Market participants' views towards and experiences with Demand Side Bidding

Version 2, January 2002

International Energy Agency Demand-Side Management Programme
Task VIII: Demand-Side Bidding in a Competitive Electricity Market

Operating Agent:
Ms Linda Roberts
EA Technology, Capenhurst Technology Park,
Capenhurst, Chester, CH1 6ES,
United Kingdom
Tel: +44 (0) 151 347 2571
Fax: +44 (0) 151 347 2226
e-mail: Linda.Roberts@eatechnology.com

IEA Demand-Side Management Programme

The International Energy Agency (IEA) was established in 1974 as an autonomous agency within the framework of the Economic Cooperation and Development (OECD) to carry out a comprehensive program of energy cooperation among its 25 Member countries and the Commission of the European Communities.

An important part of the Agency's program involves collaboration in the research, development and demonstration of new energy technologies to reduce excessive reliance on imported oil, increase long-term energy security and reduce greenhouse gas emissions. The IEA's R&D activities are headed by the Committee on Energy Research and Technology (CERT) and supported by a small Secretariat staff, headquartered in Paris. In addition, three Working Parties are charged with monitoring the various collaborative energy agreements, identifying new areas for cooperation and advising the CERT on policy matters.

Collaborative programs in the various energy technology areas are conducted under Implementing Agreements, which are signed by contracting parties (government agencies or entities designated by them). There are currently 40 Implementing Agreements covering fossil fuel technologies, renewable energy technologies, efficient energy end-use technologies, nuclear fusion science and technology and energy technology information centres.

The Demand-Side Management Programme is a new collaboration. Since 1993, the 17 Member countries and the European Commission have been working to clarify and promote opportunities for DSM.

Australia
Austria
Belgium
Canada
Denmark
European Commission
Finland
France
Greece
Italy
Japan
Korea
Netherlands
Norway
Spain
Sweden
United Kingdom
United States

A total of 10 Tasks have been initiated, 4 of which have been completed. Each Task is managed by an Operating Agent from one of the participating countries. Overall control of the program rests with an Executive Committee comprised of one representative from each contracting party to the Implementing Agreement. In addition, a number of special ad hoc activities--conferences and workshops--have been organised. The Tasks of the IEA Demand-Side Management Programme, both current and completed, are as follows:

Tasks:

Task I*	International Database on Demand-Side Management
Task II	Communications Technologies for Demand-Side Management
Task III*	Co-operative Procurement of Innovative Technologies for Demand-Side Management
Task IV*	Development of Improved Methods for Integrating Demand-Side Management
Task V*	Investigation of Techniques for Implementation of Demand-Side Management Technology in the Marketplace
Task VI*	DSM and Energy Efficiency in Changing Electricity Business Environments
Task VII	International Collaboration on Market Transformation
Task VIII	Demand Side Bidding in a Competitive Electricity Market
Task IX	The Role of Municipalities in a Liberalised System
Task X	Performance Contracting

* completed Task

For additional information contact the DSM Executive Secretary, Anne Bengtson, Box 621, 182 16 Danderyd, Sweden, Telephone: +46/8/510 50830, Fax: +46/8/510 50831, E-mail:anne.bengtson@ telia.com. Also, visit our web site at <http://dsm.iea.org>.

Contents

1 Summary

This report is an output of Stage 1 of Task VIII 'Demand Side Bidding in a Competitive Electricity Market' within the IEA Implementing Agreement on Demand Side Management Technologies and Programmes. This document supersedes the report published in May 2000.

Demand Side Bidding is important, as it is a mechanism that allows the demand side to participate in the electricity market. A definition of Demand Side Bidding (DSB) is provided, together with detailed descriptions of the various DSB products that are currently operating in the participating countries.

Surveys were conducted in the participating countries to obtain an overview of the way that electricity is traded in these countries together with the views and opinions of market participants towards Demand Side Bidding.

The results of these surveys show that although many different DSB products are currently available, only a few schemes can be considered to be operating successfully. DSB products for the provision of ancillary services to the System Operator is the area where DSB products are most successful. However, few products are operating successfully in electricity spot markets or balancing markets.

The surveys show that most market participants view DSB favourably, mainly due to improved market liquidity and an improved choice of products in the electricity market. The surveys also highlight the main barriers that prevent the development and introduction of successful DSB products in the participating countries. These barriers range from technical barriers that prevent DSB products from being correctly monitored and controlled, to ignorance whereby market participants do not fully understand the financial and environmental benefits of DSB products.

Further work is required to gather information on consumer reactions to current or possible future DSB schemes. A study of electrical technologies in the domestic, commercial, and industrial sectors is also required in order to determine which technologies can be controlled in ways suitable for use in DSB schemes.

Stage 2 will demonstrate the potential for DSB in the participating countries, together with an understanding of the impact of DSB on energy efficiency. It will evaluate the existing DSB products and determine to what extent they meet their objectives, identify the critical success factors, and understand the causes of any shortcomings.

Once Stage 2 has been completed, a further stage of work will be required to devise improvements to existing DSB schemes and propose new schemes that will overcome any previous limitations and attract active participants.

2 Introduction

This report is an output of Stage 1 of Task VIII 'Demand Side Bidding in a Competitive Electricity Market' within the IEA Implementing Agreement on Demand Side Management Technologies and Programmes.

The programme mission of the IEA Implementing Agreement on Demand Side Management Technologies and Programmes is:

> To promote energy efficiency and DSM for global sustainable development and for business opportunities

Demand Side Bidding certainly creates business opportunities, namely for the demand side, but whether or not DSB can promote energy efficiency is not so easily determined. Therefore, the overall aim of Task VIII is to evaluate and promote Demand Side Bidding as a means to improve the global environment. This will be achieved through the following objectives:-

- evaluation of current DSB schemes
- analysis of current DSB schemes for generic features, strengths and weaknesses
- provision of guidelines for the development of new DSB schemes and enhancements to existing schemes

Task VIII stared in January 1999 with five participating countries, namely Finland, Netherlands, Norway, Spain and the UK. Sweden joined the project in July 1999 and Greece subsequently joined in December 1999. The Stage 1 report published in May 2000[1] only included the results from six of the participating countries, namely Finland, Netherlands, Norway, Spain, Sweden and the UK. This report updates the first report published in May 2000, and includes the results from Greece.

Stage 1 of Task VIII consists of two subtasks. The objective of subtask 1 was to develop a common definition of Demand Side Bidding, and this is presented in Section 4 of this report. The objective of subtask 2 was to gather information about the electricity markets and trading arrangements in the participating countries together with views and opinions towards Demand Side Bidding. This information has been gathered from each of the participating countries using questionnaires. The Experts prepared five different questionnaires, one for each of the different market participants. The five market participants surveyed as part of subtask 2 were:-

- market operator
- system operator
- transmission network owner / operator
- regulator / government
- supplier / trader

Subtask 2 does not include a survey of consumers (those who consume electricity), this forms part of Stage 2 of this project. Generators have also been excluded from the survey of market participants. The reason for this was because DSB is essentially a threat to generators, and therefore it was decided that there was no value in including them in the survey.

[1] Approved by the Executive Committee in November 2000.

The Experts have collated the information collected during these surveys into seven national reports. These national reports provide an overview for each of the participating countries and can be found in the Appendix.

Section 5 of this report provides details of the many DSB products that are available and operating in the participating countries. Section 6 summarises the opinions of the market participants towards DSB, and Section 7 provides an overview of the different barriers that exist.

Subtasks 1 and 2 were conducted on a task-shared basis, and therefore the aim of this report is to summarise the results obtained by the Experts during these subtasks.

3 Structure of Markets

An electricity market can be defined in two ways;

- the physical system
- the contractual system

Both of these systems are equally important, as together with the Regulator, they define the way that electricity is traded. Although the details of both the physical and contractual system vary from country to country, any electricity market can be described using a common set of terms as shown below.

