

More than ever before, environmental issues are the focus of attention. The energy sector is at the centre of the discussions. What measures should we take in order to ensure that the future energy supply takes place in an environmentally safe and friendly way?

In this booklet, eight people give their views on the environmental issues with a connection to the energy industry.

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Energy and the environment – An odd couple?

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– An odd couple?

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Environmental issues are constantly in the news. The discussion about climate changes has led to a newly awakened interest in what mankind's activities may mean to our own future on this planet. Energy issues are at the centre of the discussions. Our dependence upon fossil fuels creates major problems today and constitutes a serious threat to the future. The transport sector is a matter unto itself, but in many ways the Swedish energy industry has assumed a global pole position in the environmental field.

With this booklet, Lunds Energikoncernen wants to allow different participants to provide their views on environmental issues with a connection to the energy industry.



MARTIN HEDBERG

Martin Hedberg is a meteorologist and has been running the Swedish Weather and Climate Centre for several years together with, among others, John Pohlman, a very experienced meteorologist. He regularly speaks about climate changes and their effects and can sometimes be seen on Swedish television.



THOMAS B. JOHANSSON

Thomas B. Johansson is a professor of energy systems and Director of the International Institute for Industrial Environmental Economics at Lund University. He is also active as an advisor to the UN in energy and climate change matters.



ELISABET FALEMO

Elisabet Falemo is State Secretary to the Minister for the Environment, Andreas Carlgren (the Centre Party), and is responsible, among others, for matters concerning sustainable development. She is educated as a civil engineer and has previously had commissions within the trade association Swedenergy (Svensk Energi).



CURT ÅSTRÖM

Curt Åström is MD of Umeå Energi AB. The company was among one of the first companies in Sweden to use refuse incineration in the production of district heating.



ANN-MARI STÅHLBERG

Ann-Mari Ståhlberg is MD of VEAB (Växjö Energi AB), which is regarded as the country's pioneer with respect to the large scale use of bio fuel.



TOMAS KÅBERGER

Tomas Kåberger is Director General for the Swedish Energy Agency. He is also chairman of the board of The Swedish Bioenergy Association (Svebio) and has taken part in several state investigations regarding energy and the environment. Tomas Kåberger has been an adjunct professor for several years at the International Institute for Industrial Environmental Economics at Lund University, conducting research within the fields of energy and sustainable development.



JAN-ÅKE JACOBSON

Jan-Åke Jacobson is MD for the wind power company Favonius AB, which is currently in charge of planning a large-scale windmill farm in the Kattegatt. He was also MD of Falkenberg Energi AB for eleven years.



LENA SLOVAK

Lena Slovak has been environmental manager at Lunds Energikoncernen since 2005. She trained as an environmental engineer in Halmstad and has worked with environmental issues in the energy industry since 2003.

We are used to thinking along environmental lines

When our group of companies now has celebrated its 100th birthday (2007), we feel proud when we look back on a company and an industry that have thought about and worked with the environment in focus for a long time.

We live in an age where environmental issues, not least in association with the ongoing debate about climate changes, have been moved even higher up on the agenda. It feels good to work in an industry where quite a bit is actually being done to reduce the greenhouse gas emissions.

The energy industry has taken environmental issues very seriously for a long time. This applies, not least, to the often municipally owned companies who have worked for more than 50 years to expand the district heating network in municipalities across the country. Expansion of the district heating system is our country's single largest contribution to a better environment. With its



high efficiency, it is an excellent way of utilising the fuel's energy content in the best possible manner.

Produced with bio fuel, it is one of the most environmentally friendly alternatives. As an energy system, district heating also allows for the utilisation of different forms of waste heat.

The political signals are clear. Discussions are being held on all levels, from the EU Council of Ministers down to non-professional municipal politicians and all are looking for definite proposals as to what can be done to reduce emissions quickly.

In this booklet, we try to capture some of the many different angles of approach there are to environmental issues associated with our industry. We look at overall issues about the causes of climate change and the need for rendering energy more effective. We discuss the political dilemma that environmental goals can sometimes conflict with other goals in society.

Also, we also show concrete examples of what we do now, have done and will do in the future. It is important that not only long-term and comprehensive issues are discussed without also looking at what can actually be done, here and now.

Much has been done, however, a great deal remains. The energy industry continues to face significant challenges.

With this booklet, we hope to be able to provide a bit of new inspiration in the environmental field.

A handwritten signature in blue ink, appearing to be 'Jan Samuelsson', written over a circular stamp or mark.

Jan Samuelsson
CEO
Lunds Energikoncernen



We knock the climate system out of balance

Environmental issues have once again ended up at the centre of public debate after several years of declining interest. Understandably, it is climate changes and man's influence upon this that have caused matters to be moved up on the agenda. But what actually are climate changes? What does man do that affects the climate? And what will the consequences be? Martin Hedberg, meteorologist and MD for the Swedish Weather & Climate Centre, SWC, clarifies the concepts.

Greenhouse gases. Climate changes. The words have probably been two of the most commonly occurring in news reports over the past year. We can read everywhere about how we affect the climate and contribute to rising temperatures, with resulting catastrophic consequences. Martin Hedberg prefers to avoid the most bombastic expressions and scaremongering propaganda, but thinks it is about time that the issues become the subject of debate.

"We have had a period of roughly 10,000 years with relatively stable climate. Man has now changed the conditions, primarily through significantly increasing the amount of greenhouse gases in the atmosphere, but also by releasing particles into the air and by cutting down forests. This knocks the climate system out of balance," he says.

When one talks about greenhouse gases, it is primarily carbon dioxide one means, but there are also other greenhouse gases such as water vapor, methane, nitrous oxide and Freon. The sun's rays, light and heat penetrate the atmosphere and hit the Earth. The Earth reflects back a large number of the rays out into space. In the atmosphere, greenhouse gases prevent part of the radiation from continuing out into space.

