

Layman's Report

Environmentally friendly cooling

The PRO KLIMA campaign from Deutsche Umwelthilfe and Verkehrsclub Deutschland is calling for the use of natural refrigerants in efficient mobile air-conditioning systems

Air-conditioning systems in cars are heating up the global climate. This is due to the fact that they increase fuel consumption. However, it is not only the air-conditioning systems themselves that are a problem, but rather the chemical refrigerant used in them known as R134a. Its contribution to global warming is 1430 times greater than that of CO₂ and for this reason it should be banned from use in mobile air conditioning systems within the EU.

The objectives of our campaign

Climate-damaging chemical refrigerants can be replaced by environmentally friendly, natural alternatives. Deutsche Umwelthilfe e.V. (DUH) and Verkehrsclub Deutschland (VCD) have advocated the natural refrigerant CO₂ (carbon dioxide) for many years. CO₂ is the most environmentally-friendly solution when used as a refrigerant. In 2010 when we launched the LIFE+ Information campaign PRO KLIMA for efficient mobile air-conditioning systems with natural refrigerants, we were able to draw upon around ten years of experience relating to refrigerants, their environmental impact and the political environment.

Our experience has shown that environmentally-friendly alternatives are accepted more readily if there is an exchange between politics, industry and research. All the relevant groups should be encouraged to pull together. It also helps if awareness of the issue is raised among the general public, thereby persuading as many car users as possible to choose to purchase a climate-friendly model. The PRO KLIMA campaign therefore has three clear objectives:

1. To educate consumers about the environmental impact of mobile air-conditioning systems
2. To promote the use of natural refrigerants as an alternative to environmentally harmful or hazardous chemical refrigerants
3. To disclose the high levels of fuel consumption through air-conditioning systems in cars and to promote more efficient systems.

Alternative refrigerants at the centre of economic interest

Following an EU Directive, the previously used refrigerant R134a has been banned from use in new vehicle models since 2011. However this does not mean the climate-damaging chemical will be off the road any time soon – and certainly not off the political agenda. The ban on R134a and the introduction of



Nowadays, almost every new car is equipped with an air-conditioning system

possible alternatives affect a wide range of economic interests. As PRO KLIMA is campaigning for the best refrigerant for the climate, the environment and consumers, independent of industrial interests, we became caught up in the middle of an industrial policy dispute. This is because in our view, the best alternative to R134a as a refrigerant is CO₂. As a gas naturally occurring in the atmosphere it is not patentable. In contrast to the harmful effects which CO₂ generally develops in conjunction with the use of fossil fuels, it has the lowest global warming potential of all refrigerants.

In the industrial sector, we have on the one side the car manufacturers: They want to save money and that is why they continue to produce their new cars with the same air-conditioning systems. CO₂ air-conditioning systems are in contrast technically more demanding and therefore somewhat more expensive (approx. 50-100 euros per system). On the other side we have the chemical corporations: They want to keep a multi-billion dollar market for refrigerants. This is the reason the two US companies DuPont and Honeywell launched the chemical R1234yf onto the market, to replace R134a after it had been banned. For these companies, R1234yf seemed to be the simplest solution. The

Why do mobile air-conditioning systems have to become more environmentally-friendly?

The air-conditioning system has become a standard feature in cars in Europe and many other parts of the world. Car users appreciate the cooling breeze in the interior especially on hot summer days. For this purpose, however, a refrigerant is required to convey the warm air outside. Up until now, our cars have mainly been cooled by the climate-damaging R134a – a substance belonging to the group of so-called fluorinated greenhouse gases (F-gases).

As air-conditioning systems are not fully closed systems, refrigerant escapes constantly. In the course of maintenance, disposal and as a result of accidents, about ten percent of the refrigerant escapes into the environment every year thus contributing to the greenhouse effect. In Germany alone, the losses of refrigerant amount to emissions equivalent to three million tons of CO₂ – that is as much carbon dioxide as two million cars emit on average per year. R134a emissions are also continuing to rise worldwide.

In addition to the direct emissions from the air-conditioning system, there are also indirect emissions resulting from increased fuel consumption. Mobile air-conditioning systems are run by the engine, using them therefore requires additional power. Consumption increases by up to two litres per 100 kilometres depending on environmental conditions. Despite the increase in fuel consumption, the current procedure does not take air-conditioning systems into account when determining the normalised consumption of a car. All auxiliary components such as the air-conditioning or the heating system are turned off during consumption measurement.



