Profits in the Norwegian electricity sector

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The electricity sector in Norway is a so-called economic rent industry. This should imply that the rate of return in this industry is higher than the return in other sectors of the economy, disregarding uncertainty. Over a long historical period, however, the return in this industry has been lower than in manufacturing industries. This was one of the reasons for deregulating the Norwegian electricity market in 1991. Following deregulation, one would expect the return to increase and that more expensive energy utilities would record a lower return than cheap energy utilities. The return, however, has risen very little. This follows partly as a result of increased competition from energy utilities in other countries with considerable production capacity in relation to demand. The underlying data from 1991 to 1997 are also unable to confirm a hypothesis concerning differences in the return due to cost differentials. This may indicate that it will still take some time before the deregulated Norwegian electricity market functions according to the intentions. Projections indicate that the outlook for a higher return in the electricity sector in the period to 2010-2020 is favourable. In the long run, the sector may recover part of the economic rent which is presumed to exist in the industry. With a cost-effective international implementation of the intentions in the Kyoto Protocol, the return in the Norwegian power supply sector may be very high.

1. Introduction

The electricity sector in Norway is a so-called economic rent industry. This industry makes use of waterfalls and river systems. It is less expensive to develop some waterfalls than others. In a market, the cheapest power station projects will be undertaken first followed by the more expensive. Power capacity will be expanded based on rising unit cost in order to derive maximum benefit from the resources. The market will ensure that no development is undertaken until the price exceeds the unit cost of the last power station to be built. Since unit costs rise, this means that the first power stations to be built, and which were therefore cheap, will have a higher return on investment over time. In particular, investments in these power stations will have a higher return than capital investments in other activities, disregarding uncertainty. This excess return is called economic rent. The same applies to some other industries, such as petroleum activities in the North Sea, the fisheries industry, parts of the agricultural sector, as well as to some extent the property market.

We know that there is a difference between theory and practice both for the fisheries and agriculture. We shall also find that the electricity industry has not achieved any economic rent, while this is obviously the case for the petroleum sector in Norway. A striking difference between these industries is that while the petroleum sector is not very labour-intensive and is primarily focused on the export market, electricity production in Norway is primarily focused on domestic demand. The fisheries industry and agriculture have been important sectors in regional employment policy in the same way as the electricity sector.

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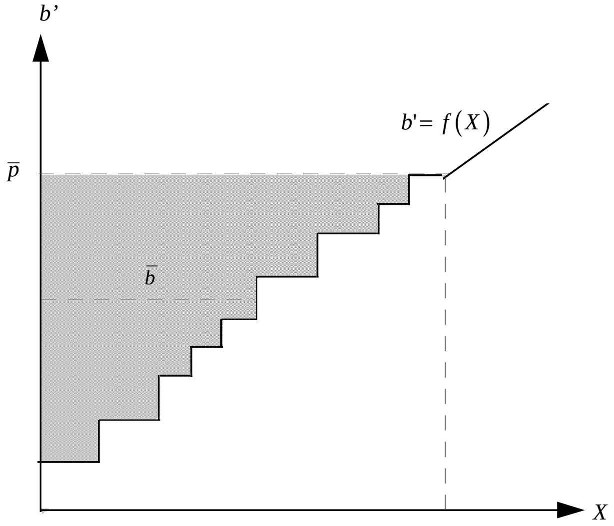
All these industries have been subject to regulation, but the regulatory content has been very different. There have been elements of volume regulation, price regulation, and regulation of turnover and competition in the electricity sector, fisheries and agriculture, while the regulation of volume dominates in the petroleum sector. The petroleum sector has also been free to sell its products at the highest possible price in the international market and to compete with others. This has been of considerable importance in terms of the opportunity to achieve a high return in the sector.

We know that many power stations that were built in Norway in the 1950s were very cheap power stations, while those that were built later were substantially more expensive. Nor has it been the case that Norway systematically built cheap power stations before the more expensive power stations. Moreover, factors such as self-sufficiency, regional power balances, industrial considerations and regional employment considerations had a considerable influence on the actual decision-making process with regard to specific power development projects.

Let us nevertheless assume that we rank power stations according to rising costs as shown in Figure 1. Here, the cost curve, b’ = f(x), is rising with respect to the power supply (x) to be produced. This is an indication that the least favourable projects (to the left in the figure) are more expensive than the cheapest (to the right in the figure). In an optimal situation, power capacity will not be expanded until the price (p) is equal to the marginal cost of the next project. If we assume that the normal return on investment in each power station is included in the rising cost curve, and that the price p is equal to the marginal cost b’, the

Figure 1. A stylistic outline of economic rent in the Norwegian hydropower sector



area between the price line and the cost curve (the shaded area) is equal to the economic rent in the hydropower sector. Bye and Johnsen (1991) estimated that the theoretical economic rent in hydropower stations that were built in Norway up to 1991 came to a good NOK 9 billion per year. This was calculated as profits exceeding normal returns on capital, given that no additional power capacity was developed before the price exceeded the cost of the marginal production plant in Norway at the time. It was also assumed that it was actually possible in the long run to achieve a price which corresponds to profitable investments at the margin. The normal return on capital that was invested in the power sector was estimated at NOK 12 billion, so that the total return should be NOK 21 billion per year. The return in the power sector the same year was only NOK 10 billion, i.e. NOK 11 billion lower than it could have been. If economic rent had been achieved, the return would have been 11 per cent, compared with the actual realised return of 5.5 per cent in 1991.

In the period up to 1978 a pricing rule was followed in the Norwegian power supply sector, primarily owned by the government, which indicated that the price should reflect average costs in the power sector, i.e. that that the price should be equal to $\bar{b}$. As the figure shows, as an average for the sector the economic rent collected by the cheapest plants will be lost because the total costs of the most expensive plants are not covered.

In the 1950s and 1960s energy-intensive manufacturing in Norway obtained 40-60 year electricity contracts at prices corresponding to the cost of some of the cheapest power projects in Norway. This entailed that a large part of the potential economic rent, the left part of the curve in figure 1, was not realised in the market. One of the main reasons for entering into these long-term contracts was that during the post-war reconstruction period in the 1950s investments in the electricity sector were considered very capital-intensive and risky projects. One way to hedge against risk was thus to tie up electricity supplies to customers on very long-term contracts. In hindsight, this appears to be an extremely risk-averse approach. Alternatively, the information available for evaluating future possible price trends was very deficient.

In studies of the return in the electricity sector in Norway, it is for several reasons important to distinguish between actual power production, the transmission of power over large distances, and the distribution of power. It is customary to assume rising marginal costs in electricity production and falling average costs in transmission and distribution. Moreover, it is important, particularly following the deregulation of the electricity market in Norway in 1991, that transmission and distribution are monopoly services, whereas electricity production is exposed to competition. For statistical reasons, however, it is not possible to distinguish between these activities when studying the electricity sector prior to 1991. After 1991, however, the statistics were revised so that this is now possible.

