Economic objectives and results of the Energy Act

Torstein Bye and Bente Halvorsen

The Norwegian power sector has been regulated and dominated by the public sector for about 90 years, partly to safeguard Norwegian ownership rights to natural resources at the beginning of the century and partly due to uncertainty concerning substantial capital investments in power development just after the last World War. As a result of formal legal aspects as well as a lack of efficiency and profitability, the time was ripe at the beginning of this decade to change the existing framework conditions and provide for greater exposure to competition in parts of this sector. Eight years following the introduction of the new Energy Act we see signs that market orientation and the regulation of the power sector are now bearing fruit. Over-investment in the power sector has been reduced, and the increase in mean annual production capacity has almost come to a halt. Differences in electricity prices between manufacturing sectors have narrowed and network charges have been sharply reduced. However, the price differential between households and some manufacturing sectors has increased slightly. It appears that a steady flow of new regulations applying to this sector, such as the requirement that power supplies be separated from transmission services, is resulting in considerable changes, and it will therefore be important to follow developments in the period ahead.

Introduction

The government authorities own most of Norway's electricity production and transmission capacity. In 1993, the state's ownership interest in total power production was just below 40 per cent. County or inter-municipal power stations accounted for almost 40 per cent, while municipal and private power stations each had a share of a little more than 10 per cent, see Bye (1997).

The high proportion of government ownership stemmed from the concern about foreign ownership at the beginning of this century. This fear was reflected, for example, in the Citizens' Rights Act of 21 April 1888, which introduced a licensing requirement for purchasing or controlling various types of real property for companies without a Norwegian board or registered office in Norway. Later came the "Panic Act" of 1906, which introduced a licensing requirement for the acquisition of waterfalls. This was followed ten years later by Act no. 16 of 14 December 1917 "relating to the acquisition of waterfalls, mines and other real property", also referred to as the Industrial Concession Act. This Act introduced a requirement entailing that everyone, excluding the state and municipalities, had to obtain a license for purchasing waterfalls.

The new Energy Act[1] (which came into force on 1 January 1991) replaced several acts: the Power Supply Act of 25 June 1948, the Electricity Rationing Act of 9 July 1948, the Electricity Act of 19 June 1969, the District Heating Act of 18 April 1986, and Chapter IV of the Industrial Concession Act of 14 December 1917. Amendments have also been made to the licensing rules in the Industrial Concession Act of 14 December 1917 and the Watercourse Regulation Act of 14 December 1917. Purchases of Norwegian power stations, however, are still primarily regulated through the *licensing requirement* in the Industrial Concession Act. This Act also includes provisions on public *pre-emotion rights* and the *right of reversion* to the state when a license expires.

Concern about the exploitation of Norwegian natural resources, and hence the emergence of extensive legislation and considerable public ownership interests, provided the real foundation for public sector regulation of the power sector in Norway. It should also be borne in mind that in connection with reconstruction after the Second World War there was considerable uncertainty attached to investments in capital-intensive projects. This laid the basis for two important developments in the Norwegian power market. The government authorities assumed the entire risk associated with development at the same time that they tried to reduce this risk by linking power production to long-term contracts with Norwegian energy-intensive manufacturing production.

Given this historical background, and the many sound motives underlying the regulation of the power sector, the question may be raised as to why the work on a new Energy Act was initiated. There were two main reasons for this. One was of a formal legal nature. Proposition no. 43 to the

Torstein Bye, Director of Research at Resource and environmental economics. E-mail: torstein.bye@ssb.no

Bente Halvorsen, research fellow at Resource and environmental economics E-mail: bente.halvorsen@ssb.no

1 See Proposition no. 43 (1989-90) to the Odelsting, sanctioned by the Crown Prince on 29 June 1990.

Odelsting states: *"Existing statutory rules are today spread among various pieces of legislation. This spread makes it difficult to obtain a total overview of energy legislation and to use existing legislation for executing future tasks in the energy sector".*

The second was of a purely economic nature. The same proposition states: *"A legal basis must be created for increasing the efficiency of the power market and providing for a more flexible use of power. Statutory rules must create conditions, which allow the organization of the energy supply sector to ensure a economically sound adaptation of production and consumption. It should be possible to use the statutory rules to promote energy efficiency".*

It was thus deemed that the regulations that had been implemented might well have been justifiable from an historical point of view, but they were hardly appropriate for the current situation. Work was therefore started on drawing up a new Energy Act that in part would cover the need for simplifying the legislation and in part provides new framework conditions to achieve a better utilization of the total resources in the power sector. Furthermore, there was a desire to enhance the basis for improving the functioning of the electricity market itself.

The main objectives of the new Energy Act can be summarized as follows:[2]

- One comprehensive act for the electricity supply sector which had previously been covered by a large number of laws and regulations.
- A clear division between those parts of production which can function in a market and those which are natural monopolies.
  - Regulation of monopolies.
  - Remove ties between large subscribers and distribution utilities with an obligation to deliver.
  - Introduce a licensing requirement for engaging in monopoly activities.
- Provide framework conditions for a more cost-effective expansion of power stations, including the selection of development solutions that reflect the willingness to pay for energy and effect, and a sound ranking of projects according to rising costs.
- Reorganization of the sector to achieve more cost-effective operations, including the desire for mergers of distribution utilities and a reduction in the number of energy utilities, at the same time that vertical integration would no longer be an objective. Emphasis was placed on a voluntary approach, but it was also pointed out that it would be desirable to have more information (for example publication of cost figures for distribution utilities) in order to gain a better basis for evaluating mergers.
- Ensure that local electricity producers were not discriminated against by distribution utilities.
- Improve the utilization of electricity by having the market provide for a narrowing of electricity price differentials between customer groups even though energy-intensive manufacturing was still kept outside the market.
- The state would continue to have import and export rights.
- Reorganize Statkraft (Norwegian Energy Corporation) by separating network and electricity production in order to promote deregulation and competition.

In this article we will focus on the economic arguments for introducing new statutory rules in the energy sector. The fact that the Energy Act was aimed at increasing efficiency in the power market and achieving a more economically sound adaptation of production and consumption is an indication that the situation in the energy sector was not as it should have been. We shall first attempt to concretize the economic problems in the existing energy market. With the help of some economic indicators, we will then discuss to what extent developments have fulfilled the intentions underlying the new Energy Act. Finally, we will draw some conclusions and discuss the outlook for the future.

Economic arguments for the introduction of the Energy Act

Prior to the introduction of the Energy Act, a number of articles were published which criticized the existing regulation of energy markets, and pointed to the potential efficiency gains which could be achieved through deregulation. In the following we will briefly review the most important problems described in these analyses.

