Oslo, Norway

Comprehensive Municipal Energy Efficiency

Profile #79

Executive Summary

Norway is a country blessed with abundant energy resources, awash in hydroelectricity, or what Norwegians call “the clean energy,” as well as North Sea oil and gas. Norway’s energy self-sufficiency is the envy of many other energy-strapped countries. What makes this profile so intriguing is that Oslo Energi and the City of Oslo have pioneered the use of an innovative revolving fund to promote energy efficiency that may well become an internationally-acclaimed model for the finance of energy efficiency, but which ironically has been generally underutilized in Oslo itself.

The Ekon Fund established by the City of Oslo in 1982 has proven to be an elegant mechanism for providing and facilitating a pool of capital for retrofits. The Fund was developed by applying a small surcharge on each kilowatt-hour sold in Olso. (The Fund has been supported with a 0.16 ¢/kWh surcharge, equal to 2.9% of average electricity rates.) This “fresh” capital, plus interest earned on the balance and oustanding loans, has created a fund of significant magnitude.

To date the Ekon Fund has enabled approximately 20,000 customers within Oslo to engage in efficiency retrofits that have resulted in 2,528 GWh of energy savings. These projects have cost a total of over $110 million. In its "banner years" the Fund saved 65 GWh, 59 GWh and 62 GWh annually. Ironically, the Fund has been challenged by its success as its primary shortcoming has been its own inability to grant and loan money fast enough. Its current balance of approximately $100 million U.S. dollars (577 million NOK) has become highly attractive to politicians keen on reallocating the money for other social programs. But for now, the City has decided to guard the Fund against such uses and maintain its capital for its original purpose: energy efficiency retrofits.

The Oslo Ekon Fund is the primary focus of this profile and represents a brilliant financing mechanism for energy efficiency that may be best transferred to other jurisdictions for a number of reasons. Energy efficiency is typically driven by high prices, which Oslo does not have. Efficiency is driven by shortages of power, which Oslo does not have. Finally, energy efficiency is driven by concerns about the security of future power supplies, and this is not a Norwegian concern either! Thus the mechanism and the full service orientation of the Fund make a good deal of sense and may be successfully replicated elsewhere, but the Fund has been proportionately less successful in Norway,... one of the Northern Hemisphere’s great energy anomalies!

City of Oslo, Norway
Oslo Ekon Fund

Utility:	Oslo Energi
Sector:	All buildings
Measures:	Primarily weatherization measures for electric, oil, natural gas, and wood energy savings expressed on a kWh-equivalent basis
Mechanism:	Revolving fund administered by the utility and supported by rate surcharge. Provides loans and grants to finance efficiency improvements
History:	Surcharge began in 1982 and ended in 1991 as Fund became self-sufficient. Financing available over that time and continues today

1992 Program Data

Income:	$13.04 million
Financing provided:	$7.40 million
Annual energy savings:	34 GWh
Lifecycle energy savings:	680 GWh

Cumulative Data (1982 - 1992)

Income:	$149.01 million
Financing provided::	$111.86 million
Energy savings:	2,528 GWh
Lifecycle energy savings:	9,420 GWh

Conventions

For the entire 1993 profile series all dollar values have been adjusted to 1990 U.S. dollar levels unless otherwise specified. Inflation and exchange rates were derived from the U.S. Department of Labor’s Consumer Price Index and the U.S. Federal Reserve's foreign exchange rates.

The Results Center uses three conventions for presenting program savings. **Annual savings** refer to the annualized value of increments of energy and capacity installed in a given year, or what might be best described as the first full-year effect of the measures installed in a given year. **Cumulative savings** represent the savings in a given year for all measures installed to date. **Lifecycle savings** are calculated by multiplying the annual savings by the assumed average measure lifetime. **Caution:** cumulative and lifecycle savings are theoretical values that usually represent only the technical measure lifetimes and are not adjusted for attrition unless specifically stated.

Norway is the western-most of the countries on the Scandinavian peninsula, bordering the North and Norwegian Seas to the west, Sweden to the east, and Russia and Finland north of Sweden in the Arctic circle. Its population of roughly 4,273,000 speak primarily Norwegian, but Swedish and English are also widely spoken. With a total area of 323,886 square kilometers (125,053 square miles) Norway is the least-densely populated of any European country except Iceland. Much of Norway's landscape is dominated by its numerous rivers and mountains. In fact, three-quarters of the land cannot be inhabited by people nor used for agriculture due to the rough terrain, climate, and heavy forestation.[R#6,7]

Norway is a constitutional monarchy that was established in 1905 when it gained peaceful independence from Sweden. The country is governed by a Parliamentary Democracy and has recently been led by a variety of shifting coalitions. Among the most prominent politicians in Norway's recent history is Gro Harlem Brundtland, the first woman to lead Norway's government and the namesake of the United Nations' now infamous, Bruntland ☞

Commission, which produced "Our Common Future" in 1987.[R#19]

Norway is proud of its history of women in government, a path paved by Mrs. Brundtland who gained international attention for both her Norwegian leadership and her United Nations capacities. Fully nine members of the 19-person Norwegian Cabinet in 1990 were women, the highest such proportion in the world. More than one-third of the national Parliament is composed of women, also the highest level of female representation in the world. The Mayor of Oslo, Ann-Marit Saebones, is also a woman and currently roughly 41% of the country's total workforce is made up of women.[R#7]

Norway's economy is based heavily on fish and forest products. The country's merchant marine fleet remains among the six largest in the world. However, revenues from North Sea reserves of oil and gas are the largest component of the Gross National Product. Norway is also the largest manufacturer of aluminum in Europe due to the abundance of hydroelectricity. Overall, exports make up 40% of the GNP making Norway's economy extremely responsive to world trading and economic conditions.[R#7]

The local currency is the Norwegian Kroner (NOK) with 100 ore per Kroner. The 1992 exchange rate was 6.2142 NOK to 1 U.S. Dollar. Per The Results Center convention, all dollars expressed in this profile reflect U.S. 1990 dollars. As such 1993 Norwegian dollars have been first converted to 1992 U.S. dollars, and then deflated to 1990 U.S. levels.

NORWAY'S ABUNDANT ENERGY SUPPLIES

Norway is extremely energy rich, making it an unlikely country for an innovative energy efficiency program. Norway has abundant oil and natural gas resources in the North Sea estimated to be between 1.719 and 2.738 trillion cubic meters (60.7 to 96.7 trillion cubic feet) making it the third largest producer in the North Sea behind only the United Kingdom and the Netherlands. In spite of these resources the country produces 99% of its electricity from hydroelectricity that is primarily generated in the mountainous regions of the country.[R#9]

These factors combine to make the country more than self-sufficient in energy use. Total energy production is 6,572,988 terajoules or TJ (6.23 quads) comprised of 4,093,617 TJ (3.88 quads) of crude oil, 1,276,618 TJ (1.21 quads) of natural gas, 1,192,213 TJ (1.13 quads) of hydroelectricity, and 10,551 TJ (0.01 quads) of coal.[R#9]

In contrast Norway uses only 1,540,382 TJ (1.46 quads) of energy of which the bulk (1,023,404 TJ/0.97 quads) is hydroelectric and the remainder is petroleum (390,371 TJ/0.37 quads), natural gas (84,404 TJ/0.08 quads), and coal (42,202 TJ/0.04 quads).[R#9]

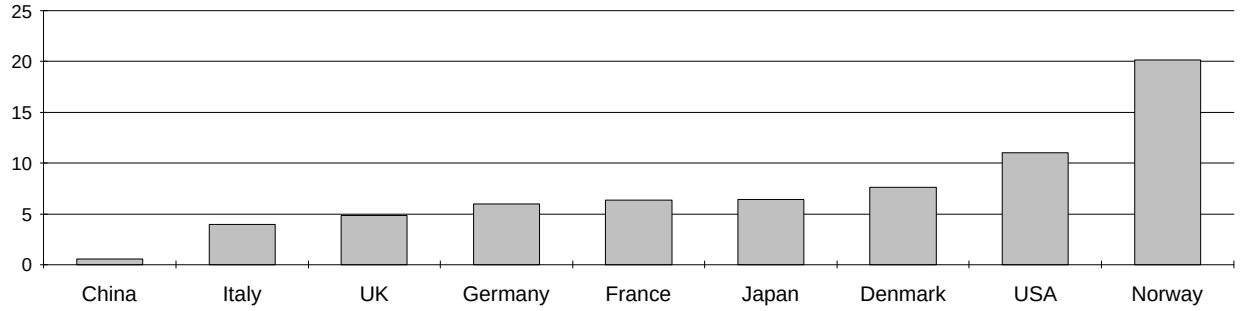
Norway's electricity use reflects abundance. Total per capita electricity use in 1991 surpassed 20 MWh, nearly double the level in the United States and just under three times the average electricity use in neighboring Denmark. More than half of this consumption was due to electric space heating. See the accompanying chart which shows the relative values for 1991.[R#4,9]

One of the interesting opportunities that Norway may have in the next 5-10 years is the ability to sell its excess power to Europe once the European Commission's rules on electricity trade become established. If rules are favorable – and Norway's CO2-free hydroelectricity should be the subject of considerable envy – then big markets could open up for Norway in the years ahead. Furthermore, if Norwegians can save energy for less than the cost of export sales, this could result in a big boom for energy efficiency in Norway.