"Thus, greenhouse gases act almost like insulation around the Earth. In itself, this is not something dangerous but, on the contrary, something positive. Greenhouse gases exist naturally in the atmosphere. If there were not any greenhouse gases at all, the Earth would have an average temperature of minus 18 degrees or colder, instead of plus 15. The problem is that we release more than what nature can handle, which contributes to the temperature rising."

A number of people maintain that climate changes are completely natural and that man's impact is only marginal. Martin Hedberg does not agree with this mode of reasoning at all. He believes that the fact that the climate has varied over time long before man began releasing greenhouse gases is something that should worry us, it is evident that nature is capable of significant changes.

"It cannot be denied that man has an influence. We know how much more carbon dioxide is in the atmosphere today, compared with the amount



200 years ago. We also know approximately how much oil and coal has been used. What we can then establish is that nature has actually been able to handle roughly half of what we have emitted. However, nature cannot handle an infinite amount."

Until now, the temperature has risen by 0.7 degrees above normal and we estimate that the emissions we have already released will increase the temperature by another 0.7 degrees.

"This may not sound like much, but already with an increase of just three degrees, we risk dramatic changes. When the temperature rises, nature's own systems also change, which might accelerate the development. One example: the seas currently absorb more carbon dioxide than they give off but when the temperature rises above a certain level, they begin releasing more carbon dioxide than they absorb. This means that nature's own emissions of greenhouse gases increases. Once we have reached this level, it becomes very difficult for us to do anything about the changes. Part of the problem is that it will take a long time to reverse the development, and what we do today will impact the climate for decades to come.

The effects of a temperature increase will be significant and have dramatic consequences.

"To a certain degree, we can predict what is going to happen, but we cannot specify the exact extent. Ice melts and the sea level rises, the likelihood of forest fires will increase in certain places, and at the same time the risk of landslides will increase in other areas because it will rain more."



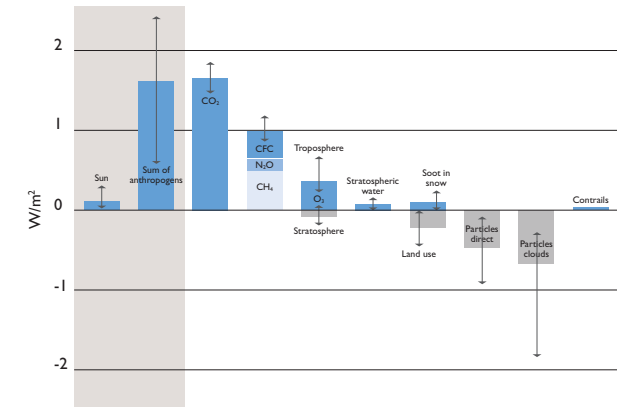
"With an increase of just three degrees, we risk dramatic changes."

Four activities are pointed out as the main villains in the drama; transport, heating of properties, the production of electricity and food production. Thus, it is all about energy in different forms. "The problem isn't the actual activities – we want to do these things - the problem is the way in which they are carried out. 80 percent of the energy comes from fossil fuels. This leads to enormous emissions of carbon dioxide, approximately double as much as nature can handle on its own." The account may sound dismal, as if we must either stop using energy or accept climate changes. However, Martin Hedberg is optimistic that the energy issue can be resolved in a positive manner. "There is 100,000 TW of energy that can be obtained from the sun and humans, as a whole, consume approximately 13 TW today. This means that if we could utilise a mere ten thousandth of all the energy the sun gives us, the energy problem would be solved. Technically speaking, it isn't difficult, but it takes time to change the energy infrastructure and to find the right economic incentive. We have, quite simply, not found smart enough solutions yet."

The problems are global, even so a lot can be done locally in Sweden.

"In Sweden, we are good at producing energy in a more environmentally friendly manner. We have shown that we can increase growth while reducing emissions at the same time. On the other hand, we use more electricity than the European average and have larger cars that pollute more. If we can reduce our energy consumption by, say 20–30 percent, which is not impossible by any means, then we would really set a good example. At the same time, our electricity could be exported and replace, for example, coal powered electricity in Europe. It would be for the benefit of the entire planet. At the same time, we must remember that we, in order to avoid disastrous climate changes, need to reduce emissions by up to 100 percent within a few dozen years. The sooner we begin, the less difficult it will be." ●

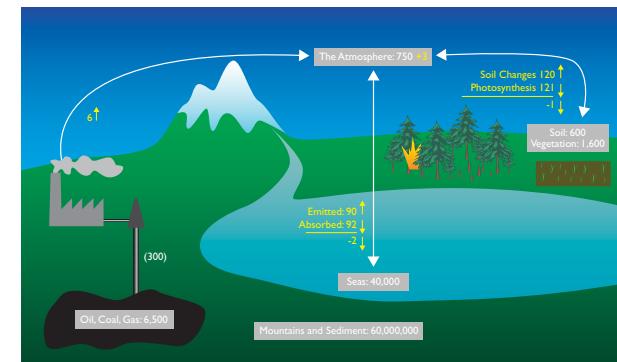
Change in radiation over the past 200 years



IPCC:WGI-AR4. Source: swc.se

The picture shows the change of the radiation balance, heating and cooling measured in watts per square metre over the past 200 years with error margins. The two bars on the left represent the change of incoming energy (sun) and the sum of changes caused by man (sum of anthropogens). Man's impact has been roughly ten times as great as the change in solar activity. The bars to the right show the individual anthropogenic contributions. Notable are the particles/air pollutants' cooling effect, the effect is, however, short-term compared with greenhouse gases that remain in the atmosphere from ten to hundreds of years.

Carbon cycle



The Carbon Cycle and Atmospheric Carbon Dioxide, IPCC 2001 and NOAA. Source: swc.se

The change in the percentage of carbon dioxide in the air is the single largest contributor to the amplified greenhouse effect. Here, the estimated carbon reserve is shown in billions of tonnes. Nature absorbs approximately half of the contribution of carbon dioxide (carbon) brought about by man. The natural flows are large, approximately 120 billion tonnes to and from forest and land, respectively 90 billion tonnes to and from the sea. However, the natural process of climate changes is also affected, for example, through the death of forests/forest fires, permafrost changes and changes in sea water temperatures. There is the risk that nature will become a source of climate gases instead of reducing them, as is currently the case.