Over-investment in power production

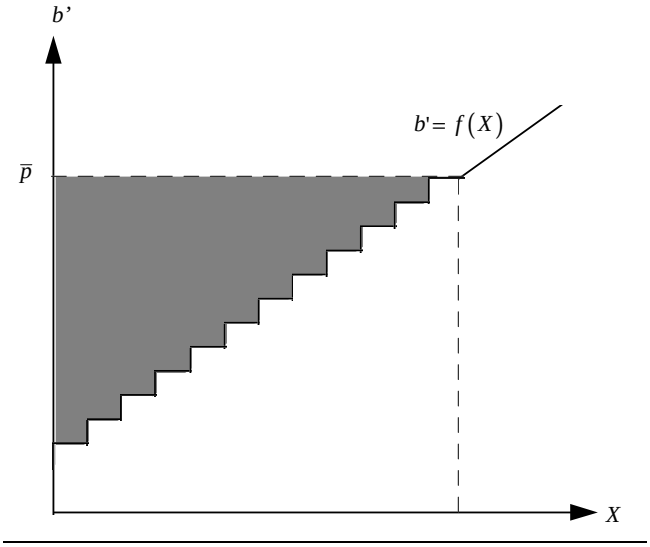
It is well know that there are rising marginal costs associated with developing hydropower, see e.g. "Master Plan for Water Resources" of 1984. If hydropower stations are ranked and constructed according to rising unit cost, and no development is undertaken until the price exceeds the unit cost of the next project, this ensures economically optimal development.

Historically, both expensive and cheap power station projects have been carried out in Norway. Furthermore, in the period prior to 1978 a pricing rule was followed which said that the price should be equal to the average cost of power development, including a 7 per cent return on capital. Development decisions were largely based on the elaboration of energy forecasts. Estimating changes in electricity prices and then calculating energy demand drew up the projections. Development was to balance with the projections of demand. Inconsistency in the estimates for prices and costs of marginal projects resulted in over-expansion. The attitude was that any increase in "need" was to be covered by increasing power capacity.

A new pricing principle was set out in the Energy Report of 1978: the price was to be equal to the marginal cost of development. It also established an escalation plan for

2 Obtained from Proposition no. 43 to the Odelsting.

Figure 1. Economic rent in the Norwegian hydropower sector



Source: Bye andJohnsen (1991).

prices so that the price was to reflect the marginal cost for general consumption in 1985. This too failed to provide the right volume of new projects for several reasons. First, the Energy Report stated that the price should be equal to the marginal cost. In the long run this meant that development was only to take place when the price was high enough to cover the cost of the last project. This applies on the assumption that the price is set in a free market. Prices, however, were still regulated. Power producers could therefore in principle always cover their costs. Too high a price, and hence too low demand in relation to the power capacity that had been developed, would then result in net exports from Norway. Thus it may be said that Norwegian consumers were punished at the expense of other countries' demand for Norwegian electricity. Second, a lack of market pricing will have effects on the cost of development. The best economic choice of development solutions will not be implemented. A further drawback was that this new principle *only* applied to 70 per cent of the market. The price of electricity supplies to manufacturing was still determined on the basis of this industry's competitiveness and not on the alternative value in the market. Fourth, there was still no sound ranking of power projects. This did not appear until the "Master Plan for Water Resources" in 1984. The pricing rule that was applied constitutes a fifth factor: the price *including* the electricity tax was to equal the marginal cost. This resulted in a tax wedge between investments made by the state and municipalities/counties.

In a power system with rising marginal costs, profits exceeding normal returns to capital, or economic rent, shall arise. Since there are many cheap power station projects, and these are not built until the price covers the unit cost of the last project, the cheapest power projects achieve a return which clearly exceeds the normal return on capital in Norway. In Figure 1 we have, in a very stylized manner, ranked "all power station projects in Norway" according to rising costs, cf. staircase line in Figure 1. Optimal development is carried out when the unit cost of the last power station (b') is equal to the price (p). The excess return in power production, also known as economic rent, then becomes the shaded area in Figure 1.

Bye and Johnsen (1991) made calculations of the return that should exist in the power sector in Norway if, given the current power production capacity, development was restrained until the price was higher than the marginal cost of new development projects.

"*Assume that a further expansion in power capacity was postponed until the price equaled the cost of new projects. With electricity prices corresponding to the long-term marginal cost and the same volume sold as in 1988, the return in the power sector might be NKr 22 billion. The normal return, calculated using a rate of 7 per cent, would amount to NKr 12 billion for the power sector. According to the national accounts, the actual operating surplus in the power sector in 1988 was NKr 9.6 billion. Including the electricity tax, the return came to NKr 12 billion. In the long term, the power sector's revenues might be increased by about NKr 9 billion".* (See Bye and Johnsen 1991, page 30.)

This shows that at that time electricity production capacity had been increased so much that the private economic return (i.e. excluding the electricity tax) did not reach a normal return (7 per cent) on capital in addition to the fact that there should have been a substantial economic rent. The return for society (i.e. including the electricity tax) should be more than 80 per cent higher than the level achieved. In this connection the earlier electricity tax may be looked upon as a type of tax on economic rent. However, since the Norwegian power market was virtually closed and power development was undertaken by the public sector, this electricity tax will entail a tax wedge in investment.

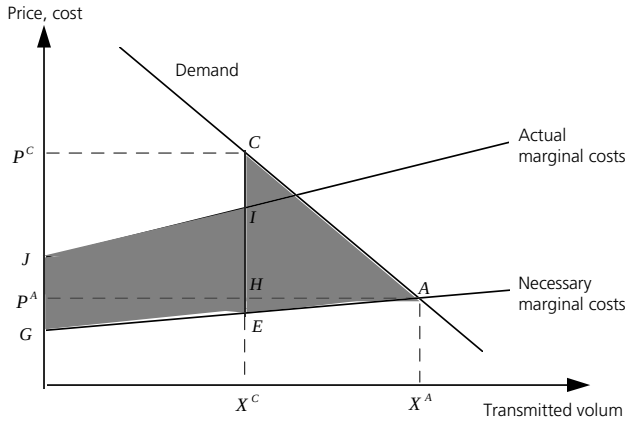
A very low return indicates substantial over-investment in the power sector in Norway at that time. This was an important argument for deregulating the power market and achieving a more market-determined basis for capacity. A sharp downward adjustment of investments as a result of deregulation through the Energy Act might therefore be expected.

Inefficient network

Network services are natural monopolies[3] due to the falling average costs of developing network services. It is therefore not automatically possible to use the same pricing rule as for power production. A price equal to the marginal cost would result in large deficits in the networks (see e.g. Bye,

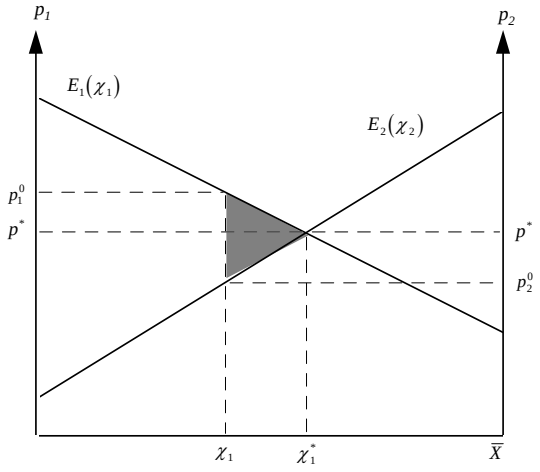
3 Berg et al. (1994) defines natural monopolies as follows: "A production activity is a natural monopoly if the total costs of producing the product volume are lower when production is carried out in one enterprise than when it is distributed on an arbitrary number of smaller enterprises". A monopoly will develop too little capacity and charge an excessive price for the service relative to the free competition solution (Gravelle and Rees 1981).

