Appendix V: National report for Sweden

Margareta Bergström, March 2000

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

Contents

1 Summary

The Swedish power market was re-regulated on January 1, 1996 when competition was introduced regarding production and sales of electricity. All customers were free to change supplier from that date. However there was a requirement of costly hourly metering if you wanted to change supplier. November 1, 1999, that requirement was abolished for customers up to 200 A or 135 kW. Above that limit, hourly-metering equipment shall be provided by the network utilities to the customer without charge. From November 1, 1999, all customers may change supplier without any cost. A recent survey concludes that 7% of all household customers have changed supplier as compared with 5 % last fall. The abolishment of the metering requirement has had a substantial effect on the price of electricity to households.

The market consists of the following five different market roles: market operator, system operator, transmission network owner/operator, regulator/government, and supplier/trader.

In Sweden the interest for Demand Side Bidding (DSB) has been increasing during this project period due to shrinking effect of reserve capacity in the country - 2500MW of oil condensation plants have been taken out of production since 1996. DSB could become a more cost-effective way to provide reserve capacity for extreme high load situations. As these occur very seldom, it is extremely costly to keep production reserves for those situations.

Representatives from all main market roles are positive or neutral to new DSB products. The demand side in the market has so far not been examined about their opinion to DSB. On the other hand, other studies have been conducted by the Swedish national Energy Administration and by the Systems operator. These studies show that there is a substantial potential if the price temporarily gets sufficiently high.

The main arguments about advantages with DSB products are that it will increase power reserves, promote a more efficient power market, improve market liquidity, more efficient system operation. It is also mentioned that it will promote energy efficiency and reduce CO2 emissions not in Sweden, but in Denmark in peak periods as import of thermal power may be reduced.

Some old industry contracts still contain a right for the supplier to cut power in certain situations. These contracts will probably not be renewed in that form. Stronger incentives will be needed.

The System Operator has so far one contract with a large industry that gives the SO the right to reduce power supply up to 85 MW within short notice and for a short period of time. This contract is part of the ancillary reserve.

Advanced DSB products need technical systems and solutions for monitoring and billing purposes. So far it is not specified how such routines should be managed.

System operators' responsibility for balance and reliability represents a main driving force in the existing products that could be further developed to DSB products. The System Operator has introduced a strong economic incentive for the Balance Responsible Actors to avoid imbalance when there is risk for shortage. The Systems operator tries to stimulate the balance responsible companies (suppliers or traders) to go into negotiations with their customers on DSB products.

The spot market is organised in a way that makes it possible to implement new DSB products.

System operator and market operator should have the key role in establishing and promoting new market organisation for DSB products.

This report is a part of an IEA project on Demand Side Management Programmes (Task VIII) with Norway, Sweden, Finland, Netherlands, Spain and United Kingdom as participants.

2 Introduction

2.1 IEA/DSM

Sweden has participated in subtask 1 and 2 of the Task VIII of the IEA Implementing Agreement on Demand Side Management Technologies and Programmes. This is the Swedish national report, which is an appendix to the main report, summarising the national reports of all participating countries (Finland, Netherlands, Norway, Spain, UK and Sweden).

The overall aim of Task VIII is to evaluate and promote Demand-Side Bidding in the electricity market. 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

The objective of subtask 1 was to reach a common definition of Demand Side Bidding. 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.

2.2 Re-regulation of the Swedish Electricity market

The Swedish electricity market was re-regulated 1996. The new law, which introduced a third party access to transmission and distribution grids with point tariffs, had the following main purposes:

- promotion of competitiveness
- promotion of rate cutting
- fulfilment of the Directive 92/96 requirements
- promote efficient corporate structure and efficient network companies and also to ensure that monopoly prices are reasonable and that excessive monopoly profits are avoided

The industry was unbundled into the following two main parts:

- Generation/supply (competitive)
- Transmission and Distribution grids (regulated natural monopolies)

Due to the high degree of concentration in the electricity production sector, it was important to increase the size of the market. The Nordic producers had a long tradition of co-operation and a Nordic market was the aim from the beginning. The re-regulating of Sweden went together with the creation of a competitive Nordic electricity market. This way the risk of market domination due to some big actors was reduced. Thus it is possible to trade electricity over the borders of the participating countries through Nord Pool, in most cases without any extra cost.