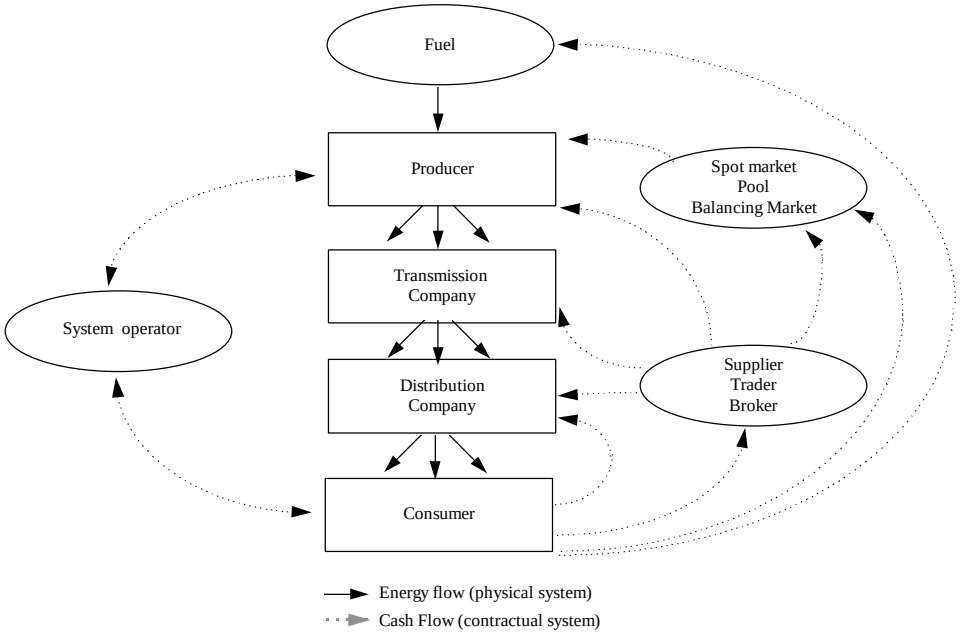

Figure 1. Electricity market

The flow of energy is from the producers (generators) to the consumers via the transmission and distribution system. However, the flow of cash is not so easily defined, as indicated by the number of different cash flow options that exist in the electricity market. For example, some consumers may pay producers directly for their energy, whilst others will purchase through a supplier or through an electricity pool or spot market. Likewise, some suppliers will contract for their electricity directly with producers whilst others will purchase via the electricity pool or spot market.

Not all of the cash flows shown in Figure 1 exist in all the countries participating in this project. In some countries consumers pay the distribution use of system charges directly to the distribution company, whilst in other countries these payments are passed via the supplier. Table 1 provides an overview of these cashflows within the electricity markets of the participating countries, together with a general overview of the market place.

Table 1. Comparison of the electricity markets in the participating countries

	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
Year	1998	1998	1999	1999	1999	1998	2000
General Statistics							
Annual consumption (TWh)	76.6	83.3	118	184.2	143.3	324.3	44.6
Annual production (TWh)	42.1	60.1	122	165.1	150.3	338.9	44.7
Annual self (on-site) generation (TWh)	25.2	27.2	0.8	24.2	Included in annual consumption	<0.1	0.4
Producers							
No. of producers	2 main + about 200	4	60	4	7	25 + others	1 (+ 10 self producers and co-generators)
Ownership	public / private	Public	mostly public	private	public / private	private	public
Fuel mix	22% hydro 8% peat 12.5% other indigenous (wood wastes) 32% nuclear 11% gas 12.5% coal 2% oil	48% coal 45% gas 5% nuclear 2% renewables	99% hydro 1% CHP	14.5% hydro 35.7% nuclear 43.9% coal 5.9% gas	47% hydro 47% nuclear 3% oil CHP 1% coal CHP 2% bio CHP	27 % nuclear 35 % coal 34 % gas 2% oil 2% hydro 2% other	68.9% coal 9,6% oil 9.1% hydro 12.4% gas
Prevailing price setting fuel	coal/gas	gas/coal	hydro	coal	hydro/nuclear	coal	Lignite coal
Ratio of system MD to generating capacity (*)							
Excluding imports	87%	65%	97%	71%	108%	72% (1)	n/a
Including imports	73%	50%	94%	68%	100%	68% (1)	60%
At time of peak demand	80%	not known	97%	not known	100%	not known	n/a

(*) Where:-
System MD = peak demand on the system
Generating capacity (excluding imports) = maximum generation capacity of the system
Generating capacity (including imports) = maximum capacity of the system including imports (i.e. maximum import capacity of all interconnectors)
Generating capacity (At the time of peak demand) = actual system capacity available at the time of the system MD

Table 1. continued

	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
Transmission system							
Ownership	public	Private	mostly public	private	public	private	public
Distribution system							
No. of distribution companies	105	15	200	4	235	14	1
Ownership	private/public	public	public	private	public / private	private	public
Payment of use of system charges	in transmission tariff	direct from liberalised consumers, in tariff for captive consumers	in transport tariff to transmission system operator	direct from liberalised consumers and via suppliers in tariff for captive consumers	in transmission tariff	via suppliers	in public tariff
Electricity market							
Is the market fully liberalised?	yes	No	yes	no	yes	yes	No
Timetable for liberalisation							
tranche 1	> 500 kW, 1995	>2 MW demand, 1999	all consumers(1), 1995	>15 GWh/year, 1/98	all consumers(1), 1996	>1 MW demand, 1990	35% (02/01)
tranche 2	all consumers (1), 1997	>3 x 80A connection, 2002	all consumers(2), 1997	>5 GWh/year, 1/99	all consumers(2), 1999	>100 kW demand, 1994	based on EU directive
tranche 3	all consumers(2), 1998	all consumers, 2007		>3 GWh/year, 4/99		all consumers, 1998	
tranche 4				>2 GWh/year, 7/99			
tranche 5				>1 GWh/year, 10/99			
tranche 6				all HV consumers, 7/00			
tranche 7				all consumers, 2007			

Table 1. continued

	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
Electricity traded through;							
Electricity pool / spot market	2 TWh / 3%	6.1 TWh / 6%	36 TWh / 9.8%	168 TWh / 95%	23 TWh / 16% Elspot 0.6 TWh Elbas(3)	282.3 TWh/ 100 % (2)	n/a
Imbalance market	not known	0 TWh / 0%	6 TWh / 1.6%	9 TWh / 5%%	1.1 TWh / 1%	-	n/a
Contracts for differences(*)	not known	not known	61 TWh / 16.7%	0	0	not publicly available (3)	n/a
Bilateral contracts	about 20 TWh / 25 % (long term contracts) short term contracts not known	20 TWh / 20%	233 TWh / 63.7%	0	118 TWh / 83% (physical). approx. 220 TWh financial	-	n/a
Futures	2 TWh / 3%	0 TWh / 0%	-	0	216 TWh (Nordpool)	-	n/a
Options	not known	0 TWh / 0%	30 TWh / 8.2%	0	Included in Futures	-	n/a
Suppliers, Traders, Brokers							
no. of suppliers	180	15	250	4	100 – 200	38	1
no. of traders	about 10	20	6	0	35	0	0
no. of brokers	about 5	5	15	0	10	0	0
% of electricity traded through non-local supplier	estimated 10 – 15%	25%	~5%	Unknown	7% (4)	28% (4)	0
Notes	(1) consumers must also have hourly metering (2) consumers <45 kW need not have hourly metering		(1) consumers must have hourly metering and must pay fee to local supplier (2) consumers **<**400 MWh/year need not have hourly metering. No fees payable		(1) consumers must have hourly metering (2) small consumers do not require hourly metering (3) between March and December (4) domestic consumers only, not applicable for other consumers	(1) England, Wales and Scotland (2) England and Wales (3) it is estimated that 90% of electricity traded through the pool is covered by CfDs (4) For 1997. By end 1998, 5% of domestic consumers (1.3 million) have changed their supplier	

(*) A Contract for Differences (CfD) is a contract which sets an agreed strike price between two parties, with one party making a payment to the other when the Pool price does not match the strike price.

3.1 Changes to the UK Market

The way that electricity is traded in the UK changed in March 2001. The New Electricity Trading Arrangements (referred to as NETA) consists of forwards markets where generators, suppliers and consumers agree bilateral energy contracts up to 3.5 hours ahead of the time of delivery. A balancing mechanism (or market) where only the System Operator can accept bids to resolve constraints on the transmission system and to balance generation and demand in real time then follows this. In setting out these trading arrangements, the UK Regulator (OFGEM) always stressed the importance of active demand participation, particularly in revealing a market price that reflects the consumer view. However, it is too early to determine how these new trading arrangements will impact on the opportunities for demand side bidding in the UK.

4 Demand Side Bidding

Demand Side Bidding (DSB) is a mechanism that enables the demand side to participate in the electricity trading market. There are two basic categories of DSB products - those involving a bid for the total demand and those involving a bid for a change in demand. Both of these types of products are important as they offer consumers the opportunity to manage their consumption of electricity and thus, have an impact on the global environment.

Measures aimed at producing long-term changes in demand, e.g. traditional Demand Side Management programmes that result in permanent demand reduction, are outside the scope of this Task. Although such programmes are beneficial in terms of energy efficiency, these are covered in detail in other IEA DSM Tasks. The types of demand side bids that are included within this Task are those that are typically made over a timescale ranging from a year to a few seconds ahead of the time of delivery of the electricity.