Figure 2. Cost and price ineffectiveness in transmission utilities



Source: Kittelsen (1994).

Figure 3. Efficiency losses from price regulation in the power market



Source: Bye and Johnsen (1991).

Johnsen and Strøm 1991). The development of networks, however, has largely been controlled on the basis of political objectives entailing that everyone in Norway could be linked to the network, and electricity utilities should guarantee that everyone received the electricity they demanded at any one time. The costs of developing the network and the pricing of the network services have, however, not been regulated. This may have resulted in two key problems in an efficiency context: lack of cost effectiveness and an overpricing of the service.

We have illustrated these two effects, monopoly pricing and cost-ineffective investments, in Figure 2. If there are natural monopolies, the price shall be set at the intersection point between the demand curve and the marginal cost curve. Let us now assume that the price is instead set at point C. In this case network operators have used their monopoly power to set too high a price, and demand will then be lower than what is economically optimal. The economically optimal price is set where the demand curve intersects marginal costs with optimal investments (necessary marginal costs) and not actual marginal costs.

Assume that it was possible through effective regulation to squeeze the costs in the network down to the line "necessary marginal costs". The price would then fall to p_A, and the demand for network services would increase. The area between the dashed lines then represents the economic loss that is due to a lack of cost effectiveness in investment, and the shaded area is the economic loss due to monopoly pricing.

Kittelsen (1994) studies in detail the costs of 171 Norwegian distribution utilities with the help of a DEA analysis[4] in order to examine these losses. Kittelsen makes use of information concerning the most efficient utility in order to estimate the total efficiency loss in Norwegian distribution utilities, adjusted for differences in topographical and climatic conditions. Kittlesen's main conclusion is that there was a considerable potential for increasing cost-effectiveness, and that the analyses did not provide a basis for maintaining that the service was overpriced given the total costs involved. In other words, the price was reasonable given the overall costs, but the costs were too high. The price was therefore also too high. Kittelsen estimated cost ineffectiveness in the network at NKr 1.1-1.8 billion a year.

Inefficient market

The Statkraft price was adjusted in the government budget each year. Many municipal and county electricity utilities followed by adjusting their prices accordingly. A characteristic feature of the energy market prior to the Energy Act was that due to government regulations to achieve various political objectives, the administratively determined prices for different user groups varied. This regulation of prices in the power market at different administrative and public levels brought about a not insignificant loss of efficiency.

This has been stylized in Figure 3 by distributing a given volume of electricity ($\overline{X}$) between two customer groups. Here the price is assumed to be adjusted for transmission costs, the differing degree of supply security (spot, long contracts, etc.) and delivery date. In the regulated situation, customer group 1will have price p_1^0 and demand volume x_1, while customer group 2 will have price p_2^0 and demand volume $(\overline{X} - x_1)$. In a market with free competition, the price of all electricity will be approximately equal. This is illustrated in Figure 3 as the intersection point between the two customer groups' demand curves (E_1 and E_2) determines the price, which is the same for both groups (p^*). Customer group 1 demands volume x_1^* and the other demands volume $\overline{X} - x_1^*$.

A market with free competition will contribute to a pricing of electricity for customers, which results in the highest possible economic surplus of the power resource. A discrimination of various customer groups, in that some pay a

4 See Kittelsen (1994) for more information about DEA analyses.

high price and some pay a low price, will result in efficiency losses.[5] The efficiency loss which arises through this price regulation is illustrated by the shaded area in Figure 3. This stylized example for two customer groups can be expanded to apply to additional customer groups.

In Bye and Johnsen (1991), an attempt was made to calculate the economic loss in Norway when different customer groups are faced with regulated prices which are different from those which a free competition market would generate. They found that the economic loss came to about NKr 4.5 billion a year.

Other market imperfections

Through government regulations in the period prior to the new Energy Act all the costs were covered by adjusting prices in step with the Statkraft price, which was an administratively determined price stipulated by the Storting (Norwegian parliament). This provided poor incentives for a cost-effective choice of development solutions in various projects. No calculations have been made of the magnitude of these efficiency losses in the power sector before the new Energy Act was introduced. In an industry where the capital value is close to NKr 200 billion, however, it is quite conceivable that these efficiency losses were substantial. The industry's own calculations through the so-called 5 per cent program (how to obtain 5 per cent more electricity from existing power stations) indicate that it is possible to obtain more power from the present resources.

In the same manner as for distribution utilities, the question may be raised whether there have also been over-expansion and incorrect dimensioning in the transmission grid. There is also reason to question whether cost-effective expansion has taken place in the transmission grid. Here, however, we know very little about the amount that could have been saved with a more cost-effective regulation of activities.

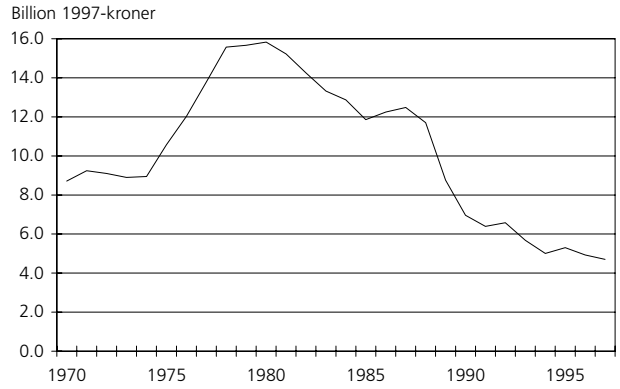
Total efficiency losses

The total, estimated efficiency losses in the power market, power production, and distribution add up to NKr 15-20 billion a year, which amounts to about 8-10 per cent of total fixed assets in the power sector, or about 2.5-3 per cent of GDP in 1991.[6] This was an important reason underlying the desire to deregulate the power market and promote increased competition.

After the Energy Act

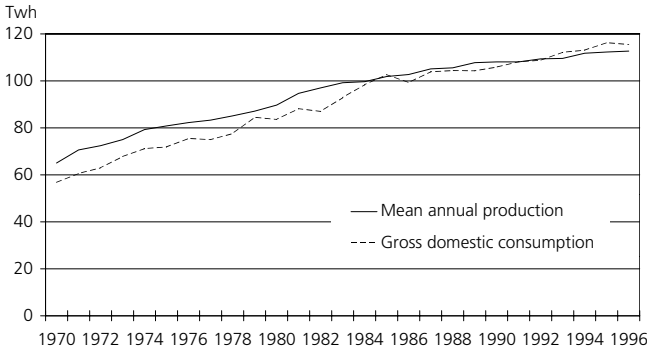
The question which now arises is what effects the Energy Act had on the energy market, and to what extent this regulation was able to reduce the substantial efficiency losses which existed in the energy market prior to the legislative change.

Figue 4. Changes in investments in power production. Billion 1997-NKr. 1970-1997



Source: Electricity Statistics, Statistics Norway.

Figure 5. Changes in mean annual production capacity and gross consumption. TWh. 1970-1996



Source: Electricity Statistics, Statistics Norway

Investments and power production

Figure 4 shows changes in investments in power production (in billions of 1997-NKr) for the period 1970 to 1997, while Figure 5 shows changes in mean annual production capacity and gross domestic consumption (in TWh) of electricity in the period 1970 to 1996. In 1989-1990, investments in the power sector in Norway amounted to about NKr 7-9 billion a year measured at constant 1997-prices. In 1996, these were reduced to NKr 4.5 billion. At the same time, *growth* in production levelled off even though the mean annual production capacity still rose from a good 108 TWh in 1990 to a little more than 112 TWh in 1996 (see Figure 5).

