even the most basic schemes, where consumers manually read and recorded their own meter readings, resulted in reductions in overall consumption. This is the result of increased awareness on the consumer's part of their own energy consumption.

Maintaining consumers' interest can be difficult, but in at least some cases the reduction persists. Some schemes found that consumers' response declined after an initial period of interest following the introduction of an in-home display or other feedback technology. Additional measures to maintain consumer engagement over a longer period were implemented in some cases.

Helping consumers to interpret data can enhance savings. A number of programmes and technologies in this category helped consumers to interpret the data they were receiving. For example, this could include showing consumption in an equivalent period in the previous year or information about their peers' electricity consumption. Where the effect of this contextual information was measured, it was found that this could enhance savings compared to a case where only consumption information (without context) was provided.

5.2.1.3 TIME OF USE TARIFFS: KEY FINDINGS

Critical peak pricing schemes can significantly reduce demand at peak. A number of the dynamic ToU tariffs we examined were focussed on reducing demand in annual peak periods. These schemes resulted in reliable reductions of 5%-15% during those peak periods, from participating loads (even without use of automation).

Most of the demand reduction in peak periods is shifted rather than removed. ToU tariffs can produce a small reduction in overall energy demand, both through consumers' increased awareness of energy use and because some types of demand removed at peak periods are not shifted into low-price periods (e.g. lighting). The main effect however is to defer or advance consumption away from high-price periods within a day and into other price periods.

Financial savings need to be considerable for consumers to be interested in ToU pricing. Because ToU schemes primarily shift rather than reduce demand, customers' savings depend on the differential between high and low-price periods. If the saving that results from load-shifting is small then consumers may not perceive the economic rewards to be proportionate to the effort required to change their behaviour.

5.2.2 IMPLICATIONS OF INTERMITTENCY STUDY

Pöyry's 'Intermittency study' modelled the effects of wind intermittency on the SEM and GB electricity markets in the period to 2030. The analysis was based on a Core Scenario which reflected a world where there is a drive towards renewables and lower carbon forms of generation. Energy efficiency measures also had some impact, leading to electricity demand growing at a relatively low rate – less than 0.5% per year in GB and under 1% in the SEM, despite some further assumed electrification of transport and heating. In addition to the Core Scenario the analysis also explored a number of other cases including two which investigated the implications of demand side management. These are described below:

- **An inflexible demand management ('dumb time of use meters') case.** This assumed that demand is moved from the peaks during the day to the troughs during the night. This is achieved by a similar system to the Economy 7 heating system in the UK or Night Saver used in the REPUBLIC OF IRELAND, with demand for space and water heating primarily moving.

- **A price responsive demand management ('smart meters') case.** This assumed that load can be dynamically moved from when required to when it is cheapest, using smart meters that receive information about wholesale prices on the day and reschedule energy demand accordingly. In effect, load can act as electricity storage, allowing consumers to change the timing of electricity demand (primarily water and space heating) to minimise their costs.

The study found that with inflexible demand management, the demand curve is flattened, with more demand during off peak hours, and the number of starts of thermal plants was significantly reduced. However, this flattening of the demand curve can create problems if output from intermittent generation falls to very low levels during the off peak period. Price responsive demand management is more effective in markets with high levels of wind generation as demand is moved to where it has the greatest reduction on price.

5.2.3 ALL ISLAND RENEWABLE GRID STUDY

Ecofys's All-Island Renewable Grid Study (Updated to include Demand Side Management) extended the quantitative modelling work undertaken within the All-Island renewable Grid Study (AIGS) to consider the potential impacts of energy efficiency and demand side flexibility. The flexibility measures considered were peak shifting, where a load could be shifted within the day; and peak clipping, where a discretionary load could be reduced at peak periods. It was assumed that the units had day-ahead visibility of within-day prices.

The study's modelling results suggested that energy efficiency measures reduced generation costs, CO2 emissions, price volatility. Against an unchanged baseline generation portfolio, the study found that the lower load factors would lead to a larger difference between the revenues realised by those generators and those required to meet their investment costs.

The study also concluded that flexible demand could realise more modest savings in overall cost, with the vast majority of these savings coming from reductions in peak load and associated reduction in peak plant investment costs. Further, it stated that reduced investment in peak plant by demand side measures should recognise the impact on the provision of ancillary services such as spinning and replacement reserve and, consequently, on overall system reliability.

5.3 METHODOLOGY TO EVALUATE THE BENEFITS OF DEMAND SIDE OPTIONS

5.3.1 DEMAND-SIDE OPTIONS EVALUATED

For each demand side option identified as being within the scope of this analysis we have attributed a 'baseline' for demand side management against which we compare implementation of alternative policy options for 2020. The baseline reflects what would be the outcome of a 'business as usual' approach to demand side management on the Island i.e. no government, or regulatory intervention, over and above that which is envisaged in the current policy framework. Note the options are not generally considered to be mutually exclusive, with the exception of some of the smart metering options, where static and dynamic time-of-use tariffs are alternatives, and the electric vehicle options, which represent different means of charging electric vehicles.

A detailed description of the baseline we have assumed and options we have assessed is set out in Table 6.

Demand-side measure	Baseline	Implementation option evaluated for 2020
Energy efficiency - industrial	We have drawn on the SEAI/KEMA report 'Central' case for energy efficiency savings to provide our baseline – these measures reflect savings that are consistent with reaching the 2020 target of a 20% reduction in energy use (see Section 4.2. for more detailed discussion of this target).	In considering an additional policy option, we have taken the 'Aggressive' scenario from the SEAI/KEMA report, in which all the economically-viable efficiency savings that have been identified in the industrial sector are assumed to be realised, scaled up to an All-Island level. In total energy terms the 'Aggressive' scenario realises 25% savings compared to the 20% achieved in the baseline scenario. In the electricity sector the saving in the 'Aggressive' scenario is 40% larger than in the SEAI/KEMA Central case.
Energy efficiency - commercial	The baseline is assumed to be the 'Central' energy efficiency case for the commercial sector from the KEMA/SEAI report.	In this option, all the economically-viable efficiency savings for the commercial sector that have been identified in the SEAI/KEMA report ('Aggressive' case) are assumed to be realised, scaled to all-Island level.
Energy efficiency - residential	The baseline is again assumed to be the 'Central' energy efficiency case for the domestic section from the KEMA/SEAI report.	In this option, all the economically-viable efficiency savings for the domestic sector that have been identified in the SEAI/KEMA report ('Aggressive' case) are assumed to be realised, scaled to All-Island level.
Behavioural change - Education	Our baseline for this option is a continuation of current levels of information provision and education.	In this option, we assume the introduction of further education and information programmes, designed to educate the public and small- and medium-sized businesses about energy-efficient behaviour and use of smart meters and other 'smart' technologies.
Smart meters – Advanced displays (billing, real-time)	Our baseline for this measure is that smart meters will be rolled out in the Republic of Ireland and Northern Ireland, and that these meters would have in-home displays showing basic information on homeowners' consumption. For the baseline, we have assumed that time-of-use tariffs are not widely rolled out, perhaps due to the barriers identified in Section 4.2.4. In practice we expect that static (and perhaps ultimately dynamic) time-of-use tariffs will be included as part of the smart meter roll-out.	This option is designed to demonstrate the benefits of providing additional information to consumers and creating a larger response as a result. In this option, all smart meters are fitted with advanced displays that provide contextualised information about consumers' electricity demand. For example this could include an indication of their consumption compared to the average of their peers' or compared to their own historic consumption. A number of studies internationally have examined the impacts of different types of feedback to consumers from in-home displays and other mediums. We have assumed that the baseline smart meters provide a response that is at the lower end of savings seen elsewhere, but that the advanced displays produce a response that is at the higher end of those achieved elsewhere. Further research currently being undertaken – particularly the smart meter trials being run by CER/ESB and by Ofgem – will add more evidence specific to the UK and Ireland within the next year. This will be useful in any future evaluation.
Smart meters - Static ToU tariff	As in the other assessment of smart metering options, our baseline is that smart meters will be rolled out in the Republic of Ireland and Northern Ireland, with basic in-home displays but no mass take-up of time-of-use tariffs.	In this option, all smart meters are assumed to be fitted with advanced displays, as in the previous option, but consumers are also subject to static time-of-use tariffs. Static time-of-use tariffs have a fixed evening peak period on each day where the retail electricity price is higher than the rest of the day. This has two effects: it makes consumers more aware of their consumption in general and as a result they consume less; and it makes consumers move some of their demand away from the evening peak period and into earlier or later parts of the day. In this option, the response is the result of human behaviour change.
Smart meters - Dynamic ToU tariff	As in the other assessment of smart metering options, our baseline is that smart meters will be rolled out in the Republic of Ireland and Northern Ireland, with basic in-home displays but no mass	In this option, all smart meters are fitted with advanced displays, as in the previous option, but consumers are also subject to dynamic time-of-use tariffs. Dynamic time-of-use tariffs reflect dynamic changes in within-day wholesale prices in the retail price paid by consumers. In practice this

	take-up of time-of-use tariffs.	can be achieved by a variety of means, including the critical peak pricing tariffs in place in California or the Tempo tariff used in France.
Home and Office Automation – including: • **Direct control; and** • **Autonomous (price responsive).**	Our baseline for this option is that no significant level of home and office automation of demand response occurs.	In this option, new technology allows domestic appliances and electrical space and water heating systems to respond automatically to system conditions. In practice, automation could be achieved in a number of different ways. Appliances may respond automatically to price signals, or they could be controlled directly by an aggregator or supply company. In practice, we anticipate that load control which is automated would deliver response with greater reliability than load control which is reliant on human behaviour. This will be especially true if dynamic (rather than static) tariffs are to be used. However, our quantitative analysis does not capture these subtleties.
Home and Office Automation – Frequency response	Our baseline for this option is that frequency-responsive relays are not incorporated in domestic or other devices.	Our baseline for this option is that frequency-responsive relays are incorporated in all new domestic refrigerators sold on the Island.
Industrial / commercial DSR – Interruption contracts	A number of large loads currently have interruption contracts with EirGrid, so that they can be instantaneously curtailed to provide reserve or frequency response, for example in the case of a sudden generator trip. Our baseline for this option is that these ancillary service-type interruption contracts continue to exist but that they are not used for price arbitrage.	In evaluating this option we assumed that a further 100MW of large demand enters into interruption contracts which are activated in response to high hourly wholesale prices. This volume of additional load is equivalent to the volume currently participating in the largest existing demand reduction schemes (80-90MW in the Winter Demand Reduction Incentive and approximately 140MW in the Winter Peak Demand Reduction Scheme).
Industrial / commercial DSR – including: • **Direct control; and** • **Autonomous (price responsive)**	Our baseline for this option is that price response from the commercial and industrial sector is limited apart from specific schemes such as the EirGrid Winter Peak Demand Reduction Scheme, and that take-up of the SEM Demand Side Unit scheme remains low.	In this option, intrinsically-flexible demand from the commercial and industrial sectors becomes more responsive to within-day prices. In practice, this could occur through a number of different mechanisms, including individual sites responding to price or through submitting to centralised dispatch through the SEM Demand Side Unit mechanism.
Heat pumps with storage	Our baseline for this scenario is that air-source heat pumps with an annual demand of 740GWh are installed in order to meet renewable heat targets for 2020, but without storage, so that their operation is driven directly by the timing of heat demand.	In this option, the heat pumps are installed coupled with heat storage devices, so that they are capable of operating at times when electricity prices are low. We have assumed that the volume of electricity consumed by heat pumps in 2020 is fully price-responsive over the course of a day, so that heat pumps consume electricity during the lowest-price periods of each day. This implicitly assumes the development of dynamic time-of-use tariffs and the supporting infrastructure.
Electric vehicles – Night charge	Our baseline for this option is a 'dumb' user charging regime for electric vehicles. In this option, we have assumed that the Republic of Ireland meets its target of 10% electric vehicles (230,000 vehicles) by 2020, but that electric vehicles are primarily charged over periods covering the evening peak, when demand is at its highest.	In this option, electric vehicles are charged overnight, when other demand is at its lowest. This option reflects a system where consumers are offered a lower overnight tariff for charging electric vehicles. In assessing this option we have assumed that the Republic of Ireland meets its target of 10% electric vehicles by 2020, and that the electrical charge required for the fleet occurs at night using the same timing pattern as is currently in use for night storage heating. We have evaluated this option as a static change in demand timing, so that the load associated with the electric vehicles – 240GWh over the year – follows the pattern currently applied to night storage heaters.