In this article we shall look more closely at the return in the electricity sector in Norway. We start in section 2 by looking at the return in a historical perspective. Here, we use statistics from the national accounts, which only permit us to study developments for the electricity sector as a whole. In section 3 we proceed to study the return in somewhat greater detail for the period following the deregulation of the electricity market, with Electricity Statistics as the source. Section 4 outlines a possible scenario for the future return in this sector provided that competition is permitted to take effect. It emerges that developments may be highly influenced by how we decide to follow up the Kyoto Protocol's provisions on restrictions in the emission of greenhouse gases in the period ahead. Section 5 summarises the most important conclusions.

2. The return in the electricity sector and manufacturing 1962-1993

Let us first examine the actual return in the electricity sector in the long regulatory period from 1962-1991 in relation to other sectors of the economy. The national accounts provides figures on the net operating profit (gross operating profit less depreciation of fixed capital) as well as the capital stock distributed by sectors of the economy – including the electricity sector as a whole. Capital stock in the national accounts consists of accumulated investment less depreciation valued at replacement cost. The ratio of the net operating profit to capital stock provides the rate of return – the percentage return on fixed assets in the industry.

2.1. The return in the electricity sector

In figure 2a (annual return) and 2b (5-year moving average) we see that the return in the electricity sector in Norway throughout the entire period from 1962 to 1980 was between 2 and 3 per cent. In this period, as noted earlier, a policy was pursued whereby the price should reflect the average cost of development. Along with the long-term contracts at low prices for manufacturing, this is

Figure 2a. Return on capital in Norwegian manufacturing and power supply sector. Per cent. 1962-1993

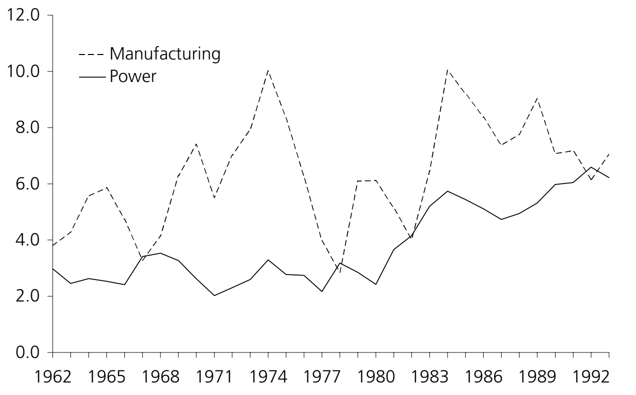


Figure 2b. Return on capital in Norwegian manufacturing and power supply sector. Per cent. 5-year moving average. 1962-1993

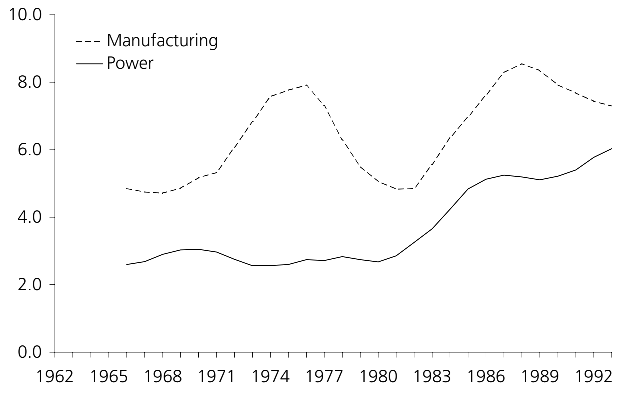


Figure 3a. Prices for electricity for households and power-intensive manufacturing. 1965-1996. Øre/kWh, including electricity tax, excluding VAT

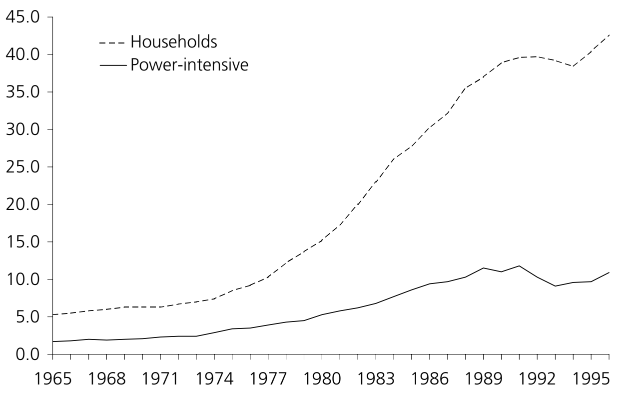
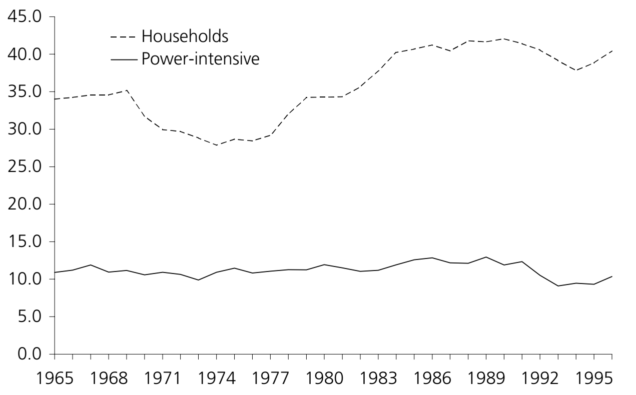


Figure 3b. Prices for electricity for households and power-intensive manufacturing. 1965-1996. Øre/kWh, including electricity tax, excluding VAT. Constant 1993-prices



the main reason for the low return in this period. We also see from Figures 3a and 3b that the price of electricity for large groups of consumers, such as households and power-intensive manufacturing, did not rise to any extent in the period until the end of the 1970s. In real terms, the actual price for the household group fell quite sharply from the end of the 1960s until the mid 1970s.

In the Energy Report which was presented in 1978, it was decided that instead of pricing electricity on the basis of average cost the price was to be equal to the long-term marginal cost with an escalation plan for prices up to 1985.[1] This also emerges clearly in the figure. The price for household customers rose sharply from 1978 up to 1992. Much of this rise in prices reflects the sharp acceleration in the rate of inflation in the Norwegian economy later in the 1980s. However, adjusted for inflation, see Figure 3b, the household price shows a rise in real terms of 30 per cent from 1978 to 1990. At the same time, we see that the price for power-intensive manufacturing only rises in nominal terms, while it falls measured at constant prices. In the period as a whole the contracts with manufacturing industry are thus not adjusted in step with the rise in consumer prices.