From January 1, 1996, all customers had the right to change supplier. However there was a requirement of hourly metering if you wanted to change supplier. The cost of the meter made a change too expensive for most households. November 1, 1999, that requirement was

abolished for customers up to 200 A or 135 kW. Above that limit, hourly-metering equipment shall be provided by the network utilities to the customer without charge. Thus, from November 1, 1999, all customers may change supplier without any cost. A recent survey concludes that 7% of all household customers have changed supplier as compared with 5 % last fall. The abolishment of the metering requirement has had a substantial effect on the price of electricity to households.

The Swedish electricity generation market is divided between the state owned Vattenfall with a market share of about 50% which together with a few large privately and community owned companies make up most of the capacity. Heating plants often are combined with power production. These companies were mainly community owned, but a concentration process is taking place, communities selling their electricity businesses.

The suppliers have lost their exclusive rights in providing "their" regional and distribution net areas with electricity and were exposed to price competition. Generators are no longer obliged to supply "their" areas. Electricity distributors should have a concession for a given area and additionally are obliged to transport electricity to all customers in the area, while the choice of supplier is free.

The main regulating authority regarding the electricity sector in Sweden constitutes a division in the Swedish National Energy Administration (STEM). Apart from being the regulator, STEM monitors the energy markets and carries out the energy policy program aiming at an economically and ecologically sustainable energy system in Sweden. Additionally the Swedish Competition Authority controls the competition within the sector.

A new regulation model for the monopoly business of distribution companies is being created and will be implemented as soon as it will prove functional. It defines a customer value model. Until the new model can be implemented, a simple rationalisation requirement is used.

Beginning the 1st January 2000, a temporary fee is introduced for those connected to the national grid to promote electricity from small-scale producers and to ensure that there is a market place for electricity from such production. This fee is administrated by Svenska kraftnät.

It is not the role of the regulator to promote DSB schemes. On the other hand, it is in the interest of the Swedish National Energy Administration in its role of promoting an effective electricity market and a sustainable energy system to promote effective DSB schemes.

2.3 Description of major participants at the market

2.3.1 Generation and supply

The Swedish electricity generation consists mainly of hydropower and nuclear electricity generation, while the rest is covered by municipal and industrial CHP generation. The number of wind power plants is increasing, but insignificant in the total balance. The hydropower capacity varies considerably between years. The total annual production in typical years is about 145 TWh.

The number of large producers in Sweden was about 10 in 1990, now 3 companies dominate the market. Apart from these, there are about 4 relatively large producers. In addition to these

companies there are a number of community-owned heating plants with CHP production as well as some industrial companies. There are also small owners of small hydro- and wind-power plants. The state-owned Vattenfall AB controls about 50% of generating capacity, while the second-largest producer Sydkraft controls about 20%. The third largest producer is Birka. Foreign ownership in Swedish generation is substantial as well as Swedish ownership abroad in countries that allow foreign owners.

The old community utilities have divided into distribution companies and supplier companies. The number of suppliers has decreased by mergers into 100-150 suppliers. There are about 35 independent traders, compared to none before 1996. Of these traders there are about 10 foreign actors, represented by a daughter company in Sweden. The number of brokers, working with trade in bilateral financial contracts of electricity is about 10.

2.3.2 Transmission and distribution

The Swedish transmission and distribution grid consists of three parts: national, regional and distributive.

Description of the transmission and distribution network

Level	Voltage, kV	Function
National grid	400 220	Transmission
Regional grid	130 70 40	Regional distribution
Distribution net	20 10	High voltage distribution Low voltage distribution

Svenska kraftnät (SvK) owns the national transmission grid and the most part of the international cables. The large producers mainly own the regional grid, although today through separate companies.

