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List of Abbreviations

APP	Application
EC’	European Commission
URL	Uniform Resource Locator
WHO	World Health Organisation
WP	Workpackage

Executive Summary

The evaluation of the CAPTOR user involvement activities in the three testbed regions (in Austria, Italy, Spain) provided us with first insights about the usefulness of the CAPTOR approach and how to improve the upcoming activities in 2018. The participants in this Citizen Science project showed a very heterogeneous picture when it comes to motivational drivers and barriers for their engagement and this diversity is also reflected in the interact with their CAPTOR ozone measuring devices and the measurement data. The pre-post-questionnaires have been complemented with in-depth insights from additional interviews and talks with the testbed organisers and participants to assess drivers and barriers of the citizen's involvement in the scientific process of CAPTOR.

Drivers for and impact of the hosts' involvement
In Spain the pre-questionnaires that were distributed to the CAPTOR hosts at the beginning of their involvement show that in the first year (2016), being involved in a research project was the most important driver and also personal impact from the citizens' involvement. During the very early pilot during summer 2016 we still faced some technical problems and citizens could not fully access their data, but they still praised the high commitment and support of the CAPTOR team and some first knowledge gains initiated by their involvement. In the second year, when CAPTORs had been improved and the data was visible on CAPTOR Air, the aspects of individual learning and awareness raising were the most highly ranked individual effects of the project involvement for hosts. Interestingly, while the knowledge and awareness raising increased, the perceived influence on the topic decreased slightly between 2016 and 2017. This decrease might be due to the fact that awareness raising does not result automatically in a successful fight against ozone pollution, but requires more time and decisions on a political level, outside the hosts sphere of influence.
In Austria the initial drivers for the hosts' motivation for involvement are comparable to the ones in Spain: There was less the wish to fight ozone pollution, but rather to be involved in a research project and to help raising awareness. Knowledge was very low in this testbed region, even lower than in the other testbeds. The direct impact was a confirmed positive experience of being involved in a research project, but also the greater awareness for the topic; again, the support of the CAPTOR team was especially highlighted. Evaluation results confirm an increased knowledge about the topic amongst the participants. Interestingly in Austria respondents thought that they do not have a lot of influence on political decisions and also rated their perceived influence on the air pollution topic very low at the beginning of their involvement. But their engagement in the project increased their perception, reaching levels compared to the other testbeds.

In Italy the most important driver for the participation of CAPTOR hosts was the whish to actively fight ozone pollution; this aspect was ranked highest in Italy compared across all three testbed regions. But the post-questionnaires showed that the most important effect on personal level was the increased awareness for ozone pollution and the positive experience of being involved in a research project, which is comparable to the other two testbeds. The relatively low knowledge about ozone pollution and relatively high expectations towards ones own influence changed throughout the summer campaign 2017: the knowledge increased slightly but the perceived influence decreased, approaching levels of Austria and Spain.

Behaviour of CAPTOR hosts
All hosts positively highlighted the low efforts of being involved in CAPTOR and the good support in case of questions, however, their behaviour has been very diverse:
We had some hosts who did not look up the data at all: some said that CAPTOR Air was not

working in the beginning so they lost interest; others said that they did no have the time to check the data again or forgot about it; others indicated that they waited for the final report and hoped mainly that authorities would look into the data and act if necessary. So, at a first glance, the involvement of these hosts, resulted "only" in the collection of ozone data for the project. However, the hosts have not yet received a final report including the full measurement dataset per device. We expect that this report might have a further impact and might stimulate further reflection, awareness raising and action.

Other hosts observed their data regularly, up to several times a day, made comparisons with other measuring devices (via Captor Air or AirAct), tried to understand the dynamics of ozone pollution, searched for back ground information. Amongst those interested in Ozone and the CAPTOR devices, there were again differences in the way they reacted.
Some hosts did not change their behaviour according to exceedances, which was for instance the case for all four interviewees in Austria and two third of the interviewees in Spain. But on the other hand one third of interviewees in Spain adapted their outdoor activities according to ozone levels, tried to reduce the usage of cars, and one person even changed his/her place of living.
Amongst those who did not adapt their behaviour, a large majority actively communicated about the ozone pollution. We heard from representatives of all three testbeds that the CAPTOR devices initiated discussions around the topic when visitors saw the devices or the hosts talked about the project within their social networks.
In Spain some hosts informed friends and family in case of exceedances, one member in Spain created a Facebook and WhatsApp group, two hosts in Italy voluntarily involved schools. In Spain half of the participants would be willing to get politically active, in Austria one host would wish to hang up a CAPTOR in his shop-room in the middle of the city to actively inform people about ozone pollution. Two people, one in Austria one in Spain, even reported about physical problems when ozone levels were high. All this shows that by providing citizens with the measurement device, we can stimulate the engagement with the topic and find additional promoters within the group of hosts.

Technical problems
In general, experienced problems with the devices were low in the summer campaign 2017, which is an important pre-condition for a successful awareness raising. Sometimes Spanish hosts reported about problems with electricity and connectivity and about the problem to measure high ozone values. In all three testbed regions the initial problems with the CAPTOR Air-App was a topic that resulted in a loss of interest of some hosts and shows again how important it is that all technical problems are sorted out in advance.

Requirement for more measuring devices
All involved CAPTOR hosts want to continue their involvement in the project, which shows the high interest and importance of the topic to participants. The citizens' aims are to help collecting data on ozone; to increase the understanding and evidence for this pollutant; support awareness raising in the population and if necessary increase the pressure on authorities to take decisions accordingly.
The more data, the more understanding, the more awareness, and the more pressure – is what seems to be the common understanding. In Spain some hosts stress the importance of an appropriate distribution of devices in the region. They say that not all devices should be in one place. In Italy the hosts require more devices. The same is true for Austria. There, one host offered his help to find the right places within one city to hang up many devices and observe and understand ozone - and find concrete, feasible measures to fight against it (e.g. measuring ozone at street level and in green courtyards and find out if it would help to put many plants and flower pots to streets).

Measuring devices at public places
Captor hosts suggest to put more devices to schools, kindergartens, nursing homes and public spaces, which shows that they grasped the main value of the devices with regard to warning those that are most vulnerable in our society.

In Austria four CAPTORs were already installed in public places, which was organised together with representatives from the local municipalities. This first test-run of cooperation at local policy level seems very promising under certain conditions:

1. A different information and communication approach compared to private hosts: since there is no personal interaction with the host, who initiates and moderates discussion around the CAPTOR device, public spaces need information panels that attract the attention of the public; these panels should include information about ozone, it's sources and risks, as well as reference levels defined by EC and WHO. Together with this background information, the actual ozone data of the device, related to the reference levels, should be shown (showing exceedances with colours codes comparable to CAPTOR Air). People would need to be made aware of the fact that the data from CAPTOR devices is not as reliable as data from reference stations. However, their visualisation would create awareness and engagement and indications could be given on the fact that this is still research.
2. Another suggestions was that, if we want to work more with official decision makers in local regions, existing meetings of mayors and local politicians should be used to make short presentations about CAPTOR and CAPTOR should connect to existing campaigns on air pollution. The ozone-topic should be integrated into existing strategic campaigns, which focus on climate change (CO2) and particulates. Ozone is another pollutant of the same cause – so it's a question of how to bundle forces with other initiatives and simplify the message.

School co-operations
Cooperation with schools have been organised in two testbeds with children aged 11-13 (Italy and Austria). The first experiences show that talking about CAPTOR is a good way to raise awareness amongst children for the air pollution problems and the topic fits well to school curricula. The evaluation results show that school workshops increase knowledge and awareness amongst pupils. In addition, pupils can be a good entry point to get their parents and adult family members involved (e.g. in the way they live their lives or via political engagement). We also need to think more about how we could address parents by the involvement of their children.

Intensified communication
Hosts from all three testbeds suggest intensifying communication about the project and the dissemination of the ozone pollution problem. This was especially important in Italy, where only a few measuring devices were dispersed across large geographical areas, but also hosts in Spain and Austria required for a broader communication. The participants' feedbacks, as well as the evaluation of street events, show that the knowledge on ozone is generally very low but the concerns about air pollution are high – so it needs more targeted information that helps to increase awareness, via e.g. television, newspaper, Facebook etc.

CAPTOR self-assessment
The feedback from hosts was one focus of our evaluation activities. The second one was a self-assessment conducted by the project partners 3 months after the 2017 campaign. It considered the feedback from the involved citizen scientists (participants dimension), but also the broader dissemination activities in WP6 (social-economic dimension) as well as the scientific outcomes (scientific dimension).

The results from the self-assessment questionnaire reveal that we attributed rather good rankings to questions relating to the scientific process and the process of communicating CAPTOR to a broader group of citizens, while we still see room for improvement with regard to the involvement of individual citizen scientists in our project. This critical analysis is also reflected by the hosts' feedback in the three testbed regions.

The project team rated the questions relating to the impact of CAPTOR in all three dimensions quite equally and expects some considerable increases in the last year, especially in the scientific dimension when we will publish the results from the sound research work on low cost ozone devices and the collection of valid, high-quality data. In the citizen science dimension, the promising results that show the potential influence of our approach on awareness raising and learning will hopefully expand to more citizens and a more active involvement (e.g. via Maker workshops). With regard to the social-economic impact a portfolio of activities conducted mainly in Spain that addressed the media, but also municipalities and actors on a political level and searched for co-operations with related initiatives, will be expanded (or is currently expanded) to the other two testbeds.

Description of the work

This deliverable describes the evaluation outcomes from two measurement campaigns (2016, 2017), where the first one took place in Spain only and the second one was organised and evaluated in all three testbeds.

Objectives

The main objectives of the deliverable are:

- Discusses the evaluation activities performed until year 2 and the corresponding results.
- Conduct a self-assessment based on the evaluation results with and from involved citizens.
- Inform other WPs on possible implications for the final project year.

1. Introduction

As outlined in Deliverable 5.1 the CAPTOR evaluation approach distinguishes between evaluation and impact assessment. Evaluation activities look at the actual development and implementation of the project while impact assessment addresses the longer-term, deeper changes resulting from the project. For both views, evaluation instruments and means of verification were designed. Evaluation data will help us to identify the strengths and weaknesses of the CAPTOR approach according to the initial goal set up by the project and to assess the potential impact of the project.

This report focuses on the evaluation activities and outcomes in the three testbeds, Austria, Italy and Spain, which were conducted during the summer campaign 2017. While Spain had already conducted a test run in 2016 in Austria and Italy the installation of CAPTOR nodes in private and public spaces was conducted for the first time. So while in Spain the same hosts were participating for the second time, the hosts in Austria and Italy where completely new to the setting. Also, there was a difference in the ozone measuring devices that were used in the different testbeds. While Spain continued to use CAPTORs, the Austrian team was providing their participants with RAPTORs and in Italy a mix of both, CAPTORs and RAPTORs were used. A detailed description of the technical details is given in deliverable D2.2.

Another difference, as we will see in the discussion of the results below, is the selected target groups that each testbed was working with for awareness raising activities. While e.g. in in Spain the focus was on the involving citizens as testbed hosts, Austria was working with two public authorities to install ozone measuring devices at public places. In Italy the testbed had a wide geographical coverage, while in Austria and Spain it was restricted to one local area. The specific settings for each of the testbeds are described in deliverable D4.2.

So, while the local settings for the testbeds where thus slightly different in each country, not only in terms of technology used, but also in terms of numbers of participants, target group for outreach, etc. the main goal and approach towards installing low cost ozone measuring stations was the same. There we were also able to apply the same evaluation instruments for some of the activities and get comparable results e.g. in terms of personal effects on the participants.

For the wider impact assessment across the different cases and for the project as a whole the consortium performed a joined activity in going through an evaluation questionnaire that was specifically designed to assess the scientific, individual and socio-ecological impact of citizen science projects.

2. Evaluation Timeline & Instruments

The following timeline (Figure 1) indicates the main activities of the CAPTOR awareness raising and measurement campaign. Although the three countries implemented the campaign in slightly different ways, adapting to the local and regional contexts, the general approach was followed in all three testbeds.

(Figure 1) also shows the main evaluation instruments that were applied in the different testbeds. The host pre- and post-questionnaires as well as interviews with hosts were conducted in all three countries. However, due to the rather low number of hosts, the evaluation shifted its focus to more qualitative feedback by conducting more interviews than originally foreseen.

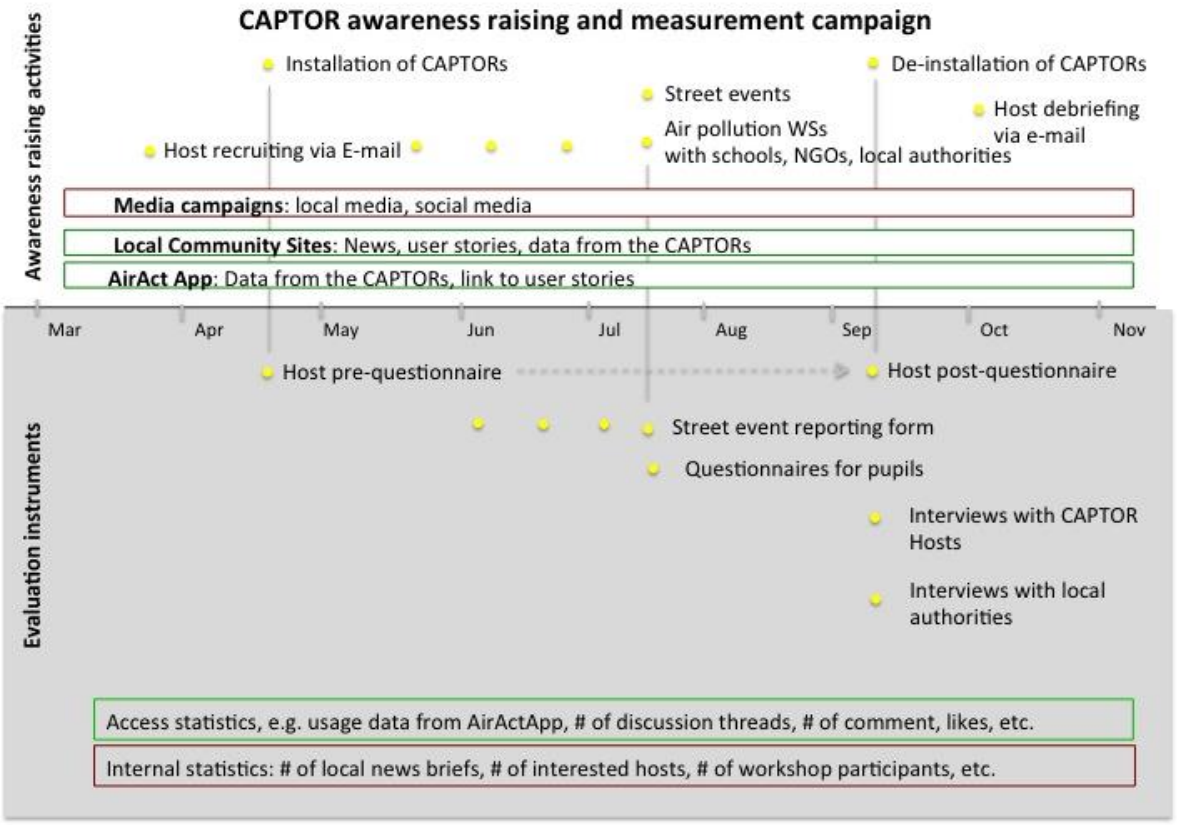

Figure 1: Timeline Summer Campaign 2017

As the following section will show, the evaluation instruments and timing varies slightly from country to country as it had to be adopted to the local setting.

