Future Generations of Solar Energy

An analysis of community knowledge and interest towards the development of a solar energy cooperative in Indre Nørrebro, Copenhagen

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Michael Cretella
cretella@wpi.edu

Bryan Kaanta
bkaanta@wpi.edu

Jenelle Pope
jpope@wpi.edu

solar-d06@wpi.edu

Project Center: Copenhagen, Denmark D06
Project Advisor: Ruth L. Smith

Abstract

The advancement of solar energy is a forthcoming initiative in Copenhagen, but growth is dependent on public involvement. This project assists the Nørrebro Agenda 21 Center in determining the best course of action for promotion of solar technology in its community. The disconnection between prospective users and existing outreach methods hinders progress towards community implementation of solar energy. A coordinated effort between environmental agencies, businesses, and the government will create the multi-faceted solar promotion program necessary to reach the community.

EXECUTIVE SUMMARY

The goal of this project is to promote awareness of the potentials of photovoltaics in Indre Nørrebro, Copenhagen in order to establish the basis for a local solar cooperative. Through extensive analysis, it was determined that a major disconnection exists between promotional organizations of solar energy and the local residents who show an interest to learn more. The recommendations made to the Agenda 21 Center take into account the environment in which the project took place and develops what were determined to be the most effective methods to promote the interest, awareness, and involvement of Nørrebro residents. It is recommended to initiate the involvement of small and larger local businesses, target individual communities in promotional efforts, increase awareness of existing photovoltaics, and alert the local government to the citizen's interest in solar energy. This plan is multifaceted to make a large impact on the community and raise awareness to the potentials of harnessing solar energy. These strategies have been developed with a solar cooperative for the community in mind as the long term goal.

During the course of the project Nørrebro residents were surveyed about their awareness of, and interest in solar energy. The results showed a lack of awareness of existing opportunities, though an openness to learn more about solar energy and what is currently available. This information shows the disconnection between the local organizations who currently promote solar power and the residents who are open to learning more. The leaders of involved organizations such as Solar City Copenhagen and Københavns Energi were interviewed to determine what efforts have been made to show the prominence of solar energy in Copenhagen and promote participation by residents. As key members of the community, local businesses in Nørrebro were also interviewed to determine their interest in committing to solar energy. Area businesses have a high potential to impact local residents in a positive way and increase awareness of solar energy quite effectively. Businesses that are reluctant to commit may be driven to participate because of a competitive dynamic for already environmentally conscious consumers. Through these initiatives, the current situation of solar energy in Nørrebro was assessed and suitable recommendations made to the Agenda 21 Center. One of these recommendations targets the local community by displaying the possibilities available in a non-intrusive informative manner. A "solar excitement" day was piloted on 3 May 2006 at a popular community gathering spot, Sankt Hans Torv in Nørrebro, the program was designed to present information in a relaxed

interactive way, as well as use resources from multiple different solar promotion organizations. By including marketing posters of Københavns Energi's Solstøm program, informational flyers and booklets from Solar City Copenhagen, and equipment and information from the Agenda 21 Center, these organizations can come together to target and inform a community to embrace solar energy.

This community is open to learning about the potential of using solar energy. Currently though, people are not willing to spend the time or money required to start an energy cooperative. Our recommendations to the Agenda 21 Center include a community outreach plan which involves different levels of outreach. Current programs do not penetrate the market they are aimed at, and research shows people would take advantage of these programs if more information was available. Current photovoltaic installations in Copenhagen need to interact with the public in such a way that people are involved with them and become interested in learning more about photovoltaics. The combined effort between Agenda 21 and Solar City Copenhagen to involve small and large businesses in committing to solar energy is a crucial joint effort that will help the community embrace and commit to solar energy. Lastly, petitioning political organizations to form alliances and advocating for funding for environmental policies will allow current programs to continue and new programs to flourish. Through these initiatives, promotional organizations in Copenhagen will work together to promote awareness of the possibilities of solar energy and raise interest in participating in solar cooperatives in the city.

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Contents

List of Figures

1 INTRODUCTION

In the last several years, energy use and resources have become one of the most globally discussed topics. Between 1970 and 2000 the global rate of oil consumption increased 60%, coal use increased 145%, and natural gas was used 130% faster (Meadows, Meadows, & Randers, 2004); these fossil fuels may be depleted in the next 100 years. Since the 1970s, this dire situation has captured the attention of world leaders and governments. The European Union (EU) provides a strong basis upon which many European countries are able to discuss and decide upon necessary energy regulation. This organization has established a number of programs and set deadlines to decrease energy consumption and speed implementation of renewable energy sources for its member countries.

Denmark has a long history of demanding even stronger energy programs from the EU and developing and integrating ambitious initiatives into its own society. About 18% of Denmark's total energy production is produced by renewable sources; this is the highest percentage of renewable energy generation in the world (EIA, 2005a). At the end of 2003, Danish wind power accounted for almost 18% of the country's total electricity generation (DEA, 2004). Although wind power is a major part of the Danish energy plan, other renewable resources must be utilized to form a stable and efficient renewable energy program. The use of photovoltaics offers many benefits to an urban area such as central Copenhagen where wind energy is not possible. Photovoltaic installations can be implemented on existing roofs or sides of buildings as well as integrated unobtrusively into windows or as roofing tiles. Danish energy policy is focused on conservation of energy as well as further implementing renewable energy in Denmark. Solar energy is a logical addition to the diversity of this already strong sustainability program.

The Local Agenda 21 Center of Indre Nørrebro is an organization which facilitates the development of environmental programs at the community level. As a community leader in environmental thinking and practices, the Agenda 21 Center has set up and currently operates three photovoltaic sites which generate electricity for the surrounding grid. These example sites are meant to stimulate public interest in solar energy. As a next step the Agenda 21 Center would like to increase community involvement with solar power by establishing a photovoltaic cooperative in Indre Nørrebro. The process of establishing this cooperative has already begun. The Agenda 21 Center has made arrangements to use rooftop space at an assisted living complex

for the photovoltaic installation.

The largest obstacle that lies ahead is to bridge the gap between the promotion of solar technology and the possible participants. Previous research has shown that there is an interest in renewable energy by individuals, but there is a relatively low level of knowledge about solar energy and the possible implementation strategies. There are numerous organizations and programs currently available in the area which people could participate in. However, the lack of communication between these organizations and the low visibility level of the available programs limits their effectiveness.

The goal of this project is to aid the Indre Nørrebro Agenda 21 Center in determining the best plan of action to promote solar technology in the community. In order to continue the development of solar energy, an investigation of the current climate surrounding solar technology is necessary to produce recommendations for the Agenda 21 Center regarding the best promotional plan. Our research shows that many factors must be taken into account, including the neighborhood's volition, the interest of small and large businesses in participation, and the current government's stance on solar development. Assembling these different viewpoints will give an accurate picture of the obstacles keeping solar technology from becoming more widely used in the community. Through our recommendations, these organizations can work together to promote Agenda 21's goal of further implementation of solar power.

2 BACKGROUND

The issue of sustainability is a world wide problem that is growing larger every year. Every country approaches energy use in a different way, some have advanced energy policies and some have no energy policies. No matter how a country approaches its energy use, it is necessary to take an extensive look at the effects of increased energy consumption in the world in order to determine the effects on the environment. Recent global initiatives to create awareness and set standards on global emissions have brought some of these issues to the forefront of international discussion. The movement away from thoughtless industrial expansion to environmentally friendly practices has been termed the Green Movement. The Green Movement is a complete behavioral change from taking the habitual energy intensive path, to thinking about the effects of our actions on the environment; and includes a shift to thinking cooperatively. There are numerous hurdles to cross before changing social opinion, which is why action must be taken to address the unsustainable use of fossil fuels. Because solar energy is not a profitable source of energy, localized involvement at the community and cooperative level is more effective than a wide spread campaign. Establishing energy cooperatives around the world is an excellent way to involve individuals in the process of energy generation and have them realize that they can make a difference. But to market this type of organization people must be interested in the availability of the technology and if it actually makes a difference in the bigger picture. This section will take a look at each of these issues individually addressing them and expanding on each of the concepts to establish a significant background in order to tackle the problem of sustainable promotion.

2.1 Global Energy Situation

The world currently relies heavily on fossil fuels for energy. Fossil fuels are hydrocarbon compounds, such as oil, natural gas, and coal, formed from decaying plants millions of years ago. The plants formed different types of carbon under different pressures and temperatures. These fuels are burned to create heat which is used to change liquid water or air into steam or a superheated vapor. The vapor is then used to run a turbine which generates electricity. When burned these fuels give off dangerous emissions, which harm the environment at an astounding rate. In order for the planet to be enjoyed by future generations, we need to look

to renewable energy now. All renewable energy sources originated from the sun in some form or another. Harnessing the sun's power will create fewer emissions, eventually zero, and help the environment. Denmark has been active in this area for years now and plans to continue that proactive policy in the future. This section examines energy concerns and recent activity in more detail.

2.1.1 Fossil Fuel Energy Situation

The world currently uses more than 80 million barrels of oil a day (Appenzeller, 2004). In 2015 this number is expected to climb to 103 million barrels per day and again it will climb to 119 million barrels per day in 2025 (EIA, 2005b). Most of the growth in oil use is attributed to the expected industry and automobile increase in China, a country with nearly 2 billion people and, as of 2004, 10 million cars, a number that is increasing daily (Appenzeller, 2004). Although China's rapid growth is using more energy, the United States is using energy at an extremely high rate, using more than they can produce. Denmark, however, is a country that uses less energy than they produce and as a result they sell excess energy to Sweden and Germany. Energy forecasters are worried that the increase in oil use will put a strain on current reserves. Energy forecasters use known reserves, consumption rates, market prices, and expected population to predict how much oil will be used in the future and when it will run out. Oil wells will eventually dry up and shutdown, this fact was first extensively analyzed in 1956 by Marion Hubbert. An American geophysicist, Hubbert published a paper at a meeting of the American Petroleum Institute, which outlined the known oil reserves and predicted, using a complex mathematical model, that world oil production would peak in 2000. This theory of peak production was coined the Hubbert Peak Theory or Peak Oil Theory. There are many theories today as for when the world peak will actually occur. Some scientists believe that we have already passed the peak, but most theorists agree that the peak will occur sometime between now and 2020. Figure 2.1 shows this bell curve, its current rate of ascent, the potential peak in 2010, and the fall off. Therefore, at current rates the world's oil supply will be depleted in the next one hundred years, if no substantial oil deposits are found. Natural gas (NG) is a fossil fuel is fast growing in popularity. It is expected to increase in consumption from 92 trillion cubic feet in 2002 to 156 trillion cubic feet in 2025 (EIA, 2005b). Natural Gas burns hotter, cleaner, and produces more energy than oil and coal. It is much more abundant and

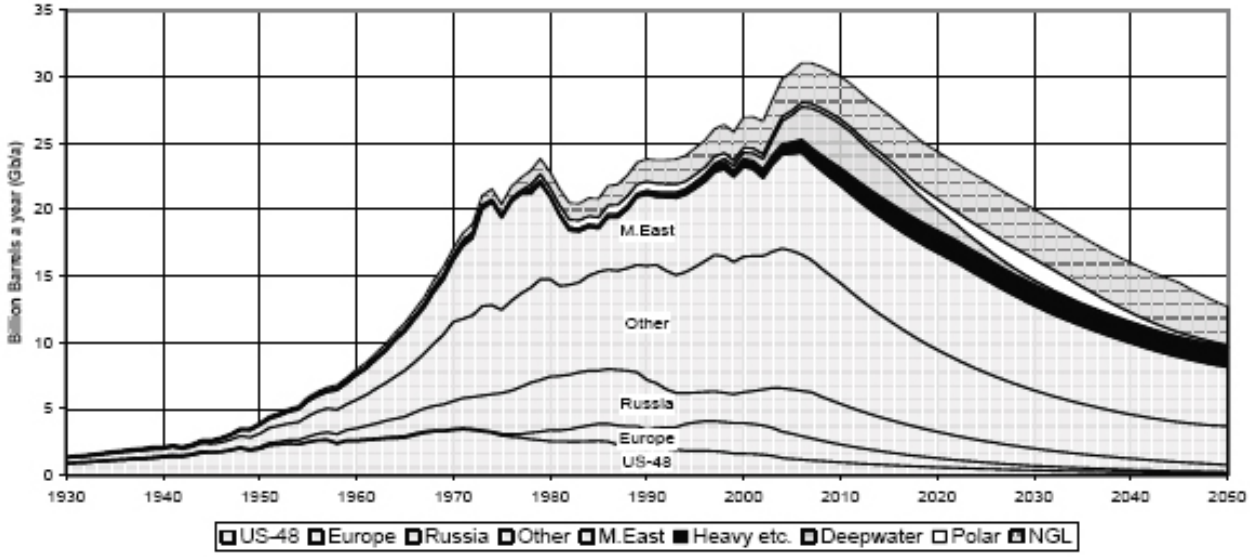


Figure 2.1: ASPO predicts that oil production will peak around 2010 (2005 August)

easier to extract and as such it is cheaper than oil. Natural gas is often found with deposits of oil and coal due to their similar nature of formation. Composed mostly of methane (CH_4), it contains much more hydrogen, which produces water when burned, rather than high levels of carbon compounds. Natural gas, like oil, has a peak although the forecast for natural gas is much more promising than that of oil. Natural gas has been predicted to last anywhere from 150 to 300 years from now. Although the outlook is much longer for natural gas than it is for oil, it will eventually run out as well. Once the oil wells have all been capped and abandoned, natural gas will become the forerunner of fossil fuels.

Coal is extremely abundant around the world. In 1999, it was estimated that the US reserves had about 285 years left in the ground, if used at the current rate and if no more reserves were found (McKenzie-Mohr & Smith, 1999). The worldwide coal deposits will last just as long as natural gas, but most likely longer. Today, coal is being used more as cleaner technologies are developed for burning it and safer methods are used for extracting it. Although coal will be around the longest of any of the fossil fuels, it gives an extremely dirty and inefficient burn if not used with the current clean technologies.

Fossil fuels release an enormous amount of energy when burned, but the emissions released are harmful to the environment and the population as a whole. World carbon dioxide emissions are projected to rise from 24.4 billion metric tons in 2002 to 30.2 billion metric tons in 2010 and 38.8 billion metric tons in 2025 (EIA, 2005b) (see Figure 2.3). Carbon dioxide is one of

the more well known side effects of burning fossils fuels, but carbon monoxide, sulfur, and particulate matter are also spewed from the exhaust towers. Natural gas, as mentioned, is the cleanest of the fossil fuels, but it still produces $0.19kg$ of carbon dioxide for every kilowatt-hour (kWh)of gas burned.

Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxides (NO_x), and sulfur dioxide (SO_2). SO_2 and NO_x when combined with water form acids commonly called sulfuric and nitric acid respectively. These acids are present in the atmosphere and rain down on earth (acid rain) and are attributed to killing plants and souring water supplies around the world. CO_2 and CH_4 create a layer of gas in the upper atmosphere that traps the heat in on earth rather than letting it escape. This trapped heat gradually warms the atmosphere to create what is popularly known as Global Warming. Emissions from cars also contribute to air pollution; Los Angeles, CA has frequent "smog days" in the summer where the air quality is so poor people are forced to stay indoors. Figure 2.2 shows how many thousand metric tons SO_2 and NO_x were produced from emissions between 1995 and 2004, which when compared to Figure 2.3, shows that only CO_2 emissions are increasing, due in part to the renewable initiatives as describe in the next two sections.

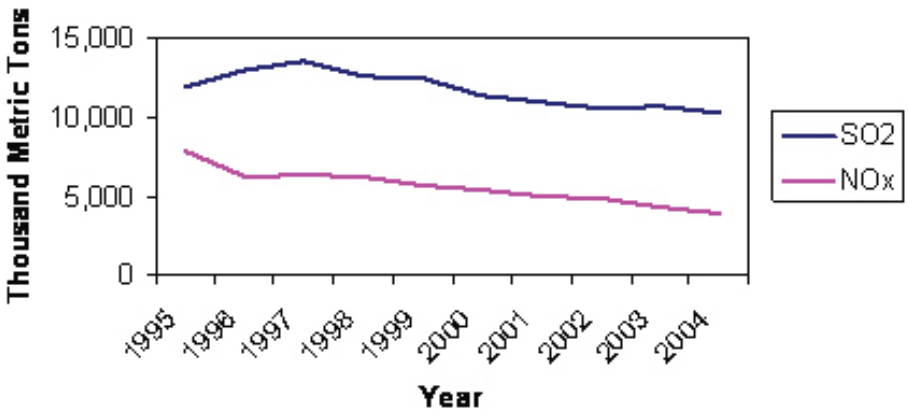


Figure 2.2: Emissions from Energy Consumption for Electricity Production and Useful Thermal Output at Combined-Heat-and-Power Plants, 1995 through 2004

2.1.2 Renewable Energy Situation

Renewable sources of energy are the best way to slow the rate of potential global warming and to drop the overall emissions from fossil fuels. These sources include hydro, biomass, geothermal, ocean (tidal or wave), wind, and solar. All of the renewable energy sources

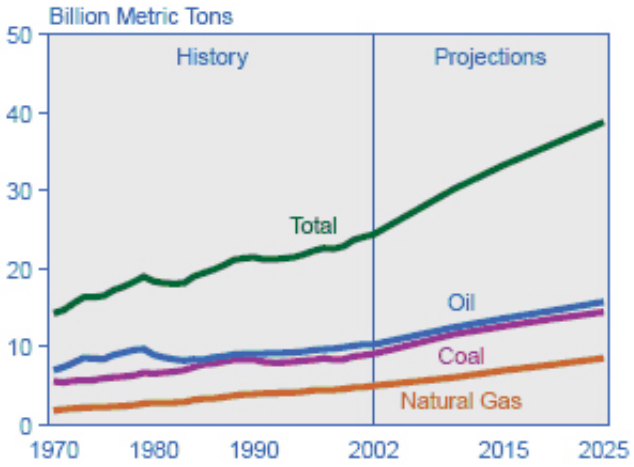


Figure 2.3: World Carbon Dioxide Emissions by Fuel Type (EIA, 2005b)

mentioned have seen developments in the past two decades with the most recent years seeing large investments in research and development. In 2004, 30 billion dollars was invested in renewable energy, excluding large hydro power, such as the projects in China; comparably the conventional power sector invested 150 billion dollars. Although fossil fuels are the most harmful to the environment, they receive the most investments because they are established in the social network. Much of the investments in renewables has been made by some of the largest conventional companies in the world, including GE, Sharp, BP, Shell, Siemens, and Sanyo (REN, 2005). Each type of renewable source has been growing at its own rate and has different expectations in different countries. Hydropower has been growing rapidly in some areas of the world. China, for example, is currently finishing construction on the Three Gorges Dam, the largest in the world, which is built across the Yangtze River. The hydroelectric plant in the dam has 26 generators which output a combined total of 84.7 billion kWh. Although they destroyed part of the ecosystem surrounding the dam, the energy produced is clean. Grid connected PV is the fastest growing renewable source at a rate of 60% per year (see Figure 2.4). Both Germany and Japan have roof initiatives, where they aim to put solar panels on a certain number of roofs. As of 2005, more than 400,000 roofs had solar panels between the US, Germany, and Japan. Wind has had the second largest growth at a rate of 17%, led by Germany who installed over 16GW by 2004. Electricity is only one part of the renewables, solar-thermal has had tremendous growth, covering almost 40 million households in China alone. Biomass for heating has had incredible growth as well, creating five times as much heat as solar thermal and geothermal combined. Biomass is used in many district heating plants because it creates

so much energy. Many developing countries have turned to renewable sources for electricity, heat, and water pumping because it is easier and much cheaper, with half a billion dollars going towards it every year, than extending the grid. Renewable sources create not only energy, but jobs as well. More than 1.7 million jobs were created in the renewable market in 2004. All of the efforts and steps towards green energy have had a positive impact on the global environment. (REN, 2005)

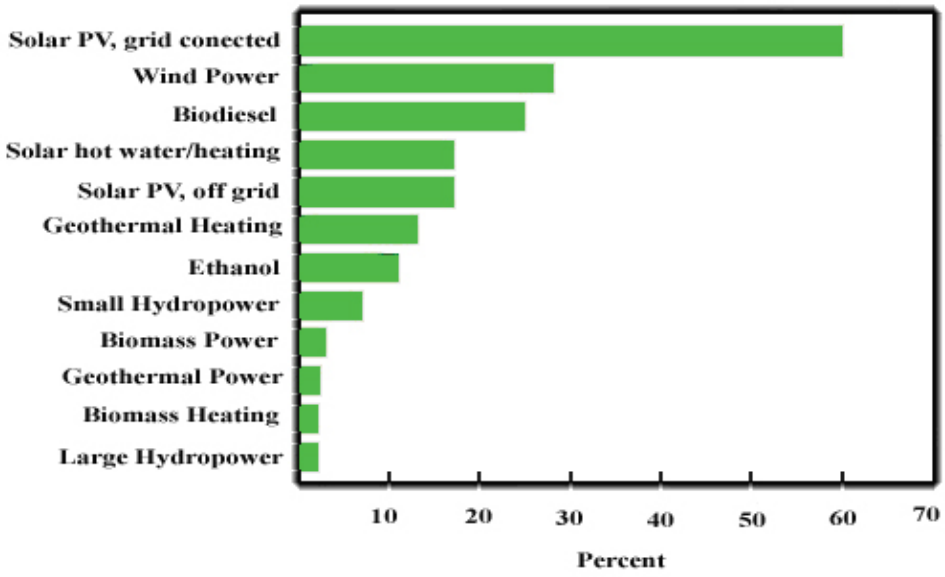
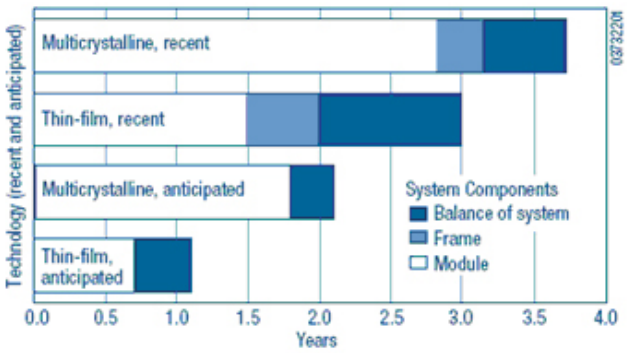


Figure 2.4: Average Annual Growth Rates of Renewable Energy, 2000-2004 (REN, 2005)

Although renewable sources of energy produce fewer emissions than fossil fuels, each has its own environmental impact that must be evaluated carefully before being implemented. Hydropower needs lakes to fall over turbines, the lakes are created by damming a river. The flooding caused by the damming and the dried riverbed during construction damages fragile ecosystems. Biomass releases carbon into the atmosphere, but because it comes directly from plants it is considered to not be as harmful as the carbon released from fossil fuels. Geothermal is an environmentally friendly resource, although the building of the plant disturbs the ecosystem. Ocean power, tidal and wave, disturbs the tidal zones with construction and piping the energy inland. Ocean power also creates hazards for migrating fish and other animals. Wind turbines have been known to cause injury to migrating birds and bats because they are not highly visible to the animals. Wind turbines are also not popular with people whose homes are near the site. Solar power has very little environmental impact while it is producing energy, but the manufacturing process requires fossil fuels. Most of the renewable sources require fossil fuels

to be processed, whether it is to power the manufacturing plant or in the plastics used in the product.

Solar energy is one of the better renewable energy sources currently on the market. Solar has a small environmental impact and it can be implemented almost anywhere. It is small enough to fit on a roof, powerful enough to power a home, and it will last as long as the sun does, which is for at least another two billion years. Despite the fact that solar seems to be flawless, careful attention needs to be given to energy payback. Energy payback is the time it takes for a solar panel (or other energy source such as a wind turbine) to pay for the energy it took to make it. This energy is also associated with the emissions from the plant that powered the facility that manufactured the solar panel (USDOE, 2004). In Figure 2.1.2 the lengths of paybacks are compared for different types of solar cells. Although the different types of mountings (ground vs. roof) are not as significant, the type of material used is extremely important. As the chart shows, thin-film is currently and will be the best model for payback. A PV system pays for itself in about the same time that a fossil fuel plant would, which takes into consideration mining, refining, transportation and construction, but PV avoids the pollution that fossil fuels exhaust into the atmosphere (USDOE, 2004). Based upon the average household and average PV panel generation, PV panels reduce SO_2 by 8 pounds, NO_x by 5 pounds and CO_2 by 1,400 pounds. These numbers increase dramatically when looked at through the life of the panel and energy payback as shown in Figure 2.6. Renewable energy has created a positive outlook for the future of the global environment; many countries have started legislation to continue the growth of green energy, including Denmark.



Reaping the environmental benefits of solar energy requires spending energy to make the PV system. But as this graphic shows, the investment is small. Assuming 30-year system life, PV systems will provide a net gain of 26 to 29 years of pollution-free and greenhouse-gas-free electrical generation.

Figure 2.5: Comparing paybacks of different types of solar cells (USDOE, 2004)

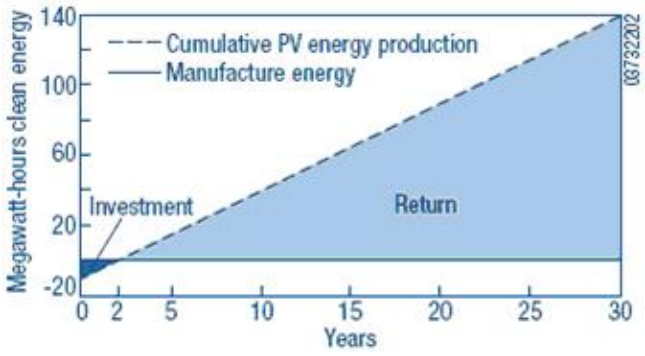


Figure 2.6: Total Clean Energy Payoff (USDOE, 2004)

2.1.3 Danish Energy Policy

Denmark has pursued an intense and extensive energy policy since the oil crisis of the 1970's. Driven by rising fuel costs, the desire to be independent of fossil fuels, and the rising concern over global warming, Denmark has taken steps to promote and implement renewable sources. The government put sanctions into effect to lower emissions before the Kyoto Protocol came into effect. The sanctions include such measures as reducing CO_2 emissions by 21% from the 1990 levels by 2012. In Denmark renewables have long been the way to go when looking at new power sources, 30% of the total electricity capacity is expected to be produced by renewables in 2010 and 75% in 2030, 50% of which is expected to be wind power (EIA, 2005b). Because of rising energy demands in all aspects of life, there is much left to do to reach those goals (Jensen, 2005).

Denmark has had numerous political changes in recent years and each political change has seen changes to the energy policies. One of the more prominent changes has been the decision to do away with nuclear power. Denmark used to produce energy through nuclear power, but it was decided that nuclear posed too large of a risk to the population and that there are cleaner, safer ways to produce energy. This policy is in contradiction throughout Scandinavia and Europe. Finland and France both want more nuclear power and both currently use a lot. Germany and Sweden have joined Denmark in doing away with nuclear power. Nuclear power is making its way back into the energy seen in Europe and the EU because of policies like these made by different countries. The most recent political agreement by the Danish Parliament was made in June 2005 and set forth energy saving initiatives for the country. Although the initiatives are ambitious, they were designed to have energy savings balance out the increase in energy use. In order to successfully meet future energy demands, especially in the renewable

sector, grid expansion must be done very carefully. Meeting the future demand is a concern for the government because energy consumption is rising faster than it can be produced and faster than conservation can be implemented (Jensen, 2005).