The international cables connect Sweden to Norway, Denmark, Finland, Germany and Poland (soon).

There are about 235 local network operators operating the distributing system in Sweden. Originally these companies were suppliers to the local community. Now the supply parts of the former local companies are subject to competition. To survive in the new environment, the local suppliers tend to get bought by larger companies or merge into independent trading companies.

2.3.3 Market operation: Nord Pool

Nord Pool is the Market maker. Trading over Nord Pool is one of several options of trading electricity with a market share in the physical Nordic market of approximately 20%. The Nord Pool is a Norwegian (Statnett SF) and Swedish (Svenska Kraftnät) owned power exchange that was established in 1996. A large number, approximately 200, of participants from Norway,

Sweden, western Denmark and Finland trade through the market. There are three kinds of participants:

- Direct participant or a trader acting on its own behalf (power producers, suppliers and industrial companies)
- Brokers, trade on behalf of customers or its own.
- Clearing customers

Nord Pool combines two markets:

- Elspot – spot market, the physical market
- Eltermin – futures market, which is a financial market.

There are several products in the financial market:

- Futures - 1-2 years ahead (week, blocks, seasons)
- Forwards - 3 years ahead (seasons, years)
- Options - "European" and "Asian" options.

Nord Pool also has a clearing and accounting service for bilateral trade.

There is also the ELBAS, a market between the day-ahead spot market and the balancing market. ELBAS is operative in Sweden and Finland.

On the spot market, a price is established where the supply and demand curves, composed by bids to the market, intersect. The reserve capacity in the Swedish system has been reduced substantially the last years. In situations when there is a fear of shortage, this price can get very high. Such peaks can be expected to happen a few times every winter.

A great deal of the physical as well as financial trade is done outside of Nord Pool, but the spot-price is the reference price for the whole market.

2.3.4 System Operation: Svenska kraftnät

The system operator Svenska kraftnät is required to imply market mechanisms on the spot market in order to relieve transmission constraints in the system. In the situation where there might be capacity limitations in the national power grid, balance is reached by counter-buying. Sweden is always only one price area, while the Nordic market as a whole can be divided into several price areas. The area prices can differ substantially from the spot-price.

Svenska kraftnät is the system operator and transmission operator with the following main responsibilities:

- System services as frequency control and grid constraints
- Regulating market
- Planning, operation and maintenance of 220 and 400 kV networks
- Settlement of imbalances
- Co-ordination of maintenance
- Rules for information exchange

The physical balance is maintained by Svenska kraftnät, which receives bids from generators to either increase or decrease output for the Regulating Market. Due to the lack of reserve capacity in cases of extreme systems load, Svenska kraftnät has recently introduced very high prices in the regulating market in situations when ancillary reserves have to be used to preserve the system (3000 SEK/350 Euro/ MWh). A three times higher price is introduced if there will be risk of disconnecting areas of the grid to maintain the system. The idea is to stimulate the traders and suppliers who have a balancing responsibility, to go into agreements with their customers on DSB schemes, thus reducing the risk of shortage and the cost of maintaining balance. The trend has been that the cost of being in imbalance has been reduced as the systems operators in the Nordic countries cooperate. In the event of shortage, though, the cost can be very high.

3 Demand Side Bidding

Definition: 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. In practice, most of Sweden's DSBs will probably belong to the second category. However the institutions are open for the first category as well.

3.1 Bid for Total Demand

The construction of the Nordic electricity pool presupposes bids of demand as well as supply. That means that there is an incentive for the actors on the market to reduce demand if the price gets sufficiently high.

3.2 Bid for a Change in Demand

3.2.1 Order of reduction a day in advance

In Sweden, as well as in the other Nordic countries, the reference price of electricity is set on the spotmarket of NordPool Power Exchange (Elspot). Before 12 PM all bids for the next day must be given. Thereafter the prices are set for all 24 hours the next day and the volumes for each bidder are fixed. The prices are set to the level where demand and supply meet each other, hour per hour. The bids are binding.