4.1 Bid for Total Demand

A bid for total demand can take one of two basic forms. Firstly, consumers and generators can agree a contract for a volume of electricity at a fixed price. This type of contract is typically referred to as a bilateral contract. In some cases, it may be a supplier that enters into the bilateral contract with the generators instead of the consumers themselves.

Alternatively, consumers can bid their total demand into an electricity market or pool in a similar way to that undertaken by generators. In these schemes, consumers bid how much electricity they will consume for a given price, and generators bid how much electricity they will generate for a given price. This results in two price-demand curves, as shown in Figure 2 below. One is a generation curve showing the increase in generation costs with increased demand, and the other is a customer curve showing a reduction in demand in response to increased cost. The point at which the two curves intersect determines the contract price.

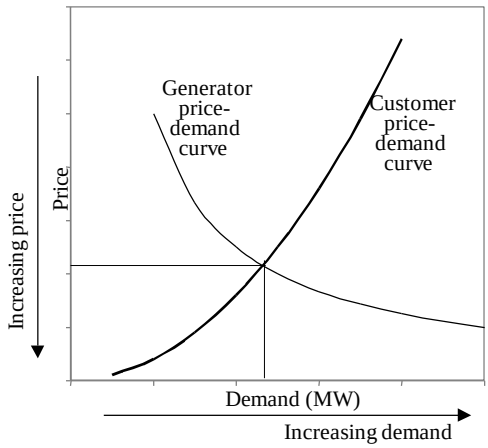

Figure 2. Price-demand curve

4.2 Bid for a Change in Demand

In these Demand Side Bidding schemes, customers (consumers) bid a change in their demand for electricity. For example, consumers could bid to reduce their demand, as shown in Figure 3, to assist the operator of the transmission network with maintaining the quality of supply.

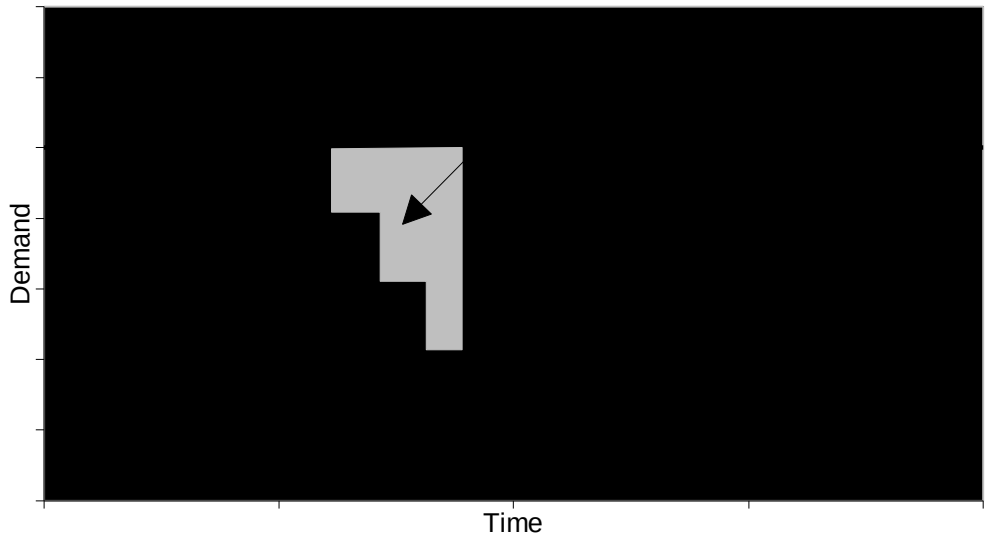

Figure 3. Demand reduction bid

The bid for a change in demand can be an offer to reduce or increase demand. The demand block can be an offer from an individual customer, e.g. a large industrial consumer, or from a group of smaller customers, e.g. domestic consumers.

The properties of a DSB block are defined by;

1. **The trigger price.**
   The price at which a consumer is willing to change their demand.
2. **The size and shape of the DSB block.**
   The size of the change in load, the shape of the load profile, and the duration for the change in consumption behaviour.
3. **The notice required for the change in demand.**
   Some consumers can shed load within a few seconds notice while other consumers will require more notice, for example a few minutes, or hours.
4. **Any limitations.**
   Is there a maximum number of occasions that a consumer can be called upon to change their load profile?
5. **Change in overall energy consumption.**
   Will the DSB block result in an overall energy saving for the consumer, ashift of energy consumption, or an increase?
6. **Fee structure.**
   Is the consumer paid only when the bid is accepted or is the consumer paid an availability fee?
7. **Communication.**
   How is the acceptance of the DSB block relayed to the consumer?
8. **Control.**
   How is the load consumption pattern changed?

9. **Monitoring.**
   How is the consumption behaviour of the consumer monitored?
10. **Buyer.**
    Who is purchasing the DSB block and why?

4.3 Categories of DSB products

DSB products can exist between the consumer and almost any of the other market participants, as suggested by the schematic below.

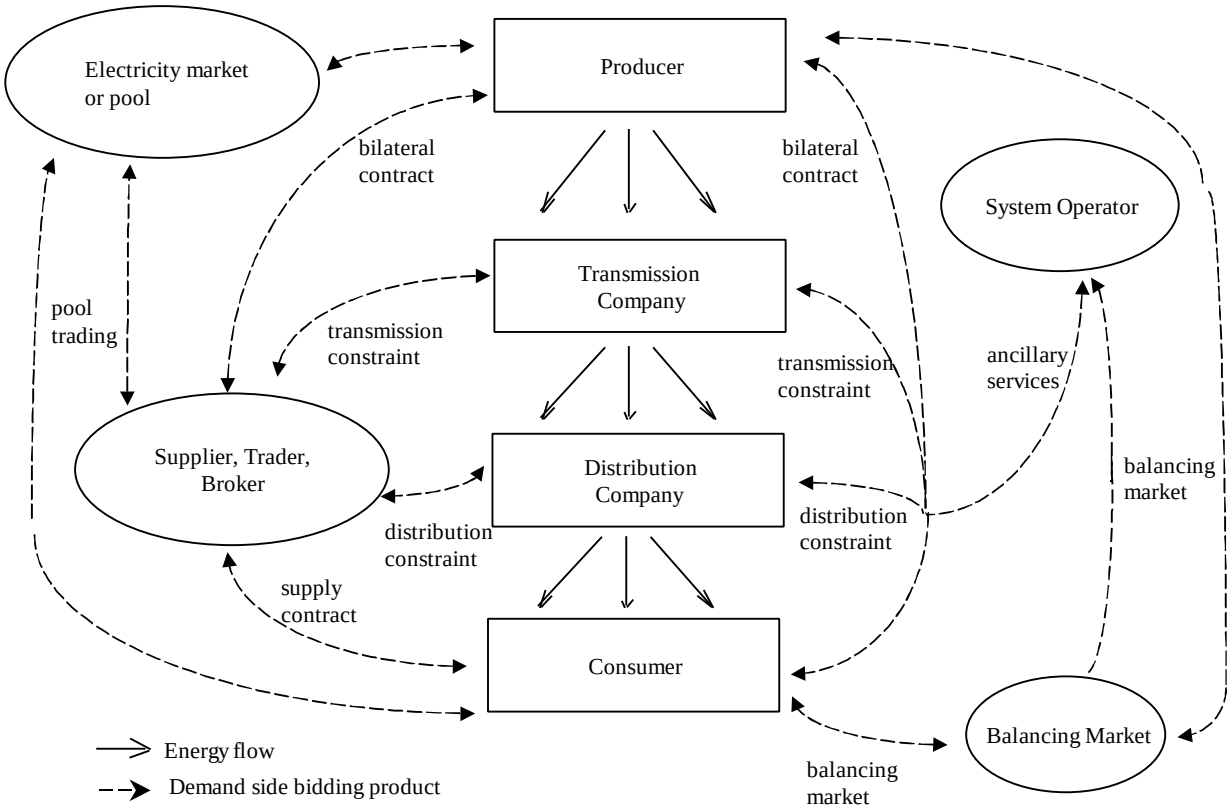

Figure 4. Schematic showing possible DSB products between the market participants

The above schematic shows some of the DSB products that can be offered in the electricity market place. The products have been broadly divided into the following categories as listed below:

- Ancillary services
- Supply contracts
- Spot market / electricity pool trading
- Bilateral contracts
- Balancing market
- Transmission / distribution constraints

These DSB products are discussed in detail below in Sections 4.3.1 to 4.3.6. The main difference between these products is the time that bids are offered and accepted in the market place, as indicated in Figure 5 below. For example, demand bids may be agreed several months or years in advance under supply contracts, but the actual demand shift required under ancillary services contracts may not be known until a few minutes or even seconds ahead the time of delivery.