Electric vehicles – Hybrid vehicles	As for the 'night charge' option, our baseline for this option is a 'dumb' (evening peak) user charging regime for electric vehicles.	In this option, electric vehicles are plug-in hybrid vehicles (PHEVs), which can elect to charge with electricity or use liquid fuel, depending on the relative price of each fuel. This represents a situation where PHEVs are the dominant electric vehicle technology by 2020. In evaluating this option we have assumed that the Republic of Ireland meets its target of 10% electric vehicles by 2020.
Electric vehicles – Price responsive charging	As for the 'night charge' option, our baseline for this option is a 'dumb' (evening peak) user charging regime for electric vehicles.	In this option, electric vehicles' charge patterns are determined by within-day price patterns, so that charging occurs during the lowest-cost periods. This represents a situation where vehicles' charging algorithms are able to respond autonomously to prices, perhaps through smart meters with dynamic tariffs, or in which electric vehicle charging is managed by suppliers or another central entity. In evaluating this option we have assumed that the Republic of Ireland meets its target of 10% electric vehicles by 2020.
Microgeneration – Controllable	Our baseline for this scenario is that 50MW of additional microgeneration capacity is installed by 2020. This is based on the upper-end estimate of the microgeneration syndicate group at the Dundalk industry workshop. In the baseline we assume that the microgeneration installed is not controllable, and that it runs baseload.	In this option, the microgeneration that is installed by 2020 is assumed to be fully controllable (e.g. micro-CHP with control technology) and price-responsive.
Aggregation of DG	Our baseline for this scenario is that there is no further participation from DG beyond the levels observed today, which participate through an AGU or in other mechanisms such as the winter peak incentives described in Section 4.1.6.	In this option, 120MW of additional DG resource begins to respond flexibly to within-day prices, participating in the market through aggregators.
Storage	Our baseline for this scenario is that there is no new bulk storage installed by 2020.	In this option, an additional volume of storage (30MW, 150MWh) is added to the system by 2020. This is based on the estimate of the expectation of the storage group at the industry workshop.

Table 6 *– Description of evaluated demand side options*

QUESTION 16: DO YOU AGREE WITH OUR IDENTIFIED SPECIFIC DEMAND SIDE MEASURES AND OUR ASSESSMENT OF THE DIFFERENT TYPES OF BENEFITS EACH DEMAND SIDE MEASURE PROVIDES?

QUESTION 17: ARE THERE ANY ADDITIONAL DEMAND SIDE MEASURES THAT WE SHOULD INDIVIDUALLY IDENTIFY AND ASSESS? IF SO, WHAT TYPE OF BENEFIT(S) IS IT FELT THEY PROVIDE?

5.3.2 EVALUATION METHODOLOGY

Our approach to evaluating the different demand side implementation options has been to perform a qualitative assessment of costs and benefits of the various options. Costs consist of high level estimates of the costs of implementing demand side options over and above that which is assumed to be implemented under a policy 'baseline' for 2020. The baseline reflects what would be the outcome of a 'business as usual' approach to demand side management on the Island i.e. no government, or regulatory intervention, over and above that which is envisaged in the current policy framework.

We break benefits, down into two groups, namely, those which are associated with broader energy policy objectives, as detailed in Section 2.4; and those which reflect specific electricity market metrics, relating to investment and operational cost savings. Inevitably, there is a degree of overlap between the two. The benefits include some consideration of the scale of the option which might be expected given an appropriate policy environment.

For each demand side option the costs and benefits are ranked into one of four relative categories, namely high, medium, low and neutral. These rankings are not normalised between different assessment criteria. The results of our evaluation are presented in a matrix from which we infer an overall ranking to inform policy priorities.

5.3.2.1 COSTS - IMPLEMENTATION

In this category we have attempted to provide an indicative ranking of the costs associated with implementing each of the demand side options. This is based on our views of the activities and potential investments associated with the implementation of each measure.

5.3.2.2 BENEFITS - POLICY IMPACTS

In this category we have qualitatively assessed the impact of demand side options on the broader energy policy goals of the Republic of Ireland and Northern Island, as set out in Section 2.4. These energy policy goals address three main areas:

- **Competitiveness:**
    - This encompasses two distinct policy objectives. The first is to further competition (including by encouraging new entry) and consumer choice in energy markets. The second refers to maximising innovation, enterprise and job creation in the energy sector. In our assessment matrix, we use 'competition & consumer choice' to refer to the former and 'job creation and innovation' to the latter.
- **Security of supply:**
    - There are a number of policy objectives related to ensuring electricity supply consistently meets demand; increasing fuel diversity in electricity generation; and maintaining and upgrading networks to ensure efficient and reliable gas and electricity delivery to customers. In our assessment we focus on two of these objectives, namely, ensuring that electricity supply can meet demand (in the sense that there is an adequate capacity margin) and the maximising the maintenance and upgrade of networks.
- **Sustainability:**
    - Two main policy objectives fall under the heading of Sustainability. The first is the acceleration of growth of renewable energy resources and the second is to enhance the efficiency of electricity use and realise savings in electricity use.

5.3.2.3 BENEFITS - ELECTRICITY MARKET

In this category we qualitatively assessed the impact of the demand side options on the All Island electricity system against four different metrics:

- effect on generation capacity costs i.e. requirements for investment in new generation capacity;
- impact on variable generation costs;
- effect on levels of CO2 emissions; and
- provision of frequency response.

QUESTION 18: HAVE WE IDENTIFIED ALL OF THE RELEVANT CRITERIA FOR ASSESSING THE INDIVIDUAL AND COMPARATIVE MERITS OF THE DEMAND SIDE MEASURES?

5.4 RESULTS OF HIGH LEVEL QUALITATIVE ASSESSMENT OF POTENTIAL DEMAND SIDE RESPONSE OPTIONS

The results of our evaluation are presented in Table 7 and are discussed in the following section.

	Competitiveness		Security of supply		Sustainability		Electricity market metrics				
	Competition & consumer choice	Green job creation	Generation capacity margin	Transmission capacity	Energy efficiency	Accelerated growth of RES	Generation costs / CO_2 emissions	Generation capacity costs	Frequency response	Cost of delivery	Overall ranking
Energy efficiency - Industrial	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Medium	No	Medium	High
Energy efficiency - Commercial	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Low	No	Medium	Medium
Energy efficiency - Domestic	Neutral	Medium	High	High	Medium	Medium	High	High	No	Medium	High
Behavioural change - Education	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Low	No	Low	Low
Smart meters - Advanced displays	Medium	Medium	High	High	Medium	Low	High	High	No	Low	Medium
Smart meters - Static ToU tariff	Medium	Medium	High	High	Medium	Medium	High	High	No	Low	Low
Smart meters - Dynamic ToU tariff	Medium	Medium	High	High	Medium	High	High	High	No	Medium	High
Home & office automation - Direct load control	Medium	Medium	High	High	Neutral	High	Medium	High	?	Medium	Medium
Home & office automation - Autonomous	Medium	Medium	High	High	Neutral	High	Medium	High	No	Low	Medium
Home & office automation - Frequency-responsive relays	Medium	Medium	Neutral	Neutral	Medium	Neutral	Low	Low	Yes	Medium	Medium
Industrial & Commercial DSR - Interruption contracts	Medium	Neutral	High	High	Neutral	High	Medium	High	No	Low	High
Industrial & Commercial DSR - Direct load control	Medium	Neutral	High	High	Neutral	High	Medium	High	?	High	High
Industrial & Commercial DSR - Demand-side bidding	Medium	Neutral	High	High	Neutral	High	Medium	High	No	High	High
Industrial & Commercial DSR - Autonomous	Medium	Neutral	High	High	Neutral	High	Medium	High	No	Medium	High
Heat pumps - Heat pumps are fitted with storage	Neutral	Low	Medium	Medium	Neutral	High	Medium	Medium	No	High	Neutral
Electric vehicles - Night charge	Neutral	Medium	Medium	Neutral	Neutral	Low	Low	Medium	No	Low	Neutral
Electric vehicles - Hybrid vehicles	Neutral	Medium	Medium	Medium	Neutral	Medium	Low	Medium	No	Medium	Neutral
Electric vehicles - Intelligent (price-reponsive) charging	Neutral	Medium	Medium	Medium	Neutral	Medium	Low	Medium	No	Medium	Medium
Microgeneration - Controllable	Neutral	Neutral	Medium	Medium	Neutral	Low	Low	Medium	?	Low	Neutral
Aggregation of DG	Low	Neutral	Medium	Medium	Neutral	Medium	Medium	High	?	Low	Medium
Storage	Neutral	Neutral	Medium	Neutral	Negative	Medium	Low	Medium	Yes	High	Low

***Table 7 –** Evaluation of the demand side options against qualitative assessment criteria*

5.4.1 COSTS OF DEMAND SIDE OPTIONS

The costs we are interested in evaluating are those involved in realising the technical potential of the different demand side measures, over and above those involved in implementing the current policy baseline.

With the exception of KEMA's 2008 study for SEAI[30] there is little, or no information on the quantification of the costs of implementing demand side measures on the Island and it is beyond the scope of this project to perform detailed, bottom-up cost estimates.

The approach we have taken is, therefore, qualitative (and highly subjective) – we have described the activities and potential investments associated with the implementation of each measure, breaking them down into those which would be borne by government and those by industry and consumers. We have then attempted to provide an indicative ranking of the costs associated with implementing the measure at levels modelled in the benefits analysis, allocating each measure into one of three different, indicative cost categories.

- Low cost: € 0 -10 million
- Medium cost: € 10 - 50 million
- High cost: > €50 million

Table 8 shows the cost category allocated to each of the demand side options.

[30] KEMA for SEI: 'Demand Side Management in Ireland – evaluating the energy efficiency opportunities'. January 2008.

Demand side measure	Required Government actions	Required industry / consumer investments	Indicative cost
Energy efficiency – Industrial	KEMA 'aggressive' scenario measures	KEMA 'aggressive' scenario measures €20m – KEMA 'aggressive' scenario	Medium €20m
Energy efficiency – Commercial	KEMA 'aggressive' scenario measures	KEMA 'aggressive' scenario measures €13m – KEMA 'aggressive' scenario	Medium €13m
Energy efficiency – Domestic	KEMA 'aggressive' scenario measures	KEMA 'aggressive' scenario measures €25m – KEMA 'aggressive' scenario	Medium €25m
Behavioural change – Education	Extended consumer education programme covering energy awareness		Low
Smart meters – Advanced displays (billing, real-time)	Tailored smart meter education campaign Additional smart meter specifications - depends on nature of current Smart Meter Programme	Additional investment in implementing revised specifications	Low
Smart meters – Static ToU tariffs	Tailored smart meter education campaign Additional smart meter specifications - depends on nature of current Smart Meter Programme Possible regulatory interventions to ensure use of ToU tariffs	Additional investment in implementing revised specifications and retail business processes Time spent by consumers in responding	Low
Smart meters – Dynamic ToU tariffs	Tailored smart meter education campaign Additional smart meter specifications - depends on nature of current Smart Meter Programme Possible regulatory interventions to ensure use of ToU tariffs	Additional investment in implementing revised specifications, including more sophisticated communications and business processes Time spent by consumers in responding	Medium
Home and Office Automation – Price responsive load (direct load control and autonomous)	Labelling scheme, promotion and consumer education for smart appliances Smart meter trial with focus on home and office automation Additional smart meter specifications – depends on nature of base Smart Meter Programme Possible subsidies for adoption of smart devices Review of interaction with distribution networks	Additional investment in implementing revised specifications for smart meter and communications to support HAN and smart appliances	Medium
Home and Office Automation – Frequency response	Labelling scheme and promotion for smart appliances Possible subsidies for adoption of smart devices	Additional cost of frequency responsive device	Low
Industrial / commercial DSR – Price responsive load (direct load control, demand side bidding and autonomous)	TSC code changes e.g. de 4MW minimis threshold for DSUs Firm day-ahead pricing in SEM Possible study on volume of flexible demand from I&C sectors Industry awareness programme	Investment in process / back-up equipment to allow for interruption of grid power supply	Medium
Industrial / commercial DSR – infrequent interruption contracts	Industry awareness programme	Cost of implementing infrequent interruptions	Low