Both the suppliers and the customers can act on the Elspot-market. Today, the Swedish customers do not act on the Elspot directly. To the extent that they adjust their demand, they act indirectly through their supplier/trader/generator. Their action could result in lower buy-bids as well as higher sell-bids, depending on the level of own generation of the supplier

The Elspot is preferable to DSB-customers that need to be informed what to do one day in advance. The existence of weekends and holidays poses a specific (potential) problem, as many suppliers/trades give their bids for Monday during the Friday before closing for the weekend. In some cases one solution is for the supplier to make a phone-call to certain contact-persons with the customer, who will make necessary arrangements for reductions the following day. This, of course, presupposes that the supplier has a working staff on holidays. This is the case for the large generators, but not for all suppliers with no or little generation of their own.

If the price on Elspot exceeds the price the suppliers' customer is willing to pay (the trigger price), the supplier gives customer orders to implement the reduction of demand that they have agreed on in earlier stages. To be able to act within the next day the customer has to have a proper organisation and routines in place.

In Sweden there is a Balance Market , the passive side of the regulating market, where the balance responsible actors buy and sell the difference between their total supply (own generation and purchases on Elspot/Elbas) and total demand (bilateral sales and sales on Elspot/Elbas). In the settlement this difference is accounted hour per hour. The prices on the Balance Market are set within the hour, and are not fixed in advance as the prices on Elspot. The price-construction punishes actors that make it more difficult for the system operator (i.e.

buy from the Balance Market while the system operator has to up-regulate the system). Up and down regulations are mainly done within the hour on the active side, the Regulating Market. The bids on this market are the basis of the prices on the Passive Side.

If the customer who has gone into an agreement to reduce demand fails to do so, the supplier has to buy the power on the Balance Market instead of on Elspot. In order to make the agreement risk-neutral for the supplier, the customer should pay the difference between the prices on the balance market and the Elspot multiplied with the difference between the promised and realised reductions. This difference could work in a positive as well as in a negative direction, depending on the actual prices on these two markets.

The share of Swedish customers that pay spot-related prices for the electricity they use is increasing. These customers pay spot prices for all energy they use, or at the margin.

Still, many Swedish customers are free to buy as much electricity as they want, hour by hour, at a fixed price. The supplier will always trade power on Elspot in order to achieve balance with their expected sales, independent of the customers' decisions to buy their electricity either at a fixed price or at the spot-price generated on Elspot.
If a customer does not realise the promised reduction of electricity use, the supplier will have adjusted the trade on Elspot, or even later, see below. This is the case for customers buying their electricity at spot prices as well as those buying it at a fixed price.

3.2.2 Reductions on short notice

Some customers have difficulties promising reductions of their electricity consumption a long time in advance, but they may be able to reduce their consumption on short notice if the circumstances are right. This could be the case for manufacturing companies with stocks that enable a stop in the production processes given that the stocks are at or above a certain level. In this case the supplier has traded on Elspot corresponding to the normal electricity use of the customer. After a short-term reduction in consumption, the supplier will be able to sell power on the balance market.

These customers must react on the (expected) prices on the balance market. A risk-neutral solution for the supplier implies that the customer will get a revenue equal to the prices on the balance market multiplied with the realised reduction of electricity consumption. In this case the customer does not have to promise any reductions in advance.

3.2.3 Use of Elbas

Elbas is a third market place in Sweden (and Finland) where the prices are set continuously until two hours ahead of delivery. The purpose is to be a complement to Elspot, where the trade is done up to 36 hours ahead. Both prices and quantities are binding when trading in Elbas, but the parties can adjust their prices and volume by continuous trading with the same product at different prices until two hours ahead.

Since the prices on the balance market are uncertain, there is a possibility to secure the price through the Elbas. This is an alternative for customers, who can adjust their electricity consumption 2-12 hours ahead, i.e. in a shorter term than NordPool's 12-36 hours ahead. If the customer does not realise the promised reduction, the compensation should be calculated by multiplying the price-difference between the balance market and Elbas by the difference

between the promised and the realised reductions. The number of participants in Elbas is lower than in Elspot.

