senter for teknologi og samfunn

STS

Trond Buland, Heidi Gjøen
and Mikael Hård

THE ELECTRIC VEHICLE IN NORWAY
Scenarios and user patterns

STS-arbeidsnotat 12/96

ISSN 0802-3573-129

arbeidsnotat
working paper

Trond Buland, Heidi Gjøen and Mikael Hård

THE ELECTRIC VEHICLE IN NORWAY: SCENARIOS AND USER PATTERNS

1. Introduction

After years of discussions and failed attempts there are now some indications that the electric vehicle (EV) might have reached a point of take-off. The Californian decision to force automobile dealers to trying to sell a certain amount of zero-emission vehicles seems to have moved General Motors to take serious action; in Switzerland, France and Germany the number of EVs now run in the thousands; and in 1997 series production of EVs will get started in Aurskog, Norway. It remains, of course, for the future to tell whether these initiatives and events will definitely mark a new trend in the history of automobility.

In this paper we attempt to analyze the initiatives to establish the EV that were taken by various actors in the Norwegian scene in the first half of the 1990s. In Chapter 2 we present some statistics and information about the energy situation, the environmental policy and the transport system in Norway. We decribe some central factors influencing the contitions for EVs in a possibly growing Norwegian market for alternative transportation solutions. The initiatives to stimulate this market have emerged from a multitude of actors and has not in the first place been called forth by any clear governmental policy. The visions and scenarios about EVs have until now not been promoted by politicians, but by vocal engineers, interested manufactures and other industrial and private actors. This "policy-making from below", described in Chapter 3, is of central importance to understand the status of EVs in Norway. In this process the experience, expectations and reactions of the users are important, and users are more than any other actors to decide the fate of the EV. In Chapter 4, we present and discuss some information about early use, and early users experience. Toward the end of the paper we propose that their way of conceiving and using the EV indicates an understanding of automobility that is a potential threat to the traditional interpretation.

2. Ecological Costs and Benefits of the Electric Vehicle

In some important ways Norway is special among its European neighbours--both when it comes to energy in general and to so-called alternative sources of energy. Because of a seemingly abundance of cheap and clean hydro-electric power, the public discussion

over alternative energy has been relatively limited, and few public programs have been developed to support and promote alternative energy. In short, what in the rest of the world is known as alternative energy has played a minor role in Norwegian energy politics, public debate and R&D.

A similar disinterest in things alternative is also to be found in the area of electric vehicles. The EV has up till recently never been seen as an realistic alternative in Norwegian transport. There has been no public programs or co-ordinated support aiming at developing and/or introducing EVs in Norway. In spite of the fact that Norwegian electricity has generally been seen as both clean and cheap, this has only by a handful of enthusiasts been used as an argument for the introduction of electric cars in Norway.

In this section we will present some basic facts about the present traffic, environmental and energy situation in Norway. These facts are meant to illuminate the Norwegian situation and give some necessary background for answering the crucial question about the possible benefits of EVs.[1] At this stage it is difficult to draw up a detailed ecological balance sheet describing the ecological costs and benefits of electric cars. Still, through presenting the following data, we hope to be able to give a broad, general picture of the actual benefits of electric cars in Norway, today and possibly in the future. These are the frames within which the discourse on EVs in Norway should be understood.

2.1. Cars and Traffic Patterns in Norway

With a population of only 4.4 million in 1996 and an area of just over 300,000 km^2 the country of Norway appears to be populated by relatively few people living very far apart. Since population density per km^2 land area was 14.2 in 1996, the impression is that the need for long distance transportation is very great. Under such conditions, the role for EVs--given today's technical limitations--should be expected to be correspondingly small.

Things are not so clear-cut, however. It is, for instance, also true that 74% of the population live in towns with over 2,000 inhabitants. In 1996 the population of Oslo and the nearby county of Akershus alone was over 900,000, or close to 20% of the total population. The EV could thus very well be expected to play a role in the greater capital area. As we will see below however, many people living in the countryside also show an interest in EVs.

From a comparatively low level, the number of private cars in Norway grew rapidly during the 1980s. Due to economic sluggishness, this growth stopped in the early 90s, only to pick up again in the last couple of years. In 1995 there was a total of 2.5 million cars, tractors and motorbikes in Norway, or close to 0.6 per capita. 1.7 million of

1. All facts and figures about Norway are quoted from official and public statistics: *Statisitisk Årbok 1996* and *Energi- og vassdragsvirksomheten i Norge - Faktaheftet 1996*, Nærings- og energidepartementet, June 1996.

those were private cars--making out 0.4 private cars per capita. In the same year, 2.7 million persons held a driver's license.

Not least due to relatively high retail prices, the fleet of private cars in Norway is among the oldest and most worn out in Europe, and political steps have been taken to ensure that some of the oldest and possibly most hazardous and worse polluting vehicles be removed from traffic.

Today, four out of five trips in Norway are made by car. Despite the country's size and thinly spread population, the average driving distance of a car in 1992/93 was just over 14,000 km a year, making an average daily distance of less than 40 km.[2] In 1991 the average trip made by private cars was 13.4 km.[3] About 70% of all cars are used in cities and urban areas. 58% of all households have only one car, while 17% have two cars or more. The larger a family, the better chance of that family owing more than one car.

While these figures show a traffic pattern not substantially different from that of smaller and more densely populated countries in Europe, it is also important to remember that the rural image is a very important part of Norwegian self-understanding. Norway was urbanized fairly late in history and many city-dwellers still have their roots in a rural environment, and most have close relatives living under rural conditions. In addition, many Norwegians own cottages and holiday homes out in the country. Outdoor life is an important part of many Norwegians' private life. Holidays and leisure time are to a large degree spent outside towns, in the countryside and mountains. This is true even for those Norwegians that lack direct family ties to rural areas. The car is very often used in connection with this outdoor life, as a means of transporting people from their homes in rural areas to their favourite arena for sport and relaxation: the countryside.

The important driving factors behind the choice of a car are not limited to the factors pertaining to actual, daily needs. Maybe just as important is the car's symbolic function and its potential capacity. And in a Norwegian cultural environment, that means that a car, in order to be defined as a "working" technology, a "good" car, should also be able to make those long distance trips far into the countryside. This is, of course, a clear potential hurdle for the wide-spread introduction of electric cars in Norway today.

2.2. Energy in Norway

Electric power is relatively cheap in Norway. Electricity delivered to private consumers was in 1995 priced at an average of NOK 0.50 per kWh (ca. 0.062 ECU).[4] This is considerable below the price level in most European countries. Although the last years have seen a price convergence between Norway and the rest of Europe, it is still the case that electricity is generally regarded by the average consumer as a cheap and plentiful

2. Lian, J.I., *Bilundersøkelsen 1992/93 - hovedfunn*, TØI arbeidsdokument, Oslo 1993.
3. Rideng, A., *Transportytelser på norsk område 1946-1991*, TØI Rapport 129/1992, Oslo 1992, p. 14.
4. Included taxes, quoted from NORDEL, *Annual report*, 1995.

commodity. There are still stories to be told about surprised foreigners that stare at Norwegians keeping the lights on when leaving a room.

The consumption of electricity doubled from 1970 to 1996. Average, per capita, use of electricity in 1995 was 27,000 kWh a year. This high figure is not in the first place a result of unconscious behaviour, but reflects very large consumption levels in industry--in addition to the high demand for heating during cold winters. In 1995, the average private household consumed 16,000 kWh. Of this private consumption, 41% was used for space heating, 24% for heating water and 11% for lighting purposes.

Electricity is of course not the only source of energy in Norway. Both private industry, public sector and private households meets their energy needs by a multitude of sources such as oil and coal. In 1995 electricity covered 49% of the total consumption of energy in Norway. Oil and gas covered 39%, solid fuels (wood, coal etc.) covered 12% and district heating 0.5% of the total energy consumption.

The common idea among Norwegians that electricity is cheap and plentiful--in addition to the fact that the previous low levels have created a high dependency on electricity—has led to a situation where prices are of little effect as a tool for regulating energy consumption in private households.[5] Experience shows that a rise in prices will not automatically lead to a decrease in consumption, and if it does, decrease is usually short-lived. It is interesting to note that some of the energy conservation campaigns being carried out through the 80s did not result in any reductions at all in the consumption of electricity. More effective utilisation of electricity, through better ovens, better insulation materials and so on, resulted in households using the same or even more of electricity. Better insulation in houses gave many the opportunity to heat larger parts of their homes for the same or only marginal higher total cost.[6] In addition, people do not think it is a damage to the environment to use a lot of electricity. A very common view is that electricity is environmentally clean because it is produced in hydro-power plants. A survey in 1991 finds that 77 % think they have found a system for heating that are sufficiently environmentally friendly.[7]

Still, we might be experiencing a shift in these very days. Following a very dry winter in central parts of the country, the price of electricity is presently rising steeply--in the autumn of 1996. Such rapid increases are nowadays possible, after a new energy law in 1990 made utilities free to set their own prices. Energy providers now warn for a 20% rise in the average price of electricity. Even if the current prices still are well below the normal level in most European countries, this sharp rise in energy prices are presented as something close to an energy crisis in the national tabloid press. There are even some indications that this new situation has led to a somewhat new pattern of use. It is yet too early to say if this new conception of electricity as expensive and scarce--rather than

5. Aune, M.: "The rivers never stop flowing"- popular perception of future energy supply in Norway, i *Nytenkning omkring effektiv energibruk og bærekraftig forbruk i husholdninger*, Workshop 23-24 May, 1996, Norges forskningsråd.

6. Hubak, M., K. Sørensen and V. Novakovic, *Prices Punishment or Pedagogics? How Norwegian energy-conservation policies affect heating and ventilation engineering*, STS-arbeidsnotat 5/95, Trondheim 1995..

7. Ljones, A., *Energimarkedsundersøkelse i husholdningene 1991*, Energidata 1992.

cheap and plentiful--will be more than a passing fad, or if we are indeed witnessing a thoroughgoing and lasting change in energy-consumption patterns.

The consumption of electricity increased by 40% from 1980 to 1995. Electricity covered 1,5% of the total energy consumption in transport (road, air, water) in 1991, the rest was covered by fossil fuels. The use of oil for transportation increased by 26% from 1980 to 1995.