Higher energy prices would improve efficiency

Thomas B. Johansson is a professor of energy systems and Director of the International Institute for Industrial Environmental Economics at Lund University. He was previously responsible for energy and climate issues within the UN's Development Program (UNDP). He says that the energy sector is responsible for between 60 and 70 percent of the emissions that influence the climate. But instead of focusing on the energy supply, we should concentrate on reducing the demand for energy.



"The most important question and the greatest challenge is how we will be able to better economise on energy and use it more efficiently. Usage can be rendered more effective at every stage, from production to distribution and consumption."

Thomas B. Johansson thinks that by rendering the entire chain more effective, it is possible to significantly reduce the use of fossil fuels, something that is absolutely essential in order to neutralise negative consequences on the environment, particularly the climate.

"The greatest improvement in efficiency can be made at the end of the chain, by those who use the electricity, the fuel or the heating. One of the best methods, and perhaps the single best method, to render consumption more efficient is to simply raise energy prices. Higher prices increase the incentive to consume energy more efficiently. This applies both to companies and households. However, there are many situations where a higher energy price is not enough to put measures for efficiency improvements in place."

He also thinks that different sectors need different instruments in order for energy efficiency to occur in the best possible manner. The building sector has much to contribute in this case.

"As we now begin renovating the massive number of buildings built in Sweden in the late 60s and early 70s, it is very possible to reduce energy needs by up to 80 percent for these households through better insulation and other measures. If Swedish homes are built and renovated in a better way, we would be able to significantly reduce the load on the Swedish district heating network and thus make bio-energy and other energy forms available for other use."

One of the reasons why we, in both society and industry, have not previously devoted so much time on how we can consume energy more efficiently is, according to Thomas B. Johansson, that focus has been on the supply side.

"This has also contributed to unsatisfactory technical knowledge about how, for example, energy-saving housing is built. This shows that the market forces alone are not enough to increase energy efficiency. We have had very low electricity prices for quite some time and, thus, the argument for applying resources to get lower energy costs has been lacking. This has now changed."

He thinks that it is now particularly important that industrialised nations start focusing more on how they can render energy use more effective. This is because many of the countries that have not come as far in the economic and technical development are about to go down the same road as today's industrialised nations have already done.



"Industrialised nations must lead by a good example, and it is the politicians who must ensure that we shift our focus from how we can produce more electricity to how we can reduce the consumption of electricity. Market forces must be supplemented with regulation. The market will not reduce the emission of climate gases if there is no incentive to do so."

Even though Thomas B. Johansson, above all, advocates energy streamlining, he thinks that politicians must also ensure that the production of electricity and heat will be increasingly done using renewable sources of energy.

"Even on the supply side, the driving force in most countries is often too small to stimulate the extraction of renewable energy. This also applies to Sweden, with the exception of bio-energy. The highly successful carbon dioxide tax was introduced in the beginning of the 1990s and has contributed to Sweden now obtaining 25 percent of its energy from different bio-energy sources. In the last decade, development has primarily taken place within district heating. Germany, on the other hand, has progressed further on the electricity side. There, laws have been introduced prescribing tariffs, which make it profitable to expand the production of renewable energy. The costs for this are put on electricity use as a whole. This is one of the reasons why Germany has come so much farther than Sweden where the development of wind power is concerned."

Thus, introducing incentives and regulations are important both from a supply and a demand perspective.

"We must devote attention to this problem. It won't solve itself. Today, it is completely possible to build houses requiring less than a tenth of the energy older houses require, but it still does not happen nearly often enough. For this reason, clear regulations and driving forces must be introduced that make it profitable to use less electricity and heating." ●



It is important to have a global perspective on environmental issues

"Where solving the climate change problem is concerned, the fact that we are doing well in Sweden is not enough. We make the most important contribution by pressing the international discussions to find common agreements," thinks Elisabet Falemo, State Secretary to the Minister for the Environment Andreas Carlgren (the Centre Party). She's, among others, responsible for matters concerning sustainable development.



"Climate changes is the largest problem we face and it risks seriously changing the conditions for humanity. The climate issue has a different character than other environmental problems, because the changes risk being so dramatic for so many. The problem is a consequence of the global emission of greenhouse gases. Therefore, it is important to have a global perspective on these issues. Emissions largely stem from the production of energy using fossil fuels such as coal and oil. Thus, it is important that energy use is efficient and that long-term sustainable energy production is developed around the world," Elisabet Falemo states.

In order to get to grips with the problem, all good forces are needed, within politics and industry as well as individuals and idealistic forces.

Everyone can contribute via their different roles. On the national political front, we should primarily work to secure international agreements. Such

discussions have already begun. For example, Sweden recently organised an informal meeting at the borders where ministers from some 30 countries participated. Among the topics of discussion were what is going to happen after the Kyoto Protocol. Both Andreas Carlgren (Minister for the Environment) and Fredrik Reinfeldt (Prime Minister) are very committed to these issues.

"In Sweden, we have come a long way in many respects, but at the same time a number of debaters think that we should be able to do much more and that our demands should be considerably stronger."

"It is important that we don't place demands on industry that only lead to production moving to a different country. This is why international agreements are so important, so that requirements are harmonized between different countries. At the same time, we should not be afraid to implement certain regulations. We must realise that industry and employment are not statistical greats. It is a natural development that different industries decrease or grow for different reasons, among these are environmental reasons. Certain things become old-fashioned, disappear and are replaced by others. Up to now, this has not been negative for Sweden, on the contrary."

The largest problems are not what regulations and requirements we should have in Sweden, but what requirements we can actually place upon countries that are currently working to develop away from poverty.

"I think that the most difficult problem is that many people actually have justified claims to a better standard of living. In the West, we have made huge improvements for ourselves, so why shouldn't other parts of the world be able to do the same? The major challenge lies here, finding a way where it is possible to combine a high level of growth for large groups with sustainable development for our environment."