Currently Norway does export some power to Sweden, but Sweden is a barrier to further and more lucrative trade. Unfortunately Sweden does not want to transmit power for Norway and this has effectively blocked power sales to attractive markets. For instance, Norway could likely sell to Denmark (see Profile #80 for a discussion of Danish purchases of Swedish excess power), but it would have to be routed through Sweden as it would be prohibitively expensive for Norway to build its own transmission link with Denmark.

The European Commission's rules will be interesting to watch as Germany has already expressed its desire to continue to support its indigenous coal industry and

1991 ELECTRICITY USE PER CAPITA (MWH)



France wants the ability to sell its excess nuclear capacity in the unified European market. Norway has also considered selling power to Russia but a lack of hard currency in that country has discouraged this pursuit.[R#12,14]

CLEAN ENERGY AND ENERGY-RICH LIFESTYLES

When in Oslo in June of 1993, The Results Center staff had the opportunity to meet Rich Ling who is an American energy consultant based in Oslo. His American perspective on energy use in Oslo was quite fascinating: For instance, he noted that Norway seems to be "the fresh air culture." The average home in Oslo is aired out for 30 minutes each day, despite freezing cold temperatures in the winter when the heaters are blasting away!

Rich commented that it's also a culture that likes to be "cozy." He seemed to over stress this phenomenon of Norwegian life and energy use. It seems that abundant hydroelectricity and the concept of "clean energy" coupled with long, cold and dark winters, have created embedded patterns of high levels of energy use. The notion of coziness is best symbolized by the fact that Norwegians leave large numbers of living room lights on all the time, regardless of whether anyone is in the room. Rich suggested that leaving one's lights on is a symbol in the evening for passersby on the streets and sidewalks that all is well. Inversely, turning off the lights is a symbol of being stingy!

One of the staff of Oslo Energi's Energy Conservation Department chimed in and told a similar story. He had counted the number of incandescent lamps in his mother-in-law's living room. Final tally: 35. Believe it or not, he continued, every evening and before she goes to bed, it is her routine to turn each light on and off individually! We were told that the average Oslo home has 11 incandescent lamps in the living room, and typically they are all illuminated every evening.[R#12,17]

RESTRUCTURING THE NORWEGIAN ELECTRIC UTILITY INDUSTRY

The history of Norway's electric utility industry is an interesting, century-old story, that has certainly become most interesting in the past few years. Electricity supply has been a local, typically-municipal business for the past 100 years. Then after World War 2 some Norwegians believed that a consolidation of the industry would make sense and would allow Norway's electric utilities to take advantage of economies of scale in power generation. There were plans discussed for 20 electric utilities to replace the 300 utilities in place at the time. A more powerful regulatory body would have had to have been established as well.[R#14]

While the plan may have made sense from an economic standpoint, the existing utilities wanted nothing to do with it and the movement was subsequently dropped and didn't rear its head until the 1980s. Then a university study at the business school in Bergen reported that Norwegians were paying too much for electricity. The economic study concluded that there were two opportunities to get the electricity supply industry in line, either by regulating it more closely or by allowing the free market forces of deregulation and competition to drive down prices. Essentially, Norway chose the latter.[R#14] ☞

In 1991, as a result of the study the Norwegian Parliament passed the 1991 Energy Law which substantially deregulated electricity production and distribution. (Only the socialist left wing of the government voted against it.) Most importantly, the government reformed its rules regarding service territory franchises and opened up the Norwegian power market to what is called "retail wheeling" in North America. Retail wheeling allows customers in Norway, regardless of their size, the opportunity to shop around for competitively-priced power. By law, utilities must open their transmission and distribution lines to "wheel" their competitors' power. Customers are no longer obligated to buy from the utility that has historically served their region or city.

While retail wheeling is attractive in some regards, for instance cutting utility costs and providing for lower cost power in the short term, it can also cause utilities to effectively cut all energy efficiency initiatives because of concerns that efficiency services will drive up their power rates and thus dull their competitive advantages. Norway was able to partially defuse this threat by requiring some levels of investments in energy efficiency as the Energy Law says that every owner of a grid must have minimum energy conservation activities. A new white paper suggests that this activity must be outside of the energy company, but this has yet to be part of the law.[R#12,14]

The resulting restructuring of the Norwegian power industry has not been without consequence, in fact there have already been clear winners and losers. Large industrial users which have been able to buy cheaper power have been winners, as have the utilities that are able to serve these loads and the distribution companies, or brokers, which of course have benefitted from new business. The losers in the short term are the utilities, such as Oslo Energi discussed in the next section, that have excess capacity and end up with stranded economic investments. They have built capacity in anticipation of a dedicated load and now part of that load has eroded, causing grave economic circumstances. Consequentially, losers in the long term are residential ratepayers who will likely not shop around and who are thus left paying for their utility's investments, now amortized over fewer kilowatt-hour sales. Note that shortly after the law was passed there was a movement afoot to repeal this aspect of the law, but the Parliament rejected the appeal.[R#14]

Two years after the landmark legislation there are now 170 producers of energy in the country that collectively operate 537 hydroelectric plants that are capable of producing 117 TWh. The power is then sold on the transmission network which consists of approximately 200 distributors. These distributors together with the larger users and traders set prices on the market. After prices have been set, tariffs are charged for transmission over the central, regional, and local distribution networks in the same fashion that distribution prices are set. The law has given rise to more than 3,000 energy companies ranging in size from Oslo Energi, the largest producer and distributor of power in Norway, to small service providers and brokers.[R#2,14]

Norway's experiment with retail wheeling (and a similar initiative in the United Kingdom) will be watched carefully by North American utilities and regulators keen on learning about whether the long term benefits of increased competition outweigh the short and medium term structural mayhem it creates. Can existing utilities survive with large asset bases which need to be amortized over fewer sales? What will be the effect on these utilities given their excess capacity? Will they be able to sell excess capacity to other parts of Europe at an even more attractive prices, thus sidestepping the entire issue and opening up a far more attractive market? If this latter scenario is the case, who will have the obligation to serve the least attractive customer classes in Norway?

One of the interesting concepts being tested in Norway relates to "exit fees." When a customer elects to leave Oslo Energi and purchase power from another distributor, the customer must pay a fee. Theoretically, if the fee is high enough it will dissuade customers from jumping ship! In Norway the fee for a residential customer to switch electric service is about 5,000 NOK ($746). As a result of this charge, virtually no customers have left the Oslo Energi grid. The fee for larger customers, however, is not serving to discourage users from seeking cheaper service as its level of cost is quite insignificant compared to the annual cost savings that these customers are accruing. While Norway has little experience with exit fees, or fees that cover certain transaction costs, all eyes will be on Norway in the coming years to assess this quite fascinating retail wheeling experiment.[R#12,14,17] ■

City Overview

Oslo is the capital of Norway and the country's largest city. Its population of 447,000 people represents more than one-tenth of Norway's entire population. Oslo is located in southeastern Norway at the head of the Oslo Fjord up from the coast of the Skagerrak passage between Norway, Sweden, and Denmark. The City is at the same latitude, 60 degrees north, as Greenland and Alaska, however it enjoys a significantly milder heating season due to the benefits of the Gulf stream. Its natural harbor has made the City a major maritime center.