The return in the electricity sector, see Figure 2a, rises sharply in the same period – from 3.2 per cent in 1978 to a good 6 per cent in 1990, with a slight decline in 1986-1987. The average return in the sector may conceal considerable differences from one power station to another, which is not possible to separate in the statistics. Another reason why the average return rises so sharply is that electricity contracts with manufacturing account for a steadily smaller share of the electricity market. Those market segments that record rising real prices (general consumption) account for a steadily higher share of the market later in the period. One factor which to some extent would point to the opposite is the increasingly expensive development projects that were implemented later in the 1980s.

1 Many have looked upon a price equal to the long-term marginal cost as a pricing criterion. When the price is equal to the long-term marginal cost, this is a signal that new investments may be profitable. It is thus an investment criterion. In the long run, however, this means that prices will move towards the long-term marginal cost for electricity in a free competitive market.

Table 1. Return on capital in some industry groups. 1962-1993. Per cent

Period	Production of consumer goods	Funiture, wood and wood products	Paper and paper products	Chemicals	Metals	Other manufac-turing	Weighted manufac-turing	Power production
1962-1971	8.6	7,.8	1.7	0.6	7.4	0.1	5.2	2.8
1972-1981	5.5	6.6	4.0	1.9	8.3	7.4	5.9	2.8
1982-1987	7.8	7.6	3.9	5.5	10.3	6.3	7.3	5.1
1987-1993	7.5	6.8	5.2	6.6	5.6	4.7	6.3	5.8
1962-1993	7.3	7.2	3.5	3.1	7.9	4.4	6.0	3.8

Electricity production in Norway has also varied considerably along a rising trend in this period. The fluctuations are primarily due to the variation in precipitation from one year to the next. At the same time, the price has fluctuated substantially, partly due to the variation in precipitation and production, but also due to changes in cyclical conditions and temperatures. This has contributed to the highly varying levels of return in the electricity sector.

2.2. The return in manufacturing industry

We also see from Figures 2a and 2b that the return in Norwegian manufacturing has been substantially higher than the return in the electricity sector. The return in manufacturing, however, varies considerably more than the return in the electricity sector. This is because manufacturing is more exposed to competition than the electricity sector and changes in the return generally shadow cyclical developments. In Table 1 we see that the return in various manufacturing sectors also varies considerably, with the production of metals showing the highest average return over several years. This is one of the industries that has the most favourable contracts for electricity. The return is lowest on average for paper and paper products and the production of chemicals, which also have very reasonable and long-term electricity contracts. Here, however, electricity costs account for a substantially lower share than in the production of metals. On average over 10-year periods, the return in manufacturing has varied between 5 and 7 per cent. It is not until after 1990 that the return in the electricity sector has approached this level. Given that the electricity industry is an economic rent industry, we thus see that historically the return in this sector has been very low.

3. The return in the electricity sector in the period 1993-1997

3.1. Return concepts and organisation

For the period 1993-1996 detailed statistics are available for the various energy utilities, entailing that it is possible to use the accounts directly for measuring the return, whereas for 1997 preliminary accounts figures are available. Several different concepts can be used to measure the profitability of an enterprise, such as the return on total assets, the return on equity, operating profit margin and asset turnover. The *return on total assets* is the most important indication of profitability. This ratio is defined as total capital remuneration (operating profit + interest expenses) in relation to total assets. Total assets are defined here as the sum of accumulated investments at current prices less accounting depreciation.[2]

Profitability in an energy utility can vary sharply from one year to the next due to fluctuations in various components of the operating profit or due to changes in total assets. Revenues primarily depend on the magnitude of energy sales and the sale of transmission services, while costs are determined by the magnitude of energy purchases, purchases of transmission services, compensation of employees, grid losses and depreciation. The reorganisation of energy utilities, or sporadic events such as a temporary production halt, may also influence the return.

Energy utilities trade in a market with greater price variations than in most other commodity markets, and the risk is therefore considerable both for purchases and sales. After the Energy Act was introduced in 1991, competition has also intensified and the spot price of electricity has shown even wider fluctuations. Many energy utilities cover a large share of their contractual obligations by buying electricity on the Power Exchange (Nord Pool ASA), and are therefore fairly vulnerable to higher spot prices. On the other hand, energy utilities that primarily sell electricity on the Power Exchange may record a less favourable result in periods with low spot prices. The uncertainty of selling and purchase prices has contributed to a sharp rise in turnover in the financial futures electricity market on the Power Exchange in recent years. The main purpose of this market is price hedging, and price guarantees in the contracts are often offered. The guarantees entail that if the market price deviates from the contract price in the period the contract is in effect, the buyer will receive, or possibly have to pay, the difference.

In recent years the electricity sector has been frequently reorganised in order to separate monopolies from activities exposed to competition. Many energy utilities have estab-

2 The return on this basis therefore deviates somewhat from the return in the previous section where depreciated replacement cost (i.e. the value of the assets has been adjusted) was applied. Depreciation there is linear depreciation, while here it is depreciation permitted pursuant to tax legislation at any given time, and which the enterprise finds profitable to apply. The level of the return based on this definition is slightly higher. Profitability still indicates the return on total assets irrespective of the composition of total assets.

Definition of different types of energy utilities

Energy utilities can be split up into different types according to their main activity. There are six main types of energy utility:

- Production plants: Electricity-generating power stations which supply very little electricity directly to the end-user.
- Wholesale utilities: Energy utilities that primarily purchase power for resale to other energy utilities. They may produce some power or supply some power to end-users through regional grids.
- Integrated utilities: Energy utilities that have their own production and supply power directly to end-users. These are in turn divided up into high-integrated and low-integrated utilities:
- High-integrated utilities have more than 20 per cent own production of power sales to end-users.
- Low-integrated utilities have less than 20 per cent own production of power sales to end-users.
- Grid companies: Includes pure grid companies that do no sell, but only distribute power.
- Industrial generators: Power plants that are part of an industrial enterprise, and primarily supply power to production units in the same enterprise.

Energy utilities by type of ownership

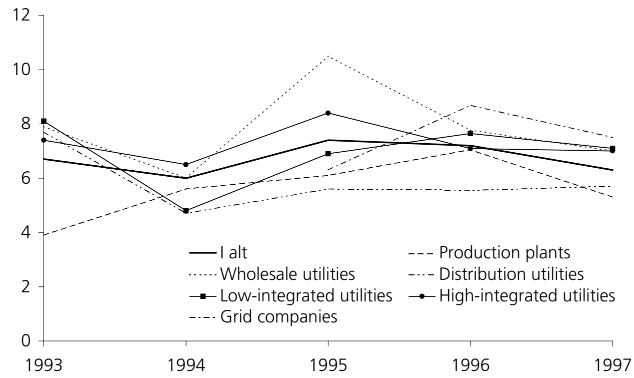
Energy utilities can also be classified according to type of ownership. A distinction is then made between municipal, state and private utilities. Municipal utilities are in turn split up into inter-municipal, county and municipal utilities.