Demand side measure	Required Government actions	Required industry / consumer investments	Indicative cost
Heat pumps with storage	Incentivisation of storage technologies for heat pumps	Investment in heat storage	High
Electric vehicles – Night charge	Study implications of EVs for electricity system Review detailed impacts on distribution system Additional smart meter specifications to ensure interaction with EV charging	Possible additional implementation costs of vehicle control systems to allow night charging	Low
Electric vehicles – Hybrid vehicles	Study implications of EVs for electricity system Review detailed impacts on distribution system Additional smart meter specifications to ensure interaction with EV charging	Additional investment in interface to smart meters and more sophisticated control systems for the vehicles Possible additional investment costs of hybrid vehicle	Medium
Electric vehicles – Price responsive charging	Study implications of EVs for electricity system Review detailed impacts on distribution system Additional smart meter specifications to ensure interaction with dynamic EV charging	Additional investment in interface to smart meters and more sophisticated control systems for the vehicles	Medium
Microgeneration – Controllable	Additional smart meter specifications to ensure interaction with microgeneration	Additional investment in implementing interfaces to smart meter and more sophisticated control units Additional smart meter specifications to ensure interaction with microgeneration	Low
Aggregation of DG	TSC code changes, e.g. 4MW de minimis threshold for AGUs Firm day-ahead pricing in SEM Standard contract structures Review of barriers Review of ASU participation	Investment in communications and control infrastructure	Low
Storage	Changes to SEM payments mechanism R&D support for distribution level storage	Investment in new storage capacity	High

***Table 8** – Qualitative estimates of costs of demand side options*

Source: Pöyry internal estimates

'Low cost' options will encompass activities ranging from Trading and Settlement Code modifications, to studies specific demand side resources, to enabling smart meters with smart display and allowing static time of use tariffs.

'Medium cost' options will include measures such as subsidies for adoption of smart devices, R&D funding for technology funding, such as distribution level storage, and the additional investment associated facilitating price-responsive load for industrial and commercial sites i.e. investment in back-up processes.

'High cost' options are associated with major capital investments, for example, a new pumped storage site or the additional costs for the roll out of smart meters and the associated communications infrastructure that would allow dynamic time of use pricing in the majority of Irish homes.

5.4.2 BENEFITS - POLICY IMPACTS OF DEMAND SIDE OPTIONS

COMPETITIVENESS – COMPETITION AND CONSUMER CHOICE

Competition has two elements, the first is competition in generation and the second is competition in supply. For the former demand side measures such as demand side bidding from the I&C sector and from aggregators of distributed generation will directly compete with conventional generation in the wholesale electricity market. The amount of competition will depend on the size of the underlying resource which in these cases is relatively small. Arguably, measures which reduce demand, particularly at peak times, can also be said to increase competition in generation, as existing plant compete to run in a smaller 'space'.

The latter is closely intertwined with consumer choice. Smart meters will allow suppliers to differentiate their offerings to domestic and commercial customers, for example through some form of direct load control and different types of tariff structure, or by developing broader service offerings. These could be developed by new entrants, rather than traditional suppliers.

COMPETITIVENESS – INNOVATION, ENTERPRISE AND JOB CREATION

The smart meter baseline roll-out is likely to create significant numbers of new jobs in the green economy. Creating and installing smart meters will require a multi-disciplined and labour-intensive process. In the Republic of Ireland, ESB plans to create 3,700 contract jobs as part of a stimulus plan, with 750 of these jobs directly related to the introduction of smart networks and meters.

For the more 'advanced' smart meter options that we have discussed, along with the development and roll-out of meters with enhanced functionality, new IT infrastructure and software products are likely to be required for the HAN and smart appliances (some of these may be generic and not specific to the All Island market).

Realisation of the electric vehicle programme, as a baseline, will require the installation of publicly accessible charging stations, domestic charging points and fast charging units. Additional jobs are likely to be created through the development and deployment of the interface to smart meters and more sophisticated control systems for the vehicles.

A proportion of these new jobs will be 'local' i.e. those related to deployment of new smart metering and IT infrastructure. Some will play to the Island's competitive strengths, namely, in the knowledge-based economy of the ICT sector and related services.

SECURITY OF SUPPLY – ENSURING GENERATION CAPACITY MEETS DEMAND

The amount of generation required on the Island depends on the size of peak demand, net of wind and net exports. Options that can reduce demand at times of low wind generation can avoid or defer new investments in peak generation capacity.

Here, the options that make the largest contribution to reducing peak demand net of wind are those that are relatively large resources in terms of capacity, and which either reduce demand consistently across the year (e.g. energy efficiency measures) or are able to dynamically reduce demand in high-price periods, as for example in the case of demand side response from the industrial and commercial sectors.

SECURITY OF SUPPLY – RELIABLE ELECTRICITY NETWORKS

Transmission and distribution networks must be sized to accommodate flows from generation to demand at peak. Options that increase the load factor of the networks by reducing peaks in demand contribute to deferring investment in distribution and – to a limited degree – in transmission networks.

Larger resources and resources that are able to reduce demand at peak have the largest potential to contribute to reliable electricity networks.

SUSTAINABILITY – ENERGY EFFICIENCY

Options that are capable of reducing overall demand contribute to improving the system's energy efficiency. This includes reductions through technical improvements in energy efficiency (e.g. domestic energy efficiency measures such as improved insulation); changes in human behaviour (e.g. savings realised through consumers responding to information on in-home displays); and improvements to the efficiency of system operation (e.g. frequency-responsive relays in appliances, which reduce the need for generation part-loading).

SUSTAINABILITY – ACCELERATED GROWTH OF RENEWABLES

The island has ambitious renewable electricity targets for 2020, much of which will be delivered by wind generation. In order to facilitate the achievement of this target and integrate wind successfully into the electricity system, other market participants will need to behave flexibly to reflect the intermittency of wind generation.

Options that are capable of contributing such flexibility by dynamically shifting demand in response to within-day prices are best able to contribute to the deployment of renewables. 'Static' measures, such as static ToU tariffs, which reduce demand peaks and move consumption to low demand, i.e. overnight, periods can reduce the need for back-up generation and also address the issue of wind curtailment. Options that improve energy efficiency are also able to contribute to attaining renewables targets, as these are defined as a proportion of energy consumed. A reduction in energy consumption therefore lowers the absolute requirement for renewable electricity by 2020.

5.4.3 BENEFITS - ELECTRICITY MARKET BENEFITS OF DEMAND SIDE OPTIONS

REDUCTIONS IN VARIABLE GENERATION COSTS

Broadly, the reductions in (variable) generation costs reflect the size of the resources related to each option (for estimates of these resources, see Section 3.3, with more detail provided in Annex A). Energy efficiency measures have a relatively large potential to reduce electricity consumption. The smart meter options, including dynamic time-of-use tariffs, are estimated as delivering similar volumes of response in terms of energy reductions, capable of delivering similar levels of reductions in variable costs.

Some options reduce variable costs without reducing overall demand, by shifting demand from high-cost generation periods to lower-cost generation periods.

Electric vehicles and heat pumps are relatively small resources with a small impact on variable costs as a result. The potential flexibility of distributed generation and storage means that they are also likely to have a significant potential to reduce variable costs.

REDUCTIONS IN CO2 EMISSIONS

CO2 emissions reductions will generally follow the same pattern as variable cost reductions for the following reasons. If we assume that by 2020 the Island is a wind-dominated system, where thermal plant (predominantly CCGTs and open cycle peaking plant) are at the margin, then a fall in the volume of generation at the margin will lead to a both a reduction in variable costs and in CO2 emissions. Consequently, reductions in CO2 emissions will also reflect the size of the resource associated with the demand side measure.

As would be expected energy efficiency measures have a relatively large potential to reduce levels of CO2 emissions from the power sector as would smart meter options.

REDUCTIONS IN GENERATION INVESTMENT

Reductions in generation investment relate to the avoided investment in peaking plants arising from the demand side measures. Investment in peaking plant can be avoided when a demand side option reliably reduces peak demand net of wind and gross exports.

Here, the options that make the largest contribution to reducing peak demand net of wind are those that are relatively large resources in terms of capacity, and which either reduce demand consistently across the year (e.g. energy efficiency measures) or are able to dynamically reduce demand in high-price periods, as for example in the case of demand side response from the industrial and commercial sectors (for estimates of these resources, see Section 3.3, with more detail provided in Annex A).

FREQUENCY RESPONSE

Maintaining the system operating frequency within a narrow permitted band is a priority for the system operator. Sudden changes in the supply/demand balance, such as a large generator trip, can cause the frequency to deviate outside this range. In order to manage such events, the system operator obtains a frequency response service – usually from part-loaded thermal units.

One of the options considered – the use of frequency-responsive relays in domestic appliances – could provide this frequency response service from the demand side rather than from generation. We have highlighted that this is an ancillary service in the last column of **Error! Reference source not found.**. While this does not contribute to the electricity market metrics in the way that other options do, it can have positive impacts on some of the policy goals. For example, if it replaces part-loaded thermal generation units in providing frequency response, the system's overall energy efficiency will be improved (in terms of reduced operating costs, CO2 emissions and also the need for generation capacity).

Storage, particularly pumped storage, is also able to provide a wide range of ancillary services, including frequency response. Direct control of industrial, home and office loads, controllable microgeneration and aggregation of distributed generation may also be able to provide frequency response, depending on the way in which load or generation control is effected, specifically, the role of the system operator in the process.

QUESTION 19: WHAT ARE YOUR VIEWS ABOUT OUR APPROACH TO HIGH LEVEL ASSESSMENT OF DIFFERENT DEMAND SIDE OPTIONS?

QUESTION 20: DO YOU AGREE WITH OUR ASSESSMENT OF EACH DEMAND SIDE MEASURE AGAINST EACH OF THE IDENTIFIED FACTORS?

QUESTION 21: DO YOU AGREE WITH OUR OVERALL ASSESSMENT OF THE RELATIVE MERITS OF THE DIFFERENT DEMAND SIDE OPTIONS?

QUESTION 22: DO YOU HAVE ANY COMMENTS ON OUR HIGH LEVEL ASSESSMENT OF THE BENEFITS OF DIFFERENT DEMAND SIDE MEASURES?

6 THE 2020 DEMAND SIDE VISION FOR THE ISLAND AND ASSOCIATED POLICY RECOMMENDATIONS

6.1 INTRODUCTION

This section sets out a 2020 Demand Side Vision for the All Island marketand our recommendations for the policies to realise it. The 'Vision' is predicated on our assessment of the value and cost of the different demand side options evaluated in Section 5. This evaluation enables us to prioritise the different policy elements which were discussed in Section 4.2.

It is important to note that the Irish Regulatory Authorities does not have responsibility for all of the areas covered by this 2020 Demand Side vision and that some of the aspects highlighted are a matter for consideration by Government.

6.2 2020 DEMAND SIDE VISION FOR THE ALL ISLAND MARKET

Table 9 shows a summary of the benefits and indicative costs of the demand side options, together with an evaluation, or overall ranking, of their part in a suggested Demand-Side Vision for 2020.

By comparing the relative costs and relative benefits of each category, the each option has been assessed and assigned to one of the four following categories:

High : a high value option for the Demand Side Vision.

Medium: a medium value option for the Demand Side Vision.

Low: a low value option for the Demand Side Vision.

Neutral: possibly of limited value for the Demand Side Vision.