In case of an accident, R1234yf can produce dangerous decomposition products

car manufacturers can use the new chemical refrigerant in technically almost identical air-conditioning systems and thereby avoid development costs for environmentally friendly CO₂ air-conditioning technology; the chemical corporations continue to make money with refrigerants.

R1234yf is actually only four times as harmful to the climate as CO₂. The new refrigerant is however extremely dangerous, as tests carried out by the DUH and investigations by the Federal Institute for Materials Research and Testing have shown. R1234yf is highly flammable and can produce extremely hazardous hydrofluoric acid in the event of fire. R1234yf therefore poses a risk for car occupants, first aiders and rescue services. For consumer protection reasons alone, the new chemical refrigerant R1234yf is therefore not an alternative to the old refrigerant.

The refrigerant preferred by PRO KLIMA, CO₂, is cheap, efficient and, in contrast to the industry favourite R1234yf, non-flammable. The use of CO₂ worldwide is cost-effective and

EU policy on mobile air-conditioning systems

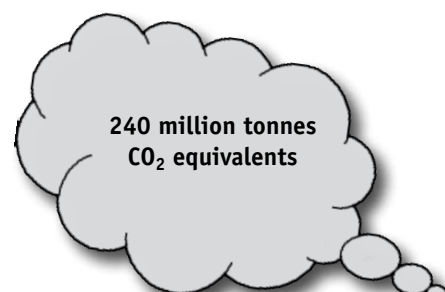
In order to reduce emissions of climate-damaging fluorinated gases, the EU adopted the F-Gas Regulation (No. 842/2006) and the Directive on mobile air-conditioning systems (2006/40/EC). This specifies that the global warming potential of the refrigerants may not be higher than 150 times that of CO₂. The EU has granted the car industry a transitional period for their introduction. Since January 2011, all new types of passenger cars must be filled with a more environmentally friendly refrigerant in accordance with the Directive. Put simply, new types of passenger cars refer to all those models, which are launched onto the market or have been significantly reengineered in comparison with the previous generation. With effect from 2017, all newly registered passenger cars will be required to use an environmentally friendly refrigerant. An extension to other types of vehicles, such as buses, is planned.

A new test cycle is to be developed to focus on the increased consumption by mobile air-conditioning systems on the initiative of the EU Commission. In this test, the fuel consumption of passenger cars will be measured with the engine running in neutral as well as at 50 and at 100 km/h comparing results with the air conditioning switched on and switched off. As yet it remains unclear how this consumption data is to be made available to car users.

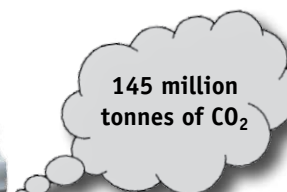
environmentally friendly. R1234yf, on the other hand, has a high procurement price, which will affect consumers with increased costs for servicing air-conditioning systems, for example. Therefore it is to be feared that the expensive R1234yf will be replaced in many cases by cheap R134a, thus making previous climate protection efforts irrelevant.

Predicted development of climate-damaging emissions from mobile air-conditioning systems

Forecast of worldwide R134a emissions from MACs in 2020









By comparison: CO₂ emissions from road traffic in Germany in 2009



Sources: Federal Environment Agency 2011; United Nations Environment Programme (UNEP) 2009; photo: Adam Spence/wikimedia GNU; layout: DUH

The three refrigerants at a glance

Two alternatives were discussed for the period after the ban of R134a: the natural refrigerant CO₂ with the refrigerant designation R744 and the synthetic refrigerant R1234yf (Tetrafluorpropene).

| | R744 (CO ₂) | R134a | R1234yf |
|---|--|---|--|
| Environmental & chemical properties | | | |
| Global warming potential | 1 (or 0, as a by-product of industrial processes) | 1430 | 4 |
| Environmental effects | Known | Partially known | Partially known |
| Critical degradation products | None | Trifluoroacetic acid (TFA)*  Corrosive | Hydrogen fluoride (HF)/ Hydrofluoric acid  Very toxic  Corrosive Carbonyl fluoride (COF ₂)  Toxic  Corrosive Trifluoroacetic acid (TFA)  Corrosive |
| Flammable | No | No** | Yes |
| Recycling necessary | No | Yes | Yes |
| Thermal & economic properties | | | |
| Operating pressure | High | Low | Low |
| Operation with heat pumps (usability for efficient heating) | Good | Poor | Poor |
| Efficiency (Reference: R134a) | 125% | 100% | 90% |
| Refrigerant costs | Low | Medium | High |

* HF-Formation possible but unlikely - less reactive than R1234yf. ** Inflammable under atmospheric conditions.