Sometimes the view is conveyed that Sweden should be able to contribute to more climate neutral energy production by, for example, expanding hydroelectric power and nuclear power.



"It is important to remember that all energy sources have their limitations. Where hydroelectric power and wind power are concerned, there are political agreements regulating what can be done, and this is why expanding these fields is not relevant."

"We must wean ourselves off thinking nationally where energy issues are concerned. Afterwards, as emission rights are tightened, it will also become tougher for other countries' energy production and this will lead to changes. For example, there are currently highly extensive plans for wind power in Germany."

In Sweden, the expansion of wind power and of the bio fuel powered combined power and heating plants is currently underway. There are almost always discussions regarding the location of new plants, but Elisabet Falemo thinks that the issues are often handled well because we have our Environmental Code (Miljöbalken), which specifies clear requirements. However, there are sometimes problems with timeframes for both large and small projects. The possibilities to appeal are relatively generous and at times it can result in processes becoming long drawn out.

"We want a system where processes are not perceived as impossible, and at the same time as we must naturally have a legal rights system where people have the opportunity to appeal. We are currently working to shorten process times and have just begun an investigation that will simplify and co-ordinate The Planning and Building Act (Plan och bygglagen) and the Environmental Code (Miljöbalken). Much can probably be solved by attempting to co-ordinate parallel processes."

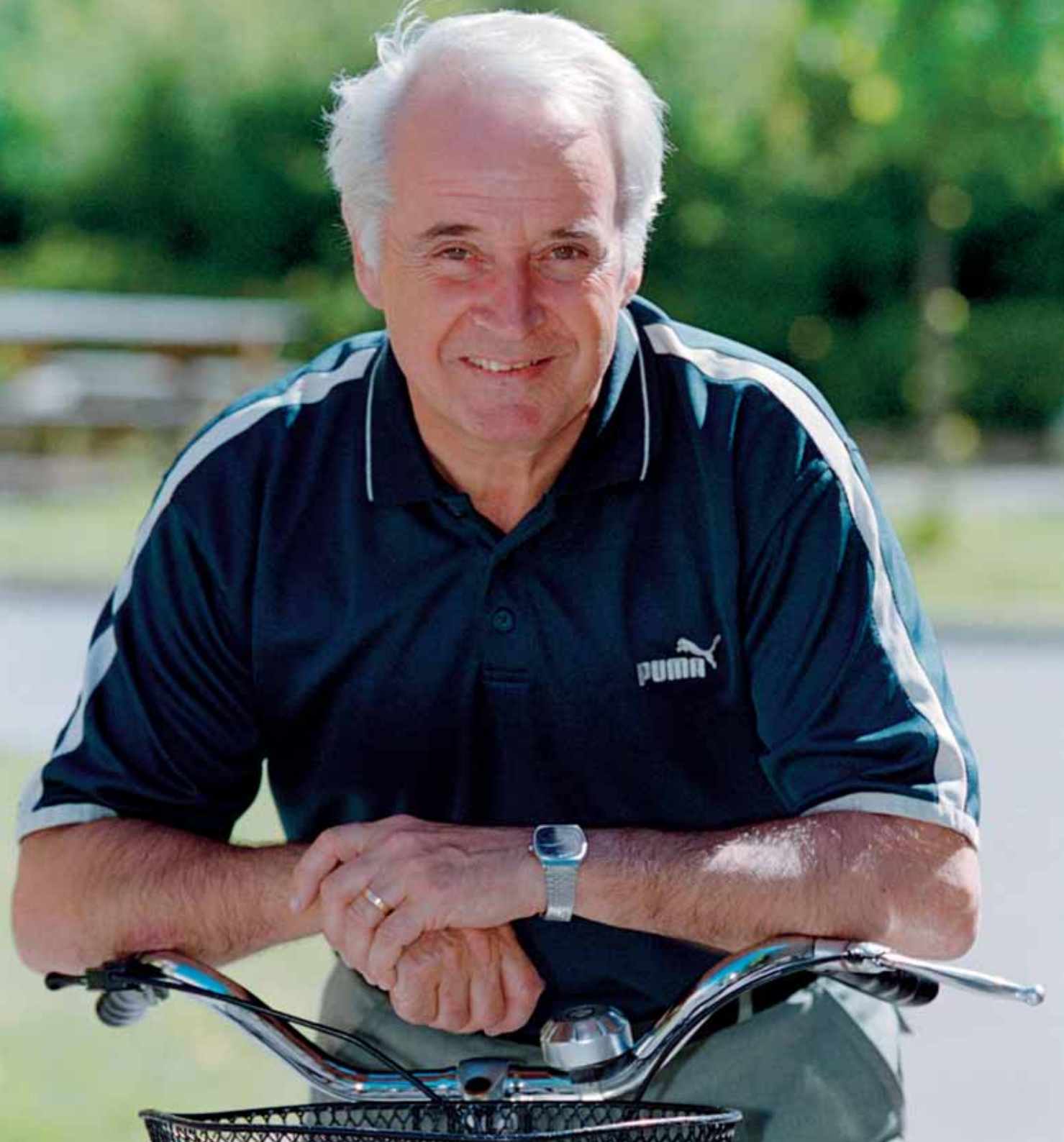
Regarding the Swedish energy industry's role in environmental issues, Elisabet Falemo believes that it should be to both inform and further develop.

"In the short-term, the Swedish energy industry can actively participate in international co-operation and contribute by setting a good example. We have come a long way in many respects, for example, concerning combined heat and power from renewable energy sources. This is an area in which other countries have much to learn."

"In the long-term, we must continue to develop smart solutions. It is about, for example, developing new methods to find more effective energy systems and to arrange the supply of energy from several different energy sources. Solar energy is the renewable energy source that has the greatest potential and we must be able to utilise this source in a better way."

"I believe it is important that the energy industry continues to develop and that customers are heard. Much has happened on the energy front, but we must continue and not just settle for what we have achieved so far," closes Elisabet Falemo. ●





There is always space between the feet when large elephants dance

"For some time now, we have had a clearly defined strategy to use several types of energy. It minimises vulnerability in our energy supply and is better for the environment," says Curt Åström, MD of Umeå Energi. The company was among the first to produce energy from refuse incineration.