In making this assessment we have taken a holistic view of the indicative costs and benefits of each option, and we have taken into consideration not only the benefit relative to the cost for each one individually, but also the amount of benefits arising from each option compared to the other options. In the case of electric vehicle charging, we have treated the options as mutually exclusive, choosing the best, from an electricity system perspective, and omitting the rest from the vision.

It is important to stress that we have not attempted to compare the demand side measures on a normalised basis. Benefits are based on a combination of the technical impact of the option and the size of the underlying demand side resource. Similarly, costs are based on nature of the activities required to realise the resource and the scale of the effort, which once again relates to the size of the resource.

	Competitiveness		Security of supply		Sustainability		Electricity market metrics				
	Competition & consumer choice	Green job creation	Generation capacity margin	Transmission capacity	Energy efficiency	Accelerated growth of RES	Generation costs / CO_2 emissions	Generation capacity costs	Frequency response	Cost of delivery	Overall ranking
Energy efficiency - Industrial	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Medium	No	Medium	High
Energy efficiency - Commercial	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Low	No	Medium	Medium
Energy efficiency - Domestic	Neutral	Medium	High	High	Medium	Medium	High	High	No	Medium	High
Behavioural change - Education	Neutral	Medium	Medium	Medium	Medium	Medium	Medium	Low	No	Low	Low
Smart meters - Advanced displays	Medium	Medium	High	High	Medium	Low	High	High	No	Low	Medium
Smart meters - Static ToU tariff	Medium	Medium	High	High	Medium	Medium	High	High	No	Low	Low
Smart meters - Dynamic ToU tariff	Medium	Medium	High	High	Medium	High	High	High	No	Medium	High
Home & office automation - Direct load control	Medium	Medium	High	High	Neutral	High	Medium	High	?	Medium	Medium
Home & office automation - Autonomous	Medium	Medium	High	High	Neutral	High	Medium	High	No	Low	Medium
Home & office automation - Frequency-responsive relays	Medium	Medium	Neutral	Neutral	Medium	Neutral	Low	Low	Yes	Medium	Medium
Industrial & Commercial DSR - Interruption contracts	Medium	Neutral	High	High	Neutral	High	Medium	High	No	Low	High
Industrial & Commercial DSR - Direct load control	Medium	Neutral	High	High	Neutral	High	Medium	High	?	High	High
Industrial & Commercial DSR - Demand-side bidding	Medium	Neutral	High	High	Neutral	High	Medium	High	No	High	High
Industrial & Commercial DSR - Autonomous	Medium	Neutral	High	High	Neutral	High	Medium	High	No	Medium	High
Heat pumps - Heat pumps are fitted with storage	Neutral	Low	Medium	Medium	Neutral	High	Medium	Medium	No	High	Neutral
Electric vehicles - Night charge	Neutral	Medium	Medium	Neutral	Neutral	Low	Low	Medium	No	Low	Neutral
Electric vehicles - Hybrid vehicles	Neutral	Medium	Medium	Medium	Neutral	Medium	Low	Medium	No	Medium	Neutral
Electric vehicles - Intelligent (price-reponsive) charging	Neutral	Medium	Medium	Medium	Neutral	Medium	Low	Medium	No	Medium	Medium
Microgeneration - Controllable	Neutral	Neutral	Medium	Medium	Neutral	Low	Low	Medium	?	Low	Neutral
Aggregation of DG	Low	Neutral	Medium	Medium	Neutral	Medium	Medium	High	?	Low	Medium
Storage	Neutral	Neutral	Medium	Neutral	Negative	Medium	Low	Medium	Yes	High	Low

***Table 9** – Matrix summarizing the costs, benefits and overall ranking of the options*

Our provisional categorisation of the value of the demand side measures defining the 2020 Demand Side Vision is as follows:

HIGH VALUE

- Energy efficiency: reach for more of the economically-viable energy efficiency potential, particularly in the domestic sector.
- Smart metering: advanced in-home displays and dynamic time-of-use tariffs.
- Industrial and commercial demand side response: more participation from loads in the industrial and commercial sectors.

MEDIUM VALUE

- Home and office automation: participation from domestic and small-commercial loads in response to price signals plus frequency relays.
- Electric vehicles: dynamic price-responsive charging of electric vehicles.
- Aggregation of Distributed Generation: more involvement from aggregations of Distributed Generation in the wholesale market.

LOW VALUE

- Behavioural change: education programmes to encourage more use of intelligent devices and smart meters, and more energy-efficient behaviour.
- Storage: growth in electricity storage on the Island.

QUESTION 23: DO YOU AGREE WITH OUR ASSESSMENT OF THE RELATIVE PRIORITIES OF DIFFERENT DEMAND SIDE OPTIONS IN DEVELOPING A 2020 DEMAND SIDE VISION?

QUESTION 24: WHAT ALTERNATIVE VIEWS DO YOU HAVE ON RELATIVE (MERITS AND) PRIORITIES?

6.2.1 DESCRIPTION OF THE 2020 DEMAND SIDE VISION

The 2020 Demand Side Vision is for a world in which electricity consumers make informed choices about their use of electricity in the short term and their selection of appliances in the longer term. The prices they face will reflect the cost of supply at those times, and will provide appropriate rewards for reductions in total consumption and changes in the profile of consumption. Consumers will face appropriate incentives to ‘invest’ (perhaps in terms of effort rather than financially) in methods which will allow them to better manage their consumption.

In the 2020 Vision, demand plays an active part in the process of system balancing and market price formation through a combination of autonomous response to expected market prices, dynamic response to market prices over a range of timescales and the inclusion of some dispatchable demand (and distributed generation) in the centralised processes of price formation and dispatch. It is recognised that different types of consumption are flexible over different timescales and with varying degrees of notice; and the demand side mechanisms offered will reflect these different needs and the different degrees of value that such flexibility delivers.

There may be certain requirements for demand management which cannot be dealt with through price alone, perhaps due to specific needs of the transmission or distribution system operators (e.g. within-hour dispatch or local network constraints), and appropriate arrangements will be in place to allow demand side flexibility to be captured for these purposes where required.

Consumers will have a different attitude to their electricity consumption compared with today. They will recognise the consequences of their consumption and the level of consumer awareness will be high.

Towards 2020 and beyond, we expect that electrification of heat and transport will play a significant role in the decarbonisation of the entire energy system for the Island, facilitating high levels of production of electricity from renewable sources. Flexibility of demand will play a key role in balancing the output of the variable sources of generation, alongside interconnection, flexible thermal generation (including distributed generators) and perhaps bulk electricity storage.

QUESTION 25: DO YOU AGREE WITH OUR PROPOSED HIGH LEVEL 2020 DEMAND SIDE VISION AS DESCRIBED ABOVE?

QUESTION 26: WHAT ALTERNATIVE VISION WOULD YOU PUT FORWARD?

6.3 PROPOSED POLICY RECOMMENDATIONS

Our proposed policy recommendations draw on the analysis set out above, and in particular:

- the drivers of value for in the future electricity system of 2020 and beyond (Section 2.4);
- those demand side resources which appear to be able to make a significant contribution (Section 3.3); and
- the qualitative assessment of costs and benefits of different demand side measures (Section 5).

In Table 10, below, we summarise a number of policy recommendations which we believe could be required to support delivery of the 2020 Demand Side Vision, grouped by 'value' and implementation time frame.

Value	Demand-Side Measure	Immediate	Short to Mid Term	Long Term
High value	Energy efficiency		More ambitious roll-out of energy efficiency measures	
	Smart meters	Smart meter specifications to allow for advanced displays & in future dynamic ToU tariffs	Education programme on benefits of smart meters	
			Interventions to accelerate adoption of ToU tariffs	
	Industrial / commercial demand side response	Create visible / firm day-ahead price and schedule for the SEM	Study on volume and natures of flexible demand available in the I&C sectors	
		Review of TSC & Grid Code to identify barriers to participation of I&C demand	Programme of engagement with I&C sectors to increase awareness of potential for demand-side participation	
Medium value	Home & office automation	Smart meter specifications to allow for future needs of smart appliances	Smart meter trial with focus on home & office automation	Mandatory standards &/or subsidies to encourage adoption of smart appliances
			Labelling scheme for smart appliances	Review the impacts of demand-side management on distribution networks
				Assess value of dynamic demand based on GB trials
	New demand – electric vehicles	Smart meter specifications to allow for interaction with EV charging systems	Review the impact of EVs for the electricity system	Review in detail the impacts of demand-side management on distribution networks
	Aggregation of distributed generation	Create visible / firm day-ahead price and schedule for the SEM	Develop standard contract structures and/or other measures to facilitate participation from DG	Detailed review of barriers facing distributed generators
		Review of TSC & Grid Code to identify barriers to participation of I&C demand	Review of network design standards or practices – identify barriers	
Low value	Behavioural change		Labelling scheme & education programme for smart appliances	
	Storage	Review payments to pumped storage through the SEM	Review support for R&D activities relating to distribution-level storage	
Limited value	New demand – heat pumps			Incentivise storage technologies for heat pumps
	Microgeneration	Smart meters required to control and interact with microgenerators		

***Table 10** – Policy options by value and timescale*

This provisional categorisation of policy recommendations can be used to define a number of potential policy pathways, which can be tailored to meet institutional responsibilities, capacity and (where required) the need for government funding.

An obvious policy pathway is to focus on the high value policy recommendations as revealed by our value assessment and then examine if there are potential synergies with other areas of demand side management and other SEM workstreams. A good example of this is the development of a firm day-ahead market, which on the demand side could facilitate both Industrial and Commercial demand side participation and aggregation of Distributed Generation. It is also a key element of the workstream seeking to improve the effectiveness of market coupling arrangements across the interconnection between SEM and BETTA.

As discussed in our key themes smart meter specification is another policy measure which cuts across multiple demand side measures, for example domestic smart meters, the ability to facilitate automation, or the operation, of smart devices in the home and office, and the interaction with electric vehicle charging.

A more pragmatic approach may be to focus initially on simple, low cost changes, such as modifications to the SEM Trading and Settlement Code and the interface with other SEM workstreams such as the Capacity Workstream and programmes of activity, such as the Smart Meter roll-out and the Electric Vehicles Programme.

QUESTION 27: DO YOU AGREE WITH OUR PROPOSED POLICY PATHWAYS FOR IMPLEMENTATION OF THE IDENTIFIED DIFFERENT POLICY OPTIONS FOR REALISING OUR PROPOSED 2020 DEMAND SIDE VISION?

QUESTION 28: WHAT ALTERNATIVE POLICY PATHWAYS WOULD YOU PROPOSE BASED ON YOUR PREVIOUS COMMENTS AND RESPONSES?

7 NEXT STEPS

This consultation document provides a first formal opportunity for all existing and potential stakeholders in the development of the demand side to both review and respond to our initial thinking regarding:

- the role and benefits that enhanced demand side activity can provide for the All Island market;
- a 2020 vision for demand side based on a high level assessment of the relative merits in terms of economics, deliverability and wider aspects of different forms of demand side activity;
- potential policy developments which might be required to help support delivery of a 2020 Demand Side Vision; and
- possible policy "pathways" for delivery of the identified policy options in order to successfully deliver the proposed 2020 Demand Side Vision.

Consequently, throughout this consultation document, we have explicitly identified key questions on which we would welcome views and responses from all stakeholders in order to help inform and guide our thinking. A full list of the consultation questions is provided in Annex C.

In order to best inform our thinking we welcome all views and comments which all existing and potential stakeholders wish to bring forward under this consultation.

QUESTION 29: DO YOU HAVE ANY ADDITIONAL VIEW OR COMMENTS YOU FEEL ARE IMPORTANT/USEFUL FOR US IN (A) ESTABLISHING A DEMAND SIDE VISION FOR 2020; (B) IDENTIFYING ASSOCIATED POLICY DEVELOPMENT AND (C) DETERMINING POLICY PATHWAYS?

We are seeking written responses to the questions posed in this consultation by Monday, 18 October 2010. To help us capture and compare the views of all stakeholders and to understand the basis of their interest in the development of the demand side in the All Island market; there is a standard Questionnaire Form published alongside this consultation paper which stakeholders can use to provide their responses to this consultation.