To start the conservation process the government has made three major legislative moves. First, an initiative obligated utility companies to buy renewable energy from private producers at a fixed price between 70 and 85 percent of retail electricity price. Second the energy tax structure was changed to a carbon dioxide based tax system which became a CO_2 related subsidy for all renewable energy technologies. The third initiative was a production incentive enacted for private producers of wind generated electricity. It is impossible to tell which of these three programs stimulated growth the most, but the 30 percent growth rate from 1992 - 2001 can certainly be attributed to all three. All of these programs were aimed at making renewable technologies more economic for the private producer (EIA, 2005b).

In January 2006 the Danish Parliament passed a directive on the energy performance of buildings. The Energy Performance of Buildings Directive (EPBD) builds upon legislation from 1995 as well as similar directives in Sweden, UK, and Germany. The "energy frame" or energy rating of a new building comes from several complicated formulas part of which is based on the heated floor area of the building. The EPBD was written in order to raise the public awareness of energy use and cause people to place more emphasis on the energy efficiency of buildings. The legislation takes into account the economic impact this new regulation will have on renovations and new construction. In order to determine if major renovations must follow this new regulation, an assessment is done to see if an energy efficient renovation will cost more than it will help save in the lifetime of the building. If the energy efficient option does not save more money than it requires on initial investment then it is not required. This is because over 75% of the buildings in Copenhagen were built before 1975. The directive established three standards beginning with a minimum level for 2006, then Class 2 which is 25% more efficient, and Class 1 which is 50% more efficient than the 2006 minimum efficiency. In 2010 Class 2 will become the minimum efficiency level and in 2015 Class 1 will be the minimum. EPBD will make people more aware of how much energy they consume in their homes. Whenever a building is constructed, sold, or rented an energy certificate will be required and the energy audit must have a receipt on file with the EPBD secretariat. In order to set a good example,

all government buildings are required to follow good energy saving practices as outlined in the directive. The EPBD directive takes into account heating, cooling, hot water, ventilation, and lighting of a building. All of these factors make it may be beneficial to build renewable sources directly into a new building rather than add them in later (Aggerhølm & Drybøl, 2006).

Another instance of Denmark's progressive approach at renewable energy is embodied in the 1997 national competition held between cities for the honor of becoming a 100% renewable city within ten years. The island of Samsø won the contest due to its location far away from any power stations and the fact that no power plant could be constructed on the island. This unique experiment has challenged the Samsø community to implement different kinds of renewable energy sources in order to successfully meet the community's energy needs. Since 1998 Samsø has been working to make the complete eco-revolution, including electricity, heat, transportation, and whatever other energy needs they may have. Currently 100% of the electricity comes from wind power and 75% of its heat comes from either solar power or biomass energy. The key to making this experiment successful has been getting the community interested, "What is important is that it is an initiative by the local people" says Jorgen Tranberg, an owner of one of the windmills and a member of the Energy and Environment Office (Tuan, 2005). The citizens of Samsø took personal control of the power generation by investing in the cooperatives, then financed the wind power as well as the district heating system. Not only do these renewable methods of energy generation pay the community back by making their air cleaner and energy less expensive, but also by creating new better paying jobs, increased tourism, and added to its economy.

As the grid owner in Copenhagen the energy utility Københavns Energi (KE) provides electricity to most of the city. KE uses conventional fossil fuels to produce much of its electricity, but recently they have begun to move into the renewable sources market. KE owns ten of the twenty wind turbines in the Middelgrunden wind power cooperative. KE also buys solar power from installations and resells it to customers at a mark-up of 0.25 DKK (about .04 USD) per kilowatt-hour (kWh). The new office building which KE just moved into has its entire south fa c ade made of glass which has a sunshield made up of solar panels that they use as power for their building. The buying and selling of solar energy by KE has created a solar power stock exchange available to all its customers. This program is called Solstrøm, which is based

on a program in Zurich, Switzerland. Solstrøm gives KE customers the option to buy a set amount of solar energy at several different levels: 250, 500, 750, or 1000 DKK per year. In order to make the program relate to every day life the different investment levels have been set to correspond to household appliances that can be run from that much electricity. The 250 DKK investment level will purchase enough solar electricity to run a toaster for a year, 500 will run a coffeepot, 750 will run a washing machine, and 1000 DKK will operate a color TV for a year. This advertising campaign makes it possible for people to identify with how much energy they are purchasing through this completely renewable source.

2.2 The Green Movement – Progress toward Sustainability

Recycling, composting, installing energy saving fluorescent bulbs, walking instead of driving, all of these activities are now considered part of the green movement. The green movement is the broad transition to patterns of resource use that are more sustainable. The movement relies on many different ideals from larger movements such as: the ecology movement, peace movement, conservation movement, environmental movement and includes a trend towards environmentalism. As can be seen from the previous section, the world is heading towards major problems with respect to environmental issues as well as fuel supply. Though implementing environmentally conscious and fuel efficient practices may not be the most inexpensive rout to take, at some point in the future the cost of renewable energy will be less than that for fossil fuels. This means that implementation of sustainable policies should happen as soon as possible. International organizations such as the United Nations (UN) and European Union (EU) recognize this need and have been moving towards international regulations on emissions. Some governments have implemented widespread national programs to promote sustainability. However the green movement has many challenges to face down the long path towards sustainability. One of the most important elements to the green movement is community involvement.

2.2.1 Agenda 21

Agenda 21 was originated as the name for a global environmental agenda for the 21st century. This set of environmental guidelines was signed into being by the UN in Rio de Janeiro at the Conference of Environment and Development, this historical meeting is also called the

Earth Summit and is now a yearly event. After the signing, Agenda 21 became a non-binding contract which united countries from around the world to a common cause. There are two major factors in the agreement which make it incredibly important. First is the realization that social, economic, and environmental development cannot be seen as separate issues any longer. The interdependence of these three major issues has been clearly established. The second reason Agenda 21 is so important was the wide range of people involved in its formulation. Negotiations involved an unprecedented number and range of people from government and private organizations, which created an intensification of the process of global democratization seen as essential for the 21st century (Bahá'í, 1994).

From the broad international agreements of the UN, a Local Agenda 21 Planning Guide was formulated to allow local governments, such as Copenhagen, to implement and follow the global contract, which holds such ideas as renewable energy and new development. In Copenhagen there two Agenda 21 centers located in Østerbro and Nørrebro. These two Copenhagen Agenda 21 Centers, do not just use the UN document for development, they use the most important resource they have, their citizens. Agenda 21 Copenhagen finds out how the citizens want to see their city changed by asking them at festivals, meetings, and awareness functions. A pamphlet has been published giving Copenhagen Agenda 21's exact plan for the 2004 - 2007 time period. The plans were worked out in conjunction with both Copenhageners and local businesses. The pamphlets give time tables and plans for environmental plans, examples of the reductions planned are in emissions, noise, and traffic. The overall goal of Copenhagen Agenda 21 is to create a cleaner more sustainable city for future generations. The Center has drawn guidelines for environmentally friendly buildings and new urban plans, forcing builders and architects to think about long term effects both environmentally and economically.

2.2.2 Solar City

In 1999 the International Energy Agency (IEA) started an organization dedicated towards the renewable energy cause in urban areas called the "IEA Solar City" program. The aim of this program was to create an international framework for Solar Heating and Cooling Program (SHCP). Through workshops held around the world much valuable input was gained, however a specific framework never materialized, and the IEA program ended in 2002. After several years of concerted efforts to realize a broadly integrated initiative for reducing emissions in

European cities, a promising new EU-wide initiative started to show great promise (ISES, 2003). In June of 2003 The European Solar Cities Initiative (ESCi) was founded by global, regional and local activists interested in sustainability of the urban environment (ESCi, 2004). The group, representing interested parties from academia, non-governmental organizations, the building sector, industry and policy groups, achieved strong consensus on the need to extensively reduce emissions in European cities to avoid environmental, economic and social disaster (ISES, 2003). According to Susan Rolf, the Co-Chairman of the International Solar Cities Congress 2006, "the world is facing the twin challenges of climate change and fossil fuel depletion that threaten our ability to survive on this planet." This is the exact reason the ESCi has been created, to help cities with technologies, policy mechanisms, financing methodologies, best practices and replicable examples. The name Solar City can be deceiving because it seems to point at only solar heating or photovoltaics when it is really meant to imply sustainable cities, through any means possible. This international organization can help provide funding for sustainability projects from a pool of money available from the European Union (EU). Professionals from companies involved with different energy generation methods usually make up the representatives of Solar City in the participating cities. These experts work together on public projects to get sustainability into the community. Copenhagen is one such city with an active Solar City contingent working to put solar projects in communities in artistic ways to raise awareness about solar energy.

2.2.3 Kyoto Protocol

Much like Agenda 21, the Kyoto Protocol is a UN agreement. The Kyoto Protocol is a document signed by approximately 180 countries at Kyoto, Japan, in December 1997. In February of 2005 the Kyoto Protocol went into effect after passing its last hurdle in November 2004 with Russia signing on to have 66.1% of world emissions represented (Mu Dong, 2005). The protocol commits 38 industrialized countries to cutting six different gas emissions, but mainly carbon dioxide, to levels 5.2 % below 1990 levels between 2008 and 2012. Where Agenda 21 was a series of guidelines and recommendations for countries to follow and use to develop more sustainable energy practices, the Kyoto Protocol is a legally binding agreement for the countries who sign it. The United States, with 36.1% of global carbon dioxide emissions, did not sign the Kyoto Protocol. The United States and Australia were the only large industrially developed so

called "Annex" I" countries to not sign the treaty. Despite the fact that the Kyoto Protocol does not directly affect energy sustainability, indirectly it will have a huge affect on energy generation. The burning of fossil fuels is the largest contributor to green house gasses which this agreement is aimed at reducing.

2.2.4 Government Adoption of Green Policies

In a paper released in February 2005 by the United States Energy Information Administration (EIA), the policies used by Denmark, the Netherlands, Germany, and Japan, are compared to the policies used in the US to promote renewable sources of energy. These four countries are the world leaders in alternative forms of energy, especially focusing on renewable sources. Denmark is the world leader in wind technology and wind turbine use for generation of electricity. Japan is the world leader in solar power through mostly implementing photovoltaics (PV). Germany and Netherlands have implemented a combination of these two types of technology with much success and support from their populations.

The policies which stimulated the growth renewable energy programs in these countries were established, for the most part, in the mid 1970's with aggressive programs of research and development. Germany's initial program for solar power was called the "1000 Roof" program, and the goal of this initiative was to move away from R&D towards demonstration. Between 1991 and 1994 under this program over two thousand PV systems were successfully installed, tested, and tied to the electricity grid, accounting for more than $5MW$ of PV power. From 1994 to 1999 local and state incentives contributed to the growth of an additional $6MW$ of PV power. To further promote PV Germany passed the 100,000 Solar Roofs Program in 1999. This special program provides consumers with low interest loans on PV systems. This catapulted PV capacity from less than $50MW$ in 1997 to about $400MW$ in 2003.

An island nation slightly smaller then California with a population of about 127 million, Japan used oil for 76 percent of its energy in 1973 during the energy crises. It was at this point that the Japanese decided to promote the development of renewable energy sources and encourage energy conservation. Driven at first by energy security concerns, environmental considerations, including climate change, have continued to drive policies in recent years. Japan has one of the most ambitious renewable energy policies in the world. The growth in PV was moved by four actions taken by the government between 1992 and 1994. Guidelines on how PV

would be connected to the national grid were set in place, as well as an ambitious goal to have $4600MW$ of PV by 2010. The third factor was a government subsidy to support the installation of PV technology. The last action item was a program much like Germany's, called the 70,000 Solar Roofs Program which encouraged the residential use of PV and to inform people about the benefits of using PV technology.

These two major case studies show that government support is an integral part of how a nation decides to use or produce energy. However, governments cannot make changes alone; the people have to stand behind the decisions and support them. This is shown by the most successful programs for PV being the programs which move the technology out into the residential areas. With new initiatives and new technology comes free advertisement in newspapers and by word of mouth thus involving the population as a whole in this new type of energy generation. As power generation is brought into local communities it raises awareness about energy use and the possibilities of producing energy in a place much closer to home. Bringing power generation closer to home is a large factor in influencing community behavior because it raises energy awareness on all fronts.

2.2.5 Dimensions and Challenges to the Green Movement

Nature is a constant in all of our lives. Everybody has contact with trees, air, and water from the time they are young. This nature all around us seems to be constant and something that does not need any help following the same course it has followed for all time. This is changing however. With the introduction of new chemicals and increased levels of pollutants it is becoming increasingly necessary to pay attention to the environment and its condition. To effectively approach the issue of the environment though, it is important to take into account the surrounding factors of economics and social values. The connection of these elements to the green movement is best described by a German economist E F Schumacher, who developed the concept of sustainability; in particular environmental sustainability from the angle of an economist. His concept holds that if the world economy will eventually collapse if it is based on fossil fuels, which are inevitably unstable due to their finite quantity. This is only a single angle from which to view the growing problem of the environment as it connects to economics, but it is very easy to see the connection. Schumacher also develops the connection of environment as related to social concepts and how these two elements are also connected to the environment.

The fact that a single individual's effect on the environment cannot be seen causes a plan of action by communities to be more feasible than action by individuals. The environmental green movement is one such concept under which people can gather to further that cause. The broad nature of the green movement creates the possibility for many people to be involved from many different areas of environmental thinking. The diversity created actually causes increased effectiveness because people approach the issue from many different paths. As will be shown, two of the most important paths that any environmental issue can be approached from are social and economic.

The main point of this section is to show the connection between social, economic, and environmental issues. The green movement lies in the sector of the environment however to be successful the green movement must use and embrace interlocking issues from the social and economic realms. Each of these factors can be seen as related and interconnected to one another, one causing an effect on another whether intended or not. Figure 2.7 which can be seen below is a triangular diagram with the three main parts just mentioned; the flow of the diagram is depicted by the arrows. Interestingly it shows how social change is necessary to make a change in the environment, and that economic change is also necessary to make environmental changes. These two major factors must be addressed in order to make the green movement successful.

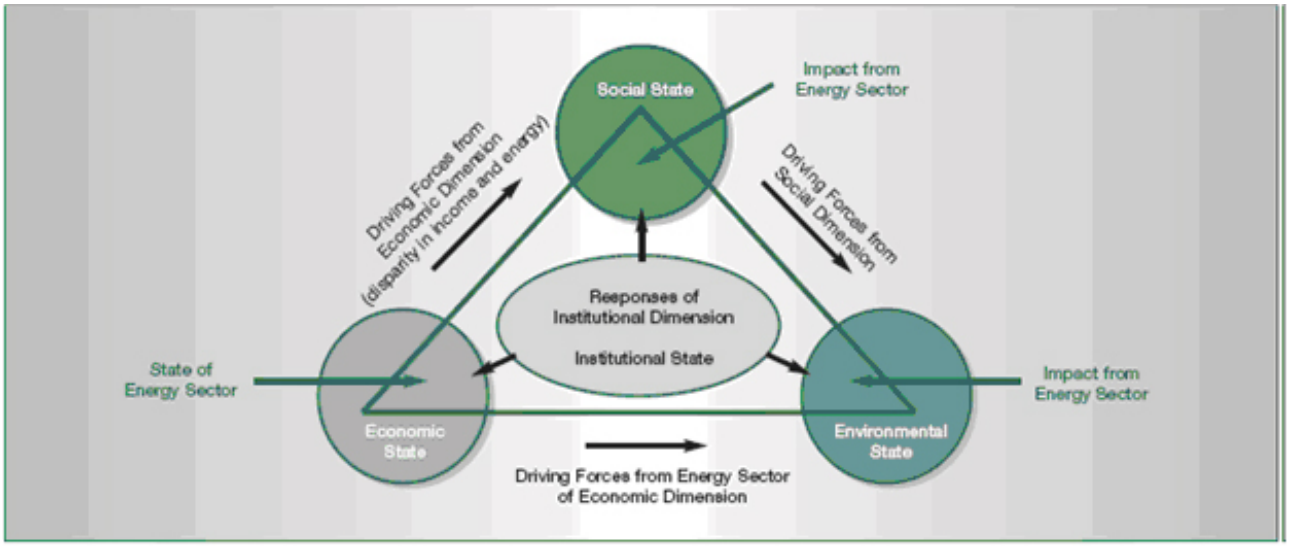


Figure 2.7: In inter-relations between sustainability dimensions of the energy system (IAEA)

Although world decisions today are made with a strong emphasis on the economic results, this practice is slowly changing and expanding to include factors from other realms. Agreements

like Agenda 21 and the Kyoto Protocol are aimed at changing the world's focus from solely economics to include concern for the environment through means of social change.

Economic factors can be seen as barriers because they cause people to look for the cheapest method before investigating the most environmentally friendly action. In 1973 E F Schumacher developed many of the concepts which are important to green thinking as related to economics. In his book, Small is Beautiful, Schumacher argues that currently the standard of living in a country is measured by how much the population consumes annually. Thus, the person who consumes the most is the best off, while a man who consumes less is obviously less well off. While this is an economic view of the standard of living it is also a reflection on how ethical a population is about their use of resources. In the United States, society stresses economic standing above environmentally friendly practices. This materialism results, for example, in not recycling because it is most expensive to get that service. However, the investment in sustainable types of energy can be seen as an investment in the future. The high capital cost of green technology causes society to shy away in favor of saving money up front. As education and awareness levels about environmental issues rise, the value of green practices also rises. Currently, as shown by Figure 2.8, energy is not a large portion of income per capita in the US and is therefore not perceived as a problem by the people.

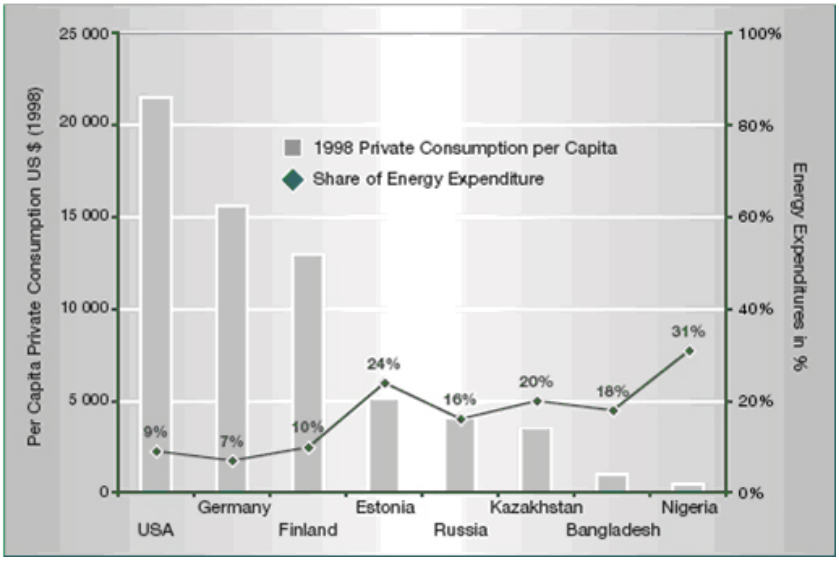


Figure 2.8: The world's share of energy per capita (IAEA)

However, in other countries as shown, energy expenditure is even lower, yet programs are in place to develop sustainable energy sources and policies (EIA, 2005b). This is due to a different social mentality. In other countries society values environmentally friendly actions (Kasemir,

2003).

This fact can be seen in a case study detailed by the book Public Participation in Sustainability Science: A Handbook (Kasemir, 2003). This book was published in 2003 by a collection of university professors in Europe to find out how "lay publics might be more effectively engaged in linking science and technology to the quest for sustainable development" (Kasemir, 2003). Results showed that in Europe the climate change due to pollution is a problem that people are willing to make changes based on the ethical/ecological considerations independent of purely economic motivation. This study discovered that people would rather that policy lead the way to ecologically benign technologies instead of making conventional energy use more expensive to discourage use. The major lesson learned from this study is that the transition to a more sustainable way of life for society is possible, if not by the behavioral changes of individuals, then by society as a whole deciding on standards to make sustainability a mainstream choice.

Social values are the principals which a social group holds to be true. These values can last anywhere from 20 to 50 years (Masters, 2006). A change in values can occur for a number of different reasons including: scientific findings, evolution of religious beliefs, changes in moral values, the persistence of vision-driven advocates, media, economic changes, technological innovation, or demographic shifts. These values propel everyday life and how a person chooses to live it. Green thinking is based on an underlying philosophy about and ethical behavior towards the environment. However, people are sometimes held back from acting ethically because of other social values that supersede this type of behavior. An example would be not composting organic waste because it takes too long to do, or because it smells bad. It is the societal value that causes the individual to value time saving higher than proper waste management (McKenzie-Mohr & Smith, 1999). Currently fossil fuel gasoline is very easy to find and is relatively cheap, so getting a hybrid car which gets better mileage is not valuable to society. Another problem with fuel efficient hybrid cars is that they do not have enough power. In society cars that are less "sporty" are not as valuable, and cars with less power fall into the same category (Kasemir, 2003). The makes a conscious effort necessary to make a change in the way people think about energy. Making alternative energy sources valuable to society, while also making them economical on a local and national level, is crucial in making the sustainable energy movement successful.

The connection between economic and social issues is clear. Economic status has a way of raising social status, and elevated social status leads to an increase in economic opportunities. This makes it necessary for a diverse program of promotion for the green movement which includes careful consideration of these factors. Government programs subsidizing green action could make the economic barriers smaller, while community action could make green action a socially valuable activity. Both of these avenues could be acceptable methods, but it is community in which the change is desired which will determine which method is the most effective.

2.3 Cooperatives

Cooperatives create a strong bond between community members and involve the local community in the everyday management of the neighborhood. Cooperatives have been established at local markets, where people buy into the store and then receive discounts while shopping. Most cooperatives are a group of concerned and highly involved local citizens. In solar cooperatives the co-op serves as the middle man for purchasing the solar panels and hardware. The co-ops are able to drive the cost of a system down for the individual by buying some parts in bulk and having experts ready to install and help service the installation. Members of a co-op make an initial investment into the system, thus paying for the one time set up, and then a yearly or monthly fee is collected to stay a part of the discounted energy source. As energy is created from the solar panels it is fed to homes and any electricity unused by the home is fed back into the main grid, which causes the co-op's net-electricity meter to run backwards, in effect giving the co-op an energy credit (CCE, 2006) . Many energy cooperatives have been established in the United States, but the largest cooperative in the world is the Middelgrunden cooperative in Copenhagen, Denmark.

2.3.1 Existing Energy Cooperatives

During the past few summers rolling blackouts and brownouts, losing power and losing voltage respectively, have adversely affected the population California. This is due to energy demand exceeding the supply. For this reason, many citizens in the state have turned to renewable energy cooperatives. Among these startups are Cooperative Community Energy (CCE) of California, which is a buyer's cooperative. Instead of people buying energy shares,

they install solar in their home through the cooperative. CCE aids its members in every aspect of implementing solar technology, from sizing a system (determining the effective size for individual homes), to hooking into the power grid, to figuring out rebates and reading electric bills. Judging by the annual newsletter CCE sends out, this organization seems to be large and functioning quite well, although no actual figures are available. CCE has helped California schools install solar panels to reduce their electric bills. As a result of their success, CCE has helped homes, businesses, and schools continue to function during blackouts and brownouts.

Many people believe that solar electricity cannot work in the north where the sun's power is not as strong. This is untrue according to the Washington Electric Cooperative (WEC) in Vermont. WEC has been around since 1939 and is known for providing green energy to rural areas where it would be too expensive to extend the electrical grid. Currently WEC has approximately 9000 members, most of whom are residential members. Unlike CCE, WEC uses a multitude of energy sources to generate electricity for their members. From hydroelectric at the Wrightsville generating plant to the recent landfill methane generating plant, WEC has renewable power generation covered. WEC is currently looking into installing wind turbines in nearby counties in order to diversify their holdings. WEC operates on a share basis, each member buys a share worth a certain amount of electricity and the co-op generates the power, this is unlike the residential owned system of CCE. Although CCE and WEC employ different cooperative styles and energy generation methods, both are successful in their mission to create an involved, aware, and green community.

2.3.2 Local Cooperatives

A Danish wind cooperative combines the WEC and CCE methods into one. The Middelgrunden Wind Cooperative serves over 8,553 members, of the 150,000 Copenhagen citizens involved in co-ops. Middelgrunden installed twenty $2MW$ off shore wind turbines just outside of the Copenhagen harbor with a yearly output of $89 - 100GWh$ (depending on wind intensity). Like CCE, Middelgrunden is made up of only one type of power, and like WEC, members buy into the program by buying shares worth a certain amount of energy. In the Middelgrunden Co-op one share is worth $1000kWh$ (Sørensen, 2005), most members opt to purchase five shares. This co-op was started by the Københavns Miljø-Energikontrolen (KMEK), Copenhagen's Environment and Energy Office. However, a working group made up of interested citizens

took a strong leading position and pushed the project to its current successful level. KMEK takes care of the maintenance of the off-shore wind turbines making it so the members are not hassled with problems and do not need to have much technical knowledge of wind energy generation. Members are encouraged to attend the annual cooperative meetings and actively participate (Sørensen, 2005).

Copenhagen has one solar cooperative called Solcellelaug. Solcellelaug was implemented by the same people who started Middelgrunden Wind Cooperative. Solcellelaug was started by only two dedicated people and an investment from the Copenhagen Municipality of 500,000 DKK. Solcellelaug sold its shares for DKK 3000 ($500). The total electricity generation of the site is approximately $30,000kWh$ annually. This cooperative has 440 shares all of which have been purchased. One of the main factors for making this cooperative possible was a contract with Københavns Energi setting a fixed purchase price for the solar power for the next twenty years. The energy KE purchases from Solcellelaug, is used in their Solstrøm program. The share owners in the cooperative do no use the solar power created by the panels, but rather own a share in the system itself and can buy solar energy through Solstrøm.

2.3.3 Community Involvement

Community involvement is huge in establishing a cooperative. Without the backing of the local officials and utility companies, cooperatives will never become a reality. People need to be engaged in the decision making process and kept informed as to new developments (Sørensen, 2005). Involving the community from the very beginning is a key aspect of this type of project, especially in Denmark. Danish people like to be kept informed as to what is happening in their community and they do not like being told something is going to happen with or without their consent. Citizens feel more attached to the project and are interested in its success when they are allowed to participate in public hearings and open discussions.

This is especially important in a cooperative. Since the members run the co-op and vote on any changes it is imperative that they feel a part of the project. Members can run for the board of directors or other leadership positions within the co-op. Members also receive a vote at annual meetings. Unlike large businesses where a person's vote weighs as much as their share, in a cooperative each member gets one vote, the number of votes is per person not per share.

A co-op is created first for the good of the members not for the community. Due to this mindset many cooperatives members have created strong ties. When a new solar panel is installed in cooperatives in Vermont, everyone turns out to help and have fun. This process can be likened to a barn-raising in the old days when farming accounted for a large part of the community, friends, family, and fun. This type of camaraderie makes new members feel welcome and important within the cooperative. In Denmark, thousands attended the official opening of the wind turbines; they all took ferry rides out to the shoal where the turbines had been constructed. By being considerate of member involvement, the members are then motivated to get others involved. In California, CCE sponsors energy days where anyone can come and learn about cooperatives, solar power, or renewables in general. The co-op owners help new people learn to read a utility bill with renewable energy on it, how to install solar power, as well as how to maintain and use it properly. Kids are also accommodated with carnival games and snacks. Thinking of young families with children is extremely important to co-ops because those are the most likely sources of new members.

Creating a co-op is a huge but rewarding undertaking. No matter the energy type, there are success stories across the board and around the world. It is always important to keep in mind the general principles of co-ops so that nothing is done out of character. Establishing a link to the community is important from the start of the project, which draws on the Danish values of being involved and well informed. By keeping this trend of involvement throughout the creation of the co-op and beyond, the co-op owners establish a solid base for renewable change in the community.