- County utilities: Energy utilities that are solely owned by a county.
- Inter-municipal utilities: Energy utilities that are owned by at least two municipalities.
- Municipal utilities: Energy utilities that are owned by one municipality alone. In addition, this includes utilities where a municipality owns a minimum 50 per cent of the equity and the state or private interests hold the remainder.
- State utilities: Includes, in addition to state power plants, all energy utilities owned by the state or where the state owns at least 50 per cent of the share capital.
- Private utilities: Energy utilities where private interests own more than 50 per cent of the capital.

An energy utility can be owned by several categories of owner. The 50 per cent rule is then often applied in order to assign a utility to a category, i.e. the energy utility is assigned to the category that has an ownership interest of more than 50 per cent, or owns more than 50 per cent of the capital.

lished separate companies for some of their activities, with the result that the number of energy utilities rose by 14 from 1994 to 1995. This is partly because the authorities required separate accounts for the supply of electricity and grid services at the beginning of the 1990s. In the period 1984-1994, however, the number of energy utilities was

Figure 4. Return on total assets in different types of energy utilities, 1993-1997. Per cent*



* 1997 figures are preliminary.

reduced by 113. The decline in this period was related to the merger of many utilities in order to achieve economies of scale in the form of, for example, joint marketing, synergy effects in the customer handling system and broader expertise. The introduction of the Energy Act in 1991 in particular contributed to the reduction in the number of utilities as a result of the increase in competition in the electricity market and efficiency requirements.

In 1998, there were also many energy utilities that merged or were negotiating a merger. This is probably related to intensified competition, less loyal customers, lower electricity prices and the greater risk associated with sharply fluctuating purchase prices. After paving the way for changing electricity supplier, in part by removing the fee for changing supplier in 1998, there has been a sharp rise in the number of supplier changes. In January 1999, 4.5 per cent of all households in Norway had a non-local supplier, while the corresponding share in October 1997 was 1.4 per cent.

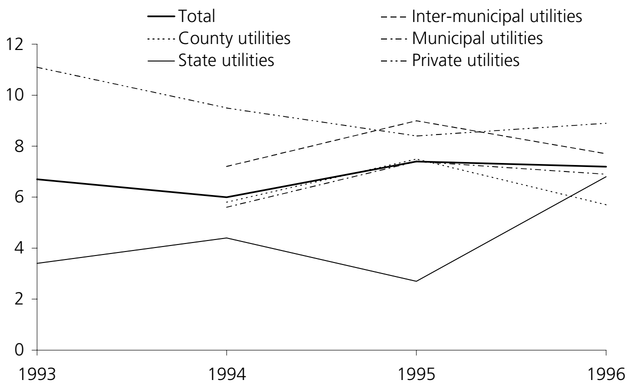
3.2. Profitability according to type of utility and ownership 1993-1997

If all power development had been undertaken in accordance with economic criteria, and the electricity market had functioned perfectly, we would expect the return in production plants to be higher than in other types of energy utilities. This is because the production plant in principle can realise economic rent in excess of a normal return. Common risk analysis should also point to the same since the risk associated with electricity production and sales is greater than for grid operations. Owners of new production plants should then demand a higher return on projects before the investment was made.

Figure 4 shows the profitability in various categories of energy utilities in the period 1993-1997 (see box for a definition of the categories).[3] This shows that production

3 Grid companies were placed in a separate category from 1995.

Figure 5. Return on total assets in energy utilities by type of ownership, 1993-1996. Per cent



plants, along with distribution utilities, have the lowest return, while high-integrated utilities, low-integrated utilities and grid companies have a higher return. The regulated segments therefore appear to have a higher return than those exposed to competition. This is partly because the deregulation of the electricity market in a number of countries, substantial production capacity and increased competition have contributed to squeezing electricity prices.

It is true that in 1994 and 1996 spot prices rose considerably due to little precipitation and a tight electricity market. In isolation, this resulted in higher revenues, but the return still fell in many energy utilities compared with previous years due to limited production and higher costs for purchasing electricity.

Energy utilities' electricity purchases are often based on a mix of short-term and long-term contracts with other energy utilities. In addition, they buy electricity over the Power Exchange and import directly from abroad. The scale and composition of purchases partly depend on risk in the electricity market and how much they produce themselves. Electricity purchases over the Power Exchange can also include imports, as operators from many countries participate in this market. Prices for bilateral contracts, import prices and spot prices for electricity traded on the Power Exchange rose substantially in 1994 and 1996.

In addition to the increase in purchase prices, a higher share of energy utilities' contractual obligations had to be covered by expensive imports or other purchases when lower-than-normal reservoir levels resulted in lower production at these utilities in these years. Energy utilities that had to cover fixed low-price contracts with imports or other purchases over the Power Exchange were probably those that fared the worst in 1994 and 1996. Wholesale utilities in particular recorded considerably higher costs and less favourable results in these years since they produce very little themselves and must cover most of their contractual obligations by buying electricity.

The decline in profitability in 1996 is also due to an upward adjustment of NOK 18 billion in total assets from the end of 1995 to the end of 1996. This results in an increase in average assets of about 6-7 per cent in these two years. Assets were increased through an upward adjustment in the values in the electricity sector in connection with the sale of power companies and reorganisation in 1995. Among other things, the value of shares, long-term claims and plant rose.

Production plants recorded a higher return both in 1994 and 1996, reflecting the fact that they produce most of the electricity themselves. Production plants with considerable water reserves in multi-year reservoirs fared particularly well in that they could sell a large share of this electricity at a high price in the spot market.

In 1995 the return in the electricity sector was higher than ever before. This may be ascribed to record-high electricity production and higher end-user prices, as well as relatively low purchase prices on the Power Exchange. Many energy utilities raised end-user prices at the beginning of 1995 because spot prices rose considerably in 1994 and remained at a high level up to the spring flood in 1995. After the spring flood, spot prices dropped substantially, and were on average 11.3 øre/kWh that year.

Wholesale utilities recorded a particularly high return since they profited from covering their long-term contracts using cheap electricity from the Power Exchange. In addition to favourable prices, financial revenues in the electricity sector rose by more than NOK 400 million from the previous year, primarily as a result of a rise in share dividends, gains on currency trading and the sale of securities.