According to Norse saga Oslo was founded around 1050 and prospered as a trade and ecclesiastical center during the Middle Ages. Its fortunes declined as the Hanseatic League dominated Northern European trade from the late Middle Ages until the 16th century, but were revived with the growth of a timber market in the 17th century.[R#10]

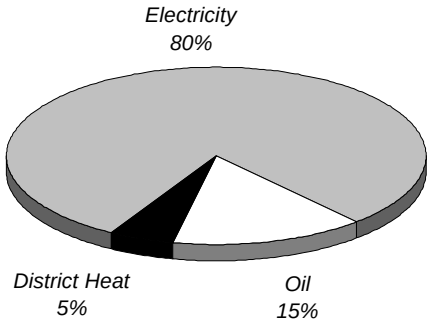
Oslo changed dramatically with industrialization in this century as factories rose on the Aker River running through the City. The population went from 227,000 in 1900 to 430,000 in 1950. This population expanded into the forests surrounding the City, resulting in the development of more than twenty suburban satellite towns and a decline in the inner City's vitality. However, Oslo has made substantial progress at revitalizing its colorful urban center recently.[R#10]

Oslo is run by a city council and governed by a mayor. The City is divided into 25 urban districts each of which has its own local governing body responsible for public health and social welfare services, some child welfare, and youth and cultural activities. Other municipal services including energy and environmental matters are the responsibility of the City administration. In addition, the City is the sole owner of the municipal utility, Oslo Energi.[R#10]

ENERGY USE IN OSLO

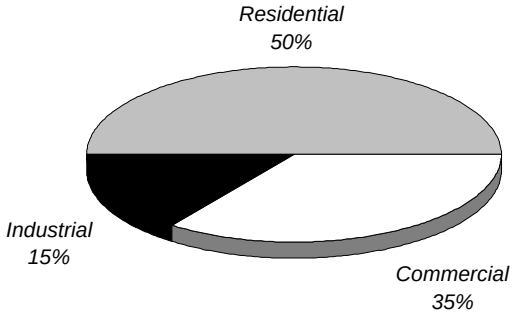
Total building energy use in Oslo is comprised of 50% residential consumption, 35% commercial, and 15% industrial. In 1992, 80% of all building energy use in Oslo was electricity. As mentioned earlier this high level of electricity use is based on the predominance of electric heating and a cultural phenomenon that relates to Norwegians' desire for a "cozy" environment, typified by warm temperatures and abundant lighting. The remaining building energy use in 1992 was 15% oil and 5% district heating.[R#5]

1992 OSLO ENERGY CONSUMPTION BY END-USE FUEL



From 1950 to 1978 electricity consumption in Oslo rose steadily at roughly 2% per year. This increased need for power was met through the financing and construction of hydroelectric plants in Norway's mountains, or what is called "the Aurland." However, in 1978 the City Council realized that when the five Aurland hydro plants

1992 OSLO ENERGY COSUMPTION BY BUILDING SECTOR



under construction were complete, that Oslo had virtually exhausted the cost-effective generation opportunities available and decided to pursue three alternative strategies through the local utility. Note that while Norway as a whole had ample energy supplies, Oslo was forced to address regional power shortages until its hydroelectric resources were complete in the Aurland, resulting in excess capacity.[R#3]

The City decided to meet its short-term power needs through the purchase of power from other sources including other utilities. At the same time the City recommended a heavy investment in the existing district heating system to cover the growing demand of new buildings as well as to convert existing electric heating. Finally the City decided to implement an aggressive energy conservation program with a goal of meeting all future power demand.[R#3]

THE OSLO EKON FUND

To fulfill the City's basic plan for meeting future energy demand, and specifically to address the priority placed on conservation by the City, an unusual fund was established called The Oslo Ekon Fund. The intent of the Fund was to provide all electricity users in the City with the capital necessary to perform energy efficiency retrofits. Money would be collected for the Fund by placing a small surcharge on every kilowatt-hour of electricity sold in Oslo.

Before moving any further with a description of the Ekon Fund, the primary focus of this profile, it's important to point out that the Fund is a function of City government that was purposefully housed within Oslo Energi and managed by the Energy Conservation Department at Oslo Energi. This arrangement made sense for two basic reasons. First, Oslo Energi collected the revenues that built the Fund through its regular customer billing. Second, Oslo Energi's Energy Conservation Department had the technical capability to administer the Fund's resources effectively. As will be discussed later in the text in more detail, the Fund has been moved out of Oslo Energi for a series of quite complex political reasons and is now directly under the control of the City Council.[R#16]

At the direction of the City Council in 1982 the utility was able to raise the price for electricity by 1 ore/kWh, the equivalent of 0.16 ¢/kWh for all customers. This increased the price of an average kilowatt-hour by 2.9%. (For a similar, but smaller, surcharge mechanism see Profile #80 on Copenhagen, Denmark.) This income of between $8.48 and $12.59 million per year (60 million NOK annually after being levelized) and was set aside in a separate energy conservation fund, The Ekon Fund. The Ekon Fund was explicitly kept separate from Oslo Energi's operating revenues as well as the City's budget to ensure that it was applied only to conservation projects.[R#3]

TRANSPORTATION NOTES

Entering Norway, it's hard not to notice that the Volvos and Saabs that abound are bigger and heavier than their western European automotive counterparts. Despite attractive reserves of petroleum in Norway the use of automobiles has been discouraged in Oslo. The City has enacted a series of disincentives to the car, one of which is a stiff entry fee into the City for automobiles. As in major American metropolitan areas, tolls coming into Oslo are steep, but are nonexistent on the way out. Many cars carry magnetic tags that record their passage through tolls without stopping. Monthly billing is then done automatically through the mail. Of course alternatives to the car are encouraged and are without commensurate charges. Oslo has a light rail system which goes underground in the downtown core and this system is complimented by numerous bus routes and trolleys. A second major disincentive to the use of private automobiles in Oslo are gasoline prices. In Oslo we witnessed prices for unleaded gas at $4.31/gallon (7.68 NOK/liter). Third, large parking fees are strictly enforced and are common. ■

Utility Overview

Oslo Energi is a municipally-owned utility that has been continuously in service since 1892 when the first electrical street lamps lit Karl Johans Gate (the main street in Oslo) on December 13, 1892. Now Oslo Energi provides electric, district heating, and telecommunications services to a total of 300,000 customers. The utility was called Oslo Lysverker from 1930 until 1991 when its name changed for the fourth time.[R#1]

Oslo Energi is the biggest utility in Norway and in 1992 had a gross income of $516.81 million (3,212 million NOK), a slight decrease from 1991 revenues of $533.46 million (3,424 million NOK). Of this income, 48.7% came from electricity sales, 38.6% from transmission, 3.9% from district heating sales, and 8.8% from other income.[R#2]

To supply power Oslo Energi owns 27 hydroelectric generating facilities which in 1992 generated 7,431 GWh. The utility's most recent plants are five hydroelectric facilities built in the Aurland between 1973 and 1984 with a high degree of controversy as many Norwegians were upset about inundating pristine valleys for development. Job creation won over conservation in the Aurland dispute and the plants were built, but Oslo Energi now has no plans for further power development given its excess capacity situation and Norway's competitive marketplace for electricity.[R#2]

Oslo Energi's self generation supplied 70.2% of its energy requirements in 1992. The utility also purchased 2,593 GWh (25.2%) from other utilities. Oslo Energi's district heating system provided 469 GWh equivalent (4.6%) of the utility's power consumed in 1992. In addition to heat supplied through the district heating system, 10% of total electricity sold by Oslo Energi, or 863 GWh, powers central electric heaters.[R#1,2,12]

OSLO ENERGI 1992 STATISTICS		
Total Revenue	$516.81	Million
Number of Electric Customers	300,000	
Number of Employees	1,448	
Electricity Sales	7,723	GWh
Generating Capacity	7,431	GWh
Purchased Power	3,062	GWh
Average Electric Rates	5.5	¢/kWh

OSLO'S DISTRICT HEATING SYSTEM

Oslo Energi also controls the district heating system in Oslo which is the most comprehensive district heating system in Norway and which is made up of slightly over 116 kilometers (72 miles) of pipes with 494 "subscription centres." District heating is not a new concept in the City with the first small network completed in 1937 to supply the area around City Hall with warm water using the waste heat of a nearby steam plant.