In 1994, total consumption of energy in Norway was 7.202 PJ, of which electricity totalled 406 PJ. Of this total consumption, 81 PJ was used for transportation purposes. Electricity covered 6 PJ of the energy consumption for transport in 1994.

It must be admitted that Norwegian electricity production is a rather clean and renewable energy source. Electric power produced today is almost exclusively hydro power. At the moment there are no major oil-, gas or coal-powered power plants, although a very large gas-powered plant is being planned on the coast. Norwegian production of electricity does therefore not in itself contribute to air-pollution. Still, all of the electricity being consumed inside Norwegian borders are not produced in Norway all the time. On a regular basis Norway exports and imports electricity to and from several European neighbours, mainly Sweden, Finland and Denmark. In 1990, Norwegian export reached a top of 16 TWh. In 1995 the net export of electricity reached 6.5 TWh.[8] At the moment, we import more electricity then we export. From Denmark alone, the import during the months January to April of 1996, varied between zero (or rather a small Norwegian export) and a top of close to 25 GWh a day.

If all Norwegian cars should powered by electricity, this would use about 7% of the total production of electricity in Norway. In the present situation this would still lead to a growing import of electric energy.

This imported electricity is of course produced by a multitude of means; hydro-electric, nuclear, oil, natural gas and coal. In 1995, 93% of the production of electricity in Sweden was hydro-electric and nuclear power, while the rest of the Swedish production was done by means of power plants powered by oil. In Denmark the main source of electricity is fossil fuels, mainly coal (close to 90%). Finland produces it's electricity by means of hydro-power (21%), nuclear energy (30%) and thermal energy (49%). In 1995 app. 33% of the Finnish thermal energy was produced by burning coal.

For most of the 80s and 90s Norwegian export of electricity has exceeded the import. One important fact is that the import/export ratio fluctuates not only from year to year, but over the year and during the day. Norwegian consumption tends to reach a peak during winter, because of much higher need of heating. Export has therefore tended to be highest during the summer. In the same way, consumption of electricity is highest during the day, and low during the night. As a result of this, the normal situation has been one of some import of electricity during peak hours in the day, and some export during the low-consumption hours in the middle of the night. In 1994, Norway imported 17 PJ electric energy, while the export at the same time reached a total volume of 18 PJ. In connection to electric vehicles this would mean that *Norwegian EVs would drive only on renewable*

8. Ibid.

hydropower if recharged during the night, while any addition to energy consumption during the peak hours would result in more import of potentially non-renewable electricity. EVs driving on electricity produced domestically, could be seen as clean, not at all as the "coal-burning cars" some would describe EVs in a Central European setting. The problem rises when electricity has to be imported from countries where the source of electricity is mixed. If EVs would contribute to rising imports of energy, this could be seen as a contribution to rising air-pollution in those countries producing that energy.

As far as we are talking about electric energy, it would still be right to say that energy is clean in Norway in spite of the problem concerning imported electricity. This fact would make the argument that introducing EVs means nothing else than transferring the pollution from the individual car's tailpipes to the powerplant's smokestack more or less irrelevant in a Norwegian setting.[9]

2.3. Environmental Issues in Norway

Environmentalism is an important part of the Norwegian self-image of the 90s: many Norwegians see themselves as very environmentally friendly. It does seem, however, that they tend to view environmental problems as less important or critical in Norway then in the rest of Europe, even if the perception of environmental problems as truly international are growing.

A large survey conducted in 1988 shoved that 42% of the population felt that their environment was "good".[10] This was significantly more than in most European countries. Still, close to 60% felt that environmental factors had deteriorated during the last 10 years. A majority was dissatisfied with the role of government in protecting the environment. Less than 20% felt that enough resources were being used on environmental protection, 89% felt that more should be done, and more than 78% was willing to pay more taxes if that would result in more/better protection of the environment. About 75% was willing to do something themselves to help protect the environment, and close to 80% said that voluntary environmental organization had an important role to play in such activities.

In the late 1980s a small majority of the population said that they would give environmental protection higher priority than economic growth,[11] which should not be interpreted to mean that economic growth is no longer an important public concern in Norway. In 1989, a survey shoved that 80% of the Norwegian public agreed to the statement "We should strive for a society with a high economic growth and productivity."

9. Rogers, A., and S. Begley, "Putting a Charge Back Into Driving", *Newsweek*, May 27, 1996.
10. Henriksen, G., and K.K. Skjåk, *Holdninger til miljøvern i 16 land. Dokumentasjon og komparativ oversikt*, NSD-rapport nr. 84, Bergen 1989.
11. Jenssen, A.T., *Growing Environmental Consciousness in a Growth Oriented Society? The Case of Norway*, Report No. 2/94, The University of Trondheim, Centre for Environment and Development, Trondheim 1994.

The group of people both pro growth and pro protection was the one with a marked raise during the 1980. This group more than doubled from 1980 to 1989. This should not be surprising, since this is in line with the environmental policy of the social democratic government, where growth is seen as complementary to protection:

> The group of people advocating reduced growth to save the environment is still a relatively small minority. The emerging environmental consciousness is in line with the growth and protection policy of the social democrats.[12]

Membership in environmental organization has declined markedly from 1980 until today.

If the EV is not considered environmentally friendly in all countries, it should be so in Norway with its relatively "clean" electricity mix. The main question is if it is seen as the right answer to what most Norwegians consider the main environmental questions. This has, up till recently, not been the case.

2.4. The Car as an Environmental Problem in Norway

As in other industrialized countries, road transportation is a major contributing factor to environmental problems in Norway. In the following table are reprinted the emissions into the air of various compounds and the relative contributions made by road traffic:

sulphur dioxide (SO_2): 35,000 tons (traffic 9%)
nitrogen oxides (NO_x): 223,000 tons (traffic 37%)
carbon monoxide (CO): 781,000 tons (traffic 76%)
carbon dioxide (CO_2): 38 million tons (traffic 21%)
volatile organic compounds except methane (NMVOC): 305,000 tons (traffic 25%)
particles: 23,000 tons (traffic 22%)
lead (Pb): 28,000 tons (traffic not recorded)[13]

Road traffic thus contributes significantly to the total emission of CO, NO_x, CO_2 and particles into the air in Norway.[14]

Despite Norway's low population density, it is estimated that 660,000 persons are exposed to NO_x levels exceeding the recommended quantity. The same figures for particles is 700,000, making up about 15% of the population. The State Pollution Agency of Norway has estimated the cost of NO_2 pollution to be approximately NOK 3,000

12. Ibid., p. 14.
13. *Statisitisk Årbok 1996*, op.cit., p. 46.
14. UNEP/GRID-Arendal: State of the Environment Norway 1995, available at http://www.grida.no/soeno95/ (Source: *Statistisk Årbok 1996*).

million (ca. 700 million ECU) per year. In 1991 about 13% of the total population felt exposed to noise from road traffic.

Behind the average figures presented above, one finds considerable differences between urban and rural areas. Inside the major cities, the car is without doubt the most important contributor to the total amount of air- and noise pollution. Local air and noise pollution in urban areas is a major environmental problem in Norway as in other countries.

In Oslo as a whole, 40% use private car for all of their travel to and from work, whereas as many as 40% use some sort of public transportation for the whole or parts of their work related transport, while one out of eight walks or uses a bicycle to get to and from work.

2.5. Environmental Policy and the Regulation of Energy Consumption

The household sector has increased its energy consumption with 2% every year since 1975 to 1993.[15] The government has seen a large potential for energy saving in this sector, and for many years the political aim has been to stabilize private energy consumption. Several energy conservation programs and campaigns have been initiated. Improved standards in buildings and information about energy saving potentials have, however, not been met by people decreasing their consumption, but by them improving their life quality, and changing their lifestyles into a more energy-intensive way of living.[16] A very common view among people is that electricity is environmentally clean, and that this energy is almost unlimited. Then the idea that low consumption of electricity should be of any environmental importance is weak.

In transport the link between energy use and pollution of the environment is more obvious, and health damages are also more visible. The problems also seem to increase as the numbers of cars and people dependent on cars for transport increases. Studies report a relative decrease in the share of peoples use of public transport in the period from 1985 to 1992.

To improve air quality in cities, the reduction of NO_x, CO, particles and dust, is of importance. The policy in this field is concerned about how to reduce the private car transport and to strengthen the conditions for public transport. The political means are both economical and technical:

a) From 1991 there have been CO_2 taxes on gasoline (83 øre [0.10 ECU] per litre in 1995) and diesel (41 øre [0.05 ECU]).
b) Focus on the need for renewing the car fleet by different economic incentives, to reduce emissions, primarily through a substantial bonus for those who scrap their old car.

15. Bergesen, H.O., *et al.*, *Norge i det globale drivhuset*, Universitetsforlaget, Oslo 1995.
16. Sørensen, K., og M. Aune, *Energisparing under energirikelighet? Om energibruk og inneklima i husholdninger*, STS-arbeidsnotat 14/95.

c) Stimulate to the use of winter tires that are not studded.
d) Continue the state subsidy of public transport.
e) More information and more widespread use of laws that are to be used in regulation and land use planning in city areas, to increase the population density. This is seen as important if the need for transport should be reduced and to improve the conditions for more and better public transport.
f) An ongoing discussion if one should extend the existing road prizing projects to cover not only the financing of new roads, but also as a means to regulate and decrease private car traffic.

Alternative transport technology plays a minor part in the environmental policy for the transport area, but the Ministry of Transport still runs their program on alternative fuels in transport. In this program some support is given to PIVCO's electric vehicle project (see 3.5. below) and to small projects on EV-technology tests in laboratory and tests during use. A major part consists of pilot projects on natural gas technology, and this priority is guided by Parliament's clear statement and will to improve the conditions for increased use of natural gas in transport. When it comes to EVs Parliament expresses a somewhat reserved attitude, although it finds that cars driven on hydro power represent a unique position, because they will not cause any damaging emission at all. But the limitation in battery capacity also limits the politicians belief in that EVs could possibly represent an alternative in Norway, unless the battery technology is improved.[17]

2.6. Norwegian Policy Programs for Electric Vehicles

Political pressure for alternative energy has never been particularly strong in Norway. The same is even more true when we are talking about alternative energy in the transport sector. It has been hard to sell the EV as a major part of a Norwegian industrial policy, and there have been no comprehensive public programs of any kind actively promoting EVs. Electric vehicles have consequently so far not been a conscious part of local and/or national energy or environmental policy in Norway. The electric car has not been seen as a way of solving environmental problems. There has been no conscious and coordinated policy with the aim of introducing EVs in Norway. Instead, public support of various kind has been given to a few isolated projects. The model is to support individual projects that are on the verge of going from development to market introduction. Government takes on a minor, catalytic function, if any at all. The aim of some of the public support of R&D on EVs have been describe as to get more knowledge about such vehicles, and not actual development and/or market introduction.