When Umeå began investing in district heating in 1965, it was important to have several different types of fuel. At that time, oil was frequently used around the country in district heating production. Umeå Energi chose to invest in handling Umeå's waste instead.

"We were basically pioneers when it came to seeing waste as an energy resource. Umeå University was being built and in connection with this many student residences were also erected. These needed to be supplied with district heating. At the same time, Umeå's old rubbish tip was full. The solution was that we built a waste incineration plant in the middle of the student area, with waste as a source of heat supply."

Naturally, establishing a thermal power station where waste was used as fuel was not completely unproblematic. According to Curt Åström, the project was a success because an open dialogue was held with neighbouring residents. In this way, everyone who was affected by the project understood what Umeå Energi wanted to achieve.

"In the beginning of the 70s, 90 percent of district heating was based on oil. Instead of importing even more oil, we wanted to make use of a bi-product. Our journey away from the use of oil began almost at the same time as district heating really became established. Most who conduct district heating operations have made similar journeys and today only 10 percent of district heating is based upon oil."

After the waste incineration facility, the next step for Umeå Energi was a cooperative partnership with SCA. Large amounts of waste heat were produced at SCA's plant in Obbola, a small island close to Umeå. But, instead of heating up the sea outside of Umeå, Umeå Energi could use the waste heat for district heating to warm up homes in Umeå.

For a time, there was a moratorium in Sweden that prevented the construction of a new waste incineration plant. The ban was lifted and instead it was recognised that waste incineration meant recycling. Umeå Energi had previously identified the opportunity to expand its waste incineration and move it to Dävamyran, a combined power and heating plant based upon waste incineration.

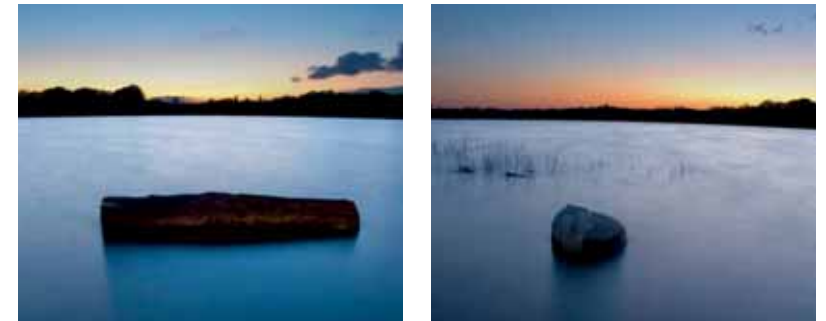
"So when the new European environmental parameters for waste incineration became clear, we were already waiting for the signal to sound. Dåva 1, as the plant was called, became one of the first plants in Europe after the moratorium was lifted. In this project, we worked with two world-class pro-



fessors in the environmental field, Christoffer Rappe and Stellan Marklund, to be able to handle environmental issues in the best way. This led to Umeå Energi boosting its image within the environmental field. Later on Dåva 1 was awarded the title "One of the World's Top Ten Waste Plants."

According to Curt Åström, recycling is a common thread throughout Umeå Energi's business. The city of Umeå is growing rapidly during 2007, Umeå Energi signed an agreement for a bio fuel boiler for Dåva 2. The philosophy of investing in different energy sources still exists.

"Bio fuel is important to the future. We must invest in renewable forms of energy that do not affect the environment. Hydroelectric power has had great significance. The forest's residual products are the next resource we aim to develop.



In other words, we can expect the use of more bio fuel in the production of electricity and heat. Dåva 2 is designed so that a plant for ethanol production can be built and directly connected."

Dåva 1 and 2 will provide Umeå Energi with its own power production of 50 MW. The company also maintained a share in a wind power station. Now, Umeå Energi will also invest in additional wind power in the form of a wind power park that will produce 25 MW of power. Even larger projects are being discussed for the long-term. The ambition is to have a larger share of own climate neutral electricity production.

"Our strategy contains, among others, plans for investigating the opportunities to use biomass gasification plants to produce heating, electricity and ethanol. We are doing this work together with, among others, Skellefteå Kraft and Övik Energi. Umeå Energi is also working with Volvo Heavy Trucks and the University of Umeå where biomass gasification is concerned. As is well known, the impact of traffic on the environment is an important matter that needs new solutions with respect to fuel."

Approximately 85 percent of all Umeå residents have district heating and approximately 700 houses per year are being connected. The expansion of district heating has involved the largest environmental investment ever in Umeå.

"There isn't a single oil boiler left in central Umeå and there is a huge demand for district heating. By working on a local basis and in close cooperation with the residents of Umeå, we are able to stand up to the national marketing "carpet bomb" sent our way by the large suppliers. There is always space between the feet when large elephants dance. ●



Växjö's environmental venture led the way

Växjö Energi is regarded as one of the country's pioneers where the large scale use of bio fuel is concerned. Ann-Mari Ståhlberg, MD of Växjö Energi, believes that this is largely due to a clear strategy from the owners to reduce the dependence on fossil fuels and to turn Växjö Municipality into a fossil fuel free municipality.



"The investment in district heating and bio fuel is by far the largest environmental investment in Växjö, and this is not down to mere chance."

"Växjö is located right in the middle of large forests, so in 1980 we had good conditions for beginning our work with replacing oil as an energy source. It was an important environmental issue, but it was also important to be able to offer reasonable long-term price levels." Växjö Energi's investment awoke the State's interest. Sweden had experienced several oil crises, and the issue regarding strong oil dependency meant that new alternatives were being sought out, not least for large-scale systems. Överstyrelsen för Ekonomiskt Försvar (a central Swedish authority handling supply issues during war) became interested, and Växjö Energi's bio fuel plant at Sandvik received financial support from the State as a test plant. In return, Växjö was to report on its experiences to the industry and the installation was to serve as a demonstration installation.