The return in energy utilities as a whole was lower in 1997 than in the previous year. This was primarily due to purchases/sales of fixed assets and write-up of assets, entailing that total book assets increased by NOK 13.5 billion from the end of 1996 to the end of 1997. The operating profit remained virtually unchanged from 1996 to 1997. Lower end-user electricity prices contributed to lower revenues for energy utilities compared with the previous year, although the costs of electricity purchases also fell due to lower purchaser prices.

The return in production plants was reduced by a substantial margin from 1996 to 1997, partly due to higher depreciation and other operating expenses along with the previously mentioned upward adjustment of total assets. As electricity prices were very high in periods of 1996, some decided to enter into long-term contracts at relatively high prices in response to fears that prices would rise to even higher levels. Others, however, chose to wait until the fall in prices in the spring of 1997 and have benefited from that decision. Power plants sustained a corresponding loss.

In 1997 the Norwegian Water Resources and Energy Administration introduced new rules, imposing a limit on the level of income companies are permitted to have from grid activities. Moreover, individual efficiency requirements were established for grid companies. Distributors

Table 2. Return on total assets in different manufacturing industries and the power sector 1993-1996

Period	Food and beverages	Wood and wood products	Pulp, paper and paper products	Chemicals and chemicals products	Metals	Metals products excl. machinery and equipment	Manufac-turing total	Power produc-tion
1993	10.9	7.5	5.1	8.7	4.9	5.0	8.1	6.7
1994	9.1	14.1	6.2	6.9	7.6	12.3	7.5	6.0
1995	11.4	6.8	17.0	7.8	18.4	9.0	10.3	7.4
1996	9.5	3.9	10.5	6.8	8.1	12.4	7.8	7.2

Source: Manufacturing Statistics in Statistics Norway. The definition of the return on total assets is the same as in Electricity Statistics.

had to increase the efficiency of operations or reduce costs beyond the efficiency requirement in order to achieve a higher return, something which appears to have occurred in some companies.

Many private utilities were built at an early stage and were cheap plants, while the state owns some of the more expensive production plants. Private utilities might thus be expected to have a higher return than government utilities. Figure 5 also shows that private utilities generally have had a substantially higher return than state utilities in large parts of the period 1993-1996. Inter-municipal utilities are approximately on a par with private utilities at the end of the period. While the return in state utilities was a good 4 per cent on average in this period, it was about 9 per cent in private utilities. Production in private utilities accounts for only 12 per cent of total production, while the corresponding share in state utilities is about 35-40 per cent. The low return in state utilities is not only related to the fact that the state owns the most expensive utilities. Another important reason is that the authorities have concluded long-term contracts for supplying cheap electricity to power-intensive manufacturing.

Historically, we saw that the return in the electricity sector was substantially lower than the return in manufacturing. In the period 1993-1996 the return in the electricity sector was still slightly lower than in manufacturing, but in recent years it has approached the level in manufacturing, see table 2. There were, however, several manufacturing sectors that recorded a high return in this period due to favourable cyclical conditions; this particularly applied to the pulp and paper industry.

3.3. The return according to the level of costs in the energy utility

If the electricity market functions, the prices charged by different types of utilities will be approximately the same irrespective of production costs at each utility. This means that the return in cheap plants shall be substantially higher than the return in more expensive plants. This particularly applies to production plants, which are primarily engaged in power production. In more integrated utilities, which are heavily involved in grid activities and where the return is regulated, a steadier return would be expected. A greater or lesser proportion of production activity points to a varying return, even for integrated utilities. This may, however, change from one year to the next as a result of varying inflow to the reservoirs and a different degree of reservoir capacity at each utility.

We have now ranked energy utilities in cost categories by apportioning the capital costs (which is the most important cost component) for activities at each utility. For production plants (see box 1) we have used total assets/production as an indicator of the cost category classification. For low-integrated and high-integrated utilities we have used total assets/(production + power transmission volume). Since these utilities both distribute and produce electricity, the transmission of electricity is also included in the cost category classification.

Figures 6-8 show the return in power-generating energy utilities according to costs per unit produced. The return of the 10 per cent of energy utilities (number) that have the lowest costs per unit electricity produced are on the left side, the 10 per cent with the highest costs on the right.

Production plants

Figure 6a shows that the return in production plants varies considerably between energy utilities. While the cheapest utilities had a return of more than 45 per cent in 1996, some of these utilities also had a return as low as 3 per cent. However, production plants with a return of more than 20 per cent are small energy utilities which altogether account for less than 2 per cent of total production.

If the 20 per cent cheapest energy utilities are disregarded, there is no clear correlation between the return and how expensive the energy utility is. (See return in cost category 3-10 in figure 6a). Here, the return varies between 3 and 15 per cent without any systematic correlation with production costs.

One important reason why we do not find any such correlation is that the price of power supplied by the various production plants covaries with production costs. This is indicated in figure 6b, which shows average prices in the same groups. Whereas the price is down to 6 øre/kWh for the cheapest energy utilities, the most expensive energy utilities have prices up to 30 øre/kWh for all years in the period 1994-1996.

Figure 6a. Return on total assets in production plants by cost category, 1994-1996. Per cent

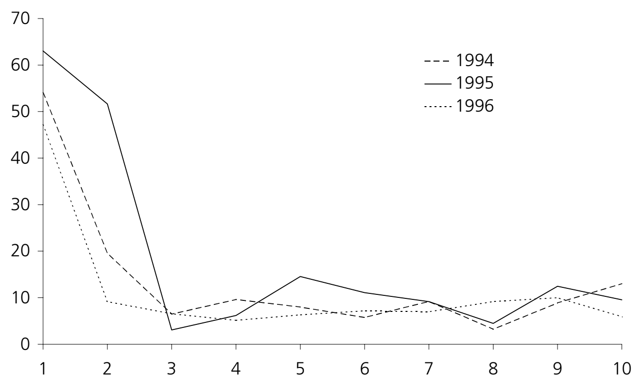
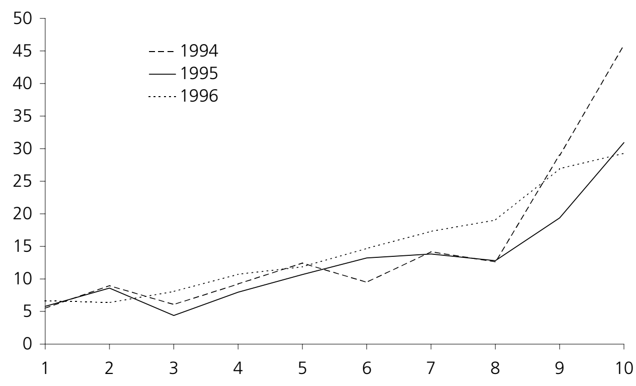


Figure 6b. Electricity prices in production plants by cost category, 1994-1996. Current prices. Øre/kWh



Prices are calculated here as an average of prices for electricity sold by the utilities to different customer groups. This includes power subject to licence requirements[4], electricity on bilateral contracts domestically (sales to e.g. another energy utility), sales to end-users, exports and sales of regulating power/spot power over the Power Exchange. Sales to end-users account for about 18 per cent of total sales, and prices can vary depending on e.g. customer type and energy utility. Prices in bilateral contracts account for the highest share, however, with this turnover representing half of the sales (excluding internal sales). Prices for power subject to license requirements are regulated pursuant to the Watercourse Regulation Act, so these are fairly uniform for all energy utilities. In addition, we have Statkraft (Norwegian Energy Corporation) which sells most of the power subject to licence requirements in Norway. Prices in the spot market and for export are also the same for energy utilities. Bilateral contract prices for sales to other energy utilities, on the other hand, vary considerably.

