Lessons from Energy Deregulation in Scandinavia and England

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During the period of July 1-18, 1997, the Association of Energy Engineers (AEE) conducted its biannual study mission to selected European cities and countries. The study mission focused upon northern Europe. Mr. Kogut lead an AEE delegation of engineers and professionals, which included members of the Cogeneration and Competitive Power Institute of AEE. The itinerary included England, Holland, Germany, Denmark, Sweden, and Norway.

Meetings were held in London, Amsterdam, Copenhagen, Stockholm, and Oslo. AEE delegates were received by various U.S. Embassy, local country government energy and environmental officials, utility executives, and energy business personnel. The purpose of the study mission was to explore and discuss in greater detail subject matters relating to electric deregulation, cogeneration, district cooling and heating, energy rates as affected by deregulation, and current energy and environmental policies set forth by the countries visited.

This article focuses on the 1997 AEE study mission and its findings. The following summarizes meetings conducted at each of the delineated European cities. Emphasis has been placed upon various subject matters addressed, and energy information obtained from each of the cities and areas visited in England and Scandinavia.

ENGLAND

London

London meetings were conducted with various groups including the U.S. Embassy, The Electricity Association, PowerGen, and the Euro-

pean Bank of Reconstruction. Discussions focused upon the deregulation of the electric power industry, the current windfall tax, and investment in energy efficiency for various building sectors and groups.

As was determined, the United Kingdom has deregulated, or privatized, its electric distribution systems since 1990. This represents one of the oldest deregulated electric systems in the world today.

Under the previous structure, the nationalized United Kingdom electric system was dominated by one large generating and transmission company, the Central Electricity Generating Board (CEGB). The CEGB sold electricity in bulk to 12 area distributing boards, each of which served a closed supply area or franchise. Under the new restructuring of the electric utility industry, the old CEGB was split into four parts as of April, 1990. The power stations were divided between two large fossil-fired generators, National Power and PowerGen, and a nuclear generator, Nuclear Electric. National Power and PowerGen joined the private sector, while Nuclear Electric remained in public ownership until 1996.

At the time of privatization, National Power became responsible for 30,000 MW of capacity, and PowerGen the remaining 18,000 MW of fossil fuel-fired plant. Some 8,400 MW of nuclear capacity previously owned by the CEGB was allocated to Nuclear Electric, and 2,100 MW of hydroelectric pumped storage capacity to the new transmission operator, NGC. The pumped storage business, First Hydro, was transferred from NGC in 1995 and is now owned by Mission Energy of the United States.

Increasingly Competitive Market

All this has led to an increasingly competitive market for base load generation. Forty-six (46) generation licenses have been issued in England and Wales since privatization, and there are already at least twenty-two (22) independent generators selling electricity into the Pool.

There are several key features to the new system. First, power is traded through an open commodity market, the Pool. Second, the generators no longer have any obligation to supply, or any assured market. They have to compete for their share of an increasingly competitive market. All the major generating companies are required to sell the electricity they produce into an open commodity market known as the Pool.

Essentially, each generating unit has to declare by 10 am each day its availability to the market, together with the price at which it is pre-

pared to generate, for each and every half hour of the following day. The units are then called to generate by the NGC in ascending order of price. The most expensive unit used established the system marginal energy price which all others receive for that half hour. There is an additional separate pricing mechanism designed to provide an incentive for the provision of generating capacity. About 90% of the electricity sold by the major generating companies is covered by contracts, both with the RECs and with individual large customers. Only around 10% of electricity sold is paid for at Pool prices.

The market has had an effect on all those who sell into it. As electricity cannot be differentiated by source of quality, the challenge is to be the least cost producer. All the generating companies have implemented a range of measures to reduce costs and have diversified fuel sources and the range of fuels used. This means burning gas in new, more efficient CCGT plant, and securing supplies of gas by contracting for independent gas production or joining with others in exploration. Companies are seeking to buy coal at world prices, whether from the UK or overseas, taking advantage of low sulfur coal. These measures have already led to major reductions in fuel costs.