2.4 Environmental Paths from Businesses to Consumers

In order to establish a marketing program for the eventual development of a photovoltaic cooperative, research must be made into previous endeavors of companies, businesses, and governments in order to involve people in caring about and supporting environmental initiatives. Some programs will start through government initiatives which place stress upon the commercial industry to comply with environmental constraints. These programs create a new purchasing dimension for consumers. Other programs are initiated by commercial industry to advance themselves past their competitors. These programs reach down to the consumer level and once again add the dynamic of environmental policy for the consumer in their purchase.

Figure 2.9: Energy Star Logo (Energy Star, 2006)

Other programs are directly targeted to the consumer on an individual level. These programs include promotions such as previously mentioned Sol 1000 but also include advertisement techniques that do not directly promote the purchasing of photovoltaics. These different programs combined discreetly raise individual awareness of the possibilities of renewable sources.

2.4.1 Consumer Incentives

In 1992 the US Department of Energy developed the Energy Star program which aimed to minimize the energy consumption of typical appliances. To appliances that fit the Energy Star certification, a badge was affixed visibly on the appliance, to show that their device is energy efficient (Energy Star, 2006). When the program was developed, specific criteria were enforced which appliances must abide by in order to contain the Energy Star sticker signifying that product is energy efficient. During the period of time when personal computers began to appear in households across the US, the Department of Energy decided this was a good venue to pilot the Energy Star program. A typical CRT monitor prior to Energy Star consumes about 85% more power than an Energy Star monitor(Energy Star, 2006). Computers sold under this program were branded both with a sticker and displayed within the software on the computer. This advertisement shows consumers that their computer is "energy efficient." Figure 2.9 shows the Energy Star sticker. Not only do consumers know they're saving energy and also money, but the sticker signifies they are also benefiting the planet as well.

The Energy Star program was successful with computers, and was then expanded in 1996 to include other appliances, including washer/dryers and refrigerators. With the expansion of the program, retailers and manufacturers of these appliances were required to display the energy usage of the appliance and the estimated yearly cost. The idea behind this move was to

present energy information as a factor that consumers must consider when purchasing a new home appliance. The strategy behind the Energy Star program shows the consumer how they can save money by purchasing an energy efficient appliance which also cuts down on energy consumption and saves the environment. The success of the Energy Star program shows an extremely effective method of public outreach: show how the consumer could benefit themselves from energy efficiency and cut down on national energy consumption as a whole.

2.4.2 Businesses' Environmental Marketing

In order to promote community involvement from different sources in the area, it is important to look at previous environmental initiatives that companies have taken to improve their business image. As noble as these companies are for obtaining their electricity through renewable sources or being particular on the source of their goods, these moves also is a hope to increase business to put these companies above their competition. Research on how previous companies have used this strategy provides insight into how small businesses in the Nørrebro area can improve business by adopting similar strategies.

Businesses such as Kinko's, IBM, and Starbucks have purchased energy certificates in order to assure consumers that a portion of their energy use is from wind generated energy. In April 2005 Starbucks made a press release stating it would purchase 5% of its energy from renewable sources. Consumers who purchase their coffee from Starbucks will know that the energy used to make their coffee came from renewable sources, specifically wind turbines. This marketing system may be the deciding factor of customers whether to choose Starbucks over a different café nextdoor.

Whole Foods is an American food vendor which is known for specifically selling only organic goods. In December of 2005, the company purchased enough energy credits from wind farms in Boulder, Colorado to cover 100% of their buildings' energy usage(Whole Foods, 2006). This remarkable purchase of over 458,000MWh makes Whole Foods the first Fortune 500 Company to cover their complete energy use by purchasing energy credits; the company hopes that other large corporations in the US follow suit. The marketing aspect of this business move is the idea that Whole Foods is more "Green" than other companies in the same business. Businesses not only invest in energy credits to improve their image while saving the environment, they also participate in social political issues in order to attempt to have an edge over their competitors.

As well as purchasing energy shares for its stores, Starbucks recently has converted to purchasing fair trade coffee. The corporation is assured that the farmer who harvested that coffee from its original source was paid fairly and under appropriate working conditions. This idea of fair trade coffee is an important topic to socially aware Americans (Starbucks, n.d.); the advertisement that Starbucks supports fair trade coffee is a marketing strategy that will attract concerned customers to the café as well as deter customers from Starbucks' competitors.

Although in the US companies have mostly advertised their support of various renewable energy programs, most Danish businesses are focused in the sale of Økologisk goods. These foods are alternatives to most agriculturally grown or harvested goods such as fruit, vegetables, dairy, and other grains. An "Ø" symbol is placed on a container guaranteeing the foods were harvested and treated in an ecological manner. In Copenhagen, environmentally concerned people do their grocery shopping at Irma Food Stores. With over 100 stores in the Copenhagen, Irma's largest marketing campaign is the sale of Økologisk foods. The company advertises their stance in store windows and states that customers specifically choose Irma for their selection of Økologisk goods. Some café s in the city purchase their coffee through fair trade organizations as well serve coffee with Økologisk cream. It is apparent that local businesses in the area are very conscious about environmental friendly treatment of food and the fair compensation for coffee farmers. The trend from businesses in the US may be a basis to promote the possible adoption of solar generated power for their stores to further bolster their corporate image against their competitors.

2.5 The Road to a Sustainable World

As the world steadily depletes the remainder of fossil fuels, some nations are fighting to obtain new sources of fossil fuels while other nations are striving to rid themselves of dirty energy generation methods from the previous century. The emergence of a strong renewable energy program is a necessity for the world. Governments and companies from most nations are making efforts to promote the use of renewable energy, but it is the cooperation of the citizens which is the key to the progress of sustainability. As one of the worlds leaders of renewable energy, Denmark's energy policies and high goals open the door to a future of complete sustainability. The use of photovoltaics is a major piece of the puzzle in the future of energy. Through international initiatives like Solar City and Agenda 21, the healthy

competition between countries and companies can help the global initiative towards renewable energy. On a more individual scale, citizens can participate in local energy cooperatives which have already been established in some nations. The involvement of the people is the driving force behind the success of any of these programs.

3 METHODOLOGY

The primary goal of this project is to aid the Nørrebro Agenda 21 Center in determining how to bridge the gap between solar technology and the Nørrebro community. This gap exists between two major entities: 'users' and 'promoters'. Users include individual people and small businesses; promoters are organizations such as Solar City, or Agenda 21 who set out to further integrate solar energy into the community. Every year the promoting organizations participate in Copenhagen's Miljøfestival in order to bring environmental organizations and people together. Although this is an effective program for Copenhagen, the targeting of individual neighborhoods is still an issue. In order for future generations of solar energy to flourish, the options for supporting solar energy must be explained and shown to the people in their own community. The methods to make this possible rely on gathering knowledge of existing efforts as well as information and tools that are available. Information must also be gathered on the community to assess the current situation in Nørrebro. After gathering information from the proper sources, an analysis of the situation must be accomplished to determine the direction in which to proceed to bridge the gap between those that promote the use of solar energy and those that may purchase shares in a cooperative.

Gathering information from a variety of sources is important because of the gap between users and promoters. The different perspectives available from each group will create an accurate picture of the current situation and identify the causes of the disconnection. In order to evaluate existing connections and disconnections, which could be important in the future, individuals, organizations and businesses were all asked about the solar energy awareness level of the Nørrebro community.

Because the project's final goal of starting a solar energy cooperative in Nørrebro is not attainable in only seven weeks, the project work in Nørrebro will create connections to stimulate community awareness of photovoltaics. To meet the broad goals of this project the following objectives were made:

- Assess community attitude of solar energy
- Evaluate the views of area business towards renewable energy
- Investigate existing programs raising awareness about solar technology

- Formulate recommendations for the Indre Nørrebro Agenda 21 Center

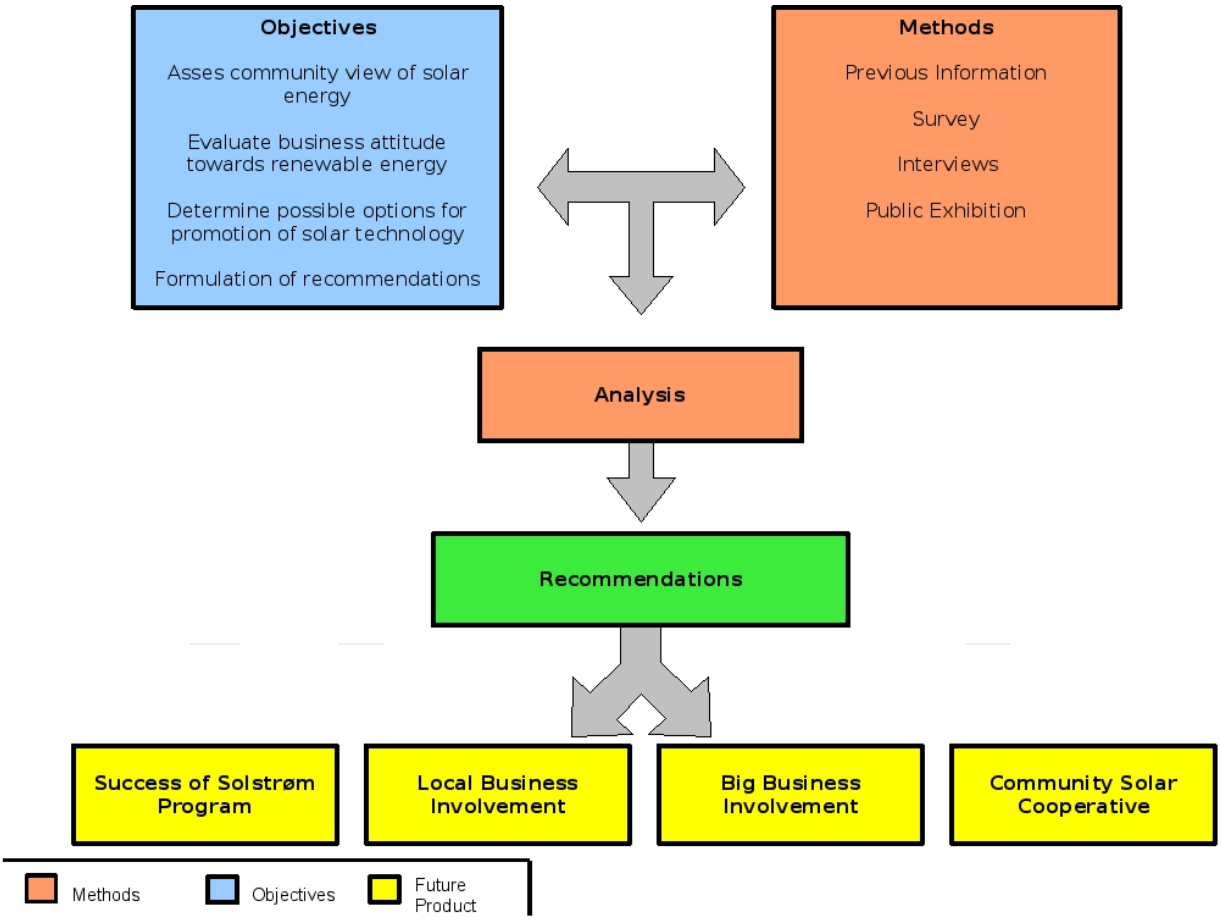


Figure 3.1: Methodology Flowchart

Figure 3.1 shows the steps that must be taken to achieve the final goal of this project. Although many of the objectives and methods rely on each other, in collaboration they form the overall analysis of the situation. This analysis leads to recommendations which if taken hopefully will lead to successful outcomes which are listed in yellow.

3.1 Community Attitude towards Solar Energy

In order for the development of a solar cooperative to take place, a strong and educated user basis must be established. To determine if members of the community are prepared to participate in this program, an analysis of the collective views of solar energy is necessary. Due to the existence of survey information that is fairly recent, analysis of Copenhagen as a whole can lead to which questions need to be asked of the Nørrebro community in particular to determine what separates the location from the rest of the city.

Previous community analysis by Københavns Energi (KE) gathered a large amount of data

about Copenhagener's feelings toward renewable energy and specifically solar power. KE had multiple surveys conducted across Denmark in 1998, 2001, and again in 2004 with a very similar survey conducted in Copenhagen (see Appendix A). Although the survey contained information from the entire country, some generalizations can be made about Copenhageners, and significant conclusions can be drawn. This survey also provides a foundation to work from to develop a similar community survey for Inner Nørrebro. Through analysis of the KE survey results and discussion with contacts in the Agenda 21 Center, gaps in the information required for this project were located in the KE survey and questions were reworded to address the necessary information pertinent to Nørrebro community. The tone of the KE survey can be used to determine the proper wording of the Nørrebro survey to make the questions as straightforward, effective, and professional as possible.

In order to make the process easy for the individuals taking the survey, the questions and multiple choice answers are translated into Danish. This survey can be found in Appendix B in English. Although these surveys could be administered over the telephone, the personal atmosphere and dialogue that can be conjured from personal administration of surveys dictates that they should be given in person. Cafés are an ideal location for people to take a survey, and Nørrebro has many cafés lining its streets. Café employees are approached first to gain permission to interrupt customers if consent is gained customers are then asked if they were willing to take a short survey. The targeted number of responses is between 25 and 50, which provides a basic foundation for local population trends to emerge. This survey will present the knowledge, desire, and potential of the possible users and shareholders of a solar cooperative. Through analysis of information gathered from this survey, the foundations of an ideal promotional program can be developed.

3.2 Evaluate Business Views of Renewable Energy

Background research indicates that local businesses both have impact on and are impacted by the policies of the community in which they reside. With this concept in mind the determination to gather information from local businesses becomes clear as a next step. It was ascertained that café s and grocery stores would be the most receptive to progressive energy ideas, and would have the largest amount of impact on the community. It has been previously affirmed that many consumers in Nørrebro will choose a store based on the business' support of Økologisk

foods. From this a parallel can be made to other environmental policies and that consumers may choose stores based on their support of renewable energy. The level of interest in solar energy is discovered through open ended discussions with café owners and managers. A major aspect of this discussion is to present the concept that investing in solar energy could create a more alluring business to environmentally conscience customers. Café and store owners can be interviewed between the morning and lunch time rushes so there is more time to talk without interrupting the flow of customers. This lets the owner feel comfortable with answering questions and be free to discuss interesting concepts because they are not disrupting their business. The interviews are conducted by two person teams in order to ask the questions and continue the discussion while recording responses and making observations about attitudes and the environment during the interview. The importance of the discussion with café owners is not only asking those questions but presenting the idea and option of renewable energy so they begin to think about it.

Small businesses as discussed previously have a connection with the community within which they are located, but these companies do not have any power to influence people outside their range. Different grocery store chains, similar to individual café s have policies on the types of food they offer their community. Irma is one such chain grocery store which offers the community Økologisk foods at a higher price than their competitor's normal type foods. This locates a possible opening for renewable energy in the same environmentally conscious light. Considering that grocers in the area including Irma are large chains, it is difficult to make contact with people who can make statements for the company or have any decision making power. Irma's competition must be approached as a control to determine if Irma's ecological policy holds any bearing on whether they would commit to the support of solar power.

3.3 Discover existing promotional methods

In order to thoroughly develop recommendations, different organizations must be interviewed in order to understand who is involved in solar promotion today. The following people were interviewed:

- Jens Larsen of Middelgrunden Windmill Cooperative, coordinator for KMEK, and member of Solar City Copenhagen
- Thomas Brædgaard Nielsen, head of KE solar division

- Jakob Klint, Architect, Kuben Byfornyelse and head of members for Solar City Copenhagen
- Karin Kappel, president of Solar City Copenhagen and key contact in Denmark's Sol 1000 program.
- Zahid Saleem of Cenergia Energy Consultants and Soltag Apartments representative

Each of these individuals holds an important role in the fabrication of solar promotion in the Copenhagen area. By meeting with people from different organizations and determining what is missing from the outreach efforts already in place, recommendations can be made about the creation of an effective outreach program for Indre Nørrebro.

3.4 Sol-Spænding: Solar Excitement

An excellent PV promotion opportunity is the Miljøfestival which is an environmental fair in May every year for all of Copenhagen. Many organizations listed above participate in the Miljøfestival advocating many forms of community awareness regarding environmental conservation. One of the topics included in previous years has been the use of photovoltaics, and Solar City in the past has established demonstrations for local residents and children to experience. This would be an excellent venue to promote PVs in Indre Nørrebro, however the festival takes place beyond the time limits of this project and therefore must be initiated by the Agenda 21 Center. Analysis from community information shows the promotion of alternative energy needs to be targeted in a more focused community level. To test the effectiveness of a live demonstration of solar energy and bring together solar energy promotion organizations, an experimental exhibition was coordinated. The small solar exhibition "Sol-spænding" (Solar Excitement) on 3 May is a pilot program targeted specifically towards Indre Nørrebro. The exhibit includes information that was gathered about solar energy and shows people that solar energy is present in Copenhagen. The information in the exhibit comes from contacts in the Agenda 21 Center, Thomas Brædgaard Nielsen of KE, and Solar City. Through analysis of existing installations in the city, it has been determined that PVs need to engage people more. Therefore, the exhibit includes solar toys such as windmills, helicopters, and other moving objects which catch the attention of people walking by or sitting in the square. A part of the program includes an idea contest. Post card size papers are designed to catch people's attention and be self explanatory for any participant. The small size is designed to keep answers short, and

make it easy for people take cards away if they are just interested in the design to show friends. Two questions are included on the card to address two separate issues facing solar proponents. The first question asks for a creative way to impalement solar panels in the Nørrebro community. The second question challenges the contestant to come up with a creative way to promote solar energy in the Nørrebro community. People who enter the contest give their address and e-mail which will create a contact list of interested people when the time comes for the development of the Nørrebro solar cooperative. Everyone who submits ideas or just enters their name on a postcard will be entered in a raffle for 250 Kr. Solstrøm package. The Solstrøm give away is designed to get at least one person involved in solar energy in the hopes that they will spread the word, and hopefully continue the program after the year is complete. The best response for each question wins the contest and these people will receive a model windmill which is powered by solar energy. Materials on display will also include an actual PV panel purchased though the Sol 1000 program for those who may have not seen a solar panel. The presence of the panel is generates interest and lets people interact with the power generation method. In addition, the Agenda 21 Center's "Miljøambulence" is a tool which can draw attention from a distance. This large van has display lights and radio powered by a PV on the side. The presence of this vehicle lets people know that there is an environmental event occurring. Photos and posters used for the solar exhibition can be seen in Appendix C.

4 ANALYSIS

Uncovering large disconnects between solar energy and possible users is not something expected to be so prominent in Copenhagen. The gaps identified include lack of knowledge about solar energy, few educational programs, and an absence of advertisement for solar programs. The search for the cause of this deficiency leads in many various directions ranging from government policies, to businesses both large and small, to the people of Nørrebro. Because promoters of solar energy are not making an impact on prospective users, a certain amount of curiosity and interest in solar technology was found in the community.

4.1 Current Situation of Solar Energy in Copenhagen

Denmark has a long history of strong renewable energy policies. In the 1970s the oil crisis sparked a movement to become energy self sufficient. This drastically changed the nation's energy policy. A major choice which had to be made was whether or not to invest in nuclear power plants. Plans were set forth for seven nuclear power plants throughout Denmark which would be able to supply plenty of power for the entire population. The Danish public however expressed strong opinions against nuclear power through many demonstrations. The decision was then made to not to build nuclear power plants and to never pursue nuclear power again. There scrapping of the nuclear power program left a large deficit in the Danish energy plan. In order to fill this energy deficit, the Danish government decided to begin work on an extensive renewable energy program which has now become a major part of Denmark's future. Wind and solar power arose as the two of the cleanest and most popular methods of renewable energy generation. At the end of the oil crisis, interest in photovoltaics dwindled due to high cost and low efficiency while interest in wind power grew. This early interest in wind energy propelled Denmark to become a world leader in wind power generation. With the integration of other programs including biomass and some solar energy, Denmark created one of the strongest renewable energy policies in the world.

To identify what solar energy needs in order to become a more widely used power source, it is important to look at the reasons why wind overcame solar in popularity during the 1970s. Solar technology in the 1970s was in its infancy with extremely low efficiencies, difficult implementation, and a high initial cost for little or no return over the lifespan of the installation.

Wind became the renewable source of choice mainly because of the weather in Denmark. With strong winds blowing directly off the North Sea into the city and without any hills to disrupt the airflow in Denmark's interior, wind turbines can be erected almost anywhere in the countryside. In this environment wind power is highly efficient. The turning blades of the wind turbines can be seen from a long way away, which lets the people, see the energy being generated. Implementation of wind generation in cities however is not possible because of the size of wind turbines and the amount of noise they generate. A low profile, quiet, and clean energy generation method caused local environmental organizations to start the movement towards solar energy. However, during the winter Denmark has very long nights with very little direct sunlight during the day as well as a year round tendency for cloudy days. These climate factors become the points on which solar energy is held up upon. Along with the climate factors, many also people think that solar energy can only be used at low latitudes mainly due to of the lack of sunlight during the winter at higher latitudes. This belief is not true, and must be thought of in terms of a full year and the amount of direct sunlight during the summer months. While solar is more effective at lower latitudes, it can still work efficiently in Denmark, especially with current advances in solar technology. This surface level of knowledge about solar energy in Copenhagen is shown by people's positive feelings but low level of activity.

4.1.1 Current Installations and Programs in Copenhagen

Although wind is the prevalent renewable energy source in Denmark, there are a number of high profile solar installations in Copenhagen. Most of these were supported by the Sol 300 or Sol 1000 subsidy programs offered by the Danish government. Some of these installations are visible from the street while others are not. Erik Christensen, chairman of Copenhagen's Solcellelaug, gained access to the roof of a municipal library to install the solar panels for the first solar cooperative in the city. On the flat roof of the library the panels face south to catch the sun most effectively, and because of the height shadows do not fall upon the panels during the day. Rooftop implementation is the most effective implementation style, but causes the panels to be hidden from public view. Erik Christensen's goal for the cooperative's photovoltaic installation was to have it be as efficient as possible. Other solar energy proponents like Jakob Klint, who is an architect as well as a head member of Solar City Copenhagen, establish photovoltaic systems which are possible for any passerby to see. These design oriented projects usually put the solar

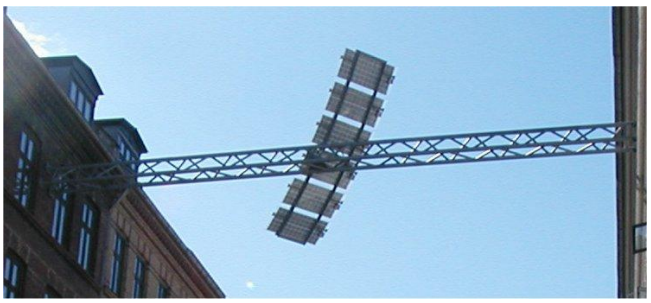


Figure 4.1: Street Installation in Vesterbro

panels in less efficient orientations however the system's purpose is different. According to Jakob Klint it is very important just for people to see the photovoltaic panels, and see that they can be implemented in aesthetically pleasing ways. There are a number of installations in Vesterbro designed to catch the public's eye and let the people know that solar technology is present in Copenhagen. One example of this is an installation that hangs over the street in Vesterbro. Shown in Figure 4.1, the idea behind this installation is to show people that solar panels can also be used in an artistic way. However, the response to this installation has been mixed. Some people think it is ugly while others like the display, but most people are unaware of it. There are other high profile installations on the entrance to the Zoo and near the Vesterbro train station. The majority of solar panels in Copenhagen are primarily installed for display rather than for generation of power in an attempt to interest the public in solar technology. Jens Larsen, who helped to initiate the wind cooperative, is the center leader of KMEK and also a member of Solar City, does not completely agree with the architectural view of installing solar panels. Larsen believes that solar panels need to be simply be distributed as much as possible and put in places where they are most effective, and that artistic systems do not aid the cause significantly. This difference in views can be read to show that there are many different styles of promotional efforts in the city and that it is necessary to determine what the members of the community are most receptive to.

This concept follows not only for raising awareness of solar energy but for motivating people to participate the solar power programs that are available. There are a few programs open to people who want to support solar energy, but they are not very well known. The first program available was the Copenhagen Solcellelaug, Copenhagen's solar cooperative. According to Jens Larsen the concept for the solar cooperative grew out of the Middelgrunden wind cooperative and used many of the same principles during startup and for the organizational structure of

the cooperative. The founding members, Erik Christensen and Peder Pedersen are both from engineering consulting companies. A small group of dedicated supporters gathered around the two founding members, these people were the motivating factors behind the success of the solar energy cooperative. Unfortunately there are no more shares available for the Copenhagen public to become involved with this solar energy cooperative. However, the fact that all 440 shares of the cooperative sold at 3000 DKK per share were all purchased within three and a half months of their initial offering shows a significant interest in solar energy in Copenhagen. The cooperative members own part of the solar installation and get 3% return on their investment per year. Jens Larsen who was very involved in the start up of Middelgrunden states that the best way to create a solar cooperative in Nørrebro would be to select a dedicated leader with a small group of about five enthusiastic and involved people. However, while talking to the Nørrebro community it was possible to see that these types of people are very rare, and must have a clear vision of how the entire project will be laid out. For people who do not have the time or dedication to start the cooperative it is still possible to support solar energy.

If people do not have time to become closely involved with solar energy, but do wish to support it, the Solstrøm program offered by KE is a good match. In an effort to cater effectively to Copenhageners' energy needs, KE purchases renewable energy from outside sources as well as generates its own wind power and solar power. Most of the solar energy KE sells through the Solstrøm program comes from independent generation sites, but primarily from the Copenhagen Solcellelaug. A 20 year fixed price contract assured the Solcellelaug members that KE would purchase energy from the cooperative at a price above the regular price for electricity. KE in turn sells this electricity at a slightly increased price to the people who participate in Solstrøm. It is a good option for people who want to support the solar energy cause, but not become overly involved. A problem is that neither of these programs is well known. It is understandable that the Solcellelaug is relatively unknown because of the speed with which the shares became unavailable. But, only 4% of the population of Copenhagen had heard of Solstrøm in 2004 and the Nørrebro survey confirmed that a similar portion of the Nørrebro community had heard of the program. For KE, solar energy is not a large money maker. The contract with the Solcellelaug causes the price of solar energy to be higher than normal, and the profit margin is small. This leaves KE with very little money to invest in marketing the program, and very

little desire to expand their solar energy assets any further.

For individuals who wish to purchase and install their own solar panels the Sol 300 and Sol 1000 are available as subsidy programs offered by the government. These programs are similar to the roof programs in Germany and Japan that were very successful and discussed in the background. Although the actual use of these programs occurs mainly in Jutland, Sol 1000 has some presence in Copenhagen. Several installations that have been put up in Copenhagen have been sponsored by Sol 1000. Only 32% of Copenhageners had heard of the solar installations in Copenhagen according to the KE survey in 2004. The government subsidy program is mainly in place to put solar panels out into the public where people can become aware of them. The problem with subsidies is that the economy surrounding photovoltaics in Denmark is not stimulated because the government is paying for it, and thus the overall price of solar energy does not drop. Because the subsidies cannot push photovoltaics or other renewable sources out into communities it is necessary to fabricate other sources of motivation.

To stir up more excitement and interest in renewable energy the Danish government sponsored a renewable energy contest across Denmark in 1997. The contest was between towns to present an environment that could feasibly become powered by 100% renewable energy within ten years. The winner was Samsø Island, and is now challenged to become 100% renewable by 2008 according to the plan it submitted as part of the contest. Samsø has not concentrated on any single type of power, but utilizes several different kinds of renewable energy (see background for description). Ærø was a competitor the same contest as Samsø, but when the community did not win they proceeded with their renewable energy plans anyway. Their goal is to become 80% to 100% renewable by 2008. The style of implementation matched the resources available to the people of the island.