Currently the heat is generated by both waste heat from incinerators and in a novel twist by extracting the heat from sewage using a heat pump at the newest plant at Skoyen Vest. We asked to visit the latter facility, but our request was summarily turned down by our otherwise most gracious hosts! In Oslo in the summer, district heating is provided solely by burning garbage (see Profile #80 for another example of municipal incineration providing summer district heating energy).[R#1]

In Oslo there are four central heating stations that combined to produce 469 GWh equivalent of district heating energy in 1992. In the same year Oslo Energi completed the final phase of the expansion of the district heating system by opening a pipeline that feeds Sentrym, the center of Oslo. This quite major expansion of the system linked two regions of Oslo to take advantage of the excess generation capacity at the Haraldrud waste incinerator. However, future expansion is likely to be limited to a much smaller scale to new customers in existing service territories due to the low prices of both electricity and oil.[R#1,2,3]

COMPETITIVE FORCES AT OSLO ENERGI

The Energy Law of 1991 discussed in the Country Overview section was passed based on economic arguments, without much regard for practical aspects of power generation and distribution. Clearly there have been major structural shifts, some very damaging, which have occurred in the past few years in Norway. We heard several comments in Norway that, "the government had made the law, now utilities and their ratepayers are starting to pay for it." In fact, Oslo Energi had to cut its overall costs by about 15% to stay in business.[R#14]

While Oslo Energi, like most electric utilities, used to "be in the business for the long run," now short term plan-

ning is the order of the day. Long term strategic planning exercises have been suspended and six month budgets are common. To maintain market shares and stay afloat the utility has been restructured into two core areas and three major divisions. The two core areas are Elkraft, or the electrical power group that produces power, and the marketing group that buys internally and externally and sells and distributes electricity. The divisions are Engineering, Telecommunications, and Buildings, Property and Services.[R#2]

Furthermore, the company was split up into 30 profit centers. Each of these centers is directly responsible for enhancing the company's bottom line and must contribute at least a 12% interest rate to the company's assets it controls. Theoretically, if a profit center can't make the return, it will be discontinued. Furthermore, if a task such as photocopying can be done cheaper down the street at an entrepreneurial reproduction center, the utility must take advantage of the cost savings rather than continuing to support its own infrastructure and staff assignments. As such the door is also open to consultants who can deliver projects under contract at less cost than the cost of internal staff work.[R#12,14]

Oslo Energi maintains ownership of its transmission and distribution lines but by law it must lease the use of its lines to transmit power to customers of other companies. In practice this has meant Oslo Energi had to wheel 350 GWh primarily for large commercial and industrial customers, or approximately 4.5% of its total electricity sales in 1992 and staff at the utility expect this level to rise to 10% in the next few years.[R#14]

Oslo Energi, however, does and will continue to collect on the use of its transmission system. They are entitled to collect 2.4 - 2.7 ¢/kWh (15 -17 ore/kWh) for wheeling other utilities' power over their grid. Oslo Energi received income for wheeling of $176.85 million (1,099 million NOK).[R#2]

In addition to the utility's loss of sales, deregulation has strongly pressed prices for electricity downward through competition. Oslo Energi decreased residential prices by 10% in July of 1991 and then cut both residential and commercial rates by 3% in the beginning of 1992. Further price cuts were made mid-way through 1992, and in order to retain load the utility has negotiated with many larger customers for special discount prices, for instance for large space heating loads.[R#2]

With lost sales and decreased prices, an immediate ramification of the law has been a major "rightsizing" of Oslo Energi. (Rightsizing is a term that most precisely relates to matching staffing levels with specific tasks, but in the North American utility industry essentially refers to cutting "excess" staff.) At Oslo Energi, since the Energy Law was passed, the staff has been cut from about 2,000 employees to 1,448 in 1992, many through an early retirement package that provided staff with two years of salary as an enticement to resign. Laying off this many workers has also had an impact on Norway's macroeconomy, as its unemployment levels stand at 6-7%, the highest in Norway's history.[R#2,12,14]

With massive staff cuts at Oslo Energi as a whole, the Energy Conservation Department has not been left unscathed. In fact, the Energy Conservation Department staff has been cut and very able talent has been released. In its heyday the Energy Conservation Department staff was made up of 20 professionals, now only 13 remain. (Staffing of this department was tied in with the administration of the City's Ekon Fund which had traditionally been managed by Oslo Energi's Energy Conservation Department staff.)[R#12]

Per Arne Skjaeveland, formerly the head of Oslo Energi's Energy Conservation Department, notes with lament that losing talent and capability is bad enough, but to lose the confidence of your customers is worse. He stressed that ramping energy efficiency activities up and down disillusions customers who had come to believe that the utility would always be there to provide important advice on how to save energy and money. Now their trust has been eroded as the utility's emphasis has shifted from providing energy services to profitability.[R#12] ■

THE OSLO EKON FUND

The Ekon Fund provides the foundation for Oslo's energy efficiency initiatives and thus is the primary focus of this section and the following sections of this profile on monitoring and evaluation, program savings, and program costs.

The Oslo Ekon Fund was begun in 1982 and was implemented under the direction of Oslo Energi and its Energy Conservation Department, headed by Per Arne Skjaeveland, until the end of 1993. The Ekon Fund is a revolving fund to finance energy efficiency improvements for all customers in Oslo in each the residential, commercial, and industrial sectors. The Fund provides grants and loans to participants for energy efficiency and conservation projects in buildings. Currently, participants take advantage of grants which equal 15% of the total amount, and loans for the remaining 85%. To date, the Fund has reached approximately 20,000 homes and many commercial and industrial establishments. When the Fund was established in 1982, the City targeted energy savings of 1,500 GWh/year by the year 2000, equivalent to slightly more than 19% of 1992 sales.[R#1]

DELIVERY: THE STEP BY STEP PROCESS

Note that this section reflects the operation of the Fund as managed by Oslo Energi. As of December 1993 the Fund has been removed from the utility and will be administered similarly but without access to the staff and resources of Oslo Energi.

THE AUDIT

The Ekon Fund is a full-service program to customers who request Oslo Energi's help in participation. First,

CASE STUDY: VOCATIONAL SCHOOL RETROFIT

At a 16-year old vocational school owned by the City, impressive electricity savings have been made and annual electricity consumption has been reduced by 75%. In fact while the trade school used to require 16 million kWh annually, it now uses only 4 million kWh/year and its occupants claim that its buildings are more comfortable with more even temperatures and fewer drafts. Trades at the school include construction, nutritionists, hair dressers, bakers, and computer technicians.

Most of the retrofit measures at the school related to heating and ventilating. Since the school required a high level of air changes for its classrooms and auto mechanic, woodworking, welding, masonry, and coppersmith shops, heat recovery ventilation was installed, and an energy management system was also put in place to facilitate managing the school's maze of a half dozen buildings. This has allowed the facility manager to carefully track his buildings' operations from a central facility and make adjustments easily using the computer-driven system. Other measures were also installed including a retrofit in the gymnasium where occupancy sensors which control the ventilation are activated by sensing any motion.

The Ekon Fund supported several phases of retrofit activity at the vocational school to the tune of approximately $3.22 million (20 million NOK). Note that approximately 15% of this sum was granted to the school, while the remaining 85% was provided as a loan. This amount will be repaid to the Fund using a five-year payback schedule. One of the complications in determining savings (with this and other projects) is that there has been a tradeoff between maximum energy savings and improved indoor air quality. By using the Fund the school was able to fulfill a primary objective of improving its indoor air quality while also recognizing significant energy savings.

Oslo Energi advisors perform a no-cost audit of the building. This audit includes both the envelope and mechanical equipment. Audit costs are covered by the Fund.[R#3]

The results of the audit are presented in a report detailing the status of the building and presenting potential efficiency improvements. The recommended improvements are set at a level above the market norm in an attempt to spur more efficiency and mitigate free ridership. On a measure-by-measure basis the report includes the required investment, the expected savings, other consequences such as environmental costs and benefits, the amount of grant funding available, and the amount of loan financing available. The Ekon Fund provides both grant and loan funding to cover the participant's initial costs with financing structured such that energy savings are greater than loan payments creating a positive cash flow for participants.[R#3]

PROJECT APPROVAL

The building owner can then use the audit report as an application to The Ekon Fund for grant and loan funding. Energy conservation staff at the utility review the application and determine whether to pursue the project. Few customers who have engaged in the process to this point have turned down the use of the Fund, but in limited cases this has happened because the administrators of the Fund required systematic energy savings and would not loan money for cream-skimming measures that could be paid for by customers without financial assistance. The Fund will support only projects with a payback period of greater than two years. [R#3,11,12]

IMPLEMENTATION

With approval of the application from Oslo Energi the building owner may implement the recommended measures with the knowledge that the project will receive funding. A customer is free to select any contractor from an approved list (including the utility) to implement the energy efficiency measures. The utility maintains a roster of 20 approved contractors and has also been developing its own capability to compete directly with the approved contractors. Upon completion and inspection payment for the cost of the project will begin from the Fund to the owner.[R#3]

The average time frame for commercial and industrial projects is two years from concept to funding. The utility believes this lead time is to the Fund's benefit as it allows projects to be approved in advance of available funding.[R#3]

MEASURES INSTALLED

All types of energy saving measures are eligible for funding from The Ekon Fund including electric, oil, gas, and wood measures. Each measure is evaluated on the basis of kWh-equivalent savings. Typical measures installed include building envelope improvements such as wall and roof insulation and window replacements.