It has been claimed, particularly by those opposed to a more open electricity market, that most customers have suffered substantial price increases since privatization. During the early years of privatization, prices rose during the period of relatively high inflation from 1989 to 1992.

In 1996, domestic electricity prices were 11% lower in real terms than at privatization. Current cost for electric for the industrial customers is approximately $0.08/kWh (USD), and approximately $0.10/kWh (USD) for residential without the VAT included. When VAT is included, UK domestic prices are still among the lowest in the European Union—32% lower than in Germany, 38% lower than in Belgium, 31% lower than in France, and 27% lower than in Spain. UK prices for moderately large industrial customers with a demand of 2.5 MW, based on published tariffs, are in the middle of the price range. However, UK industrial customers who buy electricity under competitive contracts enjoy even lower prices which are the fifth cheapest among the 15 Member States of the European Union. Additional price reductions can be expected as the fossil fuel levy is further reduced.

More Remains to Be Done

While much has already been achieved since privatization, many challenges remain. On the generation side, efforts must be made to ensure that competition continues to drive down costs and that these savings feed through into further price reductions for customers. In the regulated parts of the business, electricity companies will have to meet more demanding targets set by the Regulator, which are imposing real price reductions from year to year.

The mechanisms of the electricity marketplace will also evolve. At present, the Pool in England operates as a producer's market and the demand-side is in the early stages of development. New arrangements are presently under trial to test the scope for demand-side bidding in the Pool, whereby customers would be given incentives to reduce their consumption at certain times. There is already evidence that this is exerting a downward pressure on Pool prices. Progress can also be expected in the treatment of transmission costs, in particular those costs associated with transmission constraints. Over time, a longer term forward market in electricity may also develop.

Finally, the issue of energy efficiency will also take on greater importance. Electricity companies have already taken on a number of initiatives in the area of demand-side management and the question of incentives to promote greater efficiency is being examined both by the industry and the Regulator.

On July 2, 1997, the Chancellor announced the introduction of the proposed windfall tax on the excess profits of the privatized utilities. The one-off tax will apply to companies privatized by flotation and regulated by statute. The tax will be charged at a rate of 23 percent on the difference between company value, calculated by reference to profits over a period of up to four years following privatization, and the value placed on the company at the time of flotation. The expected yield is around 5.2 billion Pounds.

The tax will apply to companies privatized by flotation and regulated (or with a subsidiary regulated) by relevant privatizing statutes. These are the Telecommunications Act 1984, the Airports Act 1986, the Gas Act 1986, the Water Act 1989, the Electricity Act 1989 (and the Electricity (Northern Ireland) Order 1992) and the Railways Act 1993. The tax will be charged on the floated companies.

The companies falling within the scope of the windfall tax are BAA, British Energy, British Gas (now BG plc and Centrica), British

Telecom, National Power, Northern Ireland Electricity, PowerGen, Scottish Hydro, Scottish Power and Railtrack, the regional electricity companies and the privatized water and sewerage companies (including such companies now forming part of Hyder, United Utilities and Scottish Power).

The Electric Association, equivalent to the Edison Electric Institute, is not in favor of the Windfall Tax. In the end, it is believed that it will adversely affect deregulation, overall, and the resultant savings derived from a deregulated electric industry.

European Bank of Reconstruction

Meetings were conducted with the European Bank of Reconstruction (EBRD). Discussions focusing upon the implementation and financing of energy efficiency measures in various sectors of the world economy.

The EBRD is a multinational institution set up with the specific aim of assisting the countries of central and eastern Europe and the CIS to develop into market-oriented economies. Its shareholders include countries from both this region and the rest of the world, plus the European Community and the European Investment Bank.

Specifically, the EBRD seeks to promote the development of the private sector within these economies through its investment operations and through the mobilization of foreign and domestic capital. The EBRD's main advantages, compared with private commercial banks, lie in its willingness and ability to bear risk, as a result of its shareholder base. This allows the Bank to act at the frontier of commercial possibilities and to be an effective "demonstrator." It also shares the project risk by acting with other private sector entities, such as commercial banks and investment funds, as well as multilateral lenders and national export credit agencies. The EBRD assists companies that have difficulty in securing financing: as such, it complements the efforts of other lenders.