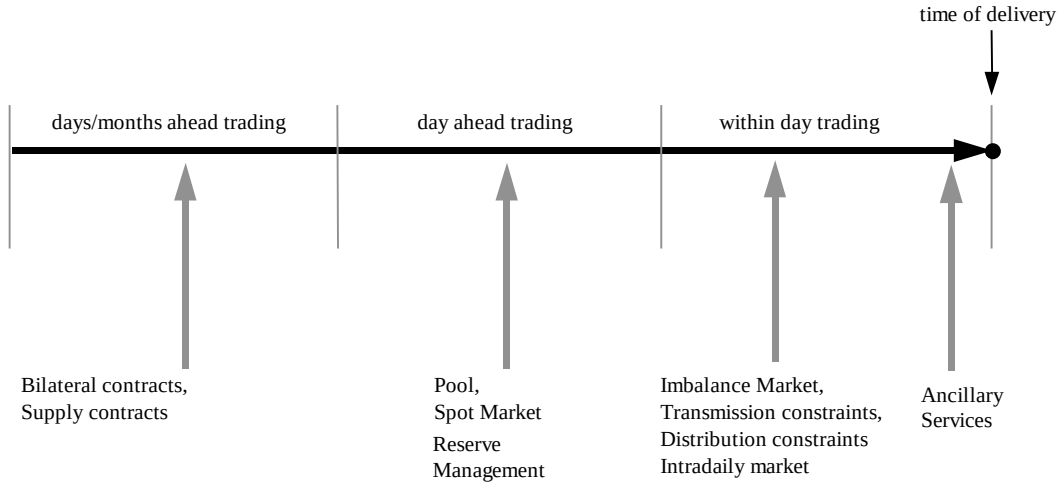

Figure 5. Timescale for bids for different DSB products

4.3.1 Ancillary Services

Ancillary Services are typically contracted for by the system operator, and are used to maintain the security and quality of the electricity supply. There are many different types of ancillary services required by a network operator, including ;

- Frequency control
- Voltage control / Reactive power
- Reserve
- Black start

This is one area where Demand Side Bidding products have been successfully operating in many of the participating countries; these experiences are discussed later in Section5. A brief description showing how DSB can help in each of these areas is given below:

- **Frequency control:** All generators are required to provide a minimum level of frequency control to maintain the frequency within specified levels. Generators can also provide additional frequency response to provide response at short notice for unexpected changes in demand or generation. Such a service can be offered by partially loaded steam plant, partially loaded gas turbines, pumped storage or load reduction.

- **Voltage Control / Reactive Power:** These services can be provided by:
  - Synchronous Generators – synchronous generators can be made to generate or absorb reactive power depending upon the excitation applied.
  - Synchronous Compensators – can provide reactive power without producing any real power (Typically, these are smaller generators, which once run up to speed and

synchronised to the system, can be declutched from their turbine to provide reactive power and no real power).
  - Capacitors and Inductors – connected to the system to adjust voltage levels.
  - Transformers – tap changers
  - Transformers – boost voltage

- **Reserve**: Contingency needs to be available in case of unexpected changes to demand or available generation. This is provided by:
  - Standby generation – a generation station held in a state of readiness to generate at short notice. Under these circumstances, fuel will be used to prepare the boiler and maintain it in a state of readiness.
  - Partially loaded steam plant
  - Partially loaded gas turbines
  - Pumped storage
  - Load reduction

- **Black Start:** This is an important quick response service for which there is no DSB alternative. However, the nature of this service is explained for completeness. Black start is the recovery procedure from a total or partial failure of the electricity transmission system. Generators, with the exception of some small hydro-electric generating stations, take electricity from the transmission system in order to start up. Therefore, to be able to 'black start' a generator must have auxiliary supplies. Gas turbines or diesel generators using a battery for start-up generally provide this.

4.3.2 Supply Contracts

Supply contracts offered by Suppliers to their customers are a relatively simple way of allowing consumers to participate in the electricity market. The contract typically takes the form of an interruptible tariff, whereby consumers are offered a favourable rate for their electricity in return for allowing an interruption their electricity supply. The interruption could apply to the whole load of the consumer, but is more likely to apply to part of the load, for example electric hot water heating or space heating. Such contracts usually include a clause to restrict the number of times that interruptions will take place. These types of contracts are reasonably widespread within the participating countries, and are offered to small and large consumers alike.

Another variation on the supply contract offers the consumer a favourable off-peak tariff, but the period of availability of the off peak electricity is determined by the supplier on a day by day basis.

Both of these types of contract help the supplier to manage the demand of their customers, and thus meet any contractual obligations they may have with the electricity markets or generators.

4.3.3 Spot Market / Electricity Pool Trading

In some countries, electricity can be traded through a spot market or electricity pool. These provide a market through which generators can sell electricity, and suppliers and consumers can buy electricity. In some cases, traders are also permitted to participate in the market without ever taking delivery of the electricity themselves.

Some electricity pools (e.g. Nord Pool in Scandinavia) take both generation offers and demand bids and set the price of electricity at the intersection of the aggregate supply and demand curves. Other electricity pools (e.g. the electricity pool in England & Wales prior to March 2001) take bids only from the generation side. Demand is estimated by the system operator, and the price of electricity is set by the marginal generating set. The marginal generating set is the most expensive generating unit required to meet the forecast demand in each half-hour. This price, known as the system marginal price, determines the price that all participants are paid for the electricity they generate (or pay for the electricity they consume), i.e. participants are not 'paid as bid.' However, the England & Wales pool prior to March 2001 permitted the participation of a limited number of consumers by treating an offer for a reduction in demand in a similar way to an offer for generation. Some pools set the price for electricity at the day ahead stage (ex-ante) whilst others set their price after delivery has taken place (ex-post).

4.3.4 Bilateral Contracts

A bilateral contract is an agreement on the price and quantity of electricity made between two parties. Such agreements are often made between suppliers and generators, but large consumers will also enter into such agreements.

4.3.5 Balancing Market

Some countries operate a balancing market to ensure that the amount of electricity generated exactly matches the demand at any time. Therefore, consumers who do not have contracts covering their demand are exposed to the price in the balancing market for their demand. Similarly, generators who cannot meet their contractual obligations are also exposed to prices in the balancing market. Demand side bids for a change in demand can often be traded alongside the generation bids in the balancing market.

The System Operator is generally the organisation that organises the balancing market. Generators, suppliers and consumers can offer bids to the balancing market. For example, if generation is not sufficient to meet the expected demand, the System Operator can accept a bid from a generator to increase generation output. Alternatively, the System Operator can accept a bid from a consumer to reduce demand. The cost of meeting these imbalances is determined solely by the terms of the bids offered by generators, suppliers and consumers. At certain times, for example at times of peak demand, the prices in the balancing market could be very high. Therefore, exposure to prices in the balancing market can be very risky.

4.3.6 Transmission and Distribution Constraints

Transmission and distribution constraints are bottlenecks that occur either on the national transmission system or on a regional distribution system, when there is insufficient capacity to transmit electricity into a particular region. The demand side has the opportunity to help alleviate these constraints by offering to reduce demand when these bottlenecks occur. Countries differ in how transmission and distribution constraints are dealt with, and more importantly how the costs of alleviating these constraints are paid for. The costs can be allocated on a nodal or zonal basis, so that the costs are more directly targeted at those participants who cause the constraints. Alternatively, market participants may be treated in a non-discriminatory manner and the costs of constraints are then averaged amongst all of the market participants.

5 Experiences

The aim of this section is to provide an overview of the experiences with Demand Side Bidding within each of the participating countries, more detailed information can be found in the individual country reports found in the Appendix. Tables 2 and 3 provide an overview of the different DSB products that can operate and are operating in each of the participating countries. The results of the country surveys show that whilst the electricity markets in all but one of the participating countries do permit DSB products to operate, in practice, there are very few schemes currently operating successfully. Moreover, those schemes that are operating are often only available to a few large industrial consumers, and demand bids, e.g. interruptions to consumer's supply, are rarely invoked.

All but one of the countries surveyed have a spot market or pool that allows the demand side to participate, however, the extent to which the demand side does participate is very limited. For example, in the England and Wales electricity pool, the demand side are currently not able to bid their total demand requirements, but instead a limited number of large consumers are permitted to offer demand reduction bids that are treated in a similar way to generation[2]. In the other countries with an electricity spot market or pool, the liberalised consumers are permitted to offer bids for their total demand into the day-ahead spot market or pool. However, very few, if any, of the consumers who participate in these markets then re-trade this electricity in the within day or balancing markets, although they could do so, due to the low clearing prices within these markets.