5 This analysis is contingent on all customer groups having the same attitude towards uncertainty. If some customer groups attempt to reduce the uncertainty of electricity prices by entering into longer contracts, the differences in prices will not necessarily result in efficiency losses.

6 As each of the studies reviewed is partial, it is not automatically possible to add up the estimates which are specified for the various components. It indicates, however, that the magnitude is considerable.

If we look *only* at the figures after 1991, it would appear that the Energy Act to a certain extent has ensured that further expansion in a period with considerable excess capacity has come to a halt. If, however, we look at developments in the power sector in a slightly longer perspective, we find that investments in the power sector in Norway started to fall sharply long before the Energy Act came into force. Through the 1970s mean production capacity rose by an average 3.3 per cent a year. For the ten-year period as a whole, the production capacity increased from 65 to 90 TWh. Investments also rose sharply in the 1970s until the period 1978-1981 when they reached a level of more than NKr 15 billion a year. It was in this period that major hydropower development projects were under way in Norway, with considerable protests from environmental protection groups. Between 1980 and 1990 investments in the power sector were reduced by half. Similarly, the growth rate for mean annual production fell to 1.9 per cent a year. Nevertheless, the amount invested was almost 40 per cent more from 1980 to 1989 than the combined amount from 1970 to 1979, while mean production capacity only grew by 18 TWh compared with 25 TWh in the 1970s. The reason for the continued high growth in production was that even though investments declined through the period, the level remained high. Lower growth in mean production capacity than in the 1970s despite higher investments reflects the rising marginal costs of hydropower development in Norway since the cheapest projects had already been carried out.

Why then did investments in the power sector fall more sharply in the first half of the 1980s than the observed decline following the introduction of the Energy Act in 1991? First, there were considerable protests from environmental protection groups concerning further hydropower development. Second, it was less profitable to develop new projects since the most profitable power stations had already been built. This was offset to some extent, however, by the reduction in electricity prices through the decision to base pricing on the marginal cost instead of pricing based on the average cost as a result of the Energy Report of 1978. The very high level of interest rates at the end of the 1980s was another reason for the decline in profitability. In a capital-intensive industry like the power sector, high interest rates will have a considerable impact on production costs, and thereby on the profitability of new projects. Similarly, the fall in interest rates through the 1990s will contribute to maintaining investments in the power sector. This may be one of the reasons why the fall in investments in the power sector was not as great as expected after the Energy Act entered into force. Furthermore, more people were concerned about domestic production capacity being higher than gross consumption in Norway (see Figure 5). It should also be noted that at the beginning of the 1980s new forecasting communities appeared (see, for example, Longva and Olsen 1982), which pointed out that the existing forecasts for consumption – which formed the basis for development plans – heavily exaggerated the growth in consumption. Another factor is that the authorities were working on the new Energy Act throughout the last half of the 1980s. Even at the time the proposals for a new Energy Act were presented by the Labor Party Government in 1987, it was fairly clear that this work would result in a system which involved greater market adaptation in the power sector. When the Syse Government took over in 1989, the Labor Party Government's proposal was withdrawn, and the Government presented new recommendations for the Energy Act where the market element was further strengthened. It is likely that those planning new hydropower development projects felt greater uncertainty about these projects, which in turn resulted in a postponement of plans or a scaling back of new project planning.

Table 1. Transmission charges for different customer groups. Øre/kWh. Weighted average of prioritized and unprioritized electricity. 1993 and 1996

	1993	1996
Mining/manufacturing	..	11,7
Transport	13,5	11,4
Other industries	15,5	12,7
Households	19,5	17,4
Total	..	15,4

Source: Electricity Statistics, Statistics Norway

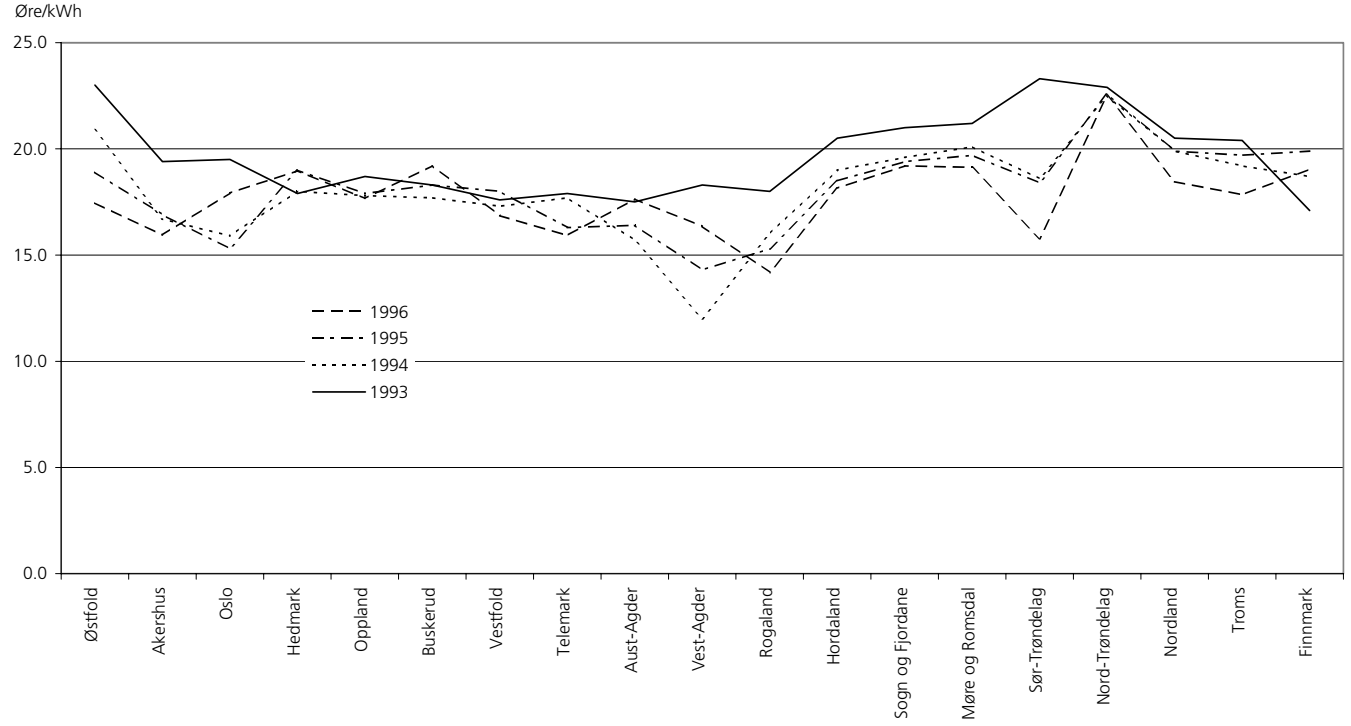
Network charges

After the Energy Act came into force, the price of electricity transmission and distribution has fallen (see Table 1). Average network charges for supplying electricity to households declined, according to Electricity Statistics, from 19.5 øre/kWh in 1993 to 17.4 øre/kWh in 1996, i.e. by 11 per cent. It is not possible to determine on the basis of these statistics how much the charges have fallen since 1991 when the Energy Act was introduced and network charges began to be more tightly regulated. The reason is that Electricity Statistics do not distinguish between electricity prices and network charges, i.e. the price of electricity transmission and distribution, prior to 1993.