Typically, the EBRD funds up to 35 percent of the total project cost for a greenfield project or 35 percent of the long-term capitalization of an established company.

Currently, the EBRD is developing framework agreements for the start-up of energy service companies (ESCO's) in Central Europe. In addition, they are investing in energy efficiency producing projects such as improved district heating, networks, and several projects aimed at reducing the energy consumption in large industrial companies. Cities

that the EBRD is working with include Kiev and other cities in the Ukraine, several cities in Russia, Sofia and Mirisk. AEE has laid some groundwork in further developing an ongoing business relationship with the EBRD and AEE's expanding chapters in eastern and central Europe.

NETHERLANDS

Amsterdam

AEE delegates met with utility executives from NV UNA. Discussions focused upon the controlled and limited deregulation market currently existing in Holland and Dutch generating companies. UNA currently has a generating capacity of 3.6 gigawatts (GW), and ranks third in the Holland utility electric utility industry, with EPZ rated at 4.6 GW and EPON rated at 4.3 GW ranked above UNA. Discussions focused around the possible merging of the three utilities pushing them to an overall ranking of eleventh within the European electricity companies.

Currently, there are four (4) Dutch generating companies: EPZ, EPON, UNA, and EZH. Prior to the current controlled form of deregulation, there existed fifty (50) distributing companies. Subsequent to deregulation, there currently exists twenty (20) distributing companies.

The present electric/heat generating plant fuel mix of UNA consists of 62% gas, 20% coal, 17% Blast Furnace Gas (BFG), and 0.41% oil. This is compared to the Netherlands generating fuel mix of 42% coal, 46% gas, 4.2% BFG, 0.3% oil, and 7.9% nuclear. The Netherlands electric energy production is estimated to be 40 GWH/year. Coal imports for electric producing plants are imported from Australia, Columbia, and South Africa. Domestic coal mines have been shut down.

Peak electric loads for the Dutch generating system is 11,700 MW, with an estimated system capacity of 10,000 MW. Typically 86% of system peaks are generated, with 14% being imported.

"Streamlining '96"

The Netherlands are currently working under an order of Economic Affairs titled—Streamlining '96. Some major points of this directive include:

- Keep transmission and distribution separate, an "arms length" from generation.
- Merger of the four (4) producers—Create a "Great Production Company."
- Provide special status for sustainable energy—ex: solar should be protected.
- A new government body would be created governing the gas and electric business. The new body would control free traffic of energy and protect "captive" users.

As a result of current energy operations, downtime in the Netherlands is approximately six (6) minutes per year. This is compared to thirty (30) minutes per year for the average in Europe.

Based on the present electric energy rates, approximately 60% of cost per kWh goes to the price of fuel. The general price for electricity for the industrial sector in the Netherlands is $0.065/kWh (USD), of which, approximately less than $0.01/kWh represents the systems grid (380 kVA) cost which is needed to be supported. Overall the Netherlands maintain a 65-70% systems load factor.

Up until recently, electricity in the Netherlands has been free of tax. Households currently have a value added tax (VAT) on energy. Residential rates with VAT added are at approximately $0.15/kWh (USD), and approximately $0.11 kWh without the VAT.

Privatization is not in the near picture for the Netherlands. Some competition exists, but rates are relatively low compared to other European countries.

DENMARK

Copenhagen

The Ministry of Environment and Energy held court for AEE delegates in Copenhagen, Denmark. Discussions focused upon development energy policies, developed by The Danish Energy Agency, as related to the country of Denmark. The agencies of energy and environment were combined since 1994.

The Danish Energy Agency, an Agency under the Ministry of Environment and Energy was established in 1976. The Agency focuses on the

production, supply and consumption of energy and ensures, on behalf of the State, the responsible development of energy in Denmark from the perspectives of society, the environment and security of supply.