The only way for domestic consumers to participate in DSB schemes is through a supply contract offered by their Supplier. Such contracts are offered to consumers with direct electric heating in Finland. In return for a favourable tariff, the Supplier has the option of interrupting the supply to a consumer's heating system a limited number of times each year. However, feedback obtained during the survey suggests that whilst the contracts are popular with consumers, the interruptions to supply are not. In practice, interruptions are rarely, if ever, invoked.

Ancillary services seems to be the main area where DSB products are operating successfully, although such products are only available to large industrial sites. In this area, the demand side can actively participate in maintaining the quality and security of supply and benefit financially from doing so. The main barrier to participation in such schemes is the need for automatic control to allow the system operator to activate the demand change, often at little or no notice to the consumer.

Table 5 provides a list of the DSB products that are available in the participating countries, whilst Table 4 provides a description of the information provided in Table 5.

[2] NB. The Electricity Pool in England and Wales no longer exists, and has now been superseded by New Electricity Trading Arrangements. Under these arrangements consumers will be able to bid into the Balance Mechanism, but at the time of writing it is too early to determine the extent of any consumer participation.

Table 2. Summary of which DSB categories are permitted to operate in the participating countries

Country	Ancillary Services	Transmission Constraints	Supply Contracts	Balancing Market	Spot Market
Finland	✓	✓	✓	✓	✓
Netherlands	✓	✓	✓	✓	✓
Norway	✓	✓	✓	✓	✓
Spain	✓	✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓
UK	✓	✓	✓	✓(*)	✓(*)
Greece					

✓	This DSB category is permitted to operate

(*) The UK did not have a balancing mechanism prior to March 2001. However, the New Electricity Trading Arrangements, saw the introduction of a balancing market into the UK. Prior to NETA, a limited number of consumers where able to offer demand reduction bids into the electricity pool. The electricity pool no longer exists under NETA. However, there are a number of power exchanges that offer consumers the opportunity to purchase electricity through a variety of contracts.

Table 3. Summary of which DSB categories are operating in the participating countries

Country	Ancillary Services	Transmission Constraints	Supply Contracts	Balancing Market	Spot Market
Finland	✓		✓		
Netherlands					
Norway		✓	✓		
Spain			✓		✓
Sweden	✓				
UK	✓	✓	✓	(*)	(*)
Greece					

✓	This DSB category is operating

(*) Since the introduction of the New Trading Arrangements in the UK in March 2001, consumers are able to bid into the Balance Mechanism. Prior to NETA, a limited number of consumers where able to offer demand reduction bids into the electricity pool. The electricity pool no longer exists under NETA. However, there are a number of power exchanges that offer consumers the opportunity to purchase electricity through a variety of contracts.

Table 4. Description of information provided in Table 5.

Country - product number	Description of information provided
Name	The name given to the product
The purpose of the product	The DSB category
The buyer of the product	The organisation who buy the product
Is a trader or aggregator involved?	Does a trader or aggregator act between the buyer and the seller?
The seller of the product	The type of consumers who sell the product
Duration of the contract	The duration of the contract between the buyer and seller
Firmness of the bid (MW)	Is the size of demand bid firm, i.e. is the exact size of the demand bid known in advance?
Penalty for non-compliance	Is there a financial penalty for non-compliance?
Control system	The type of control system, i.e. manual or automatic If automatic, the type of control should also be provided
Monitoring system	The type of system used to monitor the demand bid
Who makes any necessary investment?	Who makes the investment for the communication, control and monitoring systems required?
Is the bid for total demand or for a change in demand?	Is the bid for total demand or for a change in demand?
If product involves change in demand;	
Notice given for change in demand	How much notice is given to the seller for the change in demand
Maximum occasions that demand can be changed	The maximum occasions that demand can be changed as defined in the contract between the seller and the buyer
Limitations on the size of demand	The minimum size for any demand bid?
Duration of the demand reduction	Is the duration of any demand reduction bid fixed or variable?
Is a there an availability fee?	Is a payment made for offering a change in demand?
Amount of the availability fee	The payment made for offering a change in demand
Is there a trigger fee?	Is a payment made when the demand bid is accepted?
Amount of the trigger fee	The payment made when the demand bid is accepted
Demand bid	
The process whose demand is changed	The type of process for which the demand bid is made, e.g. water heating, furnace
Is the energy reclaimed at a later time?	If the bid involved a bid for a reduction in demand, is the energy reclaimed at a later date?
The size and shape of the DSB block	The size of the change in load, the shape of the load profile, and the duration for the change in consumption behaviour
Participation / use of product	
Number or participants	The estimated number of participants
Total MW demand	The total (aggregated) demand bids for all participating consumers
Typical number of occasions that demand is changed	The typical number of occasions per consumer, that the demand is changed
Additional notes	

Table 5. Available DSB products

Country – product number	**Finland - 1**	**Finland - 2**	**Finland - 3**
Name	DSB as momentary disturbance reserve	DSB as fast disturbance reserve	DSB in balancing market
The purpose of the product	Ancillary Services: Automatic frequency control	Ancillary Services: Maintain system security after larger disturbances	Balance supply and demand within 1 hour of delivery
The buyer of the product	System Operator	System Operator	System Operator
Is a trader or aggregator involved?	No	No	Yes
The seller of the product	Large industrial consumers	Large industrial consumers	Suppliers
Duration of the contract	1 year	1 year	not applicable
Firmness of the bid (MW)	Non firm	Non firm	Firm - once accepted
Penalty for non-compliance	Non-payment (if lack of reserves in Finland then payment)	Non-payment (if lack of reserves in Finland then payment)	Exposed to price in balancing market
Control system	Automatic	Automatic	Manual
Monitoring system	In real time, by System Operator	In real time, by System Operator	In real time, by System Operator
Who makes any necessary investment?	System Operator	System Operator	Consumer
Is the bid for total demand or for a change in demand?	Reduction of demand	Reduction of demand	Reduction of demand
If product involves change in demand;			
Notice given for change in demand	None	Few minutes	Maximum of 10 minutes
Maximum occasions that demand can be changed	None	none	None
Limitations on the size of demand	Not known	Not known	Minimum of 10 MW
Duration of the demand reduction	Variable	Variable	15 min - 1 hour
Is a there an availability fee?	Yes	Yes	No
Amount of the availability fee	0 - 15,000 - 30,000 FIM/MW(*)	0 - 15,000 - 30,000 FIM/MW	n/a
Is there a trigger fee?	Yes	Yes	Yes
Amount of the trigger fee	10 FIM/MWh	2 FIM/MWh	Marginal bid price
Demand bid			
The process whose demand is changed	Process industry	Process industry	No participants
Is the energy reclaimed at a later time?	Yes	Yes	n/a
The size and shape of the DSB block	Variable	Variable	Variable
Participation / use of product			
Number or participants	5 consumers	5 consumers	None
Total MW demand	330 MW	330 MW	
Typical number of occasions that demand is changed	Once every three years	Once a year	-
Additional notes	(*) Depending on availability of load 1 Euro ≈ 5.95 FIM 1 US$ ≈ 6.21 FIM	Can also be offered into balancing market	No demand bids are currently made into balancing market due to low prices

Table 5. continued

Country – product number	**Finland – 4**	**Finland – 5**	**Finland - 6**
Name	Supply contracts	consumer owned diesels	Large electric boilers
The purpose of the product	Peak load reduction through interruptible tariff	Peak load reduction through consumer generation	To switch off electric boilers during peak load or disturbance periods
The buyer of the product	Suppliers	Suppliers	Suppliers
Is a trader or aggregator involved?	No	No	No
The seller of the product	Domestic consumers with direct electric heating	Consumers with reserve diesel plants	District heating companies having electric boilers
Duration of the contract	Long term (continuous)	Long term	Long term
Firmness of the bid (MW)	Not applicable	Negotiable	Not firm (boilers are not always in use)
Penalty for non-compliance	not applicable	None	None
Control system	Automatic	Manual	Manual
Monitoring system	None	Local meter	Local meter
Who makes any necessary investment?	Suppliers	Consumer	Consumer
Is the bid for total demand or for a change in demand?	Reduction of demand	Reduction of demand	Reduction of demand
If product involves change in demand;			
Notice given for change in demand	None	Through phone beforehand	Through phone
Maximum occasions that demand can be changed	1 or 2 per day	None	None
Limitations on the size of demand	None	None	None
Duration of the demand reduction	Usually 0,5 to 2 hours	Variable, usually some hours	Variable
Is a there an availability fee?	Yes	No	No
Amount of the availability fee	50% reduction in fixed charge (typically 300 to 500 FIM / yr)	n/a	n/a
Is there a trigger fee?	No	Yes	Yes
Amount of the trigger fee	n/a	Negotiable	Negotiable
Demand bid			
The process whose demand is changed	Direct electric heating of domestic consumers	Consumers with reserve diesels plants	Electric boilers
Is the energy reclaimed at a later time?	Yes	No	No
The size and shape of the DSB block	Variable	Variable	Variable
Participation / use of product			
Number or participants	30 - 50,000 consumers	Not known (some tens)	Not known
Total MW demand	50 - 100 MW	not known	Not known
Typical number of occasions that demand is changed	Rarely	0 - 20 times	Not known
Additional notes			