3. Spain: Measurement campaigns 2016 and 2017

CAPTOR organised two measurement campaigns in Spain: in Summer 2016, 20 private households were involved as CAPTOR hosts in the collection of ozone data. In Summer 2017 again 20 private households took responsibility for a CAPTOR measuring device, only 1 of them was new to the project, the rest repeated their involvement from 2016.

3.1. Pre-questionnaire for CAPTOR hosts 2016

20 participants responded to the pre-questionnaire which was distributed at the beginning of the summer campaign 2016 to capture the hosts' motivation for participation and knowledge on ozone.

As shown in Figure 2 the main drivers for participation were to *help raising awareness for the air pollution problem in the region* (mean: 8.85; on a 11-point likert scale from 0="not at all" to 10="very much") , *to be involved in a research project* (mean: 8.8) and to *learn more about ozone pollution* (mean: 8.35).

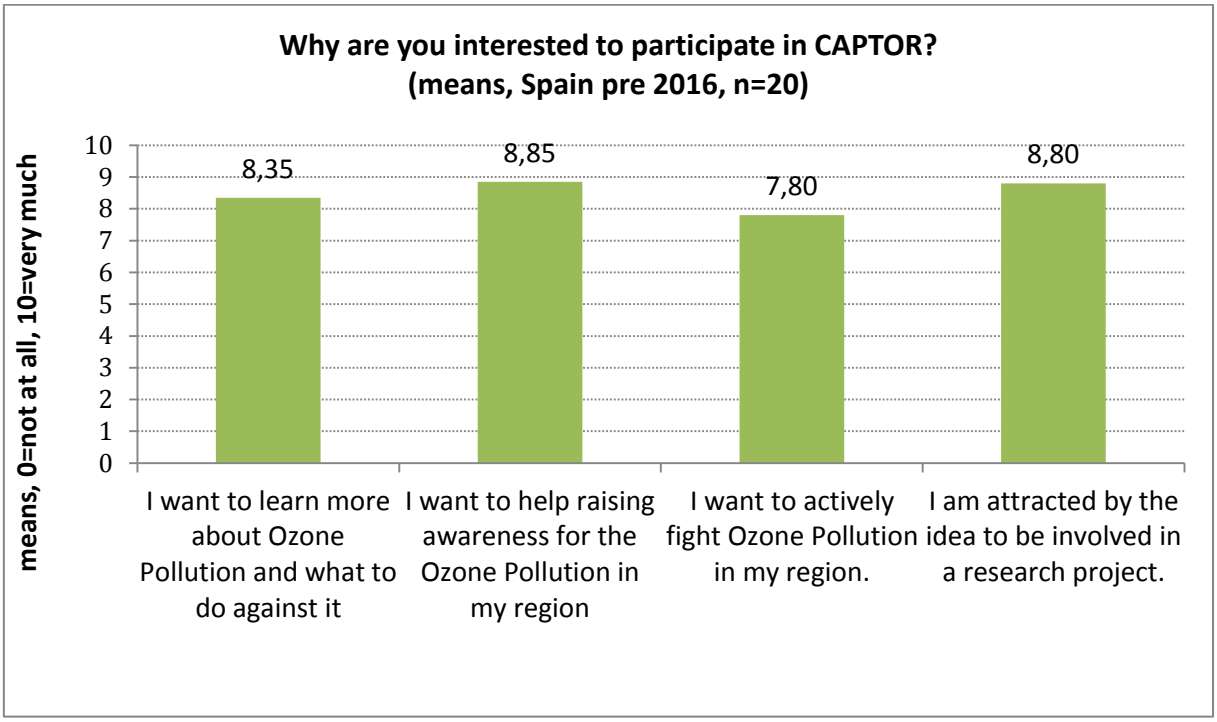

Figure 2: Drivers for participation in Spain 2016

More precisely participants state that they can influence the air quality in their region by many ways:

- Take action on a personal level to reduce pollution (14 out of the 20 participants agree, 2 disagree and 4 are do not know))
- Influence their social environment to increase awareness (18 respondents agree, one disagrees and 1 does not know)
- Influence their social and/or organizational environment to take collective measures (14 agree, 2 disagree, 4 do not know)
- Influence the policies and measures adopted by the public authorities (16 agree, 2 disagree, 2 do not know)

9 of the 20 respondents have already been aware of the ozone pollution problem since 10 and more years, only 3 of them are new to the topic and have heard about it within the last 2 years. The main communication means to get to know about the problem were TV, news, the Internet, the social network and organisations.

Although the respondents are aware of the ozone problem since many years, their *perceived knowledge on ozone* is low, and their *perceived influence* on it as well – see Figure 3, with means between 4.4 and 4.5 (on a 11 point-likert scale from 0="very low" to 10="very high").

From the 20 respondents, 11 know the *difference between stratospheric and tropospheric ozone*. 18 respondents are *aware of the pollutant effect of ozone on air and plants* (Figure 4).

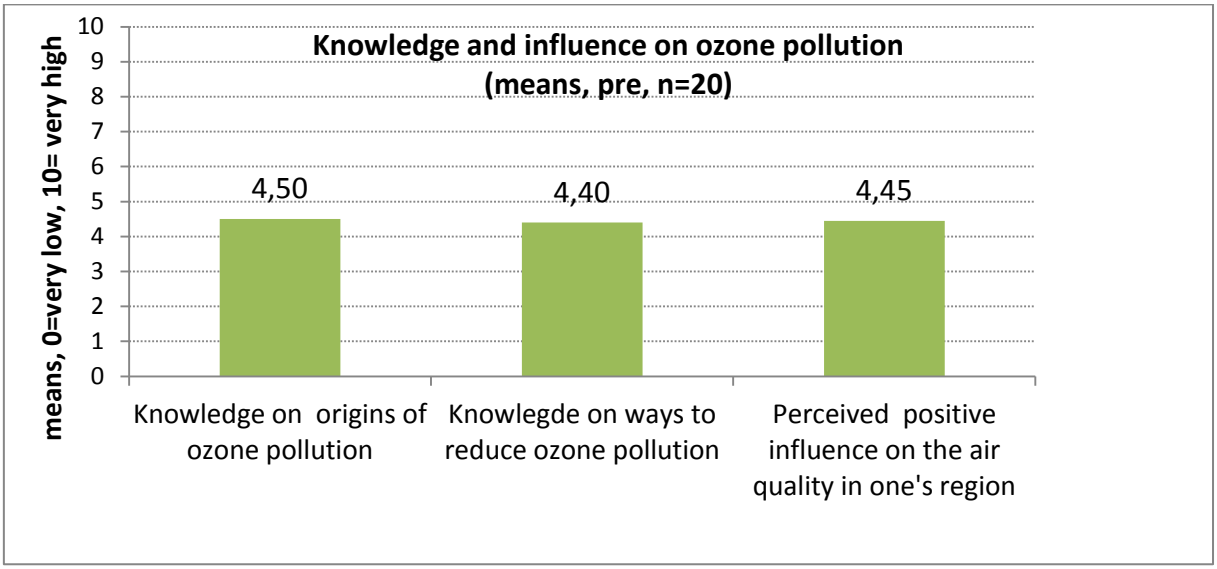

Figure 3: Perceived knowledge and influence on Ozone, Spain 2016

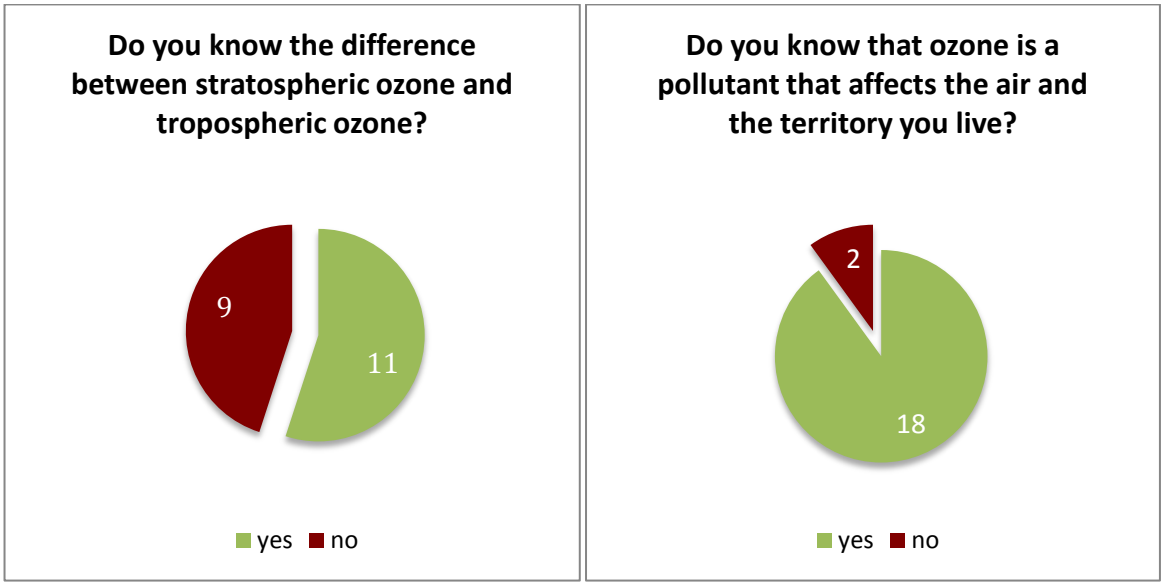

Figure 4: Knowledge about Ozone, Spain 2016

3.2.Post-questionnaire for CAPTOR hosts 2016 and 2017

The post-questionnaire was filled in by 10 participants at the end of the summer campaign 2016 and by 8 participants at the end of the summer campaign 2017.
The distribution of post-questionnaires at the end of each summer campaing, aims to collect data on respondents personal benefits of invovement over time and their feedback to the project.

In 2016, the formative feedback concerning project communication and support was rather positive (see Figure 5).

The *installation of CAPTORS was well organised* (mean: 8.9; from 0=not at all, 10=very much, there was *good support in case of questions and problems* (mean: 7.9) and the *information how to participate well elaborated* (mean: 7.8). The lowest ranking was provided for the *communication of the project objectives* with a mean of 7.6.

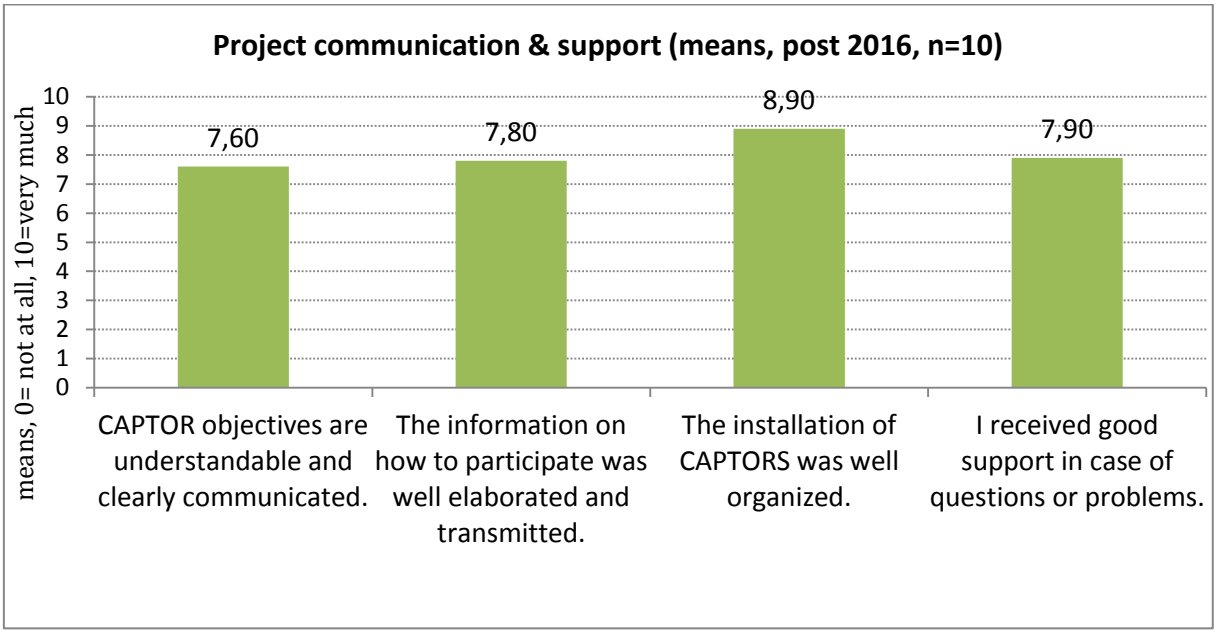

Figure 5: Project communication & support, Spain 2016

The pre-questionnaires in 2016 showed that the most important drivers for participation where the wish ”to raise awareness for the air pollution problem in the region” and “the attraction of the participation in a research project”. The post-questionnaires 2016 show that participants rated these two areas also most positively (see Figure 6).

Respondents state that it has been a rather *positive experience to be involved in a research project* (mean: 7.4, from 0=”not at all” to 10=”very much”) and the *participation helped in raising awareness for the air pollution problem* (mean: 6.7). The lowest rating was provided to the statement that CAPTOR *supported the host to fight ozone pollution in his/her region* (mean 5.5). In general the rather low ratings can be attributed to the technical challenges during this first summer campaign, which is also reflected in the qualitative feedback (see below).

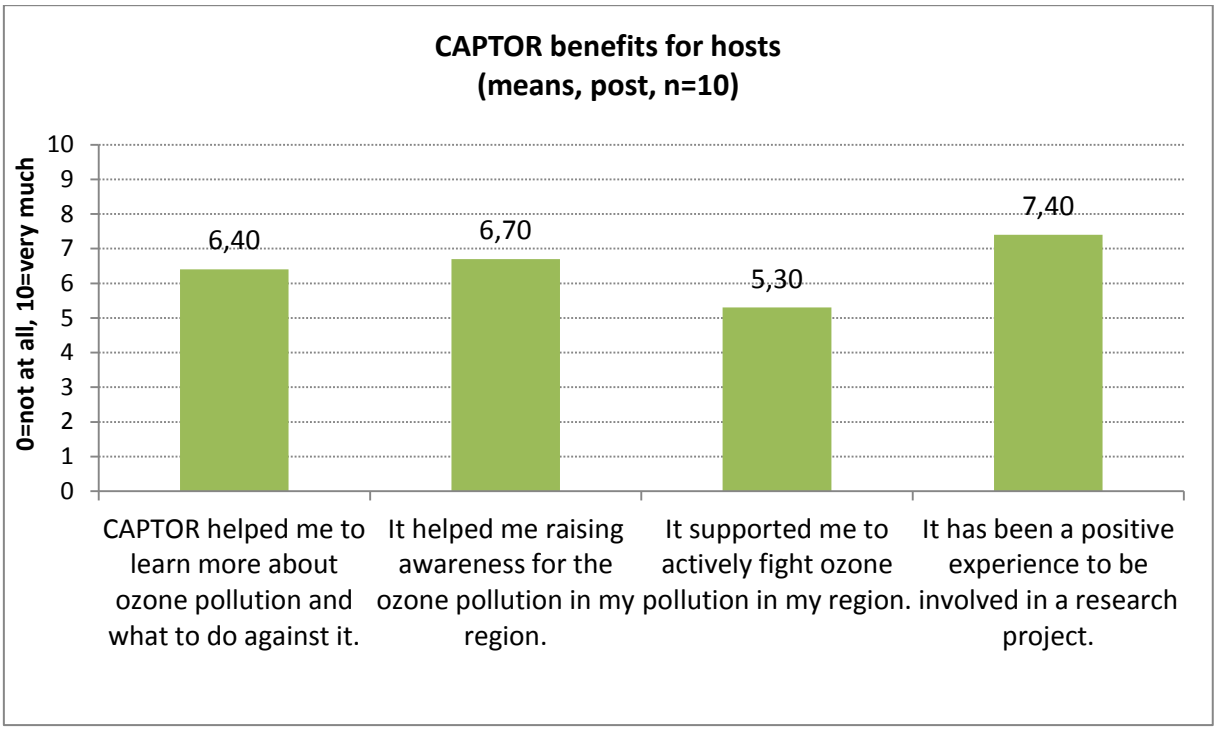

Figure 6: CAPTOR benefits for hosts, Spain 2016

A comparison of pre- and post data 2016 (see Figure 7) shows that the *perceived knowledge on ozone pollution* as well as the *perceived influence on air quality* in the region slightly increased over the summer campaign.