The explanation for the considerable price variations in bilateral contracts is that the production plants primarily sell to the owners themselves and that the prices are often set in such a way that the production plant records a zero after-tax result. This means that it will be difficult to test profitability in the various areas of activity.[5] Production plants are not exposed to the same competition as energy utilities, which primarily sell to end-users. Production plants are usually owned by one or more other energy utilities, which are engaged in the purchase, sale and distribution of electricity. Owners may, for example, be wholesale utilities, high-integrated utilities, industrial generators or other production plants.

The substantial price differences show that the cost of electricity purchases varies considerably for owners of production plants. This probably has as influence on the owners' profitability. Those who own a cheap production plant can most likely benefit from this, either by achieving a high return or through the resale of electricity to end-users at low prices. Since the Norwegian Water Resources and Energy Administration has established an upper limit for the return in grid activities, low costs will probably be reflected in low end-user prices.

Production plants, however, also sell to utilities other than the owners, and also sell considerable electricity on the Power Exchange at the market price. It is uncertain whether the contract prices for energy utilities other than the owners vary as much as illustrated here, but this may be the case if customers are tied up in long-term contracts entered into before the Energy Act was adopted. Price variations can also occur if cheaper production plants do not have the capacity to sell to large, new customers, and at the same time are tied up contractually or by the owners to supplies within their own area. Moreover, information on prices in bilateral contracts may be imperfect.

Even though it is prohibited, there may also be cross-subsidisation through the production component in the energy utility. This may contribute to a high return for expensive energy utilities. Since many energy utilities are engaged in both grid and sales activities, in addition to production, the energy utility may shift the surplus from the grid or sales component to the exposed production component if control is not satisfactory. The authorities attempt to prevent this, partly by requiring that separate accounts be kept for the various activities of energy utilities. Since the regulation of grid rates is problematic, however, this may in principle continue to occur.

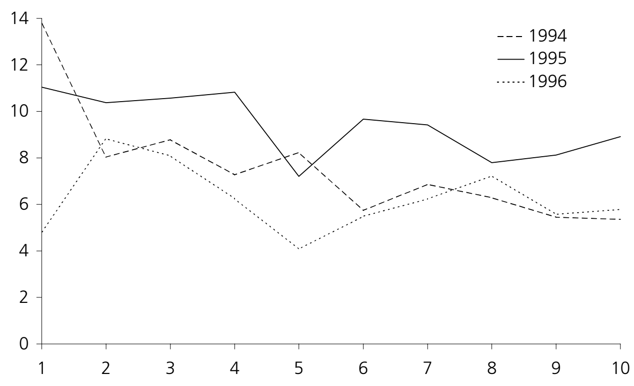
High-integrated utilities

As noted earlier, it is likely that there is less of a correlation between costs and the return in integrated utilities than

4 Power subject to licence requirements refers to the portion of electricity production which the owners of hydropower plants pursuant to the licences granted are required to supply to the municipalities affected by power development, possibly also the county and the state. Power subject to licence requirements is distributed by the licensing authorities and shall be supplied at the prices prescribed by law.

5 This may in turn be an important reason for operating with government-stipulated prices, as is actually the case in the current system, for the taxation of economic rent.

Figure 7a. Return on total assets in high-integrated utilities by cost category, 1994-1996. Per cent



in pure production plants. On the other hand, the production component will point to a lower return in expensive utilities than in cheap utilities also here. In Figure 7a, however, we see that there is a clear correlation between the return and capital costs for high-integrated utilities.[6] In 1995 and 1996, the correlation was fairly weak, while in 1994 the difference in the return was as much as 8 percentage points for the most expensive and cheapest energy utilities. One important reason why there is a stronger correlation between the return and capital costs for high-integrated utilities than for production plants is that the exposed end-user market accounts for more than 60 per cent of total sales (excluding internal sales) from high-integrated utilities. If the electricity price is set too high, the energy utility runs the risk of losing customers. A substantial portion of the electricity is also sold on the Power Exchange. Production plants, on the other hand, sell electricity to the owners themselves, and in this sense are not exposed to the same competition.

Figure 7b. Average electricity prices and grid charges in high-integrated utilities by cost category, 1994-1996. Øre/kWh

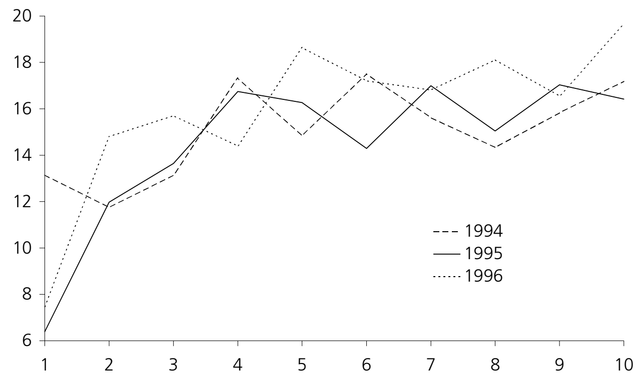
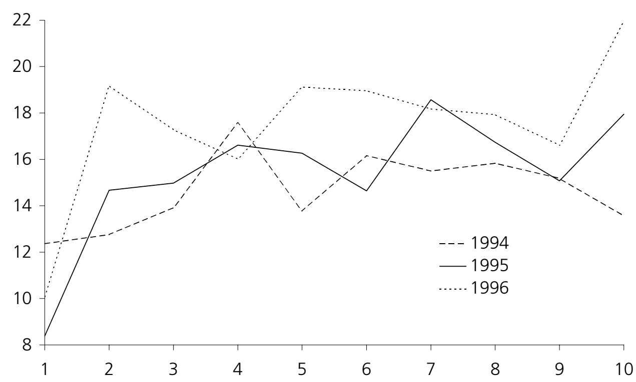


Figure 7c. Electricity prices for end-user in high-integrated utilities by cost category, 1994-1996. Øre/kWh



Figures 7b and 7c show, respectively, total average prices and electricity prices for the end-user according to the same cost categories for all utility activities and for only power sales, respectively. The average price (average of electricity prices and grid charge) for expensive utilities is about 20 øre, figure 7b, while it is down to 6-7 øre/kWh for the cheapest. The price differential is partly due to the fact that expensive utilities cover their costs by charging a high grid rate in their monopoly activity, but also because energy utilities sell to different customer types with varying levels for electricity prices and grid charges.