Source: Own research/Konvekta AG

The lengthy and heated debate on refrigerants

Industry and politics have been discussing refrigerants for mobile air-conditioning systems since the 1990s. R134a has been used since the beginning of the 1990s as a non-ozone depleting replacement for the CFC R12 in mobile air conditioning systems. It soon became clear that, as a result of the increasing number of vehicles equipped with mobile air-conditioning systems, the high global warming potential of R134a would become problematic. From the outset, environmental associations and innovative companies made references to CO₂ as a climate-friendly alternative. The environmentalists appeared to have reached a breakthrough in 2007. The German Association of the Automotive Industry (VDA) announced they would be backing the use of the natural refrigerant CO₂ in future, in order to comply with

the EU Directive. Soon afterwards however, the chemical industry presented the fluorinated refrigerant R1234yf. Deutsche Umwelthilfe carried out tests using R1234yf, the results of which have been confirmed by the Federal Institute for Materials Research and Testing and the Federal Environment Agency. The use of R1234yf poses significant safety risks, so that the use of the chemical appeared unlikely.

Numerous car manufacturers initially agreed with this assessment. Nevertheless, after a long period of stalling, the car industry announced in 2010 that it would be dropping the almost fully developed CO₂ technology in favour of the chemical refrigerant R1234yf. As the chemical corporations were not yet able to supply sufficient quantities of R1234yf, the car industry was generously granted permission on 18. April 2012 by the competent Technical Committee of the EU (Technical Committee



Official car of the Federal Environment Agency with MAC system based on CO₂.

on Motor Vehicles) to continue to use the climate-damaging refrigerant R134a, which had actually been abolished, in new type-approved cars until the end of 2012. In addition, many car manufacturers delayed the implementation of the Directive by declaring on paper that completely newly developed models were reengineered previous generation models – thereby permitting

the use of climate-damaging R134a until the end of 2016. This chaos in implementation threatens Directive 2006/40/EC as a decisive component of European F-gas policy (see chronology of refrigerant debate).

PRO KLIMA draws media attention

History shows: When we launched the PRO KLIMA campaign in 2010, the political dispute over refrigerants was already blazing. During the project's lifetime until December 2013, the conflict then flared up drastically. This brought a lot of media attention to the issue and gave us the opportunity to ideally place the campaign's messages in the media. The press and public relations work of our PRO KLIMA campaign thus focused on the following main priorities:

- » The safety risks of the refrigerant R1234yf and the benefits of natural refrigerants
- » Information on the increased consumption by mobile air-conditioning systems along with tips for consumers on how to reduce fuel consumption.

A brief chronology of the refrigerant debate

| | |
|-------------|---|
| 03/1998 | Daimler Benz AG promotes CO ₂ as the refrigerant for vehicle air-conditioning in future for the first time. |
| 02/2003 | The German Association of the Automotive Industry (VDA) advocates CO ₂ as a possible future refrigerant in the passenger car sector. |
| 07/2006 | EU adopts F-Gas Regulation and Directive on environmentally-friendly refrigerants in mobile air conditioning systems (MAC Directive). |
| 09/2007 | VDA issues an official notification stating that German car manufacturers will comply with EU guidelines and use the natural refrigerant CO ₂ . |
| 2008 | Honeywell and DuPont emerge onto the market with the alternative chemical refrigerant R1234yf. |
| 2008/2009 | Tests by Deutsche Umwelthilfe and the Federal Institute for Materials Research and Testing establish safety risks when using R1234yf. |
| 2010 | German car manufacturers announce that they will be backing the refrigerant R1234yf in future. |
| 2011 | MAC Directive enters into force: Massive decline in applications for new type approvals. |
| 08/2011 | Daimler AG applies for new type-approval for the Mercedes B-class. Due to delivery problems with the R1234yf refrigerant, the vehicle continues to be delivered containing R134a. |
| 04/2012 | Continuing delivery problems for R1234yf induce the European Commission to declare a moratorium on the MAC Directive. The requirements of the Directive are not legally binding until 1 st January 2013. |
| 09/2012 | Extensive testing by Daimler AG confirms safety risks using R1234yf. Daimler then declares it will not use the refrigerant and will initially continue to use R134a. |
| 03/2013 | Daimler, Volkswagen and BMW announce to bring CO ₂ air-conditioning technology forward to series production in the medium term. |
| 06/2013 | Daimler changes the type-approval of new models and puts them on the market based on the previous generation's type-approval. This fully exploits the transition period for the MAC Directive. Many other manufacturers are also bypassing the Directive using this or similar methods. |
| 10/2013 | Final investigative report on R1234yf is published by the German Federal Motor Transport Authority (KBA). In the simulation of a severe accident, the refrigerant in one car ignited, in two others significant amounts of hydrogen fluoride were released. The KBA therefore recommends further tests. |
| End of 2013 | The scientific and technical advice service of the European Commission, the Joint Research Centre (JRC), is commissioned to review the previous tests with the refrigerant R1234yf and to make a safety assessment based upon them. |