To help support the consultation process we will be holding a workshop on the issues raised in this consultation on 16 and 17 September in Belfast and Dublin respectively (venues to be confirmed). In addition we will be happy to hold bilateral discussions with any industry stakeholder who wishes to do so.

These steps will be followed by a Decision Paper, outlining the Regulators' views. This Decision Paper will include a proposed by publication of a Demand Response Programme which will set out the next steps in developing a detailed Demand Side Vision for 2020 and the necessary actions to realise it.

QUESTION 30: ARE THERE ANY FINAL COMMENTS INDUSTRY STAKEHOLDERS WISH TO MAKE ABOUT THIS CONSULTATION AND THE PROPOSED NEXT STEPS IN THE CONSULTATION PROCESS?

ANNEX A ELECTRICITY DEMAND IN THE ALL ISLAND MARKET

This Annex presents the publicly available data and existing studies we have used to form a view of the potential characteristics of electricity demand in 2020.

A.1 METHODOLOGY

We have used a number of published data sources in order to develop a picture of the demand side in the All Island market. This includes data from the industry and government bodies and agencies.

We have also drawn on information gathered in a Demand Side Vision workshop held in Dundalk on 26 February. During this workshop a number of syndicate groups discussed specific areas of demand side response in detail. Useful information from these groups has been included throughout this Annex A.

A.1.1 WEAKNESSES IN AVAILABLE DATA

In the course of undertaking this study, we found that very limited data is available on the detailed nature of electricity demand in the All Island market. Table 11 summarises the types of demand that exists on the system and the degree to which information is available on each category.

Area		Total		Industry		Commercial		Domestic	
		IRL	NI	IRL	NI	IRL	NI	IRL	NI
Current volume	Annual demand	✓	✓	✓	×	✓	×	✓	×
	Demand by sub-sector	N/A	N/A	✓	×	×	×	N/A	N/A
	Demand by end use	N/A	N/A	×	×	×	×	✓	×
Within year and within day patterns	Annual demand	✓	✓	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
	Demand by sub-sector	N/A	N/A	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
	Demand by end use	N/A	N/A	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
Trends in demand growth		✓	✓	✓	×	✓	×	✓	×

Key: ✓ –data available (✓) –partial data available × –no data available

***Table 11** – Summary of demand data availability*

A.2 CURRENT AND HISTORIC ELECTRICITY DEMAND

A.2.1 DEMAND BY SECTOR

Figure 8 shows total electricity demand for the Island over the period 2002-2009, broken down into sectors. As sectoral electricity consumption data for Northern Ireland is not available, we have assumed the same split as for the Republic of Ireland.

There is a fairly even division of demand between the three main sectors (industrial, services, and residential), although the proportions have been some changes over the course of the decade. In the Republic of Ireland during the period 2001-2009, the share of electricity consumed by industry fell by from 37% to 33%. During the same period the share of consumption from the commercial & public services sector grew from 28% to 34%. The share of the residential sector changed by less than 1%. In absolute terms, the industrial, residential and commercial sectors grew by 10%, 20% and 31% respectively over the period 2002-2008. Overall demand fell by some 6% between 2008 and 2009 due to the economic recession.

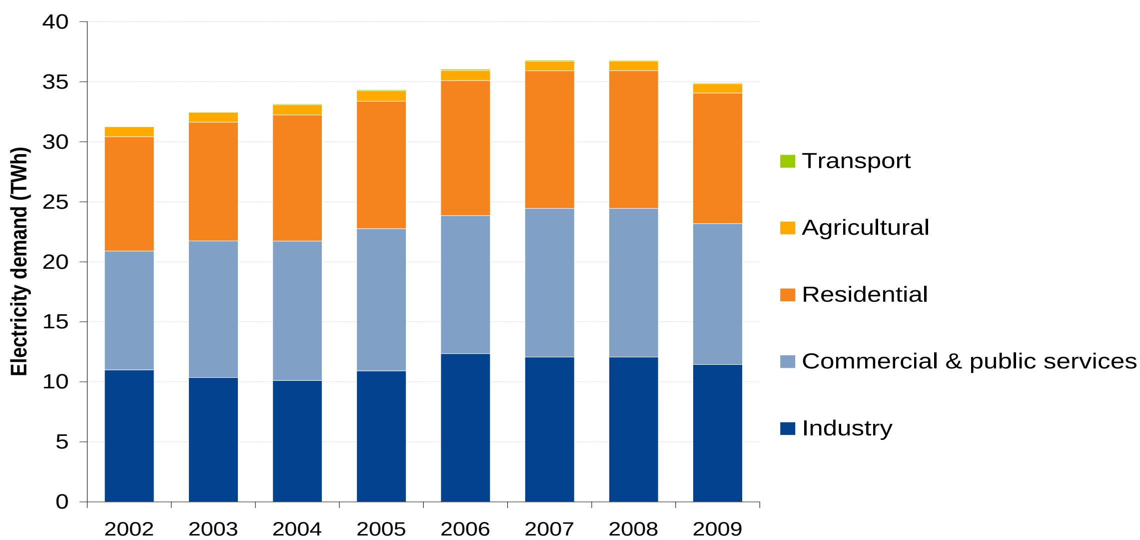

Figure 8 *– Historic electricity demand by sector for the Island*

Source: SEAI[31] and DECC data[32].

[31] SEI, Energy in Ireland 1990-2007. Viewable at: http://www.seai.ie/Publications/Statistics_Publications/Energy_in_Ireland/

[32] DECC, Energy statistics: monthly tables. 25 February 2010 version. Viewable at: http://www.decc.gov.uk/en/content/cms/statistics/source/electricity/electricity.aspx

A.2.2 DEMAND BY SUB-SECTOR

A.2.2.1. INDUSTRIAL SECTOR

Figure 9 shows the electricity demand from each industrial sub-sector in the Republic of Ireland[33].

The data reveals that a significant portion of industrial demand comes from a few specific sectors. For example, over half of industrial demand comes from the machinery, food, and chemicals sub-sectors (55% in 2007). This may be a starting point for considering which industry sub-sectors to include in any future demand side response initiatives.

Beyond this it is difficult to identify the potential either for demand reduction or enhanced flexibility from industrial demand, due to the absence of data on electricity end-uses within the industrial sector.

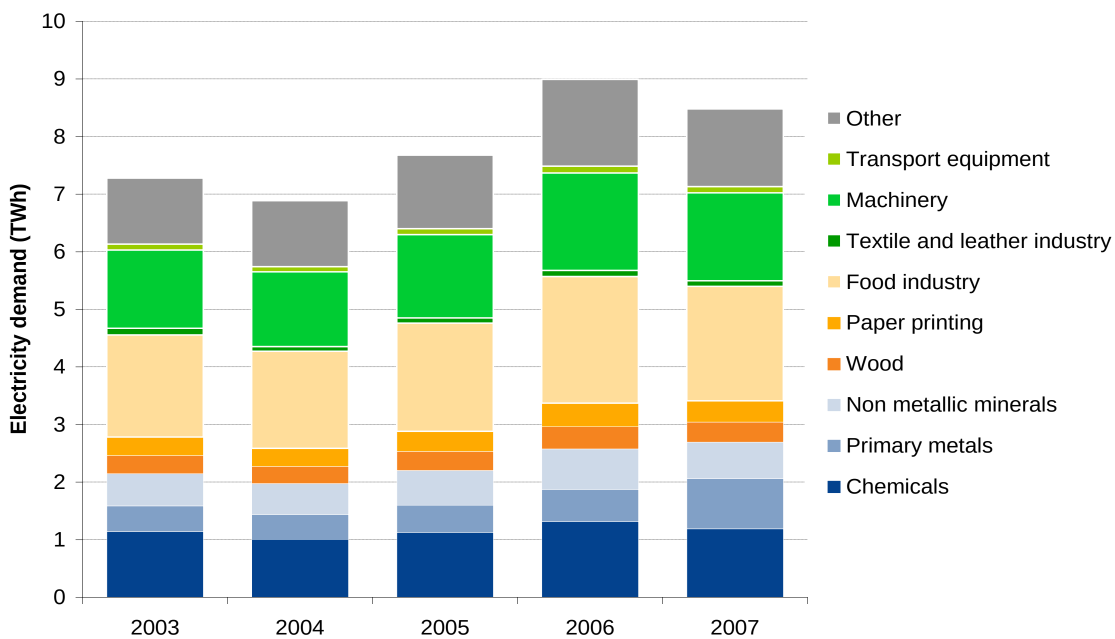

Figure 9 *– Historic industry electricity demand by sub-sector in the Republic of Ireland*

Source: Odyssee database

A.2.2.2. COMMERCIAL SECTOR

For the service sector, some European countries estimate and record this data for sub-sectors of the service industry – a selection of this data is shown in Figure 10. The data shown is for 2006 or 2007 (the most recent year for which data is available for each country).

[33] No equivalent data exists for Northern Ireland.

Equivalent estimates are not made for the Republic of Ireland or Northern Ireland. The variation between countries means that it is difficult to use international data to estimate what the pattern would be for the Island. Data on electricity end-uses in the service sector is also unavailable, making it difficult to meaningfully assess the current breakdown of electricity demand in the commercial sector.

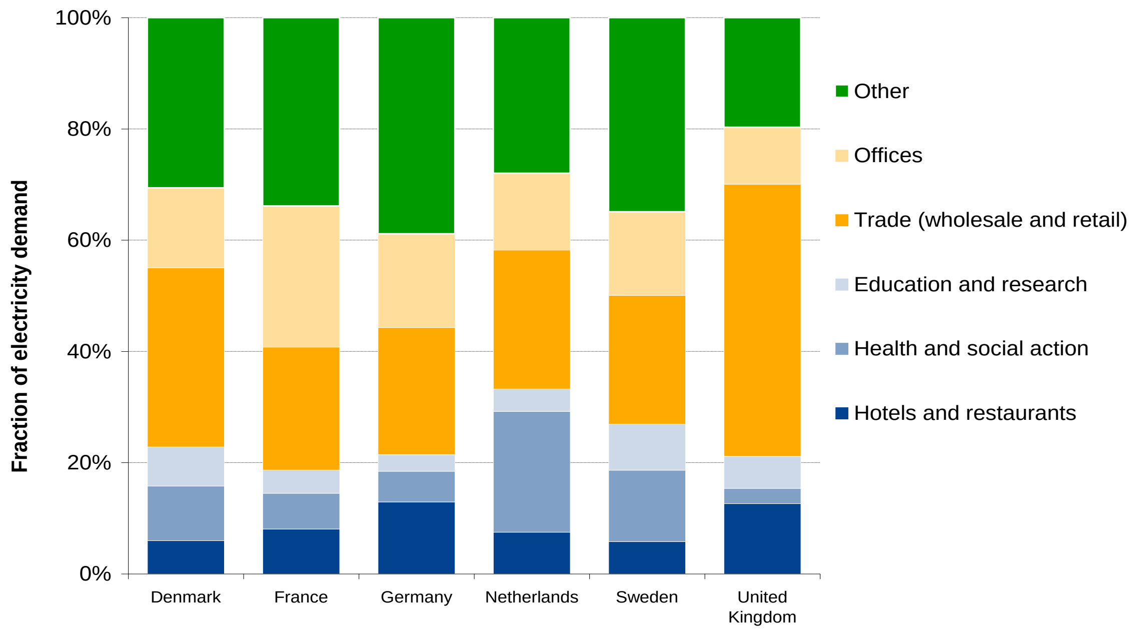

***Figure 10 –** Electricity demand by sub-sector for selected European countries*

Source: Odyssee database.

A.2.2.3. DOMESTIC SECTOR

Figure 11 shows domestic electricity consumption by end use for the epublci of Ireland and the United Kingdom. For the Republic of Ireland, data is presented for 2004 and 2007 because in 2004 an estimate was made by SEAI of the amount of domestic demand that was attributable to lighting – this estimate does not exist for other years.