The Agency drafts and administers Danish energy legislation and implements analyses and assessments of development in the energy field. One of its important tasks is to launch initiatives to translate Government energy policy into practical initiatives. In April 1996, the Government presented its action plan for energy, *Energy 21,* the aim of which is to contribute Denmark maintaining and developing its pioneering role in the achievement of sustainment of sustainable global development. In 1996, 8% of the total Danish energy consumption was covered by renewable energy sources. According to *Energy 21,* this share shall increase to 30% in 2025.

"Energy 21"

Energy 21 maintains the Government's objective of reducing CO_2 emission in Denmark by 20% by the year 2005 in relation to 1988 levels.

The Danish Energy Agency is responsible for the overall planning of power, heat and natural gas supplies in Denmark. In addition to electricity, most consumers today have access to energy supply networks consisting of district heating or natural gas. In areas not supplied by district heating or natural gas, various subsidy schemes provide incentives to consumers to switch environmentally friendly forms of heating.

Energy supply networks are in the process of being made more efficient by increasing co-production of heat and power at combined heat and power (CHP) plants. CHP supply from large-scale plants is being further developed and local district heating plants converted to CHP based on natural gas, waste and biomass. New, local district heating systems are also being established and industries are being encourage to establish their own, local CHP plants.

Denmark is also a leader with regard to energy savings. The Agency works to encourage the general public, trade and industry and public institutions to make even more efficient use of energy in order to achieve savings. Initiatives targeting private consumers include energy conservation campaigns and various subsidy schemes. Labeling of electrical appliances is being introduced to encourage consumers to purchase low-energy appliances.

The Energy Agency also administers a scheme launched in 1997 to energy-label all buildings so that buyers know the energy condition of

a building when contemplating a purchase. Furthermore, systematic energy management has been introduced in most public institutions and energy consultants encourage trade and industry to save energy by means of energy auditing schemes.

Tax Legislation

In 1996, new green tax legislation was introduced for trade and industry the revenue of which is to be recycled to business enterprises. Energy intensive enterprises can enter into agreements concerning energy efficiency measures which will allow them to receive a reduction in CO_2 tax. Subsidies may also be granted for specific projects leading to energy improvements in business enterprises.

To attain the overall objective of reducing CO_2 emissions, continual development of new, more energy-efficient technology is required. The Energy Agency administers the Energy Research Programme (ERP) that provides funds for research and development in a number of important fields including further recovery of oil and natural gas, combustion and gasification of biomass, development of large-scale, low-noise wind turbines, and fuel cell and superconductor research.

There are currently four (4) power plants in Copenhagen. Surface heat is utilized for the power plants, for process plants, and to supply heat to the residential sector.

The current value added tax (VAT) on energy is 25%, with total taxes on energy amounting to a 50% level. Electric energy cost to the Danish household is currently at $0.20/kWh USD) with taxes added. The average normal household consumes approximately 4,000 to 5,000 kWh per year.

Wind power currently accounts for 3% of the Danish power generation, with a target of 12 to 14% for renewable (solar, biomass) energy. Present windmill designs can generate up to 1.5 megawatts (MW) of power. The best overall combination of cost effective energy delivered to the Danish systems is produced from windmills in Denmark, and the purchase of hydro power from Norway. New plants built in Denmark consist of gas and straw fueled, with little emphasis on oil.

Currently, there exists seven (7) major generating companies, supported by 100 distribution companies. These companies feed into two (2) power pools. Privatization of the local distribution companies (LDC) is not on the foreseeable horizon. Denmark wants to focus on an electric system for the Danish, with little or no outside influence. Eventual liber-

alization of the Danish electric utility system will come about after Norway, Sweden, England, and the surrounding countries accomplish it.

SWEDEN

Stockholm

Meetings in Stockholm were held with Stockholm Energi. Representatives from Stockholm Energi, along with U.S. Embassy representatives from the commercial division, met with AEE delegates to discuss energy related matters focusing on deregulation, district heating, and district cooling as related to the city of Stockholm and Sweden.