Table 5. continued

Country - product number	**Norway – 1**	**Norway – 2**
Name	2 hour interruptible power	24 hour interruptible power
The purpose of the product	System protection, reduction of constraints	System protection, reduction of constraints
The buyer of the product	System operator, Network operator	System operator, Network operator
Is a trader or aggregator involved?	Yes	Yes
The seller of the product	Industrial and commercial consumers with electric boilers	Industrial and commercial consumers with electric boilers
Duration of the contract	Long term	Long term
Firmness of the bid (MW)	not applicable	not applicable
Penalty for non-compliance	None	None
Control system	Manual and automatic	Manual
Monitoring system	Time series of load	Time series of load
Who makes any necessary investment?	Consumers	Consumers
Is the bid for total demand or for a change in demand?	Reduction of demand	Reduction of demand
If product involves change in demand;		
Notice given for change in demand	2 hours	24 hours
Maximum occasions that demand can be changed	No limit	No limit
Limitations on the size of demand	No limit	No limit
Duration of the demand reduction	No limit	No limit
Is a there an availability fee?	Yes	Yes
Amount of the availability fee	Reduced transmission tariff. Connection fee from 13 to 0 NOK/kW. Peak demand fee from 57 to 3 NOK/kW.	Reduced transmission tariff. Connection fee from 13 to 0 NOK/kW. Peak demand fee from is 57 to 15 NOK/kW.
Is there a trigger fee?	No	No
Amount of the trigger fee	-	-
Demand bid	No	No
The process whose demand is changed	Consumers with dual oil / electric boilers	Consumers with dual oil / electric boilers
Is the energy reclaimed at a later time?	No	No
The size and shape of the DSB block	Variable	Variable
Participation / use of product		
Number or participants		
Total MW demand	Total 325 MW	Total 200 MW
Typical number of occasions that demand is changed	Once or twice a year	Once or twice a year
Additional notes	1 Euro ≈ 8.29 NOK 1 US $ ≈ 8.66 NOK	

Table 5. continued

Country - product number	**Spain – 1**	**Spain – 2**	**Spain – 3**
Name	Energy trading	Balancing Market	Interruptible tariffs
The purpose of the product	Day ahead trading of electricity	Balance supply and demand near to time of delivery	System protection, reduction of constraints
The buyer of the product	Market operator	Market operator	System operator
Is a trader or aggregator involved?	Yes, suppliers	Yes, suppliers	No
The seller of the product	Suppliers, distribution companies and liberalised consumers	Suppliers, distribution companies and liberalised consumers	Consumers with a general tariff in high voltage
Duration of the contract	not applicable	not applicable	Five years
Firmness of the bid (MW)	Yes	Yes	Yes
Penalty for non-compliance	Exposure to prices in balancing market	Exposure to prices in balancing market	Yes
Control system	Manual	Manual	Manual
Monitoring system	Market operator	System Operator	Time series of load
Who makes any necessary investment?	Seller	Seller	Seller
Is the bid for total demand or for a change in demand?	Demand can be segmented in blocks	Change in demand	Reduction of demand
If product involves change in demand;			
Notice given for change in demand	At 10 am on day before	In six intradaily markets	4 types: A: 16 hours, B:6 hours, C:1 hour, D: 5 minutes
Maximum occasions that demand can be changed	No maximum	No maximum	30 times/year with a maximum of 1/day, 5/week, 120 hours/month and 240 hours/year
Limitations on the size of demand	Min of 1MW	None	Min of 5 MW
Duration of the demand reduction	Variable	Variable	Maximum: A: 12 hours, B:6 hours, C:3 hour, D: 45 minutes
Is a there an availability fee?	No	No	Yes
Amount of the availability fee	-	-	Reduced tariff
Is there a trigger fee?	No	Yes	-
Amount of the trigger fee	Bid price	Bid price	-
Demand bid			No
The process whose demand is changed	Not known	Not known	Not known
Is the energy reclaimed at a later time?	Not known	Not known	No
The size and shape of the DSB block	Variable	Not defined	-
Participation / use of product			
Number or participants	Few (14)	Few	95 (January 2000)
Total MW demand			
Typical number of occasions that demand is changed	Not known	Not known	
Additional notes		Necessary to participate in Energy trading	

Table 5. continued

Country - product number	Sweden-1	Sweden-2	Sweden-3
Name	Balance service (regulating market)	Elbas: spot market for at least 2 hours ahead	Elspot: spot market for the next day
The purpose of the product	To secure the physical balance of the system and to distribute the costs of this service among suppliers / traders	Be able to adjust the bids to Elspot	The reference price for the market. Input for plans for next day.
The buyer of the product	System operator	The Power Exchange	The Power Exchange
Is a trader or aggregator involved?	Yes - supplier/trader	Yes - supplier/trader.	Yes - supplier/trader.
The seller of the product	Suppliers/traders	Suppliers/traders	Suppliers/traders
Duration of the contract	Very short term	Rather short term	Short term
Firmness of the bid (MW)	No bid	Firm	Firm
Penalty for non-compliance	Buy and sell-prices on the balance market	Trade on the balance market	Trade on the balance market
Control system	Manual	Manual	Manual
Monitoring system	In some cases real time metering.	In some cases real time metering.	In some cases real time metering.
Who makes any necessary investment?	The consumer, if not renegotiated.	The consumer, if not renegotiated.	The consumer, if not renegotiated.
Is the bid for total demand or for a change in demand?	Reduction of demand	Reduction of demand	Reduction of demand
If product involves change in demand;			
Notice given for change in demand	Within the hour.	2 hours	12-36 hours
Maximum occasions that demand can be changed	No limit.	No limit	No limit
Limitations on the size of demand	No limit	No limit	No limit
Duration of the demand reduction	No limit	No limit	No limit
Is a there an availability fee?	No (1)	No (1)	No (1)
Amount of the availability fee	Small, if part of the supplier/traders fees.	Small, if part of the supplier/traders fees.	Small, if part of the supplier/traders fees.
Is there a trigger fee?	Yes (1)	Yes (1)	Yes (1)
Amount of the trigger fee	-	-	-
Demand bid	No	The consumer puts price-necks on demand to supplier/trader.	The consumer puts price-necks on demand to supplier/trader.
The process whose demand is changed	Dual oil /electric boilers, and small reserve power generation at consumer	Dual oil /electric boilers, and small reserve power generation at consumer	Dual oil /electric boilers, and small reserve power generation at consumer
Is the energy reclaimed at a later time?	Not in dual boilers and reserve power. Often yes in other use.	Not in dual boilers and reserve power. Often yes in other use.	Not in dual boilers and reserve power. Often yes in other use.
The size and shape of the DSB block	To be seen in future.	To be seen in future.	To be seen in future.
Participation / use of product	To be seen in future.	To be seen in future.	To be seen in future.
Number or participants	0	0	0
Total MW demand		0	0
Typical number of occasions that demand is changed	Once during winter 1999/2000.	-	0
Additional notes	(1) unless renegotiated with supplier/trader.	(1) unless renegotiated with supplier/trader.	(1) unless renegotiated with supplier/trader.