STAFFING REQUIREMENTS

The Fund was staffed by the Conservation Department at Oslo Energi within the utility's Marketing area until the end of 1993. The program has been and still is managed by Per Arne Skjaeveland. The Oslo Energi Energy Conservation group has 13 staff (down from a high of 20 before deregulation), all of whom had worked on The Ekon Fund. The Ekon Fund is now staffed by largely the same individuals but is located outside of the utility. Authority for the Fund's operations rests with the City Council.

Additionally, there are 20 contractors approved to provide services under the Fund. At one time as many as 70 firms were participating, however Oslo Energi trimmed the list to those companies that were providing the best services. ☞

CASE STUDY: HIGH RISE BUILDING RETROFIT

One of the Fund retrofit sites that we visited in Oslo was a high-rise apartment building that we were told is an assisted living facility. The rather plain and drab-looking building has 48 apartments and has been through quite an extraordinary retrofit.

As an assisted living facility, building managers at this high-rise are very sensitive to the comfort of the building's occupants. Prior to the retrofit the building was chilly and discomfort was experienced particularly by corner apartment tenants who of course have two exterior walls. As such the most impressive retrofit detail was that the entire exterior of the building was completely insulated at a cost of $1.49/square foot (100 NOK per square meter) of exterior cladding. This measure was paid by another agency other than The Ekon Fund.

In addition to this exterior insulation, $144,186 (896,000 NOK) was spent on a host of measures including the installation of a new electric boilers that enable the building to benefit from purchases of "opportunity power"; insulated pipe valves for the central hot water heating system; a new HVAC control system with night setback; the heating system was balanced; thermostatically-controlled radiators were installed; new maintenance instructions were prepared for the facility; windows were repaired; hot water tanks were replaced; new low-flow showerheads were installed in the apartments; as were new compact fluorescent lamps. Fully 240, 40-watt incandescent hall lamps, which by law must be on all the time, were replaced with 9-watt compact fluorescent equivalents. This measure alone has resulted in 65.2 MWh/year in energy savings.

As mentioned above, The Ekon Fund provided the capital to install a new 450 kW electric boiler which enables the building to purchase very inexpensive off-peak and interruptible "occasional power" most of the time, and to use its more costly oil burner sparingly, in fact only for those limited periods when low cost electricity is not available. Occasional power costs half the price of firm power and was possible to use since the apartment complex had an oil backup system. There are two occasional power arrangements offered by Oslo Energi. Under the first, power can be interrupted within a day's notice, and the utility simply calls customers to alert them. Under the second contract, power can be interrupted within two hours' notice.[R#12]

MONITORING

An Ekon Fund advisor performs a site visit after implementation to ensure compliance with the initial audit and to inspect the installation of efficiency measures. This inspection is prior to the release of funding by the Fund to the contractor, so that any work not satisfactorily performed will be fixed at no cost to the customer.

Additionally, approximately 10% of the projects are examined after two years to continue evaluation of the energy savings attributable to the Fund. Oslo Energi has termed this monitoring the "post implementation performance analysis" (PIPA) and views it as an essential component of the program. PIPA includes a customer survey component and metering of installations.[R#3]

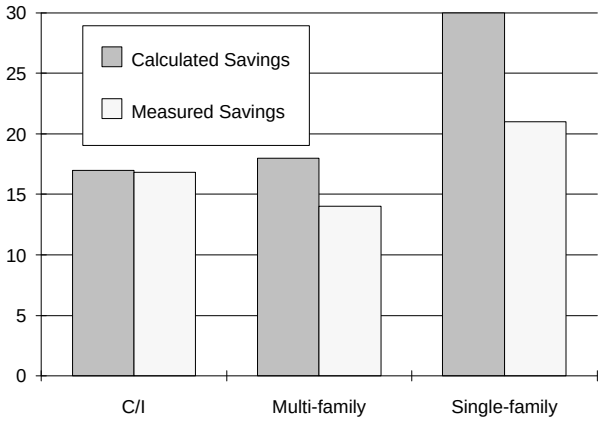
EVALUATION

Results from PIPA to date can be summarized as follows: The savings for most commercial and industrial retrofits have been very close to what they were projected to be, savings of approximately 17% of pre-implementation energy use.

For multi-family housing, measured savings of 14% were somewhat less than the estimated savings (based on engineering estimates) of 18% of pre-implementation usage. The difference between the estimated and measured savings in these buildings is attributed to increased occupancy comfort. Many of the multi-family structures that were improved under the program were built between 1890 and 1910. These buildings were extremely inefficient and often their occupants were required to use individual kerosene heaters in each room merely to keep warm. With the increased efficiency, primarily through insulation, the occupants were able to heat the rooms with electricity and without kerosene heaters, thereby taking back some of the efficiency gains.[R#3]

Measured savings from single-family retrofit projects were only 21% of the original energy consumption compared to original engineering estimates that suggested the measures would result in savings of 30% of pre-implementation usage. Oslo Energi staff attributed much of the difference in single-family housing to erroneous occupancy and comfort assumptions discussed in the Roa subdivision retrofit case study. The Ekon Fund assumes an indoor temperature of 20°C (68° Fahrenheit) in all heated areas. However, Norwegians typically keep the temperature lower in bedrooms and other spaces not used during the day. This lower temperature reduces the heat loss and thus reduces the potential savings.[R#3]

PIPA SAVINGS CALCULATIONS (%)



The PIPA also included a survey of the participants. A majority of participants agreed that the installed measures had resulted in better air quality, improved occupancy comfort, and reduced external noise pollution in addition to the energy efficiency improvements and commensurate bill savings.[R#3] ■

Program Savings

DATA ALERT: The annual savings presented in this section represent savings from projects financed using The Ekon Fund only and are rather crude approximations presented by staff at Oslo Energi. Please note that the values are intended to be representative only. Annual participation data is unavailable but total participation has again been roughly estimated by Oslo Energi for indicative purposes only.

Since the Fund's inception in 1982 annual energy savings have ranged from a low of 3 GWh in the first year when projects were just getting underway, to 25 GWh in the second year, to a high of 65 GWh in 1987. The Fund's "banner years" occurred in 1987-1989 with annual energy savings of 65 GWh, 59 GWh, and 62 GWh respectively. In 1992, the most recent year for which data exists, the Fund's investments resulted in annual energy savings of 34 GWh. For all the years combined, total annual energy savings have been 471 GWh, total cumulative energy savings have been 2,528 GWh, and lifecycle energy savings (based on a 20-year measure lifetime) have been 9,420 GWh.[R#2,12]

PARTICIPATION RATES

The Ekon Fund has been financed by all customers of the utility and as such all customers are eligible to participate on a first come, first serve basis. The utility therefore defines participation on a per customer basis but unfortunately has not tracked this parameter. Oslo Energi staff estimate that since its inception The Ekon Fund has reached approximately 20,000 participants. The bulk of participants have been residential customers, however, the bulk of the savings have resulted from energy efficiency improvements in the commercial and industrial sectors.[R#1,3,12]

MEASURE LIFETIME

Staff at Oslo Energi are unable to assign an average measure lifetime to measures installed as a result of Ekon Fund grants and loans, however, since most if the residential retrofit measures are building shell improvements (80%), and ventilation improvements and heat pumps predominate energy savings in the commercial sector, – both classes of measures represent quite durable savings – The Results Center has assigned a 20-year average lifetime for all Ekon Fund measures.

SAVINGS ADJUSTMENTS

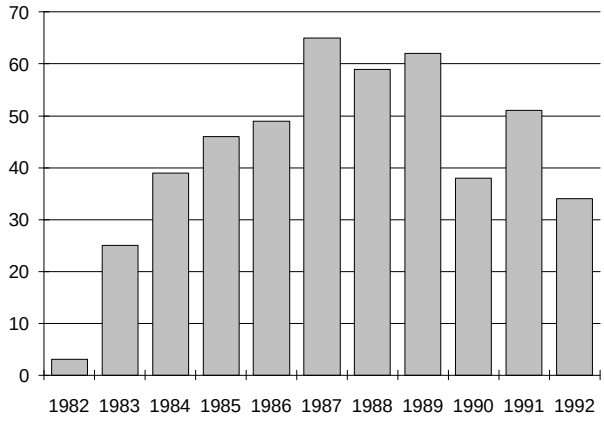
Both the City Council and Oslo Energi have recognized the potential for free ridership under a program that provides grants and loans for all energy conservation measures. In fact the free ridership issue was of major significance in determining the fate of the Fund as discussed in the section on lessons learned. To mitigate free ridership relatively high standards were set as minimums requirements for packages of measures that would be financed by the Fund. For example, the standard practice for window retrofits in Norway is double-paned, gas-filled windows. In contrast Fund administrators set a minimum of triple-glazing with a substantially lower U-value to receive funding from The Ekon Fund. In addition, the Fund would not finance measures that had less than a two-year payback. The utility also believes that the use of relatively high standards for eligibility in The Ekon Fund has spurred the introduction of newer, more efficient technologies while ensuring energy improvements that would not otherwise have been pursued.[R#3,12]