Stockholm Energi primarily serves customers in the Greater Stockholm area and Central Sweden, and is one of Sweden's leading energy companies. The Company is broadly-based, including electricity, heating, cooling, gas, and electricity supply network operations. The unique production mix with electricity and district heating operations of the same size allows flexibility in adapting production in a cost-effective way to different weather conditions. Production of electricity in the district heating operation has become a competitive alternative in dry years such as 1996, when it was important to compensate for the low production of hydroelectric power. Stockholm Energi has its own facilities for production and distribution of electricity, heating, gas and cooling.

The ability to give customers the opportunity of complementing their energy solutions with the pro-environmental district cooling has provided Stockholm Energi with competitive advantages in relation to other power companies as regards to meeting customers' total energy needs.

Deregulation

Deregulation has meant that the Electricity Business Division is no longer restricted by the Local Government Act but may carry out operations without taking into consideration local government restrictions. As a result of the collaboration with Imatran Voima Oy, it will be possible to make use of competence in the Network, Heating and Cooling Divisions on a larger market, both nationally and internationally.

The Group has around 450,000 customers, the major part of whom are customers with domestic electricity. There are over 200 large consumers of electricity, over 3 GWh. Competition for customers became tougher when the electricity market was deregulated and some down-

turn in electricity sales in the Stockholm region was noted.

Network Supply operations have not been deregulated. The Group still has the sole right to transport electricity to all customers in the Stockholm and Avesta areas on its own networks.

Sales of heating have undergone great expansion during the year, and district heating has now around 65%, of the heating market in Stockholm with around 3,500 customers. The greatest competitor for district heating is the local oil-fired heating boilers. The environmental benefits of district heating, operational reliability, and simplicity for the customer provide important competitive advantages.

The Group's oldest product, city gas, which has been supplied since 1853, is sold to 109,000 customers of which 102,000 are cooking gas market customers. Stockholm Energi's newest product, cooling, where the first delivery took place in May 1995, has around 80 customers. District cooling is primarily intended for commercial properties in central Stockholm. As in the case of district heating, district cooling's environmental profile, simplicity and operational reliability provide clear competitive advantages.

"Choice Power"... "Mega Customers"

In February 1996, the Electricity Business Division introduced the product "Choice Power," allowing the customer to choose the method of production and account for their purchases of electricity between hydroelectric power, nuclear power or Stockholm electricity. During 1996, this has been broken down to 3,563 GWh of hydro power production, 4,964 GWh of nuclear power production, and 1,112 GWh of Stockholm electric power production. Of this complement, the following produced power was sold: 47% for hydro, 23% for nuclear, and 0.4% for Stockholm electric.

Hydroelectric power production was considerably lower than normal and 1996 went down in history as an exceptionally dry year. Compared with Stockholm Energi's normal annual production of hydroelectric power of 4.8 TWh, only 3.6 TWh was produced, a reduction by 25%. The reduction in hydroelectric power was compensated for by more expensive thermal power.

During the year, a total of 10.4 TWh (10.5 TWh) of electricity was produced in wholly own and jointly owned plants.

In the autumn, Stockholm Energi introduced the concept Mega Customer. Major electricity customers who purchase more than one of the Group's energy products CM become so-called "Mega Customers."

They then benefit from favorable contracts with their own customer representative, energy audit, monthly statistic, energy balance, and simplified invoicing procedures, among other things. The intention is to reduce the customer's total energy cost and to simplify administration in contacts with customers.

Stockholm Fastighetsagareforening was the first to enter into a Mega Customer contract for 1,401 properties.

Balancing Energy Production

In a normal year, approximately 45% of the electricity produced comes from hydroelectric power, 45% from nuclear, and 10% from local. Other power is produced in big-fuel, coal and oil-heated facilities. Approximately 75% of all energy produced today comes from sea water.

1996 was an exceptionally dry year with very little precipitation. Precipitation has not been so low since 1969-70. Due to this, the Group lost around 25% of the normal hydroelectric power production. Hydroelectric power was replaced by more expensive production at an additional cost of around SEK 250 million (approximately $34.1 million USD).