These islands are prime examples of solar energy and other renewable sources hard at work. But, the most important aspect of the progress these communities are making with renewable energy is that they are doing it on their own. The government is not driving the people, but rather the community has come together and decided on how best to use their resources and what courses of action to implement. People have invested in or bought solar panels and wind turbines individually to work towards the common goal. The communities have also worked together to reduce all types of energy consumption and make the islands as efficient as possible.

These drastic changes in the way of life on the island have come about because the community as a whole is driving the change. Despite the fact that recent political shifts make future contests seem unlikely, the success had on Samsø and Ærø will be testaments to how social change comes about most quickly on a community level.

4.1.2 Solar Education in Copenhagen

There are few solar energy education opportunities in Nørrebro for the people who live in the district. The internet is a good resource, but sometimes information can be difficult to find or is unreliable. Mainly, people want to find information if they go looking on the internet. If a person is already looking on the internet for more information then the promotion and awareness programs are working. Most people have heard about solar through the media or by seeing photovoltaic panels at one of the many installations in Copenhagen. The installations in Copenhagen however do not have information about the installation near the system. It is difficult to learn the specifics about the systems displayed in Copenhagen.

Solar City Copenhagen, in conjunction with the Valby municipality, installed photovoltaics on the Valby schools and has initiated an educational project for children in the Valby. These schools organize projects for 4th and 5th grade students to take pictures of buildings then use a file of solar panel pictures to place the panels in a creative way in the picture of the buildings (Jakob Klint, 2006). Most students find efficient ways to place the photovoltaics on their home while others try to be more artistic in their designs. This project is not just for the children however, it is the hope of the program that they will bring home their work to show their parents. The idea is to bridge the gap between the panels on the school roof and the adults in the community through the children's projects. This program will also put solar energy into the minds of young people as something that is in their future and simple to implement. With young people feeling connected to the solar energy there will be fewer barriers to overcome in the future.

For older students, teachers have arranged visits to solar energy generation sites. Peder Pedersen from Cenergia Energy Consultants and one of the founding members of Solcellelaug invited us to one such field trip where Cenergia representative Zahid Saleem would be giving a tour and presentation about the Soltag apartment. The objective of the tour is to have students use information from the trip for class projects similar to the younger students, but

be more involved with the ideas of energy conservations and solar power generation. However, the students seemed uninterested and were not involved in the presentation. Few students took notes, and fewer still participated in discussion about the prototype solar apartment. The presentation was delivered as more of a sales pitch and unfortunately did not engage the students. This problem may have arisen because an investor company conducted the tour instead of an impartial educator. Giving tours of the Soltag to high school students is a good idea, and may help raise awareness of solar energy in the future. However, the current program does not interest the students effectively and many of the concepts are lost.

The need for more solar energy awareness stems from the problem that there is little common knowledge about how PVs work or reasons for implementation. It is possible to see from the Nørrebro survey that people believe it is someone else's job to implement solar energy. Although 100% of people surveyed had positive feelings towards solar energy, most said they do not have the time or the money and do not think it is their responsibility to implement solar technologies. Connected with these two responses was another question asking if their energy company, KE, should be investing in solar energy. The majority of respondents stated that KE should support solar power this reaction is not completely unexpected due to the structure of the Danish Government. The Danish people expect their government to set and enforce necessary policies for the benefit of the population. However, recent shifts in the government have placed many public institutions in the hands of private companies and individuals. This shift causes some people to be unsure where responsibility lies, with the government, the business, or with individuals.

Although people are unsure of where responsibilities lie, they are sure that they want to learn more about solar energy. An overwhelming majority of Nørrebro survey respondents wanted to learn more about solar energy. The very few who did not want to learn more usually said that they were involved with solar energy or had a close friend who was, so any information about solar energy would come from them. Of those who want to learn more they would like to learn more through TV and Radio, Newspaper, and the internet. This data gives a base for knowing what kind of solar promotion program should be put into place. A program that uses any of those mediums should be well received. One answer which received very little attention was live demonstration. From the other survey answers it was determined that the cause of the lack of

interest in a live demonstration came from people not really wanting to be involved. Engaging the people is an important part of any live demonstration, and this was tested on May 3, 2006 at the Sol-spænding exhibition event. By placing the event in the middle of a popular outdoor spot on one of the first warm and sunny days of spring, the public was placed right next to the solar energy exhibit. This pilot educational outreach program included moving solar toys and a solar panel, which was powering lights and a radio. The toys drew the attention of many young children who inevitably dragged adults over to the solar power exhibit. Information on energy conservation, the technical aspects of photovoltaics, and Solstrøm was all available for the people to take. The people were also asked to become involved with the exhibit through a contest. The contest challenged the participants to think about the marketing problems facing solar energy. In addition to engaging people's minds in solar energy, some of these ideas could actually be used to promote solar energy awareness in Nørrebro. The success of this event shows that people really are open to, and quite interested in live demonstrations. But, the survey result does not reflect this because people are unsure of how involved they should be in the process. This uncertainty about how involved to become might be due to the political system which has been slowly changing over the last decade or so.

4.2 Political Shift

In 2005 the elections of new Parliamentarians turned the government in a new direction. The Social Democrats were ousted from the majority and were replaced by the Liberals (Venstre) who have made major policy changes. The Social Democrats had made large strides in the energy policies and in implementing solar energy among other renewable sources. They had initiated a plan to have 80% of the total power generated from renewable sources within fifty years, but that plan was dropped by the new government. The renewable energy research budget was also cut in half by the new government (Martin Lidegaard, 2006). This policy change in conjunction with the European Union dropping solar subsidy program has deterred many people from investing in solar panels. As was discussed previously however studies show that the subsidies actually inhibit the growth of solar power (USDOE, 2003). People who are not aware of the bigger picture do not understand how subsidies could inhibit the growth of photovoltaics. But it is a fact that subsidies do not stimulate the economy enough to continue economic growth in solar energy on a long term scale. Despite the current government's low

interest in renewable energy they are interested in energy conservation. In early 2006 a new energy audit policy was passed called Energy Performance of Buildings Directive (EPBD), which tightens restrictions on how much energy a building can use in the next twenty years. This policy has started many homeowners and realtors thinking about how to make their buildings more energy efficient so that they conform to the new standards. This new policy has little to do with solar power, but it shows that the government has some interest in energy, however small it might be. This small amount of interest has kept the door open for solar energy in the government. Using interested political parties, such as the Red Green Alliance, solar energy and renewable sources can be brought back into Parliament. Gaining interest in the public eye will also help push solar energy concerns into parliament.

The political shift goes back further than just this last regime change. Over the past decade there has been a government move to privatize industries which were previously government owned and operated. For example, KE owns the electricity grid in Copenhagen, where the grid was previously owned by Copenhagen Municipality. The Copenhagen Municipality attempted to sell off the city water supply as well to private companies, but the people petitioned and the idea was dropped (Sys Hansen, 2006). Having private companies own the electric grid allows people to choose from a few different energy suppliers and for companies to compete on prices and policies. However, people did not want the same options for their water supply. People still want to be involved in the decision making process, but only to a certain extent. They are not quite ready to let go of all responsibility, but the new structure allows them freedom to choose between providers. The privatization process has actually created a bigger push for wind power and left solar power further behind. Wind has a faster return on investment (ROI), which is what private companies base their profits on and solar has a much longer ROI and is less efficient than current wind technologies. Private companies realize that the environment, both physically and mentally, is right for wind power, and are taking advantage of the opportunity. For this reason, the industry surrounding wind turbines, from manufacturing to maintenance, has become strong in Denmark. The privatization has also created a loss of interest in cooperatives. People expect the government to take care of their energy concerns and support renewable energy if it needs to be supported. Because the government is now absent from this role, people have shifted the same expectations onto the energy company. People at

this point do not wish to become involved in the process, and do not realize it is an option to become involved by way of a cooperative. The element which is still unclear to the majority of the population is KE's position as a private capitalistic company whose primary concern is their bottom line. In order for KE to pursue solar technology, they will need to be making a good deal of profit from it, or see long-term advantages for the company in the investment.

The Red-Green Alliance is the smallest Danish political party and has the strongest environmental policies of any party. The Red-Green Alliance only has six representatives in the parliament which makes pushing any policy forward extremely difficult for the Red-Green Alliance to do alone. With many different political parties participating in the Danish government it is always necessary for the politicians to work together across party lines. The convictions of the Red-Green Alliance make the party a perfect spokesman for the solar energy cause. But before any progress can be made it is very necessary to gain allies outside of the Red-Green party. The job of gathering people around a central point is challenging but this process occurring inside the government could work well in conjunction with pressure from the public outside the government. The hope is that the Red-Green Alliance can be a rallying point for other environmentally interested political parties and together they can move new solar and renewable energy policies through the government.

4.3 Solar Energy Awareness

When promoting any type of new idea in a community it is important to understand the community you are working within. As in other areas of Europe, Danish citizens rely on the presiding government to establish large programs that individuals can take part of at the community level (McKenzie-Mohr & Smith, 1999). The people of Denmark prefer to decide on changes rather than having the changes imposed on them by the government. Therefore, the best method of promoting green values will be to do it from the local level, after which the people will call for action by the government. In this way the social and economic barriers can be overcome in a manner acceptable to the Danish people. Community promotion is a process that distributes an idea or behavior on a community wide basis. This method of social change can be successful because the program is tailored to each community and its individual characteristics. This section gives a brief overview of some reasons people do not actively seek out sustainable energy practices, as well as some methods to change social values. This topic

is explored in a much more in-depth manor in a book by Doug MacKenzie-Mohr (1999) called Fostering Sustainable Behavior: A Guide to Social Marketing.

4.3.1 Promoting Awareness through Installations and Programs

Solar energy is known to the majority of the Nørrebro population according to the Nørrebro survey. The population's surface level knowledge of solar energy is shown by 78% of the 2004 Københavns Energi survey participants being unaware of solar power installations in Copenhagen. This is due largely to the low visibility of and low level of excitement surrounding solar panels in Copenhagen. Wind turbines are extremely large and have moving parts making them highly visible. Solar panels are flat and can be integrated into windows, roof tiles, on roof tops, and as fa cades of walls. This versatility enables solar panels to be aesthetically pleasing as well as unobtrusive to the outside observer, but the versatility also causes photovoltaics to be overlooked by the untrained eye. From a promotional stand point the strong contrast between the ideals of being unobtrusive and being well known is problematic when trying to raise awareness about solar energy.

There are some methods of marketing that are already in place that could increase the interest in solar in Copenhagen. Solar City's elementary school solar project program is another type of marketing. The hope is for the children to bring their ideas home to parents where the adults will be interested in what their children are doing to the point of being motivated towards action. The parents are the current target group for this program, but the idea also is to make solar energy something that is socially normal for the children. This clever promotion of photovoltaics on two levels still works if the information does not reach the parents because the young kids feel that solar panels are a normal occurrence.

Soltag is another clever form of advertisement and use of solar energy for all the private companies which helped to design and manufacture the prototype apartment. Because Soltag is an apartment that fits onto the roof of an existing apartment building it could be implemented in many different places and is completely CO_2 neutral. The apartment uses solar electricity, solar heating, preheating, and energy efficient windows, lights, and insulation in order to remain CO_2 neutral. Although Soltag is not officially on the market, the prototype apartment on display the campus of Denmark's Øresund Technical University can be used for educational purposes. This educational tool is not only used by the local high schools for field trips but for college

Figure 4.2: Soltag on Technical University Campus (for more pictures see the appendix

classes, on the campus where it is located. This location on the college campus is a marketing technique to get young people thinking about environmentally friendly housing, and possibly buy a Soltag apartment later in life.

The collaboration of businesses on a solar project like Soltag is just one way for businesses to become involved with solar energy. Businesses in the United States have started to buy green energy certificates and are advertising the fact that they use renewable energy. Green energy certificates work much the same way that the Solstrøm program works, where the companies buy as much renewable energy as they want. This process is complicated because there are not renewable energy generation sites everywhere these companies want to purchase power, so energy brokering companies buy and sell renewable energy certificates. Some examples of this are Starbucks, Staples, IBM and other large corporations. Corporations marketing their renewable energy use are attempting to draw in environmentally conscience customers. This is even more pronounced in Denmark and especially the Nørrebro community of Copenhagen, where the population is already aware of environmental issues. Having large businesses participate in solar technology will have a more widespread effect, but small businesses participating in solar technology will bring the concepts closer to the community.

Promotional exhibits like Soltag are a way to get solar into the community, but other exhibits need to be just as visible and interesting. The Copenhagen Zoo has a solar installation on their front gate, but because the panels and building are the same color most people just look right past them. On a positive side, the installation has a display in the corner which shows the daily and yearly energy generation. The difficulty of noticing the zoo installation is not good for the

visibility aspect of promoting solar energy, but shows the potential for solar to be completely unobtrusive in everyday life. The proposed barn installation in Valby is an example of a highly visible solar installation. This arrangement of solar panels and neon lights was produced by an

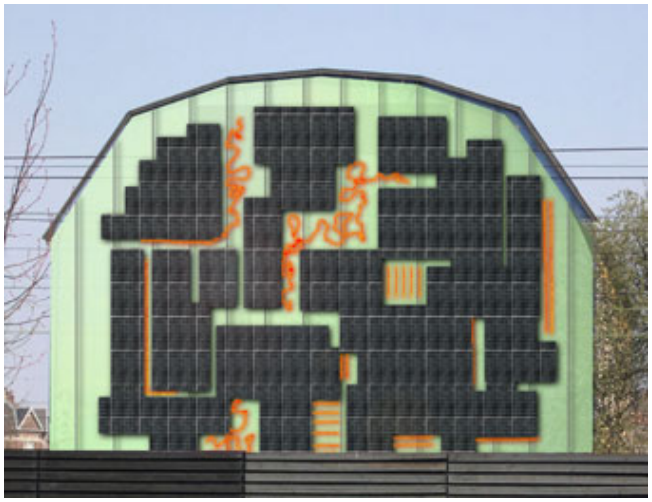


Figure 4.3: Solar City installation in Valby

artist as part of Sol 1000. The site is visible during the day and at night, but this does not mean that people know what it is or that they think about solar energy when they see it. The design is so creative in fact that people may not realize that it is constructed from solar panels instead of just being a piece of art. Some people may see the installation and think about solar energy, but they will not be thinking of energy conservation because the installation uses all the energy generated during the day to power the neon lights at night. The visible solar sites need to make people think about solar energy generation when they see them. The hidden sites need to draw attention to themselves and let people know that they are being used to make solar power more prevalent in Copenhagen.

4.3.2 Economics

Solar is also difficult to market because of the preconceived notions that people have about solar energy. Solar energy is expensive, as 66% of the population said in 2004, although it is cheaper than it was 30 years ago, and its ROI is still high. Another misconception is that solar cannot work in Denmark because the latitude is too high. Solar can actually work more effectively at the higher latitudes because of the cooler air temperatures when the sun does shine, creating higher efficiencies in the panels. This means that solar power cannot be the complete solution, and should not be trusted to power any type of important system alone, but

can be a major energy generation contributor.

Currently the most important aspect of marketing is the economics of the product. The economics of solar panels is important to the consumers, who are worried about the ROI, although that should not be the only factor when buying a solar panel. The difference between solar panels and other forms of energy is that solar energy is more than just a way to get electricity; it is a statement about the person who purchased the panels. Someone who buys a Lexus does not buy it because it is inexpensive, but rather because it is about the image of driving a Lexus through town; it makes a statement. The same principle applies to solar panels, it is not about the cost, but about the image it creates when one installs them. This concept is difficult to market because most consumers cannot separate the image from the price tag, when they are separate ideas. It must be conveyed to the consumer that solar energy cannot be implemented because it is cheap, but rather because it is the right thing to do.

It was because of the expense of solar panels that government and energy providers began offering subsidies and tax breaks to people who installed solar panels. These subsidies allow people to buy a solar system at a decent price, although still relatively expensive. The subsidies, however, allow manufacturers to keep the prices high and not develop innovations to make solar panels less expensive. This thus does not build the economy around solar energy, does not create new jobs, or encourage competition between companies. It is for these reasons that the EU dropped the subsidies on solar panels. Companies must pick up where the subsidies left off in creating new ideas and innovations in the solar industry.

4.4 Solar Supporting Organizations and Businesses

The organizations and businesses in Copenhagen that promote solar energy have been doing so for several years. These include the Agenda 21 Center, KE, Solar City and its member companies, Soltag investors, and the Solcellelaug. These groups are able to promote solar energy through their own marketing scheme and create more interest and business in the process. The interesting part about this odd congregation is that they all have access to the Copenhagen population at different levels. The different resources brought to the table between these groups are quite diverse.

The Agenda 21 Center is one of the few organizations that relies on grants and volunteered time to promote not only solar energy, but also energy conservation, waste management, and

other forms of renewable energy. The organization is successful in promoting some of these concepts to the Indre Nørrebro community. The center has an environmental van which has information about conservation of all different types as well as a mini windmill and solar panel which run small DC (direct current) devices. The Agenda 21 Center also participates in the Miljøfestival every year in May. The promotional tactics of the Agenda 21 Center include brochures and a small community newsletter, as well as some articles in the larger newspapers. The one downfall of the Agenda 21 Center in the past was the lack of funds to support any long term promotional activities. Recently the Agenda 21 Center received 100,000 DKK through a grant, which will be used to start the cooperative. This Agenda 21 Center is well known in the community and has the resources to be able to reach the general public quite effectively.

KE supports solar technology mostly though the Solstrøm program that has not been too successful. With only 4% of Copenhageners knowing about the existence of the program and less than 2% participating, it is easy to determine the reason for the small size of the program. Because KE does not make much profit from Solstrøm, they are unable to have a large scale advertising program. KE promotes energy conservation at its appliance store in downtown Copenhagen. At the store energy efficient appliances are demonstrated and sold; these appliances are similar to buying an Energy Star rated product in the United States. KE is not connected to the community at the same level as the Agenda 21 Center, although the community makes up most of its customer base.

Solar City is an EU organization that is made up of different businesses who are interested in promoting solar energy. These businesses have installed solar panels on schools and businesses in Copenhagen in the hopes of increasing interest in solar. Solar City is also responsible for engaging the schools in solar energy which is the perfect time to start the education process. Besides engaging the schools for education and marketing, Solar City has also invested time and money in the professional arena. Solar City holds conferences where professionals from solar companies, universities, or researchers come to hear different lectures on solar energy. In addition to attracting the professional community, Solar City has engaged the community a few times through similar conferences and trips to solar panels sites. Like Agenda 21, Solar City has participated in the Miljøfestival. Last May Solar City had a floating dock in the lakes which they turned into a solar island for the two day festival. There was information for every

age and expertise level, which allows the community to come together as one to learn about solar energy. This type of outreach is good because the people not only heard about solar power, but they saw it working in practical ways.

Soltag investors put money into the CO_2 neutral apartment and collaborated their different types of expertise to construct the energy efficient apartment. By participating in the project these companies are able to advertise that they support solar energy, which makes them appealing to new customers. The companies who made the windows, Velux, can now advertise that they make energy efficient windows that are part of a CO_2 neutral apartment. This type of expertise in energy efficiency draws consumers away from other companies generating more business for Velux.

The new and revolutionary Copenhagen Solcellelaug has received much praise for the ingenuity of their energy generation organizational structure. The process is interesting because it is a cooperative of almost 500 people towards a single business venture, but also because it puts the power to generate energy in the hands of the public. The aims of the Solcellelaug according to Erik Christensen are to inform additional citizens about PV, to coordinate help with Solar City Copenhagen, and hopefully to soon implement more solar cooperatives around the Copenhagen area, especially in Nørrebro.

The existence of these organizations and companies provides many resources for a future solar energy awareness program. The different levels of influence which the groups bring are very important to influence the population from many different angles. Collaboration between just some of these groups would be a very powerful alliance and could push solar energy into the public eye.

4.5 Potential Users

The success or failure of solar energy in Nørrebro lies in the hands of the people. The potential users include not only the residents of the community, but also the small businesses and large businesses in the area. These users have the ability to help solar flourish or let it falter. It is the responsibility of the groups discussed in the previous section to adequately present programs to the public. To complete this task understanding the community is essential.

4.5.1 Community Residents

Evaluating the view of potential solar energy users is important to understanding of the location of solar interest in the Nørrebro area. To develop this understanding a total of 58 Nørrebro residents were surveyed. The environment for the survey was always relaxed and open for discussion if the people wished. The twelve questions included on this survey were multiple choices to make the time commitment as short as possible. The questions were designed to mimic the style of the professionally designed KE survey and build upon information gained from the analysis of that data. The number of participants is not enough to use any of the statistics as accurate representations of the Nørrebro community but can be taken as general trends in the population. The overall results showed that people in Nørrebro have basic knowledge that solar energy exists. But as most people took the survey they became more involved with the concept and were interested in learning more. The openness to learning more about solar power is an excellent sign and shows clearly that the promotion agencies are not making much penetration into the public. If people are interested, then it should not be difficult to reach them with simple outreach programs. It was interesting to see that over half of the participants were interested in a solar energy cooperative. This interest came with very little knowledge of what the setup would be like and no idea of how the program would take shape. This interest which was not shared by the other half of participants which is not surprising. People are usually very reluctant to show any type of program which they do not understand. It is the interest in learning about solar energy that is key, because with this openness information can be distributed to let people know what the program is about. The complete findings with individual analysis of each question can be found in Appendix B.

The determination of why people would not be interested in a survey would aid in developing a program to promote the cooperative. With the knowledge of people's reasons for not being interested, a program could be designed to minimize those barriers and maximize other benefits. Of the survey participants who were not interested in solar cooperatives, a small number cited not enough time as the reason, and it was even less people who said that they were just not interested in a cooperative. This small number of people who are uninterested because of time shows that some people could be interested in a cooperative, but are lacking the knowledge to feel comfortable with the concept, and are not currently willing to put time into

learning. Almost all the respondents who were not interested in a solar cooperative, strangely enough were interested in learning more, which again shows that they are willing obtain more information and in time possibly change their opinion. As described previously this information must be presented in an acceptable fashion to the community, which may include radio, TV, newspaper, and internet as cited in the Nørrebro survey, as well as a live demonstration or exhibit as tested by the Sol-spænding project. The live demonstration actually produced useful results from the contest administered during the day. Because of the prizes involved people participated in an idea contest. Everyone was entered into a raffle drawing for a 250 DKK Solstrøm package. But, the ideas generated from this contest could be very important and some are feasible to implement. Of the 30 responses collected over the three hour duration of the exhibit approximately 12 respondents had excellent ideas for one or both of the questions presented. For creative implementation of photovoltaics in the Nørrebro community people suggested: on traffic lights, roof of community house or church, solar powered windmill in the park, solar powered water fountain, on bike garage coverings, on bus stops and sausage vendors, on train stations, on the graveyard wall, and covering current sculptures. The bus stop and sausage vendor suggestion was the winner from this group of suggestions. For creative promotion methods people answered: a marry go round in the square, fun fair run by solar cells, solar powered moving sculpture, advertising on bike flags, advertising on city bikes, a sticker done by a local artist for people to wear, street art. The winner from this category was the advertisement on bike flags, due to its simplicity and ease of implementation. Not only did the contest gather these great ideas from people but it also got their contact information so they can be some of the first people to be contacted when the cooperative is ready to begin. The whole solar excitement exhibit allowed for a chance to observe the people of Nørrebro. When approached people were very willing to participate, but if they were not approached most people would just sit back and be curious from a distance. The volume of information available, either through visual queues, posters, or in fliers there was something for anybody who walked through the square.

Through observation and talking to local activists it was possible to see that the residents of Nørrebro are more environmentally conscience than the rest of Copenhagen. In Nørrebro the demand for ecological food and drink is especially high, so businesses cater to that demand. If

a café does not serve ecological coffee or food a potential customer may be driven away. One café owner related a story about residents being sensitive enough to ecological foods that the lemons for their water had be ecological, or the person would not take the lemon. It is this awareness about ecological food that makes this the right neighborhood for progress in solar energy. The community is already knowledgeable on many environmental ideas, they just need to be more informed about the issues.

4.5.2 Cafés and small businesses

As an important part of the community the local cafés were very important to gather information from. Nørrebro holds the highest concentration of cafés of any area in the city. They are a place for people to gather and have quiet conversations and discuss current issues. Customers choose a specific café for many reasons, some include atmosphere, location, and the type of food and coffee served. The type of food and coffee is especially important in Nørrebro where people are highly conscience of ecological food. Many people will only eat and drink ecological products, which means that cafés are forced to serve ecological food if they wish to stay competitive. Having a neighborhood this concerned with the environment makes it the ideal place to start the process for a new solar cooperative. Here people are open to new and environmentally friendly ideas, which is why this is the area that first started heavily using ecological goods. Ecological cafés seem to be more popular than ones that are not. These cafés prominently advertise the ecological coffee, pastries, sodas, and other food that they serve. Because cafés are open to ecological food, and the current mindset of the population, they are also open to solar energy. If solar energy became popular in Nørrebro the cafés would have to support it in order to retain customers. If cafés began using solar energy, then some customers might be persuaded to change shops because of that. The café owners that we spoke with were unable to determine if customers would change cafés just because of solar energy. They seemed to think that there needs to be more awareness before switching to solar energy would make an impact on their business or in the community. Many cafés cited purely economic reasons for being reluctant about supporting solar energy. Several cafés are just starting up and are still paying off initial costs, while other cafés were experiencing slow time and had very low cash flow and would have to wait until business picked up again to make any decisions. These cafés state they are unable to participate in solar energy because of cash flow, so with this in

mind we determined that a logical step would be to approach larger companies which do not have the same type of low profit margin that the area cafés do. It is then possible to determine whether it is the environmental policies or just the economics which are making the decisions for the business.

4.5.3 Large Businesses

Just as the small businesses are a part of the community the larger businesses and café chains are also potential users who would be willing to invest if they thought it would be a large draw for consumers. Grocery stores that cater to the ecological mindset of the community, such as Irma, are a good starting point for marketing solar in large businesses. Irma's selling point is their high volume of ecological foods and customers are drawn in by their environmental policy. This background creates a perfect opening for the promotion of renewable energy. Netto and Aldi would also have to invest if they wish to remain competitive in the Nørrebro community. The chain reaction is based upon the fact that people will notice that Irma and other stores support solar and that the people will actually care enough to support Irma because of it. Unlike the cafés, large businesses can afford to invest in solar energy, but the investment happens at a high level of management which is difficult to influence. Although the contact information for the grocery stores was obtained from local managers, the upper management did not make any efforts to meet with us. Some offices requested emails to certain individuals. These emails however were never returned. The determination from this experience showed the need for diversity in a team of people working towards solar energy. As college students we did not have the knowledge of the correct channels to use to contact the management of large businesses. However, an organization like Solar City Copenhagen would have the necessary amount of reputation and clout in the political and professional scene to make contact with large businesses.

5 CONCLUSIONS

Soon after the start of the project the true situation of solar energy in Copenhagen was discovered. The level of awareness was far lower than had been previously expected. It was quickly identified that this project would be preliminary to any action taken towards the establishment of a solar cooperative in Nørrebro. After meeting with Københavns Energi (KE) and the leader of a cooperative, it was realized that the logistics for the startup organizations of a new solar energy cooperative presented a significant challenge. A high level of awareness about solar energy and a strong commitment to environmental values in the community would be necessary to make setting up a cooperative possible.

The first and most prominent osbstacle to a cooperative was Københavns Energi. Because the Solstrøm program does not have enough customers, supply is higher than demand and KE would not be willing to sign a contract with another solar cooperative. One of the promotion techniques used for the Solcellelaug was to show investors that they would receive a small return on their money, without a KE contract this would not be possible. This means that the energy company would not sponsor the integration of any more photovoltaics into the grid without more participation in their Solstrøm program. There is a need for customers interested in participating in Solstrøm and investors who are interested in starting a cooperative.