PROJECTED SAVINGS

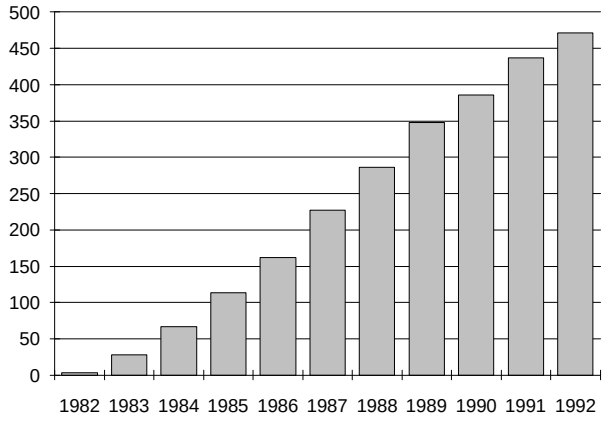
Oslo Energi has established a goal of 1,500 GWh in annual energy savings by the year 2000 from projects supported by The Ekon Fund. Annual energy savings to date of 471 GWh represent slightly less than 33% of the projected total but will result in lifecycle energy savings of 9,420 GWh.[R#1] ■

The Ekon Fund Savings Overview	*Annual Energy Savings (MWh)*	*Cumulative Energy Savings (MWh)*	*Lifecycle Energy Savings (MWh)*
1982	3,000	3,000	60,000
1983	25,000	28,000	500,000
1984	39,000	67,000	780,000
1985	46,000	113,000	920,000
1986	49,000	162,000	980,000
1987	65,000	227,000	1,300,000
1988	59,000	286,000	1,180,000
1989	62,000	348,000	1,240,000
1990	38,000	386,000	760,000
1991	51,000	437,000	1,020,000
1992	34,000	471,000	680,000
Total	471,000	2,528,000	9,420,000

ANNUAL ENERGY SAVINGS (GWH)

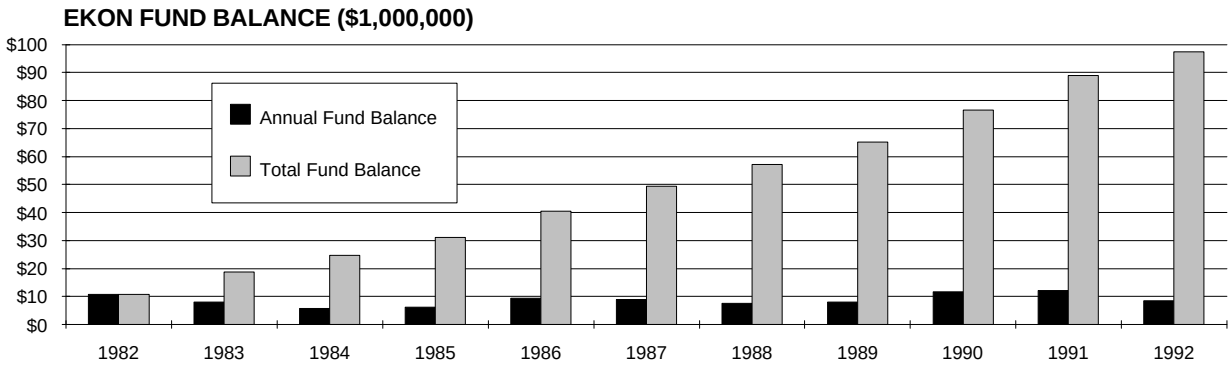


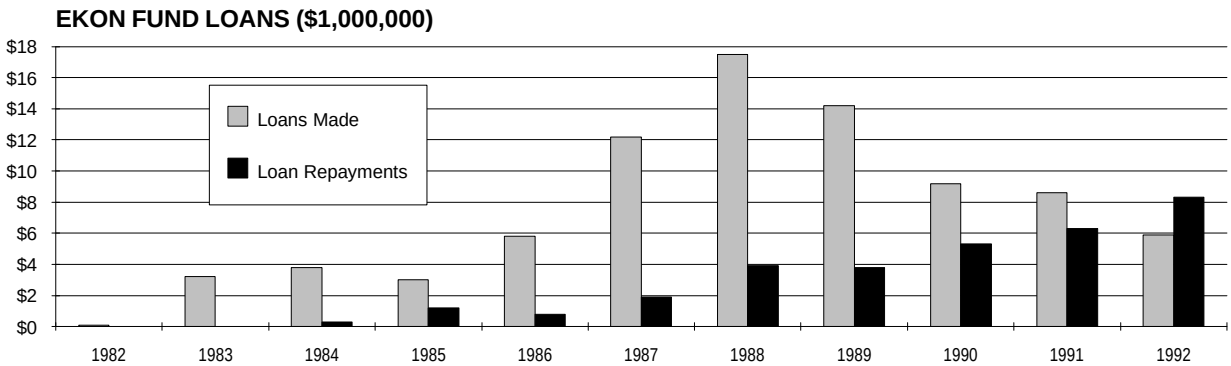
CUMULATIVE ENERGY SAVINGS (GWH)



Cost of the Program

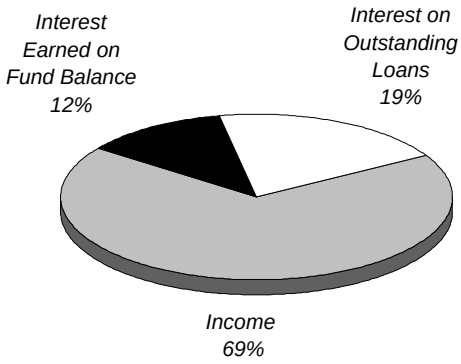
Ekon Fund in Million U.S. $	*Income*	*Interest on Fund Balance*	*Interest on Loans Out*	*Total Income*	*Loans Made*	*Loans Repaid*	*Grants Made*	*Admin Costs*	*Consult Costs*	*Pilot and R&D Grants*	*Total Costs*	*Annual Fund Balance*	*Total Fund Balance*
1982	$12.59	$0.44	$0.00	$13.03	$0.06	$0.00	$0.67	$0.29	$0.59	$0.67	$2.22	$10.80	$10.80
1983	$10.79	$0.81	$0.05	$11.65	$3.24	$0.04	$1.33	$0.45	$1.44	$0.34	$3.56	$8.09	$18.89
1984	$9.24	$0.42	$0.34	$9.99	$3.80	$0.28	$2.05	$0.54	$1.12	$0.52	$4.23	$5.76	$24.65
1985	$8.48	$1.12	$0.68	$10.27	$2.97	$1.16	$2.40	$0.59	$0.58	$0.37	$3.94	$6.33	$30.98
1986	$9.67	$2.21	$1.43	$13.31	$5.85	$0.77	$1.72	$1.00	$0.77	$0.43	$3.93	$9.38	$40.36
1987	$10.24	$2.61	$2.08	$14.93	$12.23	$1.89	$2.90	$1.36	$1.21	$0.44	$5.92	$9.01	$49.37
1988	$10.16	$1.74	$3.34	$15.24	$17.55	$3.90	$3.61	$1.90	$1.66	$0.36	$7.52	$7.72	$57.09
1989	$9.15	$0.67	$3.95	$13.77	$14.25	$3.75	$2.94	$1.45	$1.16	$0.24	$5.80	$7.98	$65.07
1990	$9.59	$1.76	$5.16	$16.52	$9.24	$5.32	$2.21	$1.54	$0.91	$0.19	$4.84	$11.67	$76.74
1991	$8.95	$2.46	$5.85	$17.27	$8.60	$6.25	$2.58	$1.15	$1.13	$0.29	$5.16	$12.11	$88.85
1992	$2.99	$3.89	$6.16	$13.04	$5.86	$8.25	$1.23	$1.69	$1.20	$0.31	$4.42	$8.61	$97.46
Total	$101.84	$18.12	$29.05	$149.01	$83.64	$31.62	$23.64	$11.96	$11.77	$4.18	$51.55	$97.46	