3.2.4 Possible development of DSB in Sweden

In practice there are at this moment only a few customers in Sweden that have regulated these matters in a contract with their suppliers, or intend to do so. However, the institutions are in place and there are several technical possibilities to achieve reductions of the use of electricity. The question is to what extent customers will establish contracts with their suppliers in order to regulate these issues. The answer is highly dependent on how often price-peaks are likely to occur and at what level. These issues are very important for the profitability of DSB-measures.

The system operator in Sweden, Svenska Kraftnät, believes that DSB is an important way to secure the effect balance in the future. They have encouraged suppliers and customers to reach mutual agreements on how to enable DSB.

Today the peak-load capacity in Sweden has been decreased by approximately 2 500 MW of oil condensation reserves, which is a substantial part of the total installed capacity of roughly 30 000 MW. This capacity is enough for the peak-load demand of roughly 27 000 MW (with a calculated maximum demand of 28 000 MW), but transmission constraints between northern and southern Sweden together with uncertainties concerning import possibilities constitute a week capacity balance in the southern parts of Sweden. This downsizing is a direct result of the decreasing electricity prices in Sweden after the deregulation in 1996, and has brought about a raised level of interest for DSB-measures. Besides DSB, the possibilities for import of electricity from neighbouring countries are also important for the Swedish capacity balance. Calculations show that the capacity balance is weaker in the south of Sweden than in any other part of the Nordic countries.

The institutions in Sweden (Elspot, Elbas and balance market) are open to customers. In practice, however, it is highly unlikely that any Swedish customer will use these markets directly in the next few years. Instead they might use them indirectly through their suppliers. The way described above is one opportunity. However, many other solutions might be possible.

One important aspect in the contracts that need to be signed between customers and suppliers concerns how the risks should be distributed between the parties. One problem is finding a way to deal with the efforts, risks and costs that can effect the customer's production process and consequently sales that sometimes occur due to a dramatic, but temporary, reduction in the use of electricity. If there is also a risk that the prices on the balance market and Elspot (Elbas) will lead to increasing costs for the customer, the willingness to partake in DSB-measures will, of course, be reduced.

Sweden uses a system with disconnectable electric kilns - the customers, industries and district heating utilities also have oil kilns. In the eighties, this system was a very good DSB-system, in which the suppliers could disconnect the deliveries in situations when oil was used for power generation in Sweden (during dry years and during cold winter days). In those cases, no tax was imposed on energy. The price of the electricity delivered to these kilns was market based in the 80ies, while other uses of electricity had such high prices that the power companies got a full cost-coverage. In all, the power companies had both the incentives and pressure (from taxation authorities) to run the electric kilns optimally and with full control during the 80ies.

Nowadays, there is no such incentive. Thus, the use of the disconnectable electric kilns has become more and more non-optimal. Today many of the power companies have lost their control of these kilns. In many cases, electric kilns are run even in periods of extremely high prices, when the customers could have used an oil kiln instead.

Some of these kilns are, however, run optimally in regard to the price of electricity and oil. Some of them are run directly from the power-companies control-rooms and others are controlled and adjusted by the customers.

The properties of a DSB in Sweden are listed below:

1. **The trigger price.**
   The price at which a customer is willing to change it's demand, or increase their internal generation. This important price will vary between customers, from some tens of Euros to some hundreds of Euros.
2. **The size and shape of the DSB block.**
   Some customers can decrease their electricity usage a lot in the short run while others can offer smaller decreases during a longer period of time.
3. **The notice required for the change in demand.**
   Some customers can shed load within a few minutes notice while other customers will require a notice of at least one day. During a dry year in the Nordic countries, the notice can be given months ahead, which opens up for larger long-time reductions.
4. **Any limitations.**
   The cost of reductions in the manufacturing industry depends on the level of orders. If a reduction in electricity consumption implies delayed delivery to customers, the costs are much higher compared with reductions in a situation when activity is lower. In some cases the costs are dependent of the store-level of a product in the production process, i.e. pulp for print paper (TMP).