5.1 Understanding the Nørrebro Community

The information gathered by Københavns Energi (KE) over multiple years and the Nørrebro survey led to the determination that people in the community are not aware enough of solar energy options available. After this determination, our research became directed at finding out how to raise awareness about solar energy. The highly positive attitudes found in the community correlated with a desire to learn more about solar energy, although people still place the responsibility of implementation with the government and KE. These positive feelings about solar energy, which are pervasive throughout the community, need to be transformed into an aspiration for implementation. However, people do not feel that they have the responsibility, the time, or the money to support solar technology.

One of the most important characteristics of the Nørrebro community is their high level of environmental and ecological consciousness. The commitment of the Nørrebro community

to environmental and ecological issues creates the perfect atmosphere for this project. The public's dedication to purchasing natural foods pushes many cafés to cater to this demand. Most successful cafés in the area are highly conscious of using all ecological products and one café uses free trade coffee. This shows awareness of world issues and environmental consciousness which is a perfect foundation from which a strong solar program in the Nørrebro community can be built. The heightened environmental and ecological awareness presents an opening through which the idea of solar energy must enter.

5.2 Business and Organizations in Solar Technology

The local businesses' place as a key part of the community was recognized while conducting the survey of individual Nørrebro residents. The ability to influence customers and the community at large is not a power that these businesses are accustomed to wielding, so it is important to gather as much information as possible before recommending action.

Although the people demanded ecological food from the café s no one has yet demanded that they use renewable types of energy. Because the café s are open to the ecological mindset of the community, they are also open to the community's environmental concerns. Solar energy is not prominent in the community so café s have not invested in solar energy. Some cafés cannot afford to support solar energy unless their customers support them, so there needs to be more outreach to the community before cafés will jump toward solar energy. This view of investing is the same as was discussed in previous sections, where the business only think of the bottom line instead if issues outside of economics. Some large companies like Starbucks and Whole Foods have thought outside of the economic box and invested in renewable energy even through it is more expensive to buy that type of energy. If this concept can be related to the businesses in Nørrebro it will not be too difficult to have one or more cafés consider participation. If a couple small businesses invest in solar technology a chain reaction could be started in which other small businesses are forced to invest in solar power in order to stay competitive in the community. This concept draws from the knowledge that the residents of Nørrebro and Copenhagen are quite environmentally interested. Buying solar brewed coffee would be another way that the community could support solar energy, but the community needs to demand solar energy investment from cafés first.

Irma is the large grocery chain that also caters to the ecological trend, but is difficult to

influence because the chain is so large. Where the local businesses have a connection to the community, the larger businesses have a much more wide spread effect reaching outside the borders of Copenhagen. For this reason it is best if a higher level solar organization contacted large businesses like Irma. Solar City Copenhagen would be the perfect choice to contact grocers such as Irma and Netto, because they will be able to reach out the higher levels of management. Although Solar City does not primarily deal with consumer businesses, their position in the community makes it an effective group to involve larger businesses.

There are a handful of solar organizations in Copenhagen that all have the same goal of implementing more solar technology in the community, but they all approach promotion in different ways. Some organizations are implementing aesthetically pleasing sites at schools and public spaces, others are investing in Soltag, some are promoting solar on a government level. This multifaceted approach to promoting and implementing reaches out to all sects of the community, but there is little coordination between the groups. If these groups connected they could outreach more effectively to the programs that each is promoting. Although these organizations are working on solar energy, most people in the community do not know this. The organizations need to become more visible to the community and there needs to be more cooperation between organizations.

5.3 Promoting Photovoltaics

It is generally known that solar electricity is not a quick and easy way to make money; it is also generally thought that solar panels are not a worthwhile investment. Solar electricity currently has poor economics due to high startup costs and a low rate of return. A complete return on investment is fifteen to twenty years. However, this outlook does not take into account the environmental impact the photovoltaic panel has over its approximately thirty year lifespan or the social prestige that comes with owning a solar panel. The environmental impact and social prestige are two factors outside of the economic realm that must be kept in mind when publicizing photovoltaics because within these two issues solar energy will be able to excel at the community level. In showing the environmental impact that PV has over its life time many ecologically minded people will be willing to invest in solar power. By showing the social prestige that solar power can bring to a person, it is possible to grab a different portion of the audience. It is in the combination of these different aspects of solar energy that an effective

promotion program lies.

Current methods of marketing solar electricity are making only surface level penetration into the minds of the Nørrebro residents. Knowledge of renewable energy and environmental issues is at a high level, however the knowledge of solar energy as a viable option for electricity generation is very low. Newspapers and television ads have heightened awareness that solar power exists. Solar panel installations at the Copenhagen Zoo, Tivoli, and around Vesterbro and Valby have raised the awareness that photovoltaics are being used in Copenhagen. But this is where the awareness ends and sometimes the impression that these installations leave is negative. Photovoltaics are fundamentally difficult to market due to one of its strongest qualities; its unobtrusiveness. Solar panels are normally placed on roofs where they receive the most direct sunlight and avoid shadows, but the panels are hidden form the public eye. This problem exacerbated by the need to raise awareness about solar energy and the idea that placing panels in plain view will better promote the technology, but creates poor aesthetics because their placement. People do not acknowledge solar power when the panels are out of sight, but they do not like the aesthetics when they are in view. The people who do not like the sight of solar panels may not understand that these installations are only to raise awareness and are not effective for generating power due to their angle with the sun. Solar panels need to be more visible in the community, but in a positive way.

This project developed over the course of seven weeks to become the preliminary work to starting a solar cooperative. The Nørrebro community is the perfect place to start a cooperative because they are open to ecological ideas and have a positive attitude towards solar energy. Many businesses are investing in solar energy in their own way and it is the diversity of approaches to the issue that creates gaps in the information presented to the community. Cafés should be involved in creating a positive atmosphere for a solar cooperative because they hold sway over the interest of the community. Large businesses are more difficult to reach and influence, so a larger business such as Solar City should contact them in the hopes of convincing them to invest in solar energy. Investing in solar energy is not just about expense, it is about social image that one has when investing or implementing solar. Catering an outreach program to the economics and social aspect of solar will attract more interested community residents. Although solar is prominent in Copenhagen, there needs to be more positive outreach.

6 RECOMMENDATIONS

This section contains the culmination of all discussion held previously and contains the product which has become this project's final aim. During the course of this project, it was discovered that the initial goal of establishing a solar cooperative would not be possible within our time constraints. The most reasonable alternative was then determined to be the groundwork of the cooperative and analysis of the community's view of solar energy. The description of the community changed along the line to include small area businesses then larger businesses and also the Danish government. The combination of the following recommendations will create programs capable of raising the solar energy awareness of Nørrebro residents and Copenhagen residents sufficiently enough to create solar cooperatives in the city. A multifaceted program through the participation of local businesses and municipal government with the assistance of solar promoting organizations will encourage participation in solar energy at the community level.

6.1 Community Involvement

Although the development of a solar energy cooperative is the desired goal, this option is currently a long term goal. The cooperative does have a bright future because people are willing to put money and some time towards it. This means that outreach programs and a variety of advertising are necessary before the community is willing to accept and participate in a cooperative. The outreach program must include information on how solar energy will impact the environment and a small amount of technical information about how photovoltaics work. This information must be presented through different media such as television, radio, newspaper, and made easily accessible on the internet. The programs already being implemented by Solar City Copenhagen in which a public speakers address a select group of citizens is also a possibility. These speakers should be oriented to the public's point of view, how to save money by conserving energy, on the economics of solar, and the social aspects of participating in solar energy generation. By allowing the public to relate to what the speaker is saying people will be more attentive to the information being presented.

Due to the fantastic success experienced by the Sol-spænding pilot program more live demonstrations of solar energy are recommended in the Nørrebro area. Another event in the

same location could draw new people and cause people who participated the previous time to talk to others about the exhibition. The repetition of this program would most certainly let people know that solar energy is forthcoming in this area. The Miljøfestival in mid May will be another excellent opportunity to put together a display including photovoltaics and energy conservation. The lessons learned from the solar excitement day were that people are interested, but sometimes are too shy to approach the displays. Once an invitation to talk in a relaxed atmosphere is extended, the person will feel comfortable engaging in discussion about the environmental issues at hand. Also it is important to have moving objects connected to the solar panels to draw both children and adults to the exhibit. Having a solar panel simply power a light is not enough to draw attention, something needs to be spinning or moving. This year's Miljøfestival is going to be spread across the city with many organizations collaborating to make environmental displays on this single day. It would be most ideal that specific communities be targeted and collaboration between promotional organizations takes place. The amount of information available is staggering so coordination between agencies must happen to assure information is presented in a manner which the information provided explains all of the options available to the public.

One of the programs that needs the most advertisement is the Solstrøm program. The lack of advertisement for this program could create a problem for the further establishment of other energy cooperatives. Thus it is important to show people that it is possible to support solar energy without sacrificing their time. Time was one of the largest barriers prohibiting people from participating in any type of cooperative, and this program provides a perfect alternative for people who still wish to invest in solar energy. The Solstrøm program from KE is set up and running with a reasonably good marketing program in place but analysis has shown it is not effective. We recommend assisting in advertising the program at all possible venues. Considering the future of solar energy in Copenhagen relies on the progression of the sale of Solstrøm, it is in all organizations best interest to promote this program. This will also assist in bridging the disconnection between organizations' individual efforts. Although individuals are encouraged to participate in the Solstrøm program, businesses also have the option of investing. Community involvement in photovoltaics will increase if local businesses make efforts to also commit to solar energy.

6.2 The Small Business Approach

In order to further the involvement of the community, we recommend convincing local café s to participate in solar power. It is vitally important to show that large successful companies have invested in solar energy, and by doing the same, their business could increase significantly. Owners need to be informed that their café can invest in Solstrøm at any level just like an individual can and in time participate in the community solar energy cooperative. Another key to gaining their participation will be the implementation of a visible solar energy symbol for display windows. This symbol will let potential customers know from outside the store that it is a business that invests in solar technology. This symbol would have a similar meaning to the Økologisk symbol seen in food stores. The Solstrøm program has a package that runs a coffeepot for a year which could benefit cafés. Customers in the community would then be able to buy a "solar" cup of coffee. Involving cafés in Solstrøm is also a good way to start conversations about solar energy. Although the involvement level is not on an individual basis, it is still held within the community so that the impact is felt locally. We recommend outreaching to café owners while outreaching to the community in order to create a positive environment for the development of solar energy.

6.3 Solar Awareness

Further accenting the existing photovoltaic installations in the city would attract the attention of people who otherwise would not notice them. Increasing the level of awareness about solar panels that already exist in the community should include a program to educate people about the individual installations. Because solar panels can blend in with their surroundings, it is important that people have some sort of signal or sign so they can know where they are. Placing a monument or sculpture in front of solar installations can identify the location as a solar site. In the design of this sculpture plans should be made to have it include a small number of photovoltaic panels and make it mobile in some way. The presence of the panels on the sculpture will give it more meaning, and the motion will eliminate the stationary problem which plagues photovoltaics. By having a local artist design the sculptures it will bring the entire project closer to home for the Copenhagen community. This action will raise awareness about the shear number of sites. The next step would be to create a solar tour throughout the

city as way to show tourists, school children, or any curious resident where the solar installations are and how they are integrated into the city they live in. The tour can be changed and adapted as more solar panels are installed. This will allow people to see the existence of solar and how the city is becoming more sustainable.

There are many good places to advertise solar energy in the city. One idea is to put advertisements on public transportation; this includes trains, buses, and city bicycles. Other areas for promotion are in local media and exhibitions. Combining the media with high profile advertisements and solar monuments creates a solid base for promoting solar energy in the community

6.4 The Big Business Approach

A step above local cafés are café chains and larger store chains investing in solar energy. Large businesses investing in solar is something that should definitely be pressured, but the effect of a large businesses involvement will have a very different effect from a small businesses. The recommendation here is to have grocery store chains such as Netto, Aldi, and especially Irma, invest in solar energy whether through Solstrøm or through purchasing their own photovoltaics. Irma is the most likely to invest because they already support ecological food, which is how they draw customers. The hope is that if Irma invests in solar energy and customers notice, then Netto and other stores will soon follow suit. We recommend that a community outreach plan be installed first in order to raise awareness about solar energy, then customers will respond to grocery stores investing in solar energy. Large chains investing in solar will have a larger overall impact on the use of solar, but may not penetrate as far into the community as café participation.

KE is another large business that we recommend contact with during the community outreach plan. As the community attitude changes towards being more accepting of solar it is important that KE be there to pick up on the change. This will allow KE to better advertise their Solstrøm program and sign up more subscribers. A recommendation to KE would be to charge extra for all electricity produced and use the extra to invest in solar panels and pipe solar energy to all customers. Our survey showed that people are willing to pay more for their energy if it comes from solar, this is especially true as oil and fossil fuel prices continue to climb.

6.5 The Government Approach

Keeping the government involved and informed of the progress of the solar promotion program is important so they are able to change policies as necessary. Whether individuals contact their party representatives personally or through an invitation to an event, it is important to keep them abreast of developments in the community. The politicians must be able to form alliances when pushing solar energy mandates and funding through parliament as the current government has already cut funding. Keeping politicians in the loop of the community outreach will give them proof of interest in solar energy when debating in Parliament. Solar needs to work its way further into the community before the government is approached and asked to incorporate further mandates. If the government executed a mandate for solar before the community was ready it would not be well accepted and people would not be happy about integrating it into their homes. It is best if the change in the community comes from the community rather than from the government.

Although this is not the method preferred by the Agenda 21 Center we recommend talking to the local Copenhagen government and having them invest more solar energy. They currently use only ecological foods in the local government buildings. Building upon this it might be wise to suggest using a certain amount of solar power for the electricity in the local government buildings. The community would certainly notice this precedence and follow suit.

6.6 Summary of Recommendations

After spending two months in Nørrebro, Copenhagen working to determine community attitudes towards solar energy and how to change those attitudes, we have concluded with the previous recommendations. The following reiterates our main findings and what needs to be done now in order to create a solar cooperative in the future. We recommend that:

- A community outreach program be developed and implemented to raise the awareness of the Nørrebro
- Solstrøm be advertised more and better with the help of KE
- The Sol-spænding program be repeated with more information available
- An exhibit is created for the Miljøfestival

- Local café owners be approached to have them be involved in the community movement towards solar energy
- A local artist create a moving or rotating sculpture with photovoltaics attached to signal the site of a solar power installation
- Large businesses be contacted once the community outreach plan has been implemented to have the businesses invest in solar energy
- Politicians be kept involved in the outreach and promotional programs to make them aware of the interest in the community

Through the use of these recommendations the realization of a cooperative in the Nørrebro community of Copenhagen is possible in the near furture.

References

Aggerhølm, S., & Drybøl, S. (2006). *Implementation of the EPDB in Denmark.* Retrieved March 29, 2006 from http://www.epbd-ca.org/Medias/Pdf/2_CO_EPBD_DK.pdf.

Appenzeller, T. (2004, June). The end of cheap oil. *National Geographic*, *6*(205).

Bahà'í Community of the United Kingdom. (1994). *Agenda 21 overview.* Retrieved on February 11, 2006. From: http://www.iol.ie/~isp/agenda21/agenda21.htm.

Cooperative Community Energy. Retrieved Feb. 06, 2006. From: http://www.cooperativecommunityenergy.com/index.html. (2006).

Danish Energy Authority (DEA). (2004). *Windturbines - introduction and basic facts.* Retrieved Feb 12, 2006 http://www.ens.dk/sw14294.asp.

Energy Information Administration (EIA). (2005a). *International energy outlook 2005: World oil markets.* Retrieved Feb. 11, 2006 http://www.eia.doe.gov/oiaf/ieo/oil.html.

Energy Information Administration (EIA). (2005b). *Policies to promote non-hydro renewable energy in the united states and selected countries.* Retrieved Jan. 30, 2006 http://www.eia.doe.gov/fuelrenewable.html.

Energy Star. (2006). *Energy star: Buying products that make a difference.* Retrieved April 20, 2006 from http://www.energystar.gov/.

International Solar Energy Society (ISES). (2003). *Sustainable cities in europe.* Accessed on March 30, 2006. From: http://www.ises.org/ISES.nsf. (New initiative provides impetus)

Jensen, E. (2005). *Danish energy policy.* Retrieved February. 18, 2006. From: http://www.ens.dk/sw12333.asp.

Kasemir, B. (2003). *Public participation in sustainability science: A handbook.* Cambridge University Press.

Masters, J. (2006). *Social values and public policy: From opportunities to rights and back to opportunities.* Retrieved on February 17, 2006. From: http://www.cencomfut.com/social_values.htm.

McKenzie-Mohr, D., & Smith, W. (1999). *Fostering sustainable behavior.* Canada.

Meadows, D. H., Meadows, D. L., & Randers, J. (2004). *Limits to growth.* Vermont: Chelsea

Green Publishing Company.

Mu Dong, X. (2005). Kyoto protocol goes into effect. *Clean Air Initiative for Asian Cities*. Retrieved on February 26, 2006. From: http://www.cleanairnet.org/asia/1412/article-59506.html.

Renewable Energy Policy Network (REN). (2005). *Renewables 2005 global status report.* Retrieved on February 28, 2006. From: http://www.worldwatch.org/brain/media/pdf/pubs/ren21/ren21-2.pdf. Washington, DC: Worldwatch Institute.

Sørensen, H. C. (2005). *The middelgrunden wind turbine cooperative.* Retrieved February 18, 2006. From: http://www.middelgrunden.dk/MG_UK/project_info/mg_pjece.htm.

Starbucks Corperation. (n.d.). *Starbucks takes action to address climate change.* Retrieved April 12, 2006 from http://www.csrwire.com/article.cgi/3782.html.

The European Solar Cities Initiative (ESCi). (2004). *Objectives & approach.* Accessed on March 30, 2006. From: http://www.eu-solarcities.org/mod.php?mod=userpage&menu=8&page_id=1.

Tuan, C. C. (2005). *Samsø, the 'green energy' island.* Retrieved Apr. 26, 2006 http://www.fuelcelltoday.com/FuelCellToday/IndustryInformation/IndustryInformationExternal/NewsDisplayArticle/0,1602,5899,00.html.

U.S. Department of Energy (USDOE). (2003). *California ramps down solar subsidies.* Retrieved May 7, 2006 from http://www.eere.energy.gov/states/news_detail.cfm/news_id=8383.

U.S. Department of Energy (USDOE). (2004). PV FAQs. *Energy Efficiency and Renewable Energy.*

Whole Foods. (2006). *Whole foods market makes largest ever purchase of wind energy credits in united states.* Retrieved April 20, 2006 from http://www.wholefoods.com/company/pr_01-10-06.html.

A Københavns Energi Survey

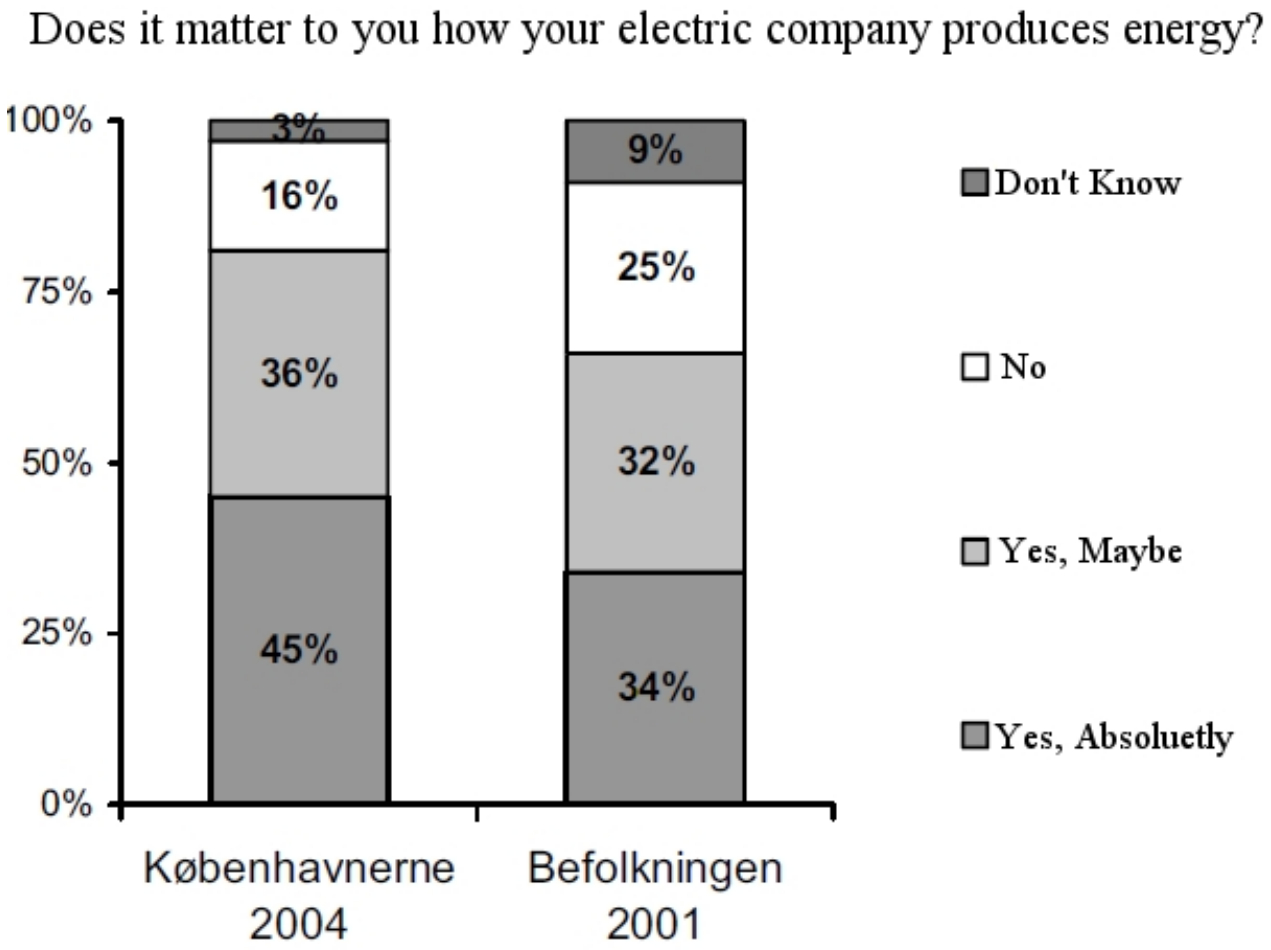
Three surveys about renewable energy and in particular solar energy were professionally conducted by Københavns Energi (KE). The first was in 1998 when fewer questions were included and people from all over Denmark were asked to participate. The survey in 2001 included a full listing of questions but again it was conducted throughout all of Denmark. The 2004 edition of this survey included only the residents of Copenhagen. A copy of the final report was recieved including the analysis through the Agenda 21 Center. Unfortunately the translation of the entire report would have taken too long, so only the answers to the individual questions were translated. The survey includes many questions pertinent to this project as well as background information which helped to give a solid direction to take with the Nørrebro community. The following results and analysis helped to draw early conclusions about the Nørrebro community. This version of the analysis, and graphs in and survey questions translated into English can be found below.

KE was interested in finding out people's view on energy and their knowledge of solar programs in Copenhagen. The survey questions being with the broad topic of energy as a whole, then narrows into just renewable sources, and then narrows further to just questions about solar energy. The survey showed that since 2001 people have thought more about renewable energy and the responses for fossil fuels dropped. People in Copenhagen care more about how their energy is produced today than in 2001, it shows that residents have become more energy conscious. Although solar energy awareness has increased almost two-fold, wind energy awareness has increased even more. This is due mainly to the Middelgrunden Wind Cooperative, which was opened in early 2001. Thus wind energy is the most widely known form of energy. In 2001 renewable energy had some negative response, but by 2004 there were no negative responses toward renewable energy.

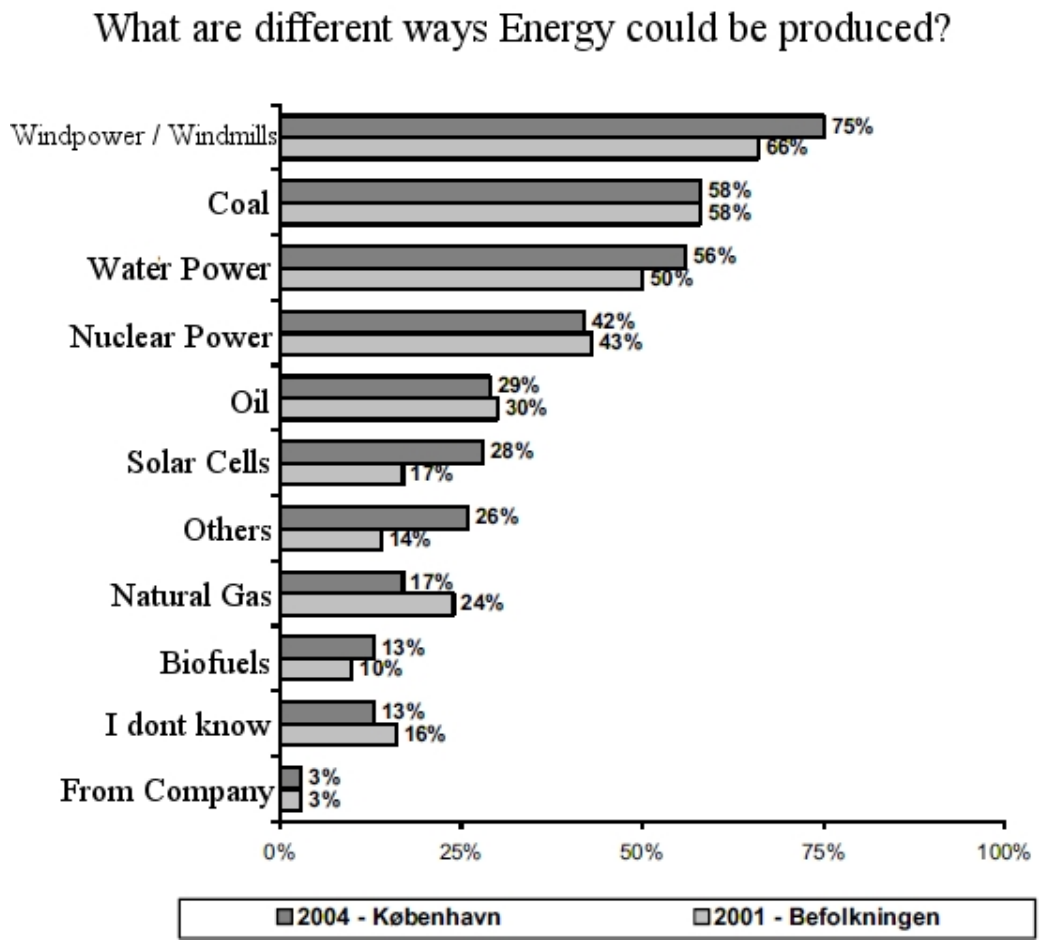
The conclusions drawn from the survey are as follows:

- Wind Power is the most popular form of energy
- Knowledge of solar energy has almost doubled since 2001
- The existing wind cooperative has had a large effect on how people view energy
- People care more about how energy is produced in 2004

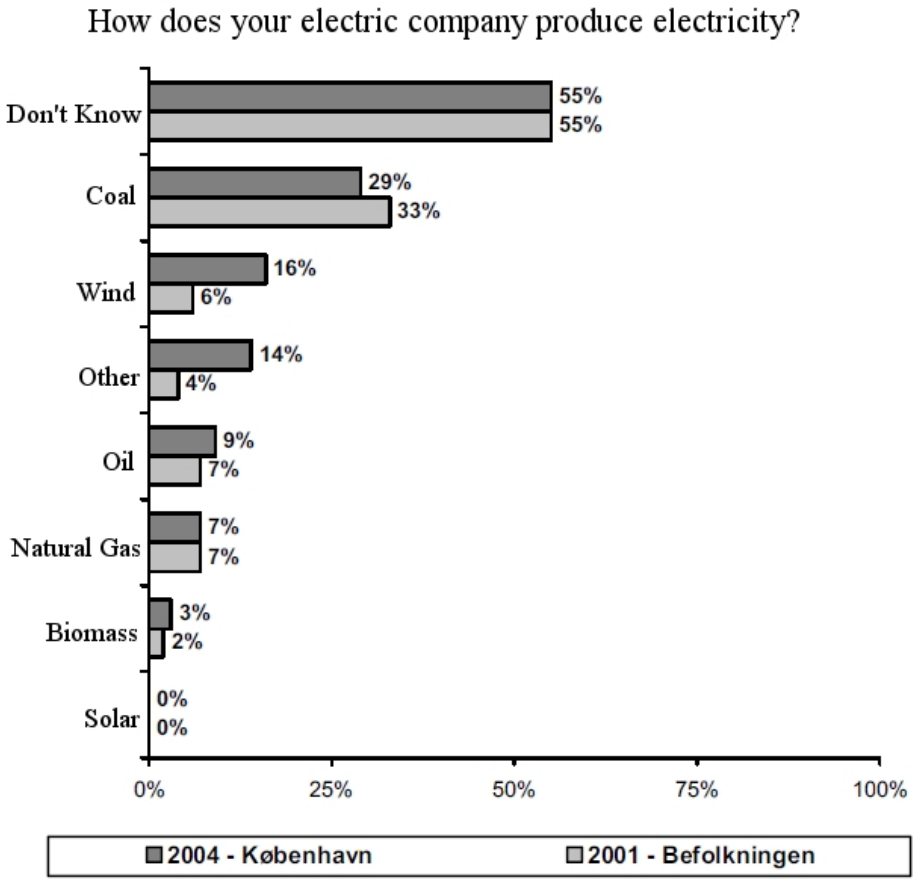
- Negativity has dropped 3% towards Renewable Energy since 2001
- Most people surveyed do not know what Solstrøm is.
- In general, people that do know what Solstrøm is, support the program and the development of solar power
- People have become more aware of prices of solar energy
- There is a larger demand for solar energy
- Solar installations need to be more visible to the public
- Media and public visibility are the best outlets for Photovoltaics.
- The amount of people who do not know about PV is halved in 2004.
- Building managers are not as eager as people to put up Photovoltaics, but they are more knowledgeable on the topic.