For other industries, the charge has fallen by nearly 20 per cent in three years. Electricity Statistics do not show changes in manufacturing industry's transmission charges from 1993, but this is now registered as a separate group entailing that it will be possible to follow developments in the future. Regulation of network services by the Norwegian Water Resources and Energy Administration has thus entailed that some of the efficiency potential referred to in Kittelsen (1994) has probably already been achieved. For example, a decline of 2 øre/kWh in the network charge for the household sector's total consumption amounts to about 35 TWh, NKr 700 million on an annual basis. This figure cannot be directly compared with Kittelsen's estimate for the efficiency potential of NKr 1.1-1.8 billion, but it is an indication that regulation has been effective.

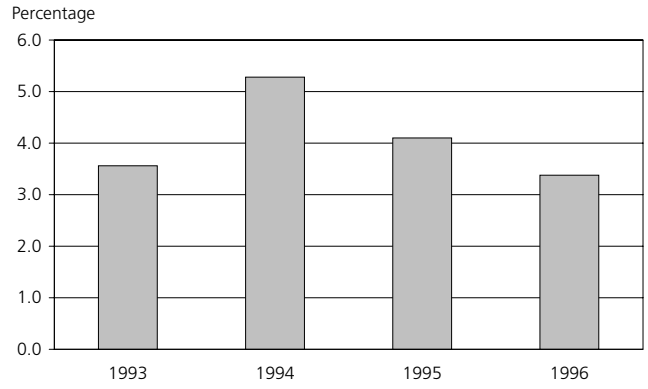
In order to illustrate the regional effects of the Energy Act on network charges we have, in Figure 6, plotted changes in the average network charge for different counties. This

Figure 6. Network charges for households distributed by county. Øre/kWh. 1993-1996



Source: Electricity Statistics, Statistics Norway.

Figure 7. Coefficient of variation for household network charges in different counties. Percentage. 1993-1996



Source: Electricity Statistics, Statistics Norway.

shows a fall in the network charge for almost all counties from 1993 to 1996, with the exception of Hedmark and Buskerud. These were counties that had charges below the average in 1993 and where the charge in these counties was higher than the average in 1996. Vest-Agder also had very low charges in 1994, but has now reached a level more on a par with the other counties.

There is reason to point out, however, that average charges at the county level may conceal a change in the magnitude of supplies from high-cost utilities within a county. The overall change for a county may thereby exaggerate or underestimate changes at the energy utility level.

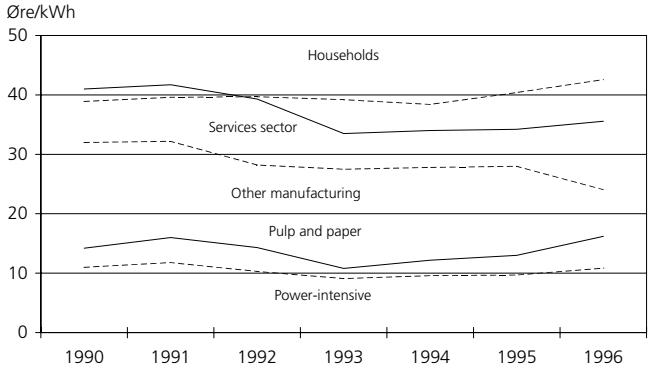
In addition to the decline in network charges since the introduction of the Energy Act, it also appears that the variation in network charges between counties has been reduced. In Figure 7 we have calculated the coefficient of variation for network charges for households in the period 1993 to 1996. The coefficient of variation[7] is a measure of the variation in charges between various countries. The higher the figure is, the greater the difference.[8]

Figure 7 shows that the coefficient of variation fell sharply from 1994 to 1996. This, combined with the fall in charges as noted above, shows that the Norwegian Water Resources and Energy Administration's regulation of charges in the wake of the Energy Act has been effective. Prices and variation have been reduced. Part of the efficiency potential pointed out by Kittelsen has thus apparently been achieved.

7 The coefficient of variation is the ratio of the standard deviation to the mean. We have also calculated the variation in household charges by applying the Gini coefficient. Since both measures provided the same overall picture we have chosen to present only the coefficient of variation.

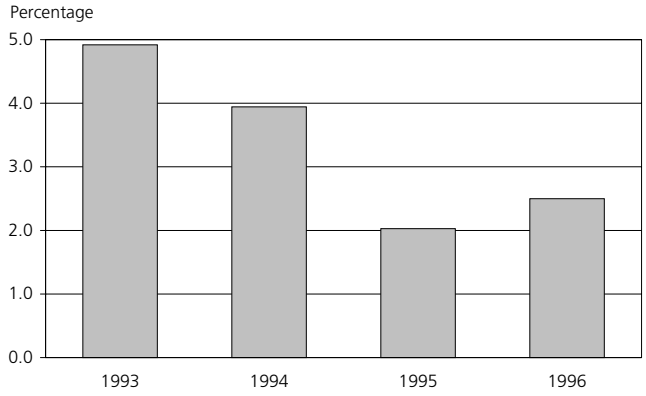
8 Due to topographical differences, network charges shall differ somewhat between the various areas covered. The variation in network charges may, however, also be due to the inefficient operation of transmission and/or distribution utilities. In recent years the Norwegian Water Resources and Energy Administration has tightened up on the regulation of energy utilities which charge a higher price than the most efficient utility, adjusted for, among other things, topographical conditions. It is therefore likely that a reduction in the price variation between the different utilities is an indication of more efficient operations.

Figure 8. Electricity prices for different user groups. Øre/kWh. Including electricity tax. 1990-1996



Source: Electricity Statistics, Statistics Norway.

Figure 9. Coefficient of variation for household electricity prices in different counties. Percentage. 1993-1996



Source: Electricity Statistics, Statistics Norway.

The market

An important aim of the Energy Act was to ensure that the market would generate less variation in prices between consumer groups, regions and within consumer groups. In brief, the market was to ensure more uniform pricing of electricity. In the following we shall use figures from Electricity Statistics and historical information concerning household charges from the Norwegian Water Resources and Energy Administration in order to shed light on developments in electricity prices.