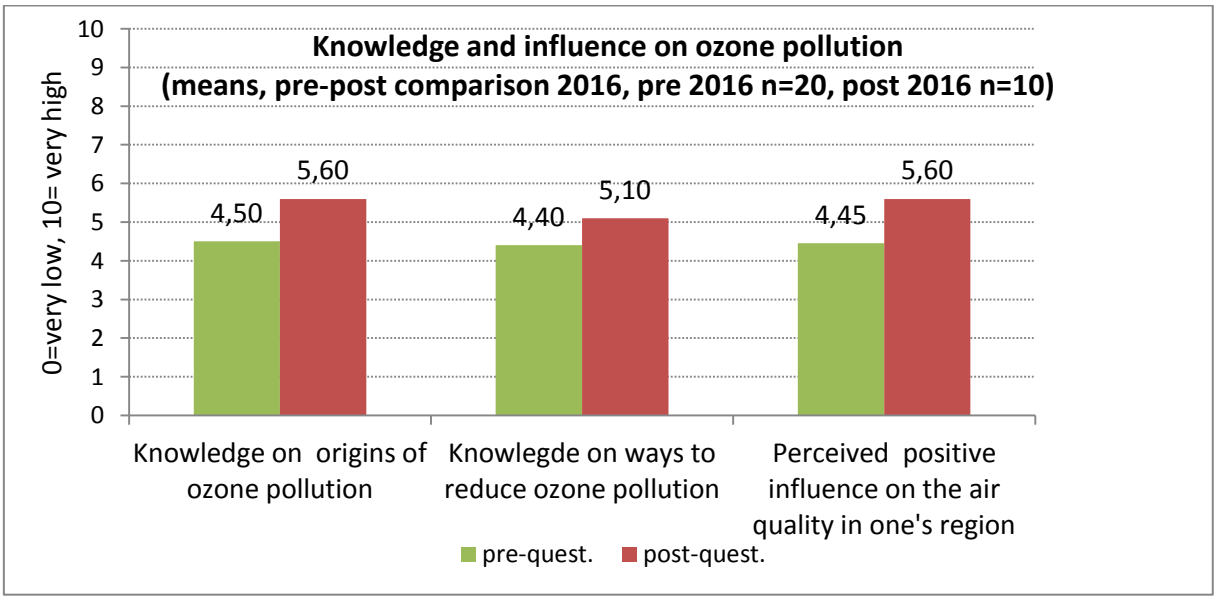

Figure 7: Pre-post comparison of perceived knowledge and influence on Ozone, Spain 2016

All Spanish participants from 2016 wished to continue their participation in CAPTOR and did so in summer 2017. The main reasons for the continuous motivation were: to collaborate and help in a research project about ozone, to know more about the problem and to collaborate for the improvement of the air quality.

Original statements are:

- *„It's a long way battle that needs more knowledge."*
- *„To collaborate in a research project about ozone and make diffusion of aire quality problems in Barcelona"*
- *„It doesn't make work and I learned"*

All participants also wanted to suggest an involvement in CAPTOR to friends and family. Reasons were mainly 1) to increase the number of involved people and data and 2) to increase pressure and awareness for the ozone problem.
Original statements are:

- *"Because as much people as we will be, more pressure we could do."*
- *"To increase the data available and people's awareness"*

In the final section for "further comments", the CAPTOR hosts 2016 provided us with a general feedback. As can be seen from the comments below, the access to the data via a digital platform was an important requirement and missing in the first summer campaign. Also one participant required for more get-togethers and exchange with other volunteers.
But in general feedback was positive. One host reported that the CAPTOR always initiated discussions with friends about the ozone pollution. Feedback also stressed the *"easy participation"* and that the involvement *"provided the feeling of being useful".*

Some original statements are:

- *"It would be good if the volunteers could see the ozone data in real time with a digital platform. From my point of view the volunteers had too little participation; it would be nice if a workshop was organized in order to meet other volunteers and be more active in the project. At the end the volunteers have only putted a site to place the captor and nothing else. I have also missed some meeting and actions of awareness"*
- *"My experience was positive. Helping people to investigate these kind of environmental problems make me useful."*
- *"The experience was positive, we are happy to collaborate with captor project. Every time that some friends have come to our house and we explained the project, all people have been interested on the project and the problem of ozone. It was amazing how captor team have shown such a dedication and closer relation all along the summer. The only thing we miss is to be able to look at the real time data, we hope next year it will be ok."*

At the end of the summer campaign 2017 the post-questionnaires were distributed to the hosts a second time to track changes over time.

Interesting in this longer-term perspective is that we can see how the impact improved with the second measurement campaign, especially related to the *knowledge on ozone* (see Figure 8, mean 2016: 6.4; mean 2017: 8.5) *and rising awareness* (mean 2016: 6.7; mean 2017: 8.4). While during the first campaign the biggest benefit for individuals was the positive experience of the research project, in 2017 this effect was still important (mean: 7.8) but the other benefits became stronger. Still, even in 2017, CAPTOR did not achieve to support volunteers in their fight against ozone pollution in their region (mean: 6). For this aim the project dissemination needs to be further improved (see open comments and interview data below).

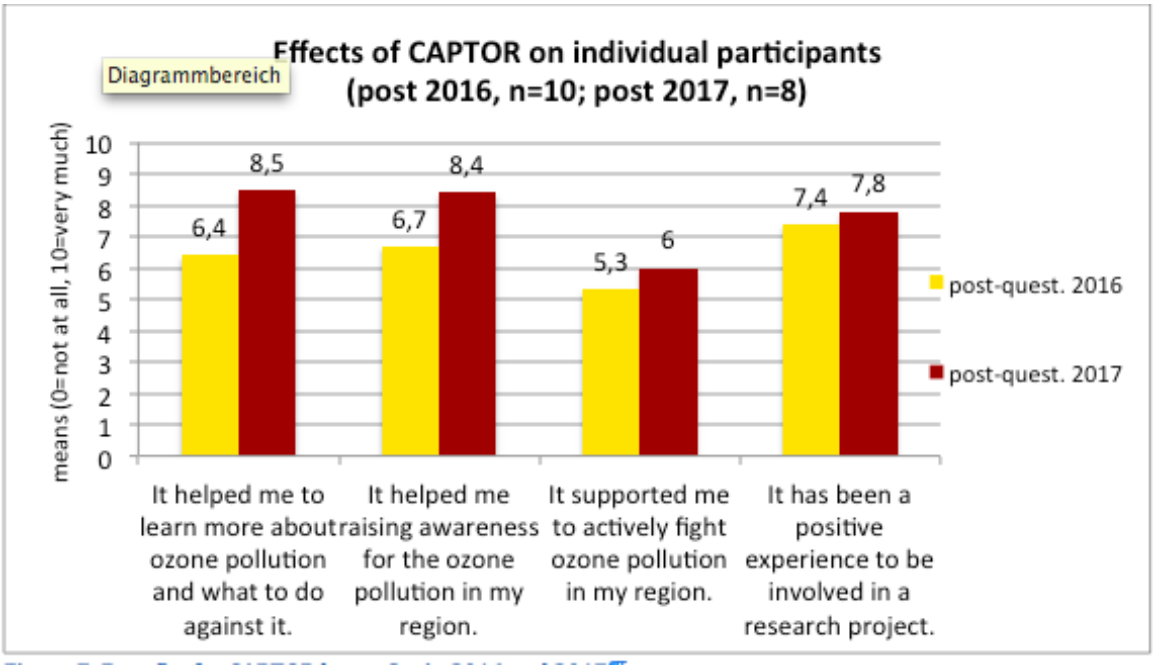

Figure 8: Benefits for CAPTOR hosts, Spain 2016 and 2017

A positive learning effect can also be observed with items that capture the *perceived knowledge related to the origins of O3 and ways to fight against it* (see Figure 8). Both items slightly increased to means of 6 (on a 11-point likers scale, from 0= "very low" to 10= "very high"). Interestingly the *perceived influence* decreased slightly from a mean of 5.6 in 2016 to a mean of 5.1 in 2017.

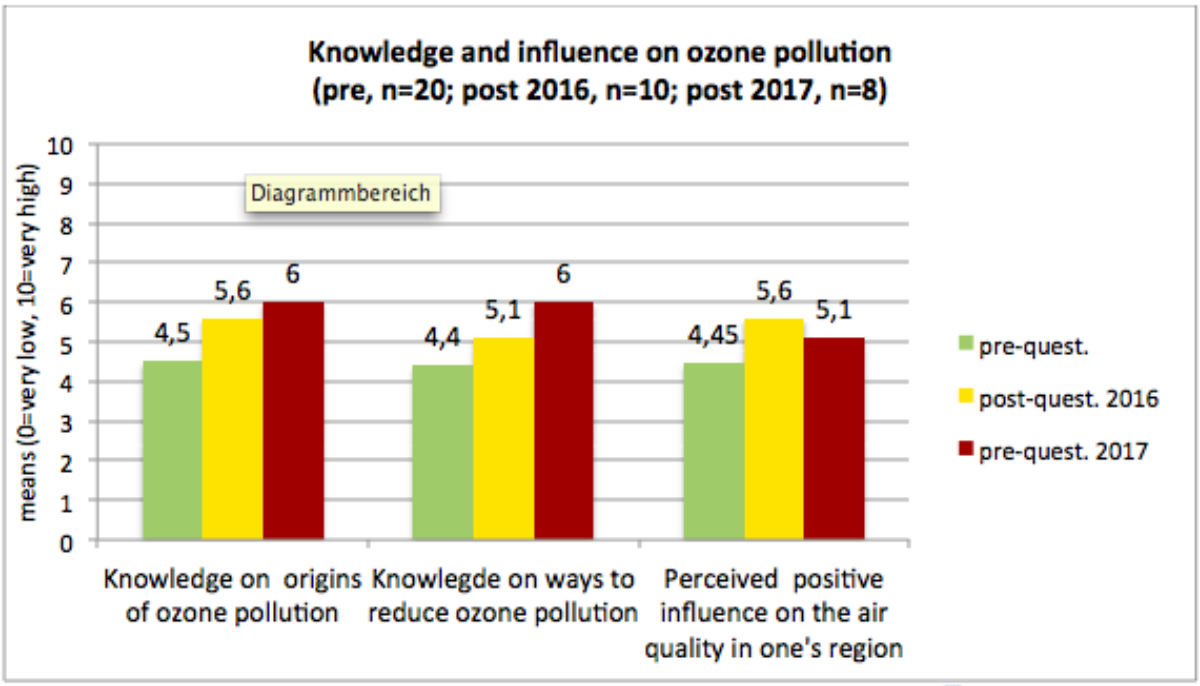

Figure 9: Perceived knowledge and influence on ozone pollution, Spain 2016 and 2017

Comparable to 2016, all participants in 2017 want to continue their involvement in the project and all participants would recommend CAPTOR to friends and family: The reasons are similar to 2016 and relate to the simple participation and the wish to track ozone pollution and thus start to fight against it.

Original statements from 2017 are:

- "*To help with increase data of ozone concentrations in our region and disseminate this problem."*
- *"To do something to press authorities and help with raise awareness within population."*

3.3.Interviews with CAPTOR Hosts 2017

Finally interviews were conducted with 13 hosts in Spain at the end of the summer campaign 2017, to better understand the hosts' activities, benefits and throw backs from their involvement in CAPTOR. The analysis shows the following results:

Activities as CAPTOR hosts

Spanish participants checked their CAPTOR quite often, with 4 participants reporting that they checked it daily. Others checked at least 1-2 times per week and only a few checked it less, e.g. two times during the whole summer. The main reason for checking was mainly to see if the electric connection worked properly.

Only few participants experienced problems with the CAPTOR and if they did, it was not frequently. The only problems reported were related to data transfer and electricity that did not work properly in a few occasions.

In the interviews one participant reported that they could not see the data of their CAPTOR in the captorAIR App and that consequently decreased their interest in the project.

For checking the data of their CAPTOR most participants used the captorAIR App. One person even checked it 3 times a day and compared it with the official data provided by the Spanish government. Another person also looked at the data via the App regularly and on days with pollution peaks various times during the day. 3 interviewees did not look at the data at all, one of them arguing that they were very busy during summer and did not check the data due to work overload.

Only about half of the people interviewed checked and observed exceedances. In some cases, they checked the official data since the CAPTOR did not show any exceedances. One volunteer observed that they had some physical problems, like feeling tired. They also informed their family and friends about the exceedance. Another volunteer observed an exceedance when checking the official data from the government, but did not warn anyone since they did not feel any reaction. One family reported that they changed their plans for activities depending on the ozone concentration and alerted their friends and family about it. And another interviewee sent information to WhatsApp, Facebook, and mentioned it in talks but only when the official data showed peaks since the CAPTOR sensor did not send the data once it reached the peak. Another host also reported this problem, namely that the sensors at the host did not show any exceedance of the limit.

While most hosts also checked the data from other measuring stations on AirAct, four participants did not. The others mostly looked up data in their surrounding stations in the area, one looked up the data from all over Catalonia and one even checked the data from the rest of the European sensors.

Three of the host who did not check the data from the measuring stations also did not share any information about CAPTOR with others. Others distributed information to friends by sending the URL, by mentioning it on WhatsApp, Twitter and Facebook or by speaking directly to friends and family about it. One participant even sent the data notification to the corresponding environmental section of their local government.

Almost all interviewed hosts in Spain confirm that they received information about other CAPTOR project activities either via CAPTOR's volunteer mailing list and the *Grup de Defensa del Ter* mailing list; one also from talks and conferences. Three of the participants were also engaged in other activities from Ecologistas en acion related to CAPTOR.

Personal gains from hosting CAPTOR

Participants mostly noticed an increase in knowledge related to the topic of air pollution, especially those who did not have a very profound knowledge before. Since most hosts already participated in the previous campaign as well, their knowledge gain was not increasing as much as last year. Still, one participant had the feeling that this year they knew more about what was happening in their area, another felt that the knowledge has deepened this year and increased their sensitivity towards the topic. One participants mentioned that they increased their knowledge every day. Only two of the interviews did not notice any knowledge increase this year.

All hosts shared the gained knowledge about air pollution and the topic of ozone, mostly with friends and family. One person even created a Facebook and WhatsApp group and one person also interacted with public authorities.

While around half of the hosts did not change anything in their lifestyle based on the knowledge they gained from their participation, five persons deliberately stopped doing outdoor sports or even walking when the ozone level was high. One person even moved to a different are that was less affected by ozone pollution, one person stopped using a private car and considered buying an electric car and one person decided to close the windows when it's hot outside.