Table 5. continued

Country - product number	UK – 1	UK - 2	UK - 3
Name	Demand Side Bidding	Ancillary Services	Ancillary Services
The purpose of the product	Day ahead trading of electricity	Frequency control	Standby reserve
The buyer of the product	Market operator	System operator	System operator
Is a trader or aggregator involved?	Yes – suppliers	Yes – suppliers	Yes – suppliers
The seller of the product	Large industrial consumers	Large industrial consumers	Large industrial consumers
Duration of the contract	Varies	Varies (1 year minimum)	1 to 2 years
Firmness of the bid (MW)	Yes	No	No
Penalty for non-compliance	Yes	Yes	Yes
Control system	Manual	Automatic	Manual or automatic
Monitoring system	Remote metering system	Remote metering system. telephone	Remote metering system
Who makes any necessary investment?	Market operator	Supplier/ system operator	Supplier/ system operator
Is the bid for total demand or for a change in demand?	Requires bid of total demand and amount to be reduced	Reduction of demand	Reduction of demand or increase in generation
If product involves change in demand;			
Notice given for change in demand	At day ahead stage, 12 hours	None, reduction is instantaneous	5 to 20 minutes
Maximum occasions that demand can be changed	No maximum	No maximum	No maximum
Limitations on the size of demand	Min of 10MW reducible load (1)	Minimum of 3MW to reducible load	3MW minimum to participate
Duration of the demand reduction	Variable – depends on pool price	Maximum of 30 minutes	Maximum of 4 hours (varies with contracts)
Is a there an availability fee?	Yes	Yes	Yes
Amount of the availability fee	Variable	Variable	?
Is there a trigger fee?	No	No	Yes
Amount of the trigger fee	System Marginal Price	-	?
Demand bid			
The process whose demand is changed	Cement mills, steel works and chemical plants	Cement mills, steel works and cold storage units	Water, cement, chemical and steelmaking companies
Is the energy reclaimed at a later time?	No	No	No
The size and shape of the DSB block	Variable	Variable	Varies
Participation / use of product			
Number or participants	38 sites (2)	33 sites	
Total MW demand	~1500MW	~160MW	655MW Total
Typical number of occasions that demand is changed	1 – 2 times a year	Up to once a month	5 – 6 times a year
Additional notes	(1) Must be at a single site, not aggregated (2) Maximum of 40 participants permitted NB. This is no longer available in the UK.		

Table 5. continued

Country - product number	**UK – 4**
Name	Ancillary Services
The purpose of the product	Transmission constraints
The buyer of the product	System operator
Is a trader or aggregator involved?	Yes – suppliers
The seller of the product	Large industrial consumers
Duration of the contract	Continuous
Firmness of the bid (MW)	Yes
Penalty for non-compliance	None
Control system	Manual or automatic
Monitoring system	Remote metering system
Who makes any necessary investment?	Supplier / system operator
Is the bid for total demand or for a change in demand?	Reduction of demand
If product involves change in demand;	
Notice given for change in demand	12 minutes for manual / none for automatic disconnection
Maximum occasions that demand can be changed	No maximum
Limitations on the size of demand	Typically around 50MW
Duration of the demand reduction	Varies, agreed in the contract
Is a there an availability fee?	Yes
Amount of the availability fee	Agreed in contract
Is there a trigger fee?	Yes
Amount of the trigger fee	?
Demand bid	
The process whose demand is changed	Any large companies in a location where system is traditionally under stress
Is the energy reclaimed at a later time?	No
The size and shape of the DSB block	Varies
Participation / use of product	
Number or participants	
Total MW demand	Approx. 250MW
Typical number of occasions that demand is changed	0 – 6 times a year
Additional notes	

6 Opinions

One of the sections of the questionnaire was concerned with obtaining the views of the market participants towards DSB. The consumers themselves are not included within the scope of subtasks 1 and 2 since their views will be obtained later in subtask 3. The aim is to establish whether or not these market participants view DSB positively or negatively. Such views are extremely important as they define the background against which any future DSB products must be introduced.

Tables 6 to 9 provide an overview of the general views of the market participants towards DSB. These Tables indicate the aspects of DSB products that are viewed positively by each of the market participants. The results show that there is no general consensus from the market participants in each of the countries surveyed. The aspects of DSB that are viewed most positively are:

- New market place products or business opportunities
- Stronger influence or more participation from demand side
- More efficient network and system operation

However, very few participants believe that DSB products can contribute towards improvements in the efficiency of operation of the network or to reduced carbon dioxide emissions.

The instances where participants have not indicated a positive view towards the various aspects of DSB products can be due to one of two reasons. They may hold negative views towards DSB, or alternatively, they may have insufficient knowledge or experience of DSB to express an opinion either way. The results of the questionnaire suggest that, in the majority of cases, the latter is the case and very little negative feedback towards DSB was received.

The Regulator has a key role in determining how electricity is traded. For example, if a Regulator believes that DSB products can make a contribution towards the Government's targets for CO_2 emissions, then it is likely that the Regulator will smooth the way for the introduction of new DSB products into the market place. The views of the Regulators varied considerably from country to country and, in one instance, even within a country. Spain has two Regulatory bodies that oversee the way that electricity is traded. The Ministerio de Industria y Energía (MINER) and the Cómision Nacional del Sistema Eléctrico (CNSE). Whilst one of the Regulators is of the opinion that DSB can help to fulfil the government's energy and environmental policies, the other Regulator does not believe that DSB is an efficient method of reducing CO_2 emissions.

The UK Regulator (OFGEM) has recently introduced new trading arrangements to replace the electricity pool. One of the key objectives of the new trading arrangements was to ensure greater participation of the demand side.

Table 6. System operator's / Transmission Network Operator's views towards DSB

	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
New market place products / business opportunities	✓	-	✓	-	-	-	-
More efficient market / improved market liquidity	-	-	-	✓	✓	-	-
Stronger influence / more participation from demand side	-	-	✓	-	✓	-	-
More efficient network and system operation	-	✓(1)	✓	✓	✓	✓	-
More efficient use of energy and power	-	-	-	✓	-	✓	-
Reduced CO_2 emissions	-	✓	-	✓	-	-	-
Notes:		(1) Useful for postponement of network reinforcement					

Table 7. Market operator's views towards DSB

	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
New market place products / business opportunities	✓	- (1)	-	✓	-	-	-
More efficient market / improved market liquidity	-	-	✓	-	✓	-	-
Stronger influence / more participation from demand side	-	-	✓	✓	✓	-	-
More efficient network and system operation	-	-	-	✓	-	-	-
More efficient use of energy and power	-	-	✓	-	✓	-	-
Reduced CO_2 emissions	-	✓	-	-	✓	-	-
Notes:		(1) Will develop market place for products					

Key	✓ = positive	✗ = negative	- = no response

Table 8. Supplier's views towards DSB

	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
New market place products / business opportunities	-	-	✓	✓	-	✓	-
More efficient market / improved market liquidity	✓	✓(1)	-	-	-	✓	-
Stronger influence / more participation from demand side	-	-	✓	✓	-	-	-
More efficient network and system operation	-	-	-	✓	✓	-	-
More efficient use of energy and power	-	-	✓	-	-	-	-
Reduced CO_2 emissions	✓	✓	✓	✓	-	-	-
Notes:		(1) Useful for portfolio/risk management					

Table 9. Regulator's views towards DSB

	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
General opinion towards DSB	✓	neutral (1)	-	neutral	-	✓	-
An efficient way of achieving energy and environmental policy objectives	-	✓	-	✓, ×(1)	-	-	-
Notes:	Alternative to network reinforce-ment	(1) Concerned only with fair treatment of all participants		(1) Regulators have opposite views			

Key	✓ = positive	× = negative	- = no response

7 Barriers

Barriers to successful DSB products exist for various reasons, and it is important to understand the existence of such barriers. These barriers may be real; i.e. the regulatory structure does not allow the participation of the demand side in the electricity trading markets. Alternatively, they could be perceived barriers, i.e. consumers may not be willing to purchase DSB products if it means an interruption to the supply to their heating or hot water systems.

Barriers to DSB products can be broadly classified into six groups:

- technical barriers
- structural barriers
- legal barriers
- ignorance
- financial
- traditional

Table 10 below provides an overview of the barriers that are perceived in each of the participating countries.

Table 10. Summary of barriers to DSB in the participating countries

Barrier	Finland	Netherlands	Norway	Spain	Sweden	UK	Greece
Technical	✓	✓	✓	✓		✓	✓
Structural	✓					✓	✓
Legal		✓					✓
Ignorance	✓	✓	✓	✓	✓	✓	✓
Traditional		✓	✓	✓	✓	✓	✓
Financial	✓	✓	✓		✓	✓	✓

Key	✓ = barriers exist

7.1 Technical Barriers

The main technical barriers to the introduction of DSB products are concerned with the need to control and monitor the demand bids.

For consumers with large demands for electricity, the financial benefits of DSB products will outweigh the additional costs for any technology that is required. For example, large consumers are often already required to have half-hourly or hourly metering, and thus there are only modest additional costs associated with monitoring their demand bids. However, the additional costs of metering, telemetry, communication and monitoring for smaller consumers would far outweigh any benefits they may receive.