Television, newspapers and other media have above all taken up the refrigerant issue and the associated discussion on safety. This eclipsed the campaign's second priority, the increased consumption through the use of mobile air-conditioning systems. Due to the fact that there is as yet no standardized method of measurement which allows for the comparability of air-conditioning systems, the aspect of efficiency has been examined in less detail. Instead, the focus was on tips on how to use the air-conditioning system.



„Air-conditioning systems increase fuel consumption: A driver needs as much fuel for his car's air-conditioning system in a year as he would use driving from Hamburg to Paris.“

*Dr. Axel Friedrich,
International transport advisor*

The PRO KLIMA project team from Deutsche Umwelthilfe e.V. and Verkehrsclub Deutschland were popular interview partners for television, radio and print media. In the course of the three-year project period, we were able to establish the PRO KLIMA campaign as a leader in the discussion on refrigerants and mobile air-conditioning systems.

The PRO KLIMA team issued a large number of press releases and supplied journalists with information packs, such as for example, the chronology of the refrigerant debate. In background discussions, we informed the journalists about all aspects of the topic. This enabled the PRO KLIMA campaign to place the complex issue of mobile air-conditioning systems regularly in TV and radio programmes, as well as in the print media. Simply through reports in such well-known television programmes as Frontal21, ZDF heute, Tagesschau or 3sat nano at least 10,5 million viewers were reached.

Our reputation as a competent partner on the subject has helped us communicate our campaign objectives to decision-makers in industry and politics. As a result of our very good contacts to business, government and political actors in the refrigerant debate, up-to-date information came together in the PRO KLIMA project office. Because air-conditioning systems have become such a hot topic in the public perception, it was also that much easier for us to conduct the broad social dialogue that we had intended through our campaign.

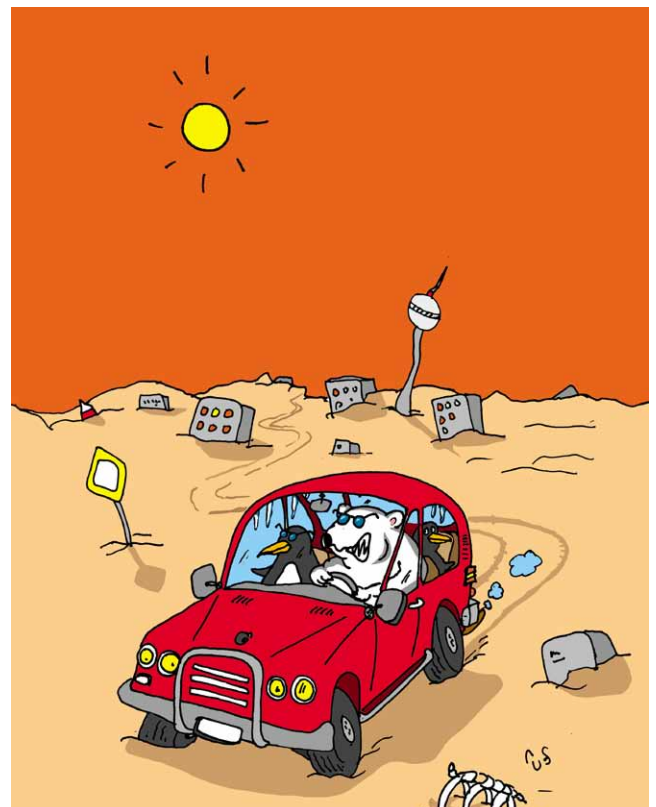
The reporting on the refrigerant R1234yf triggered a public debate on the marginal issue of car refrigerants, which then also had an effect on the decision-makers in politics and the car industry. Daimler AG finally conducted its own tests with R1234yf in the summer of 2012. The car manufacturer has stated that it actually wanted to prove that R1234yf was harmless. However, the refrigerant also ignited in the Daimler test series. Daimler thus announced in September 2012 that it would not use the