5. **Change in overall energy consumption.**
   At first DSB will run rather independently of other measures, i.e. more efficient use of energy. In the long run, however, it is not impossible that a DSB-optimisation will bring about more optimal solutions in other energy uses as well.
6. **Fee structure.**
   The discussion above is based on a risk-neutral solution for the supplier, i.e. that the profits of DSB would benefit the customer when reductions really are undertaken. Other solutions are also possible, for example a yearly fee to be prepared to reduce the use of electricity at the demand of the supplier. However, such a structure will not give the proper economical incentives for customers to make the reductions. The actual fee structure will be established on the market. This far very little has been done in Sweden. The disconnectable electric kilns are in some cases run on the basis of the spot price. More often though, they are run according to a fixed price for the next week, month or even the next year. Often the contract with the net-owner stipulates a disconnection when the distribution capacity of the local net is threatened to be overload. As a benefit, the customers receive a reduction of the net-tariff.
7. **Communication.**
   The supplier should order the customer to realise promised reductions. If contracts also cover holidays, some person(s) employed by the customer must be ready to be contacted and take agreed measures.
8. **Control.**
   The control of electrical kilns has decreased significantly since the 80ies.
9. **Monitoring.**
   According to the description above it is the difference between promised and realised reduction by the customer that changes the costs and the distribution of risk between the customer and the supplier. The larger consumers have hourly meters. One way of monitoring is to calculate the change of hourly demand before and after the promised measures of reduction have been effectuated. This could be compared to the usual pattern during the actual set of hours. Very large customers do already have real-time metering. This could be an even better way of monitoring the use of electricity.
10. **Buyer.**
    In the solution described above, the supplier re-buys electricity from the customer.

3.3 Categories of DSB products

3.3.1 Ancillary Services

Ancillary Services are handled by the Balance Market's "Active Side". The actors in the market can bid increases and decreases of generation and consumption. The bids are very short term, predominantly within the hour.

So far, only generators are participating on the Active Side, except for one electricity intensive manufacturer. That company has signed a contract with the system operator (Svenska Kraftnät). The terms of the contract are not public. The generators, however, most often get paid the prices on the Active Side of the Balance Market, i.e. the Regulating Market.

3.3.2 Supply Contracts

Supply contracts offered by suppliers to their customers are a relatively simple way of allowing customers to participate in the electricity market. Such contracts can take the form of an interruptible tariff, whereby customers are guaranteed a favourable rate for their electricity in return for allowing an interruption in their electricity supply. These kinds of contracts were rather common in Sweden earlier. After the re-regulation of the electricity market in 1996, these types of contracts have become more rare. For a large part of the dis-connectable electric kilns, this type of contract is in function, although through the net-tariffs. The connection to the net-tariffs does not necessarily have an influence on the effect-balance, which is the most important question in Sweden at the moment.

3.3.3 Spot Market / Electricity Pool Trading

An increasing share of the Swedish customers buys electricity at spot-prices (Nord Pool Elspot). So far, they do it through their supplier. According to the discussion above, DSB measures can be handled in the same way for deliveries at spot-prices as an ordinary bilateral contract at fixed prices.

3.3.4 Bilateral Contracts

See 3.3.3.

3.3.5 Balancing Market

The system operator operates the Swedish Regulating/Balance Market. On the “Passive Side” of the Market the suppliers/traders that are responsible for the balance buy and sell power to cover their imbalances.

So far no Swedish customer acts on this market, but since the market is open for everybody, some customers might enter this market in the future. One problem is that the pricing of the Balance Market does not consider that peaks and bottoms of demand equal each other for large suppliers with many customers, while this is not the case for one single customer. Thus the costs of acting on the balance market for a single customer will be significantly higher than for a supplier with many customers. If this aspect would be handled in the setting of prices it would be possible to achieve neutral competitive conditions on the Balance Market.