Figure 7c shows, however, that there are also some differences in the electricity price between expensive and cheap energy utilities in exposed activities. This may be because cheap and expensive energy utilities sell to different customer groups where sales are not necessarily determined by pure market conditions, but are more institutionally contingent contracts. For example, cheap energy utilities may be tied up in long-term low-price contracts with manufacturing industry. Households are among the customer groups that pay the most, while power-intensive manufacturing pays about one-third of the price for households. Price differentials may indicate that competition in the electricity market does not function as well as it should.

Figure 7a shows that some expensive energy utilities have a high return, while some of the cheap utilities have a low return. This may be due to many factors, and may in part be related to different terms in the contract for purchases and sales of electricity. An expensive energy utility may, for example, have favourable contracts with low purchase prices because they are co-owner of a cheap production plant. Cross-subsidisation between the various activities may also occur. By studying figures 7b and 7c, we find that electricity prices vary considerably, while the average for the grid charge and electricity price is much more stable. This may indicate that energy utilities with high electricity prices charge a low rate for use of the grid, and the reverse.

6 Total assets/(production + power transmission volume) is used as an indicator of cost categories here.

Figure 8a. Return on total assets in low-integrated utilities by cost category, 1994-1996. Per cent

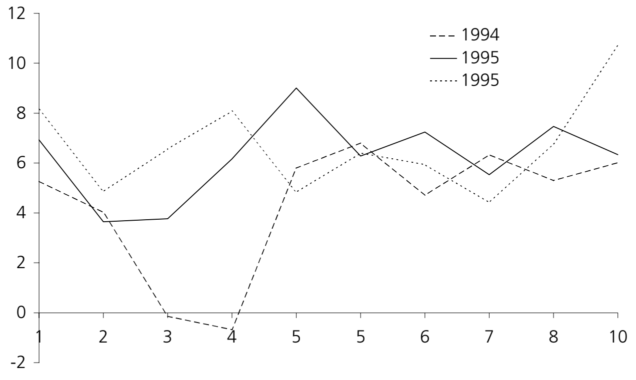


Figure 8b. Electricity prices for end-user in low-integrated utilities, 1994-1996. Øre/kWh

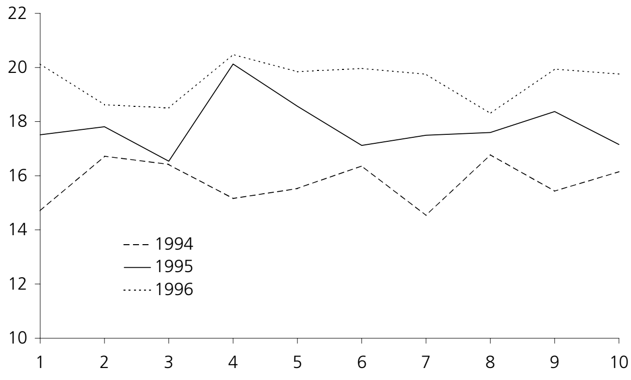
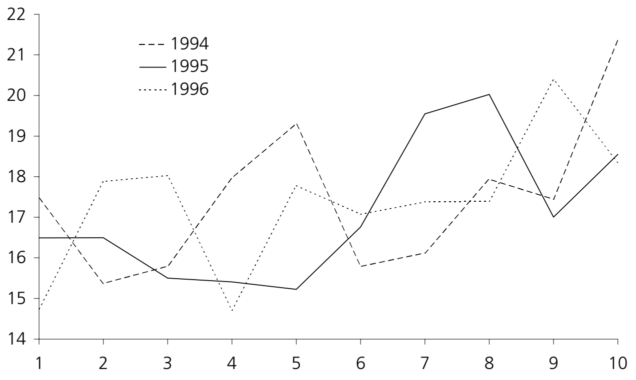


Figure 8c. Grid charges in low-integrated utilities by cost category, 1994-1996. Øre/kWh



Low-integrated energy utilities

Since there is a monopoly for grid activities, the grid charge may be set at a level where the energy utilities achieve a reasonable return on capital, as long as the return is below the upper limit stipulated by the Norwegian Water Resources and Energy Administration. This regulation points to a reasonably steady return in low-integrated utilities even though they also have some production activities. However, the difference in the grid charge between the most expensive and cheapest utilities may amount to a few øre/kWh. With high turnover, this can account for a certain differential in the return on capital.

In figure 8a we see that there is no correlation between the return and the ratio of total assets to production + power transmission volume for low-integrated utilities. Figure 8b shows that there is also no correlation between electricity prices for the end-user and capital costs. Figure 8c, however, shows that there is a weak, albeit not systematic, correlation between the grid charge and cost categories.

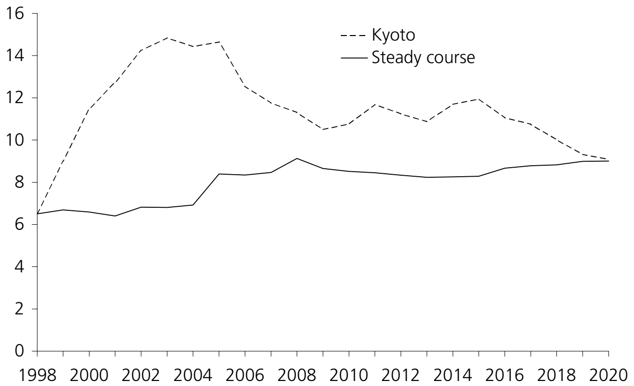
Since low-integrated utilities produce very little themselves, costs for electricity purchases will account for a higher share of total costs than capital costs. Low-integrated utilities with high profitability have in many cases slightly lower purchase prices than utilities with a low return. Moreover, total assets in low-integrated utilities are considerably lower than in high-integrated utilities. In 1996, average total assets in low-integrated utilities came to about NOK 258 million, while the figure for high-integrated utilities was about NOK 940 million, i.e. almost four times as much.