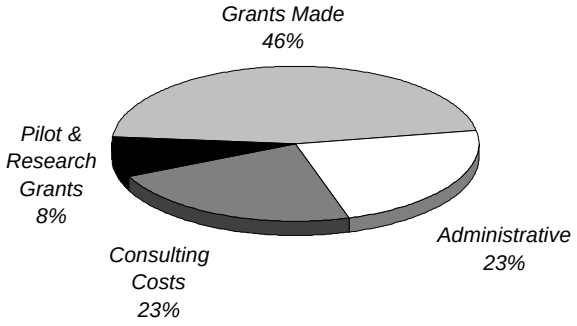
As discussed previously The Ekon Fund has been financed by a 1 ore/kWh (or roughly 0.16 ¢/kWh) surcharge on all customers bills that was initiated in 1982 and provided capital to the fund through 1991. This surcharge was able to raise an average of slightly over $10 million (60 million NOK) each year since that time as shown in the first column of the accompanying table. Note that the values presented in the table have been adjusted for inflation, and per The Results Center convention, all sums are presented in 1990 U.S. dollars.[R#16]

TOTAL EKON FUND INCOME



The interest on the Fund's balance, as shown in the second column of the table, has accrued at a rate of approximately 9% per year. This has provided the Fund with an additional $18 million (122.66 million NOK) over the life of the Fund and has been one of the factors that has allowed Oslo to discontinue the surcharge as of 1992, making 1991 the last year of ratepayer contributions or what Oslo Energi staff call "fresh capital." In addition to these contributions the utility made a voluntary payment of $2.99 million (20 million NOK) in 1992 for total contributions (absent interest) of approximately $101.84 million (620 million NOK).[R#16] ☞

TOTAL EKON FUND EXPENSES



Cost of Saved Energy (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
1982	4.98	5.45	5.95	6.46	7.00	7.55	8.12
1983	0.96	1.05	1.14	1.24	1.34	1.45	1.56
1984	0.73	0.80	0.87	0.95	1.02	1.11	1.19
1985	0.58	0.63	0.69	0.75	0.81	0.87	0.94
1986	0.54	0.59	0.64	0.70	0.76	0.82	0.88
1987	0.61	0.67	0.73	0.79	0.86	0.93	1.00
1988	0.86	0.94	1.02	1.11	1.20	1.30	1.40
1989	0.63	0.69	0.75	0.81	0.88	0.95	1.02
1990	0.86	0.94	1.02	1.11	1.20	1.30	1.40
1991	0.68	0.74	0.81	0.88	0.95	1.03	1.11
1992	0.87	0.96	1.04	1.13	1.23	1.33	1.43

As the table shows the total loans provided for energy efficiency retrofits amount to $84 million (568.69 million NOK) and grants amount to $24 million (165.61 million NOK). As such, even when factoring in the costs of operating the Fund which include administrative fees, the costs of consultants, and funds for pilot and research grants, the Fund is now financially self-sufficient and can effectively rely on interest payments and loan repayments to provide the necessary investment capital for future projects.[R#16]

COST EFFECTIVENESS

While The City of Oslo nor Oslo Energi has had to justify the Fund's expenditures as cost effective using North American definitions for cost effectiveness, The Results Center has calculated the cost of saved energy for the Fund's investments. To do so The Results Center has used the total expenses in the accompanying table (based on the costs of grants, administration, consulting costs, and pilot and research projects,... and not loans disbursed) and multiplied this times a capital recovery factor at a range of discount rates, and then divided by annual energy savings presented in the Program Savings section. Based on a 5% real discount rate, the cost of saved energy to The Ekon Fund has ranged from 0.64 ¢/kWh in 1986 to 5.95 ¢/kWh in 1982. This high value was in the program's first year and is the only cost above 1.14 ¢/kWh. In fully six of the eleven years to date, the cost of saved energy has been below 1 ¢/kWh. Note that this reflects only the ultimate cost to the City, in other words when all loan repayments have been made, and is based on a series of assumptions and extrapolations for indicative purposes only.

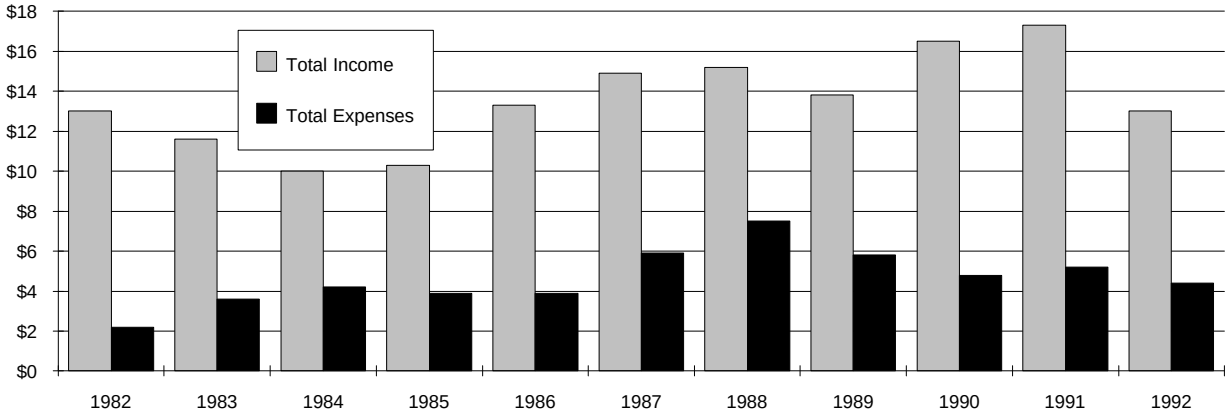
COST COMPONENTS

Cost components are divided into three areas: income, expenses, and loans. Total income to the Ekon Fund is $149.01 million (1,025.02 million NOK) with total expenses of $51.55 million (357.85 million NOK). The Ekon Fund has loaned $83.64 million (568.69 million NOK) over its eleven-year life, of which $31.62 million (38%) has been repaid. Note that many loans are on 20-year amortization schedules.[R#16]

By far the largest component of the Fund's income was derived from the rate surcharge, or $101.84 million (620 million NOK). This represents 69% of the total income with the remainder derived from interest on the balance (12%) and interest on the outstanding loans (19%).

Slightly less than half of the total expenses over the life of The Fund have been disbursements of grant financing. Total grant payment of $23.64 million (165.61 million NOK) are 46% of total expenses. Other grants for pilot and research projects to which the Fund management did not attribute any energy saving totalled $4.18 million (29.50 million NOK) (8%). Other expenses were relatively evenly divided between administrative costs and consulting costs of 23% each. ■

EKON FUND ANNUAL INCOME & EXPENSES ($1,000,000)



CASE STUDY: THE ROA RESIDENTIAL SUBDIVISION RETROFIT

A flagship project of the Ekon Fund was the retrofit of the Roa residential subdivision in 1985 and 1986. This housing project was built before World War 2 and was characterized by hollow wall cavities and clay that was poured in attic floors as a form of insulation. (Naturally the clay was not very effective!)

The community was identified as an area where customers were experiencing high bills and a general level of discomfort. Thus The Ekon Fund began by thoroughly analyzing the potentials for increased efficiency in one home and found four basic retrofit measures to be done: First, walls were insulated using fiberglass insulation. Second, the clay had to be sucked out of the attics. (This was a messy and expensive operation.) Third the clay was replaced with insulation. Fourth, windows could be replaced but since this was prohibitively expensive as a generically-recommended measure, customers were offered the opportunity to use The Ekon Fund for a portion of the financing of any window replacements.

After analyzing the first home, The Ekon Fund with the direction of Oslo Energi's Energy Conservation Department staff started with one street and sought to retrofit 80 houses. To market the program they gave every owner a letter which explained the potentials to save energy and increase comfort. Furthermore, the letter spelled out the terms saying "all you have to do is say yes" and your home will be retrofitted. Many customers didn't understand the offer and many didn't respond.

Then The Ekon Fund hired a consultant who's job it was to go door-to-door explaining the program and explaining that by using the Fund customers would have positive cash flow as their monthly energy and bill savings would exceed their repayments to the Fund. With that kind of direct marketing, virtually all the street's residents said yes and participated in the retrofit program.