EVs have up until today quite simply not been an important political issue in Norway. Those trying to make it a political issue, have had limited success. The fact that influential parts of the Norwegian environmental movement—with Bellona as the notable exception—has actually been opposed to EVs, has not helped to make their

17. St meld nr. 41 (1994-95): *Om norsk politikk mot klimaendringer og utslipp av nitrogenoksider*, s. 136.

introduction a part of national or local environmental politics. There has been a strong tradition in the Norwegian environmental movement to see the car system, based on private ownership to cars as opposed to collective, public transport and/or bicycles, as the problem, regardless of the means of propulsion inside the individual car. This has led some parts of the environmental movement to state that EVs are nothing but a new way of saving the present, environmentally damaging system of transportation.

As a consequence of the EV not being a political issue, there has been done close to nothing to ensure EVs easy access to parking and/or electricity in Norway. There has been done nothing to create an infrastructure for this kind of vehicles. The one exception attempts made by Oslo Energi, the capital's local utility. Couple of years ago, it established several parking places reserved for EVs in the central Oslo area. On these parking spaces, EVs were also able to recharge their batteries for free. In Oslo there has also been a discussion for years between local government and the environmental foundation Bellona, about the possibility for electric cars to pass the city's turnpike system without paying toll. Bellona and others have argued that this would be a quick, easy and visible way for the local authorities to show that they were willing to support EVs as a way to promoting the local environment. So far this has been rejected by the local government, even though there are at the moment some signs that the local policy on this is about to be changed. One such sign is a recent statement by social democratic head of the City Council in Oslo, Rune Gerhardsen. In a comment to the fact that the authorities in Oslo have decided to buy ten City Bee electric vehicles for use in home based care, has said to Norwegian press that it was his hope that EVs will have totally replaced internal combustion engines in Oslo within the next 20-30 years.

There has been some exemptions from taxes on the importation of EVs. Importers have for some years been exempted from some of the tax on imported cars. This will contribute to making the price of such vehicles compare favourable with internal combustion engine driven cars of the same size. Early in 1996, it was decided to exempt EVs from the annual tax on use. This will make driving an EV cost about 200 ECU less a year than driving a traditional car.

With the introduction of the City Bee, a car rental project run in Oslo and improved sale for the Kewet and other models, the situation for the EV might be changing. The most important event has been the coming of the City Bee. Different public authorities have been more or less actively promoting/funding the work being done at the Private Independent Vehicle Company (PIVCO), leading to the City Bee electrical vehicle. This support was organized as a public R&D contract. In addition to this, The Ministry of Transport and Communications has financed parts of the testing being done on the City Bee prototype. The Ministry's support of EVs is channelled through a program for alternative energy in transport. The money actually going in support of EVs is a minor part of this program. We might therefore be on the threshold of a new situation. At the present moment, there is considerable interest both among political authorities and the general public. Much of this new interest is of course a result of the, so far, success of PIVCO in both developing an EV and selling it to California.

2.7. The Role of Electric Vehicles in Norway up Until Now

Partly as a consequence of the weak policy that has been described above, there have been few EVs in use in Norway up until, and including today. Outside any major city, the chances of actually seeing a real, live EV is very small. Indeed, this has been so inside large cites too. Even in newspapers and other mass media, EVs have had a low degree of visibility. Today, approximately 120 electric cars are used in the whole of the country.[18] Most of those are driven in Oslo and the areas close to the capital.

The major part of EVs used in Norway today, are Danish produced Kewet El-Jet. This tiny two-person car has been imported and sold for several years already. The users of this car are mainly small firms/enterprises, both in the public sector and private, and a few individual users. Various local branches of the public post office of Norway and some local energy providers are among those that have been using Kewets for some time.

At the moment the Norwegian City Bee is being introduced into the market in a step-by-step way. Users already driving City Bee includes some large energy providers such as Oslo Energi and Stavanger Energi, who each received their first five cars in March 1996, the post office, Statoil and Telenor (Norwegian Telecom). Starting in May 1996, the City Bee can also be rented at Statoil's car-rental services in Oslo. Apart from these there are a low number of other EVs in Norway. As one of the first cities outside France, customers in Stavanger will soon be able to get the electric version of Peugeot 106.

It is correct to say that the environmental effects of EVs up until today has been far to low to be measurable. It also seems right to say that the potential environmental effects from reducing car traffic, or moving away from internal-combustion engines driven on fossil fuels are great. The potential for reducing air-pollution from road traffic is large. This may be especially true inside the heavily populated urban areas.

3. The Industrial Actors and their Scenarios

As it has been in the Swiss case, it could be argued that Norway, lacking an independent car industry, is relatively independent of the international car industry. During the late 1980s and early 1990s, an informal network of actors interested in EVs grew up in Norway. Individuals and organizations (and individuals within larger organizations) worked partly on their own and partly together towards a commonly shared goal, the introduction of EVs in Norway. These different actors had different interests, and different strategies on how to reach fulfil them. One interest, however, was common; they all wanted to see more EVs on Norwegian roads.

18. Figure quoted from *Elbilnytt*, no. 2.1,1996. Elbilnytt is the newsletter of NORSTART, the Norwegian organsation for EVs.

The degree of actual formal or informal cooperation between these actors varied. Some of them cooperated rather closely, others had more infrequent contact with each other. Some of them were environmentalists, others were industrialists, some were political "visionaries", some of them were scientists while others were practical "nuts and bolts" workers. The loosely defined division of labour between the different actors were sometimes formal, other times informal. And some of the actors did not even know about all the others. What kept the loosely knitted network together, was the common interest in EVs.[19] Since the Norwegian scene is so small, it is possible for us in the following to present at some length the main actors in this network.

3.1. The Industrial Visionary

One of the most visible proponents for alternative technology in the transport sector for years has his base of operations at the Norwegian University of Science and Technology (NTNU) in Trondheim. Trond Andresen, a professor of technical cybernetics, has been active both as a researcher and as a general spokesperson for EVs.

In 1989-90 Andresen was involved, together with researchers from several other faculties at NTNU (at that time the Norwegian Institute of Technology, NTH) and sister institution the Foundation for Scientific and Industrial Research (SINTEF), in building a hybrid car. The car, a modified Renault Esprit, was presented to the public in December 1990. Maybe more important than the actual hybrid was the knowledge gained by the involved actors in various fields. After finishing this project, the involved actors went on in different directions. Some of them has later cooperated with Volvo in its development of a hybrid car. Others went on to do work on environmentally friendly natural gas engines, in cooperation with a local bus company in Trondheim.

Although the initial project was finished, Andresen wanted to continue the EV path of the hybrid project. He and some of his co-operators found a possible companion in the new company Norsk Bilproduksjon A/S (Norwegian Car Production, Inc.) in Fredrikstad. This company got some public support to develop a new, internal combustion driven van, for production in Norway. What made this projected car interesting to Andresen was its weight: The new car was to be built from aluminium alone, something that would result in a weight 400 kg less than traditional cars of that type. Andresen wanted to test an electrically powered version of this car in actual use. The user was to be the local branch of the Post Office in Trondheim. Andresen and his engineering colleagues were to provide new and better control electronics for the electric engine. Apart from the low weight, the car as such was a rather traditional car.

Economic support was solicited from Trondheim Energi (the major local energy supplier), the Post Office and the Ministry of Environment. Even the Ministry of Transport and Communications contributed some, although none of these actors can be

19. When we use the term "were" that is not quite right; all of the actors described in the following are still active in the field.

said to have invested large sums of money in the project. Norsk Bilproduksjon was to contribute the car needed to carry out the project. The potential network and the project broke down, however, the reason simply being that one very important components failed to materialise: the car was never delivered. Norsk Bilproduksjon got into severe financial problems, following the withdrawal of their main industrial co-operator (Norsk Hydro) from the project. The Andresen group suddenly missed the car that was to be the central element in their project. And no car, no project!

3.2. The Enthusiasts and Importers

Kollega Bil A/S (Colleague Car, Inc.) is a small auto-shop in Oslo. The firm was founded by three mechanics who, to quote themselves, "don't like petrol". The driving force behind them is without doubt their interest in environmental issues, together with considerable technical fascination. They do all the usual kinds of repairs on traditional cars mainly to be able to afford their real interest, the import, development and maintenance of EVs. Since 1992 Kollega Bil has imported and sold the Danish Kewet El-Jet in Oslo/Norway. During the first two years in business they sold 20-24 vehicles. Kollega Bil has rather close connection to the Kewet factory in Denmark. They have visited the factory several times, and the founder and boss of Kewet has visited them in Oslo. They send regular reports to the factory about the use of the Kewet in Norway. In their own opinion, this has contributed to making the Kewet much more useable under Norwegian conditions, especially winter condition. Still, at the time we interviewed them, they were yet clearly not fully satisfied with the electrical vehicle they sold.

Perhaps due to its small size, the company can work very closely with their customers. The "colleagues" are no ordinary used car salesmen: they do not sell a Kewet to just anybody. With new customers they start out trying to get the answers to some crucial questions about the possible buyer's real needs. If they see that her/his needs will not be met by a Kewet, they try to persuade the customer NOT to buy! They reason seems to be that they do not want unsatisfied customers that threaten to give EVs a bad reputation. For that same reason, they are quite outspoken about all the vehicles limitations to the customers. The company also tries to follow up those who buy a Kewet closely. They give follow up service, technical advice and help their customers far beyond any call of duty. The colleagues at Kollega Bil see it as part of their job to create satisfied users of EVs. Such satisfied users may in turn spread the word about this alternative kind of car to other, potential users.

Maybe the most important fact is that Kollega Bil may very well be the actor in Norway that knows most about the actual, daily use and users of electrical vehicles, after working very close to their own customers for several years. The company obviously has gathered substantial knowledge about driving an EV under Norwegian conditions. This knowledge is gained both through their own work and use of the car, and through their extended contact with their customers, the average EV users.