"Later when one of the steam boilers for the production of electricity and heat was transformed from oil to bio fuel, we received support from the Swedish Energy Agency as the first combined power and heating installation in Sweden to use bio fuel." Växjö Energi's owner, Växjö Municipality, previously had plans to turn Växjö into an environmental municipality. Included in this was a move away from oil dependency. As Växjö is surrounded by different types of forestry industries, there was good access to residual products from the forest, such as chips and shavings, in addition to forest waste in the form of roots, tree tops and branches.

"There was a certain degree of worry from the cellulose industry about the competition for raw materials from the forest, but this proved to be unfounded." Växjö's investment in the environment has resulted in approximately 95 percent of the properties in Växjö city and 80 percent of houses currently having district heating. At the same time, Växjö Energi's district heating has gone from being 100 percent produced by oil in 1979, to less than 3 percent today. And this development has taken place at the same time as the market share for district heating has grown significantly.

"The investment in district heating and bio fuel is by far the largest environmental investment in Växjö and this is not down to mere chance. By working in accordance with a clear strategy, we have been able to reduce carbon dioxide emissions, but also other emissions such as sulphur dioxide."

Växjö has also been awarded the Sustainable Energy Europe Awards prize by the EU commission for its firmly rooted work with "A Fossil Fuel Free Växjö".

Success with district heating has also led to Växjö Energi investing in smaller installations at smaller locations within the municipality. It is a type of district heating that utilises shavings, chips and bark in smaller boiler installations with smaller district heating networks. In the long run, it may also be possible to combine several district heating networks and thus provide an increased basis for electricity production.

"Another strategic issue for us at the moment is the investment in wind power. The municipality has tasked us with looking into the conditions for it. You see, we get inquiries about wind power, and several different players have shown interest. This being the case, it is only natural that the municipality's own energy company becomes involved. It may happen completely under Växjö Energi's direction, or in co-operation with e.g. other energy companies or property owners."

"Our owners are clear about their priorities. Växjö Energi will expand its district heating and continue to reduce the use of oil. A fossil fuel free Växjö is part of Växjö Municipality's environmental programme," says Ann-Mari Ståhlberg. ●





Politics determine the development of bio-energy

"Sweden is at the forefront of the bio-energy industry. But, whether this is also to be the case in the future depends on the political decisions that are made in Sweden and in the EU," says Tomas Kåberger, Director General for the Swedish Energy Agency.

"During the first modern oil crisis, at the start of the 70s, interest in modern bioenergy technology was generated throughout the entire Western world. However, when prices decreased again, so did most of the interest. Yet in Sweden, interest continued to rise. Bio-energy was boosted by debates about the cost of nuclear power and the environmental effects of fossil fuels."

The use of bio-energy has accelerated. During the 1970s the use of bio fuel increased by an average of 0.5 TWh per year. During the 1980s, the increase was 2 TWh per year and during the 1990s it was 2.5 TWh per year. Now it is increasing even faster, during the 2000s the increase has been 4.5 TWh per year. Of all the energy used in Sweden, bio fuel is the second largest energy source after oil. Approximately 120 TWh comes from bio-energy. It is also the dominating energy source for the production of district heating. "This is largely due to the system of carbon dioxide taxes, which makes the significant environmental advantage of bio-energy obvious. Sweden is the best country in the world where bio-energy per inhabitant is concerned. Countries such as China and the US are now working actively to obtain industrial know-how from Sweden.

"Tomas Kåberger thinks that political decisions have significant influence on the supply and demand for bio fuel. He mentions the agriculture policy as an example. "To begin growing energy forests is a long-term investment. You have to plan at least 10 to 15 years ahead. During that time, you may be able to harvest 3 to 4 times. Unfortunately, we have an agricultural policy in Europe that is controlled by means that are difficult to predict, and thus there are few who dare to make decisions about perennial crops.

"He is also critical of political means of control such as electricity certificates and emission rights. He believes that these artificial markets create unnecessary uncertainty for investors, uncertainty that prolongs the decisions that are required if the EU is to achieve its energy targets by 2020.

"But, for the most part, I believe that we have a smart policy in Sweden. Most important are the carbon dioxide taxes that have existed for many years. However, with today's oil prices, bio energy solutions are profitable even where taxes do not control, so there are significant opportunities for the industry to continue growing. However, I am not saying that we should replace all fossil fuel with bio fuel. That would not be economically viable."

"To begin growing energy forests is a long-term investment."



The EU has ambitious bio-energy targets. In 2012, usage shall be three times higher than it was in 2000. In 2020, renewable energy shall constitute 20 percent of the energy used and bio fuel 10 percent of the total fuel used. However, Tomas Kåberger thinks that these targets will be difficult to achieve. "Unfortunately, the EU is unable to make decisions about taxes on fossil fuels, which I believe is the best means of control for increasing the share of bio-energy. Instead, it is up to each member state to decide upon the means of control to be used. However, Sweden's means of control is working, and the government can easily exert control so that we meet the targets of the Kyoto Protocol." Just like all energy use, bio-energy has risks and costs. Tomas Kåberger mentions local air pollution from old small-scale installations. He believes that this is a problem that can quickly be solved by modern installations. Other problems include damage to nature through refining bio fuel. One example that has been much discussed is bio-energy extracted from palm oil and that such production would contribute to speeding up deforestation of rain forests.

"In Sweden the situation is different. Our increased use of bio-energy has come far, at the same time as the forestry industry has begun taking the environment into consideration in forestry. Both legislation and industry culture are important in order for this to work well."

The most important advantage that Tomas Kåberger wants to emphasize is that bio-energy can be used without any climate influencing gases being released into the atmosphere. This is also the primary reason why we should continue stimulating the use of bio-energy. The global potential is enormous but he cannot say how much will be used.

"Bio fuel can represent between 10 and 100 percent of the total energy consumption. Political means of control will cause us to end up somewhere in-between these figures." ●

In Sweden, interest in wind power has begun picking up

"In Sweden, we can significantly expand the use of wind power. It is entirely possible to reach a level where 40 TWh comes from wind power," states Jan-Åke Jacobson, MD for the wind power company Favonius AB and former MD of Falkenberg Energi.





