Title: Opening of the Power Market to End Users in Norway 1991 - 1999	**Report No. 2**
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SUMMARY
This report discusses the development and effects of the rules and regulations that opened the Norwegian power market to all end users of power. In this report importance has been attached to explaining how the settlement of the power market functions. The key to giving all end users full market access lies in the settlement method, which is based on the adjusted system load profile. Our report encompasses a detailed discussion of this method. In the last part of this report we will take a look at a few surveys that illustrate the market impact after the power market was opened to all end users.

Keywords:
Metering, settlement, market access, adjusted system load profile, hourly metering, balance settlement

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1 Conclusion and summary

The Norwegian power market has been formally open to competition since 1991, but real market access for all the end user groups was not established until 1995 through settlement based on the adjusted system load profile. Both the practical implementation and market impact has in our experience been good on the whole. A good illustration of the benefits of the open power market that we have in Norway may be achieved by making comparisons to the market in Sweden. The conclusion is clear. Swedish households paid in 1998 almost twice as much for power compared to the Norwegian households.

The market is now regarded as being sufficiently open in order to realise an efficient market over time. What remains now is to establish electronic data routines that can improve the efficiency of the information management in order to increase the flexibility of the market and reduce the management costs. The table below sums up the development of market access since 1991.

Table 1-1: Annual changes in the market access regulations for end users

1991	Introduction of the Energy Act Hourly metering requirement for change of supplier Local supplier has a significant market advantage NOK 5000 per year per customer stipulated as maximum fee for using a supplier other than the local supplier
1992	
1993	
1994	Maximum fee reduced to NOK 4000 per year per customer.
1995	Hourly metering requirement for change of supplier eliminated. Settlement based on the adjusted system load profile. Non-hourly metered end users can change suppliers on a quarterly basis. NOK 246 stipulated as maximum fee for changing suppliers. Network owners can collect up to NOK 4000 from each supplier for which regulating power is settled in his network.
1996	Hourly metering for electricity consumption in excess of 500 MWh per year. Standard GS2 file format requirement.
1997	Fees are eliminated.
1998	All end users can change suppliers on a weekly basis. Network owners must send settlement data by means of EDIEL.
1999	Hourly metering for all installations over 400 MWh. Messages regarding change of supplier must be sent by means of EDIEL.
2000	Mandatory continuous balance settlement. Reading of all end users at the end of the year.

2 Introduction

This report discusses the development and effects of the rules and regulations that opened the Norwegian power market to all end users of power. In this report importance has been attached to explaining how the settlement of the power market functions. The key to giving everyone full market access lies in the settlement method, which is based on the adjusted system load profile. Our report encompasses a detailed discussion of this method. In the last part of this report we take a look at a few surveys that illustrate the market impact after the power market was opened to all end users.

The efforts of the Norwegian Water Resources and Energy Administration (NVE) to establish new regulations for the metering and settlement of trading in electricity started in February 1994. Our task was to develop a better method of complying with the requirements of the Energy Act regarding market access for the end users of electricity. In addition, there was a need to clarify the rights of the parties involved in the trading of electricity, i.e. the network owners, power suppliers, power exchange/power pool and end users.

The network owner's obligation to make provisions so that the end users could change their supplier was established in the Energy Act of June 1990 and the Regulations of December 1990 pursuant to this Act. Section 4-4b of the regulations states: "The concessionaire is obligated to make unused transmission capacity in the network system available to others engaged in the supply of electricity, as well as the producers and users of electrical energy. This obligation also applies when the users of electrical energy buy power on the power market or from other suppliers." Since it is not permitted to operate a network or sell energy without a concession, the entire Norwegian electricity supply market is thus subject to this rule.

Section 4-4b of the regulations also states: "The concessionaire must not discriminate against any users of the network, and he must offer them the same tariffs, adjusted according to differences in the period of use, quality of delivery, etc." This rule must be interpreted to mean that a network owner must treat all power suppliers equally. This entails that the local supplier, which was in any case integrated with the same company as the local network owner in 1991, cannot be given any special rights in relation to the other suppliers. In 1991 no model or regulations had been established that would allow compliance with the rule stipulating equal treatment of suppliers.

3 Prerequisites for power trading

Free trading in electricity is dependent on the establishment of a system for the metering and calculation of how much electricity is bought and sold at all times. An immediate balance between production and consumption is a prerequisite for a power system. The consumption will change continuously according to the end users' demand for power for heating, lighting, etc. Consumption will thus change significantly in the course of a day or year. Thus it must be possible to quickly regulate the production of power to cover the fluctuations in consumption. Due to the continuous fluctuations in production and consumption, the value of the power will also change frequently. In Norway the power prices are fixed on an hourly basis.

As with many other goods, the power price is set before delivery is made. The price will be dependent on the supply and demand of power for future delivery periods.

The normal trading products on the Norwegian power market are listed below.

Spot electricity	On the Nord Pool power exchange, spot electricity[1] is traded every day with hourly prices for the purchase and sales volume for the following day. The prices are fixed based on the overall purchase and sales desires of the participants.
Electricity futures	Nord Pool also organises a market for the trading of standardised futures contracts. The market is organised as a futures market without physical delivery when the contracts fall due. There is a financial settlement during the delivery period in which the contracts are settled against the system price on the spot electricity market. This means that there is no physical settlement of futures market trading in the power system.
Bilateral contracts	All the participants in the power market have an opportunity to enter into bilateral contracts between themselves. There are currently a number of companies that broker standardised bilateral contracts.

Because the consumption of power takes place in accordance with the self-service principle, the purchase and sales commitments that are fixed up to one day before delivery will not coincide with the actual consumption by the end user and the input by the producer. Buyers and sellers of power are, however, obligated to minimise this discrepancy pursuant to the regulations issued by the Norwegian Water Resources and Energy Administration (NVE)[2]. Unforeseen temperature changes and production changes in the industry may nevertheless cause a significant discrepancy.

The discrepancy between consumption/input and purchase/sales commitments must be identified and a price must be determined. In Norway, Statnett is responsible for settlement of this difference or discrepancy. Statnett must be able to identify the hourly discrepancy for each individual supplier who trades power in the Norwegian power system. The value of the discrepancy is determined by the regulation power market[3], which is managed by Statnett, the organisation responsible for the Norwegian power system.

Statnett has the authority to instruct producers to regulate their production up or down on short notice to ensure an immediate balance of power. The order in which power plants are instructed to regulate production is determined by the pricing of the regulating capacity by

those companies with regulating output. When Statnett needs more power in the system on short notice, Statnett notifies the producer that has the lowest regulating price. Correspondingly, if the consumption falls because of a rise in the temperature that was not forecasted, for example, and Statnett sees that there is a need to reduce production, then the producer with the highest regulating price is notified.

It is the price of the regulating output last used which determines the hourly regulating power price, the price which is used to determine the value of the discrepancy between consumption/input and purchase/sales commitments.

Table 3-1: Settlement data for Statnett

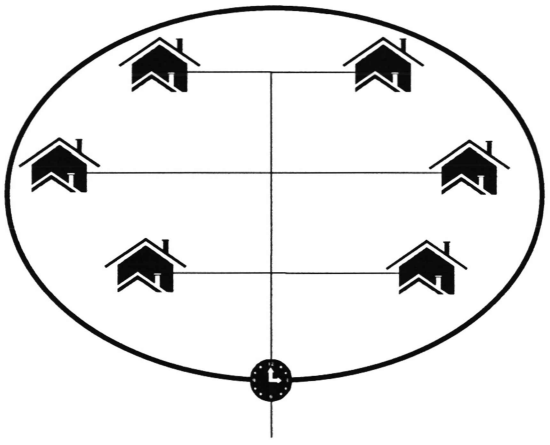
Balance respon-sibility	Consump-tion/input	Purchase/ Sales commitment	Difference	R-price /øre/kWh)	Financial settlement
A	-1 700	-1 800	-100	22,30	-2 230
B	-2 150	-1 975	175	22,30	3 903
C	2 300	2 350	50	22,30	1 115
D	1 550	1 425	-125	22,30	-2 788
Total	0	0	0		0

Table 3-1 illustrates the information Statnett must have every hour to settle the power traded. The table depicts a power market consisting of four participants (in real life there are over a hundred). In the table negative figures are consumption/purchases and positive figures are input/sales. We see that the total consumption/input and total purchase/sales commitments balance. The table also illustrates the financial settlement of the discrepancy between the suppliers according to the regulating power price.

4 Market access from 1991 to 1995

One of the main problems associated with establishing free and non-discriminatory market access for the end users of power is obtaining information on and processing the volume of power exchanged per unit of time. In Norway, the pricing period has been stipulated as one hour. As a power pool, Statnett must have accurate information on how much power each individual supplier has consumed or inputted hourly. In addition, it must be possible to identify where in the network the power has been exchanged, because bottlenecks in the Norwegian network are handled by differences in price on each side of the bottleneck.

In 1991 each individual supplier was responsible for submitting hourly settlement data to the power pool[1] on a weekly basis, i.e. all power inputted into the network from production or consumed through sales to end users. In a situation where the trading and network were both part of the same company and this company was responsible for power sales within the network, it was appropriate that the supplier itself submitted the settlement data to Statnett. It was also easy to obtain the exchange data, as all that was necessary was to meter the exchange with adjacent networks.



Figur 4-1: Hourly metering with one supplier

The need for hourly metered points in a network with only one supplier is illustrated in Figure 4-1.

The Energy Act of 1990 gave all the suppliers of electricity in Norway with a trading concession the legal right to sell power in all the electricity networks in Norway. In the very beginning of 1991 the first change of supplier took place, whereby an end user changed over from his local integrated power company to another supplier. These suppliers were called "foreign suppliers" by the local power companies, which indicates the attitude of many of the power companies toward these new suppliers.

The new situation in which it was possible and common to have more than one supplier in a network created new needs for metering data. Now it was not adequate to meter the exchange

[1] Responsibility for the settlement of regulating power was transferred from Nord Pool to Statnett in the spring of 1997

with adjacent networks, because hourly metering data had to be collected at the end user level in order to determine the exchange with each individual supplier.

The need for metering data with more than one supplier within a single network is illustrated in Figure 4-2.

Since it was the supplier who was responsible for obtaining his own settlement data and sending it to Statnett, it was often the new supplier who had to see to that the necessary metering equipment was installed.

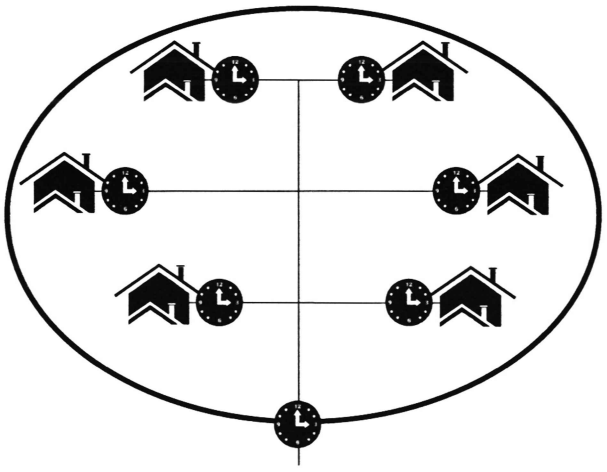


Figure 4-2: Hourly metering with more than one supplier

Who was supposed to own, install and operate the metering equipment was not regulated. There were cases where the network owner purchased and installed the equipment, and sent the metering data periodically to the supplier. In other cases it was the supplier itself who owned the meter, saw to the installation and collected the meter data by a direct dial-up connection to the meter.