The breakdown for the UK is shown as there is no data available for Northern Ireland specifically, but it is likely that the profile of electricity end use in the Northern Ireland domestic sector is significantly different to the UK's and the Republic of Ireland's, particularly due to the high number of oil-heated properties in the province. Figure 12 shows the proportion of customers using oil, gas, coal and electricity for heating in the domestic and commercial sectors in Northern Ireland. Only 4% of Northern Irish homes are currently electrically-heated.

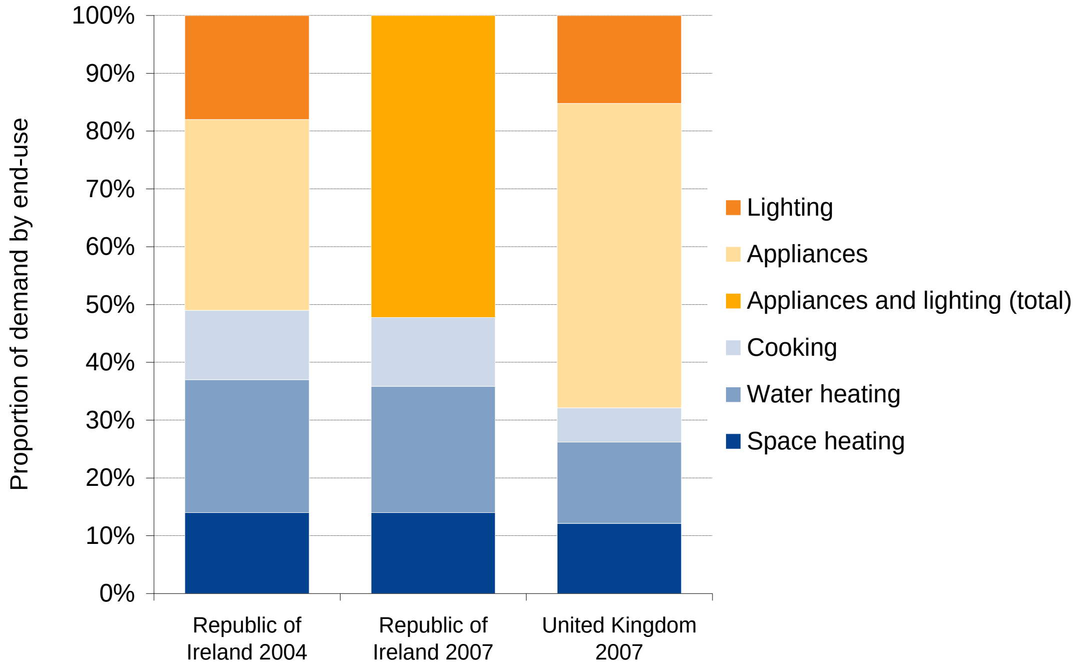

Figure 11 – *Domestic electricity demand by end-use for the Republic of Ireland and UK*

Source: Odyssee database

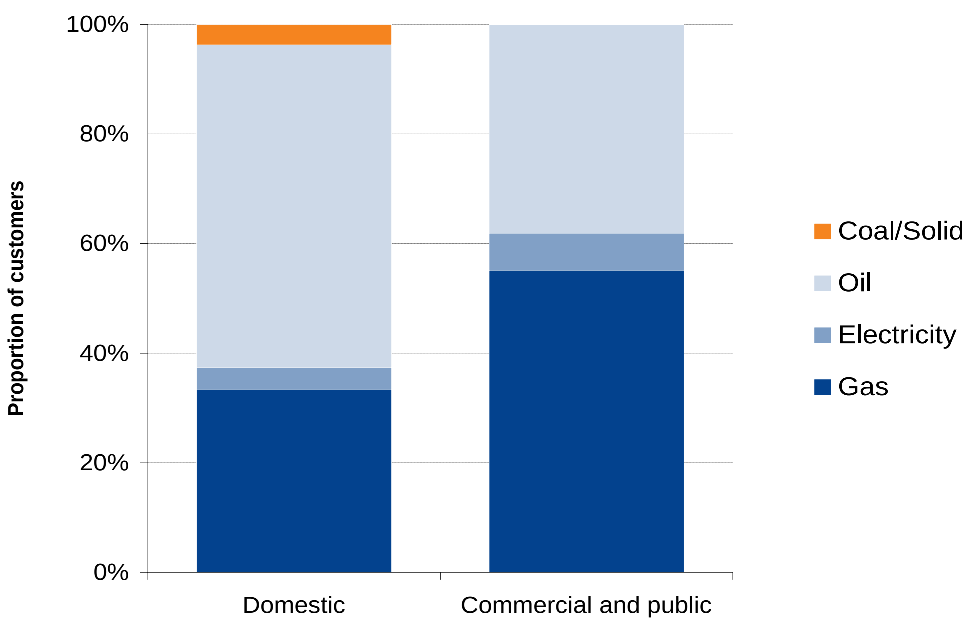

Figure 12 *– Heating fuels in Northern Ireland, commercial and domestic sectors*

Source: Census data and 2009 Northern Ireland House Condition Survey, and Pöyry/AECOM analysis.

A.2.3 ELECTRICITY DEMAND PATTERNS

Figure 13 shows average within-day demand profiles for the SEM, on business days and non-business days in summer (July) and winter (January).

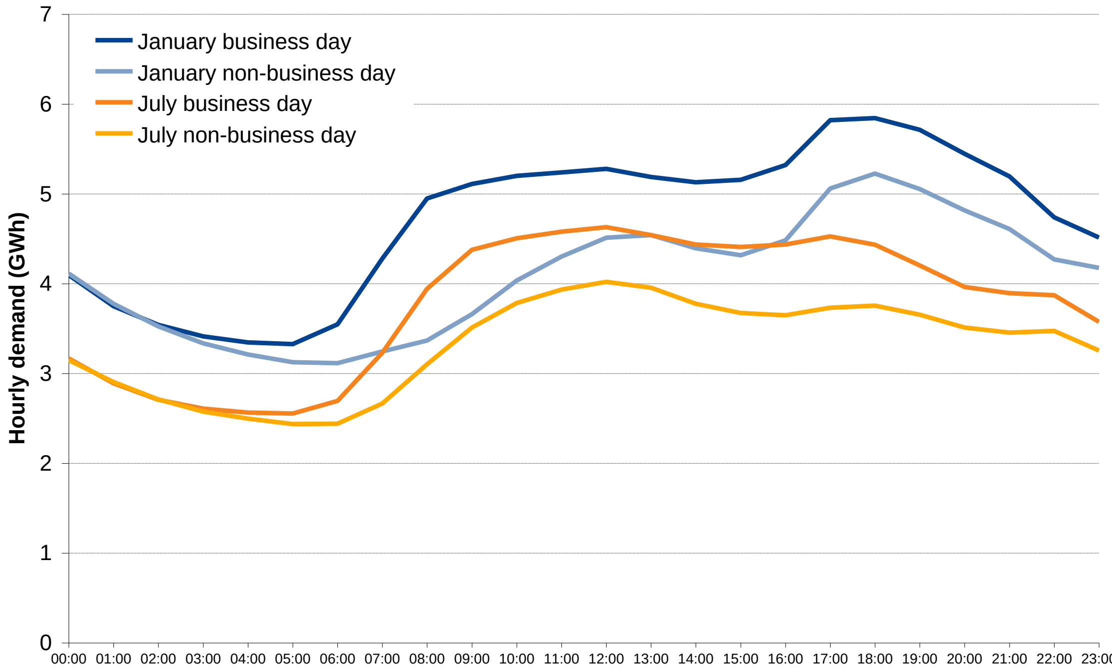

Figure 13 *– Projected average within-day demand profiles for the SEM in 2010*

Source: SEMO data and Pöyry analysis.

Demand in the SEM exhibits a 'peakier' pattern than in other comparable markets. Figure 14 shows normalised within-day demand for a summer and a winter month in the SEM and in Great Britain. The night-time 'trough' in the Island market is noticeably deeper than in Great Britain. This adds value for flexibility, compared to other markets, as it makes the value of capacity relatively high per unit of electricity delivered.

The All-Island electricity system is also comparatively small relative to the size of the largest potential infeed loss, which means that the holding of part-loaded plant (and demand) for near-instantaneous response is a significant driver of generation dispatch. Peak winter demand on the SEM is around 6.5GW, while the maximum infeed loss will be around 500MW when the new East-West interconnector is commissioned[34].

[34] Construction has not yet started on this project, which is due to be completed by 2012.

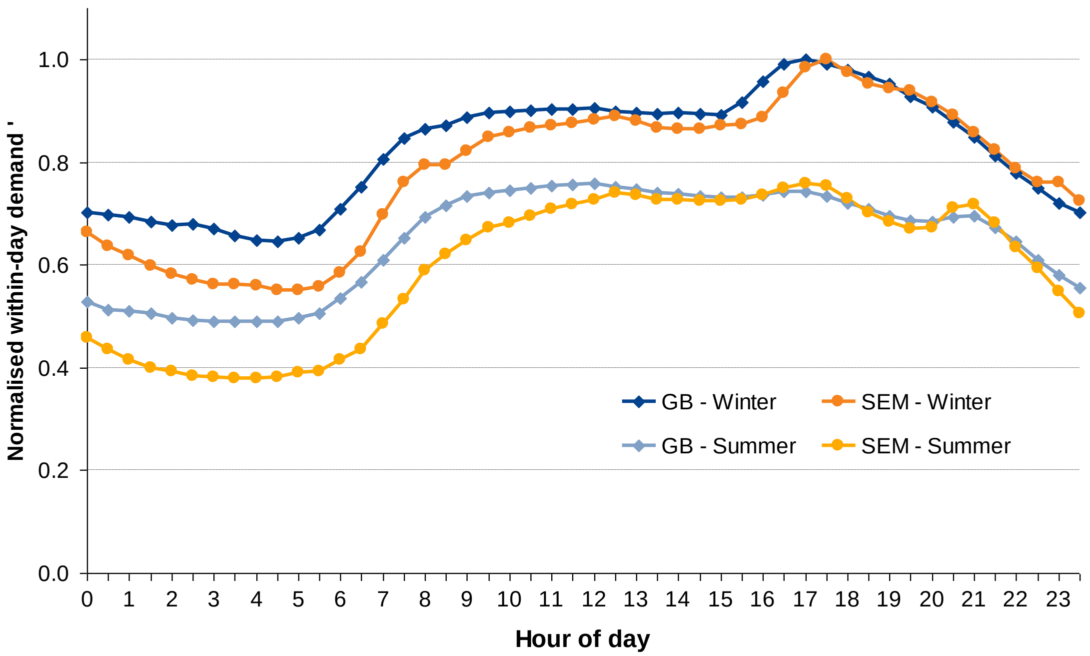

Figure 14 – Normalised electricity demand in the SEM and in Great Britain

Source: SEMO data and Pöyry analysis.

It is possible to use seasonal variations in load profiles to infer some of the underlying characteristics of demand. This is based on two assumptions:

- seasonal differences in electricity demand arise mainly because of increased heating requirements in winter, and also due to increased use of lighting due to the shorter day; and
- differences between demand on business days and non-business days arise from the additional electricity demand from industrial and commercial activities that occur only on weekdays.

Figure 15 summarises the different types of load and the types of day on which they occur.

The difference between energy consumption on a non-business day in winter and a non-business day in summer is therefore an indicator of the additional heating and lighting load of consumers and continuous industrial processes in winter compared to the summer.

Similarly, the difference between the additional load on a winter business day compared to a winter non-business day and the additional load on a summer business day compared to a summer non-business day is a measure of the additional seasonal heating and lighting demand from the industrial and commercial sectors.