Half of the Spanish hosts also indicated that they would be willing to engage on a political level to fight ozone pollution with one person being already heavily active. The reason for those who would not like to get politically engaged is mainly lack of time.

Value for the region

Most interviewees think that more CAPTORs should be installed in the region, since it is one of the most affected areas and so their feeling is, the more sensors, the better and the more knowledge is available. One interviewee thinks that an increase in the number of sensors would also increase people involved, and raise more awareness about the problem. Similarly, another participant thinks that with more sensors, more conscience about the problem is created. One person thinks that it would be nice that there were more sensors in Barcelona, as it is a metropolitan area and one would reach many people.

For one person an important thing would be to make a model of forecasting ozone episodes, while another participant thinks you should see the air movements to make a more accurate distribution of sensors. Still another host believes that the important thing is that the sensors measure correctly. They believe the location of some sensors does not make much sense as they are too close to each other and that the sensors should be better spread over the territory. For example, mount them where there are meteorological stations. On the other hand, they think that it is necessary to reconsider the issue of volunteers who host the CAPTORs, as it would need to be people already engaged and accustomed to doing it.

Four of the host think that the number and geographical spread of the CAPTORs is appropriate.

Spreading further in the region

Some of the hosts made very specific suggestions as to where CAPTORs could be hosted in the future, including schools, nursing homes and public spaces:

- Town hall Masies de Voltregà
- In Agrupació Astronomica d'Osona http://astroosona.net/blog/ It's a group where there are scientists and where are many talks and dissemination of knowledge.
- Ecomuseu del blat: http://www.ecomuseudelblat.cat/
- For example in the nursing homes. Would be places where you would do a thorough monitoring of what is happening.
- IRTA: http://www.irta.cat/es-ES/RIT/Centres/Paginas/TorreMarimon.aspx
- Centre excursionista de Badalona, hiker center in Badalona http://www.cebadalona.org/
- Els verds de Badalona: https://www.facebook.com/Els-Verds-De-Badalona-Associaci%C3%B3-1639866999635838/
- In schools, so that children know the problem. For example, in the many environmental issues are already working Angels Garriga school: http://agora.xtec.cat/ceipangelsgarrigabcn/ampa/celebracio-del-dia-mundial-sense-cotxes/
- Fablab Valldaura: http://valldaura.net/

Possible improvements

Suggestions for improvement include a model of forecasting ozone episodes, some additional material with simple information, such as videos, pictures, more information of other air pollutants and make it user friendly and easier to access with common knowledge.

One participant thinks that the sensors should be more reliable and allow the measurement of ozone peaks, which is confirmed by another host, who believes that it's not the amount, but the quality of the sensors that is important. This would also create data to put some pressure in order to follow the limits set by the WHO or EC. One more participant would like to see measures such as stopping the traffic when the ozone level is high and create more political impact.

One participant thinks that it is necessary that information about ozone appears more often in the media. But at the same time it would be necessary to provide a holistic view of the problem, since the issue of ozone is only part of a much bigger problem. Focusing only on ozone removes strength to the fight.

One host believes that it has created a social alarm unfounded, since, for example, the sensor that staying at home has not exceeded in no time limits. Considers that it is magnifying a problem that is not so serious.

Engaging with others

Around of half of the interviewed hosts do not engage with others, either face-to-face or via online fora to discuss the topic of air pollution. Those who talk about do via both channels, in face-to-face talks as well online. Lack of time is mentioned as a barrier. One person also talks to local councils and schools and one person would like to talk with people from Madrid to bring the topic to a national level.

Four of the interviewees in Spain are part of the environmental group Grup de Defensa del Ter; one mentioned their engagement in Ecologistes en acció, Mediambient Badalona and the Iniciativa per Catalunya dels verds and one in the Plataforma per la Qualitat de l'Aire. The others mainly referred to a lack of time as the main reason for not engaging more in any social organisation fighting pollution.

3.4. Summary of the Evaluation in Spain

After the two experiences during the summer of 2016 and 2017 we do already have a good evidence base to draw some conclusions from the Spanish testbed.

First it should be mentioned that most of the hosts were recruited via the "Qualitat del Aire" platform, which is an existing community of people concerned with air pollution. So a majority of the hosts in Spain were already interested in the topic and somehow aware of air pollution, although not necessarily about the details of ozone pollution, as the results from the questionnaires have shown.

The interventions clearly had an effect on the awareness and the knowledge of the participants. There is evidence that some learning has taken place.

Characteristic for Spain is also the political activism that can be observed and that has been supported with CAPTOR. As participants stated, there has been some support to fight air pollution in the region.

Overall, there are good chances that in this test region the establishment of a private and open ozone measuring network could be sustained and contribute to a change in lifestyle as well as political action to fight ozone. However, there are still important aspects that should be improved in order to establish a regional network of CAPTOR nodes, especially the reliability of the data and a broad and easy communication of the topic.

4. Italy: measurement campaign 2017

In Italy 19 (10 CAPTORS/ 10 RAPTORS were installed in the testbed region during the measurement campaign 2017, 7 of them in official reference stations, the remaining 12 in private households.

4.1.Pre-questionnaire for CAPTOR hosts 2017

The pre-questionnaire was filled in by 11 CAPTOR hosts at the beginning of their involvement, to collect insights on the motivation to participate in this environmental project and to investigate the level of knowledge on O3 pollution.

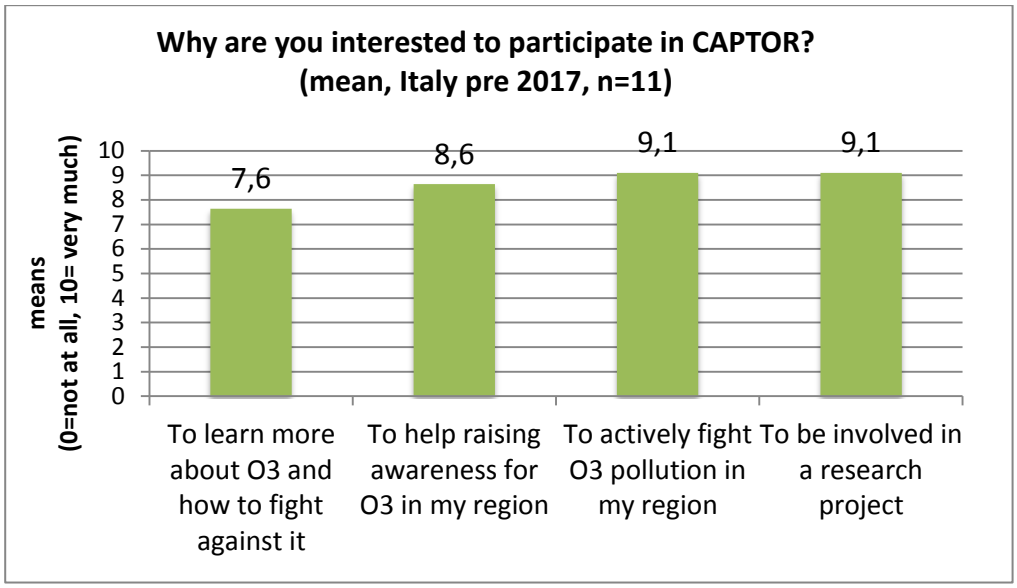

Figure 10: Drivers for participation in CAPTOR, Italy 2017

The two most important drivers for participation in CAPTOR were *to actively fight ozone pollution in my region* (mean: 9,1, on a 11-point likert scale from 0=”not at all” to 10=”very much”) and *to be involved in a research project* (mean: 9,1). Thus the results are a bit different compared to the Spanish testbeds, where the active fight against ozone pollution was not such a strong driver.

More precisely participants state that they can influence the air quality in their region by many ways:

- Take action on a personal level to reduce pollution (all 11 participants agree to this statement)
- Influence their social environment to increase awareness (all 11 respondents agree)
- Influence their social and/or organizational environment to take collective measures (all 11 respondents agree)
- Influence the policies and measures adopted by the public authorities (only one of the 11 participants disagrees)

Eight out of the 11 respondents stated that they had heard about ozone only within the last year. Three participants said that they follow the topic since years. The participants became aware of the air pollution problem through news, social networks, Legambiente, or scientific literature and studies.

The level of *perceived knowledge on ozone* is rather low, but a bit higher than in Spain, and reflects the fact that the O3 topic is quite new to most of the respondents. Both items, *the perceived knowledge on the origins of O3* as well as *they ways to fight against it*, reach average means of 5 (on a 11 point-likert scale with 0=”very low” and 10=”very high”) – see Figure 11. Five out of the 11 participants do not know the difference between stratospheric and tropospheric ozone (see Figure 12), 10 out of the 11 respondents are aware of the fact that ozone affects the air they breathe and the plants around them.

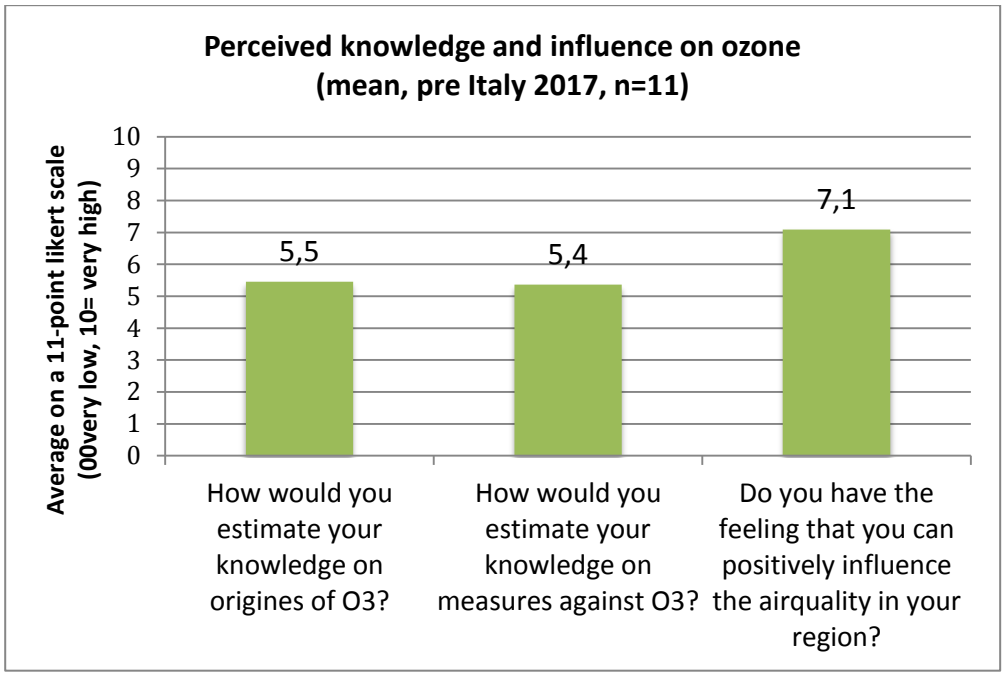

Figure 11: Perceived knowledge and influence on ozone, Italy 2017

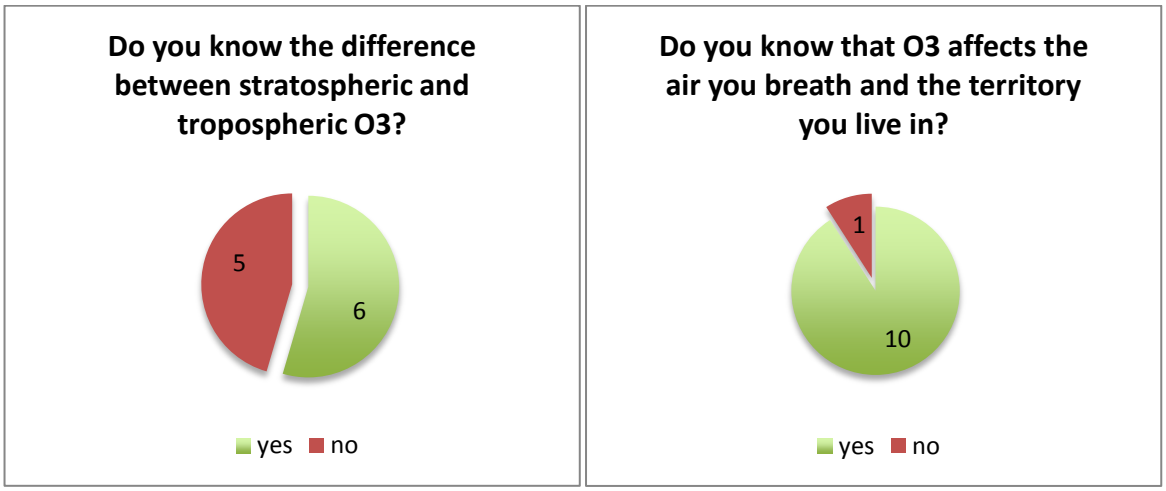

Figure 12: Knowledge on Ozone, Italy 2017

At the beginning of their involvement in CAPTOR, participants do rather have the feeling that they *can influence the air quality in their region* (mean=7,1, on a 11 point likert scale with 0=”very low” and 10=”very high”).

4.2.Post-questionnaire for CAPTOR hosts 2017

The post-questionnaire was distributed to the CAPTOR host in Italy at the end of the summer campaign 2017, to collect feedback on the project involvement and investigate in how far the project could impact the knowledge of participants. 7 respondents filled in the post-questionnaire.

In one question block, formative questions collected insights regarding the project communication and support. The answers show that the project support was perceived as quite good (with means of 7,3 and 7,1 on the 11-point likert scale), but the project communication requires for improvements

(mean of 6,6) - see Figure 13.

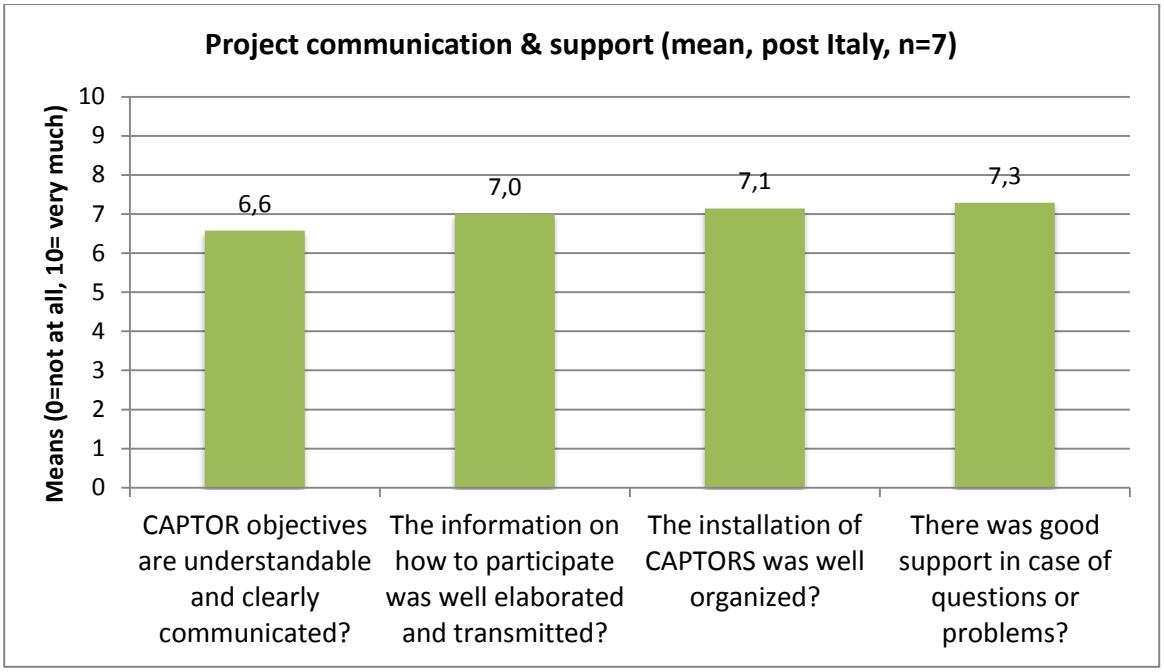

Figure 13: Project communication & support, Italy 2017

Additional comments from respondents from an open text field highlight the aspect of an improved communication. Original statements related to this are:

- *"The idea is good, I recommend improving communication with volunteers in order to increase the awareness of the project you are participating in."*
- *„Better dissemination of the project"*
- *„There may be more communication about the collected data"*

This aspect of communication also impacts the effects of the project on the participants, which were investigated in another question block. Answers relating to CAPTOR effects reveal that the biggest impact of the project was the positive experience for CAPTOR hosts *to be involved in a research project* (mean: 8,1, from 0=not at all to 10=very much), followed by the fact that *CAPTOR helped to raise awareness for ozone pollution in the region* (mean=7,9) and *to learn more about ozone pollution* (mean=7). What CAPTOR could not accomplish yet in 2017 is to *support individuals to fight ozone pollution in their region* (mean=5) – see Figure 14.