It was the suppliers who had to cover the cost of providing the metering data, normally through a bill he received from the network owner, as the network owner was permitted to do in accordance with the applicable regulations[4]. The annual costs per metering point for new suppliers was in the magnitude of NOK 5000. The dominant local supplier, i.e. the integrated company, avoided these costs, because only new or so-called "foreign" suppliers had to meter the end user's consumption hourly. In order to determine his exchange volume, the local supplier used the network owner's exchange with other networks, and then he deducted the hourly values from the other suppliers in the network. The local supplier demanded by virtue of his integration with the network owner, access to the hourly values from the other suppliers.

Table 4-1: Hourly settlement data

	Hour 1	Hour 2	Hour 3	Hour 4
Exchange w/ other networks	1 000	960	880	875
Supplier A	5	4	4	3
Supplier B	10	9	11	8
Supplier C	15	12	9	8
Local supplier	970	935	856	856

Table 4-1 illustrates how the local supplier obtains hourly settlement data. It was customary for new suppliers to be obligated to obtain hourly values from their customers and to bear the associated costs. The local integrated supplier did not need to meter his customers hourly and used at the same time customer information from other suppliers to calculate his electricity consumption. This was clearly unfair as regards competition. As a result, only the largest end users found it profitable to change suppliers because of the significant costs associated with having a supplier other than the local supplier. The Norwegian Water Resources and Energy Administration (NVE) regulated the amount the network owner could demand from the suppliers to cover the cost of hourly metering. The limits were fixed at NOK 5000[5] per year per metering point/end user in 1991 and reduced to NOK 4000[6] in 1994.

This practice lasted from 1991 when the market was legally opened up until the end of 1994, even though the authorities saw that it restricted competition and was in violation of the Energy Act. The Norwegian Water Resources and Energy Administration (NVE) confirmed this practice in a number of decisions in disputes between integrated power companies, in which the integrated companies received approval for the collection of fees for the installation and operation of equipment for hourly metering[7]. The grounds given for the NVE's decision was the fact that there were no practical solutions available so that the suppliers could avoid metering their customers on an hourly basis.

5 Development of regulations

Since a large portion of the end user market was in reality not open to competition, giving the local supplier a significant competitive advantage, efforts to develop special guidelines for the metering and settlement of electricity trading started in February 1994. The purpose of this was to develop a method that would give all the suppliers the same competitive conditions and offer at the same time a reasonable degree of market access for all end user groups.

An important goal of the Norwegian Water Resources and Energy Administration's efforts to improve real market access was to discontinue the practice of forcing anyone who had a supplier other than the local power company to install meters that measured their consumption hourly. Our challenge was to find a method that gave an approximately correct picture of the end users' hourly consumption profile without exposing the network owners to the risk of significant losses from covering inaccuracies. In addition, the suppliers had to be treated equally, i.e. the local supplier was not to have any special rights or obligations in relation to other suppliers.

5.1 Draft guidelines in June 1994

The Norwegian Water Resources and Energy Administration (NVE) desired continuous and close contact with the power industry during the process to develop the method and final guidelines. Draft guidelines were sent out for comments on 10 June 1994, and the deadline for submitting comments was set at 11 August of the same year. During the period prior to sending out the draft, we held a number of meetings with traditional integrated power companies, in addition to Statkraft, as an independent producer and trader.

To follow up the process and to thoroughly document our work so as to give it legitimacy in the industry we chose to work with the Energy Supply Research Institute (now SINTEF Energy Research) as our partner. We also established close contact with Nord Pool, which was responsible for the settlement of regulating power at that time.

A proposal was put forth which entailed that the small end users would not have physical access to the power market, but that they could hedge the price of the electricity delivered to them through financial contracts. The network owner would on its part be obligated to deliver power at the spot market price to its network customers. Thus all physical trading of power would take place on the spot market[8].

In 1994 the Social and Commercial Research Foundation (SNF) carried out an analysis of this model for the Norwegian Water Resources and Energy Administration (NVE)[9]. Based on this analysis the NVE concluded that the spot market model would not give small end users real market access, and that it could result in unfortunate market-driven adaptations with regard to the integrated power companies, which would have been forced to play an unfortunate double role. Thus the NVE found that it should attempt to develop another model in which all the end users would have direct access to the physical power market.

The first stage in the development of a method that would eliminate the need for hourly metering involved the use of standard curves for the consumption profile for the various customer groups. The standard curves could be used to distribute an assumed consumption at

the hourly level so that the suppliers could calculate the hourly settlement volume in relation to Statnett for those end users that were not metered hourly. The assortment of standard curves that could be used for customer groups could easily grow to become very large. The standard curves would differ in accordance with the various types of dwellings and commercial buildings, and the different types of commercial activities, and there would also be divisions for geographical areas. The NVE drew the conclusion that the work required to establish a standard curve that was as accurate as possible for each individual end user would easily become complicated and difficult to manage. The NVE also envisioned that conflicts between the end user, supplier and network owner could arise with regard to what curve should be used. In addition, every discrepancy between the standard curve and the actual consumption profile would represent a loss risk to the network owner. The sum total of the discrepancies between the standard curve and the actual consumption profile would represent a significant loss risk to the network owner.

The second stage involved the use of a curve that was unique for each individual network area instead of specific curves for customer groups[ii]. This curve would be calculated on the basis of each individual network owner's system load profile, i.e. hourly input into the network owner's power network. The system load profile for the last known year would be used, meaning that the profile for 1994 would be used for 1995. To adapt the profile as accurately as possible to the end users that were not metered hourly, the network owners would deduct the hourly values for those end users that were metered hourly. The profile would be used for all end users that were not metered hourly.

Since the system load profile was from the previous year and random temperature fluctuations could have made an impact on that profile, it would be adjusted in relation to the standard temperature. The profile would subsequently be adjusted in accordance with the actual temperature. The "actual" temperature would be based on forecasts of the weekly mean temperature issued by the Norwegian Meteorological Institute.

For the network owner this method would also represent a certain risk if the system load profile based on the previous year that was used differed from the current year, and the temperature adjustment did not completely counterbalance the differences.

The method described in the draft eliminated the need for hourly metering in connection with changing suppliers, and fulfilled in our opinion the prerequisites for our work with regard to real market access and equal treatment of suppliers.

5.2 Final guidelines in October 1994

The reactions to the draft from the entire industry were strong and vehement. The most important input received was that the method was very complicated and that the network owner would be exposed to risk through the use of a historical system load profile. In addition, there were a number of complaints that the fees the network owners could charge in connection with handling suppliers were too low.

On 5 October 1994 the Norwegian Water Resources and Energy Administration (NVE) distributed the final guidelines for the metering and settlement of trading in electricity. The guidelines entered into force as of 1 January 1995. We had sought through these guidelines to

[ii] The method was identical to the method described in the draft guidelines.

take the most important input received in connection with the draft into account. An important change was that the actual system load profile was to be used and not the historical profile for the settlement of end users that were not metered hourly.

5.3 From guidelines to regulations

During the period from 1995 to 1998 the guidelines were revised annually. The preliminary draft for the revised guidelines was distributed in June, and the interested parties were given two months to submit their comments. The final guidelines were then distributed in October and became effective as of 1 January the following year.

Due to the fact that the development of the power market has changed so much since the Energy Act and regulations pursuant to the Act were written in 1990, the Ministry of Petroleum and Energy and Norwegian Water Resources and Energy Administration (NVE)[10] found in the spring of 1998 that it was necessary to update the rules and regulations and give the NVE a more precisely defined legal authority. The Ministry of Petroleum and Energy had also received a legal report[11] from the Norwegian Electricity Federation which included a discussion of the NVE's legal authority.

The work to revise the regulations pursuant to the Energy Act started in the spring of 1998 and was led by the Ministry of Petroleum and Energy. This work resulted in the distribution of revised Energy Act regulations by the Ministry of Petroleum and Energy for comments in September 1998. In these regulations the Norwegian Water Resources and Energy Administration (NVE) was given the authority to issue its own regulations in specific areas that included metering and settlement. The NVE distributed at the same time regulations relating to metering, settlement and coordinated joint action in connection with power trading and the invoicing of network services for comments. These regulations replaced the previous guidelines for metering and settlement, and the invoicing of network services. In the new regulations from the NVE the obligations and rights described in the old guidelines were cleared up and formulated more precisely as rules of law.

5.4 Annual changes in the market access regulations for end users

The table below lists the annual changes in the regulations governing market access for end users in Norway.

Table 5-1: Annual changes in the market access regulations for end users

1991	Introduction of the Energy Act Hourly metering requirement for change of supplier Local supplier has a significant market advantage NOK 5000 per year per customer stipulated as maximum fee for using a supplier other than the local supplier
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2000	Mandatory continuous balance settlement. Reading of all end users at the end of the year.

6 Regulating power settlement principles

This chapter describes the principles that currently apply for settlement of the Norwegian power system. Our discussion is based on the draft regulations for metering, settlement and coordinated joint action in connection with power trading and the invoicing of network services for comments[12]. These were distributed for comments in September 1998. These principles are to a large extent identical to what the regulations have been in Norway since 1995. There have of course been changes in the rules and regulations from 1995 to the regulations that are to apply as of 1999, but the nature of these changes has been that of minor improvements.

Table 6-1: The normal power market participants

Power pool	Trading concession holder who is responsible for the settlement of regulating power pursuant to his trading concession. In Norway Statnett holds a concession for performing this job.
Entity with balance responsibility	Trading concession holder for whom regulating power is settled in the network owner's power network. End users and network owners who are responsible in the regulating power market are regarded as entities with balance responsibility.
Supplier	Entity with balance responsibility that sells electrical energy to end users.
Network owner	Trading concession holder who owns the transmission network. The network owner is responsible for the metering and settlement data.
End user	Buyer of electrical energy who does not resell.
Spot electricity market	Market where contracts for the purchase and sale of electrical energy are traded on an hourly basis for the next day. Only Nord Pool ASA has a concession for such a market in Norway.
Regulating power market	Market for handling imbalances in the Norwegian power system after the spot electricity market has been cleared. Statnett has a concession for organising the regulating power market.

In order to organise a power market it is important to distinguish between network operations and power trading. Power trading is carried out by participants who are called entities with balance responsibility in the regulations. An entity with balance responsibility is responsible for the difference between its contractual purchase and sale obligations and the metered consumption or input in the network areas he is operating in. The entity with balance responsibility is therefore charged for regulating power based on the physically metered power.

An entity with balance responsibility that sells power to end users is called a supplier in the Norwegian rules and regulations. An entity with balance responsibility that only buys and sells on the wholesale market is therefore not a supplier pursuant to the rules and regulations. Both end users and network owners can themselves be entities with balance responsibility if they desire to be charged directly for regulating power. These end users will normally be large industrial concerns with a high consumption of energy that buy power on the wholesale

market themselves. Network owners with balance responsibility will be the entities that buy network losses directly on the wholesale market.

6.1 Network owners and the suppliers' basis for settlement of regulating power

The table below describes the division of functions between the network owners and the entities with balance responsibility.

Network owner	Entity with balance responsibility
It is the network owner who meters all electricity consumption or power input associated with his power network. The network owner prepares and submits the settlement data to Statnett.	It is the entities with balance responsibility themselves that report their power commitments, but they do not provide settlement data. The power commitments of an entity with balance responsibility may be established through buying or selling on the spot electricity market or through bilateral contracts with another entity with balance responsibility.

The figures below illustrate the flow of information and division of responsibility for regulating power settlement.