By doing an entire street of homes, and then later an entire subdivision, The Ekon Fund was able to get good contractor prices for the volume of retrofits. In fact several contractors vied for the job, although the clay removal wasn't so enthusiastically received. In terms of cost, excluding the optional window component, the average cost per home was $3,218.44 (20,000 NOK) and this included the wall, ceiling, and crawlspace insulation.[R#12]

Several interesting lessons were learned from the subdivision-wide retrofit. First, the program was quite easily marketed, but this did require a good deal of personal attention. (The letter in the mail approach seemed to offer a deal that might have been too good to be true!) Second, by aggregating households of a similar construction stock, measures were standardized and thus unit costs plummeted. Finally, one of the most interesting lessons learned by the administrators of the Fund was that the ratio of grant to loan sums was less important than they suspected. At the beginning of the subdivision retrofit program, 30% of the retrofit cost was provided as grant and the remaining 70% as a loan. Towards the end of the program the grant level was reduced to 15% and to their surprise the Fund's administrators didn't notice any difference in participation or even customer comments regarding the relative attractiveness of the financing![R#12]

The Roa subdivision also taught the Fund's administrators some interesting lessons regarding evaluation of energy savings from efficiency retrofits. Almost universally, people in the neighborhood were very satisfied with the retrofits and all commented on their increased comfort. But the erosion of savings was dramatic. Since their walls were better insulated, residents began to use more floor area in their homes, perhaps opening up back bedrooms that had been closed off for the winter and the like. Residents also began to turn up their thermostats. Additionally, the pre-retrofit baseline temperatures used to calculate savings were later found to be inaccurate. Since the homes were so poorly insulated homeowners had purposely left their homes rather chilly, but analysts had wrongly assumed that the homes were heated to average Norway indoor temperatures. Since the pre-retrofit temperatures were actually cooler, and the post-retrofit temperatures were warmer, the delta between the two was greater than anticipated and the resulting energy savings were less than anticipated. This was determined in one of Norway's first and most extensive post-installation metering and monitoring exercises.[R#12]

LESSONS LEARNED

Oslo Energi has designed and implemented The Ekon Fund which is among the most innovative energy conservation programs in Europe. The Fund, established in 1982, is a revolving fund providing grants and loans for any energy-conserving measure in the building sector. While its elegant simplicity and success make it an attractive model, the context in which it exists is truly fascinating.

Before getting into the detailed lessons learned by the Oslo Energi staff who managed the day to day administration of The Ekon Fund, the success of The Ekon Fund must be put in perspective. Norway is awash in energy and "clean" electricity. As such, energy conservation is not at the top of most to-do lists and the Fund has been clearly underutilized. Many cost effective retrofit opportunities have not been put in place because of a general lack of awareness and concern about energy efficiency. Because of this, the Fund has grown to dramatic proportions and has been challenged and its destiny until very recently has been unclear as discussed below.

The most important lesson learned in Oslo has to do with the mechanism for the Ekon Fund and is simply that if a utility or municipality can add a small surcharge 1 ore/kWh, the equivalent of 0.16 ¢/kWh, or 1/34th or 2.9% of average electricity rates in Oslo, to each and every kilowatt-hour sold in the service territory or City, significant amounts of money can accrue which can be used for energy efficiency retrofits. The kicker is getting the surcharge in place, a political challenge that if feasible, creates a very viable DSM program but can become mired in concerns about rate impacts. Many policy makers still focus on rates, when customers' utility bills are really the issue. Ekon Fund participants clearly end up with lower bills even though their electricity rates have increased by 2.9%.

A host of lessons have been learned by the managers of the Fund at Oslo Energi. Per Arne Skjaeveland provided the following pragmatic lessons as he recapped his ten-year involvement at the helm of The Ekon Fund:

One of the earliest lessons was the need for simplicity. The magnitude and scope of The Ekon Fund requires rules and regulations that are as simple as possible for both the participants, the consultants, and the staff of the utility.

Oslo Energi has strived to make the management of the Fund as even and neutral as possible. Making funding available to all customers on an equal basis has been important to keep perception of the Fund positive. Locating the management of the Fund outside the city bureaucracy has also enhanced this perception.

The use of energy consultants to audit the buildings was found to be a key component of the program. Customers viewed this service as essential for providing unbiased information on measures and strategies.

The long lead time in implementing projects of up to two years has been beneficial. It allows the Fund to commit financing for large projects, even exceeding the current balance with the knowledge that repayments from past projects will be in place when implementation of new efforts begins.

Finally, in the Fund's first year there was a frenzy of initial activity that its administrators could not keep up with. Per Arne Skjaeveland noted that while customers were told that applications would be handled as soon as possible, grant payments and loans disbursed never picked up the steam they had in the Fund's first year. Thus, a key lesson learned is to be able to handle the initial enthusiasm a fund can create.

The most relevant lesson learned for those in Oslo who truly believe in the Fund and its importance, is that politics can really gum up the works and strip the effectiveness of such a mechanism unless it has a clear and independent mission to succeed. Despite the fact that Oslo Energi's Energy Conservation Department had the able staff to manage the Fund, the social democrats in control of City government wanted the Fund removed from the now competitive utility environment. As it has grown in magnitude, the Fund has become an attractive pool of money, and as such is the envy of many social programs with fiscal constraints. Despite the importance of maintaining the Fund for its initial purpose, it has been pulled and tugged, and this embattlement has created a tension that has certainly taken the "wind out of the sails" of the Fund and its staff.

The most direct effect has been that most of the Energy Conservation Department at Oslo Energi has been dropped and as such an important capability has been lost to effectively continue to manage the Fund's assets. While political change is inevitable, a lesson learned in Oslo is that retaining key staff is important and often overlooked by politicians.

At the time of this writing (December 1993) the Fund has recently moved out of Oslo Energi and relocated in the City government under the direct control of the City Council but this transition has not been smooth or predictable. The Fund was being pulled in several directions. For instance, some City leaders wanted to locate the Fund in the water and sewage utility for political reasons. Other politicians wanted to use the $100 million for other social programs with fiscal constraints. Others wanted to devote more of the capital to grants, especially for City-owned buildings and low income housing.

Per Arne Skjaeveland argued that the Fund must not be disbanded nor deemphasized and that its continuity would become very much part of its long term success. He urged decision-makers to recognize that in the long term, Norway may well have the opportunity to export its clean hydroelectricity at a profit, and as such an energy efficiency infrastructure must be supported and maintained. He also suggested that part of the Fund's capital could be devoted to indoor air quality research. By taking indoor air quality very seriously, an issue closely related to energy conservation, the Fund could present energy conservation in a new light, symbolizing a social commitment to energy services in the truest form.

Another concept proposed was to use the Fund to create regional energy efficiency centers that could provide one-stop shopping for energy efficiency, from information to hardware sales to financing. Potentially the Fund could have been administered by a new institution with the dual responsibility of establishing and running regional energy centers and managing the Fund.

While the Fund has been maintained in its initial form, with Per Arne Skjaeveland as its director, there will be some changes. The City wants to focus the use of the Fund's capital to retrofit City buildings and has proposed to invest $13.68 million (85 million NOK) per year to do so. The City also wants to dramatically change the grant to loan ratio, increasing the grant amount by a factor of seven! Some experts have been concerned, however, that by doing so the Fund will become depleted in 3-4 years. Record low interest rates are also putting downward pressure on the Fund's ability to make large-scale loans.

TRANSFERABILITY

The Oslo Ekon Fund mechanism seems directly transferable to jurisdictions where a surcharge for energy efficiency is politically feasible. Once a fund is established the capital becomes available for a wide variety of uses at the discretion of the administrators of the fund. As discussed above, a surcharge need not be the only means of capitalizing a fund, but in Oslo it has proven to be an expeditious means of raising capital, and by doing so has been able to reap the significant levels of interest on the capital. Naturally, administrators of the Fund must assure than enough capital is left in the Fund's balance to carry on.

In the coming years The Results Center will be exploring other types of revolving fund programs, such as The City of Phoenix, Arizona's fund for municipal facilities and the State of Texas' Loan Star Fund. Our knowledge of these programs to date shows that revolving fund mechanisms have at least two basic sources for initial funds. They can either be capitalized with a surcharge on kilowatt-hours sold, or from another source such as oil overcharge funds. In either case these resources provide the seed money necessary to build a fund while allowing for generous amounts of loans.

An interesting option that funds have is what to require loan recipients to pay back. The Ekon Fund requires repayment of 100% of the loan amount, plus interest. Other funds, such as The City of Phoenix, Arizona revolving fund for municipal buildings, require repayment of 100% of the loan amount, plus interest, plus a portion of the dollar savings that accrue as a result of the retrofit after the measures have been paid off. This latter form of fund repayment allows a smaller initial sum to grow, while the Oslo Ekon Fund shows us that if it is possible to continue to collect the surcharge amount, this additional repayment is not necessary.

Finally, it is important to look at the key drivers for energy efficiency to assess the transferability of a particular energy efficiency program. While regional distribution issues encouraged Oslo to create the Fund, perhaps more than any other driving factor for efficiency in Norway was the now world-famous report prepared for the United Nations by then-prime minister of Norway, Gro Harlem Brundtland. The report gave people around the world and of course in Norway a global view of energy use and environmental ills. It instilled an ethic of global responsibility in Norway, that despite Norway's unusual and privileged energy position, the country must regard energy as a regional if not global issue. ■

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