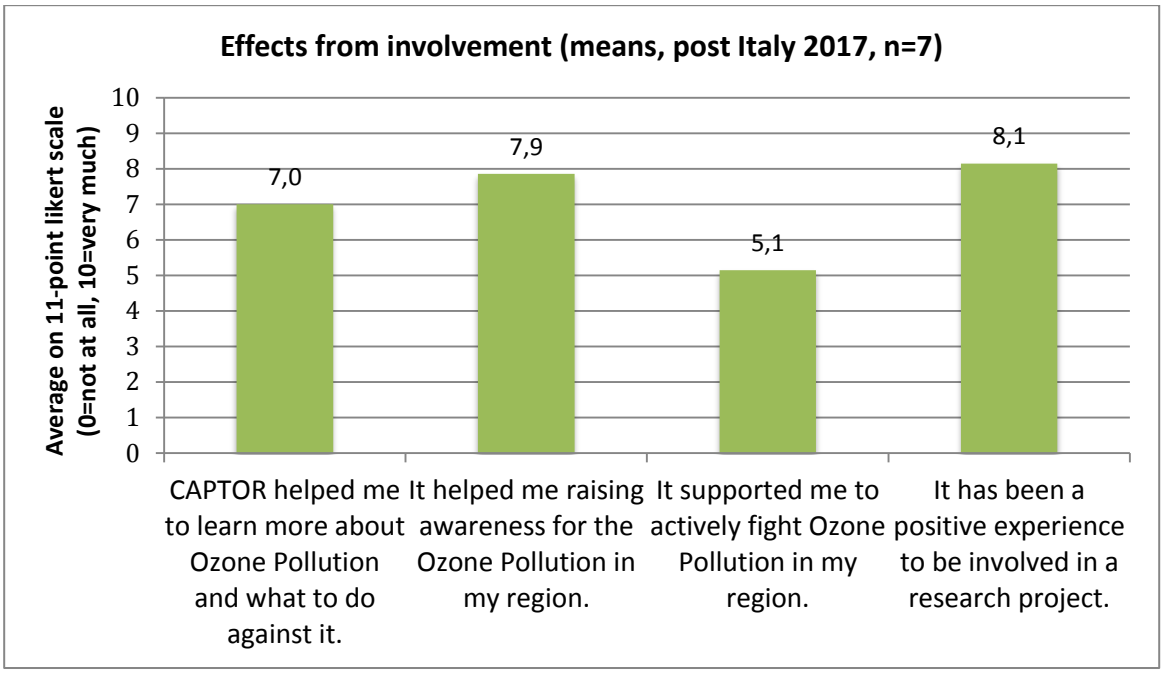

Figure 14: Benefits for CAPTOR hosts, Italy 2017

These results are also confirmed by a comparison of the means from pre- and post-questionnaires related to the perceived knowledge and influence (Figure 15). It shows that the *perceived knowledge on ozone pollution* stayed nearly the same between the pre- and the post-questionnaire (means between 5 and 6, on a 11 point-likert scale from 0=very low and 10=very high), but the *confidence to positively influence the air quality in the region decreased* (from a mean of 7.1. in the pre-questionnaire to a mean of 5.1 in the post questionnaire).

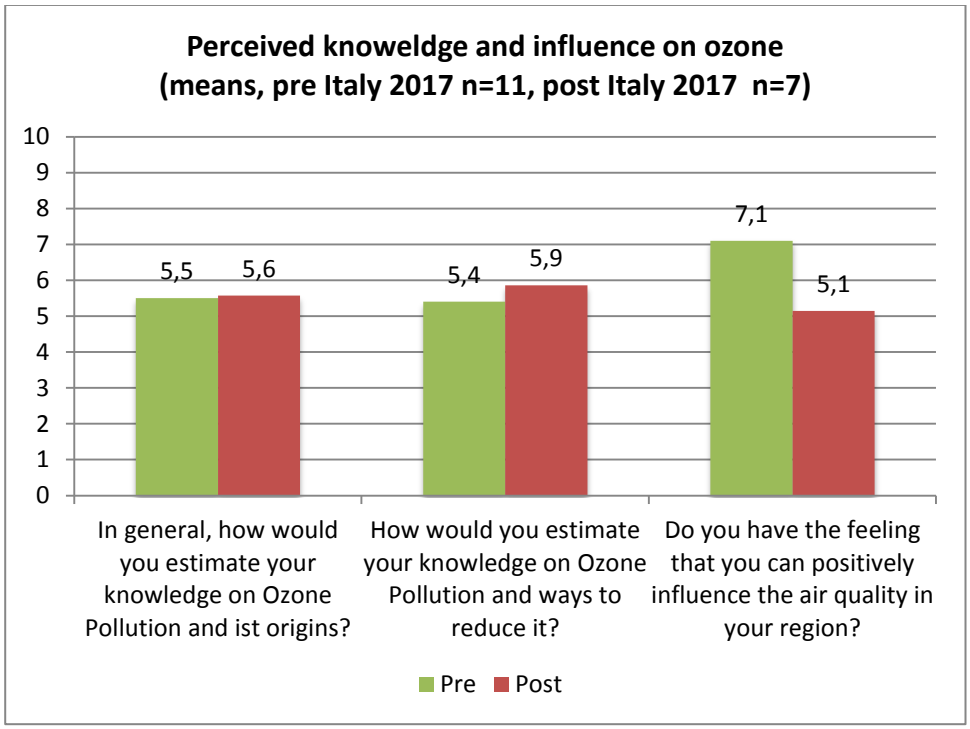

Figure 15: Perceived knowledge and influence on ozone, pre-post comparison, Italy 2017

Finally respondents were asked, if they would like to participate in the next measurement campaign 2018, which was affirmed by all participants and their explanations provide a rich feedback concerning the value of the project (original statement as follows):

- The desire to participate actively in environmental projects.
- The opportunity to make an active contribution to my region.
- The protection of the environment must be the priority for a better and responsible life
- Increase my knowledge of the matter and know the levels of ozone pollution in the area I live in.
- Check the data flow from one year to the next
- The positive result of the first year

In addition, all respondents would recommend the participation in the project to their friends and family. The reasons were:

- It's great to be part of a "community" that monitors your territory
- To feel part of the change and to deepen your knowledge
- Because it costs relatively little and can be very useful.
- It is a beautiful experience of direct management of environmental information
- To engage and thus to know the problems better
- To increase participation and spread knowledge

4.3.Interviews with CAPTOR Hosts 2017

The Italian testbed hosts conducted interviews with 6 CAPTOR hosts at the end of the summer campaign 2017. The results from these interviews can be summarized as follows:

Efforts and tasks as a CAPTOR host:
All interviewees mentioned that their efforts as CAPTOR hosts have been little and not demanding. Some of the hosts reported that they regularly (one even daily) observed the data from their nodes. When they realized that the CAPTOR was not working or anomalies happened, the hosts called someone from the CAPTOR team and the problem was solved.
Some concrete problems were reported with regard to the integration of data to the website, which was not working for one interviewee during the whole summer campaign and another interviewee reported about problems with the measured data in the first week only.

Several participants express the need for a more intense project communication to the outside and a higher number of nodes to show real effects.

- *"The divulgation of the project could be better. The interview in TV was the most effective thing: many people, also the mayor, ask me information about the project and about the O_3 pollution."*

As a result of the involvement, one host reports about having searched for information on ozone pollution and about the meaning of the measurements.

Values of involvement:

- *"This project was a great opportunity to deepen a topic that I did not known so well and it was also a satisfaction to take part in a monitoring project regarding a problem that affects a lot my region. I took note of the problem, I shared this topic with the members of my club to link this topic with the winter pollution of air or to other campaign of Legambiente to deepen our knowledge on this kind of pollution that affects in particular our region. Of*

course, this project can play a role highlighting the need to change these ways of life, starting from mine."

- *"This project was very useful for me and working with the guys at school too, the pollution concerns everyone's life. I hope to pass down this kind of problems so I am very happy to give my contribution in this project and to pass it down to everyone I can. The lack of education does not help: the more we know, the more we can pass down. I would like to participate also the next year."*

The same positive feedback comes from another teacher. She states that the CAPTOR project is an opportunity to inform the children and then their parents about the ozone pollution. She says that there is the idea that the air pollution reaches high level especially in winter seasons, but the tropospheric ozone is typical of summer, so it's fundamental to explain how to act in these conditions and the negative effects. She involves children at the first class of secondary school in the project and expects them to elaborate different scripts (video, ppt presentation) at the end of the project.

- *"It was useful to understand more about O_3 pollution that is a not well-known problem. Talking with friends and with ecologists, I understand that people does not perceived the risk from O_3 pollution."*

- *"I observed a lot of exceedances and was surprised because I didn' t think that in a small country as Bove we could have so high ozone measurement. But I have not changed something in my life yet due to this experiences."*

Future plans:
All hosts want to keep their involvement in the project and provide us with insights how they want to further extend it, via e.g. talking to other people, to the administration etc.

- *"Everyone has to be interested and I want to keep my friends informed during the development of the project. I would like to involve my sons and friends; I would like to keep me informed also with data from other regions. I absolutely give my availability for the next year because it was not so demanding and it was good to feel me responsible for the divulgation of this kind of pollution."*
- *"I will take part also the next year in this project, because I think that is very important to have more points, and because the monitoring is the scientific base to give considerations and to find causes and solutions, I am very sensible on this problem."*
- *"I will talk with guys, in schools, or with the parents of the friends of my daughters or with the citizens more interested in these topics, taking more attention on the administrators that can realize actions from a politic side but also communicating with citizens trying to change ways of life."*

One hosts suggestion to intensify the work with schools.

- *"It would be interesting to do some longer activities with children and follow them during the year."*

Another host says that local institutions could be interested on this project, like schools, museums, and other associations.

4.4. Summary of the Evaluation in Italy

From the data collected during this first campaign in Italy a main conclusion for the project is to work further on the communication process and structures, on the one hand towards the hosts, but also towards a wider audience in the region. In Italy the CAPTORs were distributed over a large region, therefore hosts asked for more devices, more data, and more intense communication. It seems important to inform about the problem and raise greater awareness, as hosts indicate that the level of knowledge on ozone is low and people are not aware of it's effects. There has already been a cooperation with one school in the Italian testbed, which was perceived as an effective mean to raise awareness amongst young people but also their parents. Addressing different target groups, including schools, with different means of communication can definitely lead to more impact. An interview in TV was mentioned as very effective dissemination format, which raised a lot of interest among people and also political decision makers.

The fact that all hosts want to contribute to the project again in 2018 shows that ozone pollution is an important problem for them and that they want to engage further, even on a political level. But in order to do so they need the right instruments and more knowledge about measures to avoid ozone pollution.

5. Austria: measurement campaign 2017

In Austria 14 RAPTORs were installed in the testbed region during the measurement campaign 2017; three of them in reference stations and 11 with citizens. Amongst those 11, five RAPTORs were installed in public places, namely at the 1) central place Hartberg, 2) the public outdoor swimming pool Hartberg, 3) the school in Gleisdorf, 4) the Innovation Centre Weiz, 5) the Municipal office Weiz. Private households hosted the remaining six RAPTORS.

The feedback rate of the pre- and post questionnaires was very low in Austria, thus numbers have to be interpreted cautiously. In general they show comparative trends to those observed in Spain and Italy.

5.1.Pre-questionnaire for CAPTOR hosts in 2017

The 4 respondents who filled in the pre-questionnaire were *motivated by the involvement in a research project* (mean: 7,75, from 0="not at all" to 10="very much"), followed by the wish *to learn more about ozone pollution* (mean: 7,3). The lowest rating received the fact *to actively fight ozone pollution* (mean: 3,75) see Figure 16. Thus the results resemble results from the pre-questionnaires in Spain.

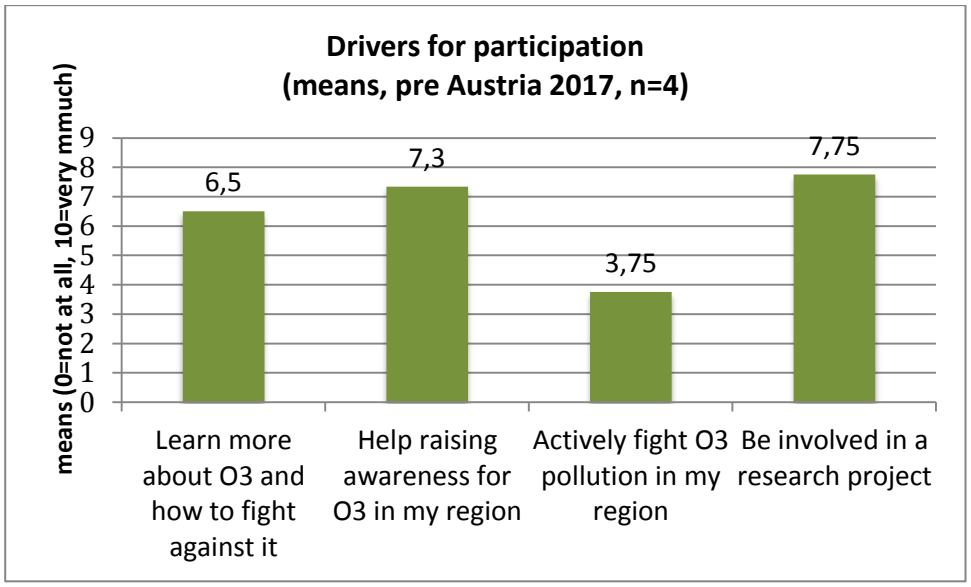

Figure 16: Drivers for participation in Austria 2017

In addition to the items above there was one very interesting reason for participation mentioned:

- "*It is personally very interesting for me, as I have the feeling that my body can feel exceedances of ozone and with the CAPTOR I can follow the levels*."

Another participant said:

- "*Ozone is for long time a forgotten pollutant and I want to strengthen the awareness for this amongst citizens*"

From the 4 respondents three worry about the ozone pollution since at least 10 years. Reasons that made them aware of the problem were: environmental education by parents but also sick trees and own health problems, like burning eyes or difficulties to breath.

The four participants rate their capability to influence air pollution a bit more critical than the hosts in Spain and Italy.