The control of consumers' loads can be either done remotely, for example by the system operator for frequency control purposes, or can be done manually by the consumers themselves in response to a message from the system operator or simply in response to the

price of electricity. Controlling consumer loads remotely is well established in many countries, and technology is available to allow the loads of large and small consumers alike to be controlled. For example, ripple control has been used in some of the countries participating in this project to control the heating or hot water systems of domestic consumers. Allowing consumers to control their load manually requires a method of communicating the need to shift demand to the consumer. This can operate successfully with large consumers, but is not likely to be successful with domestic consumers who may be unable or unwilling to change their demand upon request. The results of the surveys also show that domestic consumers are unwilling to accept any interruption to their supply if it means a loss of comfort or service. This suggests that domestic consumers need technology that automates the demand shifting process without any loss of comfort. For example, domestic consumers are only concerned that their houses are heated at minimum cost, and are not concerned whether this is achieved by storage heating or direct heating.

The results of the survey suggest that an additional barrier to the introduction of DSB products may be the additional complexity required to bill consumers. For example, consumers who offer demand reduction bids will need to be paid for electricity that they haven't used as well as charged for what they have used. However, this complexity can be avoided through the use of supply tariffs that cover the cost per unit of electricity consumed, irrespective of any demand interruptions that occur.

7.2 Structural barriers

Structural barriers, i.e. market rules that prevent the introduction of DSB products, were only identified in one of the participating countries, Greece. The structural barriers in Greece were broken into two areas; the market structure and the organisational structure within the vertically integrated utility that has a monopoly position within the electricity supply chain. However, this does not necessarily imply that structural changes are not required in any of the other countries. Changes to the way that electricity is traded may still be required to make it easier for the demand side to participate. For example, although a number of DSB products are currently operating successfully in the UK, there are structural barriers that currently prevent smaller consumers from participating. The electricity pool DSB scheme operating in the UK prior to March 2001 limited the number of participants to 40, and each consumer was required to be able to offer a demand reduction bid of at least 10 MW.

Although not strictly a structural barrier, geography can have an impact on the opportunity for DSB. For example, some of the islands of Greece are connected to the mainland by underwater cable, whilst other islands are completed 'isolated' from the mainland. Such fragmentation may make DSB difficult to implement. However, if suitable loads are available, DSB does offer an ideal opportunity to provide assistance with maintaining the quality and security of supply when importing electricity from neighbouring networks is not an option.

7.3 Legal barriers

Legal barriers are very much linked to the obligations placed upon the different market participants, and these barriers are closely related to the structural barriers. In an established market, such as in Norway, the roles of each of the market participants are clearly defined. However, in emerging markets, such as in the Netherlands, the roles are still being defined, and until these have been established it will be difficult for DSB products to flourish.

7.4 Ignorance

Ignorance is a major barrier to the development of DSB products. If participants do not fully understand the financial and environmental benefits of DSB products, then they cannot be expected to buy or sell them.

Ignorance was listed as a barrier to DSB by all of the participating countries. It can be overcome in a number of ways including education, demonstration projects, as well as the formation of an organisation with a responsibility to promote DSB products

7.5 Financial

Financial considerations are the major driving factor in the trade of any commodity, and unless there is a financial benefit consumers are unlikely to participate in DSB schemes, no matter how much they contribute to environmental efficiency.

For example, if the market price in the balancing market is low, as is the case in Finland, there is little or no incentive for consumers to offer bids to reduce their demand in order to offset additional generation.

A well developed program of DSB requires a high level of commitment from the market participants, and this is encouraged when the participants are incentivised to make profits. In countries such as Greece, where the electricity supply chain is dominated by a monopoly with little focus on making profits, the move to a competitive market, and one that involves DSB, may take some time to evolve.

7.6 Tradition

Tradition is often cited as a barrier to change, and DSB is no exception to this. For example, consumers may have long term supply contracts that protect them from the true market price and are unwilling to change their position. However, if consumers can see a financial benefit, without potential loss of service, they may be willing to investigate different supply contracts.

Alternatively, in Norway, there is a tradition that, regarding ancillary services, the demand side is not seen as a real market participant, and unless this view is reversed it is unlikely that new and successful products will be introduced into the market.

In some electricity markets, the consumers have traditionally taken a passive role in the economy, and therefore it may take time for these consumer to actively embrace the benefits associated with becoming active participants.

8 Conclusions

This report summarises the results of National surveys undertaken in seven countries, namely, Finland, Greece, Netherlands, Norway, Spain, Sweden and the UK. The aim of the National surveys was to gain an understanding of the views and opinions of market participants towards Demand Side Bidding, together with an overview of the different types of DSB products that are currently available. The full details of the National surveys can be found in the Appendix to this document.

This report also provides a definition of Demand Side Bidding, together with a detailed description of the different types of DSB products that can operate in the electricity market.

The results of the National surveys show that a wide range of different DSB products is already available, and detailed descriptions of the different DSB products are provided in this report. Whilst DSB products should be available for all demand side consumers, the surveys demonstrate that the vast majority of products are only available to a relatively small number of large consumers. However, DSB offers the potential for all consumers to actively participate in the electricity trading market, and Stage 2 of the project will investigate this potential in each of the participating countries.

The results of the National surveys also show that those consumers who do participate in DSB, have their demand changed on only very few occasions, typically less than 10 times per year. This is due to a number of reasons, including the view that consumers are generally reluctant to be subjected to too many interruptions. This is an important factor, because if the incentives (i.e. the financial rewards) are sufficient to compensate the consumer for any inconvenience or loss of production, then they may be more amenable to longer and more frequent interruptions. The view of consumers was not within the scope of this project, their views and opinions will be explored more fully in Stage 2 of the project.

Whilst the results of the National surveys show that DSB products are currently able to operate in six of the seven participating countries, the number of different DSB products that are actually operating varies considerably from country to country. For example, there are five different DSB products currently operating in Finland compared to none in Netherlands. The surveys show that barriers preventing the operation of successful DSB products exist in all of the participating countries. These barriers range from technical barriers that prevent DSB products from being correctly monitored and controlled, to ignorance of the financial and environmental benefits of DSB products. Probably one of the most important barriers identified was ignorance, whereby participants do not understand what Demand Side Bidding is, and therefore cannot appreciate the potential benefits of DSB. The potential benefits include the financial benefits to the consumer, together with the financial, technical and environmental benefits to the buyer of the product. Educating all market participants about DSB and its potential is, therefore, a key factor in ensuring the success of DSB.

Some of these barriers should be relatively easy to remove. For example, publicity, education and demonstration projects should ensure that the ignorance barrier is removed. However, some of the barriers may not be so easily removed. For example, overcoming legal and structural barriers often requires changes in legislation, which can take considerable time. Therefore, further work is required to identify clearly these barriers and suggest ways of either removing or overcoming them so that DSB products can operate successfully in the participating countries

The work presented in this report represents only the 'tip of the iceberg' and Stage 2 continues to investigate the potential for DSB. The survey of consumers will complete the survey of all market participants. The views and opinions of consumers, coupled with the results of the Stage 1 surveys will provide an overall picture of the views and opinions towards DSB in the participating countries. This, coupled with information on the types of technologies available for controlling and monitoring demand side bids, will develop a greater understanding of the factors that influence the success or otherwise of DSB.

Stage 2 will demonstrate the potential for DSB in the participating countries, together with an understanding of the impact of DSB on energy efficiency. It will evaluate the existing DSB products and determine to what extent they meet their objectives, identify the critical success factors, and understand the causes of any shortcomings. Once this has been completed, a further stage of work will be required to devise improvements to existing DSB schemes and propose new schemes that will overcome any previous limitations and attract active participants.

ACKNOWLEDGEMENTS

This report was prepared by the following Task Experts:

Linda Roberts	Operating Agent	EA Technology, UK
Seppo Kärkkäinen	Expert	VTT Energy, Finland
Jan Griffioen	Expert	ENECO, Netherlands
Klaus Livik / Bjorn Grinden	Expert	Sintef, Norway
Fernando Manzanares	Expert	ENDESA, Spain
Margareta Bergström	Expert	National Energy Administration, Sweden
Mark Bailey	Expert	Yorkshire Electricity, UK
Constantin Anastasopoulos / P. Efstathiou	Expert	Public Power Corporation, Greece

The authors would like to thank the following persons and organisations that contributed to this report.

VTT Energy, Finland

Public Power Corporation, Greece

Hellenic Republic Ministry of Development, Greece

A. G. Jongepier, KEMA, Netherlands

ENECO, Netherlands

Andrei Morch, Sintef, Norway

Sintef, Norway

NVE, Norway

Victòria Homar Pons, Gesa, Spain

Carlos González, UNESA, Spain

Minesterio de Industria y Energía, Spain

Comisión Nacional de la Energía, Spain

Compañia Operadora del Mercado Eléctrico, Spain

Red Eléctrica de España, Spain

ENDESA, Spain

IBERDROLA, Spain

UNIÓN FENOSA, Spain

Hidroeléctrica del Cantábrico, Spain

STEM, Sweden

EA Technology, UK

Yorkshire Electricity, UK