refrigerant R1234yf. The Federal Motor Transport Authority subsequently also investigated R1234yf and forwarded the results to the European Commission's JRC Research Centre. Through its activities, the PRO KLIMA campaign has thus initiated detailed investigations of R1234yf by the national regulatory authorities and the ongoing review of the previous tests of R1234yf in the Joint Research Centre.

At the Geneva Motor Show in spring 2013, the car manufacturers Daimler, Volkswagen and BMW finally announced that they would be working to bring air-conditioning systems using the natural refrigerant CO₂ to series maturity. This substantially increases the chances of one of the major objectives of the PRO KLIMA campaign being implemented in the medium term.

Results of the campaign work

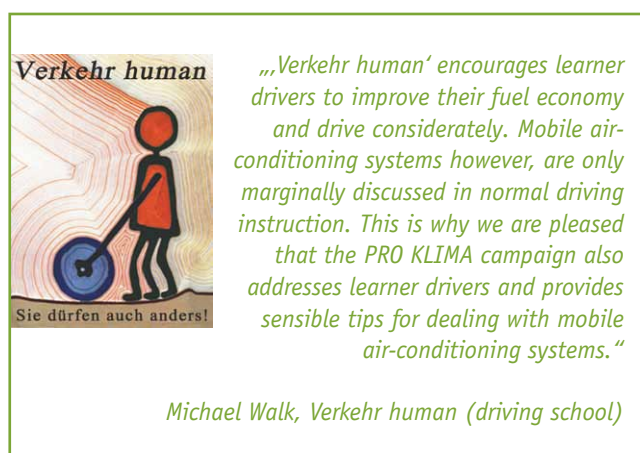
- » In total, we have published 27 press releases, organised 9 press conferences and conducted numerous background discussions with journalists.
- » This has resulted in more than 450 print and online articles...
- » ...as well as nearly 30 TV and radio features on the refrigerant issue.
- » As a result, more than 10,5 million people were reached through reports in well-known television programmes.



Cartoon of the winner Mario Lars.

PRO KLIMA is looking for allies – the information campaign for new drivers and fleet operators

The information campaign has from the beginning been based on three pillars: The press, addressing consumers through public relations work and a direct appeal to multipliers. To this end, we have written to around 2000 driving schools we wanted to gain as partners. The driving school market is highly competitive and environmental aspects do not play a major role in many schools. Some driving schools therefore reacted unexpectedly harshly to the campaign and rejected every discussion. However, more than 220 driving schools did become involved in the campaign and thereby showed that environmental protection also carries weight in driving school instruction. We provide our partner driving schools with a flyer entitled „Keep cool!“, which explains how an air-conditioning system works and specifies its advantages and disadvantages. We also provide useful tips for saving fuel when using the air-conditioning system. Before designing the „Keep Cool“ flyer, we first held a cartoon competition, because we wanted to make the flyer attractive for young adults. We also offer the flyer in German, English and Turkish beyond the end of the project.



Around 60 percent of newly registered cars in Germany belong to the vehicle fleets owned by companies, authorities, associations, municipalities, etc. The fleet operators are therefore extremely important contacts for us. With representatives from German companies such as Deutsche Telekom, Deutsche Bahn, Tchibo and Puma we have conducted workshops on efficient air-conditioning systems. Our focus was on increased consumption through air-conditioning systems, explained by engineers from TÜV Rheinland and scientists from Graz University of Technology and Chemnitz University of Technology. We presented the EU method of measuring mobile air-conditioning systems and discussed this with the fleet operators and representatives of the federal ministries. The companies were united in their support of the campaign's demand for more transparency in the measurement of fuel consumption. Air-conditioning systems and other auxiliary components should be running during consumption measurement.