- Take action on a personal level to reduce pollution (all 4 participants agree to this statement)
- Influence their social environment to increase awareness (3 agree, 1 doesn't know)
- Influence their social and/or organizational environment to take collective measures (3 agree, 1 disagrees)
- Influence the policies and measures adopted by the public authorities (only one of the 3 disagree, 1 says "partly")

The question on perceived knowledge and influence on ozone were rated a little bit lower by Austrian participants compared to the Spanish and Italian testbed hosts with means between 3,8 and 5,3 (on a 11-point likers scale, 0="not at all", 10="very much) – see Figure 17.

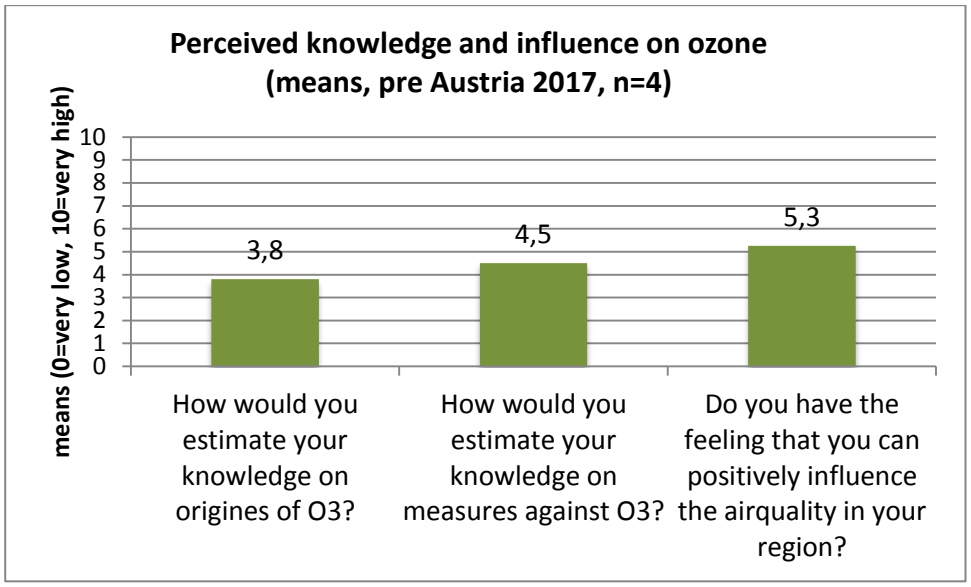

Figure 17: Perceived knowledge and influence on ozone, Austria 2017

5.2.Post-questionnaire for CAPTOR hosts in 2017

The overall feedback concerning project communication and support from the post questionnaire, filled in at the end of the measurement campaign 2017 by 6 hosts, was positive. Especially the items "*Did you receive support in case of questions"* and "*Do you think that the installation of the CAPTORs was well organized"* received very good ratings (means of 9,3 and 9,5; 0="not at all", 10= "very much"), as can be seen in Figure 18.

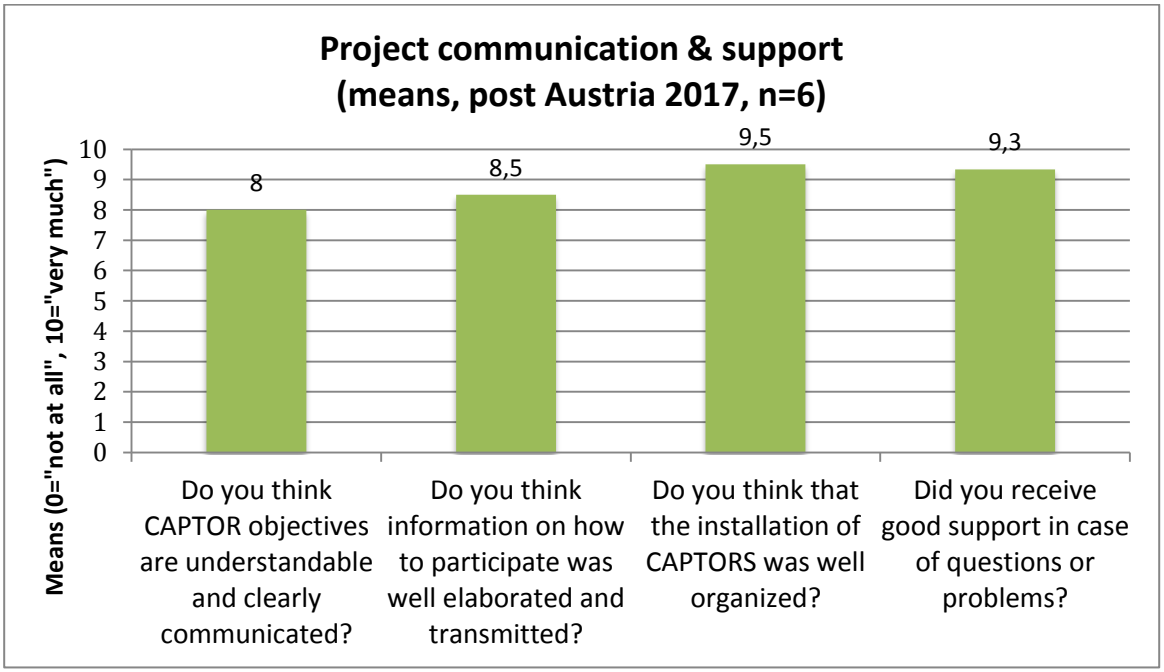

Figure 18: Project communication & support, Austria 2017

Amongst the benefits for CAPTOR hosts, the most important one was *the positive experience to be involved in a research project* (mean: 8.8; 0="not at all", 10="very much) and *to raise awareness*

for the ozone pollution (mean: 7.2). Comparable to the results from Spain and Italy the CAPTOR Project could not support hosts in the active fight against ozone pollution yet (mean: 5.0) – see Figure 19.

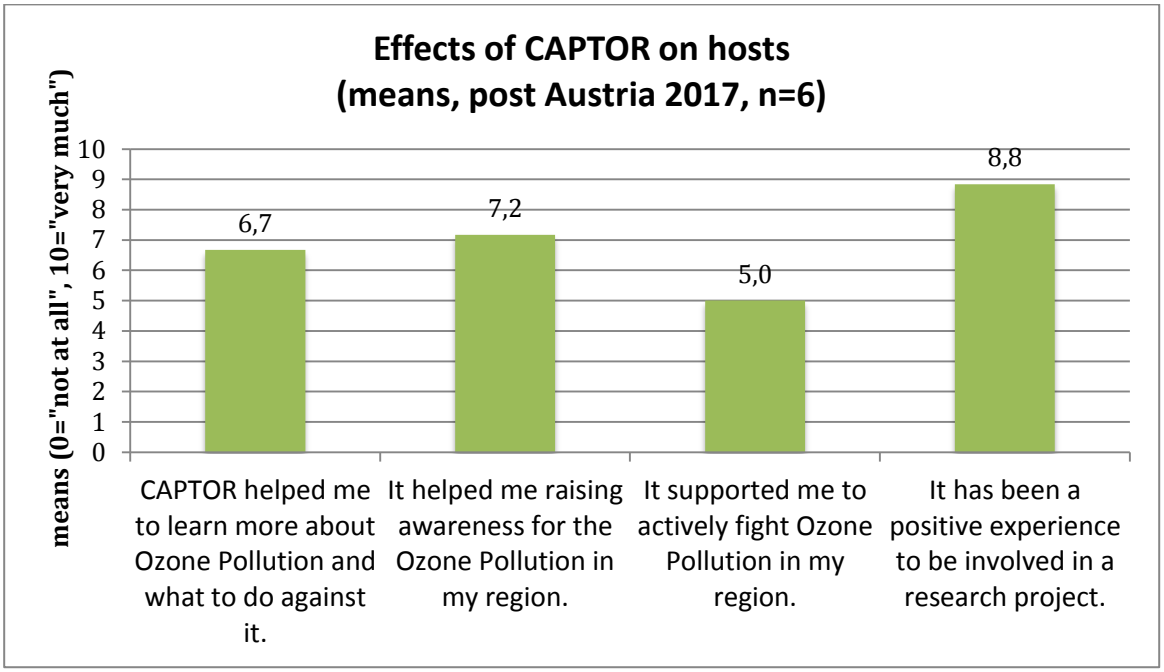

Figure 19: Benefits for CAPTOR hosts, Austria 2017

A comparison of the pre- and post-questionnaires in Austria shows that the perceived knowledge and influence increase with the involvement in the measurement campaign, as shown in Figure 20.

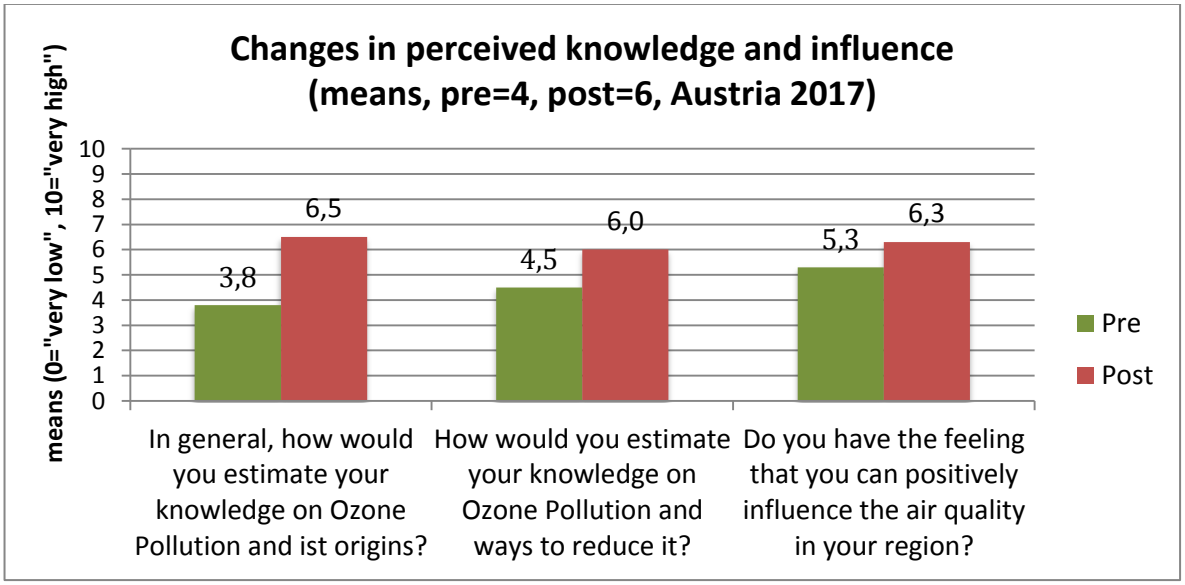

Figure 20: Changes in perceived knowledge and influence, Austria 2017

All of the participants indicate that they would wish to continue as it was not a lot of effort and helps to make ozone pollution visible and motivates to change behaviour. Only one respondent said that he would *not* recommend the participation in the Project to friends and family as he thought

that it is not important enough. All the others would recommend participation.

The respondents stated for example that:

- *"It would be great to have a project like this over a whole school year .From the beginning of next year we will have one class that focuses on natural sciences. This would be a great project."*
- *"Some of my guests asked me about the "box" [the CAPTOR] on my wall and this was the starting point for diverging discussions. All very positive, about the environmental protection in general, about Ozone more specifically, ... own possibilities to react (less driving with cars/more cycling, ...). One discussion was with a former employee of the Austrian Environmental Ministry. He said that there are enough measuring stations in Austria"*

5.3.Interviews with Austrian CAPTOR hosts in 2017

In addition to the questionnaires, the evaluation team conducted extended interviews with 4 persons at the end of the summer campaign: 2 of them were political decision makers, one from Hartberg and one from Weiz; 2 of them private RAPTOR hosts. Please note that all interviewees are indicated with "he" to unify the data and keep privacy high, which does not mean that all of them were male.

The two interviewed private hosts, showed different motivations to participate and behaviour related to the project. Both interviewees were very much interested in the measurement of environmental data as such (e.g. both provide of private weather stations) and both showed high affinity and interest towards technical issues (so both are interested how the measurement works technically, how the measurement device is built etc.).

But while one of the interviewed hosts was actively communicating about CAPTOR the other saw his involvement as "very private". He told us that he mentioned CAPTOR once, sitting together with friends in the local tavern, but as nobody showed real interest in the topic, he did not further push it. The general opinion in this social setting was that the air quality in the countryside is good enough and there are more important topics to worry about. In the host's opinion this did not mean that people refused the idea of CAPTOR, they rather showed ignorance towards the ozone problem and thus thought that there was no real pressure to act. This host was very happy to be part of the project and happily volunteered to participate in a second campaign again. Nevertheless, he never watched the ozone data. He said that it was not working in the beginning and then he forgot about it. But he hoped that, if his CAPTOR measured some exceedances, the respective relevant authority would react accordingly. This seems to be another motivator in addition to the personal interest in measuring devices.

The second host was more actively interacting with the project's device and also ideas. He had the CAPTOR device installed at his terrace and the high visibility attracted his visitors' interest and initiated plenty of interesting and fruitful discussions about ozone and the air pollution topic in general. He told us that he talked with his neighbour, a pig-farmer, about the project and realized that he had not enough knowledge to explain ozone properly. So he started to look for more information on the Internet, actively extended his knowledge as reaction to his role as CAPTOR host. He frequently looked up the data of his device, compared them with other regions, and compared values of rural areas with those of cities. He discussed with his son if they would find a way to influence the data of their CAPTOR (e.g. by putting a black plastic back around it) but then

did not dare to do so in order not to destroy the device.

The active occupation with the data had a positive impact on him as he realized that ozone data were not as high in his location then for instance in the urban area. This host suggested to create the opportunity for being alerted when the certain measurement levels are exceeded.

Both hosts would not change their way of living due to high ozone data. So we can see that there is awareness and interest, but not to the point that people are alarmed by the health risk and would change their behaviour. They rather expect the official authorities to react if needed. One host saw a more pro-active role in enriching insights on what to do. He suggested taking more devices during a next measurement campaign (e.g. one at street level, one at the insight green court) to compare levels of ozone and improve the understanding of ozone. In his opinion, this would also help to find arguments for political decision makers, how to do to improve the air – and if it's only small things: Installing car-free zones, putting more plants next to the streets. He also suggested that we could contact him if we want to try CAPTOR out at larger scale in his region, as he knows other people and could thus support us in finding very different settings for the devices.

In this host's understanding, a deeper involvement of his region in this topic could have positive effects as it shows not only that people take care of the place they live. But if they can prove that the air quality is better than elsewhere, it represents an important advantage compared to other regions with regard to a high living quality.

The two political decision makers from different municipalities, who we interviewed, brought different arguments. Both of them were responsible for a device at public places each. Both praised the low efforts of involvement and volunteered to take CAPTORs again, if required.

Both highlighted that the awareness raising would considerably improve, when the CAPTORS are not installed unimposingly in public places, but they would provide of huge (1 to 2 meter) panels that explain what is done here, why and at which levels ozone is dangerous, what to do against it, etc. They suggested to install a system (e.g. LED tablet), that directly indicates the devices' measured ozone levels in relation to the WHO/EC reference levels, using for instance the colour code of green, yellow, red as we do on AirAct. Only if people can directly see what the device measures, what this measurement serves for, what this has to do with their personal health – then they would take notice of what we are doing.