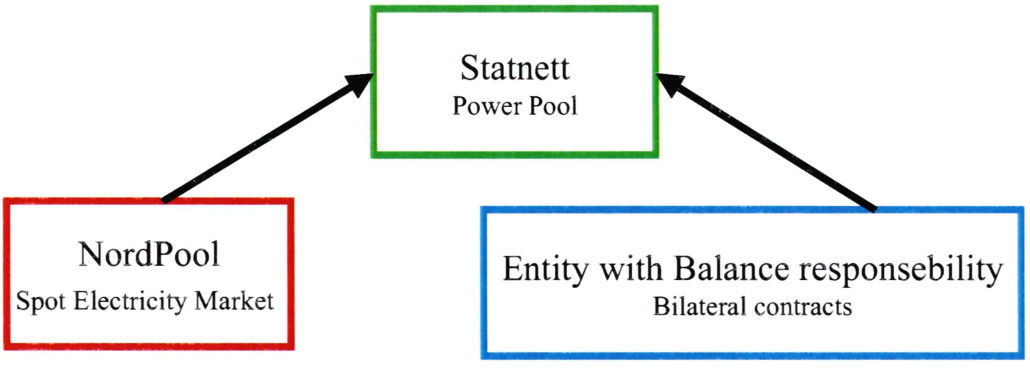

Figure 6-1: Flow of information in connection with trading on the spot electricity market and bilateral trading

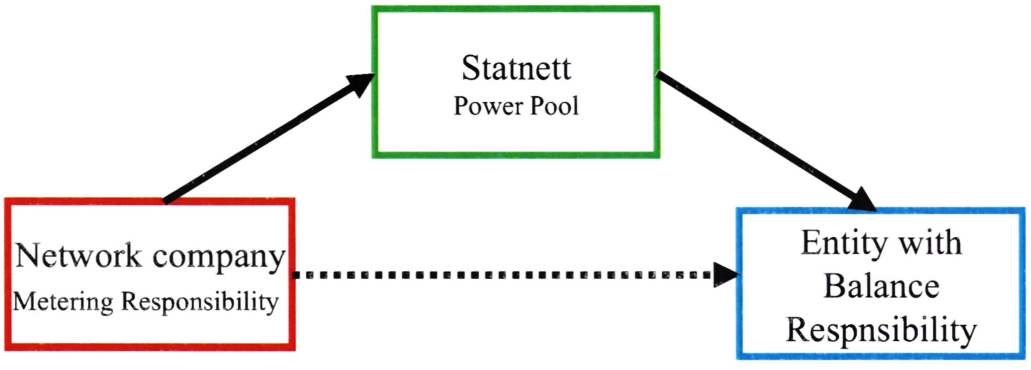

Figure 6-2: Regulating power settlement based on reported purchase and sales commitments and settlement data from the network owner

In the Norwegian rules and regulations it is the network owner's obligation to send the settlement data to the power pool on behalf of the individual entities with balance responsibility who sell power in their concession area. This is different from the period before 1995 when it was the entities with balance responsibility themselves who submitted the settlement data to the power pool. Today's system simplifies the exchange of information since the network owner is responsible for all the metering data, and it ensures that the power pool receives settlement data that coincides with the total input to the network owner's power network.

Table 6-2: Settlement of the Norwegian power market

For one hour	Net-work 1	Net-work 2	Net-work 3			
Exchange w/ other networks	1285	2280	-3565	Consump-tion/input	Purchase/ sales com-mitments	Discrepancy
Entity w/ balance responsibility A	-200	-500	-1000	-1700	-1800	100
Entity w/ balance responsibility B	-1000	-1150		-2150	-2200	50
Entity w/ balance responsibility C		-500	-300	-800	-830	30
Entity w/ balance responsibility D			4960	4960	5160	-200
Network loss Settlement	-85	-130	-95	-310	-330	20
			Total:	0	0	0
Network loss purchase commitment	-90	-140	-100			
Network loss discrepancy	5	10	5			

Table 6-2 shows how the settlement data and purchase and sales commitment data (contractual obligations) are derived. The table depicts the Norwegian power system, consisting for the sake of simplicity of three networks (1, 2 and 3) and four entities with balance responsibility (A, B, C and D). The contract and settlement data refers to one hour. Positive numbers are input and negative numbers are consumption.

First we look at Network 1 to see how the settlement data for this network has been derived. The network owner shall use the input into the network of 1285 as his point of departure. Then the network owner shall obtain metered or calculated consumption data for each individual entity with balance responsibility in his network for the hour in question. The figure for Entity A is 200, and for Entity B it is 1000. The network loss for this hour is then the difference between the input of 1285 and the consumption of 200 and 1000. The loss is thus 85. This is the settlement data that the network owner is supposed to send to the power pool. In other words the network owner must "show" the power pool that the network input is

equal to the consumption of the individual entities with balance responsibility and the network loss. In this manner, settlement against the superjacent networks of the concession area as a whole is correct.

Network 2 and 3 shall reconcile their networks in a corresponding manner and submit the settlement data to the power pool.

The network owner can purchase the network loss directly on the wholesale market by acting as an entity with balance responsibility himself, or he can purchase it from an entity with balance responsibility.

An entity with balance responsibility is responsible for reporting its purchase or sales commitments to the power pool. If we use Entity A as an example, he has reported a commitment for the purchase of power of 1800. This is power that this entity with balance responsibility purchases to resell to end users. The settlement data from the network owners gives the power pool a basis for calculating how much power Entity A has consumed during a particular hour. In Network 1 the figure is 200, in Network 2, 500, and in Network 3, 1000, for a total of 1700. The difference between the total consumption and the reported purchase of power for this hour is settled between the power pool and the entity with balance responsibility at the regulating power price for the same hour.

The power pool settles the accounts for the other entities with balance responsibility in a corresponding manner. Here we see that the sum total of all the reported contractual obligations is zero, i.e. the total purchase and sales commitments are the same. The power pool must continuously control that the purchase and sales commitments actually do add up to zero. The purchases and sales must be identical for all hours. If the purchases and sales are not identical, then the volume in and out of the regulating power market will not add up right.

This is a given for the organised markets as the price is fixed at a market point where the supply and the demand are the same. This is more problematic with bilateral contracts. The power pool must control that the reported purchases on the consumption side and the sales on the input side agree for each individual bilateral contract.

The settlement must accordingly add up to zero. This means that the metered consumption of power and the settled network loss equal the metered input. According to the regulations it is the network owners themselves that must balance their networks and send the settlement data to the power pool. The possibility of an error is thus reduced.

This method of settlement entails that any inaccuracies in the settlement of the entities with balance responsibility are incorporated into the network owners' loss calculations. If the consumption of an entity with balance responsibility is listed in the settlement at a value lower than the actual consumption, then the calculated network loss will increase by the difference between the actual consumption and the calculated consumption. This represents a cost to the network owner. To avoid that the network owner is charged excessive costs due to the inaccurate settlement of the entities with balance responsibility, metered hourly values, or estimated hourly values based on the network owner's adjusted system load profile shall be used in the settlement against the power pool.

7 Settlement based on the network owner's system load profile

In the settlement data which the network owner sends to the power pool, the data for the entities with balance responsibility shall be derived from metered or estimated hourly values based on the network owner's adjusted system load profile. It is on this point that the uncertainty concerning the rules and regulations was the greatest when they were introduced in 1995. If the adjusted system load profile is used, there is not any need to meter the consumption of the new power suppliers hourly.

We will now review how the adjusted system load profile shall be used as a basis for settlement. Since the entities with balance responsibility that are settled by the adjusted system load profile are suppliers to end users, we will call them suppliers in this chapter for the sake of simplicity. In our explanation of the use of the adjusted system load profile we will review the following four items:

- ✓ How the profile is derived
- ✓ How the profile is distributed among the various suppliers
- ✓ How the network owner carries out a periodic financial settlement between the suppliers
- ✓ Risks associated with settlement based on the adjusted system load profile

7.1 How the profile is derived

The network owner's system load profile represents the hourly net input into the network owner's power network. The adjusted system load profile is derived by taking the system load profile as a point of departure, deducting the network loss, and then deducting the actual end users and producers with hourly settlement. The adjusted system load profile thus represents the average consumption profile for those end users that are not metered hourly. In this connection we would like to point out that the profile is not a so-called predefined profile determined prior to consumption of the power. This is a profile that is derived on the basis of the actual hourly power input.

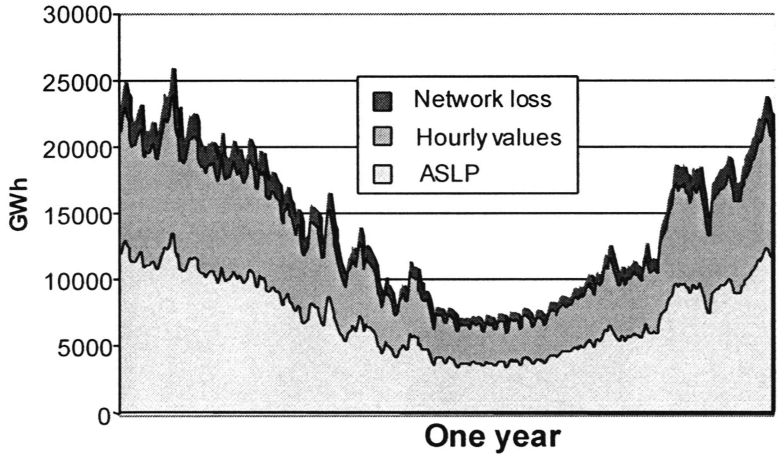

Figure 7-1: Adjusted system load profile

The adjustment for network losses should be made based on empirical data. This means that the hourly loss values shall be deducted from the hourly power input. The empirical data that many network owners have with regard to losses is quite inadequate. Firstly it is uncertain how large the loss will be on an annual basis, due, among other things, to the fact that the meter readings are scattered throughout the year. Secondly, there has been little knowledge of how the loss is distributed throughout the year.

Both of these conditions are of significance if the total cost of losses to be charged to the transmission tariff is to be calculated. The purpose of the method of settlement based on the adjusted system load profile is, however, not to calculate losses with a high level of accuracy. An inaccurate estimate will only result in an incorrect distribution of the loss throughout the year. The loss volume will be correct, because all the suppliers are settled in the end according to the actual volume of energy supplied.

The estimates the network owner has for the annual loss combined with the hourly network load and network configuration is an adequate basis for calculating the hourly loss.

7.2 How the profile is distributed among the various suppliers

In the following we will explain how the adjusted system load profile is distributed among the various suppliers.[iii]

Table 7-1: Distribution of the adjusted system load profile among the suppliers

	Share	Hour 1	Hour 2	Hour 3	Hour 4
Power input		200	175	165	160
Expected network loss		20	14	9	6
Hourly metered values		100	95	92	92
Adjusted system load profile		80	66	64	62
Supplier A	75,0 %	60	49,5	48	46,5
Supplier B	15,0 %	12	9,9	9,6	9,3
Supplier C	10,0 %	8	6,6	6,4	6,2
Total not metered hourly		80	66	64	62

Table 7-1 illustrates how the adjusted system load profile is derived for a network owner for four hours. The power input less the expected network loss less the metered hourly values gives us the adjusted system load profile. The table also illustrates that the adjusted system load profile is distributed among the various suppliers by percentages.

This shows us that the adjusted system load profile together with the percentage distribution of consumption is used by the network owner to obtain the individual supplier's settlement

[iii] A supplier who sells power to end users must have balance responsibility in relation to Statnett

data for the power pool. The end users that are metered hourly come in addition. This means that a supplier's settlement data from a network can consist of both hourly metered values and estimated hourly values based on the adjusted system load profile.

The percentage shall be calculated based on the supplier's expected share of consumption that is not metered hourly. The network owner shall use as his basis the end users that the supplier has as customers and the expected annual power consumption. Normally, the consumption for the previous year can be used as a basis.

Table 7-2: Calculation of percentage distribution between suppliers

Sup. No.	Cust. no.	Meter no.	15.12.95 kWh	15.12.96 kWh	Period kWh	Basis % calculation kWh
2	5	12	465 532	739 840	274 308	274 308
2	5	31	35 209	151 645	116 436	116 436
2	100	250	141 200	164 980	23 780	23 780
2	304	640				26 000
Estimated consumption for supplier no. 2 - not metered hourly						440 524
Estimated consumption for network - not metered hourly						250 466 100
Percentage for distribution of adjusted system load profile						0,18%

Table 7-2 above shows an example of a selection of data from a network owner's customer information system. It consists of the supplier no., customer no., meter no., meter reading as of 15 January 1995, meter reading as of 15 January 1996, electricity consumption between the two meter readings and the calculation basis for the distribution percentage.