Some suppliers let their costs for acting on the Balance Market for a specific customer be carried on to the customer through the bill. In these cases the customer must make a forecast for his hourly consumption. The differentials in the actual consumption compared to the forecasted hourly consumption are billed to the customer considering the prices on the Balance Market. In these cases DSB measures are automatically monitored by calculating the difference between the forecasted and the actual consumption, hour by hour for the time period with promised reductions.

However, a large majority of the suppliers do not bill the costs for the Balance Market separately, but include this cost-element in the total fee.

3.3.6 Transmission and Distribution Constraints

In Sweden the system operator handles distribution constraints on the grid by buying and selling on the Regulating Market on the "right" sides of the bottleneck. This implies that the actors' incentive to take DSB measures do not vary depending on where in the country they are located. In reality a DSB measure can be completely worthless. The revenue of such an action would go to the customer and his supplier, while the system operator would pay for the costs of such actions. The net gains for Sweden as a whole would be zero.

This would probably be the case with most of DSB measures activated in the north of Sweden, since the grid in the middle of Sweden is a bottleneck in peak load situations. The grid is used to its full capacity to transport hydropower from the north of Sweden to the consumers in the south of Sweden.

Another aspect is that DSB is a means to handle constraints in the transmission and regional grid. Some netowners have the right to reduce supply to certain customers to avoid overload.

4 Experiences with Demand Side Bidding

As described above, the Swedish power market is organised and regulated in a way that makes it possible for DSB products to be implemented and operated. Based on information collected from market participants, the conclusion is that the only DSB products so far implemented and in function is one contract, signed last fall, adding 85 MW to the ancillary reserve by the permission to reduce supply within short notice to one large industry. In addition to that, there are a few old interruptible supply contracts.

The table gives a description of relevant DSB-related products and indicates which of them that are available and operating in Sweden.

List of relevant DSB products and which of them are available in Sweden.

DSB product	Available	Operating
Frequency response including spinning reserve	x	-
Fast power reserves (regulating objects in balance market)	x	-
System protection schemes	x	-
Big customers sell back power to spot market	x	-
Big customers sell back power to balance market	x	-
Big customers sign contract to accept certain reductions	x	x
Big customers sell back power to DSB trader	-	-
Medium and small customers sell back power to DSB trader	-	-
Reactive power	-	-

Prior to the reform, electric boilers were on special disruptible contracts. After the reform, the owners of boilers have negotiated the types of contracts that serve them. Some are exposed to the spot market price for their boilers, using them only when the price is low.

5 Views towards Demand Side Bidding

All kinds of market participants express a positive or neutral opinion to DSB products. The table below presents how different market participants in different roles pointed out advantages of having DSB products operating. Due to the fact that Sweden has mainly hydro and nuclear generation, reduced CO2 emissions is not specified as an advantage. However it is important to remember that Sweden during a dry year is net importer of thermal power from Europe and partly relies on imported thermal power as high load reserve.

Market opinions about advantages of having DSB products in operation.

ADVANTAGES	**SYS OP**	**MO**	**SUPP**	**GEN**
More business opportunities			x	
Market with stronger influence of demand side	x	x		
More efficient market	x			
New market place products	x			
More participation from the demand side	x	x		
Improved market liquidity *in peak periods*		x		
More efficient network and system operation	x			
More efficient use of energy and power		x	x	
Reduced CO2 emissions *Less use of "dirty" power in peak-load situations.*		x		
Other*: The exposure to high prices on the spot and balancing market will be reduced for traders and suppliers. The customers will in some cases have an increased risk of process problems at the same time as they will gain economically.*			x	

SYS OP = System operator
MO = Market operator
SUPP = Supplier
GEN = Generator

Ancillary services are a normal part of balance regulation during extreme peak load periods and rapid reserve. Both are part of System services. Here, DSB-related products have been in use for a long time, although only generators participate today except for one industry.

From November 1, 1999, the regulator does not supervise or in any other way get involved in issues regarding electricity prices, agreements or other questions relating to the sale of electricity. The Swedish National Energy Administration views DSB an interesting alternative to reserve production capacity pro peak load situations.