The driver for the political decision makers to be involved in CAPTOR, was to show to their community that they take care of the environment and people living there. But discussions about this topic took different courses. One of the interviewees said that it might be difficult to put CAPTOR to higher strategic levels. The interviewee stated that there was a political decision for the whole province to fight against the climate change (CO2) and particulates, which are currently an important topic in this province. Ozone and NO2 are more pollutants, but of the same cause (traffic, industry). Adding these two topics to the current debate, the communication with and knowledge transfer to the citizens will get more and more complicated and difficult. However, the interviewee suggested us to present the project's objectives during a regional meeting with all mayors from the district, where the importance of ozone and its' added value for the CO2 and particulates could be explained. The involvement of the municipalities should be as simple as possible and the devices easy in handling like distributing them via mail (without face-to-face meetings) or fixing them via vacuum cups on windows.

For the future, it is unclear how far the community could get more involved in the ozone topic, since at present the municipalities are strongly focused on the reduction of CO2 and particulates. The interviewee also emphasized, that awareness rising for a certain topic should be accompanied by a set of activities in order to show concrete offerings how to fight against it and overcome the problem.

The other political decision maker argued on a less strategic level. It seemed to be a personal worry of the interviewee that ozone is a forgotten pollutant, displaced by discussions on particulates. In the interviewee's observation people in general take environmental issues less important than years ago. He stressed out, that the measurement of ozone would make sense with several devices, over several years to reach a better understanding of the topic. Measurement reports could be presented in the municipality's environmental committee and initiate discussions where and how to plan concrete actions.

The interviewee suggested the CAPTOR team to make more use of social media tools like Facebook, aiming to attract not only those people who are already interested in environmental protection, but also younger people, who are using these information channels frequently and get interested for this topic. Besides, the interviewee from this municipality is involved in several international research projects and could make connections to other similar initiatives.

All interviewees are interested in the final report that summarizes the measurement data for their regions, but also compares with other regions, even across country borders and contains suggestions what others do to successfully fight ozone pollution.

5.4.School workshops 2017

In Austria CAPTOR organised four school workshops. All together 88 pupils from three different schools, aged between 11 and 13 years old, participated in the workshops. At the end of the workshops the pupils filled in questionnaire, which tried to collect insights on the effects.
The biggest effect was that a large majority of pupils provided agreement to the fact "that air pollution poses a big problem" (mean: 8.9; 0=not at all to 10=very much) and that "they learned a lot about it in the workshop" (mean: 8.1) see Figure 21.

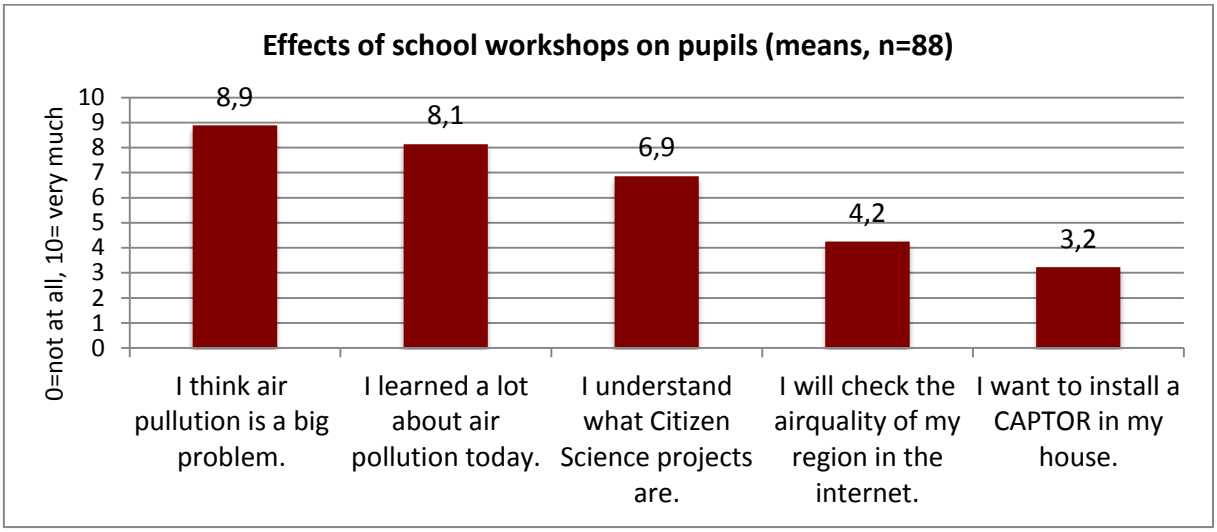

Figure 21: Effects of Austrian school workshop on pupils

When asked about their personal influence on ozone pollution and whether pupils feel that they can information their family and friends about ozone pollution the answers show that a bit less than half of all would feel able to do so. It is clear that a single intervention in the form of a workshop may have limited effects. Thus the number of positive answers is quite surprising (see Figure 22

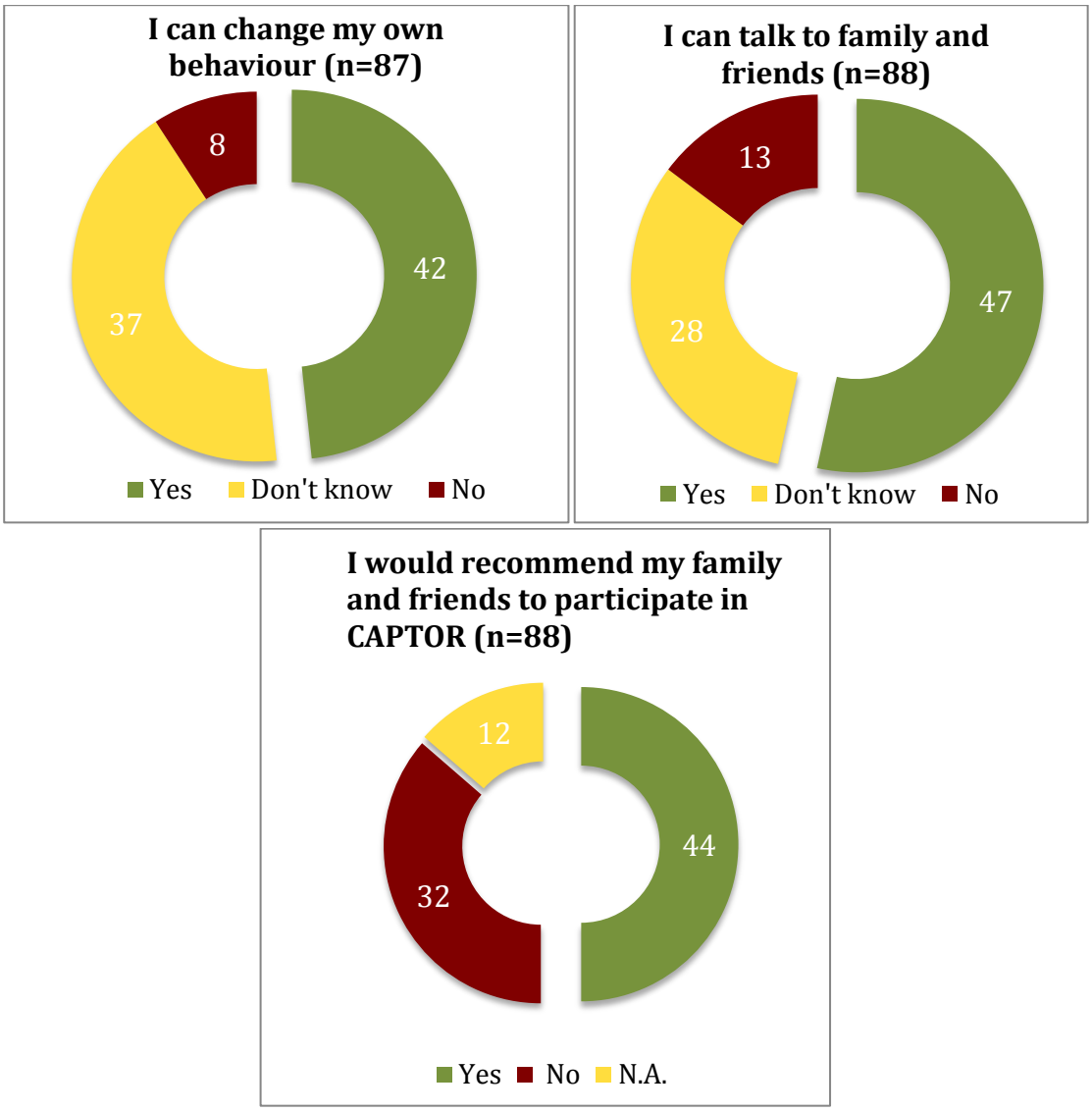

Figure 22: Effects of Austrian school workshop on pupils

When asked about the reasons for recommending the project to family and friend the answers were mostly because they find the project interesting & important.

- *"we need to act"*

Some reasons to vote no:

- *it is not interesting,*
- *I do not have enough knowledge,*
- *we have good air,*
- *they talked too much*

In addition, to the feedback from the pupils, we also conducted an interview with one of the teachers who participated in two of the workshops. Their feedback gave important insights into how the specific target group of pupils in secondary education should be addressed.

After the workshop the teacher reflected with both classes about the intervention and confirms that the students' awareness about the topic of ozone pollution has increased. Especially the ozone measuring device impressed the pupils, as they were able to have a look inside the CAPTOR box.

Constructive feedback related mainly to the didactical way the content was presented. Pupils this age need a lot of active engagement and hands-on experiences to make a highly complex topic, such as ozone, understandable and something they would like to follow up or get deeper involved. According to the teacher pupils would be more motivated if they could construct a CAPTOR measuring device for themselves and hand it up together.

Another important feedback from the teacher was to work with pedagogical experts to make the interventions more appealing for different age groups. Using appropriate language that is easy to understand is core in science communication, but scientist tend to forget about it. The teacher reminded us that in order to be successful with pupils the language needs to be adapted to their requirements.

And finally, it is very important that everything is working properly. E.g. since the App did not work at the beginning pupils loose interest and do not come back. The same is true for adult host, not only pupils. Another recommendation that was also shared by the interviews with the policy makers is to make the measuring station more visible via e.g. a big sign showing the data directly or at least a quick link to the data online.

Some of the suggestions were taken up directly and integrated in the following workshops, where students participated during the installation of the device on their school building. Unfortunately building a CAPTOR device in school is still very complex, but might be taken up as far as possible in the workshops in 2018.

5.5.Street activities in Austria

During the campaign in Austria a series of street events took place that provided additional evaluation input. The poster questionnaire on ozone pollution is a good means to get people involved without much effort on their side. During public events participants were asked to answer a set of questions on a scale from very low to very high and add a sticker for their answers. Figure 23 show the answers from the Citizen Science Day at the Natural History Museum in Vienna.

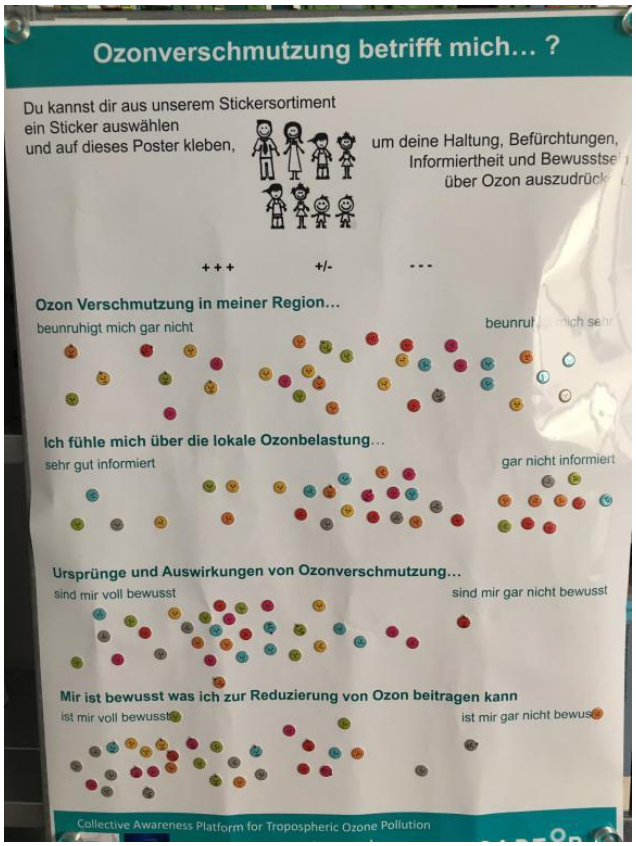

Figure 23: Vienna – Natural History Museum

While the event in the Natural History Museum was taking place in Vienna and in the context of a Citizen Science Day, the other two street events took place in the rural municipalities where the testbeds were implemented. Figure 24 shows the results from these 2 locations, where an information booth was set up in the centre of town and people were given information about the project as such and the topic of ozone pollution.

Figure 24: Public feedback tables in Hartberg (re) and Weiz (li)

The main messages we can derive from this data are the following:

- Citizens rather know the origins of ozone pollution and what to do against it
- Citizens do not feel well informed about ozone pollution in their region or do not know what to think about it.
- Citizens either worry about ozone pollution in their region or do not know what to think about it.

5.6.Summary of the evaluation in Austria

In Austria, the campaign in 2017 clearly showed that people are interested in the topic of air pollution and also more specifically in ozone pollution. From an individual perspective we learned that things have to work properly if we want citizens to engage with a research project. Still, it will be the people with strong intrinsic motivation that we will reach first and should try to engage them in order to gain more attention and expand the network. For a younger audience, which could be a good entry point to reach parents and families, it is highly important to make interventions hands-on and use the right language.

For gaining attention and raising awareness more visibility is required. While the hosts were aware of the problem, only some checked the data regularly. Displaying the data in highly visible places and formats is recommended by most participants to increase awareness for the topic.

On a political level we also find that air pollution is an important issue. However, ozone is competing with other pollutants and the topic is highly complex. Thus, it might be important to find

common strategies and alliances with other activities that address similar topics of air pollution and jointly make wider information campaigns. The interviews with political decision makers were highly interesting to understand how we could engage public authorities more in our project.

Finally, a very important feedback from this round of evaluation is the necessary information about measures to avoid ozone. People would like to know what they can do about it. Only knowing about the problem without having a set of recommendations and guidelines on how to react is not very satisfying.

6. Self-assessment of Citizen Science Process and Impact

As indicated in D5.1 a self-assessment was conducted as a critical reflection exercise of the whole consortium in an online meeting. The basis for the self-assessment is the citizen science evaluation framework (Kieslinger et al. 2017) that has been transferred into an online questionnaire and is offered to Citizen Science projects. The discussion and agreement about the ratings as well as the answering of the open questions help us to make our strengths evident and to see our shortcomings.

6.1.Organisation of the self-assessment exercise

The self-assessment of the project was organised in a two-hours online meeting, where all consortium partners were represented. The aim of the meeting was to reflect about the project's process and impact after two years, using the Citizen Science Self-Assessment questionnaire (described in D5.1). The meeting was organised subsequent to the Scientific Advisory Board and the Citizen Science Board meetings in order to consider the feedback from those assemblies in our self-assessment.
In an intense discussion process all partners had to find agreement in filling in 21 questions, which are organised along three dimensions:

1) the scientific dimension
2) the involvement of individual citizens in the scientific process,
3) the broader impact on society, environment and economy

For each of the three dimensions

a) process indicators and
b) outcome indicators

are investigated.