Prices for user groups

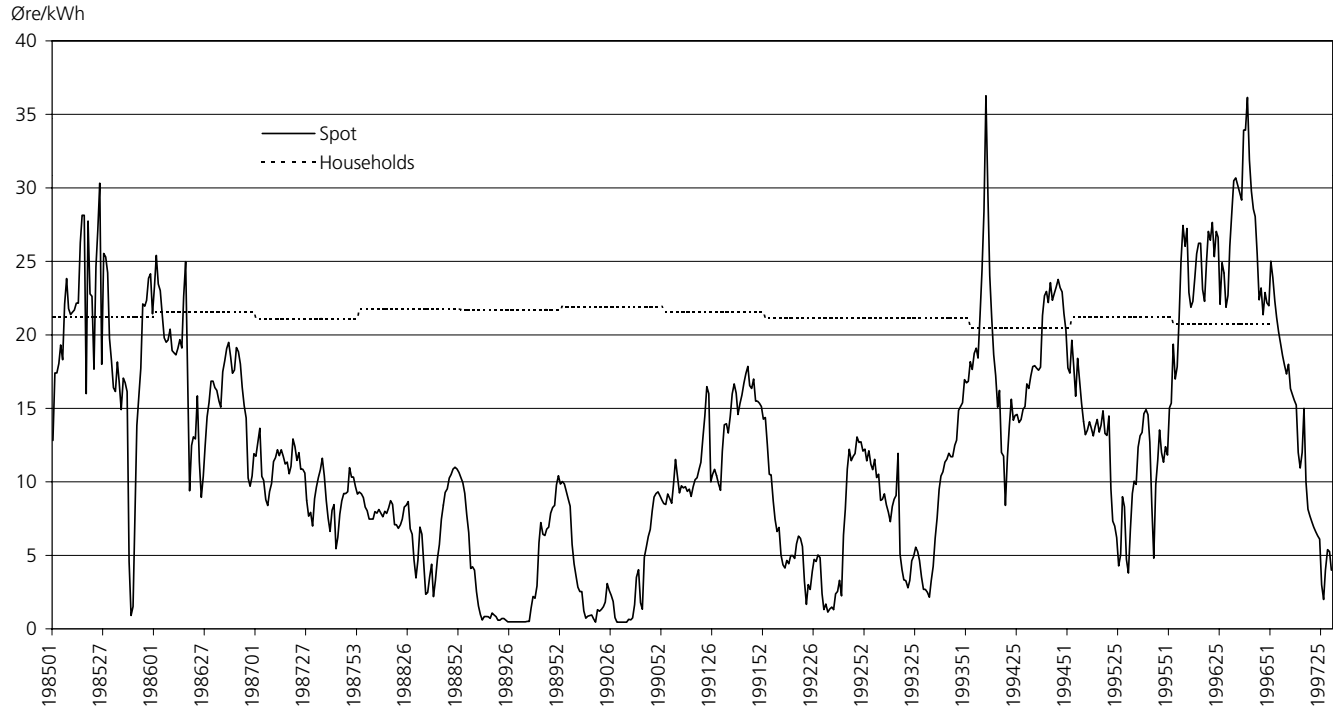
Bye and Johnsen (1991) estimated efficiency losses as a result of considerable price discrimination in the electricity market between various user groups at NKr 4.5 billion a year. The most important discrimination related to differences in pricing between industries. Figure 8 shows changes in electricity prices, including the electricity tax, for some groups of industries.

As Figure 8 illustrates, there has been a clear narrowing of price differentials between pulp and paper and other manufacturing sectors. While the price for pulp and paper has increased, it has fallen sharply for other manufacturing sectors. Part of this is probably due to a large proportion of electricity purchases at spot prices for the pulp and paper sector's boilers. The spot price was considerably lower than the fixed price early in the period. Later, the spot price rose and in periods was higher than fixed prices, which fell slightly in the market. The sector that initially had a low average price thereby experienced higher prices, while those sectors which were more exposed to the market experienced slightly lower prices. It may seem somewhat surprising that prices for manufacturing industry fell by a considerable margin from 1995 to 1996 in spite of the electricity crisis in 1996. This may in part reflect good adaptation in manufacturing, where longer-term contracts were entered into in a period of low prices (1995) and where expectations of continued low prices were high.

We also see from Figure 8 that the price for households and service sectors, which were the most negatively discriminated sectors with the highest prices according to Bye and Johnsen (1991), also fell slightly in the first few years following the introduction of the Energy Act. The rise in prices in 1996 for these groups may be due to little precipitation and high prices in the market, but also that these groups had not hedged sufficiently against a short-term rise in prices through longer contracts. There is also reason to emphasize the administrative arrangements that prevented consumers from participating in the market in the initial period after the Energy Act came into force. First, the Energy Act states directly that household customers are not likely to derive considerable benefits from participating actively in the market. Second, a system was established with relatively high fees for household customers who wanted to change supplier were an effective barrier to such changes. The fees were gradually reduced and finally eliminated. This coincided, however, with a period of increased volatility in the market, entailing that household customers are cautious in terms of active market participation. On the other hand, energy utilities have become better at participating in the market through their purchases of electricity. This has in turn contributed to transferring part of the market gains to customers, including households.

We also see from Figure 8 that the price for power-intensive manufacturing as a whole rose through the period. This was the sector that in absolute terms had the lowest price initially due to very favorable long-term contracts. Some of the electricity this sector previously had access to has been subject to renegotiations, where this has resulted in slightly rising prices. Two events in this segment of the market deserve considerable attention. The political authorities have still been willing to negotiate contracts with manufacturing industry, but have exerted considerable pressure on the industry to first attempt to negotiate contracts on a commercial basis with suppliers of electricity, basically Statkraft. As a result, Norsk Hydro has actually concluded a commercial contract with Statkraft. In more recent periods Elkem, as another large power-intensive manufacturing player, has

Figure 10. Spot price and price for households. Øre/kWh in 1996-prices. 1985-1996



Source: Electricity Statistics, Statistics Norway.

also negotiated a commercial contract with the largest Swedish power producer, Vattenfall, concerning electricity supplies on long contracts. These are important events both because they would hardly have been possible under the old regime, and because the largest share of the efficiency potential calculated by Bye and Johnsen (1991) for the power market was found in the lack of market relationships inherent in the pricing of electricity for this industry. Once again, the Energy Act has produced a new regime where a large efficiency potential is in the process of being achieved.

These may be viewed as examples of how the Energy Act has had influence on developments in the electricity market, with prices declining for large consumer groups. Differences in prices for various manufacturing sectors have narrowed, but there is still a price differential between households and manufacturing which has not been appreciably reduced in this period. However, recent developments with market-based pricing for energy-intensive manufacturing may in the long run entail reduced variation here. In Figure 8, all prices include the electricity tax, and some of the price differentials therefore partly reflect the considerable variation in the electricity tax between different user groups. This means that a differentiation of the electricity tax will amplify the differences in electricity prices between various user groups.

Price variations between regions

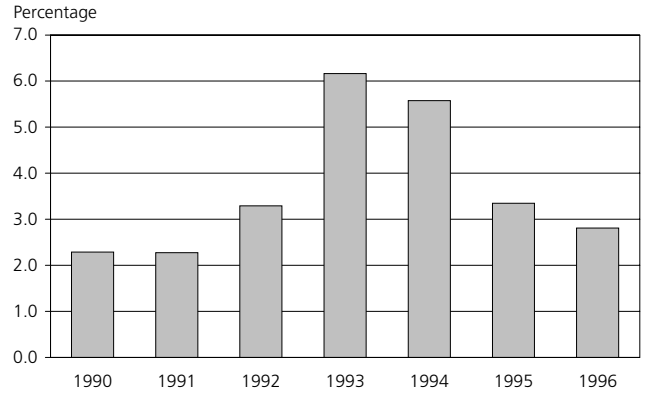
In the above we saw that prices for large consumer groups have declined, and electricity price differentials between various production sectors have narrowed somewhat. The price for households, however, has risen slightly in this period. In order to investigate whether differences in electricity prices between households on a regional basis have narrowed, we have in Figure 9 plotted the coefficient of variation for the electricity price for households in various counties for the period 1993 to 1996.[9]

Figure 9 shows that in spite of the rise in prices for households in this period, the variation in the electricity price for households between counties has been reduced. The coefficient of variation in 1996 is about half the level in 1993.