In Sweden, wind power currently represents almost 1 TWh per year, which is less than one percent of the total electricity produced. If wind power was expanded to 40 TWh, it would, if everything else remains constant, represent almost 30 percent of the current total electricity production in the country.

"Compared to earlier, we now have the opportunity to get more out of wind power by building larger plants. But such developments will have to be made offshore. On shore, we have reached a limit to the size of facilities that can be built, because transport costs, road accessibility and other such things would be far too comprehensive if we were to make wind power plants any larger."

On the other hand, he believes that it is possible to place very large wind power plants offshore. Today, there are prototypes with power between 5 and 6 MW.

According to Jan-Åke Jacobsson there are many advantages of investing in wind power. The most important advantage is, quite simply, that it is 100% renewable energy. Also, the raw material is completely clean. He believes the disadvantages are largely of an aesthetic nature. For example, a number of people feel that a wind power plant destroys the landscape and produces noise.

"Noise from a wind power plant indicates poor efficiency. A machine that is functioning optimally can barely be heard. Wing design has developed quite a bit in recent years and this has meant that new wind power plants make significantly less noise than older models."

A wind power plant that is functioning optimally can, in theory, make use of 59 percent of the wind energy. In practice, modern machines are currently at approximately 50 percent. For older wind power plants, the figure is somewhat lower at roughly 40 percent.

"If one counts on a depreciation period of 20 years, one must have a price of between 50 to 60 öre/kWh in order for wind power to be profitable. The Swedish electricity certificate system (Elcertifikat) contributes approximately 20 öre. This money is given to power plants that transform energy from renewable sources for 15 years.

Jan-Åke Jacobson believes that, at present, there are no major hindrances to a comprehensive expansion of wind power, even though he considers it to be a tough task.

"Politically, we have a cross-party commitment. We want to invest more and more in renewable energy. The Swedish Parliament has set a target that wind power will represent 7 percent of the electricity consumed in 2015. This means that 10 TWh must come from wind power and I too believe that this is possible. In Germany and also in Spain, politicians were quick off the mark where the development of wind power is concerned. This is why they have also come very far in these countries. But now things have also begun picking up in Sweden. Municipalities can receive State support to draw up detailed plans for wind power."

He believes the hinders that still remain are more of a technical and logistical nature. For example, time-wise it is very difficult to expand the power supply network at the same pace as wind power plants are built at different locations throughout the country and offshore.

"Additionally, the great demand for wind power plants has resulted in long delivery times. Because the demand is so great, it also means that the prices rise."

In his capacity as MD for Favonius, Jan-Åke Jacobson is well under way with leading the Skottarev project in the Kattegatt outside of Falkenberg. The area has good conditions for wind power. It is planned that 30 wind turbines will be built seven kilometres out to sea, and these will be able to produce approximately 500 GWh per year.

"Sweden has good access to wind energy, better than many other countries. We must utilise this. Out to sea, wind energy can be up to 40 percent higher than on land. Therefore, it is only natural that the expansion takes place through us building future wind power plants off the coasts."

"One also needs to keep in mind that the fossil fuels are limited and moreover that they are hazardous to the environment. Renewable energy, whether it is wind power or something else, is necessary in the long-term. But, as I said, it has begun picking up now both politically and technically. I am optimistic, but there is still too much talk and too little action." ●



Invest in energy efficiency and renewable fuel

"The greenhouse effect is currently the largest environmental problem. We must find a way to supply society with climate neutral heating and electricity. In Sweden, we are relatively good at this but the problem is that our production isn't always sufficient enough", says Lena Slovak, environmental manager at Lunds Energikoncernen. She thinks that, in many ways, the Swedish energy industry has been an example in environmental issues, even though there is still more work to do.

"All energy production affects the environment in some way. This not only applies to power stations using coal or oil. Wind power is also criticized because it affects the landscape and sometimes causes noise. Hydroelectric power receives criticism because plants are built in rivers and they affect the biological multiplicity there. The largest problem is the fossil fuels and we must strive to reduce their negative impact on the environment."

"At present, approximately 80 percent of the world's energy production occurs through burning fossil fuels. If one looks at the Swedish energy production, we have come rather far in replacing the fossil fuels."

Lena Slovak is of the opinion that we must focus on increasing our own production of renewable energy, at the same time as we reduce the use of energy through energy efficiency.

"Of our electricity in Sweden, approximately 45 percent is produced by hydroelectric power and equally much by nuclear power. The remainder comes from bio fuel, wind power, solar power, etc. Thus, our own electricity production is relatively climate neutral, that is to say, it does not release very much carbon dioxide. However, the production does impact the environment because e.g. nuclear power is associated with major problems regarding the storage of waste. When we have a high demand for electricity in Sweden, we import electricity that is produced e.g. in coal-fired (condensation) power plants in Denmark or Poland. By building bio fuel-fired combined power and heating plants, utilising the potential for wind power in the country and developing technology regarding other renewable energy



"At present, approximately 80 percent of the world's energy production occurs through burning fossil fuels. If one looks at the Swedish energy production, we have come rather far in replacing the fossil fuels."



sources, such as wave power and solar cells, we may even be able to export clean electricity in the long run. One prerequisite is that both end users and industry become more energy efficient."

According to Lena Slovak, the expansion of the district heating network that was carried out for approximately 50 years in more than 500 Swedish population centres is one of the most important environmental investments in the country. One single district heating network replaces thousands of household boilers, often oil-fired.

"In the Lunds Energikoncernen, we have been quick off the mark in many respects and for quite some time, our ambition has been to reduce the use of oil. Already in the beginning of the 80s, we reused warm waste water in the production of district heating. In 1985, we were the first in Sweden to produce district heating using geothermal energy and today, our

geothermal plant is responsible for 45 percent of the needs for district heating in Lund's population centres. In recent years, we have made new attempts at further developing geothermics, unfortunately without success."