Prices on the Norwegian-Swedish energy exchange rose successively at the beginning of the year due to the initially cold period with low precipitation. When the expected spring flood was late and small, energy prices rose further. Price peaked early in the autumn, to fall subsequently as in-flow increased and import of power took place, especially from Denmark.

In the 1990's, Stockholm Energi has aimed to create a balance in its own production of electricity between hydroelectric power and nuclear power. This strategy was followed up in 1995 when further hydroelectric power resources were acquired from Akzo Nobel. The consequences of a phasing-out of nuclear power will affect the whole energy sector.

Present electric rates for Stockholm converted to US $ equate to approximately $0.09/kWh (USD) for residential, and approximately $0.04 to $0.05/kWh (USD) for industrial and commercial sectors. Pricing of electric is broken down to approximately 1/3 for fuel cost, 1/3 for transmission costs, and 1/3 for taxes (varies for industrial and commercial sectors).

On January 1, 1996, the 90-year-old electricity legislation was replaced by a new electricity act, and the deregulation of the electricity market became a reality. Currently, the wholesale level is fully deregu-

lated. Households are slowly being brought into the picture.

Sales amounted to 13.2 TWh (14.2 TWh) of which 1.8 TWh (1.8 TWh) were internal sales. The reduction largely depends on lower sales to other power suppliers.

The deregulation of the electricity sector led to tougher competition to the benefit of customers. It is to be expected that the exchange price and customer price will be more closely related, especially in the sectors exposed to competition. The margin between the price to the customer and the exchange price will diminish, as well as price differences between different suppliers.

The Nordic exchanges will be integrated which will result in the Nordic countries becoming a common market. The free electricity market, especially in northern Europe will develop successively in response to customer pressure. Through partnership and expanded competence, Stockholm Energi intends to participate in this European development.

Concentrated production of district heating makes it possible to use renewable sources of energy and thus reduce emissions compared with individual heating. During the past three years, Stockholm Energi has expanded its district heating market share by a further 10%. Local oil-heated boilers have been replaced by district heating or local heating solutions. During the same period supplies of district heating increased by the equivalent of the annual heating requirement for 25,000 detached houses.

For the third year running, district heating prices were unchanged despite increased taxes and rising oil prices.

New sales during the year amounted to the equivalent of SEK 100 million/year (250 GWh/year) in income. This expansion took place primarily in Sodermalm, and through new establishment primarily in the southwestern suburbs.

In all, sales amounted to 6,981 GWh (5,993 GWh) including deliveries to Sollentuna, Jarfalla and Avesta with 440 GWh (387 GWh). Heat pumps, pellets, bio-oil, and refuse fuel accounted for 60% of the energy supply. Coal, oil and electricity accounted for the remainder. Electricity production amounted to a full 1,627 GWh during the year, of which 515 GWh came from production in condensing power plant. The high proportion of condense production was caused by high electricity prices due to the dry year.

Simplicity is created primarily in relation to customers. Invoices via EDI are already a reality and more and more customers will be able

to read consumption statistics etc. via Internet. All customers were given the opportunity of becoming Mega customers of Stockholm Energi.

Gas Supply

In regards to gas supply, the Business Division of Stockholm Energi offers a competitively-priced range of gas products to customers in the Greater Stockholm area. City gas sales amounted to 396 GWh, an increase by 34 GWh. Marketing activities are focused on continuing efforts to make new sales to real estate owners. New agreements equivalent to deliveries of 26 GWh were established.

During the year, SE Gas was given the assignment of creating good conditions for continued gas operations. Active efforts to reduce the annual loss of cooking gas customers, and to develop the home-heating market were initiated. Real estate owners can now, for instance, enter into agreements on residual value guarantees when replacing old gas cookers by new.