3.3. The Energy Providers

Oslo Energi (Oslo Energi) is the main supplier of electricity in the Oslo area. They are not new to the concept of EVs. Oslo Lysverker (the forerunner of today's Oslo Energi) received one of the three electric vans/mini buses developed in the early 70s. The company's interest in EVs did not stop with that (unsuccessful) attempt to introduce electric cars in Norway. Today, Oslo Energi—and particularly its strong man in this field, Knut Erik Madsen—is one of the most important actors in the work being done on EVs in Norway. For years it has been active in promoting EVs in a number of ways. Its role in the network may be seen as that of the co-ordinator, the one weaving all the different threads together. Oslo Energi and Madsen are the actors that all the others in one way or another have had a relation to. At Oslo Energi a lot of the other initiatives meet or are brought together. In most, if not to say all the project concerning EVs in Norway during the last several years, Oslo Energi has been a (more or less visible) part.

Some of the projects of Oslo Energi should be mentioned here:

- Oslo Energi gave economic support to the development of the City Bee at PIVCO; see 2.5 below. At an early stage of the City Bee project, drawings of the future vehicle carrying the colours and logo of Oslo Energi was used in the presentation. Oslo Energi was presented as a future user of the future car, and thereby gave the project its public approval. Today, Oslo Energi is using their first City Bees, and has become a shareholder in PIVCO.
- Oslo Energi is involved in a project together with the Norwegian state controlled oil company STATOIL. STATOIL recently engaged in the car rental business, and as part of that is at the moment possible to rent a City Bee from various shops in Oslo (including one at Oslo Airport Fornebu). This EV rental service is run in close cooperation with Oslo Energi. Oslo Energi provides technical support, and wants to collect and analyse the experiences of the those renting the vehicle. This will be done by a short survey among those users.
- Oslo Energi is also probably discussing further cooperation with STATOIL regarding the future technical infrastructure for EVs in Norway. Our contact at Oslo Energi was of the opinion that it would be futile to establish a net of stations for battery recharging and service independent of the existing gasoline stations. As an important provider of electric energy, it is clear that Oslo Energi would like to be in on that future activity, together with a major oil company, running gasoline stations.
- On their own, Oslo Energi established a net of parking- and recharging-stations in inner city Oslo. Owners of EVs simply had to contact Oslo Energi to get a key-card. Supplied with this key-card, they could park and recharge their batteries. This is a service that Oslo Energi actually provides for free. The main reason for establishing this park&recharge system was political. Oslo Energi wanted to show the authorities of Oslo one example of what could be done if they wanted to see more EVs in the city. In addition, it is clear that Oslo Energi got considerable media coverage and marketing value out of this initiative.

- Before establishing the recharging stations in Oslo, Oslo Energi conducted a survey of those in the Oslo and Akershus area that at that moment were using EVs. Besides getting some information on the needs for such a net of recharging stations, they got interesting information on the users' experience from driving EVs under Norwegian conditions.
- Oslo Energi was of central importance in establishing the Norwegian association for electric vehicles, NORSTART.
- Oslo Energi was involved in a pollution project together with the city authorities of Oslo. The aim of this project was to map potential environmental effects of replacing parts of the traffic in down town Oslo with EVs. The project was to study some areas in the central Oslo dominated by heavy traffic and where local air pollution is high. The aim of the project was to map the inputs to this pollution, and to come up with potential remedies. It is not given that the answer will be EVs, even if it is a strong belief of Oslo Energi that there are considerable potential reductions in local air-pollution if EVs replace internal combustion engines.

3.4. The Interest Group

For some years there have been various attempts made to establish a organization for those working to introduce EVs in Norway. Trond Andresen is one of the actors that for several years has called for such an organization to be established. To him, one important function of such a organization would be to get the Norwegian car component industry, and the importers/sellers of cars involved in this work through the membership of such an organization. Oslo Energi is of course another actor that for a long time worked on the establishing of such an organization.

NORSTART was finally established in Oslo on the 1st of November 1995. At the start, 17 organizations were involved. Among these were four power companies/energy providers, one major car importer, PIVCO, two battery producers, Kollega Bil, The Post Office and the county authorities of Oslo. Among those most notably not involved in NORSTART at the beginning, were the Norwegian producers of car parts . Both Oslo Energi, PIVCO and Kollega Bil are represented in the organizations board of directors.

3.5. PIVCO and the Art of Convincing Others

The actor getting by far the most attention at the moment is the Oslo-based Personal Independent Vehicle Company (PIVCO), and their EV called *City Bee*. PIVCO is the outcome of a long time manufacturer of various products made from plastic, Bakelittfabrikken, founded in 1947. This company has through the years developed considerable know-how on the production of, among other things, plastic boats and training ammunition for the Norwegian armed forces, both moulded from plastics.

Bakelittfabrikken is described as one of the pioneers of Norwegian plastics industry, and this know-how is at the core of the development of an EV.

The idea of developing an EV based on the same production concept as the plastic boats emerged during the "oil crisis" following the Yom Kippur war between Israel and its Arab neighbours in the 70s. The director of Bakelittfabrikken has toyed with the idea of making cars since then. In order to make this dream reality, Bakelittfabrikken/PIVCO had to build a large network of actors necessary to carry out the project. The most important actors enrolled in the PIVCO network were:

- *Hydro Aluminium*: Norsk Hydro is one of the giants in Norwegian industry, and the Aluminium branch of the corporation is among Europe's leading producers of components for cars. Hydro Aluminium developed and produced the frame of the new vehicle. Norsk Hydro is involved partly because of their general interest in the car industry, but more important because of their interest in the growing market for small, ultra-light cars. Important parts of the PIV concept, such as the frame, the body, the production process, including the recyclibility of the parts, is not dependent on electric power. This is technology that could just as well be applied in traditionally powered cars. Hydro may see this part of the car market as one of future importance. Therefore they may feel the need to build their own knowledge base on this kind of car. The City Bee project may be on one possible way of getting this knowledge. That way, the project may open a door into a future important market for Hydro.
- *STATOIL*, the state controlled Norwegian oil company, and another giant of Norwegian industry, was enrolled primarily because of the company's competence in advanced plastics. Small cars, and maybe electric cars, is a potential growing market for producers of plastics. In addition, it seems clear that STATOIL was motivated by the need for a more environmentally friendly image. As an oil company it is also obvious that STATOIL is interested in all kinds of road transport; if the future of road transport should turn out to be electric, then STATOIL would want a part of the future. In spite of this, it is rather clear that STATOIL's engagement in the City Bee was not part of any large, co-ordinated strategic investment on behalf of the company.
- *Oslo Energi* was enrolled as a future important user, as a generally known public proponent of EVs, and as a supplier of energy. To Oslo Energi, it is clear that this is a part of their broad interest in EVs. In addition, Oslo Energi is clearly interested in looking into the potential markets in transport. To involve themselves in the City Bee network could be one way of getting closer contact to transport and thereby to the oil and gas related actors in the energy business.
- *ETH (Eidgenössische Technische Hochschule)* in Zurich participates with, among other things, safety-tests. (This part of the project being organized as a joint Norwegian - Swiss EUREKA-project).
- *Steyr Daimler-Puch*, the Austrian producer of auto-parts, was enrolled primarily because of their competence in electric engines.
- *The Ministry of Transport and Communications* gave some economic support as part of the Ministry's general work on alternative fuels/energy for the transport sector. The

Ministry let themselves be involved as part of their broader work on building a larger knowledge base for alternative energy. The Ministry wanted to try out various alternatives to fossil fuels in transport, and saw the City Bee project as part of this larger project. More knowledge about EVs was the Ministry's main objective, and this knowledge was not necessarily dependent on a successful development. The engagement in the City Bee development was not part of any broader strategy for EVs on behalf of the Ministry. The participation of the Ministry of Transportation in the network seems to be at least partly a result of the enrolment at the political level: the Minister himself was said to be very interested in the project. That may have been an important factor behind the decision to support the development. It would, however, be wrong to say that the Ministry's engagement is part of any important, broad support of EVs. The aims and interest of the Ministry are rather limited, as has been its economic support.

- *The Norwegian Research Council*, and later *SND* (The National Industrial and Regional Development Foundation) gave economic support organized as a public development contract. The research council helped finance the start of the project. When PIVCO together with Oslo Energi later applied for a public development contract, SND took this responsibility.
- *Telenor*, the national telephone company, supported the project in various ways, including economical. Telenor's interest seems to be mainly motivated by this marketing effect. An EV may be important in creating an image of being modern, high tech and environmentally friendly. An EV is visible, gets media coverage, and creates a lot of interest in large parts of the general public, the customers of Norwegian Telecom. In addition, a company like Telecom has its own needs of light transport services that can be met by an EV.
- *The Norwegian Post Office* gave some economic support, and acted as an arena for early testing under ordinary condition for use. The Post Office was enrolled because they are in great need of environmentally friendly, economic light cars for transport of post to the general public. It is clear that an EV even today can meet some of the demands for such transport. In addition the Post Office had obvious marketing interests in the project.
- *Bellona*, a nation-wide environmental organization, plays a somewhat peripheral role in the network, as general proponent of EVs, and thereby a possible door opener to larger markets. To Bellona, the engagement is part of their general work on EVs. Bellona and PIVCO have common interest in getting more EVs on the road, and they both want public authorities to play a more active role in achieving this. The work of Bellona may also contribute to a more visible position of the EV in the eye of the general public.
- *The Technological Institute* (TI) in Oslo is doing the independent testing, verifying PIVCO's own figures on the vehicle's performance. TI was the natural place to test the vehicle in Norway. This publicly funded and partly financed institute is giving technical assistance and help to Norwegian industry. Among other things they have established a department for road transport technology, equipped to run the necessary testing on a vehicle like this. TI has also done several projects focused on EVs during the last four or

five years, financed by the Ministry of Transportation and others. TI may be the institution in Norway today having most systematic knowledge about EVs.[20]

This network has been carefully constructed by PIVCO around the City Bee, but was done so in a loose and informal way. All the different participants did not play very active roles, but have allowed themselves to follow PIVCO's lead. PIVCO enrolled the others and defined their parts of the project, which all the time has stayed under PIVCO's firm control.