BVG and other transportation companies already use CO₂-systems in buses

One of the objectives of the PRO KLIMA campaign was also to find an action alliance for natural refrigerants with the fleet operators. Unfortunately, this was not possible, as fleet operators currently do not have an opportunity to buy or lease a car using natural refrigerants due to the industrial policy decision of the automotive industry. The first CO₂ air-conditioned models will come onto the market in 2016 according to Daimler AG. Instead, a general circle of supporters has been established, comprising around 30 organisations, institutions, companies and fleet operators across Europe and made visible through statements on our website.

Many transportation companies want to back CO₂ air-conditioning technology in the future

In addition, PRO KLIMA has questioned transportation companies on their future air-conditioning strategy. More than 40 German and Austrian transportation companies indicated that they would in future acquire vehicles with a CO₂ air-conditioning system, once the current inadequate support from bus manufacturers relating to CO₂ air-conditioning equipment has been remedied. The reasons for this are obvious, because CO₂ is also the refrigerant of choice for economic reasons. CO₂ is cheap, has a high refrigerating capacity and low maintenance costs.



Workshop for fleet operators

The refrigerant CO₂ therefore makes financial sense for fleet operators and transport companies. This is particularly true for air-conditioning systems, which as heat pumps also heat the vehicle efficiently.

In our various technical discussions, representatives of public transportation companies reported on the operation, maintenance and cost of the systems. The experience made by the public transport companies clearly shows that the CO₂ air-conditioning systems are extremely effective in daily use.

Results of the campaign work

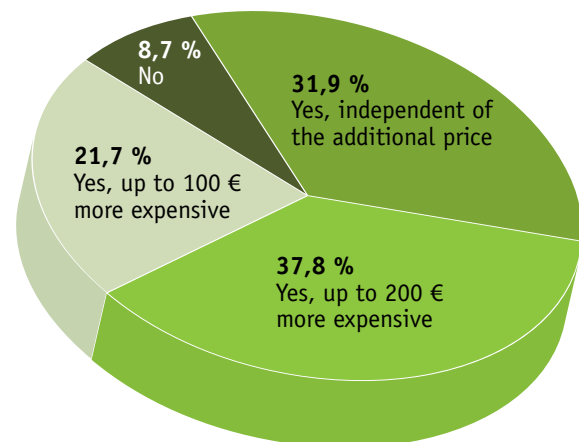
- » We were able to raise the awareness of this issue with more than 350,000 learner drivers through our flyers and short film.
- » In addition to the contacts with over 220 partner driving schools, we have built up a circle of supporters comprising around 30 associations, companies and fleet operators during the lifetime of the project.
- » With our two workshops for fleet operators we were able to inform a total of more than 75 stakeholders about the environmental impacts of mobile air-conditioning systems (including Deutsche Telekom, Deutsche Bahn, Bundesverband Carsharing, Tchibo and Puma, among others).

The special events from the PRO KLIMA campaign

As part of our information campaign for multipliers we have also run two specialist conferences and held six technical discussions. At these events, we discussed the issue with representatives of the car industry and its suppliers, the Federal Government and authorities, as well as scientists and engineers from research institutions and testing institutes such as TÜV. An average of 30 experts from this broad corporate, political and scientific spectrum took part in the technical discussions. The refusal of the car industry to participate made things increasingly difficult for the PRO KLIMA project team. Since the safety debate on R1234yf was conducted vehemently, car manufacturers and their related supply industries increasingly shied away from our technical discussions. Research institutions that are dependent on third-party funding from the automotive industry were in part no longer willing to take a firm position in favour of natural refrigerants.

Around 80 participants from these professional circles also discussed the safety aspects of R1234yf intensively at both the opening and the closing conferences. However, the climate of opinion has changed significantly in the course of the three years. At the beginning, the German Association of the Automotive Industry and the Association of International Motor Vehicle Manufacturers were convinced that R1234yf would be used in any

If you had the possibility, would you opt for an ecologically friendly air conditioning system with an inflammable refrigerant when buying a new vehicle, even if it is more expensive than a conventional air conditioning system?



Online survey: High willingness to pay for sustainable technology

case in mobile air-conditioning systems. The majority of experts present at the final conference in December 2013 came out in favour of CO₂ as the future refrigerant in mobile air-conditioning systems, as a short survey revealed.