By comparing the information in Figures 8 and 9 it appears that the introduction of the Energy Act has resulted in smaller variations in electricity prices between different manufacturing sectors and regionally between households. However, the differences in electricity prices between manufacturing and households do not appear to have been reduced noteworthy. It should be borne in mind that the market for household customers did not function very efficiently in the period following the introduction of the Energy Act, partly due to high transfer fees. This is clearly illustrated in Figure 10, which shows weekly average variations in the spot price for electricity and the average electricity price for households for the period 1985-1996. The spot price in the electricity market was very low for long periods without this having a major impact on changes in the household price.

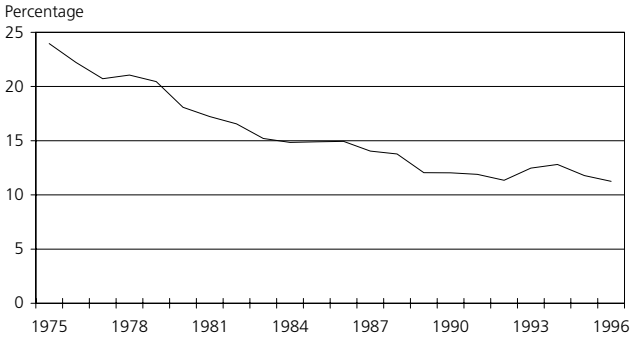
9 Unfortunately Electricity Statistics do not separate the network chare and the electricity price prior to 1993.

Figure 11. Coefficient of variation for the total electricity price for households in different counties. Percentage. 1990-1996



Source: Electricity Statistics, Statistics Norway.

Figure 12. Variation in H4-charge, variable component at energy utility level, measured by the coefficient of variation. Percentage. 1975-1996



Source: Scales of charges 1975-1987 from Nor Energi, primary material from Electricity Statistics.

There has been virtually no correlation between the spot price and the average household price in this period even though in principal households could participate actively in the market. Throughout the entire period relatively few households have changed their contract type and supplier. However, this situation has changed somewhat the last two years when fees for changing supplier were removed. At the same time, however, the spot price has increased so that the potential for profiting from a change has been reduced. It is likely that the strong focus on the "electricity crisis" through 1996 also created increased uncertainty and prompted renewed caution among household customers with a view to using the market to obtain cheaper electricity supplies even though there has been a considerable potential for benefiting from such a change.

As noted earlier, Electricity Statistics do not provide a basis for studying changes in electricity prices and network charges separately in years prior to 1993. The statistics do, however, allow us to study electricity prices including network charge for households distributed by county. In connection with the discussion of Figures 7 and 9 we concluded that differences in prices for network services and electricity for households narrowed in the period 1993 to 1996. This conclusion, however, may depend on the time period chosen, which has been selected here for statistical reasons. The trend we observe in the period 1993 to 1996 may be a random fluctuation, which is due to other factors.

If we look at Figure 11, which shows the variation in electricity prices for households, including network rent, for the period 1990 to 1996, we find that differences in the price of electricity have not been reduced from 1991 to 1996. In the period 1991 to 1993 actual prices varied more, followed by a narrowing of differentials in the years to 1996. This may be due to several factors. First, the degree to which the various energy companies managed to follow up the intentions in the Energy Act the first few years probably varied. The fact that some actually adapted while others did not adapt will result in greater variation in prices in the short term. Furthermore, high fees for changing supplier prevented market adaptation. Third, fluctuations in market prices that do not have a full impact on all market segments in the short term (cf. Figure 10) will be observed, partly because different types of customers have different degrees of risk aversion. Figure 11 leads us to conclude that the new Energy Act resulted in a lager variation in prices in the short term, but this trend has been reversed in recent years. It will therefore be important to follow developments in the period ahead.

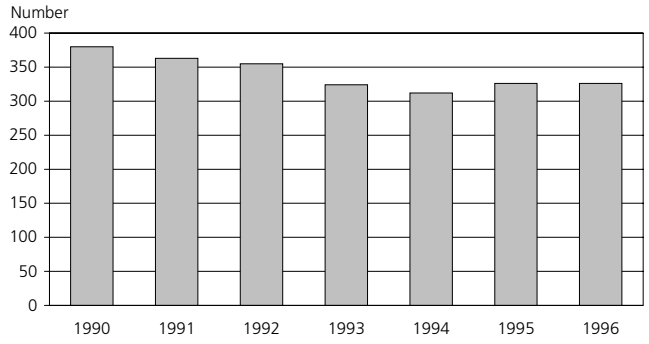
Household prices at the energy utility level

So far we have used Electricity Statistics, which provide information about average electricity prices by county, in order to comment on the regional variation in electricity prices between households. This aggregation by county may, however, conceal considerable price variations since there is a fairly wide variation in household charges between energy utilities within each county. For example, we know that a number of municipal energy utilities attempt to maintain low prices for customers in their own area even though the alternative value of the electricity (the value in the market) may be substantially higher. Rising prices in the market may entail that the variation in prices, as measured by the consumer, will be greater. With lower prices in the market, the variation due to this is smaller. In order to study developments in household charges at the energy utility level, we have applied information about household tariffs from the Association of Norwegian Energy Utilities for the period 1975 to 1987,[10] as well as primary material for Electricity Statistics. Figure 12 shows changes in the coefficient of variation for the variable component of H4-charges for households in the period 1975-1996.

Here we find the same trend as in Figure 11; the variance in the charges increases in the period 1991 to 1993 and

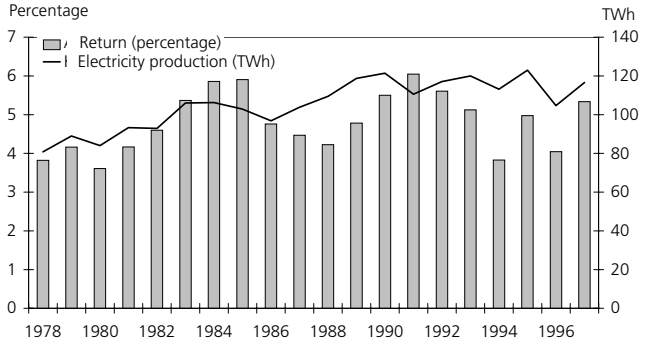
10 See Association of Norwegian Energy Utilities (1975-1987).

Figure 13. Number of energy utilities in Norway (including production plant, industrial generators, wholesale and distribution utilities and network companies). 1990-1996



Source: Electricity Statistics, Statistics Norway.