A sort has been performed by supplier number so that the percentage for each individual supplier could be calculated. We see that consumption data for Supplier no. 2 exists from 1995 for both Customer no. 5 and 100. This data can be used as a calculation basis for the percentages. There is no meter data for Customer no. 304, and in this case the network owner must estimate a value based on the type of customer. All in all this gives an estimated consumption for Supplier no. 2 of 440 524 kWh. Viewed in relation to the network's total consumption that is not metered hourly of 250 466 100 kWh, this gives a percentage for Supplier no. 2 of 0.18 %.

It is important that all the numbers used for calculation of the percentage refer to the same period so that differences in temperature do not affect the data.

The situation in most networks is still one major supplier with over 90% of the market. Thus it will be adequate to perform the calculation we have illustrated for those suppliers that represent the remaining 10 per cent.

Table 7-3: Calculation of percentage distribution for the dominant supplier

Total network consumption	**250 466 100**	**100.00%**
Supplier 1	440 524	0,18%
Supplier 2	5 500 700	2,20%
Supplier 3	18 700 850	7,47%
Supplier 4	225 824 026	90,16%

Table 7-3 shows that after calculating the percentages for the three smallest suppliers in this case, the network owner can use these rates to calculate the percentage for the largest supplier. Thus the network owner is not required to add up every single customer the large supplier has.

The examples above show that a situation with a high level of mobility in the end user market will require a great deal of flexibility and functionality with regard to the network owner's customer information system.

As we have seen, the percentage rate is the result of what customers the individual supplier has. This means that the network owner must update the percentage every time an end user changes his supplier. To avoid the network owners having to perform these calculations on a continuos basis, restrictions can be placed on when a change of supplier can take place. Up to 31 December 1997 end users who were not metered hourly could change their suppliers at the beginning of every quarter.

Such a limitation is a clear weakness because an end user can risk being locked into his supplier for up to 3 months. This means that the end user does not have any real opportunity to change suppliers during a quarter even if the power prices fall. The rules were changed as of 1998, and end users now have the right to change suppliers every Monday. Theoretically an end user can now change his supplier every week. Chapter 7-5 describes a model for how information can be handled when the supplier changes are so frequent, provided there is a flexible customer information system.

7.3 How the network owner carries out periodic financial settlement between the suppliers

The percentage distribution of the consumption of the individual suppliers calculated by the network owner will not be in agreement with the actual distribution. Settlement by means of the adjusted system load profile requires therefore that the meters belonging to the supplier's customers are read periodically, for example once a year.

It is important to point out that this settlement is not analogous to Statnett's regulating power settlement. This is only a settlement between suppliers within an individual network. The discrepancies between the suppliers within a network do not have any impact with regard to the power system because the suppliers will on the whole purchase power for the network in question in accordance with the expected consumption for non-hourly metered end users. Therefore it is not relevant to price the discrepancies at the regulating power price, because the regulating power price shall be an expression of the system related costs of upward and

downward adjustments due to underconsumption or overconsumption after a market has been cleared. Table 7-4 above illustrates how such a financial settlement between a network owner and three suppliers can be made. The calculated distribution is the power volume that the network owners have derived based on the adjusted system load profile and the percentages for the settlement period. In this example the settlement period is one year. The calculated values shall be included in the settlement data that the network owner sends to the power pool every week.

The metered distribution is what the individual suppliers have consumed in the course of the settlement period based on meter readings. In this example we have assumed that all the end user meters are read at the same time. The sum total of the calculated distribution and actual distribution will always be the same, because both distributions are based on the metered input into the network.

The difference between the calculated distribution and the measured distribution shows how "accurately" the network owner has calculated the percentage distribution between the suppliers. In this case we see that Supplier A has consumed less than calculated, while the other suppliers, B and C, have consumed more than calculated. The network owner has also calculated too little network loss. The sum total of the discrepancies will always be zero, because we are dealing with the distribution of a given volume.

Table 7-4: Periodic financial settlement between the suppliers

	Sup. A	Sup. B	Sup. C	Net-work loss	Total
Calculated distribution (GWh)	800	100	60	70	1030
Metered distribution (GWh)	790	105	63	72	1030
Difference (GWh)	10	-5	-3	-2	0
Weighted spot power price (NOK/MWh)	170	170	170	170	
Financial settlement with network owner (NOK 1000)	1700	-850	-510	-340	0

The difference shall be settled between the network owner and the individual suppliers at the weighted spot electricity price. The spot electricity price shall be weighed in relation to the adjusted system load profile during the calendar period. The reason why the spot electricity price is used is because it best represents the suppliers' alternative price if the end users had been metered hourly.

Since the sum total of the differences in volume equals zero, the sum total of the financial settlement will also be zero. This illustrates that the network owner is not exposed to any financial risk by this type of settlement. Of course this only holds true provided the suppliers who have consumed more power than calculated actually pay for the excess power. The length of the settlement period is determined by the network owner, but settlement shall as a minimum be made at the end of the year.

The meter readings shall be taken at the same time for all the end users in the network[iv], as illustrated in the example. This will primarily be performed by self-reading. Self-reading systems will often be the most cost-effective systems.

Another alternative would be to read each individual supplier separately. One supplier in January, one in February, etc. If this is based on manual reading by the network owner himself, then it may not be possible to take the readings in an efficient manner, as the supplier's customers may be geographically scattered.

A third alternative can be an efficient method in cases where one supplier is dominant in a network. In this alternative the customers of the small suppliers are read together, for example in the course of January, while the customers of the dominant supplier are read scattered throughout the rest of the year. This is possible under the assumption that the dominant supplier accepts such a solution. The settlement for the small suppliers will be accurate, but the settlement in relation to the dominant supplier will be less accurate.

7.4 Risks associated with settlement based on the adjusted system load profile

We will now sum up how the various parties are exposed to risks through settlement by means of this profile. The discussion below is based on the following prerequisites:

- ✓ Readings will be taken for all end users and they will be invoiced for their actual consumption at the end of the year.
- ✓ Calculation of percentage distribution between suppliers is based on the expected annual consumption.
- ✓ Balance settlement is priced at the spot electricity price weighted by the adjusted system load profile for the calendar year[v].

In Chapter 7.4.1 we will discuss how the risk conditions change if there is any deviation from these prerequisites.

[iv] The draft regulations that have been distributed for comments are setting the stage for simultaneous reading of all meter points at the end of the year starting in the year 2000

[v] Pursuant to the draft regulations distributed for comments, meter values at the end of the year can be used as a basis for calculating prices up to 1 March 2000.

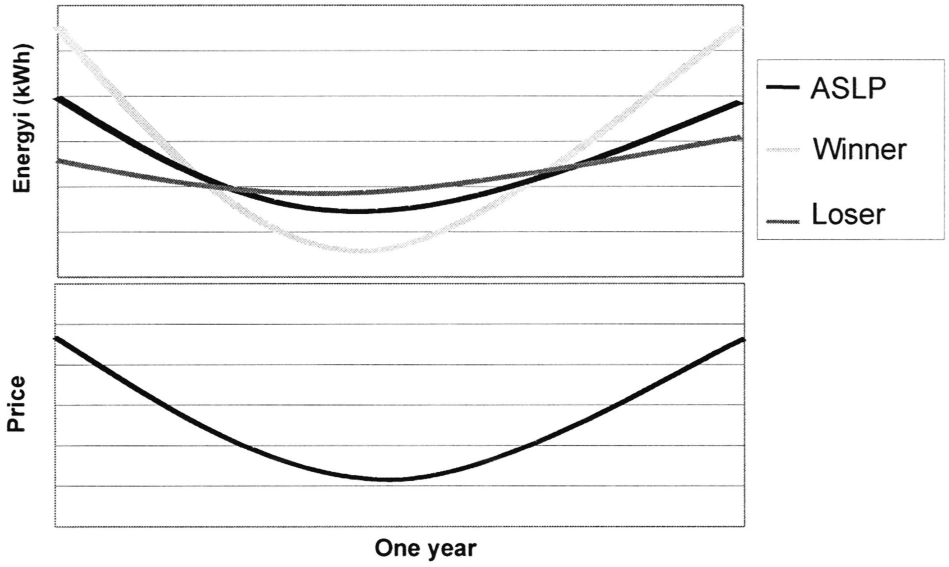

Figure 7-2: Risk associated with use of the adjusted system load profile

We will take a look at the network owner first. Network owners are not exposed to any risk associated with the cost of the suppliers' hourly discrepancies between the reported power purchases and actual power consumption. This is because the settlement is based on the actual power input. There is, however, a certain risk that the suppliers are insolvent at the time of settlement in situations where the suppliers have consumed more power than expected.

The power pool does not run any risk in connection with settlement based on the network owners' adjusted system load profile, as all inaccuracies associated with differences between actual and estimated consumption are settled internally within the individual concession areas. For the power pool there is thus no change in how the regulating power settlement is handled by settlement based on the network owners' adjusted system load profile, in relation to settlement by hourly metered values.

The aforementioned method will not be accurate for the individual end user in relation to his actual consumption profile. The suppliers' purchasing costs for power will be based on the adjusted system load profile, because this is what will be used for settlement with the suppliers. We assumed therefore that the suppliers will also chose to use the adjusted system load profile for settlement with their customers. This is, however, not mandatory.

The end users who have a consumption that is relatively higher than the average consumption when the prices are high and consumption that is relatively lower when the prices are low will gain from settlement based on the network owners' adjusted system load profile.

The end users who relatively speaking have a lower consumption when the prices are high and consume more when the prices are low will lose out with settlement based on adjusted system load profiles.

The end users who lose out will be interested in settlement based on hourly metering. This means that a certain share of the end users will choose to have hourly metered power consumption, because they stand to gain from such a solution. This means that those end users who remain in the adjusted system load profile will have actual consumption profiles that will become more alike over time.

The reflections that are made here with regard to the end user assume that the price to the end user actually varies throughout the year. The end users that have fixed annual prices will of course not lose or gain even if their profile deviates from the adjusted system load profile.

If we look at the relationship between the suppliers, settlement based on the adjusted system load profile will not upset the internal competitive conditions. If an end user is not metered hourly, then the settlement with the supplier who has such a user as a customer will be the same regardless of who the supplier is. This means that the suppliers' costs will not be affected.

A situation whereby some end users will be more attractive for suppliers depending on what their actual consumption profile is like in relation to the adjusted system load profile will not arise either. An end user that is not metered hourly will generate the same relative purchasing costs for the supplier, regardless of the end user's actual consumption profile.

A supplier bears, however, a certain price risk in connection with the new customers they have gained during the period from the last balance settlement to the next balance settlement. This is associated with the fact that the balance settlement is priced according to the spot electricity price weighted by the adjusted system load profile for the entire calendar year. If a supplier gains a new customer on 1 July then the deviation between what the customer is expected to use and what the customer actually user will be priced according to the spot electricity price for the entire year, while the supplier's purchase costs for this customer will be according to the prices for the second half of the year. If the price during the first half of the year is higher than during the second half, then the supplier will make a loss if the customer uses more than assumed and correspondingly gain if the customer uses less than assumed.

7.4.1 Risks associated with changed prerequisites

If the prerequisites for settlement based on the adjusted system load profile are changed, then the risk relationship between the participants is changed. We will use the following situation as an illustration:

- ✓ Readings are taken from end users and they are invoiced based on actual consumption several times during the year (as opposed to once a year in the discussion above).
- ✓ Calculation of percentage distribution between suppliers is based on the expected annual consumption.
- ✓ Balance settlement is priced at the spot electricity price weighted by the adjusted system load profile for the calendar year.