The heavy industrial actors have been, at least up till now, rather lightly engaged. They participated with know-how and vehicle components, but without playing any dominant role. The control of the project was clearly in PIVCO's own hands, and the heavy industrial actors did not take any great economic risk by participating. A failure would not have meant much to Hydro and STATOIL, and this project was no large or very important part of these two companies general strategy. Their aims were limited, as were the risks taken. The EV would be PIVCO's vehicle, as would a possible failure to produce such a vehicle. Still, they would both gain knowledge in fields important to them, and get some environmental image in addition. The strength of the enrolment strategy of PIVCO was that Hydro and STATOIL did not have to be devoted to EVs to be enrolled in the project. The project gave these industrial actors a way of reaching more limited goals on their own, while at the same time contributing to PIVCO's own and clearly defined goal; to developments a small personal independent vehicle, and a new way of producing such a vehicle.

At the same time, we have seen a marked escalation of PIVCO's own publicly expressed goals in the project. At the outset, their goal was quite simply to find out it would be possible to build an EV using the kind of techniques they knew from boat manufacturing. The nest goal was to make a working prototype, to study how such a vehicle would behave in ordinary traffic. That goal quickly changed to the one being reached today; to develop the prototype into a pre-production model, suited for industrial production. The next goal will be to start manufacturing the vehicle, in the USA and in Norway. This way, they were able to sell the project, step by step, to potential partners.

3.6. Users - What Users?

What place do the users, both the actual users of today and the potential users of the future, play in the various actors' scenarios and work? Who do these actors, all of which have several years of experience working with EVs, see as the most likely groups to use this kind of roads transportation in the near future?

To *Trond Andresen*, the question of users is quite simple and rational: As soon as the coming technological revolution is a fact, everybody will be using EVs. That is his

20. Examples of this work can be found in Figenbaum, E., *Elbiler*, Rapport nr. 271 (01) 1993, Teknologisk Institutt, Oslo mars 1993, and Bang, J.R., and E. Holden, *Elektriske biler -utslippsanalyse*, Rapport nr. 271(02)/92, Teknologisk Institutt, Oslo 1993

main reason for promoting this as an industrial area of crucial importance. At the short run, he sees public and private organizations in need of short distance transport as those groups most likely to use a EV. But even today, his opinion is that much more ordinary people would use EVs, if only public authorities would do something to make it easier and cheaper to do so.

Based on their own experience as importers and salesmen of the Kewet, *Kollega Bil* described today's and the near future's Norwegian users of EVs as follows:
- small and medium sized companies, in search of a light and relatively cheap mode of short distance transportation, in addition to the PR effect from owning an unusual and visible E; the marketing effect is and will probably be the most important for some time;
- various public agencies wanting to improve their image as environmentally friendly;
- "rich alternative people", environmentally conscious and economically well to-do people, able to afford an EV as a way of completing their image as "high tech", "alternative", "green" and "avant garde" at the same time. In certain circles, the EV is fast becoming a potent symbol of life style: "Everybody can get a Jaguar, only the elite will drive an EV";
- the last group of existing and potential users in Norway, Kollega Bil described as "nice ladies from the better parts of town": Women with a good private economy, in need of a small, nice, quite and easily controlled and parked car, that in addition is friendly to the environment.

As we will argue below, it seems as if the last two groups will be the most important users of EVs. This also seems to square with *Bellona*'s view of the matter. In their daily use of the Larel, Bellona gets a lot of attention from various groups of the public. Most of this attention is clearly positive. The groups most interested, and therefore maybe the most probable near future users are, according to Bellona:
- men interested in technology, drawn to the new and high-tech aspect of the EV ("these are the once that want to have a look under the hood");
- environmentally conscious women who wants a car that's small and easy to handle, and clean at the same time;
- "yuppie" men who sees the EV as an alternative and yet unusual and therefore exciting life style effect, something that goes well together with the cellular phone;
- "the artistic ladies": women in creative work (artists, architects, media, marketing and so on) who are interested in environmental issues and at the same time looking for a "special" and personal car to help underline their own creativity and individualism. It could be a sports car, but an EV covers more, carries an even stronger message about the user.

One of the male employees at Bellona mentioned that more ladies turned his way when he was driving an EV than when driving a sports car. Prominent groups clearly uninterested or opposed the whole idea, are among others the "classical old guard of 68"; the traditional alternative, green/left wing activists or former activists. To this loosely defined group, both cars and technology are seen as negative, or even evil, as something to keep at a safe distance. And EVs are nothing more than another kind of cars.

It is worth noting that the traditional "car enthusiasts", those connected to the traditional car either through occupational and/or emotional bounds, are not particularly interested. These groups tend to see EVs not as "real cars", even if our contact at Bellona did see some possible small changes in that. Motor journalists and others working close to and identifying with cars may be slowly getting more interested in this new kind of car.

According to our contact at Bellona, importers of traditional cars were among those most negative. In addition, some auto-importers had told people from Bellona that they didn't want to get into EVs because of the fear of being laughed at. EVs were obviously not seen as serious car business in those circles.

At Oslo Energi our contact told us about a lot of friendly interest around the vehicles. People as a general are interested, and positive, even if someone still is sceptical as to the actual use of such cars in Norway. As a general, he would say that it is easy to talk about EVs, it is great fun to drive an EV also because of all the spectators. And it is always easy to get media coverage. The groups most interested today seem to be children and young people, what our informant called "the green generation". This is a new generation growing up environmentally conscious and maybe without some of the older generations beliefs about what a "car" should be, do and mean.

In the following we will present some results from two investigations that indeed support some observations made by the above-mentioned actors.

4. Consumer Reactions and Patterns of Use

4.1 EV Users in Norway—An Early Survey

It is only a few years since the EV was first taken in use in Norway. In the beginning it was mainly the Danish Kewet El-Jet that was imported. By 1993 there were between 30 and 40 EVs in Oslo and only a few at other places in the country. In order to map the interest in parking spaces with battery recharging facilities, Oslo Energi in 1993 sent a questionnaire to all EV users in and close to Oslo, asking about their experience driving EVs. 14 of them responded. This is of course a small number, but there is no obvious reason to believe that the responses are biased or not representative for the EV-users at that time. Some of the results are given below (see next page):

Sex

Male: 12	Female: 1	Not reported: 1

Ownership

Company: 10	Private: 4

Type of use (more than one category possible)

Company use: 10	Private purpose: 7
Passenger Transport: 6	Delivery of goods: 3

Days of use per week

Two days or less: 2	Three or four days: 0	Five or more days: 12

Number of trips per day

One or two trips: 6	Three or four trips: 7	More than four trips: 1

Daily driving distance

Less than 30 km: 11	31-49 km: 1	More than 50 km: 2

Area of use

Only inner city: 6	Only outside city: 3	Inside and outside city: 5

The results are more or less self-explanatory. It might be of interest to point out, however, that there is a clear over-representation of company cars in the study, an observation reflecting the situation in 1993, when actors promoting EVs in Norway only rarely recommended private persons to buy an EV. They thought that the car should mainly be used by companies, who could afford the negative consequences driving EV. In return they would get a valuable positive marketing effect, far less expensive than any other alternatives, in addition to cheap transportation over short distances. As we will show below, there are reasons to believe that such a strategy is no longer viable.

All of the users in the 1993 survey had access to battery recharging during the night. Ten of them also said that the car was recharged during the day. From this information we can clearly see a pattern of use, dominated by short distance trips, mainly for personal transport in, or in and out of, the inner city of Oslo. It also shows that EVs at that time were in frequent use, daily and often several times each day. Even at this very early stage of introduction, we find that the EVs were put into a relatively *stable and frequent pattern of use*.

In the survey the users were asked to evaluate fourteen different aspects of their EV on a scale from 1 ("bad") to 5 ("satisfactory"). The dominant picture growing out of this evaluation is that of a *satisfied user*. The energy use is mostly satisfactory, low level of noise in the car is satisfactory, top scores are given to the car's handling ability, driving costs and the need for maintenance. Two important, but not surprising,

exceptions are the scores given to driving distance and speed. Nobody said that the driving distance was satisfactory. Half suggest the driving distance is more bad than satisfactory, whereas the other half puts their score in the middle. When we know that the car only gave their users an average of 50 km driving distance between recharging, it could be said to be surprising that as many as 9 out of 14 gave the score 3 and 4.

When we look at the report on average distance and frequency of use, the EV had obviously been integrated into a stable pattern of use. It looks as if the users had adjusted their behaviour, and to a certain degree their expectations, to the EVs actual performance.

An important disadvantage reported in the survey was the marked reduction in driving distance during the winter. Lead batteries do not endure cold and frost without loosing energy. Also the coupé heating of the vehicles (powered by propane) were not good enough in the winter, and a few had replaced it with new and better ones. Winter climate did indeed affect the EV and its quality. On the other hand, the ability to get started was reported as very good because an EV will start at once, if batteries are loaded. Difficult, hard cold starts is a usual problem for gasoline cars in a cold climate.

To summarize: The first EVs in Norway were company owned cars, but used for private tasks as well as for the company's transportation needs. A very interesting result is that the EVs at this early stage were integrated in a transport pattern for frequent and mostly daily use. They were mostly in use in the centre of Oslo, or for transport in and out of the centre. The first EVs had a very short driving distance, and winter climate further reduced the distance to drive. Despite this, the evaluation done by the EV users indicate that they are generally very well pleased with their EVs. Qualities like low noise, good driving abilities, and low running expenses were favoured. Low average driving distance were not evaluated as satisfactory, although only a few thought it was bad.

4.2. Actual Use—A Preliminary Typology

Building on this survey, but also on six in-depth interviews with representatives of three companies (a university administration, a pizza delivery service and a post terminal), one non-governmental organization and two individual users, we find that two patterns of use can be distinguished: company deliveries and private transport. Our perhaps surprising conclusion is that the latter category in fact seems to be best suited to the use of EVs.

a. Company deliveries

As we could find in the Oslo Energi survey the first EVs in Norway were mostly company-owned cars. This strategy for diffusion has been very important during the first period for introduction. Big public companies have been among the first to take EVs into use. Also private companies of different kind have been and are still using EVs. On the surface, it looks as if this strategy to a certain degree has been successful. Some Post Office divisions, electricity companies, and hospitals have some EVs in use today, and

more public services of different kind plan to buy the new City Bee that will soon be available for sale at the marked.