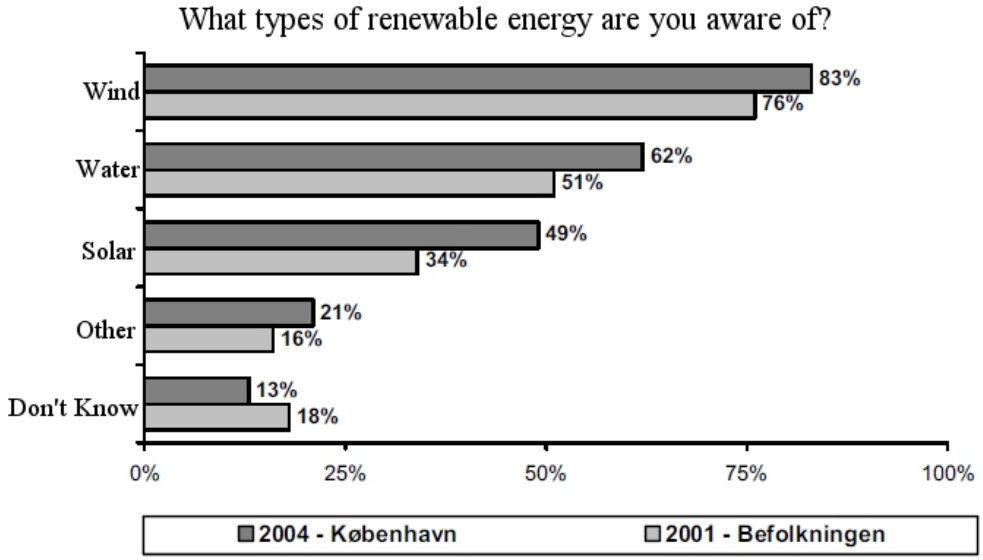
In general people care more about how their energy is produced now than they did in 2001. There are a couple of reasons for this. Residents in Copenhagen may be more energy conscious than those in other areas of Denmark. Global warming has been advertised a lot since 2001 and this could affect how people think about the production of energy. These are factors should be considered when analyzing the validity and strength of the answers. Because the results changed so much, people have changed their thinking about how important it is to be aware of energy sources.



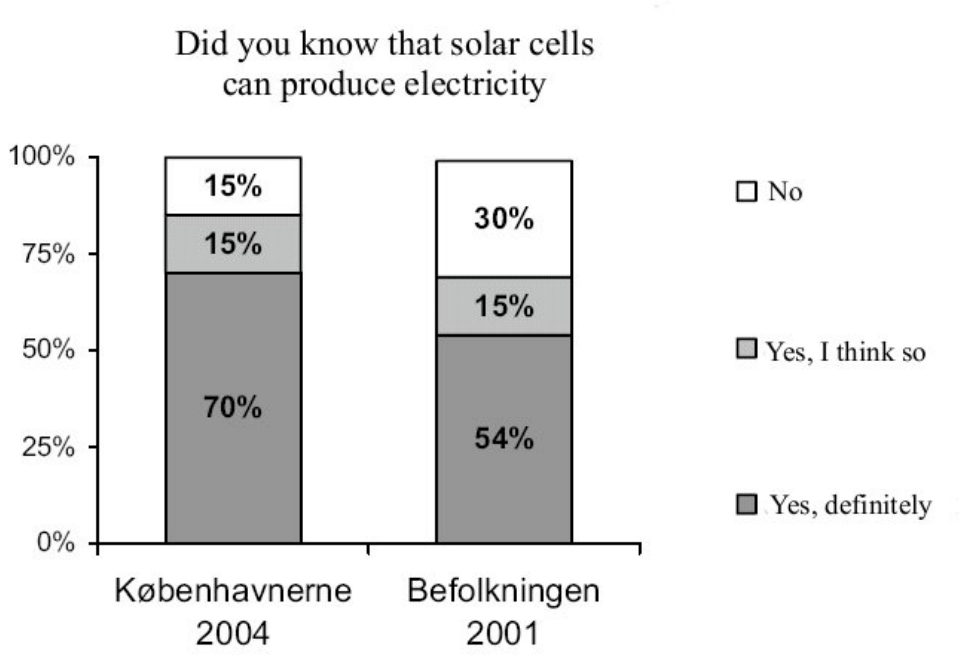
This question was given as an open ended response, so it shows what kinds of energy people have on their minds. Wind power was the largest knowledge base in both years the survey was taken, most likely due to the Middelgrunden Co-operative in the harbor. The clean renewable energies showed an increase in answers, while nuclear and fossil fuel energy showed a decrease in response, this is good for our project. If people had responded more on fossil energy our project would have to focus more on educating people about the good side of renewable energy. Those who selected I don't know or from company probably weren't sure what the question was asking because in the next question no one answered that way.



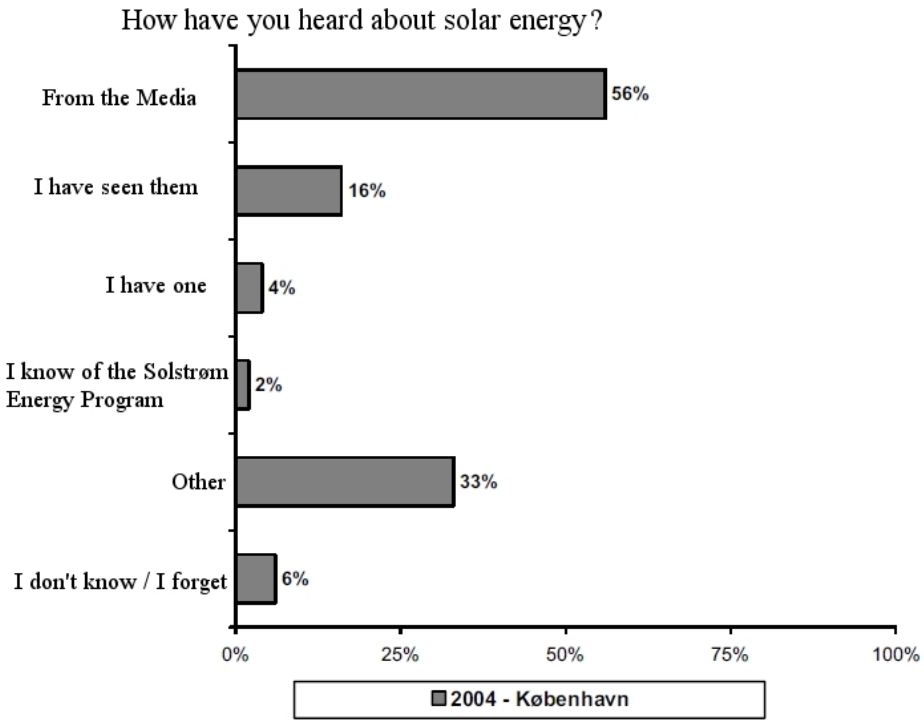
Most people do not know how their electricity is produced, 55% of responses in both years. The answer for wind increased signaling that the wind cooperative has had an effect on people's awareness. Although KE does produce solar energy, no one put it down as an answer, showing that more needs to be done to promote solar energy and show the companies involvement.



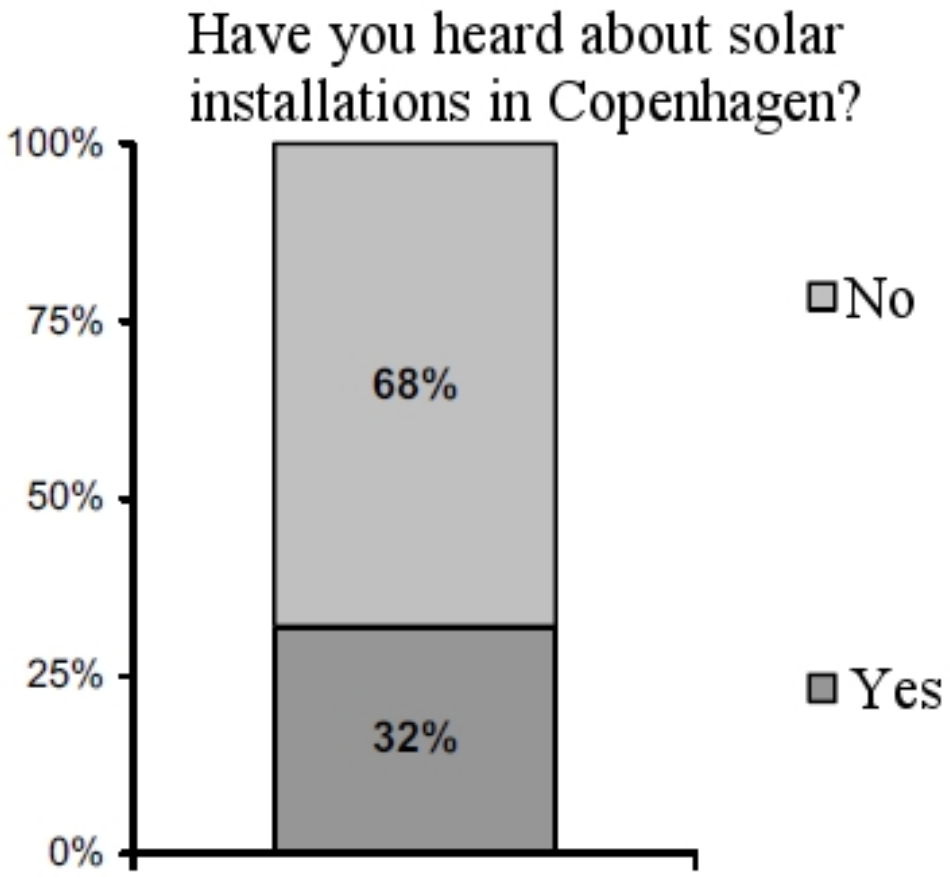
This question takes fossil fuels out of the picture and takes the survey straight to renewable energy. The percentage of people who do not know about renewable energy decreased and the percentage of people aware of solar energy increased. This is perfect for our project because it means that whatever Copenhagen has done to promote solar energy is working in a small way. The questions later on get more into depth with solar energy.



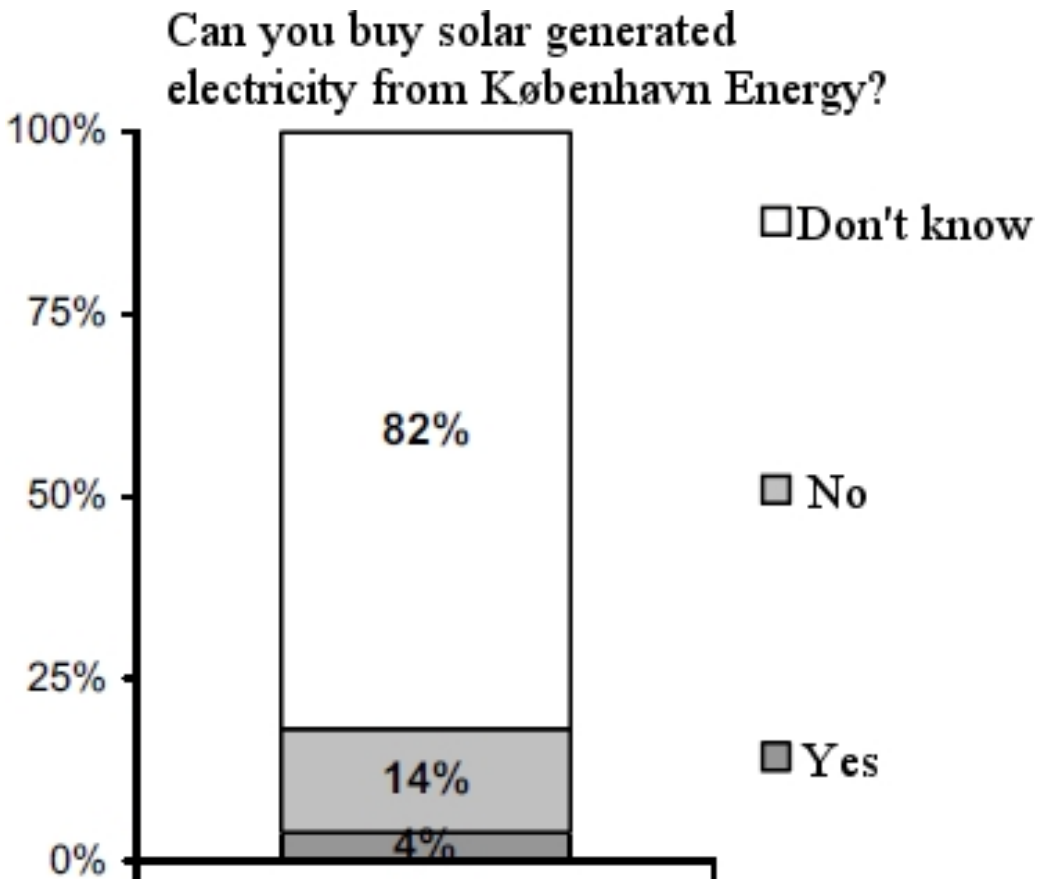
This question shows that people are more aware of solar energy, which is good for this project. The amount of people who said no was cut in half between 2001 and 2004. The next question shows how people receive information about solar energy. People's knowledge of solar cells increased dramatically from 2001 to 2004. The amount of people, who said no, was cut in half from 2001 to 2004.



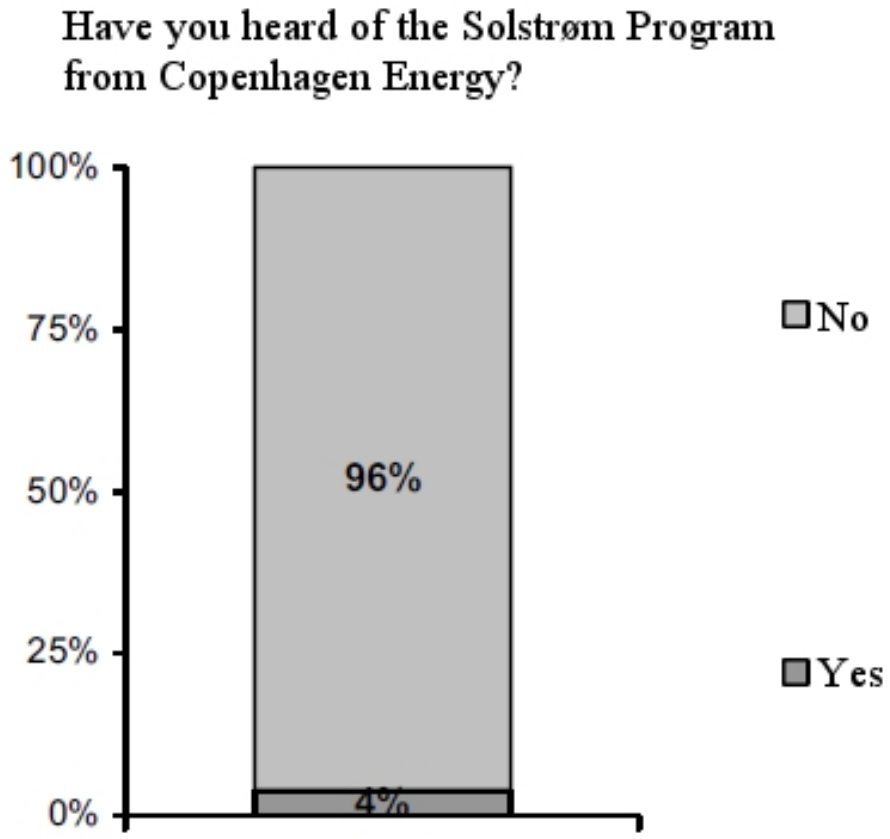
This question is one of the most important to our project. If we are to reach the community in the fastest and most comprehensive way possible we need to know how they find out about solar energy. Most people find out about it through the media (newspapers, radio, TV, etc.) The next largest response, other doesn't give us much information. In our community survey we plan to expand that response to be open ended. We hope to see responses such as a friend, night class, or in a book. Seeing solar panels was also a popular response and because it was, we hope to have a demonstration of solar energy. Respondents indicate that media is the best way (TV, newspaper, radio) followed by "other" possibly by word of mouth, adult classes, school, or something else. Seeing the solar panels also scored high, so showing a demonstration would be a great way to spread the word. We will be doing a similar question in order to figure out how people in this community find out



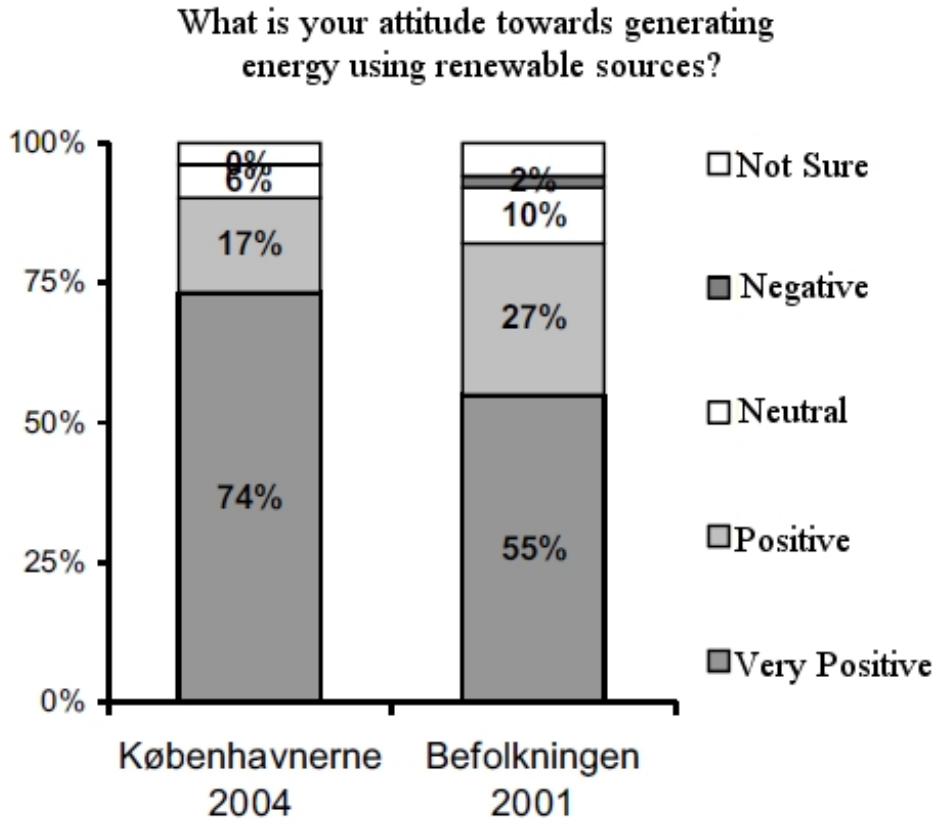
Although people have heard of solar power, they have not necessarily heard of solar installations in Copenhagen. This means that it has not been as heavily advertised or they are not as visible to the public, like the wind turbines are. Because they do exist in Copenhagen and are actually growing in popularity, we need to figure out how to get the word about Copenhagen installations out to the public.



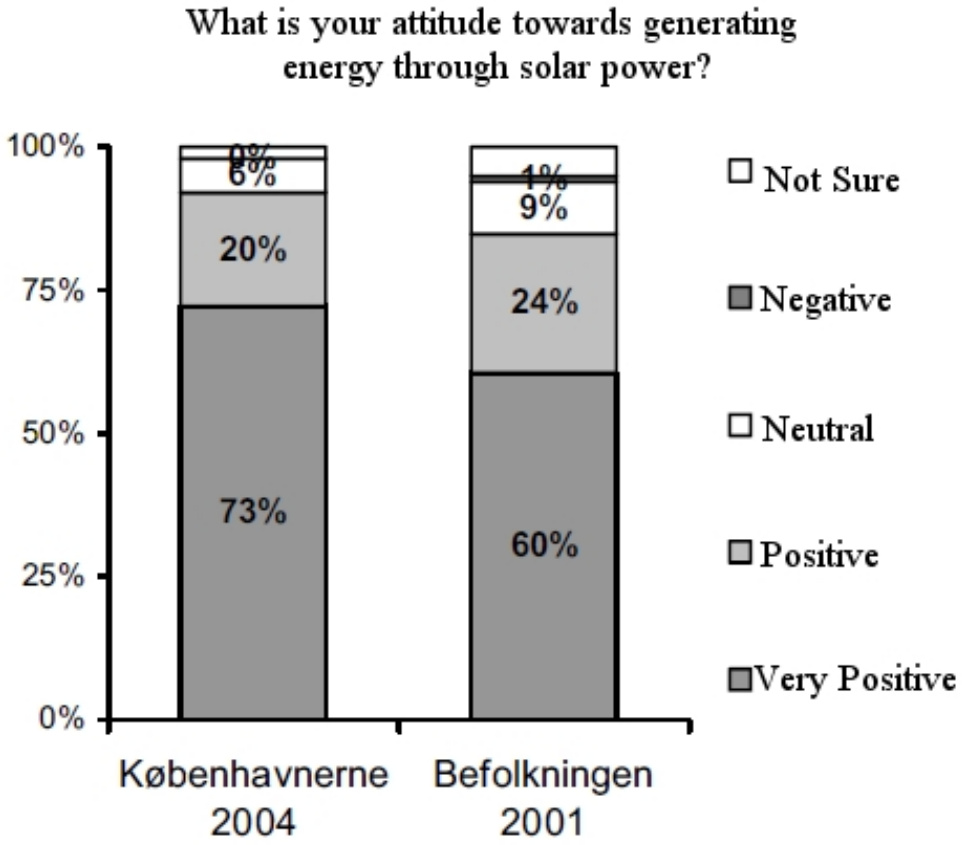
The correct answer is yes. Only 4% of the population were aware of this fact showing that KE's promotion of this service has not penetrated the market at all. This presents a problem for future solar cooperatives because KE owns the grid and will not purchase energy from a solar cooperative unless they can sell it to other people at a profit.



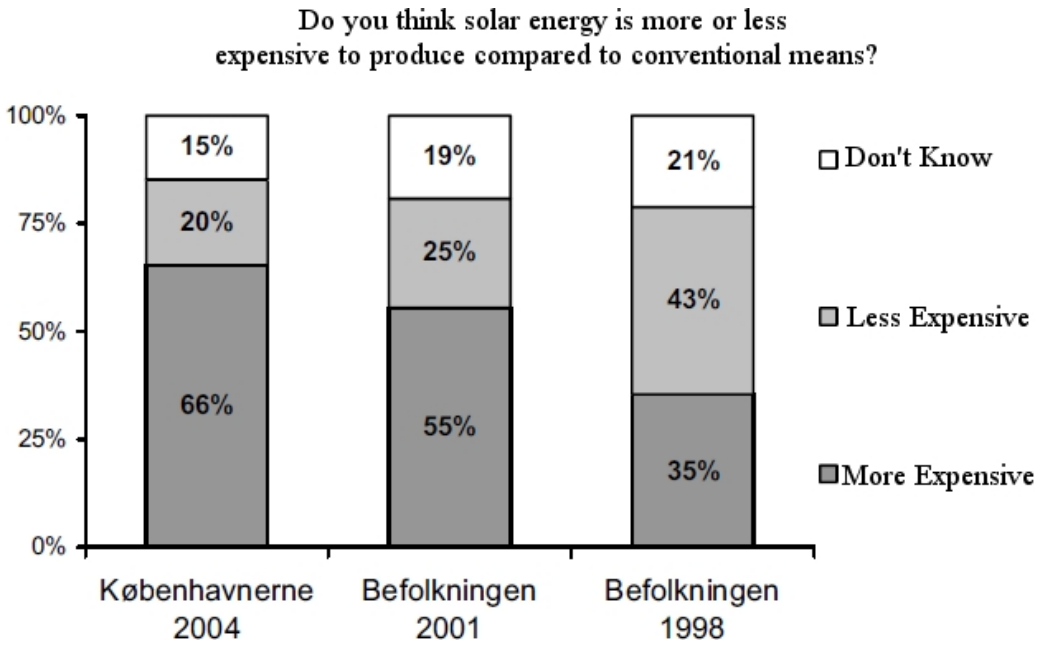
Most of the responses to the yes category here probably came from the yes category in the previous question. That shows that only the people who know about the program know that KE supplies solar energy. Again, advertising and outreach needs to be increased so people can become aware of programs that are available.



From this we see people's attitudes towards renewable sources are positive. In 2004 no responder thought that renewable energy was a negative idea, so much progress has been made. This Overall in 2004 91% of people thought that renewable energy sources were a good thing. 6% was neutral, but 0% was negative.