This alternative is identical to the content of the draft regulations that will take effect as of 1999 in Norway.

The changed risk situation for the suppliers is due to the deviation between the basis for the suppliers' purchasing costs and the suppliers' invoice basis in relation to the end users. A supplier's purchasing costs will be determined by the adjusted system load profile and the expected annual consumption of his customers. This means that his purchasing costs are unaffected by the end user's actual consumption profile. The supplier's invoice basis will, however, be unaffected by the customer's actual consumption profile because a reading is

taken from the customer and he is invoiced based on actual consumption several times throughout the year.

A supplier who has customers with relatively high consumption during high price periods and can thus invoice the customers for their actual consumption during the high price period will not be charged for and incur the purchasing costs associated with this relatively high consumption during the same period. With regard to the market, customers with high consumption during high price periods will be more attractive than customers with high consumption during low price periods.

Under the normal Norwegian annual price conditions with higher prices in the winter than in the summer, suppliers will have a higher sales margin for customers with a high winter consumption than customers with a high summer consumption even though their annual consumption is the same, provided the retail prices are the same. Alternatively, the suppliers will sell power at a lower price to customers with a high winter consumption than customers with a high summer consumption.

Table 7-5: Impact on supplier of customers with different consumption profiles

	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.	Annual
Customer A consumption equal to ASLP[vi]	30 %	20 %	20 %	30 %	
Customer B high winter consumption	40 %	10 %	10 %	40 %	
Customer C flat consumption	25 %	25 %	25 %	25 %	
Customer A consumption equal to ASLP	6000	4000	4000	6000	20000
Customer B high winter consumption	8000	2000	2000	8000	20000
Customer C flat consumption	5000	5000	5000	5000	20000
Sales price øre/kWh	0,20	0,15	0,15	0,20	
Purchase price øre/kWh	0,18	0,13	0,13	0,18	
Income Customer A	1200	600	600	1200	3600
Income Customer B	1600	300	300	1600	3800
Income Customer C	1000	750	750	1000	3500
Purchasing costs	1080	520	520	1080	3200
Profit Customer A	120	80	80	120	400
Profit Customer B	520	-220	-220	520	600
Profit Customer C	-80	230	230	-80	300

If the percentage distribution between the suppliers was based on the expected consumption between the readings and not based on the expected annual consumption, then there would not be any discrepancy between the basis for the suppliers' purchasing costs and the invoice basis in relation to the suppliers' customers.

The reason why the expected consumption between readings is not used as the basis for the percentage distribution between the suppliers is because it results in extra work for the

[vi] ASLP is the adjusted system load profile

network owners. In addition, the history for the quarterly consumption for each individual customer would be poor in connection with a transition from annual reading to quarterly reading. An alternative is to change over to percentage distribution based on expected consumption between the readings when a couple of years of data history has been recorded.

7.5 Continuous balance settlement

Continuous balance[13] settlement builds on the method for settlement based on the adjusted system load profile. The change in relation to the method described in Chapter 7.1 to 7.4 concerns the calculation of how the adjusted system load profile is distributed among the various suppliers in the network area. In the description in Chapter 7.2 the network owner makes a percentage distribution based on each supplier's non-hourly metered customers. The method entails a requirement to read all of the end users at the same time so that the balance settlement adds up to zero from the perspective of the network owner. This method also entails that the suppliers bear a price risk for any discrepancy between the expected consumption and actual consumption for new customers gained by the supplier after the last balance settlement until the next balance settlement.

By distributing the adjusted system load profile according to the end user/meter level instead of the supplier level the weaknesses mentioned above can be avoided.

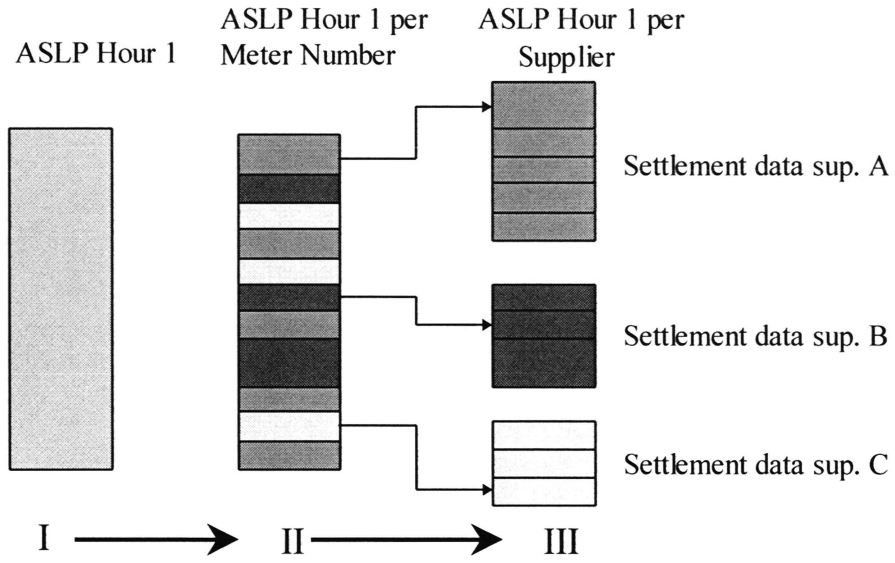

Figure 7-3: Distribution of adjusted system load profile at the meter level

Figure 7-3 illustrates how this can be accomplished. The adjusted system load profile (ASLP) for an hour (I) is shown here. The volume for this hour is distributed among each individual metering point based on the expected annual consumption (II). In order to obtain settlement data for an individual supplier, the network owner must sort the distributed volume at the meter level by supplier (III). This means that the network owner must have a link in his meter value database between the meter number and the supplier number.

Figure 7-4 illustrates the distribution of the adjusted system load profile at the meter level for 2160 hours, i.e. one quarter. The network owner can add up the settled volume at all times for the individual meter points. The network owner needs this total when the meter point is read.

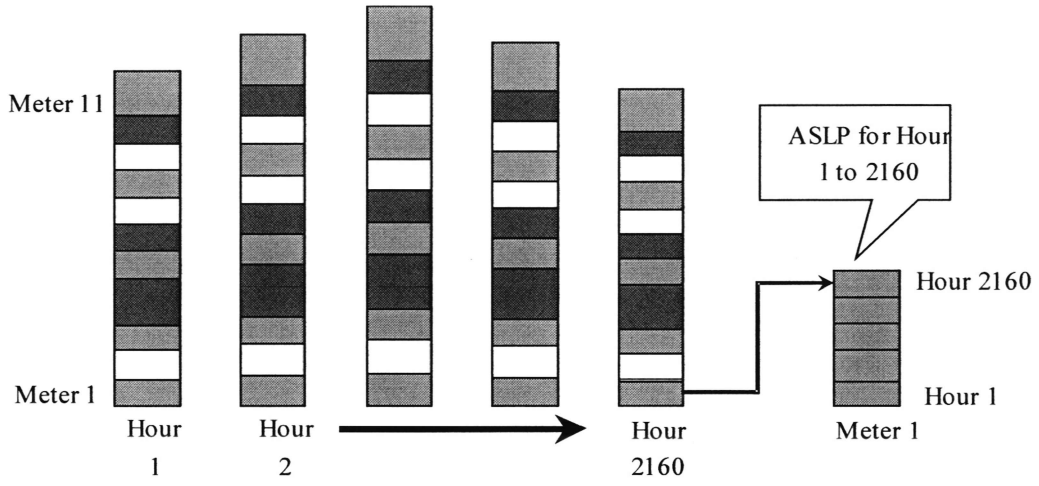

Figure 7-4: Distribution of adjusted system load profile by meter point for one quarter

Figure 7-5 shows that meter no. 1 is read after hour 2160. The network owner can compare the difference then between the settled volume and read volume for the meter point. This volume is priced according to the spot electricity price weighted by the adjusted system load profile from hour 1, which was the last reading, to hour 2160. The value of the discrepancy is added to the supplier's debit and credit balance settlement account. This account is periodically settled with the supplier. In Figure 7-5 we see that the sum total of the values for the meter points that have used more than expected is higher than the sum total of the value of the discrepancy for the meter points that have used less than expected. When the account is settled after the value of the discrepancy for meter number 1 has been added to the account, the supplier will owe the network owner money, and the network owner can send an invoice to the supplier.

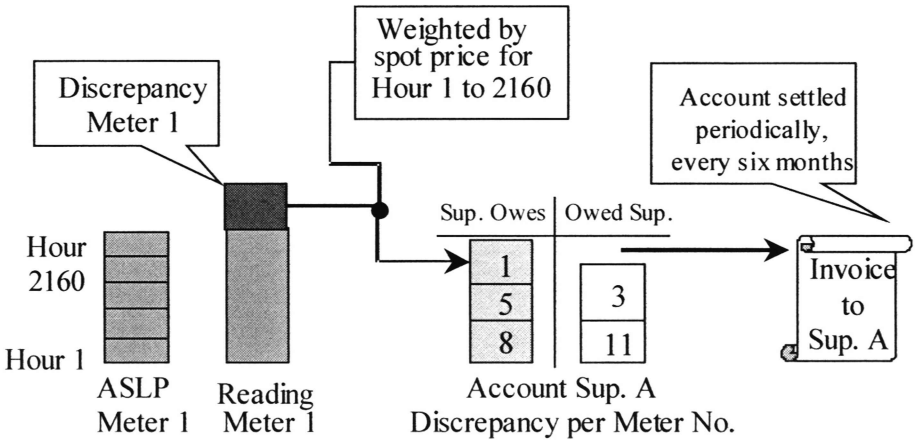

Figure 7-5: Financial settlement between network owner and supplier

This method entails that the network owner updates the accounts for suppliers each time a meter reading is taken. Pricing the discrepancy according to the spot electricity price weighted by the adjusted system load profile between readings results in a correct and relevant pricing of the discrepancy. Thus the suppliers' price risk is eliminated, according to the method described in Chapter 7.4, for new customers between the periodic balance statements. The continuous balance settlement method entails that settlement based on the adjusted system

load profile does not place any limitations on when the meters are to be read. Thus the meter points do not have to be read at the same time.

Under certain circumstances continuous balance settlement entails an increased risk for the network owner. This is the case when the network owner reads some end users more often than others. We can illustrate this in an example where a network owner has two meter points, one that is read once a year and another that is read four times a year.

Table 7-6: Risks for network owners associated with continuous balance settlement

	Meter 1	Discrepancy	Price	Value	Meter 2	Discrepancy	Price	Value
Settled					6500			
Reading 31 Mar.					7500	-1000	0,20	-200
Settled					3500			
Reading 30 Jun.					2500	1000	0,15	150
Settled					3500			
Reading 30 Sep.					2500	1000	0,15	150
Settled	20000				6500			
Reading 30 Dec.	20000	0	0,18	0	7500	-1000	0,20	-200
Total		0		0		0		-100

Table 7-6 shows that there is no discrepancy between the expected and actual consumption for the entire year. In the case of Meter 2 we see, however, that there is a discrepancy between the expected and actual consumption between each reading. Since there are price differences throughout the year, the sum total of the priced discrepancies will not be zero, as is the case for the volume discrepancies. If Meter 1 had also been read four times, then the value of the discrepancies for Meter 1 would have compensated for the value of the discrepancies for Meter No. 2.

This means that the network owner incurs a price risk if some meter points are read more often than others. If the meter points that are read more often than others have an actual consumption profile that is unbiased and equal to the adjusted system load profile, then the sum total of the positive and negative discrepancies will compensate for each other over time. If this is not the case, then the sum total of the suppliers' balance settlement accounts will not equal zero over time.

8 Hourly metering

In this chapter we will review how the hourly metering requirements have been handled from 1995 and why end users with high consumption should be metered hourly.

Settlement based on the adjusted system load profile has made it possible for several suppliers to deliver power in a network without having to meter the consumption hourly. Thus this could also mean that no consumption in a network should be metered hourly. It is discussed below why it is nevertheless necessary to meter consumption hourly for end users who use a lot of power.