A closer look reveals, however, that the EV is only partly integrated in the business transport activities at such companies. The driving distance is too limited for it to be a satisfying car for pizza deliveries. It is too slow to get the pizza still hot to their customers if the distance is too far and it only takes a minor part of the total deliveries. One should suppose that EVs were more suitable for planned deliveries, like postal service. But here the problem seems to be mistrust as to how much the car can carry when it has a large volume of mail, and how this affects driving distance. The university did for such reasons not use it at all. At the post terminal they handled this problem by putting the EV on a route for company deliveries, with few stops and less to carry.

In other instances, the EV was only occasionally in service for delivering goods, but in use for personal transport in the city area. The cars were only used for short tours nearby and when parked they were recharged at once. Then the EVs were recharged only after a short time and ready for use. It seems to be that the EV is more suitable, and flexible in use for short-distance personal transport, even for frequent use as long as it is possible to recharge it between the tours.

The Oslo Energi survey indicates that the first EV users in Norway had integrated the EV into its daily pattern of use. They were mostly in use in the centre of Oslo, or for transport in and out of the centre. Most of them were in use for personal transport, and only occasionally for commercial deliveries. Our interviews also indicate that if EVs are to be integrated in delivery services it is probably very important to increase the driving distance. This is so because factors like height weight and winter climate further decrease the distance to drive and then make EVs even less flexible for such use. The developers of the City Bee has to some extent been aware of these problems, and despite the fact that it is far more expensive, they equip the car with nickel-cadmium batteries, which are not influenced by cold like lead batteries. Subsequently, also the driving distance is increased. Besides, the boot is larger in the City Bee and makes it more suitable for different kinds of delivery services.

If the EV has not been fully integrated in company's daily lives, it seems to have been more successful on another level: namely for reasons of public relations. Our informant at the pizza delivery service was not very pleased about the EVs qualities related to his need for deliveries, but more than pleased about its PR qualities. He had got a lot of publicity because of the car. Some customers ordered pizza delivered by his EV, and he had got several media reports. Such valuable PR attention he could not have bought elsewhere to the cost of an EV. Also at the post terminal they had received a lot of media attention, and at the university the PR effect seems to be the only EV asset.

It could also be noted that the same PR effects was observed in the case of a non-governmental organization like Bellona. In this particular case the effect worked both ways: the Bellona name is as much a PR for the EV as the other way round. First and foremost they have done a valuable work for introducing the EV as an environmental friendly alternative to the traditional private car transport in Norway. But in return they

have also got a lot of media attention, in television as well as in newspapers. As environmental activists, they are very well aware of the difference having media there to cover their actions and not.

b. Small city-cars for shopping and personal transport

The users that belong to this category are, in fact, women—with a good private economy, in need of a small, nice, quiet car, easy to control and park, and one considered friendly to the environment. One of our male informants (from a private company) thought that the EV should be more suitable as a shopping-car than for deliveries. Two of our female interviewees partly testify to this. They use the EV frequently also for private tasks, for instance for doing their shopping. One evaluation of the car is specially related to the EV's city-driving qualities, where she appreciates the good overview and that the EV is easy to park and manoeuvre in city traffic. As a city car it should be very well suited for meeting such needs. Besides, who are doing the shopping? Women are, and studies show that women are also more willing than men to buy a car with alternative technology, like an EV.[21]

Whereas in the case of companies we found EVs contributing a PR effect, in the case of individuals we find, in the first place, a concern with environmental questions. Private informants are particularly concerned with the air pollution caused by traffic in the city, and EVs are to them an answer to this problem. They did not want to contribute to this problem driving an ordinary car and saw EVs as part of a solution improving the air-quality in cities. One female interviewee has strengthened this view during her one year driving an EV, and as often as possible she prefers the EV instead of her other sportscar. One male informant is maybe not more engaged in environmental issues than other people, but this orientation has to a certain degree been of importance for his decision to have his company buy an EV. To the woman also the symbol value driving EV seems to be important. The conception of rich alternative people who can afford an EV as a way of completing their image as "high tech", "alternative", "green" and "avant garde" at the same time, might as well characterize her profile. She gives the impression of a life style where the EV is also a very conspicuous status symbol. It is important to her that the EV looks significant different from other cars.

4.3. The EV Revolution Seen From Below

If there will ever be an EV revolution, then it will, we suggest, be largely driven by the last user category. Statistics Norway has recently published a survey where the potential demand for EVs are investigated—a survey that backs up this suggestion. Some 600 individuals were asked about their stated preferences for various types of automobiles: electric, natural-gas and petrol. Being aware of the methodological

21. Dagsvik, J.K., D.G. Wetterwald and R. Aaberge, *Potential Demand for Alternative Fuel Vehicles*, Statistics Norway, Discussion paper No. 165, 1996.

problems (so-called "external validation") connected to posing hypothetical questions, the survey, nevertheless, reveals some interesting points about how the EV is valued by potential customers in Norway today. When asked what type of car—all other things being equal—they would choose if they were to buy a car today, 46% of the respondents answered that they would buy an electric. Although females were markedly more positive (52%) toward EVs than men (40%), both sexes ranked the electric ahead of the natural-gas and the petrol car. Middle-age (30-49 years) customers were more positive toward the EV than younger or older persons, and people living in the countryside, in villages or in small towns were more positive than people from medium-size towns or cities.

The potential, ideal-typical customer that emerges out of this survey is thus a middle-age woman living in the country or in a town with less than 2,000 inhabitants—certainly not the kind of social carrier that most EV scenarios have constructed. To the extent that such visions discuss individual users at all, they usually focus on well-to-do, male city-dwellers.

Qualitative interviews that we have carried out with Norwegian users of the Danish Kewet in a nice way complement this quantitative survey from Statistics Norway. They support the impression that women are inclined to be more approving of the EV than men, but they also give a more thorough understanding of the cognitive reaction to the actual use of such vehicles. We will below focus on a limited number of informants and use them to depict some of the EV visions that presently seem to be emerging, so to speak, from below.

a. A New Safety Concept

Most EVs are small and light. This is particularly true about vehicles that have been designed so-to-speak from scratch and are not converted standard cars (like GM's Impact). Since smallness and lightness ordinarily imply unsafety and danger in relation to cars, many engineering groups have gone through great pains in trying to develop alternative safety equipment. In Switzerland, where several light-weight vehicles have been developed, also a new concept of light-weight safety has emerged. This concept has also influenced PIVCO. During the development of its City Bee the company has put substantial effort into increasing the vehicle's safety qualities. The City Bee has no steel frame, it is not (at least not yet) equipped with airbags or an advanced (ABC) brake-system. In addition, it is made out of plastic, and it is very small. Adopting the Swiss concept, it seems, however, to be possible to combine these characteristics with a large degree of safety. PIVCO has cooperated in several EURECA projects on this topic, and it has had crash tests made at the *Eidgenössische Technische Hochschule* in Zurich. The problem that PIVCO's representatives now is concerned with is not one of objective unsafety, but how the new safety concept will be perceived by the users. In short, they are afraid that the standard definition of what constitutes a safe car will scare potential customers away from the EV.

Their fear might prove to be exaggerated, however. From our interviews a comforting and perhaps surprising picture emerges. Let us just listen to Ann, a person who used to like driving fast cars at high speed before she got an EV:

> I had to get rid of this habit [of driving fast]. The EV has taught me to be patient. When driving an EV you have to make plans, much more than if you drive an ordinary car. Spontaneous tours are impossible without planning. You have to adjust yourself to such a car, and all the time calculate how far you have left to drive before you must load the batteries. [...] It does not run that fast, and I take no chances in this car, no overtaking and things like that. But now and then I think about what would happen if I was hit by a car from behind.

Although some of the traditional fears remain, it is still quite clear that the EV has contributed to Ann changing her driving habits and behaviour in a safer direction. Ann's interpretation of the safety qualities are connected to the EV's "weak" qualities, like the slow speed and limited driving distance, which she translates into safety qualities. She has adapted to these characteristics and is more careful when driving an EV than an ordinary internal-combustion car. At large, safety is evaluated as good, partly because Ann herself has changed. A new safety problem has, however, entered with the EV. Since these vehicles are almost noiseless, cyclists and pedestrians are more at peril: "They don't hear me when I'm there, so I'm forced to be extra careful in such situations." All in all, Ann focuses on the fact that she has become a lot more sensitive when driving after she got her EV. She adjusts her driving more to other road users, observes more carefully the traffic around her, is more calm than before, and has time to take more care.

We find in the example of Ann that the—in the standard definition—"limited" technology that results in short distance drive, low speed, hours of recharging and small size, are suddenly described as something positive. Not only Ann's habits and behaviour have changed in the face of this new technology; so have her conceptions and attitudes.

Also another interviewee, Sylvia, tells us that the EV has done something with her way of driving and her notion about safety:

> You learn to drive a car in a very different and more careful way when driving an EV. You get quite a new relation to speed. In the beginning I was somewhat impatient; it was embarrassing to get reactions from other drivers who thought you drove too slow. Now I take it easy, and whenever somebody honks their horn at me, I just think "poor man, you'll soon be killed at that speed." [...] Everything is relative! I would not like to collide front-to-front in 120 km/h with this car, but, on the other hand, that is not possible. I never drive in high speeds with the EV. Besides, it is extremely easy to manoeuvre and gives you a very good outside view.

Like Ann, Sylvia finds safety acceptable, because she has adjusted her driving behaviour to the car's qualities.

Females are known to be more patient drivers than men, but also our male informants report the same change in attitude when driving EVs. Tore, a male informant, tells us: "It is not a car you want to collide in, and I can't tell you it feels very safe for such occasions. But it turns out that you are taking extra care when driving, and drive more defensive." Also Petter, another male informant, reports having become "more careful when driving EV."

EV users thus feel that they have become more friendly and careful drivers, more aware of the others on the road. In order not to run out of electricity too soon, they have to economize on speed, thus becoming more patient when driving. As we asked if they felt safe in the EV, we usually got an affirmative answer followed by the explanation that their own attitudes and behaviour had changed when driving EV. They have transformed "safety" from something in the car—like air-bags, steel frames, or other gadgets—to a quality in their own head and body.

b. A New "Car" Definition

After having used her EV one year, our informant Sylvia is more than happy with it. The reason is not only that it contributes to a cleaner environmental consciousness, but also that its traffic performance has turned out to be beyond her expectations: "The car is just great to drive in city traffic. You have extremely good overview, and parking is a piece of cake." Comparing it to ordinary cars, she claims that the electric car is indeed "much easier to drive." Not even winter driving had turned out problematic: "I got around everywhere. I never got stuck!" To guarantee successful starting in the wintertime she had arranged for the batteries to be heated overnight, and to make for good comfort she had had a coupé heating device installed.