Figure 8a shows that the return in low-integrated utilities fluctuates considerably. One would expect the return to be fairly stable since a high proportion of sales consists of grid activities, which are regulated. The fluctuations are probably due to variations in purchase prices or in the end-user price. With high purchase prices, energy utilities run the risk of having to cover fixed-price supplies to the end-user at a loss. This is one of the reasons why some energy utilities recorded a negative return in 1994. In addition, the variations in the return from one year to the next may be due to an excess return on grid activities achieved by energy utilities. A return in excess of the stipulated maximum return shall be repaid to customers in the form of reduced grid charges in the future. On the other hand, a lower return, i.e. failure to cover costs, can be recovered in the form of higher grid charges in the future. The maximum return was set at 7.5 per cent up to 1996, and was raised to 8.3 per cent in 1997.

4. The return in the period to the year 2020

What will be the return in the electricity sector in the period ahead? In the Energy Report, which was presented in the summer of 1998, see NOU 1998:11, several calculations were made of the potential for the future electricity market in Norway and the Nordic countries. Calculations were presented on price developments in the electricity market under differing framework conditions in the period to the year 2020. Two projections are of particular interest. One was called a "Steady course", which was the baseline scenario for the Commission. This represents a type of business-as-usual scenario. The second is presented in Annex 3 of the report and is called "Cost-effective Kyoto". This shows possible price developments assuming that the

Figure 9. Average return on capital in the electricity sector 1998-2020. Operating profit on assets written down to replacement cost. Per Cent. Kyoto and Steady course



Kyoto Protocol shall be implemented based on an internationally cost-effective set of instruments.

Based on the price paths in these two scenarios, it is now possible to calculate the return for the electricity sector as a whole in Norway in the same way as in section 2. Figure 9 shows that the return in the "Steady course" scenario remains approximately constant at the current level, 6.5 per cent in the period to the year 2005. The return remains virtually constant for a long period early in the calculations because of the considerable surplus capacity in the Nordic electricity market. This contributes to keeping prices low. The return then rises rapidly to a level of about 9 per cent in the period to 2010 as surplus capacity in the North European electricity market declines. Higher demand contributes to pushing up the electricity price in the market to the cost of developing new capacity. The return then remains at about 8-9 per cent. Some of the economic rent in the sector is realised. However, there are still some older, expensive projects that will provide a low return. One of the main reasons that the return does not exceed 9 per cent, even though the report indicates that the equilibrium price of electricity in the calculations is 20-21 øre/kWh, is that it is assumed in this scenario that power-intensive manufacturing will have their electricity contracts extended at favourable prices. Moreover, it is assumed that the required rate of return for new power development projects is 7 per cent.

In order to illustrate some of the uncertainty of these calculations, an alternative scenario was presented in the Energy Report. There it is assumed that international agreement will be reached concerning a system for tradable permits for emissions of greenhouse gases, and that this system will generate cost-effective reductions of emissions throughout the world. Bruvoll and Bye (1998), Lindholt (1998) and Aune, Bye, Hansen and Johnsen (1998) estimate the cost-effective permit price in the period to the year 2020 at about NOK 200 per CO_2-equivalent. Such a cost for greenhouse gas emissions will contribute to increasing the price in the electricity market fairly quickly. This will occur partly through higher production costs for power plants that use fossil energy. The electricity price in the market will be influenced because parts of the sector must be closed down due to poor profitability with this emission cost. This will create a faster balance between production capacity and demand. Prices will thus be pushed up more quickly than would have been the case without this climate cost. This is true even if it is assumed that power-intensive manufacturing will have to pay market prices for electricity, and thereby contribute to freeing up a substantial volume of electricity for other users. This is of limited importance to the price in a deregulated Nordic electricity market since this industry accounts for a relatively small part of an integrated Nordic and North European electricity market (see Bye, Hoel and Strøm (1999)).

We see from Figure 9 that the return in this case increases to 15 per cent fairly quickly. Existing capacity accounts for the dominating share of electricity production capacity, and prices increase sharply. For developments in the average return in the electricity sector, it is important that power-intensive manufacturing must also pay market prices in this calculation. Gradually, however, the return again falls to about 9 per cent. This is the result of an increase in the costs for new power plants, partly due to the cost of greenhouse gas emissions for plants based on fossil fuels, and partly due to the use of more expensive alternative technology instead of power plants based on fossil fuels. Gas-generated electricity will be unprofitable under this CO_2 regime, and the alternative technologies that are applied instead of gas-generated electricity will be more expensive than gas-generated electricity would have been without CO_2 costs. This contributes to increasing the average costs in electricity production. Since the required return on capital for electricity investments is 7 per cent, this will also keep down the average return. For large parts of the electricity sector, which are not affected by higher costs and only benefit from a rise in prices as a result of prices for greenhouse gas emissions, the return will be very high.

Other elements of uncertainty may entail that the return in the future will actually be lower. For example, technological advances in general may reduce the level of costs for new power development projects. This may contribute to lower electricity prices than those assumed here. Under a climate regime, particularly the supply of new renewable sources for electricity production and consumption, or new technologies, may contribute to lower electricity prices than suggested here. However, the underlying growth in electricity consumption should not be underestimated, which entails that the supply of new renewable or non-polluting technologies must be of a fairly large scale if this is to influence prices.

5. Summary

The electricity sector in Norway is a so-called economic rent industry. This should imply that the return in this industry is higher than the return in other sectors of the economy, disregarding uncertainty. Over a long historical period the return in this industry has been lower than in manufacturing industries. This was one of the reasons for deregulating the Norwegian electricity market in 1991.

Following deregulation, one would expect the return to be higher and that more expensive energy utilities would record a lower return than cheap energy utilities. The return, however, has risen very little, partly as a result of increased competition from utilities in other countries with considerable production capacity in relation to demand.

Private utilities have a higher return on average than government-owned utilities. This is partly related to costs, but the way in which electricity is sold from the various types of utilities is also important.

One would expect expensive power plants to have a lower return than cheap power plants. Figures from the accounts for 1993-1997 cannot confirm this hypothesis. On the contrary, it appears that the return is virtually independent of costs.

The fact that the return is independent of costs at energy utilities is due to the apparent covariation of prices with costs. This indicates that the current electricity market does not function as well as might be desired. One of the main reasons for this is probably that a considerable portion of electricity is sold on bilateral contracts that are not directly exposed to the market.

The return in high-integrated utilities and low-integrated utilities by cost categories better corresponds to what theory would imply for production plants. This is probably because integrated utilities are more exposed to the market than power turnover in production plants.

The projections indicate that the outlook for a higher return in the electricity sector in the period to the year 2020 is favourable. In the long run the sector may recover part of the economic rent that is presumed to exist in the industry. With a cost-effective international implementation of the intentions in the Kyoto Protocol, the return may be very high in the Norwegian electricity supply sector.

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