8.1 Why meter customers with high consumption hourly

Firstly, end users with a high consumption of power could have too great an effect on the adjusted system load profile. This will apply especially to industries that use electricity as an input factor in their production, and thus have a consumption profile that deviates from the consumption of households and service companies, where the electricity is primarily used for heating and lighting. If large power consumers with deviant consumption patterns are included in the adjusted system load profile, then the profile will not be representative for a large segment of the electricity consumers including, among others, households.

Secondly, the end users that are metered hourly will have more motivation to change their consumption in connection with price changes. If, for example, we were to consider an end user with settlement based on the adjusted system load profile and periodical meter reading in January whose supplier increases the price as of 1 October, then the marginal effect of the price increase will be greatly reduced because his consumption is balanced out by the adjusted system load profile. The end user would thus not reduce his consumption as much as the price increase would indicate. An end user who is metered hourly will feel an immediate effect when he reduces his consumption if the price is increased.

An upper limit of 500 MWh[14] was therefore set in Norway for the annual energy consumption per metering point for settlement based on adjusted system load profiles. The Norwegian Water Resources and Energy Administration (NVE) has estimated that there are approximately 10000 metering points in Norway over the limit of 500 MWh which do not have any equipment for hourly metering at the start of 1995. The network owners were given until 1 January 1996 to phase in the installation of metering equipment. As of 1 January 1999 this limit has been reduced to 400 MWh[15]. The original intention was to reduce the limit of 400 MWh all the way to 100 MWh, but this did not offer any benefits on the basis of a cost/benefit analysis[16].

8.2 Covering the costs of hourly metering

End users with a metering point that have an annual power consumption of over 400 MWh must in other words always be metered hourly. Network owners are responsible for ensuring that measurements are taken and that they are correct. This does not entail that it is the network owner himself who must perform all the measurements or own the meters. The network owner is free to farm the meter job out to others or to let others install and own the

meters. The costs associated with such equipment shall be defrayed by the network owner and included in the calculation basis for the transmission tariff for the relevant network level.

The end user can demand that a metering point with an expected annual energy consumption of less than 400 MWh shall be settled based on hourly metered values. The end user must then himself defray the additional costs associated with the hourly metering. Network owners are also responsible for the hourly values for hourly metering below the limit of 400 MWh per year. The reason why an end user desires that his consumption is metered hourly may be that the end user loses out with settlement based on the adjusted system load profile in relation to his actual consumption profile, or that the end user desires to have a financial gain from the flexibility of his consumption with regard to price changes. In 1995 there was a maximum limit of NOK 2000 per metering point for how much a network owner could charge for the hourly metering of an installation. Thus it was advantageous for an end user to demand hourly metering if he lost more than NOK 2000 annually from settlement based on the adjusted system load profile. As of 1996 the Norwegian Water Resources and Energy Administration (NVE) discontinued such a restriction because the cost of installation and operating an hourly metered installation varied greatly. As far as the NVE knows very few end users have desired hourly metering of their installations.

Some network owners may themselves desire to hourly meter certain end users or to reduce the general limit for hourly metered consumption. The reason for this may for example be the fact that the network owner desires to meter transmission for certain customers hourly. The network owner must in such cases himself defray the costs associated with the hourly metering.

9 Change of supplier fees and transaction costs

In 1995 and 1996 there were fees for changing suppliers and the network owner's handling of suppliers. These fees were to be set so that there was not any discrimination against any of the network's users. The purpose of these fees was to make the end users and suppliers aware of what costs they would incur in connection with changing suppliers. In this manner the end users and suppliers could adapt their behaviour on the market in accordance with the costs associated with their behaviour.

The network owner was permitted to charge a fee of up to NOK 246 each time an end user changed his supplier. The idea behind the size of the fee was that the costs incurred by the network owners were to be defrayed, and the fee was at the same time not to be so high that it prevented small end users from changing their supplier.

In addition, the network owner could charge a fee of up to NOK 4000 per year for each individual supplier that sold power in his concession area. The fee was supposed to defray the costs incurred by the network owners in connection with handling the suppliers. In addition, the fee of NOK 4000 was to make it more favourable for a supplier to have many customers in a few networks, rather than having its customers scattered across many networks.

As of 1997 the Norwegian Water Resources and Energy Administration (NVE) eliminated the network owners' opportunity to charge fees or to receive any other payment for services in connection with the metering and settlement of trading in electricity from suppliers delivering power in their own network[17]. The reason why we eliminated the opportunity to charge fees was the fact that the network owners had had two years of experience from changing suppliers, and it should be easier for them to handle a larger number of suppliers and supplier changes now. Another element is that even small fees will reduce the willingness of the end users to change suppliers, and the fee would have the effect of locking the customer into the supplier. As a result, the suppliers would be able to have higher margins without any risk of losing customers.

In general one can regard the costs a network owner incurs from handling supplier changes as part of their duty as a monopolist. As regards the other costs incurred by the network owner, these are covered through the network user fee. It is therefore not unnatural that the costs associated with handling suppliers are covered in a corresponding manner.

10 Information management

In this chapter we will provide a summary of the exchange of information between market participants that is required in order to maintain an efficient power market. In order to ensure low transaction costs for power trading and to prevent misunderstandings and conflicts, the market participants must know what information is to be exchanged. The exchange of information in Norway is clearly defined through the EDIEL messages[vii] that are defined in the regulations[viii]. Below we will review the messages that must be used in connection with supplier changes, the transmission of meter data from network owners to suppliers and the settlement of regulating power.

10.1 Change of supplier

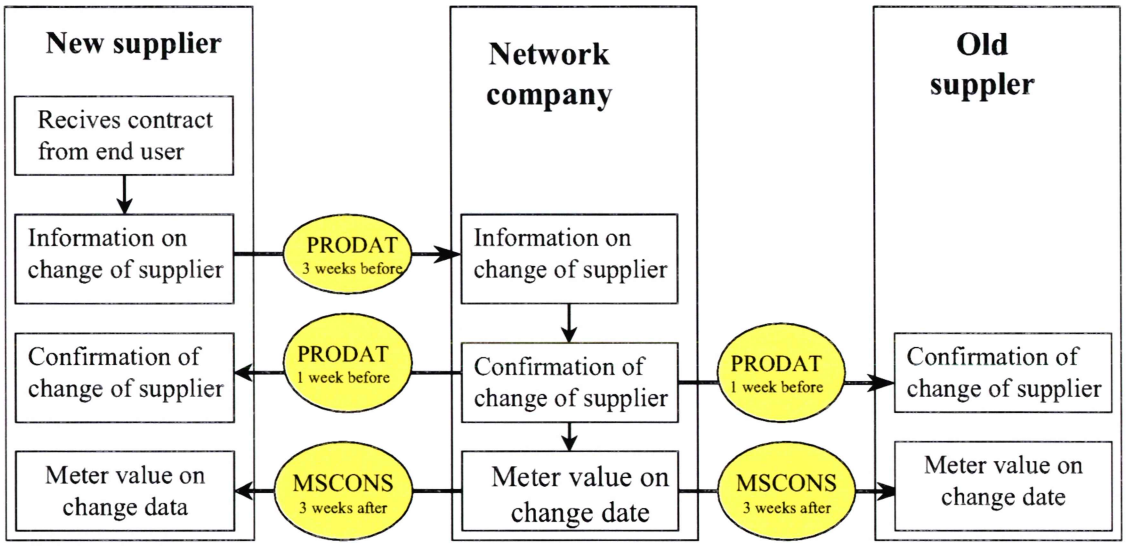

Figure 10-1: Exchange of information for change of supplier

The parties that are involved in changing suppliers is the network owner, new supplier and old supplier. Figure 10-1 shows the flow of the exchange of information from when a new supplier enters into a contract with an end user until the supplier receives the meter value on the change date three weeks after the delivery has started.

The new supplier sends a message to the network owner containing the name, address, meter number etc. no later than three weeks before the change is to take effect. One week before the change the network owner sends a supplier change confirmation to both the new and old supplier. The new supplier receives in this connection more detailed information on the customer such as the expected annual consumption. The network owner has three weeks after the change date to send meter data at the time of the change to the new and old suppliers. The message types PRODAT and MSCONS are electronic message types that are described in Chapter 11.

[vii] See Chapter 11

[viii] The regulations stipulate mandatory use of EDIEL messages

10.2 Regulating power settlement

The parties that are involved in regulating power settlement are the network owners, entities with balance responsibility and Statnett as the power pool. Pursuant to the regulations the network owner shall send settlement data to Statnett three days after the delivery week. This means that the network owner shall send Statnett the 7 times 24 hourly values for the previous week on Wednesday for each individual entity with balance responsibility that settles power in his network. The network owner shall not distinguish between the hourly metered and calculated values in relation to Statnett, he shall send the accumulated settlement data for each entity with balance responsibility. The network owner shall send the same data to the entities with balance responsibility. The entities with balance responsibility can use this data as a basis for controlling the settlement from Statnett.

The network owner shall also send hourly values for the installations that the individual entities with balance responsibility deliver power to. In addition, the network owner shall send the adjusted system load profile share for the entities with balance responsibility. This is data that the entities with balance responsibility use as a basis for invoicing their customers.

Statnett has nine days after the delivery week to carry out a settlement in relation to the entities with balance responsibility by means of a debit or credit.

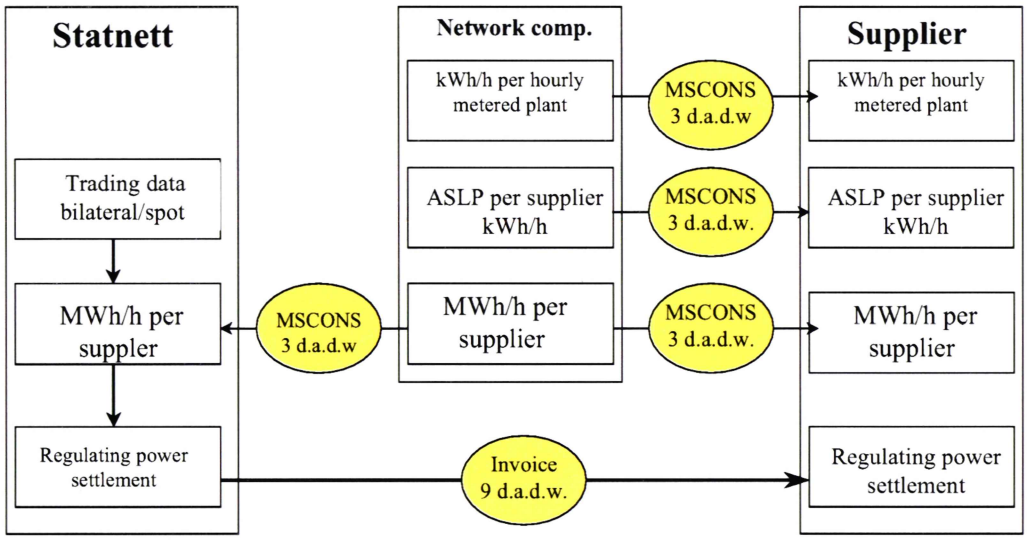

Figure 10-2: Exchange of information for settlement

11 EDIEL standard format for the exchange of data

Information is exchanged between the end user, power supplier and network owner in connection with a change of power supplier. Settlement data is sent from the network owners to the power suppliers and the power pool for regulating power for settlement of the power market. Without the existence of a standard method of transmitting data, this entails a high degree of manual handling in connection with the transmission of data and import of data into the settlement and customer information systems.

The purpose of transmitting data in a standardised manner is to enable electronic handling and storage without manual intervention. This increases the speed, security and reliability of the data transmissions and ensures that the stored information is correct. It has been decided that EDIEL (Electronic Data Interchange in the ELectricity industry) shall be used as a standard of communication.