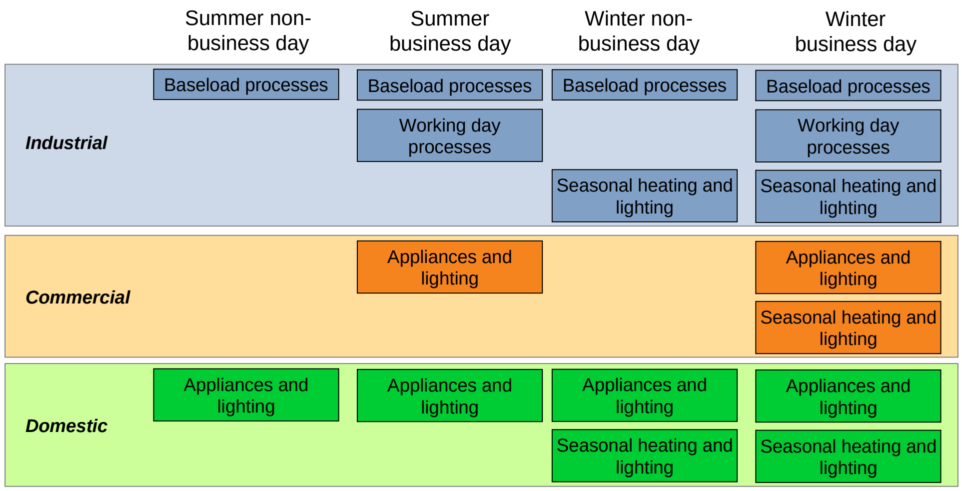

Figure 15 *– Load on summer and winter business and non-business days*

At a very crude level, these differentials might be used to infer proxy values for electrical heating loads in the commercial/industrial and domestic sectors, respectively. Using this as a measure excludes any electrical heating load that is present in summer, and is not capable of distinguishing between continuous non-domestic activities and domestic load. Despite these shortcomings this approach provides a very preliminary indication of the size of electrical heating demand and its within-day and within-year behaviour.

This is shown in Figure 16, which shows the additional winter load attributable to industrial and commercial activity that occurs only on business days, and the additional winter load arising from all other activity. This is calculated using the load profiles shown in Figure 13.

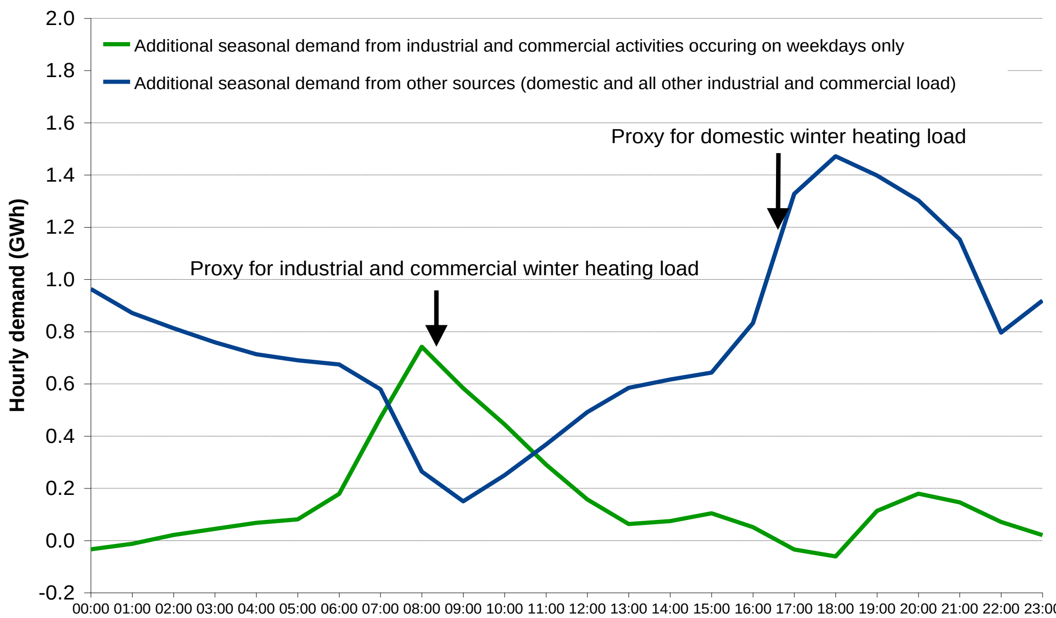

Figure 16 *– Proxies for winter heating loads derived from within-day profiles*

Source: Pöyry analysis

By calculating the additional heating and lighting load in each month of the year, it is possible to estimate the proportion of annual demand that is attributable to heating in the domestic and commercial/industrial sectors. By looking at hourly profiles it is also possible to estimate the peak demand from these sources. Table 12 shows estimates made for domestic and commercial/industrial heating loads in 2010 (assuming that additional lighting is small compared to additional heating in cold months).

	Total annual demand (TWh)	Peak demand (MW)
Domestic	3.5	1,500
Commercial and industrial	0.7	740

Table 12 *– Estimates of space and water heating demand based on load profiles*

In addition to inferences drawn from demand profiles, some data exists on participation by large loads and distributed generation in specific peak management schemes. In summary, these are:

- 25MW of load in the EirGrid STAR scheme;
- 50MW of voluntary demand reduction in the Powersave scheme;
- 137MW of load participating in the Winter Peak Demand Reduction Scheme in the Republic of Ireland; and
- 80-90MW (estimated) of load in the Winter Demand Reduction Incentive in the Republic of Ireland.

This is a total of around 300MW of demand that is already providing a response at peak times. While this is a useful indicator of demand side flexibility in the industrial sector, it is not a complete depiction, as it does not include the actions of Demand Side Units that are participating in the SEM. It is also unclear to what degree distributed generation contributes to these responses.

> ***Demand Side Vision workshop insight:***
>
> *It was estimated that the domestic sector heating market is around 700MW, though current electricity-fuelled hot water is considerably less than this. This is based on 2.4m consumers, 3kW heaters, and a diversity factor to reflect the fact that not all consumers will demand energy simultaneously.*

Data is also available on the standard demand profiles that are used to settle the accounts of consumers that are not interval metered. The characteristics of these profiles give an indication of the degree to which they are seasonal, which may serve as a useful proxy for the timing of heat-related electricity demand in the day. In order to make use of this data it would be necessary to know how many meter points are allocated to each standard profile.

A.3 TRENDS IN ELECTRICITY DEMAND

Figure 17 shows a projection of future electricity demand by sector, along with the historic data shown in Figure 8. Projections of growth in the period 2010-2016 are based on the growth rates used in EirGrid's latest Generation

Adequacy Report (GAR). Beyond 2016, the last year of the GAR, we have extrapolated the projection using the same growth rate as used by the GAR in the last four years of its projections (2.13% pa)[35].

The projections shown in the chart assume that the proportion of energy demand from each sector remains unchanged during the period 2010-2020.

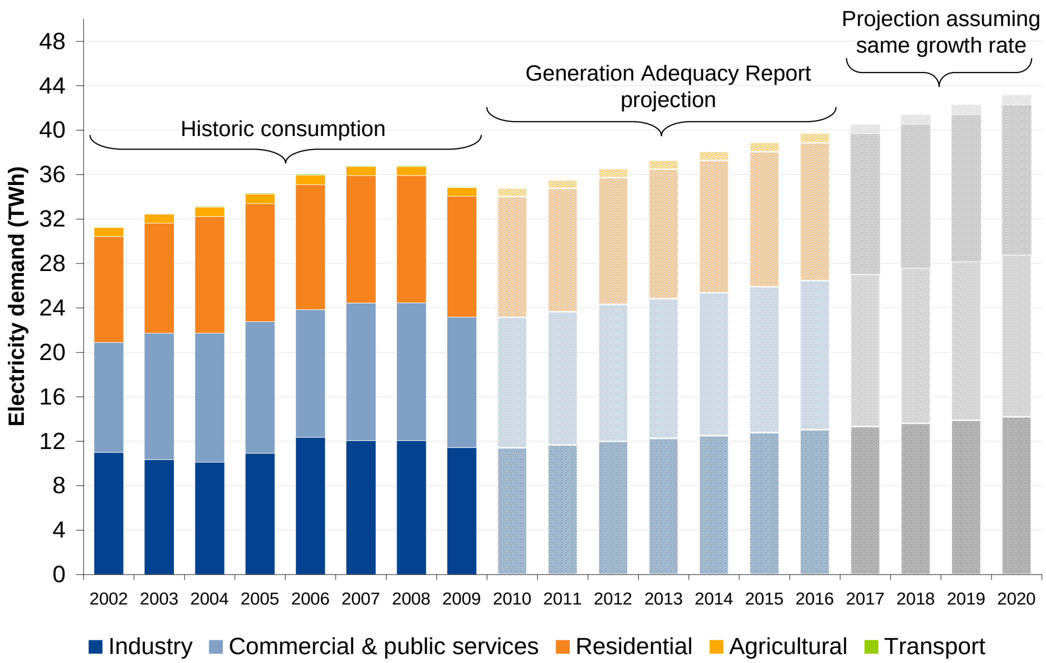

***Figure 17** – Historic and projected sector electricity demand, All-Island market*

Source: SEAI[31], DECC[32] , EirGrid[36], and Pöyry analysis.

A.3.1 STRUCTURAL ECONOMIC TRENDS

The most recently-available data on the energy intensity of the Republic f Ireland's industrial sector indicates that approximately half the improvement in the sector's energy efficiency over the period 1997-2007 was due to structural changes in the sector; while the other half was due to improvements in technical energy efficiency. This is shown in Figure 18.

A continuation of this trend during the next decade would entail a further erosion of the share of electricity demand from the industrial sector, so that the growth in industrial electricity demand may fall short of that shown in Figure 17.

[35] The recent extension of the All-Island Grid study to include Demand Side Management assumed a higher annual load growth of 3%. (AIGS extended to include DSM, Ecofys, 2009)

[36] 'Generation Adequacy Report 2010-2016'. EirGrid, 2009. Viewable at: http://www.eirgrid.com/media/Generation%20Adequacy%20Report%202010-2016.pdf

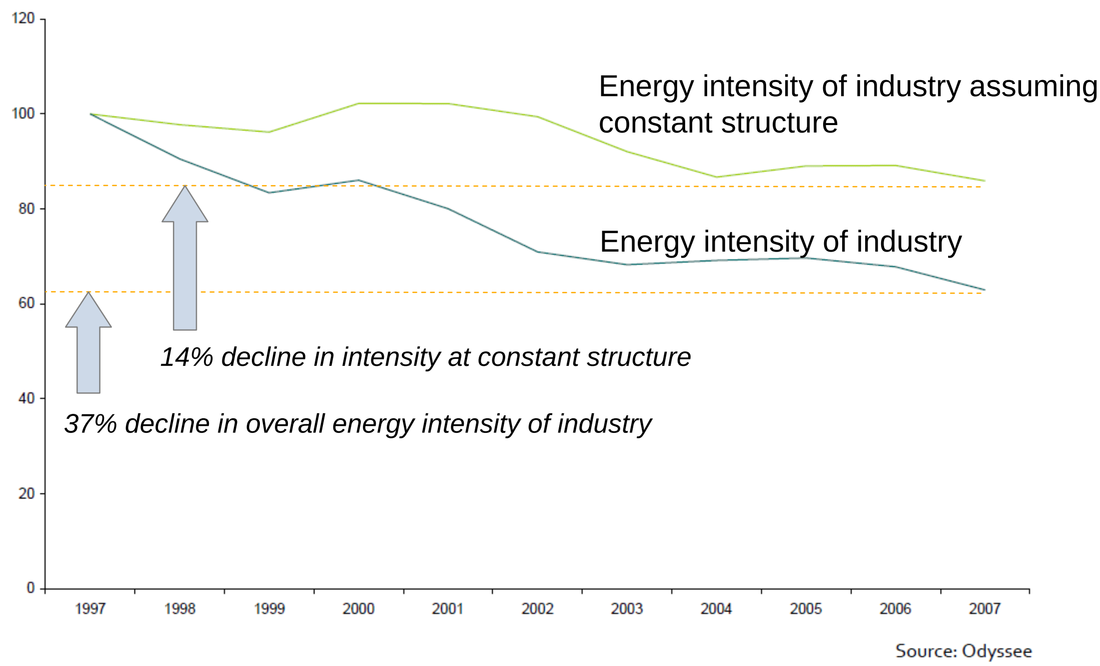

Figure 18 *– Technical and structural changes in industrial energy efficiency*

Source: Odyssee database

A.3.2 FURTHER POSSIBLE IMPROVEMENTS TO ENERGY EFFICIENCY

Figure 19 shows Ireland's energy consumption in 2020[37] alongside the technical and economic savings estimated in SEAI's 2008 report on energy efficiency. The report is for the Republic of Ireland only, so the savings have been scaled up in proportion with the ratio of demand in the Republic of Ireland to demand in Northern Ireland. Because SEAI's report does not detail its assumptions about future demand growth, it is not possible to ensure that both sets of figures are consistent. This does however provide an indication of the best-available public estimate of potential energy savings to 2020.