The number of customers was 109,000 (113,000) at the end of the year, of which 101,500 (105,000) were on a cooking gas tariff. Customers are in Stockholm, Solna, Sundbyberg and Nacka. Stepping up the tendency for customers to move away from gas cookers is of decisive importance for SE Gas's future profitability. The Business Division has therefore started active effects to maintain its place on the cooking gas and home-heating markets. The aim is to reduce the loss of gas cookers from 4,000 per year in 1996 to 2,000 by 2000.

City gas production takes place in a cracked gas plant. 41,500 tons of naphtha were used as raw material in 1996.

New sales of building heating are continuing. Use of gas as a vehicle fuel is being developed further. Within the framework of the EU—supported ZEUS project, 180 vehicles will be powered by biogas.

District cooling, with the aid of cold sea water, has been successfully introduced as a new product and a strong complement to Stockholm Energi's traditional supply of energy. After over two years, district cooling has achieved a market share of 35% on the cooling market in the distribution area.

The year's new sales 26 MW were made to over 40 customers. The connection of new customers meant that local refrigeration plants containing around 7,000 kg Freon could be eliminated. At the turn of the year, the total connected capacity was 52 MW (26 MW) and the energy

supplied during the year reached 34 GWh (17 GWh). The city system includes a connected capacity of over 120 MW.

Stockholm Energi's unique district cooling investment has met a response throughout the world. The concept for establishment of district cooling can be introduced both in Sweden and abroad.

NORWAY

Oslo

AEE delegates met with ENRON Nordic Energy in Oslo, Norway. ENRON is directly involved with the energy commodities market and NORD POOL. ENRON buys and sells energy contracts for various industrial and commercial customers as determined by the unit cost of energy set by time of day and daily pricing of the Pool.

Norway's total production of electric energy in 1995 was reported at 123.2 TWh, which is an increase of 8.8% from 1994, and 1.4 TWh over the old production record from 1990. Exports of electric power (in 1994) amounted to 4,836 GWh, while imports accounted for 4,968 GWh. Total hydroelectric production capacity with normal supply of water is estimated at 112.3 TWh.

Power Production Strategies

Typically in a dry year, the coal-fired plants are the last to be brought on, and in a wet year, the nuclear plants are the last to be brought on. This is typical for the Norwegian market of Norway, Sweden, Finland, and Denmark, and the power grid system. Total energy consumption for the Norwegian countries is approximately 370 TWh.

There are currently no nuclear power, coal or gas fired energy plants in Norway. Ninety-five percent of the electric supply (in excess of 118 TWh annually) is based on hydroelectric power produced in more than 600 power plants throughout the country. Norway is considered to be the world's largest consumer, per capita, of electricity.

Most of this energy has been generated, controlled and distributed by Statkraft and Statnett Grid, two GON owned entities with an annual investment level of about USD 200 million. However, hydroelectric energy has gradually been liberalized from a strict local monopoly status, and the various power plants are now individually permitted to compete with each other domestically and on international markets.

From the total 1995 production of 27,555 MW, Statkraft supplied close to 30%; municipal and local government utilities supplied 55%, while private and industrial power plants accounted for 15%.

The annual per capita electricity consumption in Norway at present is approaching 25,000 kWh. The average price for electricity to regular consumers was in 1995, NOK .55 per kWh, ($0.086/kWh—USD), while average price for heating oil was reported at NOK 2,55 per liter (NOK 6.40 equals USD 1.00). Norway's energy rates to the end-user are typically broken down to: 1/3 wholesale cost + 1/3 transmission + 1/3 taxes. All transport and distribution lines are operated by Statnett (Norway's state owned Power Grid Company) controlling a grid of more than 200,000 km.

GON, Norway's state owned power grid company, has opened up the local markets to competition so that the nearest power plant does not have its own area automatically guaranteed with monopoly pricing. Local power plants are now delivering electricity to various organizations and customers located in Oslo or elsewhere in the country. Norwegian authorities claim that Norway was the first country in Europe providing free competition among the various domestic energy producers. To date, even with deregulation, no real net savings on energy have been realized at the end-user level. Profits have been basically observed at the transmission level.