Work with replacing the majority of fossil fuels in electricity and district heating production with renewable fuel is currently being carried out at full speed ahead. In 2006, connection of the district heating network between Lund and Eslöv was completed. This also allowed the group to receive waste heat from the sugar factory in Örtofta.

"The single largest investment is the bio-combined power and heating plant we plan to build in Örtofta between Lund and Eslöv. The plant is estimated for completion in 2011 and will reduce carbon dioxide emissions by 350,000 tonnes, if one anticipates that the electricity and heating produced will replace fossil fuel based production in Sweden and abroad. This is as much as 150,000 cars release, on average, during one year. In addition to this, we are also investing in, among others, bio oils, increasing the amount of waste heat in the system and increasing our wind power production. But it isn't only the large projects that count. For Lunds Energikoncernen, the environment is an important issue that is considered in everything that is done."

"For example, we train our staff on an ongoing basis. I believe that this is important in order to keep environmental thinking up to date, that one is constantly reminded of new aspects. This year, many staff members have undergone



training in eco-driving, how to drive in a more environmentally friendly way. Where transport is concerned, we have also made investments in vehicle gas. We currently have two public filling stations in Lund and a third one is on the way. We are working to increase the production of bio gas to increase the share of renewable fuel in the vehicle gas," Lena Slovak states.

One problem with district heating production is that it is best suited to densely populated areas. For houses that are located on their own or houses in smaller communities, it is difficult to use district heating because the cost is too high.

"In smaller communities, we can conceive building smaller district heating networks in the future with local bio fuel-fired boilers. This won't really be as effective as a large district heating plant, but tremendously better than the alternative using oil."

According to Lena Slovak, the energy companies both can and consequently does quite a lot. However, she stresses that quite a lot of the power to change lies with the individual consumer. There is much one can do, a few big things and many small.

"The first thing is, if at all possible, to change to a more environmentally friendly form of heating such as district heating. The second thing is to purchase a more environmentally friendly car, such as a bio gas car, and to use public transport more often. Then, there are a number of small things that, when combined, make a great difference. It's about everything from changing to energy-efficient refrigerators and freezers, to buying low-energy light bulbs and low flow shower heads." ●



Different forms of energy

Bio fuel

Renewable fuel. For example, products from the vegetable kingdom such as waste products from forestry and agriculture. Does not result in any net contribution of carbon dioxide when burned, the carbon dioxide that is formed during combustion is the same amount that the plant takes up during its life.



Biogas

Renewable fuel that is formed when organic material is broken down. Can be produced through the rotting of biological waste. Does not result in any net contribution of carbon dioxide when burned.



Fossil fuel

Fuel that takes a very long time to form, often several million years. Because it is used much faster than it is formed, it is not renewable. Fossil fuels are formed in the following steps:

Peat (not fossil) → Brown coal → Pit coal
Kerogen (not fossil) → Natural gas → Oil



Renewable energy

Energy that is recreated at the same speed as it is consumed. Solar, wind and hydroelectric power are examples of renewable energy sources, just as bio fuel.



Geothermal energy

Renewable. Warm water from the Earth's interior is used to produce district heating. Does not release any carbon dioxide and is therefore climate neutral.

Coal

Fossil fuel. The world's largest fossil energy resource, but also gives rise to the largest carbon dioxide emissions, in addition to nitric oxides and sulphuric oxides. There are two main types, where brown coal is viewed as being more damaging to the environment than pit coal. Both quarrying and transport of the fuel also leads to environmental problems.

Nuclear power

Energy is generated by splitting atomic nuclei. Does not release any carbon dioxide and is therefore climate neutral. However, nuclear power entails other risks, primarily the radioactive radiation that occurs when atomic nuclei are split. The storage of burned out and radioactive nuclear fuel is regarded as a major environmental problem.

Natural gas

Fossil fuel. Mainly comprised of methane. Provides roughly 30% lower carbon dioxide emissions than oil and 45% lower emissions than coal. Natural gas does not contain sulphur, dust or heavy metals.

Oil

Fossil fuel. Combustion causes the emission of carbon dioxide, nitric oxides and sulphuric oxides. The oil is transported long distances from the oil field to oil-fired boilers, which is an environmental problem in itself. Also, the extraction of oil often results in local environmental problems.



Peat

Peat is used as fuel and is classed by the UN's Intergovernmental Panel on Climate Change (IPCC) as a cross between bio fuel and fossil fuel. It takes roughly 10, 000 years to form peat, which can be found in highly abundant quantities in Sweden.

Solar energy

Renewable energy source that is based upon utilising energy from solar radiation. The energy is generated in solar cells, but so far these have been expensive to produce, which has meant that solar energy has not been a major success up until now.



Hydroelectric power

Renewable energy that is generated by flowing water. Does not release any carbon dioxide and is therefore climate neutral. However, hydroelectric power involves interference in nature and often disturbs the natural ecosystem surrounding the plants.

Waste heat

Surplus energy, often heat from e.g. industries that would otherwise go to waste is utilised. Can be used for the production of district heating.



Wind power

Renewable energy source where energy is generated by the wind. Does not release any carbon dioxide and is therefore climate neutral. Wind power sometimes receives criticism because it affects the landscape and because the turbines cause low frequency noise.

Lunds Energikoncernen AB (publ)

Lunds Energikoncernen AB is owned, via the holding company Krafringen AB, by four Scanian municipalities with the following distribution 82.4 % by Lund Municipality, 12.0 % by Eslöv Municipality, 3.5 % by Hörby Municipality and 2.1 % by Lomma Municipality. The number of energy customers amounts to 284, 000, and the group employs approximately 450 people. The group's activities include network operations, electricity sales, electricity production, district heating, district cooling, natural gas, communications networks, lighting, and contract work and services.

The main focus of our operations is in Scania, and the parent company is located in Lund. The group is also strongly established in Blekinge, Småland and Södermanland, as well as in the Sjuhärads district and the Västergötland plains.

Local ties are one of the corner stones in the group's strategy. Each local company has a local sales department, local customer services, locally stationed installation resources and boards with local ties, where at least two representatives come from the municipality or local industry.