Her back against the wall, Sylvia does admit, however, that the Kewet has not been able to fulfil all her transportation needs. If she plans longer trips than to work and back—all in all 14 kilometers—she does consider taking her traditional, internal-combustion car, a smart sportscar, although she now finds this car "heavy and cumbersome." Both cold weather and heavy loads tend to reduce the driving range of the electric and thus to be clear sources of anxiety: "Twice I have experienced to run out of power in the last uphill slope on my way home."

There is another side of this coin. Although Sylvia agrees that the electric has its limitations, she also claims that this should not necessarily be seen as a drawback. Her year with the Kewet has taught her to plan more carefully where to drive, what way to choose, and how much to drive. Her driving style has also changed: "You learn to drive in a very different and more friendly way when you drive an electric car. You get a very different attitude to speed." In short, her traffic behaviour has changed with the acquisition of the electric. Or, putting it in another way, this act has led her to become an agent contributing to the deconstruction of what a car is and to the construction of a new sense of mobility. Most likely without knowing it, Sylvia has become a co-designer of an emerging socio-technical system.

Sylvia finds her EV very cute, and indeed calls it her "Barbie"—in order to contrast it to her more masculine, standard sportscar. Although a small observation, we believe that we have here found the core of a new understanding of mobility. Like the petrol car, the EV is interpreted in terms that remind us of a toy, but this time it is a typical girl's toy. With the EV emerges a new interpretation of the automobile. The car is no longer only a male or boyish artifact that is judged according to speed and power characteristics; it can also be small, slow and friendly in a traditionally female or girlish manner.

5. The Socio-technical State-of-the-Art and its Potentials

Why is, despite the positive reactions reported by these private users, the EV still only for the few? The Kewet El-jet was and still is, not a cheap car, but has to be related to the prize of other small cars. Although the driving costs are minor, total shift of batteries are needed after some years, and exactly when is not predictable. For families in need of a (second) car, it may be risky, inflexible, and not that inexpensive to buy an EV. It is obviously an advantages if one can afford the risk and cost. The price is of course very important if one in the future wants the average man and women to drive EVs.

One problem for those selling EVs is that the driving costs are included as a part of the investment cost of the car. This is specially so when nickel-cadmium batteries are to take over for lead batteries. The prize of the batteries will almost be the same as the cost of the car. An alternative in the future might be to lease batteries. Then the driving cost can be dispersed over time and so they can get the prize of an EV below the prize of other small cars. Because of high petrol prices (and low price of electricity), it would still be possible to keep the driving costs relatively low. A study shows that in addition to price, people are also concerned with the driving distance when evaluating whether they would buy an alternative car or not. If the driving distance increase to 500 km, three times as many people would have preferred an EV.

It is obvious that a high cost-price is detrimental to the adoption of EVs. Let us, therefore, in the following concentrate on some less obvious, non-economic factors that may influence the spread of this technology. Let us also at some length describe the central characteristics of PIVCO's City Bee, which by far is the internationally most interesting EV project at the moment in Norway, and one with particular potentials for the future. In-between, we will also pose the interesting question if the spread of EVs will lead to new driver attitudes and changing patterns of car use.

5.1. How to Use or not to Use - That's the Question.

a. Short distance use in cities, especially private transport

The most central idea in the scenarios for the EV is that the car easily can substitute private cars in city areas and especially the driving distance from home to workplace. If such a replacement takes place, then EVs can be an environmentally friendly alternative, at least in cities. This was the primary scenario among most Norwegian actors, until PIVCO designed the City-Bee (and its users). In this scenario it is thought that the EV cannot fulfil all the functions of traditional cars. The limits for possible use set by the technology create a vehicle less flexible than gasoline cars. The flexibility of traditional cars is probably the most important reason for their success. You can drive to work, take spontaneous short tours and detours to visit grandmother after work, but you can also drive thousands of kilometres during vacation. An EV today demands a rational user, a user well prepared for planning its daily use. The car we know is an all-round car, and of such reasons an EV will not be a satisfying "car" for the average user. Yet PIVCO looked at data on what kind of transport is usually performed in cities, at the average daily driving distance and at the speed in city traffic, finding a relatively large marked niche which the EV can meet also with today's battery technology. A PIVCO director summerized it this way:

> Surveys show that in urban setting most cars rarely travels for more than 50 kilometers per trip, and on average carry less than 2 people. A small, lightweight, electrically powered PIV (Personal Independent Vehicle) could easily fulfil this mission, and produce much less pollution in the process.

The Oslo Energi survey indicated that the first users in Norway to a large extent have developed a user pattern in accordance with this scenario.

The EVs' limited technological qualities are often described as disadvantages. In our interviews the users tell us what the EV has done to them. Very clear descriptions are made of how they felt the EV has contributed to their change as a driver. Then the limited technology that results in short distance, low speed, hours of recharging, and small size, are suddenly described as something positive. They feel they have become more friendly drivers, more aware of the other road-user and more careful. They have to economize on speed, and have also learned to be more patience when driving. When asked if they felt safe in the EV the answer was usually yes—the reason for this being their own changed attitudes and behaviour when driving an EV. Safety was not something *in* the car, like air-bag, steel frame or connected to other technical equipment (or the absence of such equipment), but a quality gradually developed in their own head and body. Partly this is developed also as a response to the risk low noise represent to cyclists and pedestrians.

Because of limited driving distance the users also have changed their pattern of use. They are more aware when to use the car, where to drive and how to shorten the distance when choosing the route to drive. They foresee their use and make plans beforehand.

If the EV becomes a substitution for collective transport in urban areas it would not be of any environmental advantage. One informant represents a user scenario which is not wanted by many EV enthusiasts or environmentalists. Her preference for driving EV is primarily based on the time saved compared to the time spent when riding public transport. In Oslo large part of the town is thinly populated. Because of this mass transport is not fully developed all over town, and often you have to change transport, wait and/or make detours to change. In such situations there might well be so that the EV could be a favourable alternative to dissatisfied tram, train and bus users. Even more scaring is the critique that EVs will be used for short distance trips else done by bicycles or by walking.

b. Station car projects and EV rental services

In the last few years we find the realization of alternatives, like station-car projects, where EVs are integrated in a total transport package. This inspiration from abroad seem to be more present also in the Norwegian debate. Such projects have had a lot of media attention after several City Bees were sold to the San Francisco area. The idea is that EVs integrated in a total transport package (*Verbundsystem*) will improve the mass transport alternative as well as it will reduce the need for traditional private car transport.

Late in 1995, the City Bee was chosen to take part in a demonstration project in the San Francisco area, organized by Bay Area Rapid Transit (BART), the local public mass transportation company. The aim of this project, was to try new solutions combining mass transportation and independent EVs, what is called "station cars": "The station car concept is an exciting new form of mobility. Station cars are electric vehicles (EVs) driven to and from mass transit stations by transit riders. They are an extension of mass transit, providing the same instant - yet more convenient - mobility as conventional vehicles."[22] The idea is that the commuters are to use the City Bee as a way of going from their place of employment to and from the train station. Long distance travel from home would be taken care of by trains and other kinds of mass transportation, while the EV would take care of the rest the journey. The background of the project is described like this:

> BART statistics show that thousands of commuters drive all the way to work each day and end up a mere one to five miles from a BART station. The link from BART to their work site is not well served by either public transportation, taxis, company shuttles, or any other service. This untapped commuter market is ideal for a station car service, especially if offered in cooperation with major employers who are mandated by statutory air quality regulations to implement employee trip reduction programs (designed to reduce the use of polluting cars.)[23]

A total of 40 City Bees are used in this experiment in California. Plans are being made for manufacturing the City Bee in California, in a co-operative effort between

22. Quoted from the World Wide Web homepage of the project, at http://www.stncar.com/
23. *About the San Francisco Bay Area Station Car Demonstration*, at ibid.

PIVCO and CALSTART,[24] calling itself CITI (Clean Intelligent Transportation, Inc.). The vehicles will be used by BART and Pacific Gas & Electric Company (PG&E) employees and selected public/private participants in the project. At one BART station, a small parking lot has been converted for EV parking exclusively. Electric power is provided through outlets that provide charging for two EVs at either 208 or 120 volt.

The first station car facility was opened by the king and queen of Norway. This happening got broad coverage in Norwegian mass media, as well as some coverage in American media. CNN covered the station car project, and the PIVCO City Bee, in some length.[25] To Norwegian media, the fact of a Norwegian company "exporting" cars to America, was certainly interesting new to make main headlines for a few days.

The fact that the City Bee was chosen for the station car project may in fact become an important breakthrough for the company, even back at its Norwegian and European home market. The fact that Californian authorities found the car suitable for their use, may be a strong argument used at PIVCO's local arena. The usual thinking is that a product must first be tested and proven sufficient on the home market to be exported. This may very well prove to be the other way around: By being proved good enough in America, the City Bee may be "exported" back to the original home market of the developers. Success at home may follow, and partly be a result of success abroad. In Oslo, PIVCO, Oslo Energi and STATOIL have in some years planned to start a "rent an EV"- project at STATOIL's rent a car division at the airport of Fornebu (Oslo) and at Kiellands Plass, in the inner city of Oslo. This has now finally been realized, and ten City Bees are now available for rent in this area. The idea behind this project is that people should bee able, to a relatively low cost, drive an EV. Then people can evaluate and learn by use, whether an EV is something for their need or not. In addition users experience will bee evaluated during the project and they are asked to answer a questionnaire during the rent period. The results are to bee of importance for the further development of City Bee, before large scale series of the car is put in production in Aurskog in the fall of 1997.