So questions are structured according to the following matrix:

Table 1: Citizen science evaluation framework

Dimension	Process & Feasibility	Outcome & Impact
Scientific	● Scientific objectives ● Data & systems ● Evaluation & adaptation ● Cooperation & synergies	● Scientific knowledge & publications ● New research fields & structures ● New knowledge resources

Participant	• Target group alignment • Degree of involvement • Facilitation & communication	• Knowledge & attitudes • Behavior & ownership • Motivation & engagement
Socio-ecological and economic	• Target group alignment • Active involvement • Collaboration & synergies	• Societal impact • Ecological impact • Wider innovation potential

Each of the 21 indicators was rated applying a 7-point likert scale, where 0 represents the lowest rating and 7 the highest rating. Thus, the higher the rating for each dimension, the more this respective dimension presents strength of the project, and vice versa.

6.2.Results of the self-assessment

Figure 25 shows an overview of the self-assessment results, with regard to the three dimensions (science, social-economic, citizens) on two levels (process, impact) explained above. The detailed results for each of the 21 questions can be found in the Annex of this document.

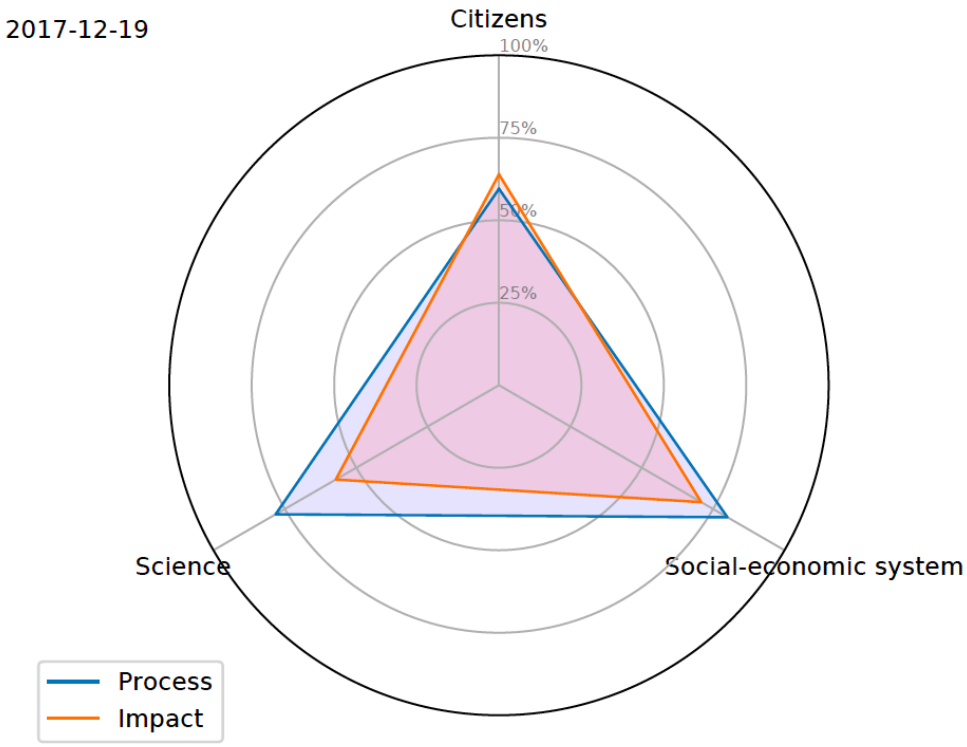

Figure 25 Overview of self-assessment results (% of maximum reachable points)

Taking a look at the scientific dimension, the spider chart shows that we attributed rather high rankings to the questions concerning CAPTORs scientific process, e.g. research objectives, evaluation strategies, openness of data (76% of the maximum reachable points). This is due to the sound scientific approach of CAPTOR that is expected to result in several publications, which are

going to increase the scientific impact of CAPTOR (scientific impact is now at around 53% of all reachable points and is expected to increase between this self-assessment and a self-assessment at the end of year 3).

In the social-economic dimension we assessed our project equally good with regard to the process. We think that CAPTOR developed a portfolio of dissemination instruments, e.g. website, Twitter feeds, videos, workshops, participation in conferences etc. in several languages and for different target groups. These instruments are a good basis that will help us to support awareness raising for ozone pollution in the broader public and thus positively influence our impact in this dimension (currently at around 68% of all reachable points). Important for the future increase in impact are concrete exploitation strategies developed in WP7 as well.

The weakest dimension in our self-assessment is the dimension that relates to the involvement of individual citizens as citizens scientists in our project. Here we still see room for improvement in the coming year. Various aspects are making this still a challenge for the project. Our current analysis regarding this point reveals the following:

In CAPTOR we have two research objectives:

1) To collect high-quality ozone data using low cost sensors
2) To investigate in how far the collaboration of NGOs, citizens and scientists supports greater awareness raising for the ozone topic

The combination of these two objectives is what makes our project a challenge. The scientific perspective of creating measuring devices and an accompanying process of calibration, analysis and provision of valid ozone data was certainly one of the key activities during the first 24 months of the project. We had considerable lessons learned on how to reach our goal related to measuring ozone with two different low-cost devices – results that will contribute to the scientific knowledge landscape via a range of around 10 publications that are foreseen for the coming project year. The feedback from our scientific advisory board was very positive and we think that we have highly interesting research results in this area, but this iterative process took time and attention.

The second research objective aims to raise awareness for tropospheric ozone combining citizen science with grass roots movements. To reach this aim, it first required a stable base of measuring devices and the collection of valid ozone data in order to use these data for further awareness raising and mutual learning. So it builds upon the research objective 1). That's why we started only in year two (and not in year 1) with a broader roll-out of devices to all testbed regions. The creation of the CAPTORs/RAPTORs, the on-site calibration, the selection of adequate places from private hosts, the installation of the measurement devices as well as the support in case of technical problems, were main tasks in this context. The positive feedback from CAPTOR hosts in all three testbed regions relating to the installation and dedicated support from the CAPTOR team shows that our efforts were fruitful. Also, the quality of collected data was much better than in 2016 and thus provides an interesting input for further awareness raising and learning.

In the internal discussions we agreed that we provided many options for involvement (e.g. hosting the CAPTOR, accessing the data via AirAct and CAPTOR Air, discussions on the local CAPs platforms or sharing best practices, participating in workshops etc.) but we also think that we still can improve in this regard – aiming to involve more citizens as more active players.
First evaluation results show how promising the taken approach can be – when hosts act as promoters within their own community, discussions on ozone are initiated by the fact that measuring devices are installed and interested citizens start to actively search for more information on ozone. The collected data shows that the project positively impacted citizens' knowledge on and

awareness for ozone. Nevertheless, feedback also shows that the complexity of our project creates barriers for an active involvement. E.g.

- Due to the requirement for calibration at relatively high levels of ozone, measuring devices can only be installed in participant's homes at the beginning of the summer season. This reduces the timeframe for active campaigning to a few months only (June to September), where many citizens are on holidays. This seasonal restriction also needs careful planning for e.g. school involvement.
- The fact that citizens who are exposed to high levels of ozone are most often not the causers of this pollutant leaves a certain feeling of helplessness and the need for more concrete inputs on how to effectively fight the pollutant.
- Citizens are interested in building their own CAPTORs but paying a few hundred euros for a device that needs to be professionally calibrated 2 times per measuring campaign and has a rather short lifetime of maximum 2 years before sensors need to be replaced, is a barrier.
- The fact that ozone is one more pollutant next to better-known pollutants as NOX, Co2 or particular matters is a challenge if we want to involve political decision makers, as political plans and strategies seem to focus on Co2, NOX and particular matters, which are highly discussed in media and thus seen as important.

We consider these reasons as main impediments in the citizen science dimension and still see room for improvement. For 2018 we thus foresee the organisation of maker events (but still need to overcome the barriers mentioned above) and different formats of awareness raising activities described in D4.2 and D4.3. We plan to extent the measurement campaign to a maximum (ideally starting in May) and will more actively promote our platforms (AirAct, captorAIR, local CAPS) for discussions and learning (as they are in place and properly working now).

On the social-economic dimension we agreed that we have appealing and target group specific dissemination instruments and formats (text and audio-visual media which supported online and offline communication) at hand. Especially in Spain but also in Italy a large range of (also political) activities resulted in a greater awareness for ozone and air pollution in general due to project activities (see more of these activities in D6.2, e.g. campaigns, press releases, workshops). For the coming project year, we foresee to continue these broader dissemination activities and plan to intensify them in Austria.

7. Conclusions and Outlook

With the detailed feedback we obtained from the three testbeds we got very important insights into what can be further improved during the campaign in 2018. However, it needs to be stated that there are currently some technical and structural limitations that do not allow realising all recommendations given by hosts and other stakeholders.

Recommendation 1: Have more measurement devices

The recommendation to have more measurement devices within each region or even within municipalities has to be embedded within the constraints of the project structure. The distribution of additional Captors in the three testbeds regions is limited by budget constraint with regard to the required parts and personnel constraints that limit the efforts to construct, calibrate and install the measurement devices. We therefore aim to involve additional people via CAPTOR building workshops. An important pre-requisite for a smooth transfer process from the project to external

stakeholders are fully documented and pre-tested instruction hand-outs and tutorials, guidelines for calibration and connection to the database etc. These activities are also key for WP7 on exploitation and off-springs.

Recommendation 2: Intensify communication and dissemination
In D4.2 and D4.3 and D6.2 we have elaborated detailed communication and dissemination plans that show the number of planned events as well as involved target groups and also help us to find synergies between the testbeds (e.g. transferring ideas between testbeds, collaboratively working on dissemination material). Synergies with other initiatives, especially those related to air pollution, are positively organised in Spain and strived for in all testbed regions, to increase the effect of our project.

Recommendation 3: Make CAPTOR devices more visible in public places
Installing CAPTOR devices in public spaces has proved to be a good means for awareness raising, only if it is combined with a greater visibility of the device. In the campaign 2018 in Austria we thus plan to work again with the two local municipalities, but adding visible elements about CAPTOR in the public space. This will give us additional insights into whether the effectiveness has improved or not.

Recommendation 4: Work more with schools
School events are planned in Austria and Italy for 2018 and we aim to collect further insights on their impact, not only on pupils but also on parents. As far as possible the workshops should be designed as hands-on experiments where pupils can get detailed insights into the CAPTOR measuring devices by exploring the different components.

Recommendation 5: No obstacles
Although the hosts did not explicitly address it, implicit feedback shows that when working in real world scenarios all hardware and software has to be presented in an easy to use and appealing design, and most importantly, it has to work properly. A lot of effort needs to be dedicated to preparing the campaign in 2018 and make sure that the AirAct app is running and participants can directly access the data of their measuring devices.

References

Kieslinger, B., Schäfer, T., Heigl, F., Dörler, D., Richter, R., Bonn, B. (2017). The Challenge of Evaluation: An Open Framework for Evaluating Citizen Science Activities. SocArXiv. September 20. http://doi.org/10.17605/OSF.IO/ENZC9

Annex I: Self-assessment questionnaire

Citizen Science Evaluierung

Survey response 1

Response ID
26

Date submitted
2017-12-19 12:57:05

Last page
7

Start language
en

Date started
2017-12-19 11:04:47

Date last action
2017-12-19 12:57:05

Introduction

Do you want to share your results with others and in return receive insights into the performance of the Citizen Science projects?
Yes

project name or acronym
CAPTOR

Citizens

Target group alignment & options for involvement [The options of involvement for participating citizens are attractive.]
5

Target group alignment & options for involvement [The project offers a variety of options to get involved (depending on interests, availability, knowledge, ...)]
5

Target group alignment & options for involvement [Citizen can choose to participate in various project phases (e.g. during definition of research questions, data gathering, data analysis, dissemination of results)]
3

Support, training & communication [Training measures and support material is aligned according to different target groups (e.g. age, language, ...).]
6

Support, training & communication [Project objectives are clearly formulated and communicated towards participants.]
5

Support, training & communication [The different project roles and responsibilities are clear and transparent.]
6

Support, training & communication [Citizen participants can interact and communicate with scientist during various phases of the project (e.g. research design, data collection, data analysis, dissemination of results).]
2

Impact - Citizens

Knowledge, skills & competences [Participants achieve a personal learning outcome.]
5

Knowledge, skills & competences [The project contributes to a better understanding of science amongst the participants.]
4

Knowledge, skills & competences [The project contributes to a better understanding of the specific research topic amongst the participants.]
6

Responsibility & ownership [The project fosters ownership and responsibility for the project goals amongst the participants.]
4

Responsibility & ownership [The project contributes to a personal change in behaviour amongst project participants.]
3

Engagement [The participants are motivated to continue the project or get involved in similar activities.]
7 strongly agree

Science

Scientific objectives [The scientific goals are sufficiently clear and authentic.]
6

Scientific objectives [The scientific objectives can be reached by involving citizens in the scientific process.]
4

Scientific objectives [The scientific objectives address socially relevant problems.]
7 strongly agree

Data & systems [The project follows clear and transparent ethical guidelines.]
5

Data & systems [The project has a data management and privacy protection plan.]
6

Data & systems [The project has an open interface to connect to other systems and platforms.]
6

Data & systems [The generated data is shared publicly, given that this is in accordance with ethical and scientific guidelines.]
7 strongly agree

Evaluation & adaptation [The project has an evaluation concept to assess scientific outcomes.]
7 strongly agree

Evaluation & adaptation [The project has an evaluation concept, that considers the impact on the individual participants.]
6

Evaluation & adaptation [The project has an evaluation concept, that considers the impact on wider society, ecology and economy.]
5

Evaluation & adaptation [Feedback and evaluation results are continuously taken up by an adaptive project management.]
4

Co-operations & synergies [The project fosters co-operation with other projects and initiatives.]
4

Co-operations & synergies [The project connects experts from different disciplines.]
7 strongly agree

Impact - Science

Scientific knowledge & publications [Research results are actively contributing to the scientific discourse (e.g. via scientific publications, blogs, etc.).]
4

Scientific knowledge & publications [Citizens are included in publications either actively or they are recognised as contributors in the publications.]
4

Scientific knowledge & publications [Project results are made available to a wide public audience, in appropriate understandable formats.]
5

Exploitation [Project results are taken up by other projects.]
4

Exploitation [The project leads to new research questions, new projects or proposals.]
6

Knowledge transfer [The project eases the access to local and traditional knowledge resources.]
4

Knowledge transfer [The project contributes to a mutual understanding of science and society.]
4

Socio-ecological system

Dissemination & Outreach [The project makes use of different media to reach a wide public audience (e.g. print, online, social media, etc.)]
6

Dissemination & Outreach [The project includes innovative methods for dissemination (e.g. co-operation with artists, etc.)]
5

Dissemination & Outreach [The dissemination strategy includes bi-directional communication for the general public.]
6

Co-operations & synergies for communication [The project fosters co-operation with non-scientific organisations.]
6

Co-operations & synergies for communication [The project leverages existing networks and civic society organisations for dissemination.]
6

Impact - Socio-ecological system

Collective Capacity [The project fosters resilience and the collective capacity to advocate common goals.]
5

Politische Partizipation [The project stimulates political participation amongst project participants.]
6

Politische Partizipation [Project results have an impact on political decisions or political institutions.]
4

Ecological impact [The project supports measures to protect natural resources.]
7 strongly agree

Ecological impact [The project contributes to a better understanding for environmental topics.]
7 strongly agree

Sustainability (social, economic, ecological impact) [The project has a clear sustainability plan (for social, economic or ecological aspects)]
4

Sustainability (social, economic, ecological impact) [Project results are transferable to other contexts.]
5

Economic potential [The project generates economic impact, such as cost reduction, new job creation, new markets, new business models, etc.]
4