Effective 1 January 1998, the Norwegian Water Resources and Energy Administration (NVE) introduced a requirement that the EDIEL message MSCONS shall be used for the transmission of settlement data. Effective 1 July 1999 the EDIEL message PRODAT shall be used for the transmission of data in connection with the change of suppliers.

The use of EDIEL is unique in the world. Foreign market participants have expressed an interest in the introduction of EDIEL in Norway. The Norwegian participants will benefit if the communication standard EDIEL is also implemented elsewhere in Europe and the rest of the world.

11.1 EDIEL in general

With a higher demand and need for reliable data at the right place and at the right time, the use of Electronic Data Interchange (EDI) as a tool is necessary. Electronic Data Interchange (EDI) will replace the routines that are currently performed manually. Operations can be made more efficient in this manner and the investments made in IT solutions will pay off.

EDIEL is an acronym for EDI (Electronic Data Interchange) in the ELectricity industry. EDI is defined as the "electronic transmission of business documents between different computers in a standardised format". EDIEL makes use of EDIFACT messages.

The data format GS2 (Interface 2) was introduced as an external format in 1996[18]. The format proved to have certain weaknesses, such as little security for large amounts of data and no built-in receipt acknowledgement[19]. It was decided that EDIEL was to take over as a common external format. The advantages of EDIEL are for example, high security, international standard (X.400), a central body (UN) providing guidelines and rules for use of the format, many suppliers, etc.

EDIFACT is a standard that has been developed by the UN and is currently approved as an ISO standard. The standard describes the layout and syntax of various documents. An

interchange defines a collection of several messages and message groups. The layout of a message is formed by means of a defined fixed format of codes and data elements.

EDIEL makes use of a selection of EDIFACT messages where the document types that are relevant to the power market have been defined. EDIEL is in other words based entirely on the established EDIFACT standard. The format will thus be widely used in general in the future, at the same time as a number of defined documents that can be used are available. The EDIEL organisation is working on the definition of EDIFACT messages that will cover the needs of all the participants in the power market for the external exchange of information.

EDIEL – Scandinavian Forum
In order to handle the increasing need for the exchange of information between the various participants in the electricity supply market, a joint organisation was established in the autumn of 1995, the Scandinavian EDIEL Forum.

The purpose of EDIEL is to standardise the use of EDI based on the international EDI standard UN/EDIFACT within the electricity supply market. EDIEL will seek to handle the need for the exchange of data between participants and industry organisations within the electricity supply market, both nationally and internationally. The Forum will also study related areas such as communication standards and security solutions.

EDIEL Message Handbook
To ensure that information can also be exchanged across national boundaries based on the same formats, EDIEL has prepared a common message handbook[20]. The message handbook contains common implementation guides for commonly used messages within the electricity supply market. A functional description containing information that is of universal application with regard to the various implementation guides has also been prepared. This includes relationships between the various message types, use of codes and code lists, special circumstances related to individual countries (such as the use of time zones), terminology, etc. This documentation is primarily aimed at individuals who will be implementing EDIFACT messages in applications and EDI software.

Norwegian EDIEL Steering Group
The purpose of the Norwegian EDIEL Steering Group is to work on problems related to EDIEL in Norway. This includes, for example, acting as a contact forum for the electricity supply market, initiating pilot projects, arranging financing for development tasks and defining business procedures within the electricity supply market in connection with work related to EDIEL and EDIFACT.

Interchange agreements
The Scandinavian EDIEL Forum is currently working on the formulation of a common interchange agreement for the use of EDIEL in the Scandinavian countries. This interchange agreement will be based on the EU's interchange agreement.

The intention is that all the participants in the power market should be able to enter into this agreement with a central participant in order to avoid all the participants having to sign separate agreements among themselves. In Norway an agreement will probably be entered into with Statnett SF.

11.2 MSCONS message

MSCONS (Metered Services Consumption Report message) is used in the power market to report metered values. This includes for example the reporting of production and consumption data to be used for settlement and statistics. The message can be sent between various market participants such as network owners, suppliers and Statnett.

In the Regulations relating to metering, settlement and coordinated joint action in connection with power trading and the invoicing of network services the Norwegian Water Resources and Energy Administration (NVE) stipulates mandatory use of MSCONS for:

- Transmission of settlement data from network owners to suppliers.
- Transmission of settlement data from network owners to Statnett.
- Transmission of meter readings from network owners to suppliers.
- Quarterly transmission of expected consumption per metering point.

MSCONS Implementation Guide

The implementation guide[21] for MSCONS (Message handbook for Ediel, Implementation Guide for Metered Service Consumption report) describes the content of the MSCONS message. The guide can be downloaded from EDIEL Norway's Internet site http://www.ediel.org/norge/.

User Handbook for the MSCONS message
The User Handbook[22] for the MSCONS message describes how EDIEL's MSCONS message is to be implemented in Norway. The document is intended as an aid for market participants who will be implementing the MSCONS message in Norway and it must be read together with EDIEL's Implementation Guide for the MSCONS message.

11.3 PRODAT message

Information is exchanged between the end user, power supplier and network owner in connection with a change of power supplier. The PRODAT message is used within the electricity supply market in connection with the change of suppliers for the transmission of master data – data that is rarely changed – between network owners and producers.

At the start of the message a message function is defined that describes the function of the message in question. The following functions are defined:

Z01 Request for Enduser-information from potential Supplier
Z02 Answer on Request for Enduser information
Z03 Information about change of supplier
Z04 Acknowledge on change of supplier (incl. update of master data)
Z05 Acknowledge on change of supplier
Z06 Portfolio status, incl. update of master data
Z08 Delivery contract closure
Z09 Update of Master data
Z10 Change of Meter
Z11 Meter information – ***Not used in Norway***

11.4 PRODAT Implementation Guide

The implementation guide[23] for PRODAT (Message handbook for Ediel, Implementation Guide for Product Data Message) describes the content of the PRODAT message. The guide can be downloaded from EDIEL Norway's Internet site http://www.ediel.org/norge/.

Norwegian user handbook for the PRODAT message
The Norwegian user handbook[24] for the PRODAT message describes how EDIEL's PRODAT message should be implemented in Norway and is intended as a supplement to the Implementation Guide for the PRODAT message from EDIEL. The document is designed for suppliers of customer information systems and others who send or receive the PRODAT message. The document is based on requirements and guidelines from the Norwegian Water Resources and Energy Administration (NVE) and the Scandinavian EDIEL Forum. The document will be updated as required. New versions will be published on EDIWL Norway's website http://www.ediel.org/norge/.

11.5 User support and future strategy

In accordance with the draft regulations distributed for comments, all communication between the network owner, entity with balance responsibility and Statnett concerning change of suppliers, settlement and balance settlement shall take place electronically by the end of 1999. The purpose of this is to reduce the transaction costs associated with power trading and to actually enable a greater number of and more frequent supplier changes. This strategy represents a significant advance for the industry in the field of information technology. A great deal of resources have been used on the part of the Norwegian Water Resources and Energy Administration (NVE) not only to develop standards, but also to test the use of these through cooperation with the country's largest system supplier to the industry.

A user support service for EDIEL communication was established in the autumn of 1998 as a tool to help the industry introduce the standards. Responsibility for the user support will be assigned to Statnett through its concession. Statnett's responsibility will also entail further development and testing of the EDIEL standard. In addition to a pure help desk function the user support will function according to plan as a test partner in connection with the testing of new participants and/or software that will be implementing MSCONS messages. Separate test procedures will be prepared for use by new participants and new software versions.

The goal of the Norwegian Water Resources and Energy Administration (NVE) for its work with EDIEL in the future is to ensure that the introduction of EDIEL in Norway goes smoothly, in addition to spreading information on EDIEL to foreign market participants and authorities. The user support for EDIEL will play a key role in this connection.

12 Market developments

Before the elimination of the hourly metering requirement hardly any household customers changed their suppliers. In 1995 and 1996, which were the first two years after the elimination of the hourly metering requirement, the movements on the market were very small. This is probably due in part to the fee for changing suppliers of NOK 246 and the fact that the suppliers had to pay NOK 4000 to each and every network they sold power in.

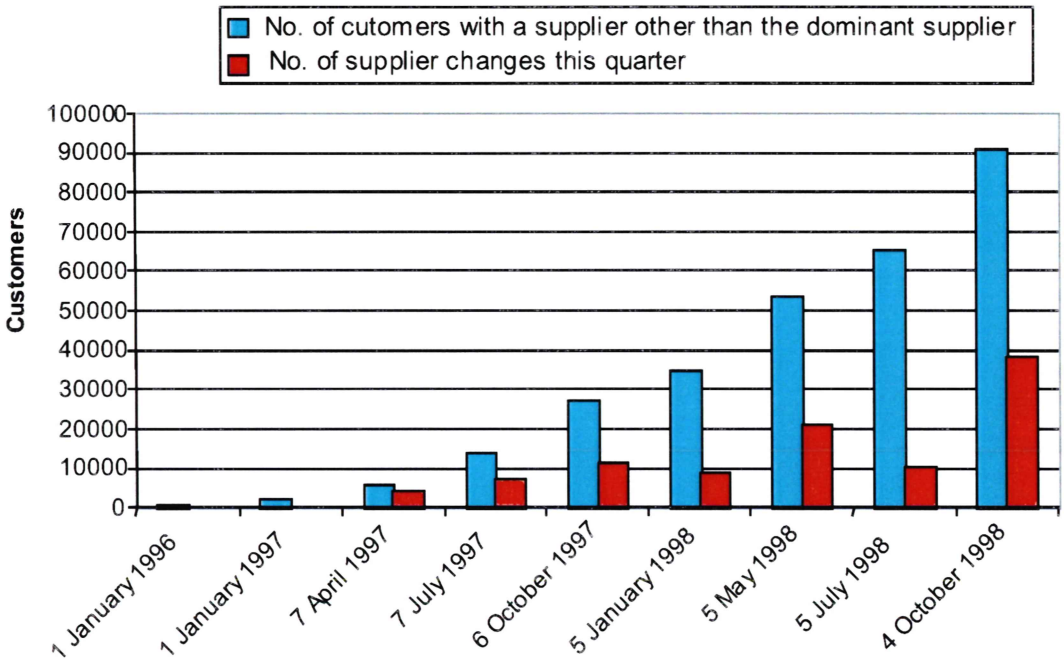

Figure 12-1: Change of supplier for households

Another element is the fact that the power suppliers only made an active effort on the market to a limited extent, and in many cases it was difficult for the households to find another supplier. Furthermore there was probably little knowledge about the open power market. In the second half of 1996 the wholesale prices rose sharply due to low inflow and low magazine levels. Primarily for reasons of local politics, most of the local suppliers did not increase their prices to the households correspondingly. This resulted in low and in many cases negative margins for the suppliers, and thus the household market was not of any interest to those who wanted to find new customers.

As of 1997 the network owners' opportunity to charge fees in connection with changing suppliers was eliminated. This fact combined with more normal power prices started to move the household market. At the end of 1997 almost 35 thousand households had a supplier other than the local supplier. This development has been reinforced in 1998, as it is possible to change suppliers at the start of every week as opposed to the start of every quarter earlier. According to the Norwegian Water Resources and Energy Administration's (NVE's) survey over 90 thousand or 4.5% of the households had a supplier other than the local supplier as of 4 October 1998.

Figure 12-2 shows the market share for the dominant market participants in the 40 network areas with the greatest number of households for October 1998. We see there are great

differences between the areas. In October 1998 there are three network areas where the dominant supplier has a market share of around 80%.