[37] Projected on the same basis as for the All-Island demand shown in Figure 17.

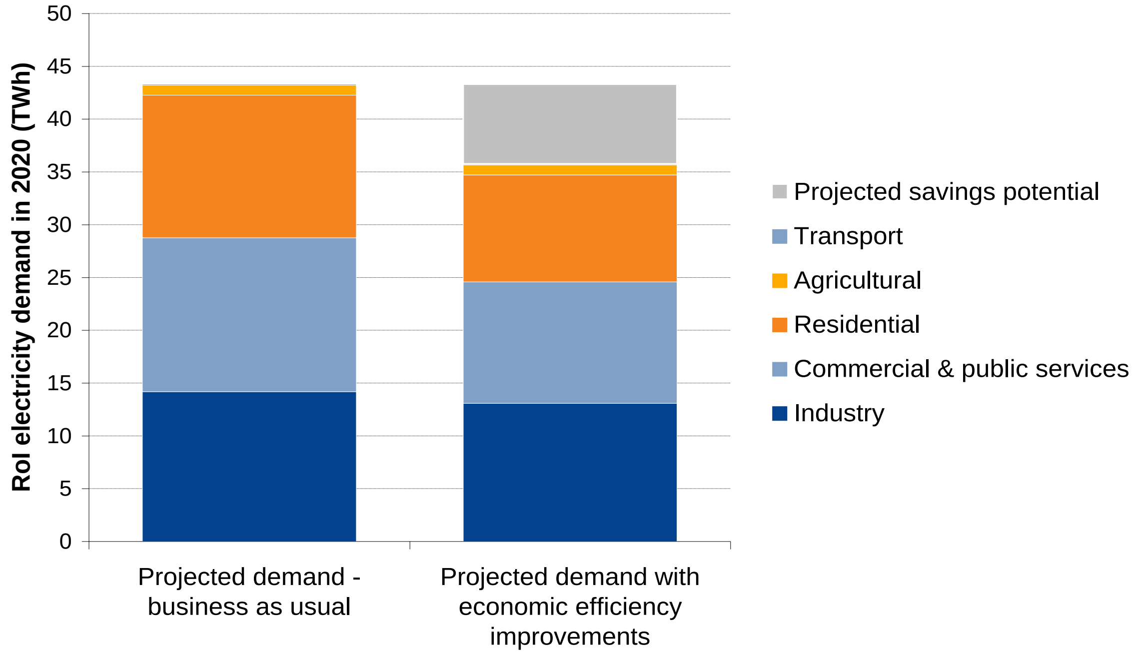

Figure 19 *– Potential for economic efficiency improvements in the All Island market*

Source: SEAI and Pöyry analysis.

A.3.3 NEW SOURCES OF DEMAND AND DISTRIBUTED GENERATION

A.3.3.1. ELECTRIC VEHICLES

The Republic of Ireland has adopted a goal to ensure that 10% of the vehicles on its roads are electric by 2020. This has been followed by the signing of a Memorandum of Understanding between Renault-Nissan and the Irish government, and an announcement in February 2010 that the first charging points are to be installed during spring 2010[38].

If met, this goal would represent around 230,000 vehicles using the electricity system by 2020[39].

> ***Demand Side Vision workshop insight:***
>
> *The gross capacity of 230,000 vehicles with 3kW of load would be around 700MW, although if they were all to charge only once a week then less than 15% of this capacity (~100MW) is likely to be demanding electricity at any one time.*

[38] Irish Times: 'First electric car charge points to be ready for use before Easter'. 19 February 2010. Viewed at: http://www.irishtimes.com/newspaper/ireland/2010/0219/1224264797639.html

[39] 'Sustainable Transport'. Department of Transport, undated. Viewable at http://www.transport.ie/transport/Sustainable/index.asp?lang=ENG&loc=1913

> ***Demand Side Vision workshop insight:***
>
> *Typical small electric cars store 16kWh of electricity; larger ones store 24kWh. Assuming an average capacity of 20kWh, charging once a week, the total load from 230,000 electric vehicles would be 20 x 52 x 230,000 = 240GWh annually.*
>
> *The cost of a single charge is relatively low for an electric vehicle (€2-5 per charge, for 160km of driving). This may limit the degree to which consumers will be prepared to be flexile in the timing of their charge cycles.*

A.3.3.2. HEAT PUMPS

The Republic of Ireland has a renewable energy target of 16% by 2020 under the EU's 20/20/20 climate and energy package. The UK's target is 15%. We have modelled the potential for each Member State to meet its EU renewable energy target, including the potential for renewable heat technologies.

Our renewable energy modelling for the Republic of Ireland[40] suggests that under an economically-rational deployment of renewable energy technologies, demand from ground source heat pumps would be 0.5TWh annually by 2020.

In that study we did not model Northern Ireland independently, and projecting uptake of heat pumps is difficult because of the high proportion of oil-heated customers in the region. Scaling the result for the United Kingdom by the proportion of UK population in Northern Ireland gives a figure of 0.7TWh of demand from heat pumps across the Island.

A.3.3.3. STORAGE

Currently the Turlough Hill pumped storage facility (240MW) is the Island's main storage source.

> ***Demand Side Vision workshop insight:***
>
> *Typical sizes for pumped storage and compressed air energy storage (CAES) facilities are in excess of 50MW. Both technologies are typically capable of sustaining their responses for several hours. Their technical potential is limited by geography and geology.*
>
> *Flywheel and battery technologies typically come in unit sizes ranging from less than 10kW to around 20MW. They are capable of sustaining a response typically ranging form seconds to minutes. Their potential is not geographically-restricted.*

[40] 'Compliance Costs for Meeting the 20% Renewable Electricity Target in 2020', Pöyry Energy Consulting, May 2009 report for DBERR. Viewable at: http://www.bis.gov.uk/files/file45238.pdf

A.3.3.4. DISTRIBUTED GENERATION

Demand Side Vision workshop insight:

Around 120MW of standby generation is estimated to exist in Northern Ireland. Additional capacity also exists in the Republic of Ireland, but it is not clear how much of this is synchronised to the system.

ANNEX B INFORMATION SOURCES USED FOR REVIEW OF INTERNATIONAL DSM EXPERIENCE

This annex lists the sources used in the review of international experience of demand side response. Some are meta-studies that summarise a large number of cases from a range of countries; others are more specific reports on individual countries or programmes.

"Automated demand response – how the internet helps the electricity grid in California". Allan Chen. Berkeley Laboratories. March 2008.

"Deferral of network investments by DSM – New Zealand experiences". Magnus Hindsberger (Transpower New Zealand). March 2008.

"Demand response: a decisive breakthrough for Europe". CapGemini, 2008.

"Demand side market participation report". IHS Global Insights. DECC, July 2009.

"DSM best practices guidebook for Pacific Island utilities". IIEC. UNDESA /SOPAC, July 2006.

"DSM in Ireland - evaluating the energy efficiency opportunities". KEMA. SEI, 2008.

"E-ISLAND: Expandable Internet-Sustained Load and Demand side management for the integration into virtual power plants". Hans Schäfers, Franz Schubert, Holger Ambrüster. Presented at CIRED, May 2007.

"Evaluating energy efficiency policy measures & DSM programmes (Volume II)". Harry Vreuls (SenterNovem). IEA DSM, October 2005.

"INDEEP analysis report". Evert van der Laar & Harry Vreuls (SenterNovem). IEA DSM, July 2004.

"International experience in using DSM to support electricity grids". David Crossley, Energy Futures Australia Pty Ltd. March 2008.

"Management of demand and microgeneration using a radio broadcast of bulk generation efficiency". Peter Boait & Mark Rylatt. Presented at CIRED, May 2007.

"The potential for dynamic demand". DECC / SEDG. November 2008.

"The potential for behavioural and demand side management measures to save electricity, gas and carbon in the domestic sector, and resulting supply-side implications". Mike Bullard (Enviros). DEFRA, November 2008.

"Reducing the cost of demand side intermittency by using demand side control measures". IPA Consulting, Econnect & Martin Energy. DTI, 2006.

"Worldwide survey of network-driven demand side management projects". Dr David Crossley, Energy Futures Australia Pty Ltd. IEA DSM, October 2008.

ANNEX C FULL LIST OF CONSULTATION QUESTIONS

SECTION 2

QUESTION 1: Do you agree with our characterisation of the four types of benefits that demand side management can provide?

QUESTION 2: Are there other cost savings which you believe demand side management can deliver?

QUESTION 3: Are there additional studies and reports (to those listed in Annex B) which you are aware of and believe we should review?

QUESTION 4: What other insights do you have from your experience of demand side management adopted internationally?

QUESTION 5: Are you aware of other quantitative findings from international experience which you believe are important for us to capture and consider?

QUESTION 6: Do you agree with our identified drivers of future value for demand side response/management? Are there any additional drivers we should consider?

SECTION 3

QUESTION 7: Are there any other aspects of current demand side activity in the All Island market which should be captured?

QUESTION 8: Do you agree with our high level assessment of the potential for demand side management in the All Island market by 2020?

SECTION 4

QUESTION 9: Do you agree with our definition of each individual demand side measure?

QUESTION 10: Is our description of the current policy baseline for each demand side measure accurate and complete. If there are omissions please point them out.

QUESTION 11: Do you agree with our categorisation of different types of "market issue" and typical remedies for each?

QUESTION 12: Do you agree with our identified barriers and enablers for each of the specific demand side measures we have identified?

QUESTION 13: Do you agree with our identified market issues for each specific demand side measure and our proposed remedies to address these?

QUESTION 14: What are your views on the likelihood and effectiveness of the identified policy options addressing the specified market issue and delivering the desired change?

QUESTION 15: Are there any unintended undesirable consequences that any of the options might create elsewhere?

SECTION 5

QUESTION 16: Do you agree with our identified specific demand side measures and our assessment of the different types of benefits each demand side measure provides?

QUESTION 17: Are there any additional demand side measures that we should individually identify and assess? If so, what type of benefit(s) is it felt they provide?

QUESTION 18: Have we identified all of the relevant criteria for assessing the individual and comparative merits of the demand side measures?

QUESTION 19: What are your views about our approach to high level assessment of different demand side options?

QUESTION 20: Do you agree with our assessment of each demand side measure against each of the identified factors?

QUESTION 21: Do you agree with our overall assessment of the relative merits of the different demand side options?

QUESTION 22: Do you have any comments on our high level assessment of the benefits of different demand side measures?

SECTION 6

QUESTION 23: Do you agree with our assessment of the relative priorities of different demand side options in developing a 2020 Demand Side Vision?

QUESTION 24: What alternative views do you have on relative (merits and) priorities?

QUESTION 25: Do you agree with our proposed high level 2020 Demand Side Vision as described above?

QUESTION 26: What alternative vision would you put forward?

QUESTION 27: Do you agree with our proposed policy pathways for implementation of the identified different policy options for realising our proposed 2020 Demand Side Vision?

QUESTION 28: What alternative policy pathways would you propose based on your previous comments and responses?

SECTION 7

QUESTION 29: Do you have any additional view or comments you feel are important/useful for us in (a) establishing a Demand Side Vision for 2020; (b) identifying associated policy development and (c) determining policy pathways?

QUESTION 30: Are there any final comments industry stakeholders wish to make about this consultation and the proposed next steps in the consultation process?