Power-intensive industry such as aluminum works, ferrosilicon works, and wood processing plants currently account for 25 percent of the power consumption in Norway. The rest of the industrial sector, the service industry and transport consume 45 percent. The remaining 30 percent is consumption by households.

Noting that hydroelectric power accounts for virtually all electricity generated in Norway, there is a general consent that a highly developed country cannot base its power supplies exclusively on the weather. The Government has decided to build two gas fired power plants at an estimated value of approximately USD 500 million on the west coast of Norway; Electric energy has always been regarded as an important export potential, particularly to Norway's neighboring countries.

Abundant Norwegian natural gas resources in the North Sea is now scheduled to be pumped into two 350 MW gas fired power plants. The project recently obtained approval from the Norwegian parliament and is managed by Statoil (Norway's state-owned oil and gas producer), Statskraft (Norway's state-owned hydroelectric power utility), and

Norsk Hydro (gas producer and industrial flagship, -51 percent controlled by the Norwegian state). Each company has one third ownership in the gas fired plant. The two plants are scheduled to be in operation by 1999 and 2000 respectively.

Conclusions

Since the implementation of electric deregulation/ privatization in England in 1990, the impact of full deregulation in various countries visited and reviewed, has yet to be realized. While much has already been achieved since privatization, many challenges remain in England and the Scandinavian countries.

Some of these challenges, future areas of change, and general comments include:

On the generation side, efforts must be made to insure that competition continues to drive down costs and that these savings feed through into further price reductions for the customers.

- In general, the transmission portion of the electric utility industry must be deregulated to fully realize the impact of end-user cost reductions.
- In England, the regulated parts of the business, electricity companies will have to meet more demanding targets set by the Regulator, which are imposing real price reductions from year to year.
- Privatization does not appear to be in the near picture for the Netherlands.
- Eventual liberalization of the Danish electric utility system will come about after Norway, Sweden, England, and the surrounding countries accomplish deregulation/privatization. Denmark's focus is on developing and enhancing the electric system and infrastructure for the Danish, with little or no outside influence.
- In Sweden, currently the wholesale level is fully deregulated. Households are slowly being brought into the picture.
- The Nordic exchanges are shifting towards an integrated exchange which will result in the Nordic countries becoming a common market.

In summary, the expansion of electric deregulation will create expanding opportunities which will result in enhanced energy cost savings to the end-user. Controlled deregulation of the electric utility industry would be a prudent course to follow. This would still allow for end-user savings to occur, and focus on not diminishing the overall integrity of the electric utility system. As we are about to enter the twenty-first century, we are beginning to see the future of the energy industry and its impact on our world environment.

ABOUT THE AUTHOR

Kenneth J. Kogut, P.E., CEM, maintains a professional energy management consulting firm serving clients in the commercial, industrial, institutional, and governmental sectors. Through the efforts of Mr. Kogut, professional energy consulting services have been provided in the areas of energy audits and the development and implementation of energy management programs for his firm's clientele. Mr. Kogut has been actively involved in the energy field in the capacities of designing, developing, managing, and implementing energy management programs and energy conservation projects for over twenty-five years.

Mr. Kogut has accomplished energy reviews and assessments for the firm's clientele across the North American continent, Canada, and Puerto Rico. Prior to the establishment of his Firm, Mr. Kogut assisted in developing testimony to the Washington, D.C., Public Service Commission in one of the first time-of-day rate cases in the country. Mr. Kogut was also involved in the development of one of the first electric rate structures for the eastern part of Saudi Arabia.

He has consulted to various electric and gas utilities in aspects of utility operations, and, as a consulting engineer, was responsible for technological forecasting and development of electric usage rate structures, and feasibility studies associated with the state-of-the-art and advanced energy systems for the electric utility industry. Mr. Kogut has published a number of papers on the subject of energy, is a registered Professional Engineer (P.E.) in Illinois, and a Certified Energy Manager (CEM). He holds a bachelor of mechanical engineering (BME) and a master of engineering (ME) degree from the University of Detroit, and was also an Alfred P. Sloan Fellow at the University. He was president of the Association of Energy Engineers (AEE) for 1998.

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