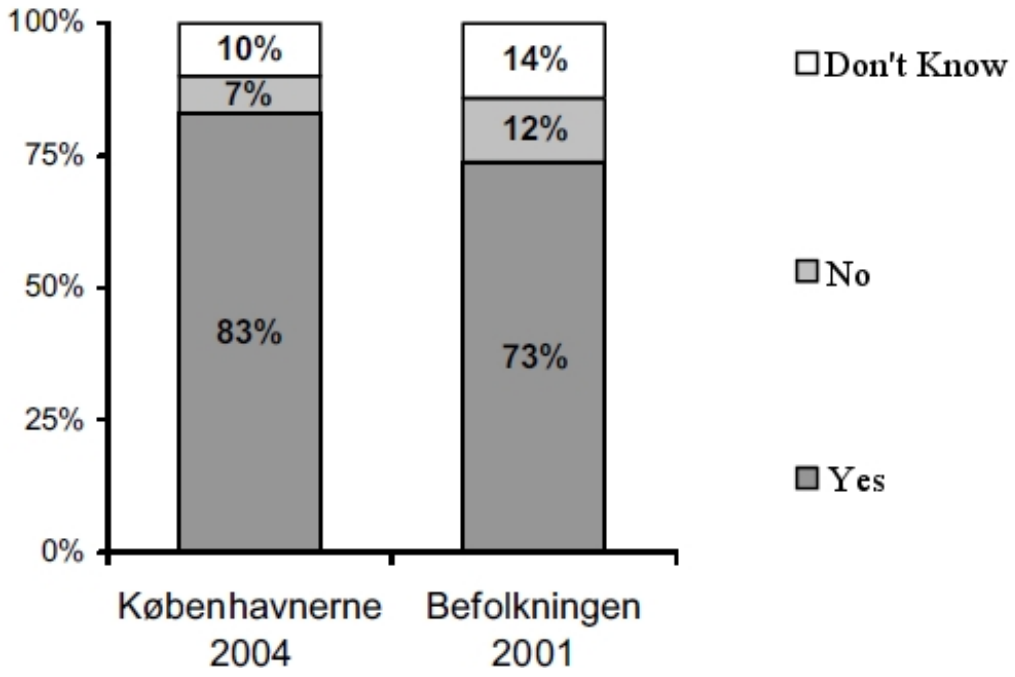


No one has a negative attitude towards solar, which is very good for our project. This means that people will be receptive to demonstrations or additional information given to them. There was a strong increase in the positive feeling towards solar in the past 3 years. 93% see solar as a positive thing, up from 84% in 2001. No one sees it as being negative, but 6% are still neutral. The small portion of people who are neutral probably are not involved in environmental issues, like the majority of people in Denmark. Historically Denmark is a very environmentally conscious nation which accounts for the positive feelings.

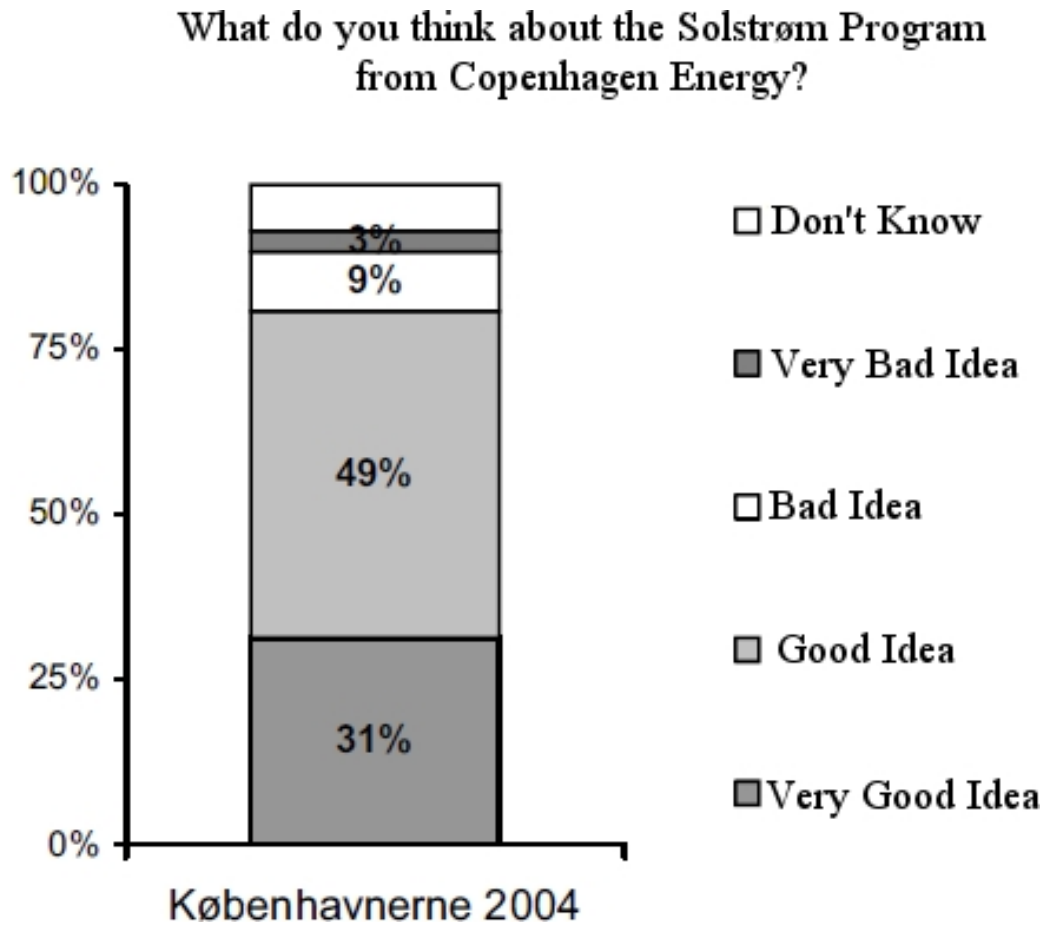


People have become more aware of the cost of solar energy, because it is more expensive than common energy sources.

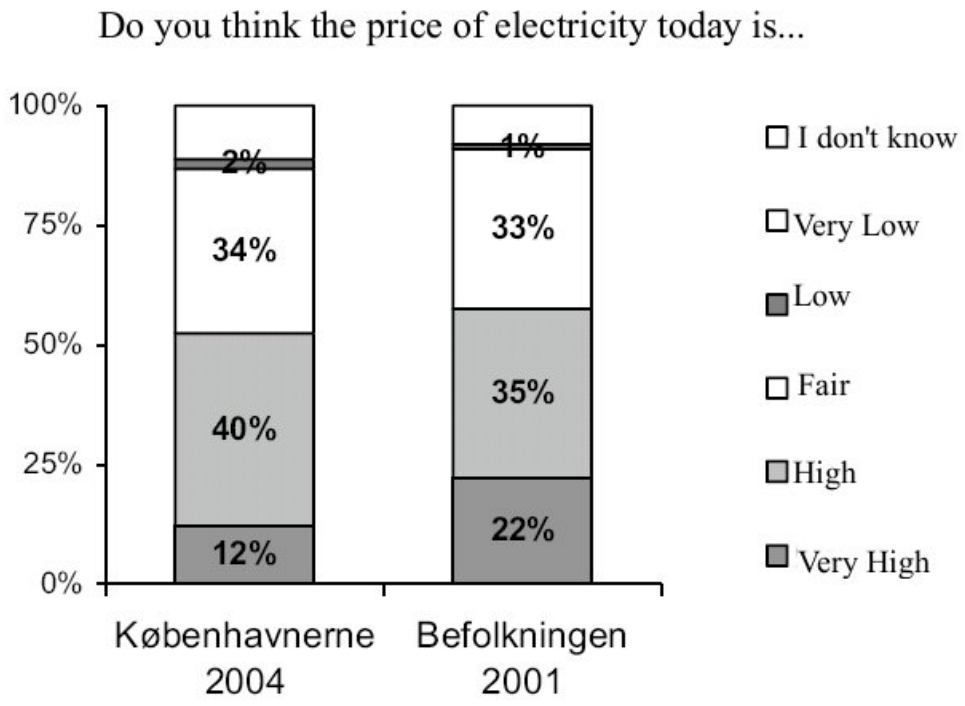
Do you think Copenhagen Energy should produce more solar energy?



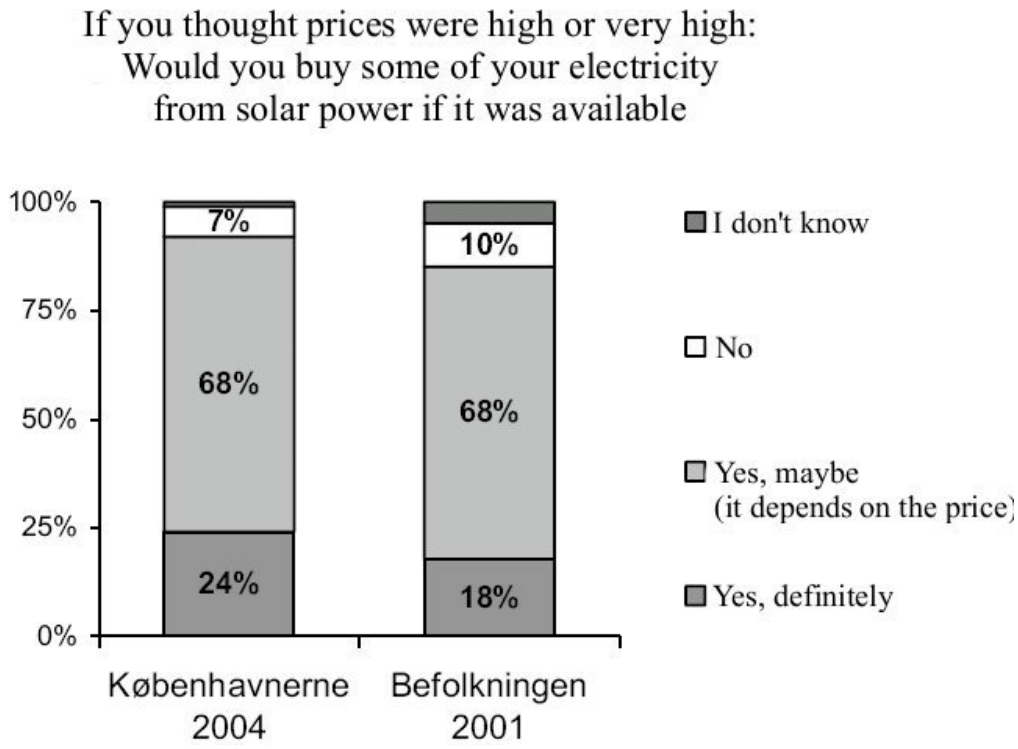
This question showed a 10% increase in the "yes" Copenhagen energy should produce more solar energy category. Although the percentage of people who said "no" is at 7% it is down from 12% in 2001 and the "I don't know" category decreased from 14% to 10% Copenhagen Energy or another entity should seriously look into the possibility of incorporating solar energy in the main grid



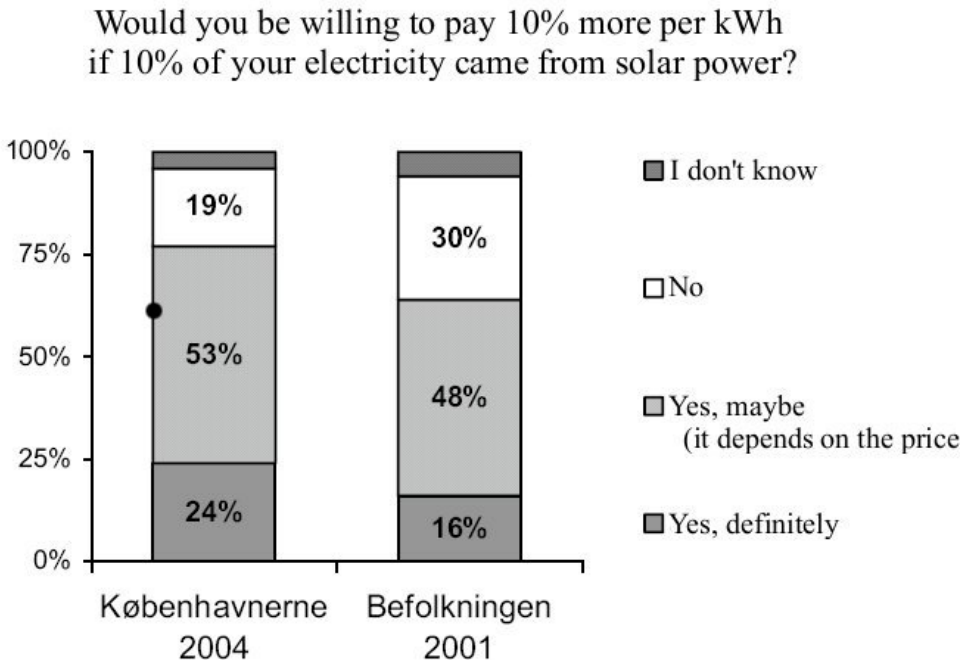
80% of the population surveyed think that Solstrøm is a good idea. However we don't know how many people think the program should be changed a little or how many people just aren't interested. Unfortunately there are not any follow-up questions to this one which would help determine why the program is not being very successful with such a high percentage of people who think it is a good idea.



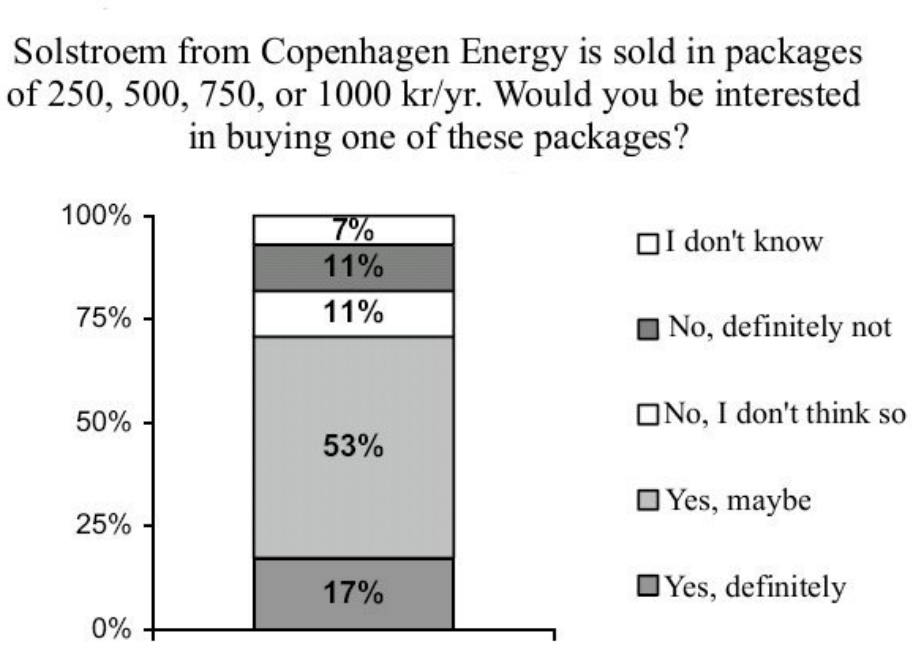
Interestingly, although the price of oil per barrel has gone up, people think that the price of energy is not as high as it was. People may see the price of oil or natural gas and realize that their energy is still fairly priced or is low. As a result of this they may think that electricity isn't as highly priced as they originally thought. The increase in people thinking that electricity is priced high went up, possibly from those who thought it was very high dropped to high.



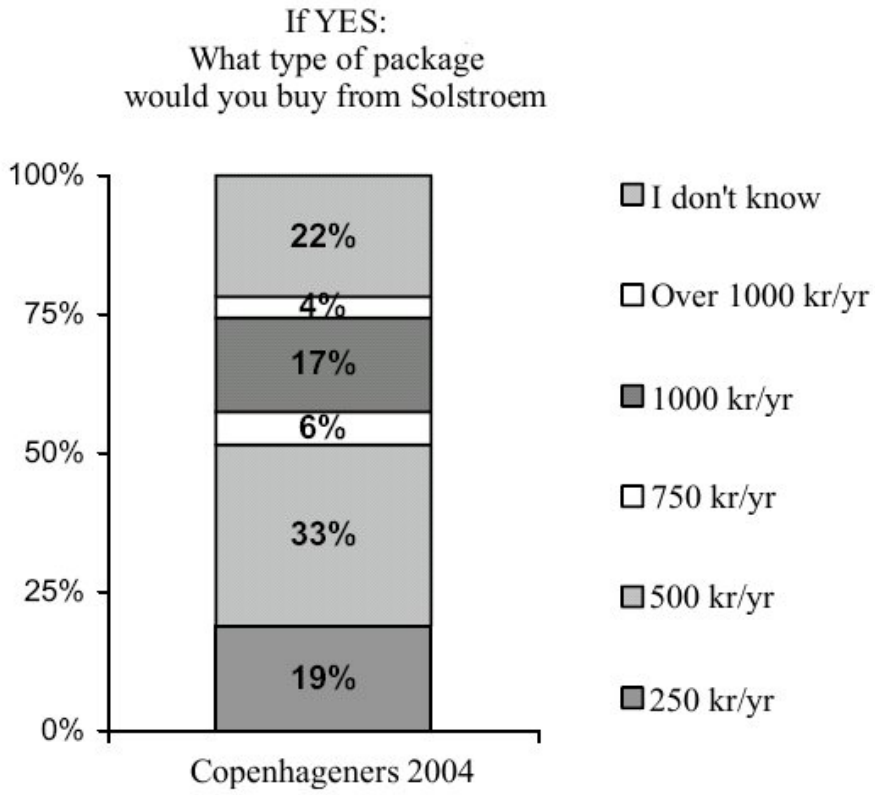
Those who thought electricity was high or very high were asked to complete this question, and both years 68% said that it depends on the price. Although those who said they would definitely do it increased and those who would no do it went down.



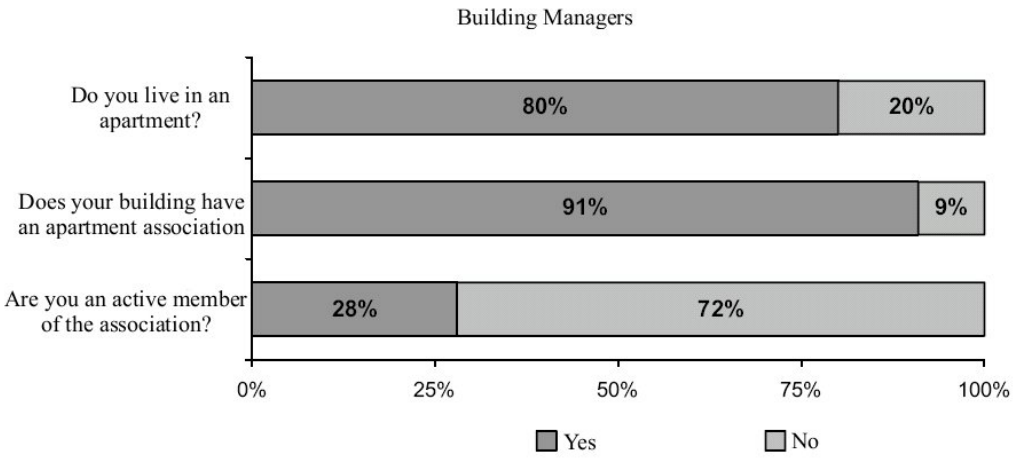
Here the "yes" increased from 2001, meaning that people are more open to solar power, however the majority of consumers are still worried about the cost.



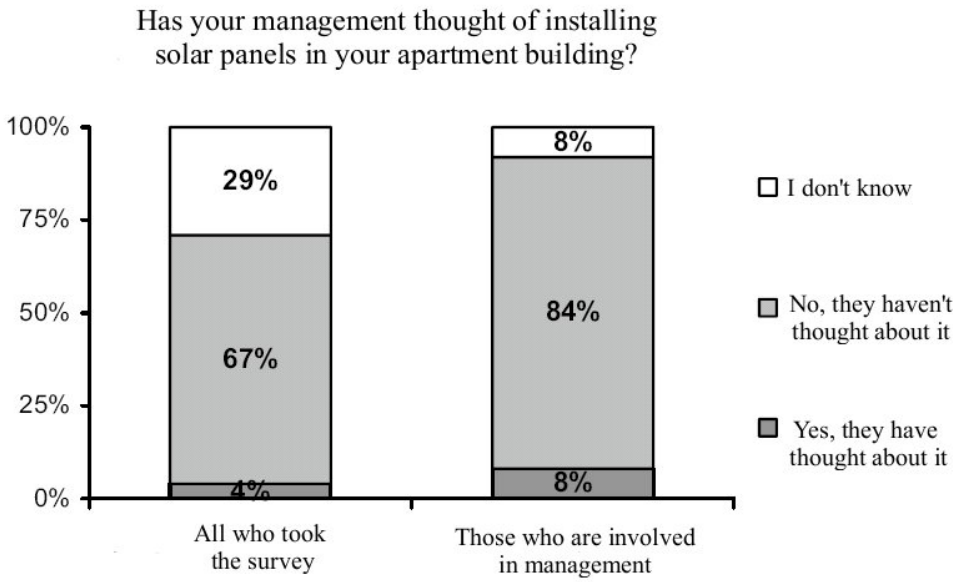
70% of those surveyed would be interested in buying from the Solstrøm program. This means again that solar power is beginning to take a precedent in people's lives, but holding people to this response is a problem. When it actually comes to investing the money people seem to realize that they do not know enough about solar energy to put their money forward.



Most consumers picked the average cost of 500kr.yr. This shows that they are not willing to be extravagant, but there is a desire to help the environment by using solar power. 17% said they would go for 1000kr/yr. This question was answered without knowledge of how many kWh the price will covers or what part of the bill it will consist of, but it is surprising to see that many people willing to pay over 1000 ($167) per year for solar electricity.



Most people in Copenhagen live in apartments due to the lack of land area for houses. Most of those in apartments have associations to help with the upkeep and maintenance of the building and surrounding yard. It also helps to instill quiet hours and respect and decision making in the building Most people are not active members, which seems to suggest that the associations are more of an office position rather than committee



It seems that many people although not directly involved in the management of the apartment; they do know what is going on. Most managers have never even thought about solar panels or thought about it and dismissed it. This is probably do to the expense and upkeep of the panels

B Solar Energy Survey: Indre Nørrebro

This Appendix contains data obtained through the use of the survey included on the following page which was administered to the Indre Nørrebro area between 10 April and 3 May. The 58 surveys given were conducted personally at cafés, at the local square Sankt Hans Torv, and in various other small businesses in the Indre Nørrebro area. The survey demographics are shown in the following table as well as visualized in the figure at the bottom of the page. Because of the informal nature of this survey demographical quotas were not set and the resulting demographics of the survey are skewed towards women and young people. For a more professional survey it would have been necessary to include an equal amount of males and females as well as even number of people from each age group. However, the demographics of Indre Nørrebro show that the majority of residents are in the mid to lowest age category, therefore we believe our survey results accurately depict the community's age.

	18-29	**30-50**	**50+**	
Female	19 (33%)	20 (34%)	1 (2%)	*40 (69%)*
Male	3 (5%)	10 (17%)	5 (9%)	*18 (31%)*
Total	*22 (38%)*	*30 (52%)*	*6 (10%)*	***58***

Table 1: Survey Demographics

Solar Energy Survey: Indre Nørrebro

1 Age: ◯ 18-29 ◯ 30-50 ◯ 50+

2 Gender: ◯ Male ◯ Female

3 How have you heard about solar energy? (mark all that apply)

☐ TV / Radio ☐ Newspaper ☐ I have seen them ☐ I have one
☐ Haven't Heard of it ☐ Don't Know / Forget Other _____

4 What is your attitude towards generating energy through solar power?

◯ Very Positive ◯ Positive ◯ Neutral ◯ Negative ◯ Unsure

5 Have you heard of the Solstrøm Solar Stock Exchange program offered by Copenhagen Energy?

◯ No ◯ I am a part of it ◯ I have heard but would like to know more
◯ I know of it and chose not to participate

6 Have you heard of Solcellelaug or Vindmillaug?

◯ Yes ◯ No ◯ I participate in Solcellelaug ◯ I participate in the Vindmøllelaug

7 Is it important to you that your energy company invests in renewable types of energy?

◯ Yes ◯ No ◯ Don't Care

8 If electricity generated through solar panels was available at 4 times the normal price would how much money would you be willing to put towards that type of energy?

◯ Over 1000Kr/yr ◯ 1000 Kr/yr ◯ 750 kr/yr ◯ 500 kr/yr ◯ 250 kr/yr ◯ Not Interested

9 Would you like to learn more about Solar Energy?

◯ Yes ◯ No

9a If yes, How would you like to get information about solar energy? (mark all that apply)

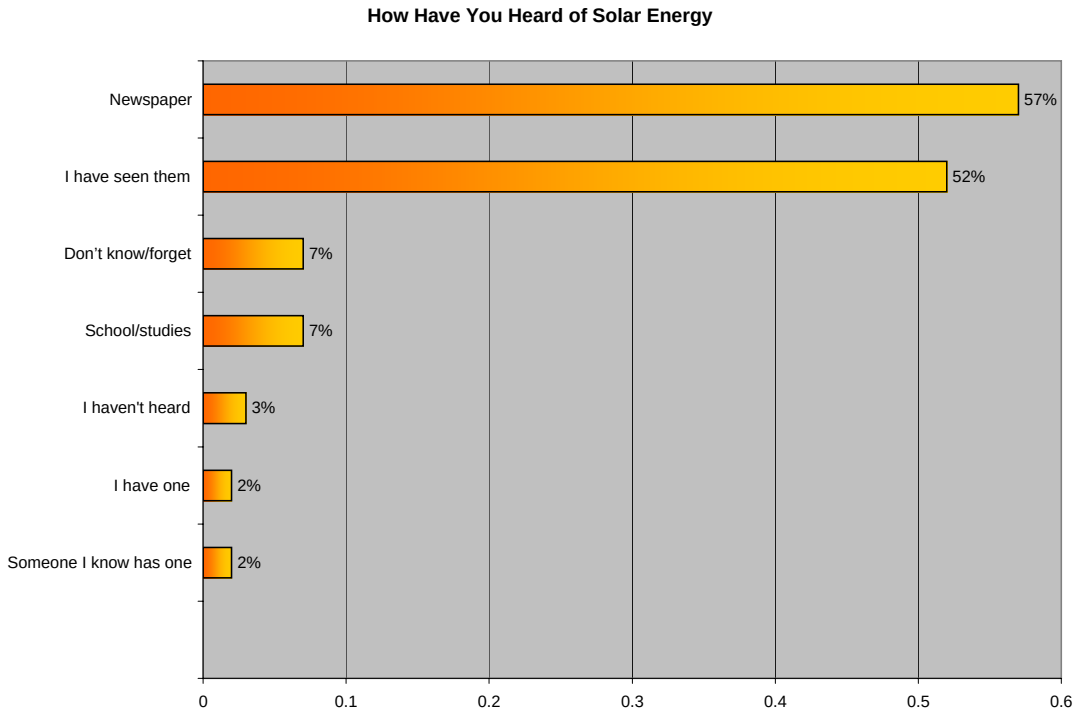
☐ TV / Radio ☐ Newspaper ☐ Internet Site ☐ Community Newsletter ☐ Live Demonstration

10 If a solar cooperative was established in the Nørrebro district, would you be... (mark all that apply)

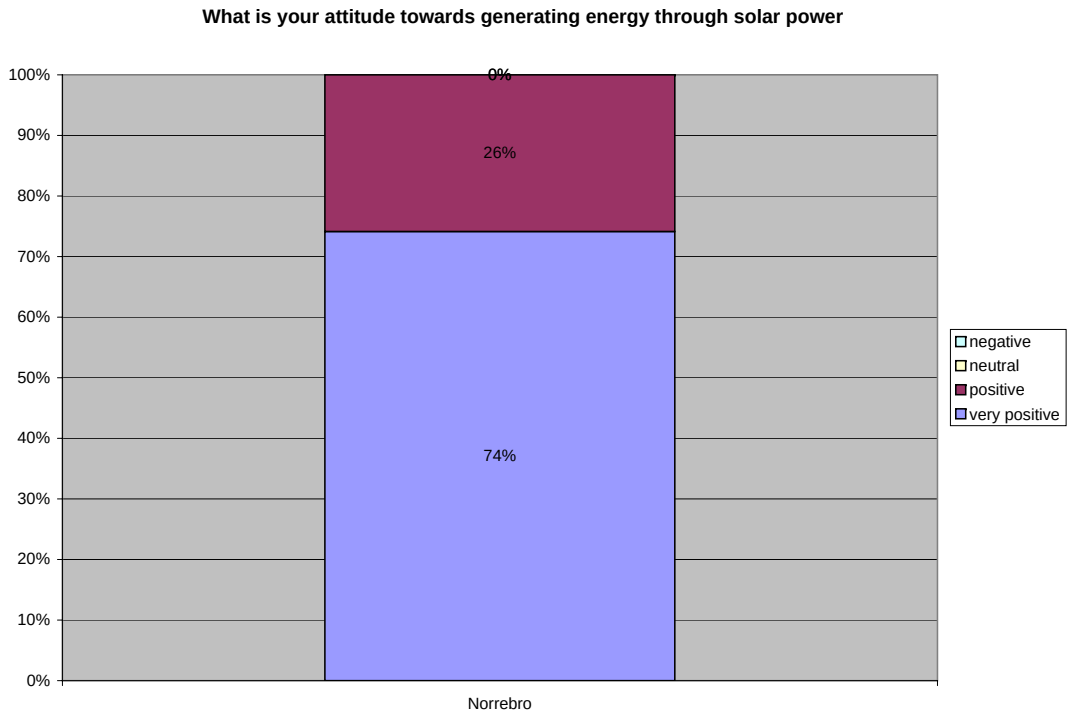
☐ interested in purchasing shares ☐ Interested in donating for the inital setup
☐ interested in helping advertise ☐ Not at all interested

10a If no, what is blocking you from participating in Solar Development?