Figure 14. Changes in the return (per cent) and electricity production (TWh). 1978-1997



Source: Electricity Statistics, Statistics Norway.

then declines. The most interesting aspect of Figure 12, however, is that the variation in H4-charges for households was reduced substantially from 1975 until work on the new Energy Act began at the end of the 1980s. The most important reason for this is probably a sharp rise in electricity prices for households in the period 1975-1985. In this period, household prices rose by almost 70 per cent in excess of inflation. When the authorities increased the Statkraft price, most power companies probably followed suit and raised prices by the same margin. If the differences in øre/kWh have been partly maintained through the power utilities' pricing policy. This might explain the decline in the percentage deviation from the average price through the period. It may also seem surprising that the price differentials did not increase in 1996 as a result of the sharp rise in market prices due to little precipitation that year. One explanation is that even though spot prices were rising, contract prices were not increased by the same margin. Nor were many contract prices increased until the end of 1996, at a time when spot market prices resumed a downward trend.

Organization of the activity

Compared with many other countries, Norway has many energy utilities. Figure 13 shows changes in the number of energy utilities in Norway in the period 1990 to 1996. In 1990, Norway had 380 energy utilities. A number of utilities were expected to merge as a result of the Energy Act in order to position themselves and be better equipped to compete in the new market. Larger entities may have a number of advantages, e.g. through economies of scale at the administrative level, through purchases of equipment for expansion, upgrading and maintenance of existing equipment and through possible electricity purchases.

Economies of scale in administration and through electricity purchases have probably been decisive for mergers of energy utilities, which took place in the period 1990-1994. In 1994, the number of energy utilities had been reduced from 380 in 1990 to 312, i.e. a reduction of nearly 20 per cent in the course of four years. In recent years, however, the net number of energy utilities has risen again by 14 utilities, primarily because several energy utilities have been split up into an electricity supplier and a network service supplier. The increase in the number of energy utilities in recent years has been motivated by the authorities' requirements concerning separate accounts for supplying electricity and network deliveries. It is likely, however, that in the long run increasingly stringent efficiency requirements established by the Norwegian Water Resources and Energy Administration for energy utilities will result in more mergers, both for network companies and electricity suppliers, in order to benefit from any economies of scale.

The return in the power sector

In order to examine the effects of the Energy Act on the return for energy utilities, we have in Figure 14 plotted changes in total electricity production and the return in per cent for the period 1978 to 1996.

Figure 14 shows that production capacity has shown little increase in this period, i.e. 4 per cent or 4.5 TWh. With rising prices and rising production, we might expect a certain increase in the return in the sector. We know, however, that electricity production in Norway has also varied substantially in this period, from a peak of 120 TWh in 1995 to a trough of 104 TWh in 1996. This primarily reflects the considerable variation in precipitation from one year to the next. Prices have also varied extensively due to variations in precipitation and production, but also due to changes in cyclical conditions and temperatures on the demand side. This has resulted in sharp variations in the return. In 1993, the rate of return (per cent of fixed assets) in the power sector was down to the level recorded in 1978 even though production was approximately at the mean year production level. From a level of 5-6 per cent in 1990-1991, the level is now barely 5 per cent. Higher prices and higher production have thus been offset by expensive investments in recent years. For the period 1991-1997 the average return has been 4.5-5 per cent. With continued low prices, the return

and hence the profitability of new development projects are likely to be low for some years ahead.[11]

Concluding remarks

The introduction of the Energy Act was motivated not only on the basis of the formal administrative view that existing legislation should be streamlined, but was also based on several studies which demonstrated considerable efficiency losses as a result of the way in which the electricity market was regulated. Against the background of the analyses presented here, we may conclude that the Energy Act has basically functioned according to its intentions, but that this has taken somewhat longer than expected due to rigidities in the initial phase, like fees in the household sector and the exclusion of manufacturing contracts. It appears, however that the effect of the Energy Act has been fairly extensive. Investments in the power sector have continued to decline substantially and the increase in mean annual production capacity has almost come to a halt.

Moreover, electricity prices have remained relatively stable for many consumer groups when we disregard the extremely low precipitation year 1996 and subsequent rise in prices in late 1996 and in 1997. Price differentials have narrowed somewhat between manufacturing sectors, while the difference between manufacturing, services and households has widened. The situation for households in particular was less favorable in the initial phase. Differences in prices at the county level and energy utility level were greater in the first few years following deregulation, but these differences have again narrowed in recent years (see Figure 11). In a longer term perspective it might be said that the narrowing of differentials in household charges after the new Energy Act came into force is marginal compared with developments in the period 1975-1985 (see Figure 12). Furthermore, network charges have been reduced sharply, entailing that much of the efficiency potential that existed in 1991 has probably been achieved. However, technological advances, mergers, etc., which can boost the potential in the period ahead, will continue to take place.

Mergers of energy utilities have been fairly extensive, a development which will most probably increase over time. The rate of return in the power sector has also declined. This has in turn contributed to restraining investments. Even though the power sector loses out, society as a whole gains from this development. It may take many years before economic rent, which this sector commands, is achieved due to considerable over-expansion not only in Norway but also in other North European countries. This results in low prices and a low return.

The outlook points to continued low prices and little expansion. Competitive conditions may result in both greater and smaller price differentials in the period ahead. This depends in part on the various market participants' attitude towards risk. In the long term, international climate agreements may also result in sharply rising electricity prices, and economic rent in the power sector may gradually be achieved and at a faster pace than otherwise. In addition, an environmental rent may be obtained in the long term.

References

Association of Norwegian Energy Utilities (1975-1987): *Tariffoversikt 1975-01-01 – Tariffoversikt 1987-01-01*. (Scale of charges 1975-01-01- Scale of charges 1987-01-01).

Berg, M., K. P. Hagen and Chr. Riis (1994): Betingelser for effektivitet, stabilitet og styring i det norske markedet for telekommunikasjon (Conditions for efficiency, stability and management in the Norwegian market for telecommunications), *Report 40/1994*, Foundation for Social and Industrial Research.

Bye, T., T.A. Johnsen and S. Strøm (1991): Tariffer i overføringssystemet. Optimale tariffer i kraftoverføringen (Rates in the transmission system. Optimal rates in electricity transmission), SNF report 39/91.

Bye, T. (1997): Hvor interessante er norske kraftressurser for utenlandske oppkjøpere? (How interesting are Norwegian power resources to foreign buyers), *Sosialøkonomen* 1, 1997, 2-9.

Bye, T. and T.A. Johnsen (1991): *Effektivisering av kraftmarkedet* (Increasing the efficiency of the power market), Reports 91/13, Statistics Norway.

Gravelle, H. and R.Rees (1981): *Microeconomics*, Longman Group, England.

Hoel, M. and K.O. Moene (1987): *Produksjonsteori* (Production theory), University Press, Oslo.

Kittelsen, S.A.C. (1994): *Effektivitet og regulering i norsk elektrisitetsdistribusjon* (Efficiency and regulation in Norwegian electricity distribution), SNF report 3/1994.

NOU 1998:11: *Energi- og kraftbalansen mot 2020* (Energy and power balance to 2020), Ministry of Petroleum and Energy.

Proposition no. 43 (1989-1990) to the Odelsting: Om lov om produksjon, omforming, overføring, omsetning og fordeling av energi m.m. (Energiloven) (the Act relating to production, reorganization, transmission, turnover and distribution of energy, etc. (Energy Act), Ministry of Petroleum and Energy.

11 See, for example, the Energy Report NOU 1998:11 where low prices and large net imports are assumed for a number of years following the turn of the century