Monitoring and billing routines for DSB products are necessary to develop and implement. How this should be done in detail is not discussed in questionnaires. Attitudes to DSB differ between different suppliers/traders as well as large customers. While suppliers/traders may benefit from a lessened exposure to sudden extreme spot or balancing market prices, the customer who has its supply reduced may get its risk of production problems increased. The contract will have to handle this so that there is an incentive for the customer to participate.

A general impression is that market actors are not very familiar with DSB and its possible impact on the power market. The replies are given after explanations and discussions and it is registered an overall increasing interest in DSB as different products as well as how they could be implemented in the existing market. The special situation in Sweden is that some 2500 MW of reserve capacity in oil condensation plants have been shut down after 1996 since their figures turned red even during the dry year of 1996. Only some 330 MW have been temporarily "saved" by Svenska kraftnät in order to secure some reserves in southern Sweden in case of a breakdown of the system. This situation has led to new thinking where an increased flexibility on the demand side of the market is seen as one of the solutions.

6 Barriers to Demand Side Bidding

Market solution and legislative framework do not represent main barriers for that DSB is not in real function in the Swedish power market. DSB measures are in use for ancillary services. They can also be of interest as an alternative to increasing generation in case of capacity shortages. During the last years reserve production capacity (oil condensation plants) of 2500 MW have been taken out of use. In the old system, all producers using the national grid had to show that they had adequate reserve capacity. In the new market, no such provision is there, and on a competitive market, the cost of keeping this reserve capacity is too high. This means that it is difficult to find additional generation capacity in extreme peak-load situations. The high prices in those situations constitute the incentive for DSB. There is still very little experience of price peaks. The frequency and height of these peaks is an important input to the discussion.

Should DSB products be successful market products in the Swedish power market, several main barriers should be demolished. Due to information from different market participants and a general evaluation of the existing power market, these barriers are of different character, and the following actions could contribute to their elimination:

- Rethinking in the power industry about demand side participation in all market segments.
- The possibilities for doing business with DSB products have to be cleared up and publicly discussed. New entrants for this kind of business would then be attracted.
- Demonstration projects where different types of contracts, monitoring and control systems are demonstrated are needed.
- Technical challenges regarding monitoring and billing of realised products should be investigated and tested. In Sweden, only large consumers will have hourly metering, which is necessary for monitoring DSB. Metering must be done separately from the normal metering/reporting process, which is done by the netowners.
- International experiences with DSB must be known.
- Principles, methods for pricing and market operation of DSB products must be developed.
- The demand side must be oriented and educated in possibilities for cost reductions/profit by participating in the DSB market.
- Socio-economical benefits of a well functioning DSB market should be clarified.

A superior barrier that will influence all DSB schedules is the value of the DSB product. If the value is lower than the operating cost including investments in technical infrastructure/monitoring, the demand side will not participate in the market. In a study conducted late 1998, large industries and suppliers were interviewed. When the DSB mechanisms were explained to them, they could in many cases give examples of loads that can be reduced for shorter periods together with an assessment of the cost/risk of such a scheme.

The potential for DSB will be substantial when we get so far that the customer, not the SO or the supplier, can monitor the short time price and decide what to do.

7 Conclusion

All market participants asked for information about DSB schedules and products give positive or neutral replies when DSB is explained to them, although some suppliers find it too complicated. There are no legal or institutional barriers to DSB in Sweden. For DSB to develop outside the ancillary services, examples of DSB have to be developed and demonstrated. Important parts in this development are monitoring, communication and contractual considerations. Another important part is how often peaks will occur in the future.

The system operator, Svenska kraftnät, already has different DSB-related products established. Svenska kraftnät is promoting DSB contracts signed between supplier and customer. There is little experience of DSB on the new, competitive market. The systems operator has recently signed one contract with a large industry.

DSB in Sweden is of interest for ancillary services and as a reserve in extreme load situations. In these situations, the price will peak and provide an incentive for the customers to lower their load.