Results of the campaign work

- » About 30 representatives from politics, research and industry took part in each of our 6 technical discussions and exchanged views on individual aspects of vehicle air-conditioning.
- » In our two conferences, a total of more than 140 experts from Germany and abroad discussed air-conditioning for passenger cars in the future.

The campaign retains a presence

On the PRO KLIMA website (www.autoklimaanlage.info) we provide information on the content, events and objectives of the campaign. Visitors will find a wealth of technical and environmental information on the site, as well as a short film on air-conditioning systems, consumer tips for dealing with air-conditioning systems and also the places where the campaign exhibition is currently touring. As our intention has been to inform a wider public than simply the experts about the environmental impact of mobile air-conditioning systems, we have devised and implemented a number of appealing methods of communication. These include the exhibition, films on YouTube or the „Keep Cool“ flyer for young learner drivers. All these materials remain available beyond the end of the project.

This also applies to our online survey. Through the website we surveyed consumers on how they use mobile air-conditioning systems and what they would like to see in vehicle cooling. By the end of the project, almost 3,000 people had taken part in the survey. About 90 percent of the respondents call for the increased fuel consumption resulting from the air conditioning system to be indicated separately. More than 90 percent of respondents would be prepared to pay more money for an environmentally-friendly air-conditioning system with a non-flammable refrigerant. At the same time, two-thirds of those questioned meanwhile agree that the air-conditioning system is „important“ or „essential“ when buying a car.

Extension of the campaign and future challenges

It will still take a number of years until only environmentally-friendly mobile air-conditioning systems are installed in the EU. The industrial dispute between the manufacturers and the EU has significantly delayed the implementation of the climate protection directive. And yet we remain optimistic for the future. All the signs bode well for the use of the natural refrigerant CO₂. The major German car manufacturers are working on series production technology for CO₂ air-conditioning systems. From experience however, we are convinced that the industry's commitment to cooling with CO₂ requires critical accompaniment. Both policy makers and the public should follow very closely how the automotive industry implements the EU climate protection directive.

Through its information campaign, PRO KLIMA has made a major contribution to paving the way for the early use of natural refrigerants in mobile air-conditioning systems. We have built up a broad circle of supporters for the campaign in Germany and, despite the difficult conditions, have also been able to extend this to include other European countries. With press and public relations work on mobile air-conditioning systems in Austria, Denmark, Hungary and Italy, we have been able to bring the topic of mobile air-conditioning systems to the focus of the local media and public attention. We have also conducted a total of four workshops on the topic of refrigerants for mobile air-conditioning systems in Vienna, Warsaw and in Brussels. During



Mobile exhibition „Climate protection – also in your car!“

the events in Brussels, we were also able to discuss solutions to the current chaos in implementation with representatives of the EU Commission, the European automotive industry and European non-governmental organisations, and received valuable information on the strategy for a medium-term breakthrough in CO₂ air-conditioning technology. This has been included in our work and has contributed to the promising future. Individual partner organisations made a particular effort: Despite a shortage of personnel, for example, our Hungarian partner subtitled the short film from the Clean Air Action Group, so that Hungarian drivers can now also understand the film.

Results of the campaign work

- » We organised four workshops in other European countries, two of these with representatives of the European Commission in Brussels.
- » More than 3000 persons concerned with environmental and consumer protection received the necessary know-how to initiate activities in other European countries.
- » Through the EU workshops, as well as the accompanying public relations work, PRO KLIMA has made a contribution to the implementation of the EU guidelines as well as helping to push forward the discussion on alternative refrigerants.

The contacts we have established with our European partners are extremely valuable for our work. Together we can also solve future questions concerning environmentally friendly mobile air-conditioning systems and keep a close and vigilant eye on industry and policy makers. We have come a long way with the PRO KLIMA campaign. But there is still a lot of work to be done before climate-friendly refrigeration becomes standard in cars.

Summary Project Information

- » Title: PRO KLIMA: Efficient mobile air-conditioning systems with natural refrigerants
- » LIFE project number: LIFE09/INF/DE/000012
- » Overall coordination: Deutsche Umwelthilfe e.V. (DUH)
- » Project partner: Verkehrsclub Deutschland e.V. (VCD)
- » Duration: 01.09.2010 - 31.12.2013
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- » EU funding: € 399,554 (49.94 %)



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