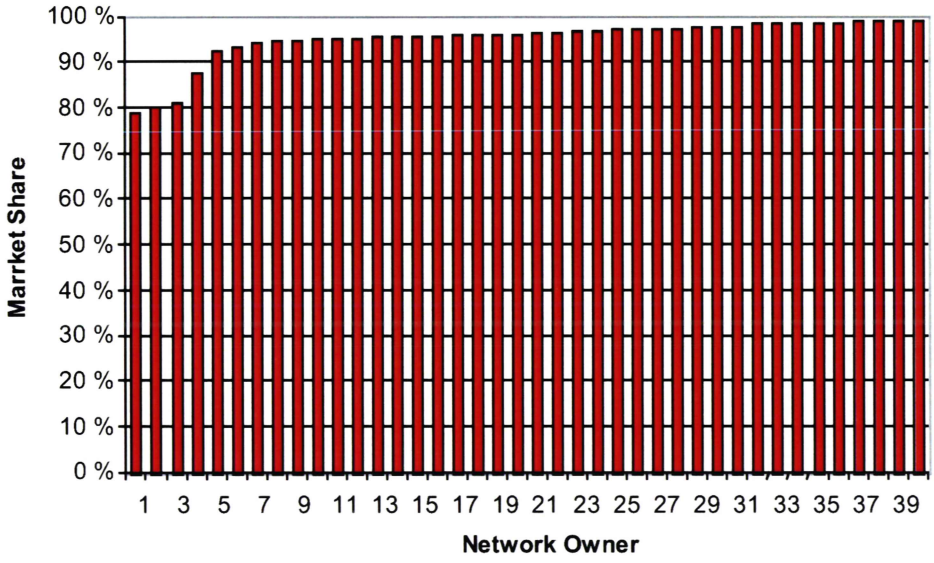

Figure 12-2: Market share of dominant supplier in the 40 largest network areas as of October 1998

Figure 12-3 shows the development of the household prices and spot electricity price from 1995 to November 1998. Up until 1998 the household prices are based on surveys conducted by the Norwegian Water Resources and Energy Administration (NVE). Starting in 1998 the prices are taken from the Norwegian Competition Authority's collected data. The prices are volume weighted. The NVE conducted price surveys as of 1 January 1995 and 1 January 1996, as well as 1 and 10 October 1996. In 1997 the NVE conducted quarterly surveys. Starting in 1998 the Norwegian Competition Authority updated the prices to households every week. Quarterly prices are listed for 1997 and 1998 in the figure.

The surveys from January 1995 and January 1996 gave almost the same price of 17.9 and 17.8 øre/kWh, respectively. It is not very probable that the prices changed significantly in 1995, even though we do not have any certain figures for this. In 1995 the local power companies still stipulated annual prices as they traditionally had done. This was the situation for the beginning of 1996 as well, and even through the spot electricity prices increased to around 25 øre/kWh, the power companies did not significantly increase the prices to households. When the Norwegian Water Resources and Energy Administration (NVE) conducted its price survey in October 1996, the spot electricity price had increased to over 30 øre/kWh. At start of 1997 the household price had increased to just under 25 øre/kWh, while the spot electricity price had fallen to 23 – 24 øre/kWh. From Figure 11-3 we see that the household prices from 1997 do follow the spot electricity prices to a certain extent, but there is a significant delay. We must assume that with stronger competition there would be greater covariation between the spot electricity prices and the household prices.

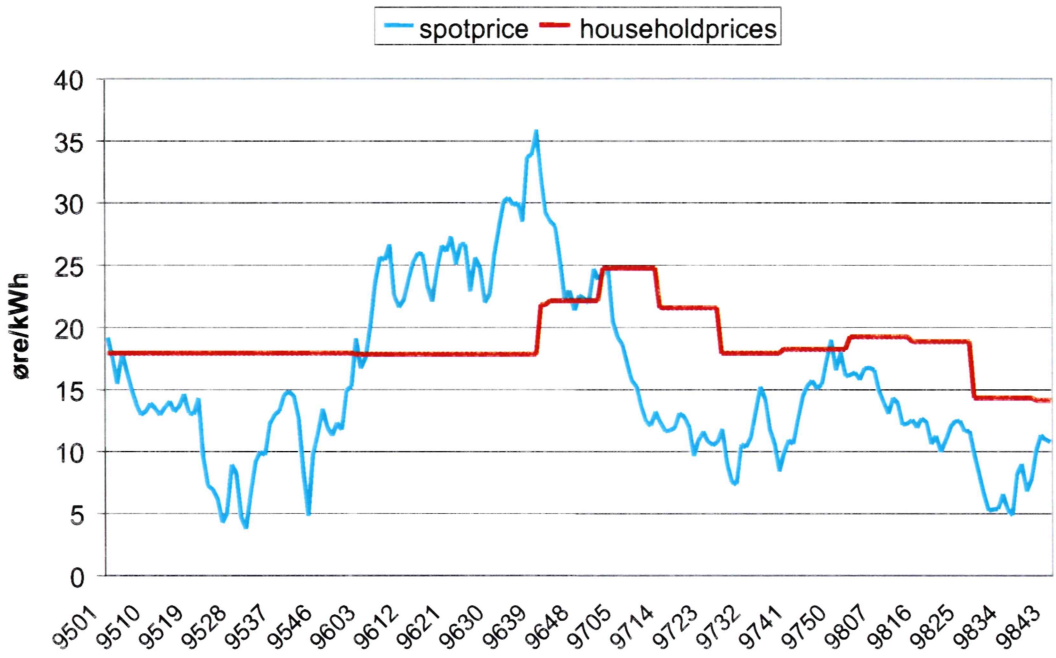

Figure 12-3: Weekly average for NordPool's spot electricity price and household prices without taxes

The figures in Figure 12-3 and 12-4 are based on standard price offers from the dominant supplier in the individual network areas. There is a source of error here, but since the market share of the dominant supplier has gone from 100% to 90% it does nevertheless give a precise enough picture of reality. We see from Figure 12-4 that there was a very large price spread in January 1997, which is probably due to the high level of uncertainty concerning the power situation at that point in time. In January 1998 the prices had converged again, and the prices for October 1998 show very small variations.

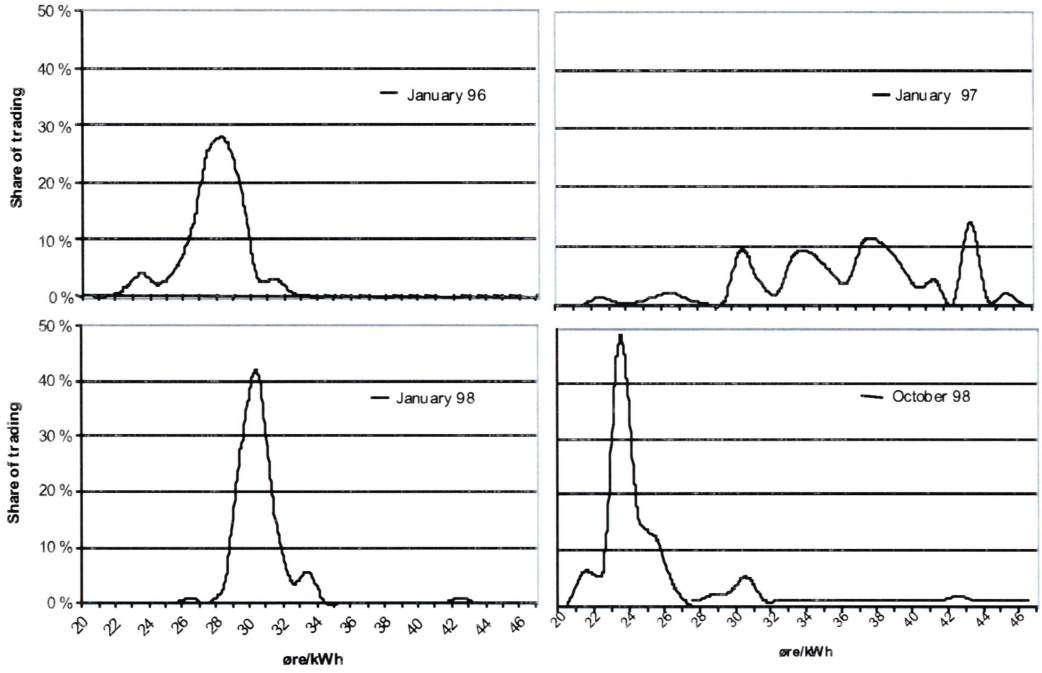

Figure 12-4: Price spread 1995 - 1999

It is probable that the price differences on the household market will be very small in the future, but there will still be some spread. The various suppliers may have different opinions on future price developments and thus they will price the power differently, especially in a situation with a great deal of uncertainty such as magazine levels and inflow below normal. When such uncertainty is reduced the prices will probably converge again the way they did in 1997.

What the households actually pay may, however, vary more, because fixed price contracts may have been entered into at different points in time. If the underlying power market changes, then power contracts for the same period may be priced differently, depending on the point in time the contract was entered into. Therefore a certain amount of spread in what the households pay for power is not a sign of the market functioning poorly as long as there is little variation in the prices for identical contracts that are entered into at the same point in time.

Figure 12-5 shows the power price for households in Sweden and Norway for 1997 and 1998. Sweden opened its power market in 1996, but it has maintained the hourly metering requirement in connection with supplier changes. The suppliers in both countries have access to the same wholesale prices due to the joint Swedish/Norwegian power exchange.

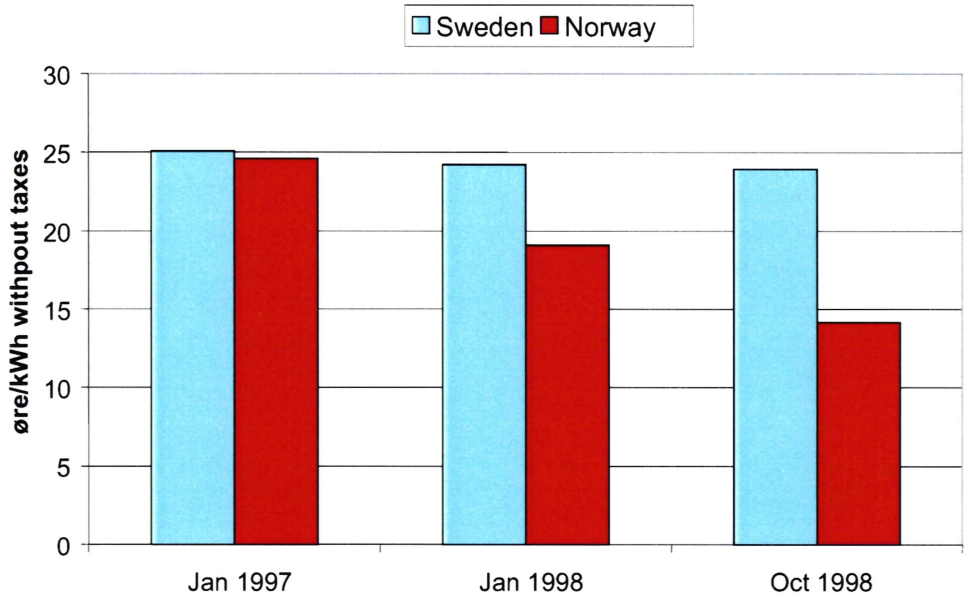

Figure 12-5: Price comparison for Sweden and Norway without taxes in Norwegian kroner (Source NVE and the Energy Authority)

We see that the prices in Sweden and Norway were more or less the same in January 1997. The Norwegian prices have been reduced significantly due to the low energy prices, while the Swedish prices have remained high at around 25 øre/kWh. There is reason to believe that the cause of the high prices in Sweden is the hourly metering requirement for those who change their supplier. With a cost of 2500 kroner to establish hourly metering, a Swedish household with an annual consumption of 20000 kWh must save 12.5 øre/kWh with a new supplier for one year or 6.25 øre/kWh for two years in order to make changing suppliers profitable. It looks like the Swedish delivery concessionaires[25], who have a monopoly on selling electricity without an hourly meter, adapt to this by having high prices to households.

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