5.2. The City Bee as one Possible Answer to Future Demand

It thus looks as if the situation regarding EVs is about to change in Norway. From being a curious phenomenon, of interest to some few masochistic enthusiasts, there is a growing visibility of this technology, both as an alternative to traditional means of road transport and as an industrial possibility. If this will lead to a large scale breakthrough in the diffusion of EVs in Norway, remains to be seen. We would expect the interest to keep growing, at least as long as PIVCO and the City Bee is seen as a success. This

24. CALSTART is a non-profit consortium, based in California. It's aim is to create an advanced transportation industry in the state. CALSTART has 140 participants, including electronic, defence and aerospace technology firms, as well as vehicles manufacturers. In addition all the state's major natural gas and electricity providers, transit districts, public agencies and labour and environmental groups take part in CALSTART.
25. Broadcasted in Europe at Sunday November 12. 1995

interest will also without doubt lead to a growing number of people using EVs. The first new users will most probably be various public agencies. As soon as the City Bee is available to ordinary customers, we expect the number of private users to grow, even if we expect this growth to be slower than in the public sector. Much will of course depend on the price of the vehicle, and the price and quality of the batteries.

Our last question thus is what kind of vehicle the City Bee is, and what it tells the world. Or, in other words: what is the Norwegian cutting-edge contribution to this technology?

The City Bee is a small personal independent vehicle, carrying two passengers and a small amount of luggage, a vehicle of the same general kind as the projected Swatch car: "A small ecological car for two people and two cases of beer".[26] It is 2,8 meters long, 1,5 meters wide, 1,5 meters high and a weight of 750 kg (including the batteries). The vehicle is developed for individual transportation and city use, and the producers claim that it can easily be converted for different kinds of specialised use. No retail price is yet given, but in USA it is said that the car is "designed to cost under $ 10 000",[27] making it cheap compared to other small (if not that small) cars.

Total driving range in city-use is 125 km. At a constant speed of 50 km/h the range is close to 160 km. Top-speed is between 90 and 95 km/h, and the vehicle accelerates from 0-50 km/h in 7 seconds.[28] The City Bee is constructed around a space frame made from aluminium extrusion, which according to the producers "rivals the strength of steel". The frame is developed at Hydro Aluminium's factory in Denmark. This frame has be subjected to extensive crash testing, both in Switzerland and at NTNU in Trondheim, to ensure it meets the safety standards of both Europe and the USA. The body is moulded in thermoplastics, using the same processes as in the boat production of Bakelittfabrikken. The colour is an integrated part of the body; i.e. the car is not painted. This contributes to making the recycling process easier. At the same time it helps to reduce the environmental effects from manufacturing. The plastic body is said to be fairly crash resistant. According to the producers, the body will not even dent or scratch as the result of a low speed collision. In addition, the finished vehicle is to be equipped with air-bags.

Manufacturing the car is said to be very inexpensive, because the quite simple process needs low capital investment in facilities. Part of the PIVCO package is that the car could, and should be manufactured as close to the existing markets as possible. In the words of PIVCO's American partners, CALSTART, they have: "reinvented how a car is made".[29] Or, to quote PIVCO's own presentation of the car: "Designated PIV, for

26. As described by Swatch boss Nicolas Hayek, quoted after Truffer, B., and G. Dürrenberger: "In search of an alternative car: The role of innovative regional milieues" in Sørensen, K.H., ed., *The Car and its Environments - The Past, Present and Future of the Motorcar in Europe*, Proceedings from the COST A4 Workshop in Trondheim, Norway May 6-8 1993, Brussels and Luxembourg 1994

27. Http://www.calstart.org/news/pr/101/

28. According to tests being done by Technological Institute in Oslo, results being quoted in *El-bilnytt* (Electric Vehicle News, the newsletter of NORSTART) no. 2.1

29. http://www.calstart.org/news/pr/101/

Personal Independent Vehicle, the project's goals and means differ from existing automotive technologies and customs."[30]

The City Bee is, naturally, a small car; smaller than any present comparable internal combustion car, but still somewhat larger than competitors like Kewet. The design is that of a typically modern compact yet streamlined small car. It looks modern, and different, and fast. And even if it's a different kind of car, it still without doubt resembles a "car". Compared to the Danish Kewet, the City Bee is much more "car-like". The City Bee is different, yet familiar to those used to the car as we know it. CALSTART describes it like this: "The Pre-production car, known as the PIVCO City Bee, is a roomy, fun and cute two-passenger car that perfectly fits a prime, early market for EVs—as a family's second or third car used for commuting and errands around town."[31]

Even the car's name tells something about it's use and the image PIVCO wants to communicate: This is a vehicle made for cities. The bee on the other hand, is a part of nature: A bee is a hard working builder of advanced constructions, and the producer of delicious food, honey. It is generally seen as a useful and friendly creature, yet with the ability to sting. The bee is temperamental, it is quick and fast and strong for such an tiny creature, yet somewhat sweet and cuddly. To once again quote CALSTART, it is "roomy, fun and cute", at the same time practical and funny. Most importantly, the bee signals something about nature and environment, about something not hurting nature even while building and producing. The combination of City and Bee gives a double signal. A city bee is a piece of nature, clean, useful, hard working, yet living it the city and therefore urban, modern and efficient. And at the same time it contributes in making the city a better, cleaner, more silent and more friendly place to live.

It is possible to see the City Bee as one of the first in a radical new generation of "cars", as an important step towards a social reconstruction of the technology known as a car. The definition of this technology, and the definition of what constitutes a "good" car is socially constructed: The image of a car, what it is, should be able to do and what it mean, to both users and producers alike, is the result of a long historical process of social construction. These social definitions have, of course, changed over time, and will go on changing. If those who say that transforming the traditional car to electric power is insufficient, and that what is called for is a radical transformation of the social definition of a car are right, the City Bee and related vehicles may be seen as a first step in this direction.

By aiming at being a "car" in the traditional meaning of the word, the City Bee may help establishing that a vehicle can be something else, and still "function". Unlike the General Motors' EV1/Impact, which is clearly modelled on a traditional car, the City Bee is something new. The EV1 aims to please those who wants a Car, the City Bee's aim is to meet the new demands, a new kind of use, and not to compete with the internal combustion car on the latter's own premises.

30. Quoted from PIVCO's first public booklet/brochure presenting the City Bee.
31. Quoted from CALSTART's World Wide Web homepage, http://www.calstart.org/news/pr/101

It may seem that the City Bee's chance of success is greater than the EV1. The EV1 and similar technological solutions will be judged as a car. Given present battery technology the outcome of this judgement will most likely be negative; the EV cannot today compete on the traditional cars own grounds, following the traditional car's own rules. By not trying to conform to the traditional car and its standards, the City Bee and related vehicles may give rise new patterns of use, and new kind of users, those in need of something else than a car. In the presentations of the vehicle it is time after time stressed that this is no ordinary car, this is new technology, something pointing ahead to the future.

PIVCO's own presentation also stress the point that this is something new, the "car" of the future, not to be confused with car of the past as we all know it: "The PIV project aims to meet the city car needs of the 21st century."[32] In other words, PIVCO tells us that the City Bee should be understood, and judged, within a new frame of reference, using other codes, than those we utilise to understand and judge the meaning and performance of a traditional car of yesterday and today. It remains to be seen if the future will accept such a redefinition of what a car should be.

6. Emerging Concepts of Electric Mobility—A New Convergence?

What is immediately striking from the material that we have presented is that by far the most positive EV owners are *women* who mostly drive the car *privately*. This is in fact in sharp contrast to what the original scenario builders predicted. From French engineers in the 1970s via Norwegian enthusiasts to the large automobile companies today, the main potential user groups have been expected to be found in various businesses or public authorities. According to these visions, the typical customer would be an organization in need of a large number of small, interchangeable vehicles. Utilities like the post office, public or private telephone companies, or electric power suppliers were thus high on the list—and partly remain so. Already in the early 1970s, an electrically propelled delivery vehicle was sold in substantial quantities to the Swedish post office (incidentally, it was named *Tjorven*, after the main actress (!) in *Saltkråkan*, a popular children's movie based on one of Astrid Lindgren's books). However, it could be expected that this traditional focus on large fleet owners in the long run will prove counterproductive. Our, albeit limited, empirical material from Norway indicates that the end-users of such companies are less than happy about the EVs. Although managers high up in the organization liked it, employees at a delivery service at a large Norwegian public institution found that these vehicles were rather strange creatures. They were not interested in adjusting their own habits to the EV and did not use it as much as they could have done. Hans Fogelberg, a Swedish researcher who has studied the Californian situation in great detail, makes the additional point that

32. Quoted from the first booklet presenting the vehicle and the project.

a focus on fleet owners will make it even harder in the future to redefine the EV to fit private user needs.[33]

Now, not all EV engineers and manufacturers have stayed with the original scenarios. Colleague Car, for one, has shown considerable flexibility in adjusting its ideas about the perfect customer in light of new experience. The firm has learned through its close contacts with individual users what problems are to be expected, and what kind of user pattern is most likely to square with the demands set by its *Kewet*. Surely, users are "configurated" in at least two senses. They are, in the first instance, picked and chosen by the engineer-salesmen and, in the second instance, influenced and "moved" by the car itself. But, the habits that the users develop in using their EVs influence, in turn, the Colleague Car people.

It is also worth pointing out that the City Bee is not launched as a car, but as a "private independent vehicle" (PIV), an artifact with which it is possible to transport one or two persons and "a case of beer" within a city area. Quite consciously, the PIVCO engineers and salesmen have from the outset not depicted their product as an inferior automobile with limited range and speed. Instead, they have tried to create an image that signals something else, something alternative. Or, in the words of one of their Californian collaborators: "This is a new kind of vehicle, not just a gasoline-powered car with an electric motor. What the personal computer is to mainframe computers, the PIVCO is to gasoline cars—this is personal transportation."[34]

Although this statement is made for PR reasons only, it does seem that PIVCO has been on the right track when designing a scenario which takes actual driving patterns at face value. What the PIV people originally did was to accept actual user patterns as the standard for their new vehicle. Instead of using the ultimate, extreme performance of the common automobile as their role-model, they created a scenario that accepted actual use as a basis for a new artifact. And, as a next step, they tried to convince customers that the PIV squares perfectly well with this use. If they succeed, the outcome might be a convergence between actual use, the company's acceptance of this use, and users' awareness of their own use. And—very importantly—such an awareness has only developed as the new vehicle has been put into use. As we hope to have shown with our interviews, awareness develops in practice.

33. Fogelberg, H., *Aktörer, argument och aktiviteter i den kaliforniska elbilsdebatten*, KFB-Meddelande 1996:11, Stockholm, 1996, p. 24.

34. Quote from Michael Gage of CALSTART, a Californian consortium that is presently constructing a full-scale test using the Norwegian PIV.