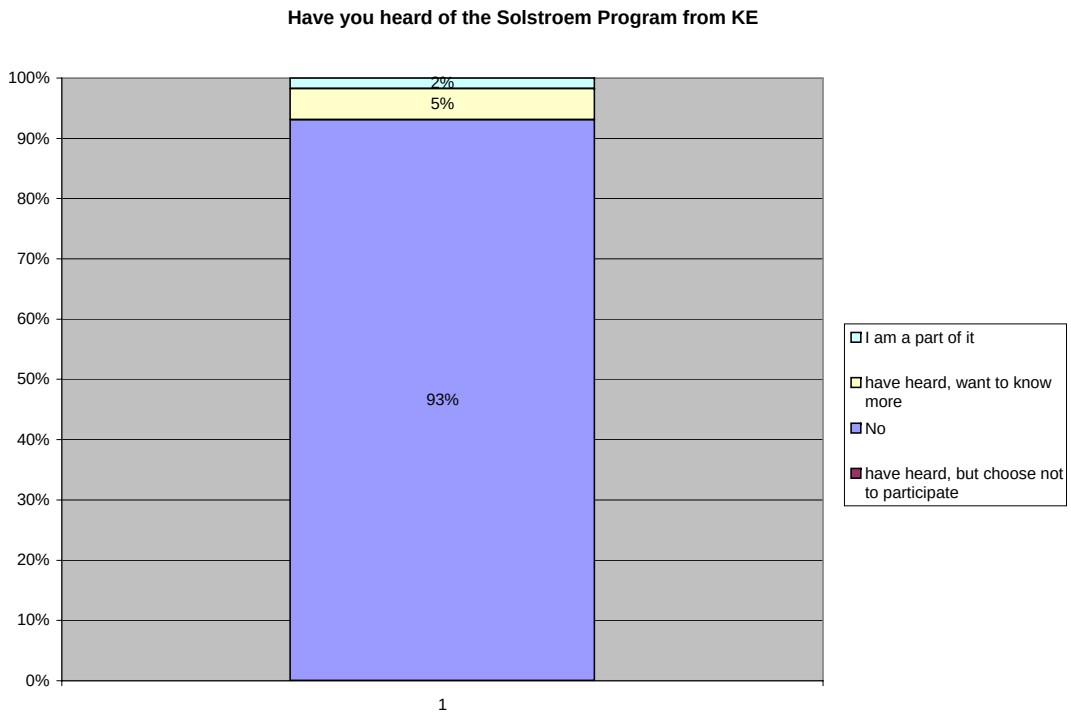
◯ Not Enough Information ◯ Too Expensive ◯ No reason to be involved
◯ Don't know of any opportunities ◯ Not Interested ◯ Not enough time



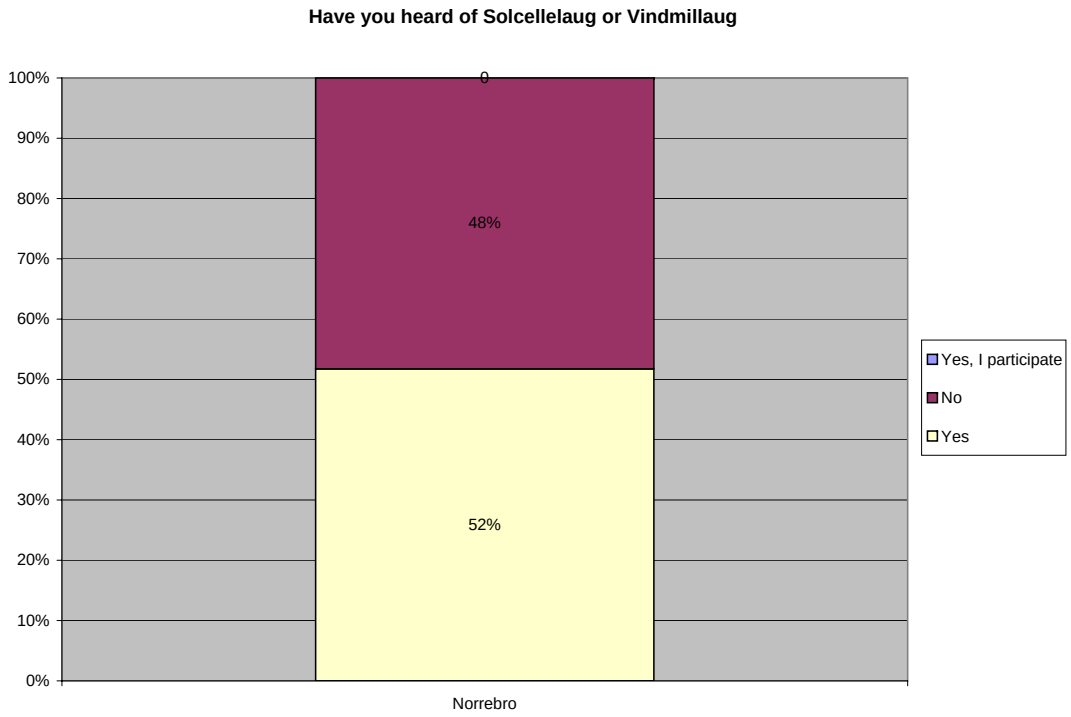
Knowing how people have gotten information about solar energy in the past will indicate which methods have already been used. This answer correlated with the question about how people would like to learn about solar energy will show what methods should continue because they are effective and which should not continue. This information will also be put together with the information gathered form organizations about the types of activities they offer to the community. This multiple choice question was supplemented by an "other category" which produced such answers as "school" and "someone I know has one".



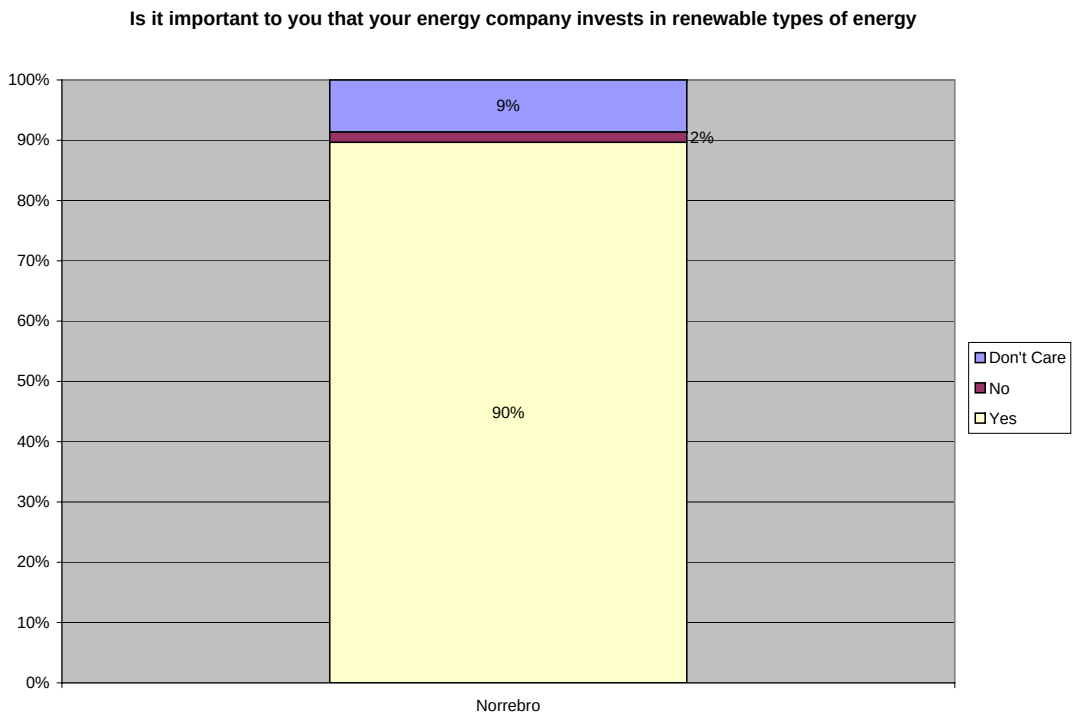
This question determined the communities attitude towards solar energy. The extremely positive response from this question shows the knowledge of people that solar energy helps the environment. However, this question does not show how willing people are to be involved with solar energy. The response to this question showed that the lack of involvement with solar technology is probably due to the low awareness level. If the response had been negative the project would have been changed greatly towards an outreach program rather than simply raising awareness.



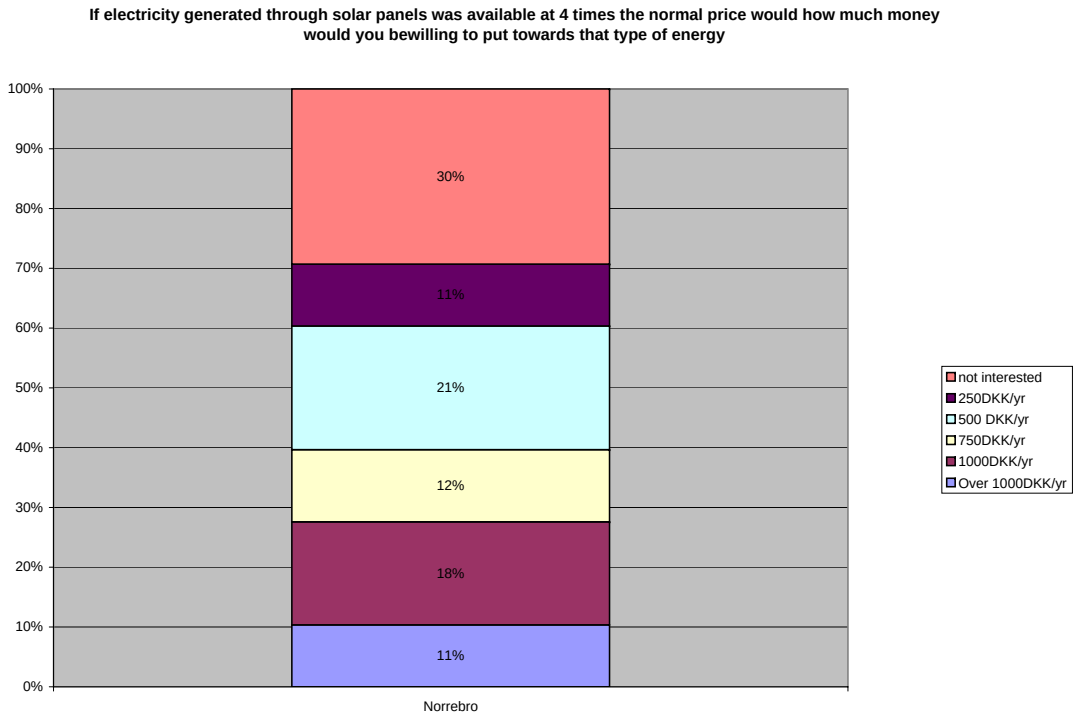
From Københavns Energi's survey in 2004 only 4% of Copenhageners had heard of Solstrøm. Determining whether or not this had changed showed how much additional marketing had been done for the program and if the Nørrebro community was more or less aware than the rest of the city. As can be seen from the graph above, the awareness of the current program has remained stagnant since 2004.



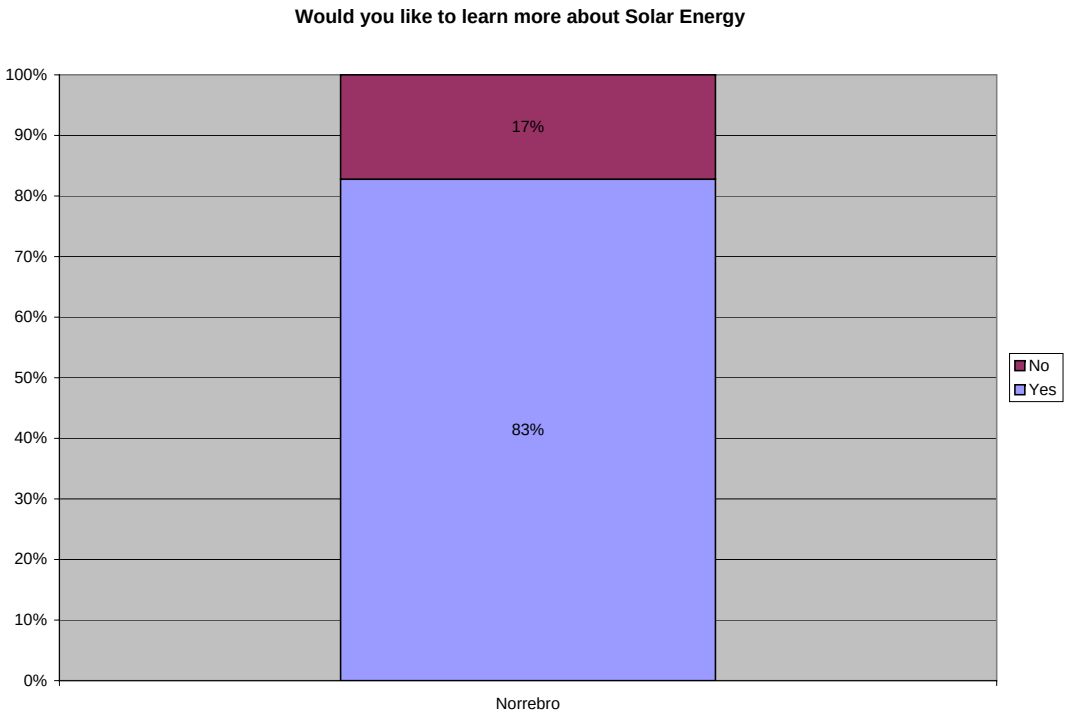
The awareness of Nørrebro residents about cooperatives could determine how open they are to the concept. If the majority of people had not heard of a cooperative or did not understand this organizational structure it would be necessary to include that in the outreach programs. Surprisingly only about 50% have heard of either of the large energy cooperatives in Copenhagen. These cooperatives were used as examples because they are very large and have had a high amount of visibility in the past few years.



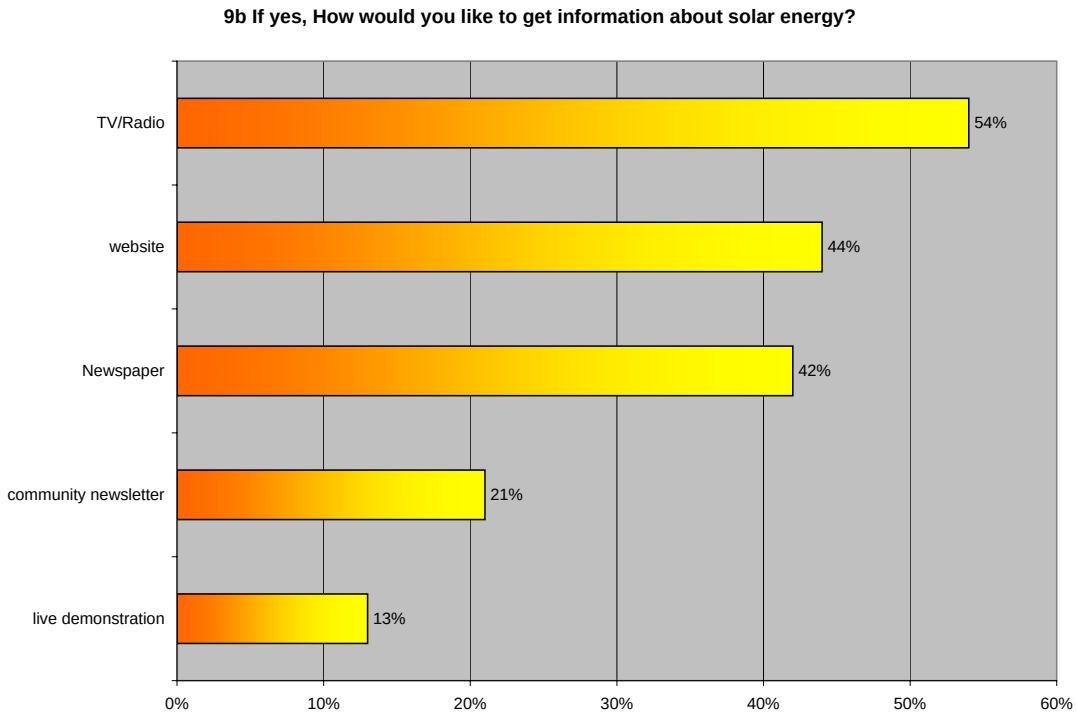
This question was asked on the KE survey in 2004. It was important to see if people had shifted their opinions and if the opinions were different in Nørrebro. More people in Nørrebro have stated that they care if KE invests in renewable types of energy, which bodes well for the future of solar in Nørrebro.



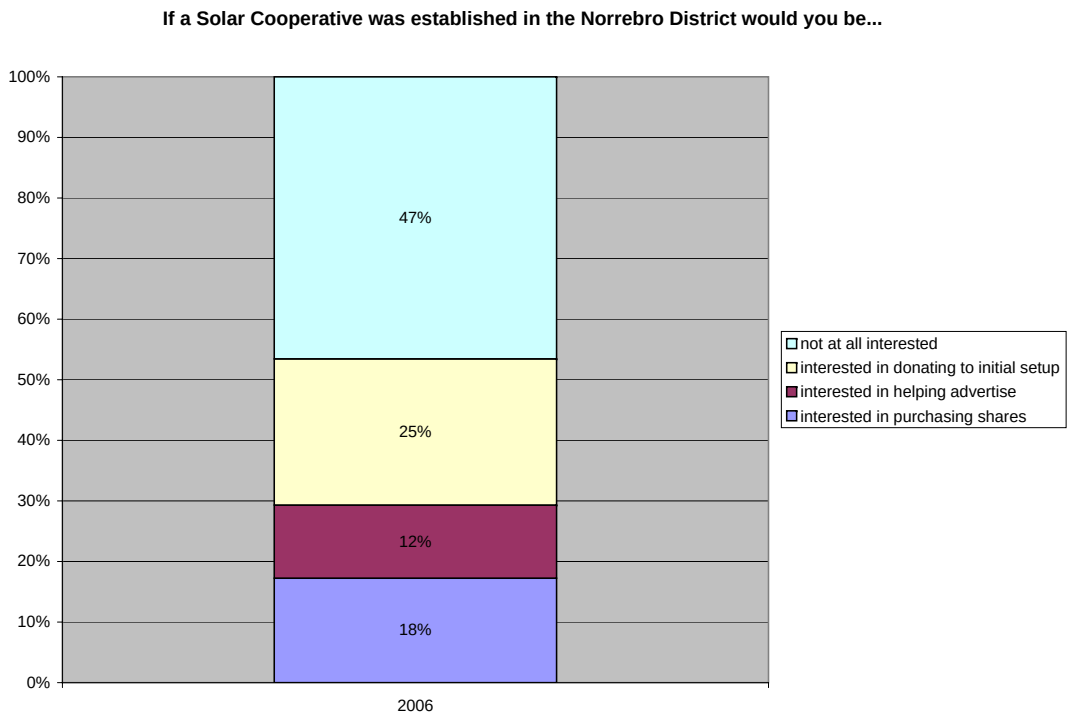
A similar question was asked on the KE survey and received different responses. From this question it can be seen that most people are willing to spend more for solar energy, this shows that people would be interested in a cooperative if one was developed. The problem with this type of question however is getting people to follow through. Although many people have indicated that they would be willing to spend extra amounts of money on solar energy, it is hard to hold people to this claim in the future.



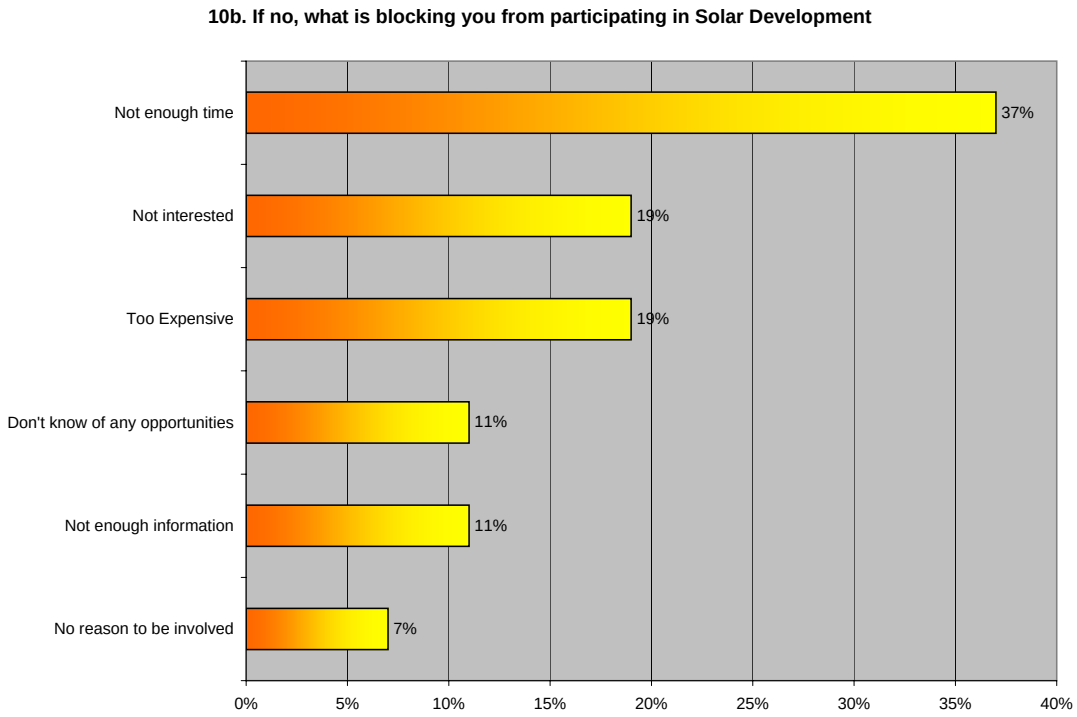
This question shows if people were interested in learning more about solar energy. This means that a community outreach or promotional program will be well received and effective if presented through the proper medium, which is possible to determine through the use of question 9b.



This part of the question shows how people would like to learn about solar energy in the future. TV and radio were the biggest choices and the internet and newspaper were close behind. A community outreach program needs to make use of this information by catering to the top responses. This does not take into account the success of the solar exhibition pilot program however. It has been determined that people selected answers which would take little to no effort on their part, and which would not be engaging. However, upon testing the live demonstration choice it was proven that people are interested in having live demonstrations.



This question asks if the community was at all interested in a solar cooperative. Half of the responses are positive, which is a good start for any new type of program which the people have not heard of before. The follow up question is used to identify what causes people to say they are uninterested in a solar cooperative.



This question shows the barriers that people have to investing and becoming involved with solar energy. Time and money are the biggest reasons for not becoming involved, although some people are just not interested in solar energy. The information from this part of the last question will be used to create a promotion program which can target the reasons cited here.

C SOL-SPÆNDING: Solar Excitement Exhibit

Figure C.1: Solspænding contest entry table

Figure C.2: Miljøambulence and Solspænding display, solstrøm and solar city information

Figure C.3: A child looking at the animated solar power toys

Figure C.4: Team members surveying local residents in the square

Sol-Spænding or "Solar Excitement" was held on 3 May, 2006 at Sankt Hans Torv, Nørrebro across the street of the Agenda 21 Center. The location for this event was ideal considering its popularity as a local hangout and close proximity to the Agenda 21 Center allowing easy transportation of promotional items from the Agenda Center. The event also took place in the center of Indre Nørrebro which was this project's target zone. The possibility of piloting

a promotional program in this area was an opportunity that needed to be taken advantage of. As can be seen in Figure C.4 many people gather in the square on sunny spring days and the weather on 3 May was extremely supportive of the program as one of the first warm and sunny days of the season. Through observation it has been noted the busiest times in the square were in the late afternoon, therefore the program was to start at 1400 and continue till 1700.

As an attempt to bridge the gap between different organizations in the local area, materials were gathered from each organization for display to the community. A contact from Københavns Energi provided advertisement easels with Solstrøm posters on one side and in-depth information on the Solstrøm program displayed on the other. KE also provided pamphlets and postcards with Solstrøm purchasing information. Solar City Copenhagen provided a few pamphlets and a photo book on the Sol 1000 program which included examples of creative implementation of PVs in the city. Jens Larsen from KMEK provided the Miljøambulance (Environment Ambulance) which had a mounted PV demonstration system with a light and a radio. The truck was a beacon for around the area which most likely was one of the reasons people stopped to see the exhibit. The Agenda 21 Center provided basic necessities such as a display board, tables, as well as the temporary donation of a large photovoltaic panel which was displayed against one of the tables so people could get a close look at the otherwise mysterious device. The Agenda 21 Center also provided various solar promoting tools for display; the most valuable displays were those which were in motion. A box of hats with solar powered fans attached was available for purchase at the table. Advertising logos, informational flyers, and contest postcards were designed by members of the project team for display in and around the exhibit. The contest postcards are shown on the following page.

Sys Hansen and others from the Agenda Center were present at the exhibit to speak with local residents in their native language about the possibilities of solar energy. Meanwhile, surveys and contest postcards were distributed to people who were interested in the program or were relaxing around the square. The contest postcards are explained in full detail in section 3.4. Prizes for the program were displayed at the fair, and people could see what they may win in the contest. 30 postcards were received in total. The contest winners were decided and their responses are as follows:

What is a creative way to implement solar panels in Indre Nørrebro?

Place solar panels at bus stops and street vendors.

What is a creative way to promote solar energy in Indre Nørrebro?

Advertise solar power on flags on the back of bikes

Children were enticed to the display by the moving toys and the parents were soon chasing after their kids to the display table. This unexpected but pleasant result had parents being just as interested as the children. The children and adults alike enjoyed creating shadows over the solar panels to see how it affected the rotational speed of the toy. A few people we spoke with were interested in buying solar panels or looking for more in depth information, so we were able to point them to the Agenda 21 website, but having a solar site would be helpful for people to have. Although our displays were in Danish, it would be better to have even more posters, explaining the solar toys for example or the solar windmills.

Figure C.5: Solspænding logo

Figure C.6: Contest Postcard in Danish